



# **DM6C** Series Servo Drive

## User Manual

WUXI XINJE ELECTRIC CO., LTD.

Reference number: SM6 01 20260226

|                                        |                                            |    |
|----------------------------------------|--------------------------------------------|----|
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## General instructions

- ◆ Thank you for purchasing XINJE DM6C Series Servo Drive products.
- ◆ This manual primarily introduces product information for the DM6C Series Servo Drives and MS6 Series Servo Motors.
- ◆ Before using the product, please read this manual carefully and ensure all wiring is performed under full understanding of the content.
- ◆ Please deliver this manual to the end user.

## This manual is intended for the following users:

- ◆ Servo system designers
- ◆ Installation and wiring personnel
- ◆ Commissioning and servo debugging personnel
- ◆ Maintenance and inspection personnel

## Ways to Obtain the Manual

- ◆ Electronic version  
Download from XINJE official website: [www.xinje.com](http://www.xinje.com)

## Disclaimer

- ◆ Although the content of this manual has been carefully reviewed, errors may still occur. We cannot guarantee complete accuracy.
- ◆ We regularly review the content of this manual and make corrections in subsequent editions. Your valuable feedback is welcome.
- ◆ The content described in this manual is subject to change without prior notice.

## Contact information

If you have any questions regarding the use of this product, please contact the distributor or office where you purchased the product, or reach out to XINJE directly.

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## Safety Precautions

Before using this product, be sure to read this section carefully and ensure all operations are performed only after fully understanding the product's usage, safety requirements, and precautions. Exercise extreme caution when connecting the product to power sources.

Potential risks that may arise during product use are primarily outlined in the safety precautions, which are categorized into two levels: Attention and Dangerous. For matters not explicitly covered, please adhere to standard electrical operation procedures.



ATTENTION

Indicates a potential hazard that, if ignored, could result in moderate or minor personal injury, or property damage.



DANGEROUS

Indicates a potentially hazardous situation that, if not avoided, could result in serious injury, death, or significant property damage.



### Product Inspection Precautions

1. Do not install drives that are damaged, have missing parts, or do not meet the required model specifications.



### Storage and Handling Precautions

1. Do not place or store the product in areas exposed to direct sunlight, where the ambient temperature exceeds the specified storage, where the relative humidity exceeds the specified storage, where there are significant temperature fluctuations, or where condensation occurs.
2. Avoid contact with corrosive or flammable gases, and areas with high levels of dust.
3. Do not place in locations where excessive vibration or impact is directly transmitted to the drive.
4. Never lift or carry the unit by holding the motor cables.



### Installation Precautions

1. Never install near flammable gases, as this may cause a fire.
2. Always adhere to the specified installation orientation to prevent drive malfunctions.
3. Never expose the product to moisture, corrosive substances, or flammable gases, as this poses risks of electric shock and fire.
4. Before installation, always disconnect the power supply and verify that the power indicator light is off to prevent electric shock.
5. Do not touch the conductive parts of the product directly, as this may cause malfunction, damage, or electric shock.





### Wiring Precautions

1. Please correctly connect the AC power supply to the dedicated power terminals of the drive (L/N or L1/L2/L3 or R/S/T). Do not connect the output terminals U, V, W of the drive to the three-phase power supply.
2. Please properly connect the ground wire. Poor grounding may cause electric shock. Use a 2mm<sup>2</sup> wire to ground the drive's grounding terminal.
3. Please tighten the terminal screws securely; otherwise, it may cause a fire.
4. Before performing wiring operations on the drive, be sure to disconnect all external power sources.
5. Ensure that the encoder and power cables are in a loose state during wiring. Do not tighten them excessively to avoid cable damage.



### Operational Precautions

1. After the drive starts operating, do not touch the rotating parts of the motor to prevent injury.
2. During trial operation, run the motor without load to prevent accidents; otherwise, it may cause personal injury.
3. After connecting to the machinery, set appropriate parameters before operation; otherwise, it may lead to loss of control or malfunction of the machinery.
4. During operation, do not touch the heat sink, as there is a risk of burns.
5. Do not change wiring while the system is energized, as it may cause injury.
6. Do not frequently turn the power on and off. If multiple power cycles are required, limit them to once every 2 minutes. Otherwise, it may damage the drive's charging resistor. Frequent switching may cause the relay to trip before it has released.



### Maintenance and Inspection

1. Power-on and power-off operations should be performed by qualified personnel.
2. Do not use gasoline, acidic, thinning, or alkaline detergents, as they may damage or discolor the casing.
3. When replacing the drive, transfer the parameters from the original drive to the new one before resuming operation; otherwise, it may cause mechanical damage or even personal injury.
4. Do not change wiring while the system is energized, as it may cause electric shock or injury.
5. Do not remove the servo motor during operation, as it may cause electric shock or injury.
6. Do not touch the interior of the servo drive or servo motor during operation, as it may cause electric shock or injury.
7. Do not touch the terminals within 10 minutes after turning off the power, as residual voltage may cause electric shock or injury.



### Wiring Precautions

1. Do not run power lines and control signal lines through the same conduit or bundle them together. Keep power lines and control signal lines at least 30 cm apart.
2. For signal lines and encoder (PG) feedback lines, use multi-strand twisted pairs and multi-core overall shielded twisted pairs.
3. The maximum length for signal input lines is 3 meters, and for PG feedback lines, it is 20 meters.
4. Ensure wiring is correct and secure; otherwise, it may cause motor 失控 or malfunction, and in severe cases, personal injury.

5. Do not use the drive under poor power conditions or outside the specified voltage range, as it may cause mechanical damage.
6. Take appropriate shielding measures in environments with static electricity, strong electromagnetic fields, radiation, or nearby power lines.

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## ►► Product Arrival Confirmation

Upon the arrival of the products, please confirm the integrity of the products based on the following aspects:

| Confirmation Item                                         | Remarks                                                                              |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------|
| Does the arrived product match the ordered model?         | Confirm based on the nameplate of the servo motor and servo unit.                    |
| Does the rotating shaft of the servo motor move smoothly? | It is normal if it can be turned gently by hand. Motors with brakes will not rotate. |
| Are there any signs of damage?                            | Visually inspect the entire exterior for damage caused by transportation, etc.       |
| Are there any loose screws?                               | Check for loose screws using a screwdriver.                                          |
| Is the motor code consistent?                             | Verify that the motor code on the drive (U3-70) matches the code on the motor label. |

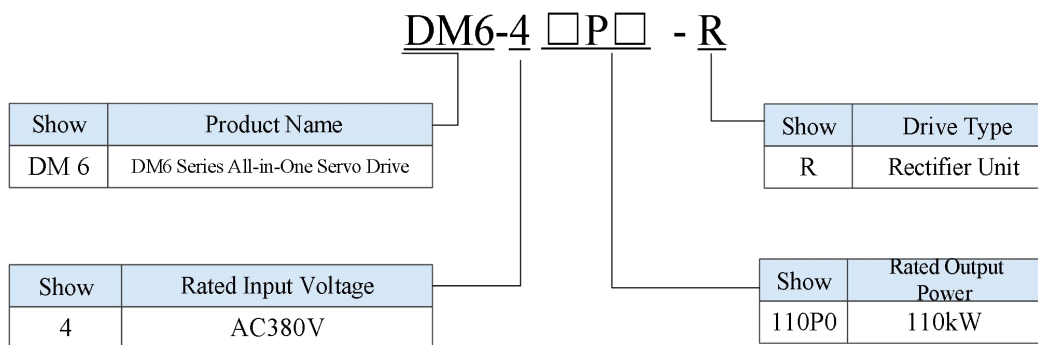
Do not install any drives that are damaged, have missing parts, or do not meet the required model specifications. If any discrepancies are found, please contact the agent, office, or XINJE's sales department for this product promptly.

# 1. Servo System Selection

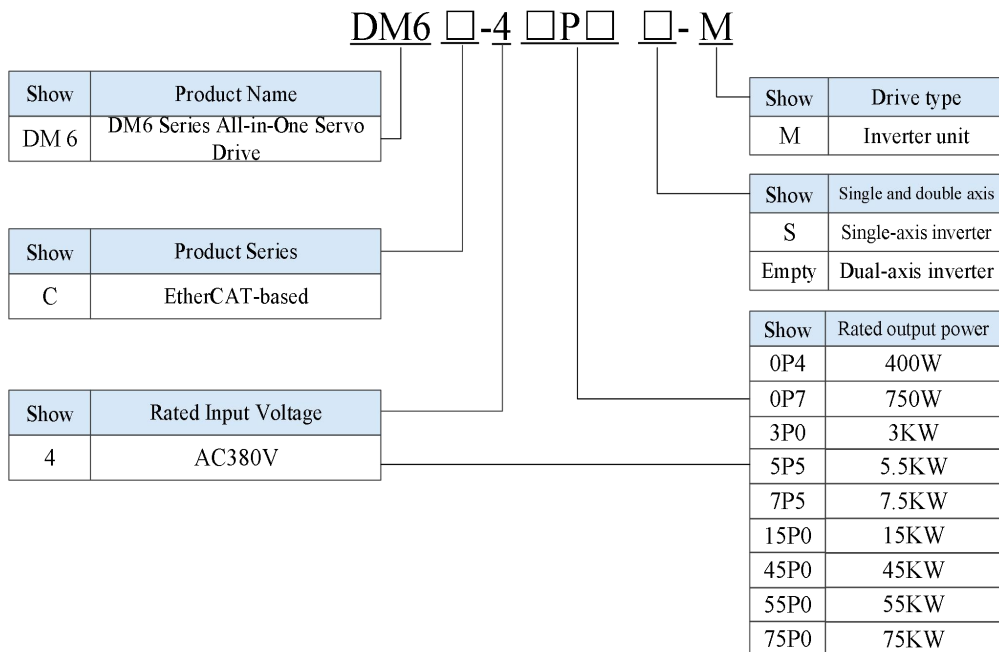
## 1.1 Servo Drive Selection

### 1.1.1 Model Nomenclature

#### ■ Rectifier Unit



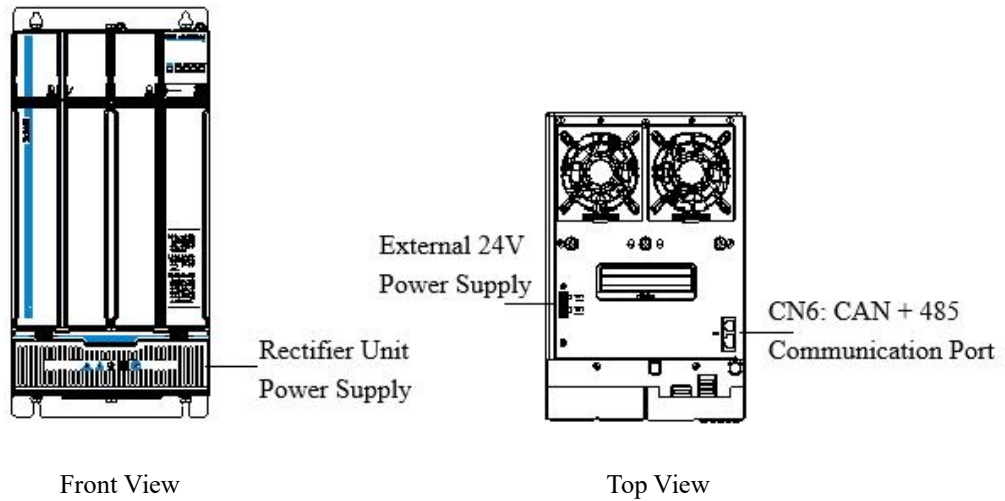
#### ■ Inverter unit



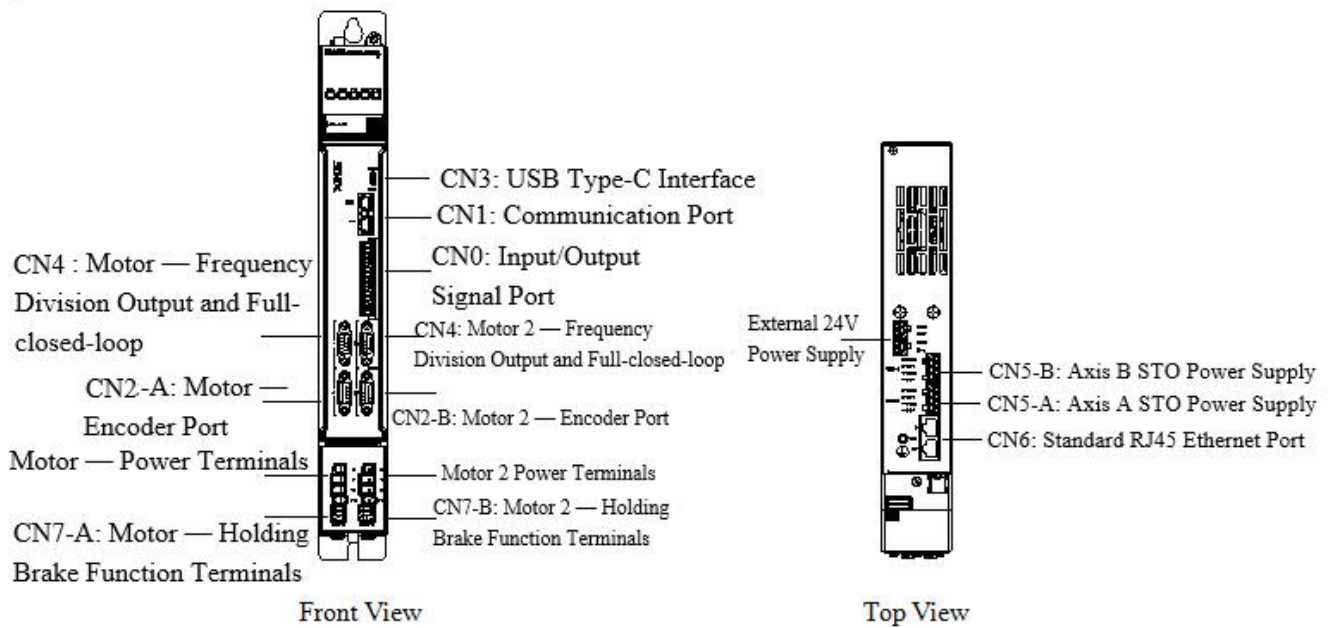
45kW, 55kW, and 75kW models are only available as single-axis inverter units.

## 1.1.2 Description of Components

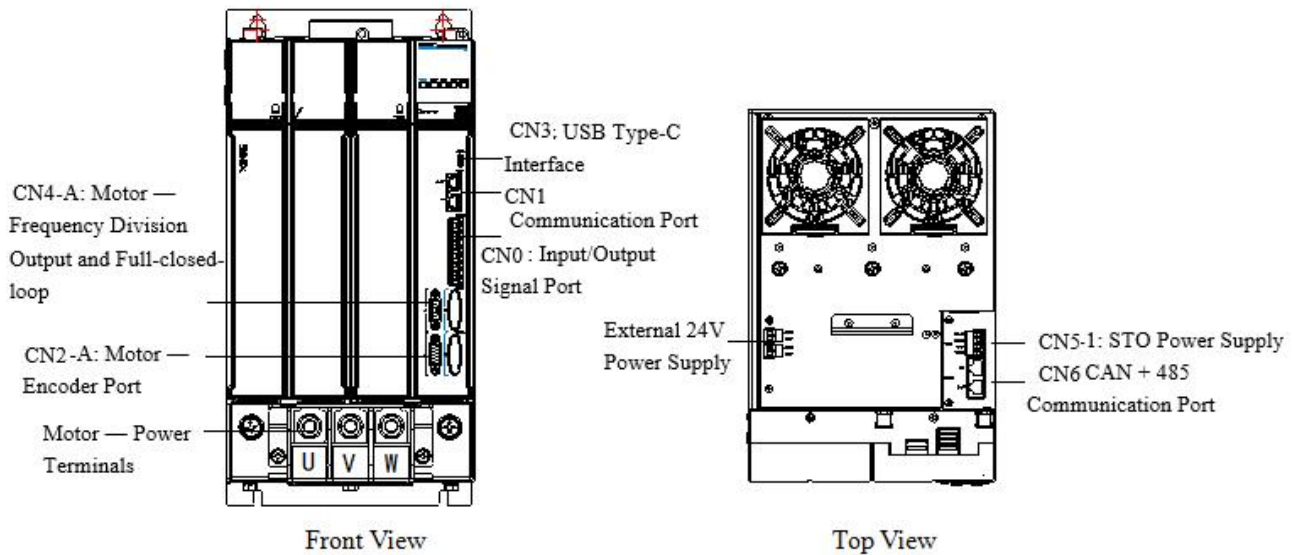
### ■ Rectifier Unit



### ■ Dual-Axis Inverter Unit



### ■ Single-Axis Inverter Unit



### 1.1.3 Performance Specifications

|                    |                       |                                                                                                              |
|--------------------|-----------------------|--------------------------------------------------------------------------------------------------------------|
| Servo Unit         |                       | DM6C Series Servo Drive                                                                                      |
| Compatible Encoder |                       | Standard: 19-bit / 23-bit Communication Encoder                                                              |
| Input Power        |                       | DM6-4□P□-R: 3-phase AC380–440V, 50/60 Hz                                                                     |
| Control Method     |                       | Three-phase full-wave rectification, IPM PWM control, sinusoidal current drive method                        |
| Service conditions | Operating Temperature | -10~+40 °C                                                                                                   |
|                    | Storage Temperature   | -20~+60 °C                                                                                                   |
|                    | Ambient Humidity      | 90% RH or less (non-condensing)                                                                              |
|                    | Vibration Resistance  | 4.9m/s <sup>2</sup>                                                                                          |
|                    | Altitude              | 1000 m or below. For altitudes above 1000 m, please derate the unit (derate by 1% for every 100 m increase). |

### 1.1.4 Electrical Specifications

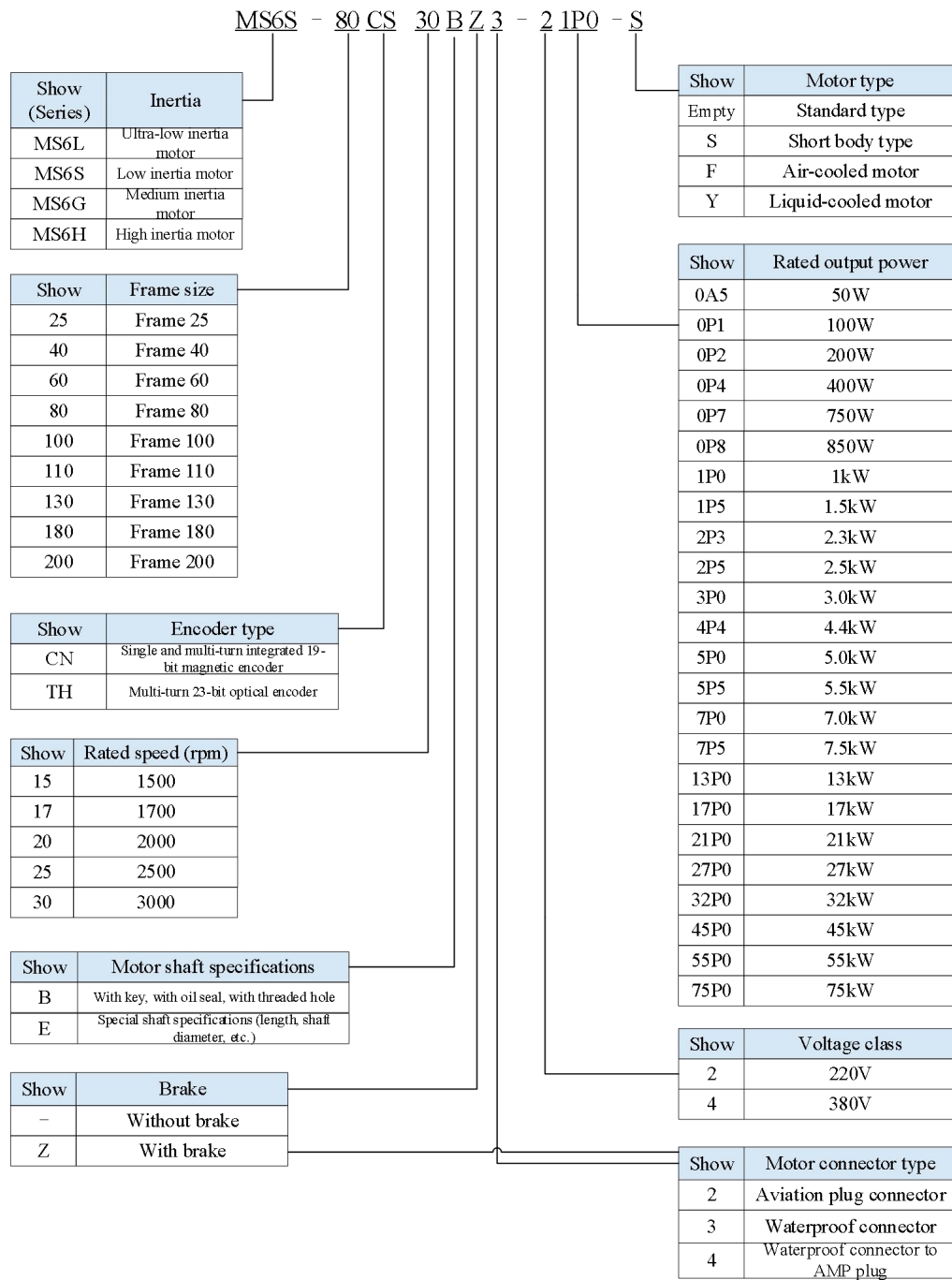
| Drive Model | Drive Power (kW) | Continuous Output Current (A) | Maximum Output Current (A) | Power Supply               | Cooling Method |
|-------------|------------------|-------------------------------|----------------------------|----------------------------|----------------|
| DM6C-40P4-M | 0.4kW            | 2.8                           | 9.8                        | Supplied by Rectifier Unit | Air-Cooled     |
| DM6C-40P7-M | 0.75kW           | 4.8                           | 16.8                       | Supplied by Rectifier Unit | Air-Cooled     |
| DM6C-43P0-M | 3kW              | 11                            | 29.7                       | Supplied by Rectifier Unit | Air-Cooled     |
| DM6C-45P5-M | 5.5kW            | 20                            | 50                         | Supplied by                | Air-Cooled     |

| Drive Model   | Drive Power (kW) | Continuous Output Current (A) | Maximum Output Current (A) | Power Supply                    | Cooling Method |
|---------------|------------------|-------------------------------|----------------------------|---------------------------------|----------------|
|               |                  |                               |                            | Rectifier Unit                  |                |
| DM6C-47P5-M   | 7.5kW            | 25                            | 62.5                       | Supplied by Rectifier Unit      | Air-Cooled     |
| DM6C-415P0-M  | 15kW             | 37                            | 66.6                       | Supplied by Rectifier Unit      | Air-Cooled     |
| DM6C-445P0S-M | 45kW             | 100                           | 220                        | Supplied by Rectifier Unit      | Air-Cooled     |
| DM6C-455P0S-M | 55kW             | 126                           | 283.5                      | Supplied by Rectifier Unit      | Air-Cooled     |
| DM6C-475P0S-M | 75kW             | 152                           | 273.6                      | Supplied by Rectifier Unit      | Air-Cooled     |
| DM6-4110P0-R  | 110kW            | 240                           | -                          | Three-Phase AC380~440V, 50/60Hz | Air-Cooled     |

## 1.2 Servo motor selection

### 1.2.1 Model naming

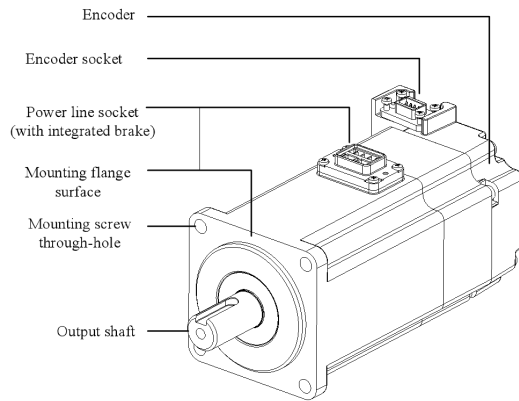
#### ■ MS6 series motor



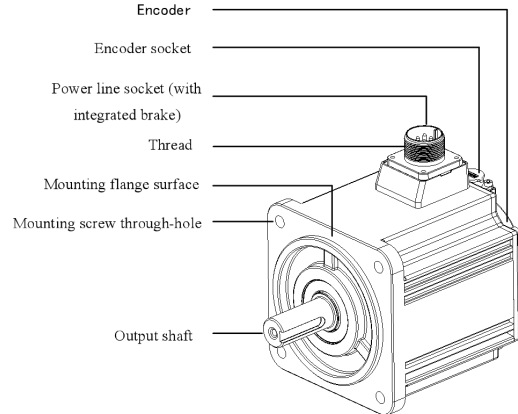
Currently, only CN and TH combinations are available for encoder type selection.

## 1.2.2 Description of Each Section

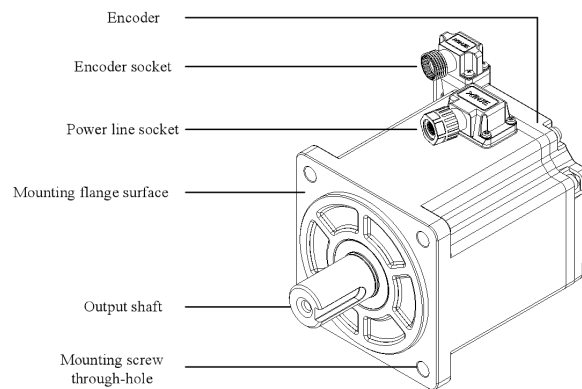
### ■ B2/B3/B4 type motors



B3 motor

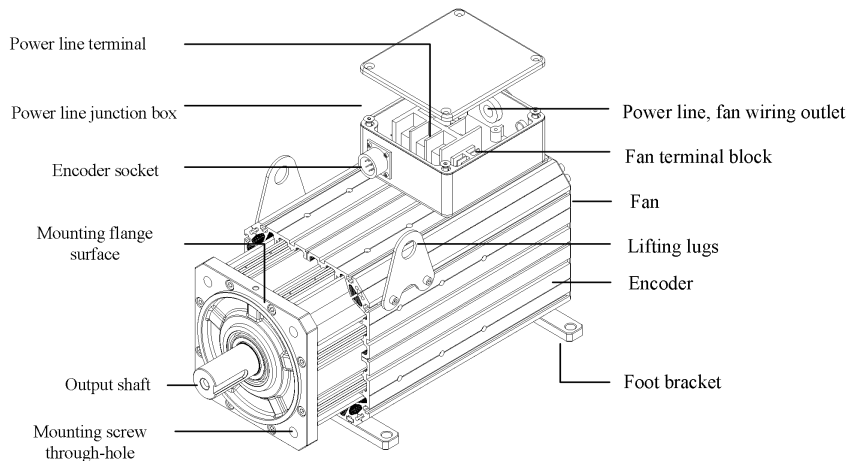


B2 motor

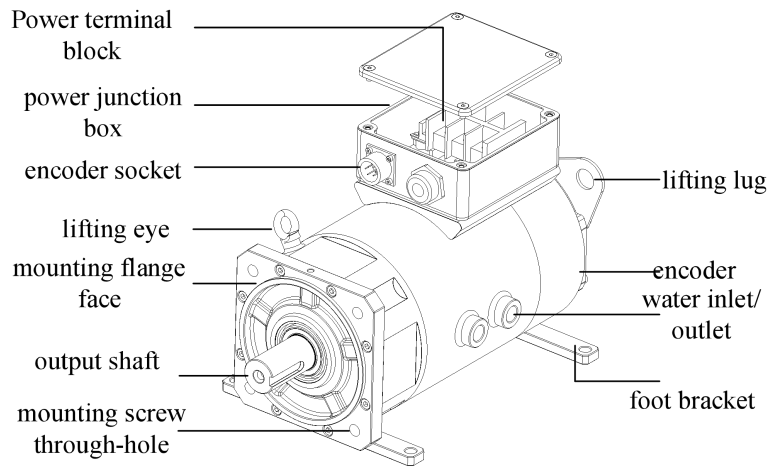


B3 motor

### ■ High-Power Air-Cooled/Liquid-Cooled Motors

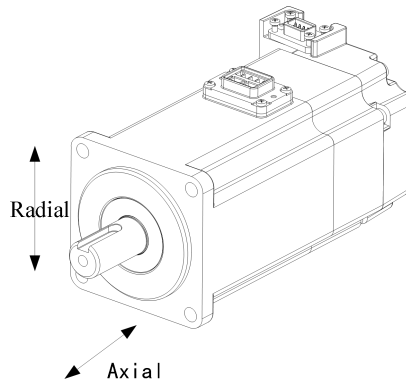


High-power air-cooled motor



high-power liquid-cooled motor

### 1.2.3 Axial Load and Radial Load Specifications



| Frame size  | 40  | 60   | 80   | 100  | 110  | 130  | 180  | 200   | 220   | 265   |
|-------------|-----|------|------|------|------|------|------|-------|-------|-------|
| Axial Load  | 54N | 74N  | 147N | 196N | 147N | 196N | 400N | 640N  | 686N  | 1120N |
| Radial Load | 78N | 245N | 392N | 500N | 392N | 686N | 800N | 1880N | 2254N | 3200N |



## 1.3 Cable Selection

### 1.3.1 model naming

#### ■ Encoder Cable Model Number

CP - SP T - M - 02

| Code | Cable type              |
|------|-------------------------|
| CP   | Standard Encoder Cable  |
| CPT  | High-Flex Encoder Cable |

| Code | Connector Type                        |
|------|---------------------------------------|
| SP   | AMP Connector                         |
| SL   | 15-pin Aviation Plug                  |
| SC   | 10-pin Compact Aviation Plug          |
| SE   | B3 Top Exit Connector (Motor Side)    |
| SF   | B3 Bottom Exit Connector (Motor Side) |
| ZDL  | Straight DB Plug (Drive Side)         |

| Code | Length (M) | Code | Length (M) |
|------|------------|------|------------|
| 02   | 2          | 12   | 12         |
| 03   | 3          | 16   | 16         |
| 05   | 5          | 20   | 20         |
| 08   | 8          | 25   | 25         |
| 10   | 10         | 30   | 30         |

| Code | Connector Type                         |
|------|----------------------------------------|
| M    | Without Battery Box                    |
| B    | With Battery Box (Frame 110 and above) |
| BM   | With Battery Box (Frame 90 and below)  |

| Code  | Connector Type                                 |
|-------|------------------------------------------------|
| T     | Threaded Snap-on Type (For Frame 130/180 only) |
| Blank | Standard Type                                  |

#### ■ Power Cable Model

CM T - E 05 A - 03

| Code | Cable Type                  |
|------|-----------------------------|
| CM   | Power Cable - Without Brake |
| CMB  | Power Cable - With Brake    |

| Code  | Cable Type                |
|-------|---------------------------|
| T     | High-Flex                 |
| G     | High-Flex & Oil-Resistant |
| Blank | Standard                  |

| Code | Connector Type                        |
|------|---------------------------------------|
| E    | B3 Top Exit Connector (Motor Side)    |
| F    | B3 Bottom Exit Connector (Motor Side) |
| L    | 4-pin Compact Aviation Plug           |
| XL   | 4-pin Medium Aviation Plug            |
| D    | 4-pin Q-Type Connector                |

| Code | Length (M) | Code | Length (M) |
|------|------------|------|------------|
| 02   | 2          | 03   | 3          |
| 05   | 5          | 08   | 8          |
| 10   | 10         | 12   | 12         |
| 16   | 16         | 20   | 20         |
| 25   | 25         | 30   | 30         |

| Code  | Terminal (Drive Side)             |
|-------|-----------------------------------|
| A/B   | Pin Terminal                      |
| T     | Pin Terminal                      |
| Blank | U-Type Terminal / U-Type Terminal |

| Code | Cross-Section (mm <sup>2</sup> ) | Code | Cross-Section (mm <sup>2</sup> ) |
|------|----------------------------------|------|----------------------------------|
| 03   | 0.3                              | 100  | 10.0                             |
| 05   | 0.5                              | 120  | 12.0                             |
| 15   | 1.5                              | 160  | 16.0                             |
| 20   | 2.0                              | 300  | 30.0                             |
| 60   | 6.0                              |      |                                  |

### ■ EtherCAT Communication Cable Model Number

JC - CB - 1

| Code | Designation                                      |
|------|--------------------------------------------------|
| JC   | Designation for EtherCAT Communication Cable Set |

| Code | Designation  |
|------|--------------|
| CB   | Cat 5e Cable |

| Code | Length (M) |
|------|------------|
| 0P2  | 0.2        |
| 0P3  | 0.3        |
| 0P5  | 0.5        |
| 1    | 1          |
| 3    | 3          |
| 5    | 5          |

S



Currently available cable lengths are 0.2 m, 0.3 m, 0.5 m, 1 m, 3 m, 5 m, 10 m, and 20 m.

### ■ CAN&RS485 Communication Cable Model Number

JN - CA - 2

| Code | Designation                                    |
|------|------------------------------------------------|
| JN   | Designation for CAN485 Communication Cable Set |

| Code | Designation  |
|------|--------------|
| CA   | Cat 5e Cable |

| Code | Length (M) |
|------|------------|
| 0P3  | 0.3        |
| 2    | 2          |



Currently available cable lengths are 0.3 m and 2 m.

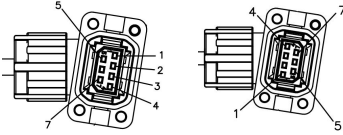
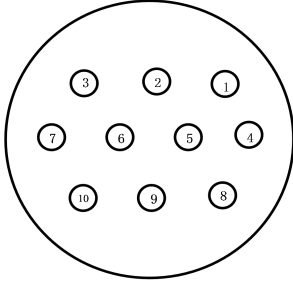
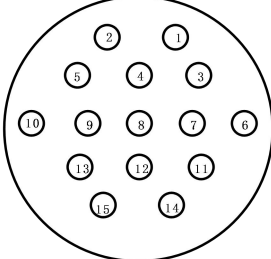
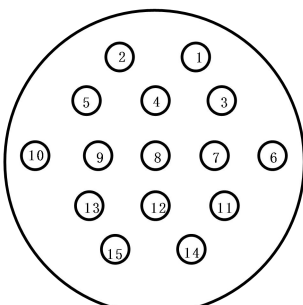
## 1.3.2 Cable Terminal Definitions

### ■ Encoder Cable

#### (1) Servo Motor Side Encoder Cable Pinout

|  | Interface Pinout |               |         |            |
|--|------------------|---------------|---------|------------|
|  | Pin No.          | Definition    | Pin No. | Definition |
|  | 1                | Temp Sensor - | 6       | GND        |
|  | 2                | Temp Sensor+  | 7       | /          |
|  | 3                | 485-B         | 8       | +5V        |
|  | 4                | 485-A         | 9       | /          |
|  | 5                | Shield Layer  | /       | /          |
|  |                  |               |         |            |

#### (2) Servo Motor Side Encoder Cable Pinout

| Motor Model                 | Connector Pin                                                                                                                                                              | Interface Pinout |            |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------|
|                             |                                                                                                                                                                            | Pin No.          | Definition |
| MS6-40、60、80 frame B3 motor |  <p>Front-facing Cable Outlet<br/>Rear-facing Cable Outlet<br/>(Viewing Perspective)</p> | 1                | 5V         |
|                             |                                                                                                                                                                            | 2                | GND        |
|                             |                                                                                                                                                                            | 3                | Battery+   |
|                             |                                                                                                                                                                            | 4                | Battery-   |
|                             |                                                                                                                                                                            | 5                | 485-A      |
|                             |                                                                                                                                                                            | 6                | 485-B      |
|                             |                                                                                                                                                                            | 7                | Shield     |
| MS6-130 frame B2 motor      |                                                                                          | Pin No.          | Definition |
|                             |                                                                                                                                                                            | 1                | /          |
|                             |                                                                                                                                                                            | 2                | 5V         |
|                             |                                                                                                                                                                            | 3                | GND        |
|                             |                                                                                                                                                                            | 4                | 485-A      |
|                             |                                                                                                                                                                            | 5                | 485-B      |
|                             |                                                                                                                                                                            | 6                | Battery+   |
|                             |                                                                                                                                                                            | 7                | Battery-   |
|                             |                                                                                                                                                                            | 8                | /          |
|                             |                                                                                                                                                                            | 9                | /          |
|                             |                                                                                                                                                                            | 10               | Shield     |
| MS6-180 frame B2 motor      |                                                                                        | Pin No.          | Definition |
|                             |                                                                                                                                                                            | 1                | Shield     |
|                             |                                                                                                                                                                            | 2                | /          |
|                             |                                                                                                                                                                            | 3                | 485-B      |
|                             |                                                                                                                                                                            | 4                | 485-A      |
|                             |                                                                                                                                                                            | 5                | /          |
|                             |                                                                                                                                                                            | 6                | GND        |
|                             |                                                                                                                                                                            | 7                | Battery-   |
|                             |                                                                                                                                                                            | 8                | 5V         |
|                             |                                                                                                                                                                            | 9                | Battery+   |
| 200、265 frame motor         |                                                                                        | Pin No.          | Definition |
|                             |                                                                                                                                                                            | 1                | Shield     |
|                             |                                                                                                                                                                            | 2                | /          |
|                             |                                                                                                                                                                            | 3                | 485-B      |
|                             |                                                                                                                                                                            | 4                | 485-A      |
|                             |                                                                                                                                                                            | 5                | /          |
|                             |                                                                                                                                                                            | 6                | GND        |
|                             |                                                                                                                                                                            | 7                | Battery-   |
|                             |                                                                                                                                                                            | 8                | 5V         |
|                             |                                                                                                                                                                            | 9                | Battery+   |
|                             |                                                                                                                                                                            | 14               | Temp-      |
|                             |                                                                                                                                                                            | 15               | Temp+      |

**Battery Box Note:**

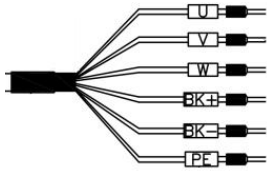
1) The cables for the encoders listed above, which include the Battery+ and Battery- pin definitions, are used for absolute value motors. These pins are not present in the cables for non-absolute value

motors.

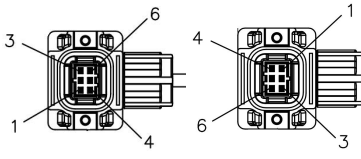
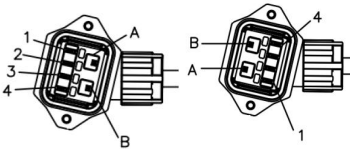
2) Only the absolute value motor is compatible with the external battery box, which features a built-in 3.6V/2.7Ah high-capacity battery and supports battery replacement without power interruption. The battery life is no less than 2 years. For battery replacement methods, refer to Section 5.1.2 "Battery Replacement".

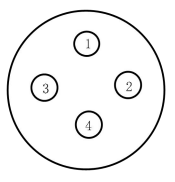
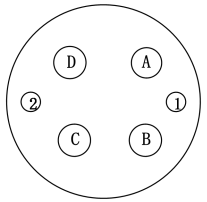
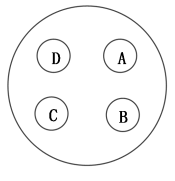
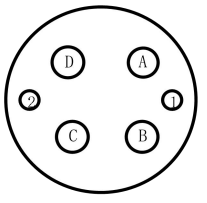
## ■ Motor Power Cable

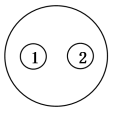
### (1) Servo Drive Side Power Cable Pin Definitions

| Motor Model                        | Connector Appearance                                                                                | Interface Pin Definitions |            |
|------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------|------------|
|                                    |                                                                                                     | Color                     | Definition |
| MS6 Series B3 Motor                |                    | Red                       | U          |
|                                    |                                                                                                     | White                     | V          |
|                                    |                                                                                                     | Black                     | W          |
|                                    |                                                                                                     | Yellow&Green              | PE         |
|                                    |                                                                                                     | Blue                      | BK+        |
|                                    |                                                                                                     | Brown                     | BK-        |
|                                    |                                                                                                     |                           |            |
| MS6 Series 130, 180 Frame B2 Motor |                   | Color                     | Definition |
|                                    |                                                                                                     | Brown                     | U          |
|                                    |                                                                                                     | Black                     | V          |
|                                    |                                                                                                     | Blue                      | W          |
|                                    |                                                                                                     | Yellow&Green              | PE         |
|                                    |                                                                                                     | Red                       | BK+        |
| MS6 Series 200 Frame B2 Motor      | 200 frame motors have no socket. Note: Connect U, V, W on the drive side and motor side one-to-one. | Black                     | BK-        |
|                                    |                                                                                                     | Color                     | Definition |
|                                    |                                                                                                     | Red                       | U          |
|                                    |                                                                                                     | Yellow                    | V          |
|                                    |                                                                                                     | Blue                      | W          |
|                                    |                                                                                                     | Yellow&Green              | PE         |

## (2) Motor Side Power Cable Solder Pin Definitions

| Motor Model               | Connector Pinout                                                                                                                          | Interface Pin Definitions |            |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------|
|                           |                                                                                                                                           | Pin No.                   | Definition |
| MS6-40 Frame B3 Motor     |  <p>Front Exit      Rear Exit<br/>(User View Angle)</p> | 1                         | W          |
|                           |                                                                                                                                           | 2                         | V          |
|                           |                                                                                                                                           | 3                         | U          |
|                           |                                                                                                                                           | 4                         | PE         |
|                           |                                                                                                                                           | 5                         | BK+        |
|                           |                                                                                                                                           | 6                         | BK-        |
| MS6-60, 80 Frame B3 Motor |  <p>Front Exit      Rear Exit<br/>(User View Angle)</p> | Pin No.                   | Definition |
|                           |                                                                                                                                           | 1                         | U          |
|                           |                                                                                                                                           | 2                         | V          |
|                           |                                                                                                                                           | 3                         | W          |
|                           |                                                                                                                                           | 4                         | PE         |
|                           |                                                                                                                                           | A                         | BK+        |
|                           |                                                                                                                                           | B                         | BK-        |

| Motor Model                    | Connector Pin                                                                       | Interface Pin Definition |            |
|--------------------------------|-------------------------------------------------------------------------------------|--------------------------|------------|
|                                |                                                                                     | Pin No.                  | Definition |
| MS6H-180 Frame Non-brake Motor |   | 1                        | PE         |
|                                |                                                                                     | 2                        | U          |
|                                |                                                                                     | 3                        | V          |
|                                |                                                                                     | 4                        | W          |
| MS6H-180 Frame Brake Motor     |  | Pin No.                  | Definition |
|                                |                                                                                     | A                        | U          |
|                                |                                                                                     | B                        | V          |
|                                |                                                                                     | C                        | W          |
|                                |                                                                                     | D                        | PE         |
|                                |                                                                                     | 1                        | BK+        |
|                                |                                                                                     | 2                        | BK-        |
| MS6G-130 Frame Non-brake Motor |  | Pin No.                  | Definition |
|                                |                                                                                     | A                        | W          |
|                                |                                                                                     | B                        | V          |
|                                |                                                                                     | C                        | U          |
|                                |                                                                                     | D                        | PE         |
| MS6G-130 Frame Brake Motor     |  | Pin No.                  | Definition |
|                                |                                                                                     | A                        | PE         |
|                                |                                                                                     | B                        | W          |
|                                |                                                                                     | C                        | V          |
|                                |                                                                                     | D                        | U          |
|                                |                                                                                     | 1                        | BK+        |
|                                |                                                                                     | 2                        | BK-        |
| 200/265 Frame Motor            |  | Color                    | Definition |
|                                |                                                                                     | Red                      | U          |

| Motor Model               | Connector Pin                                                                     | Interface Pin Definition |            |
|---------------------------|-----------------------------------------------------------------------------------|--------------------------|------------|
|                           |                                                                                   | Green                    | V          |
|                           |                                                                                   | Blue                     | W          |
|                           |                                                                                   | Yellow&Green             | PE         |
| 200/265 Frame Brake Motor |  | Color                    | Definition |
|                           |                                                                                   | 1                        | BK+        |
|                           |                                                                                   | 2                        | BK-        |

**Brake Pin Description:**

The cable pin definitions above that include BK+ and BK- are used for motors with brakes. Cables for non-brake motors do not have these pins; the terminals are empty.

## 2. Installation of the Servo System

---

### 2.1 Installation of the Servo Drive

#### 2.1.1 Installation Location

- Install the unit inside a control cabinet, protected from direct sunlight and rain.
- Do not use the product in environments near corrosive or flammable gases and materials, such as hydrogen sulfide, chlorine, ammonia, sulfur, oxidizing gases, acids, alkalis, salts, or combustibles. Do not install the unit in environments with high temperature, humidity, dust, or metal dust.
- Install the unit in a location free from vibration.

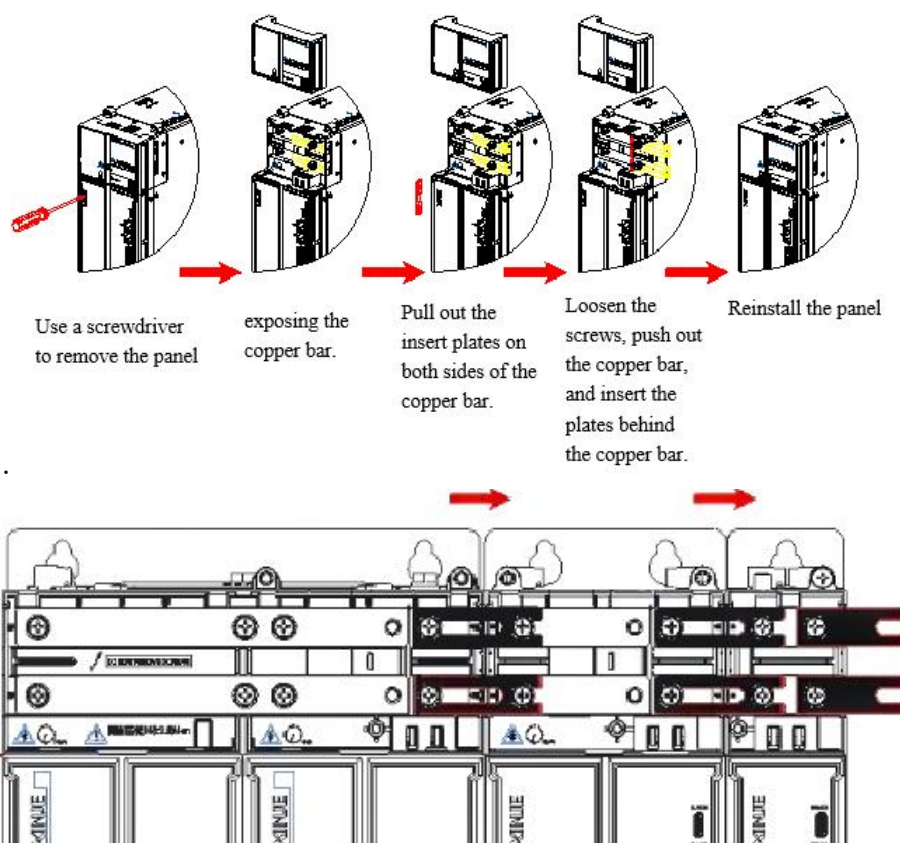
#### 2.1.2 Environmental Conditions

| Item                          | Specification                                                                                |
|-------------------------------|----------------------------------------------------------------------------------------------|
| Operating Ambient Temperature | -10~40°C                                                                                     |
| Operating Ambient Humidity    | 20~90%RH (non-condensing)                                                                    |
| Storage Temperature           | -20~60°C                                                                                     |
| Storage Humidity              | 20~90%RH (non-condensing)                                                                    |
| Vibration Resistance          | 4.9 m/s <sup>2</sup> or less                                                                 |
| Altitude                      | 1000 m or below. For altitudes above 1000 m, derate the unit by 1% for every 100 m increase. |

#### 2.1.3 Installation Standard

The installation standard shown in the figure below must be strictly followed. This standard applies when

combining a rectifier module with inverter modules. The combination of multiple inverter modules follows a similar process, extending to the right. Note that the shorting cover plate and the snap-fit cover plate must be installed on the final inverter module



#### ■ Servo Drive Orientation

During installation, ensure the front face of the servo drive (the actual mounting surface facing the operator) is oriented toward the operator and perpendicular to the wall.

#### ■ Cooling

Sufficient space must be reserved around the servo drive to allow for effective cooling via the fan and natural convection.

#### ■ Group Installation

A cooling fan should be installed above the servo drive. To prevent localized overheating of the servo drive, maintain a uniform temperature distribution inside the control cabinet.

- Environmental Conditions Inside the Control Cabinet
- Operating ambient temperature:  $-10^{\circ}\text{C}$  to  $40^{\circ}\text{C}$ .
- Humidity: 90% RH or less.
- Vibration:  $4.9 \text{ m/s}^2$ .
- Avoid conditions leading to freezing or condensation.

- For long-term reliability, use in an ambient temperature below 50°C.



## 2.2 Servo Motor Installation

MS6 series servo motors can be mounted in either horizontal or vertical orientations. However, incorrect installation or installation in an unsuitable location may shorten the motor's lifespan or cause unexpected accidents. Please ensure proper installation by following the precautions below.



### Attention

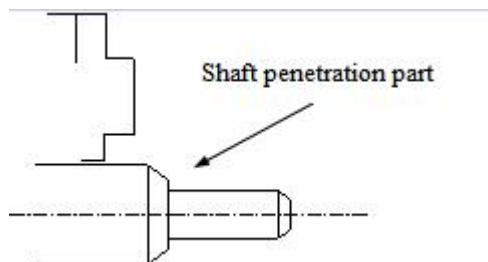
1. The shaft end is coated with "anti-rust agent." Before installing the motor, wipe off the anti-rust agent with a cloth soaked in "thinner."
2. When wiping off the anti-rust agent, ensure the thinner does not come into contact with other parts of the servo motor.

### 2.2.1 Installation Location

- Do not use the motor in environments containing corrosive or flammable substances such as hydrogen sulfide, chlorine, ammonia, sulfur, oxidizing gases, acids, alkalis, salts, or near combustible materials.
- In areas exposed to grinding fluid, oil mist, iron dust, or cuttings, select a model equipped with an oil seal.
- Keep the motor away from heat sources such as furnaces.
- Do not use the motor in enclosed environments. Enclosed spaces can cause overheating and reduce the motor's service life.

### 2.2.2 Environmental Conditions

If there is a risk of water dripping in the equipment installation environment (excluding the motor shaft end), verify whether the motor's ingress protection (IP) rating meets the operational requirements. When the motor shaft penetration area may be exposed to oil splashing, a servo motor equipped with an oil seal must be selected.



The MS6 series servo motors are designed for indoor use. Operate the motor under the following environmental conditions:

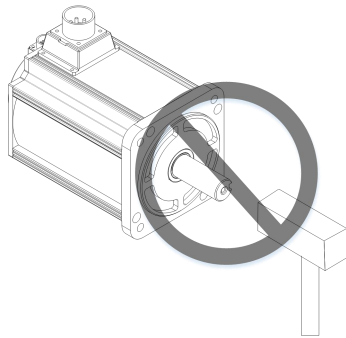
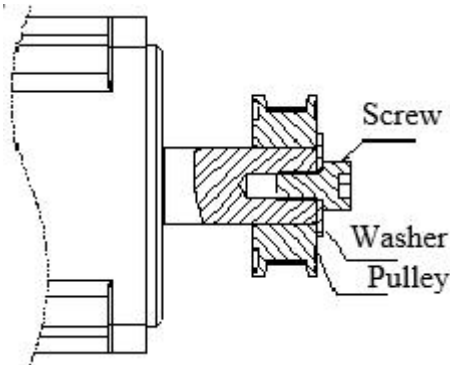
| Item                | Description               |
|---------------------|---------------------------|
| Ambient Temperature | -10°C~40°C(non-freezing)  |
| Ambient Humidity    | 20%~90%RH(non-condensing) |

| Item                                          | Description                                                                                                                                               |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage Temperature                           | -20°C~60°C                                                                                                                                                |
| Storage Humidity                              | 20%~90%RH(non-condensing)                                                                                                                                 |
| Vibration Resistance (Vibration Acceleration) | Radial: 49m/s <sup>2</sup><br>Axial: 24.5m/s <sup>2</sup>                                                                                                 |
| Altitude                                      | ≤ 1000 m. Derate by 1% for every 100 m above 1000 m                                                                                                       |
| Cooling Method                                | Air-cooled / Liquid-cooled / Natural convection                                                                                                           |
| Protection Rating                             | IP54 (200-frame and larger motors)<br>IP65 (100-180 frame MS6H series motors)<br>IP67 (80-frame and smaller motors; 100-180 frame non-MS6H series motors) |



- The vibration intensity acting on the servo motor varies depending on the application. Always verify the vibration acceleration with the actual product.
- The specified protection ratings are achieved only when the motor and compatible cable are correctly mated and securely locked.

### 2.2.3 Installation Precautions

| Item            | Description                                                                                                                                                                                                                                                                                                                                                             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rust Prevention | <p>◆ Before installation, completely wipe off the anti-rust agent from the motor shaft extension and apply appropriate anti-corrosion treatment.</p>                                                                                                                                                                                                                    |
| Encoder Caution | <p>◆ Do not impact the shaft extension during installation, as this may damage the internal encoder.</p>   <p>◆ Before installing a pulley on the servo motor, ensure all components (servo</p> |

| Item | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <p>motor, pulley, shim, screws, etc.) are complete and undamaged. Prepare suitable tools (e.g., wrenches).</p> <ul style="list-style-type: none"><li>◆Align the pulley's bore with the motor shaft and push it on smoothly to ensure concentricity.</li><li>◆Place a shim of the correct specification over the motor shaft to compensate for tolerances, increase friction, and prevent loosening.</li><li>◆Finally, insert the screw into the threaded hole and gradually tighten it against the shim and into the pulley to secure the pulley firmly.</li></ul> |

## 2.3 Servo Cable Installation

The MS6 series servo motors utilize communication-type encoders. Improper use or adverse environmental conditions may lead to unpredictable effects. The following points must be observed when installing optional power and encoder cables.

### 2.3.1 Selecting Xinje Cables

Our standard cable materials include regular and high-flexibility types. For motors of frame size 80 and below, compatible cable connectors are available in aviation plug and AMP types. For motors above frame size 80, the compatible cable connectors are aviation plug type.

For **standard applications**, strictly adhere to the specifications provided by Xinje (see section 2.3.2 Xinje Cable Specifications) when selecting cables from other manufacturers.

For **non-standard applications**, select cables from other manufacturers that meet or exceed Xinje's current specifications based on the actual conditions.

#### **Standard Application** Considerations:

- Keep the pulse command signal cable length below 3 meters.
- Keep encoder cable lengths within 20 meters. For lengths exceeding 20 meters, special cables are recommended. The encoder cable's cross-sectional area depends on the required length. Longer cables have higher resistance, leading to greater voltage drop or signal distortion, potentially causing lost pulses or undetected signals. Generally, use custom special cables for lengths over 20 meters.
- The power cable's cross-sectional area depends on the motor's current. Typically, select an area equal to 1/10 of the motor's maximum current (e.g., 6 mm<sup>2</sup> for a 60A motor).
- If interference occurs, separate high-power and low-power cables. It is advised to route power cables separately from encoder and signal cables.
- Ensure proper grounding of the servo drive and motor. Grounding resistance should not exceed 4  $\Omega$ , with a grounding depth greater than 2 meters. Use 4x40 galvanized angle steel or a 40mm diameter galvanized steel pipe.
- For customer-made cables, refer to Xinje's specifications (section 2.3.2). Ensure reliable soldering, avoiding cold joints, bridges, wrong connections, or missed spots. Test continuity between both ends after soldering.

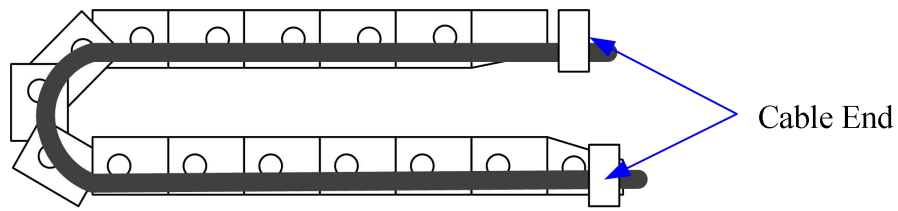
#### **Non-Standard Application** Considerations:

##### 1) Cable Dragging and Bending:

- Avoid bending cables or subjecting them to tension. Signal cable cores are only 0.2mm or 0.3mm in diameter and break easily. Handle with care.
- Use high-flex cables for moving applications. Standard cables are prone to damage under repeated bending. Integral cables on small motors (below frame size 80) are not suitable for moving applications.

When using cable carriers:

- ① Maintain a bending radius of at least 10 times the cable's outer diameter;
- ② Do not clamp or bundle cables inside the carrier; only secure them at the fixed ends outside the carrier.
- ③ Prevent cables from twisting or tangling.
- ④ Keep the fill ratio inside the carrier below 60%.
- ⑤ Do not mix cables with significantly different sizes to prevent crushing thinner cables. If mixing is necessary, use partitions within the carrier.



## 2) Oily or Humid Environments

- It is recommended to select cables with aviation-style connectors; the use of AMP-style interface cables is discouraged.
- If AMP-style cables are already deployed on-site, appropriate protective measures (such as applying silicone sealant or wrapping with insulating tape) must be implemented.
- Use specially rated cables for these conditions.

## 3) Environments with Interference or High Current/Power (e.g., Welding Equipment)

- Ensure the motor is correctly grounded.
- Ground high-current equipment separately.
- Employ proper cabling routing, such as separating power and signal cables.
- Shield encoder cables with metal shielding or add ferrite cores to suppress interference.

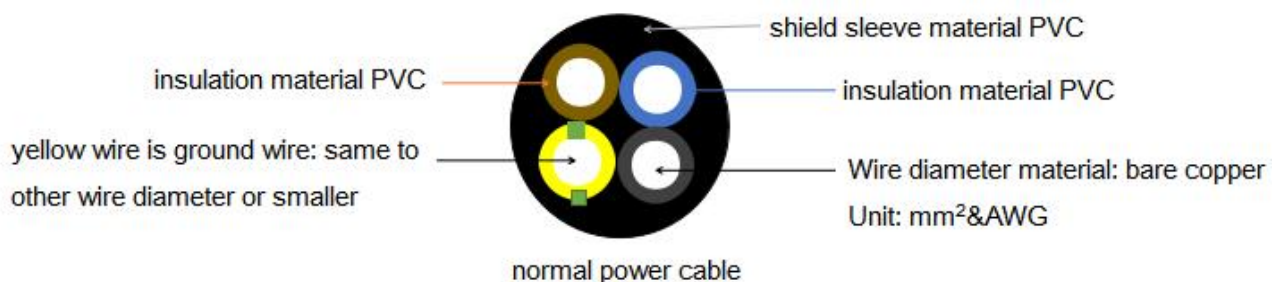
## 4) Low-Temperature or High-Temperature Environments

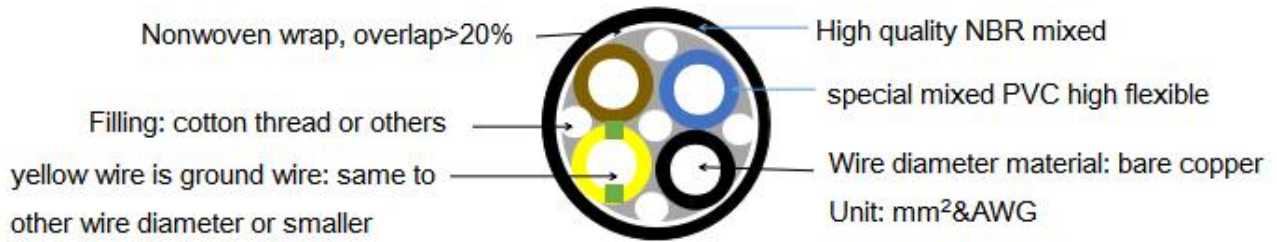
- Select cables (special types) rated for the specific operating temperature conditions.

## 2.3.2 XINJE Cable Specifications

### 1) XINJE Cable Material Composition

Cross-sectional diagrams of the cables (encoder, power) are provided. These diagrams correspond to descriptions of the sheath material, conductor gauge/size, core material, and shielding layer material.

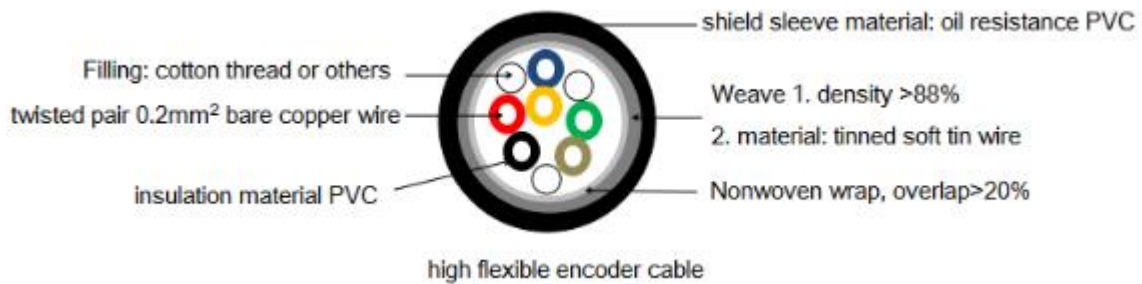




high flexible power cable



normal encoder cable



high flexible encoder cable

## 2) Cable Gauge Specifications

| Frame Size                   | Encoder Cable Diameter      |                                                                                                                                                                           | Power Cable Diameter                             |                                                 |                                     |
|------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------|-------------------------------------|
|                              | Overall Diameter (Standard) | Individual Conductor                                                                                                                                                      | Overall Dia. (mm) (Non-brake/Brake)              | Power Core Gauge (mm <sup>2</sup> )             | Brake Core Gauge (mm <sup>2</sup> ) |
| 40 Motor Frame               | 6 mm                        | 15m below:<br>3P*0.2 mm <sup>2</sup><br>15m~30m:<br>2P*0.2 mm <sup>2</sup> +<br>1P*0.34 mm <sup>2</sup><br>30m~50m:<br>2P*0.2 mm <sup>2</sup> +<br>1P*0.4 mm <sup>2</sup> | Standard / High-flex:<br>5.2/5.8 mm              | 4*0.3 mm <sup>2</sup>                           | 2*0.3 mm <sup>2</sup>               |
| 60、80 Motor Frame            |                             |                                                                                                                                                                           | Standard / High-flex:<br>6.2/6.5 mm              | 4*0.5 mm <sup>2</sup>                           |                                     |
| 100、110、130 Motor Frame      | 6.2 mm                      |                                                                                                                                                                           | Standard: 9.4/9.4mm<br>High-flex: 9.6/9.6 mm     | 4*1.5 mm <sup>2</sup>                           |                                     |
| 180 Motor Frame<br>3kW       |                             |                                                                                                                                                                           | Standard: 9.7/9.8 mm<br>High-flex: 9.8/9.8 mm    | 4*2.0 mm <sup>2</sup>                           |                                     |
| 180 Motor Frame<br>3kW above |                             |                                                                                                                                                                           | Standard: 14.5/14.5 mm<br>High-flex:15.8/15.8 mm | 3*6.0mm <sup>2</sup> +<br>1*2.5 mm <sup>2</sup> |                                     |
| 200 Motor Frame 13、<br>17kW  |                             |                                                                                                                                                                           | 7.9 mm                                           | Standard: 14.5mm<br>High-flex: 15.5mm           |                                     |

|                         |  |  |                  |                                                 |  |
|-------------------------|--|--|------------------|-------------------------------------------------|--|
| 200 Motor Frame<br>21kW |  |  | Standard: 19.6mm | 4*10.0mm <sup>2</sup>                           |  |
| 200 Motor Frame<br>27kW |  |  | Standard: 20mm   | 3*12.0mm <sup>2</sup> +<br>1*4 mm <sup>2</sup>  |  |
| 265 Motor Frame<br>32kW |  |  | Standard: 22mm   | 4*16.0mm <sup>2</sup>                           |  |
| 265 Motor Frame<br>45kW |  |  | Standard: 29mm   | 3*30.0mm <sup>2</sup> +<br>1*16 mm <sup>2</sup> |  |



For encoder cables of 15 meters and longer, the power wires (5V and GND) must have an increased gauge to prevent voltage drop over the long distance, which could affect encoder signal transmission.

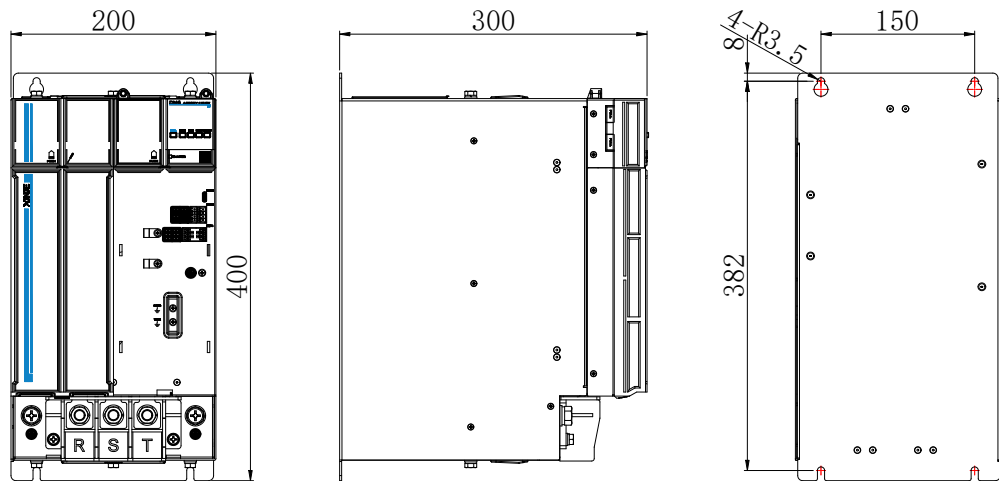
### 3) Cable Technical Specifications

| Cable Type                                                                     | Cable Performance Specifications |                      | Cable Installation Specifications |                                                                                                                        |
|--------------------------------------------------------------------------------|----------------------------------|----------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------|
|                                                                                | Temperature Rating               | Voltage Withstanding | Fixed Installation                | Moving Installation                                                                                                    |
| Standard Cable                                                                 | -20°C~80°C                       | 2000V/min            | ≥5*D                              | /                                                                                                                      |
| High-Flex Cable                                                                | -20°C~80°C                       | 2000V/min            |                                   | If travel ≤ 2m and R ≥ 7.5 × D, then N ≥ 3 million cycles;<br>If travel ≤ 2m and R ≥ 10 × D, then N ≥ 5 million cycles |
| Note: D = Finished Cable Diameter, R = Bending Radius, N = Flexing Cycle Life. |                                  |                      |                                   |                                                                                                                        |

## 2.4 Servo Drive Outline Dimensions

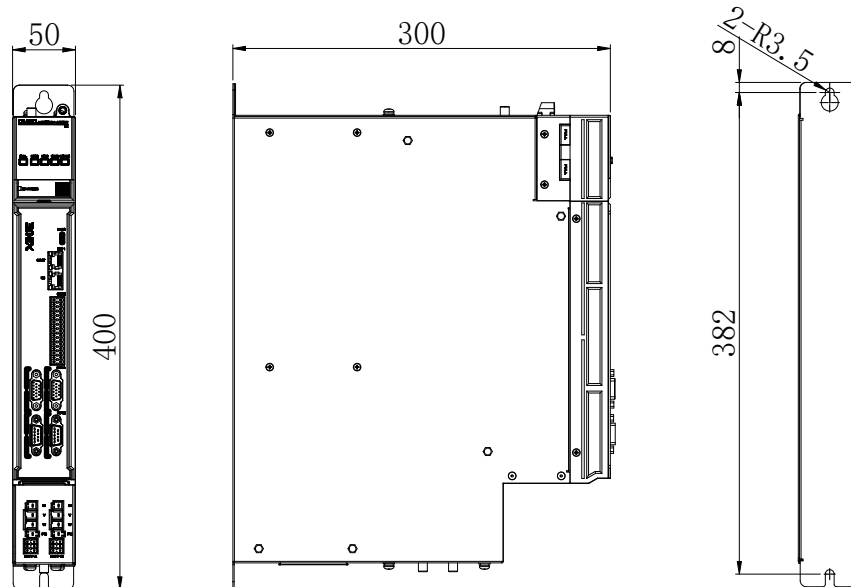
### ■ DM6-4110P0-R

unit: mm



### ■ DM6C-40P4-M, DM6C-40P7-M, DM6C-43P0-M

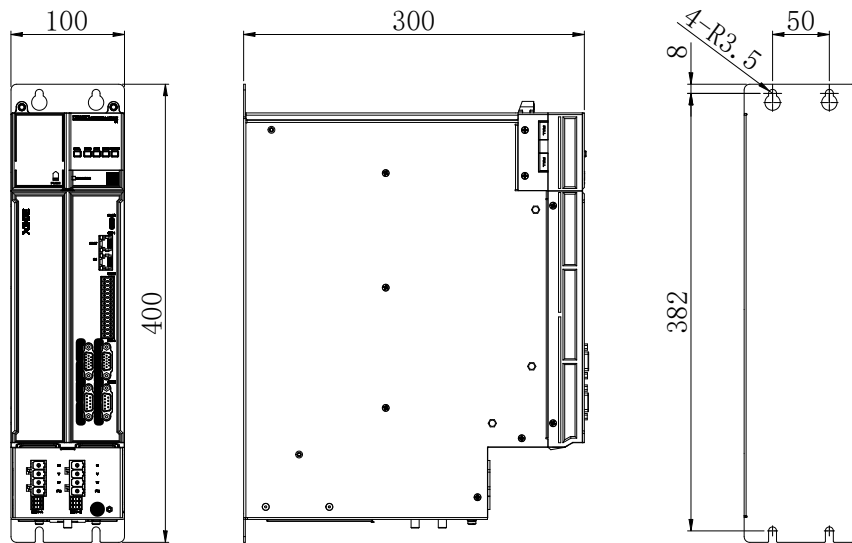
unit: mm





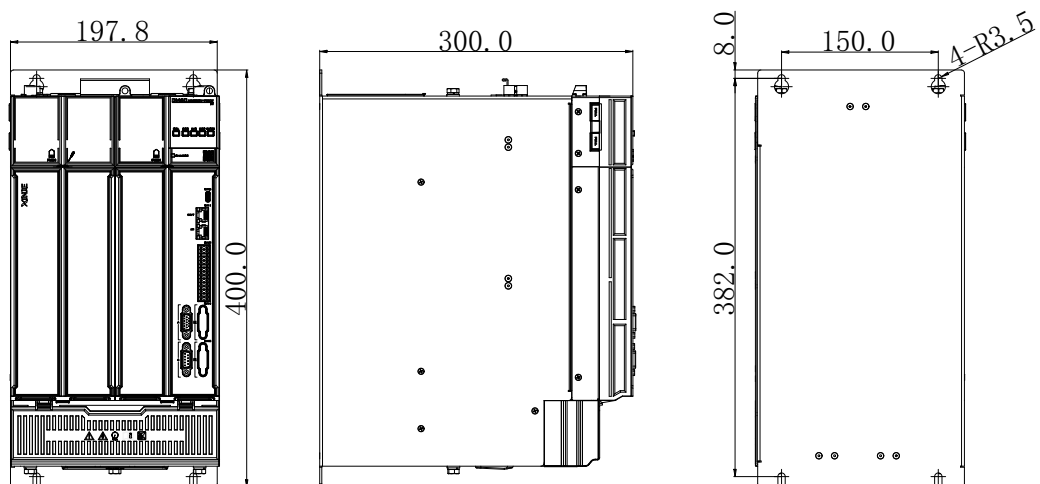
## ■ DM6C-45P5-M、DM6C-47P5-M、DM6C-415P0-M

unit: mm



## ■ DM6C-445P0S-M、DM6C-455P0S-M、DM6C-475P0S-M

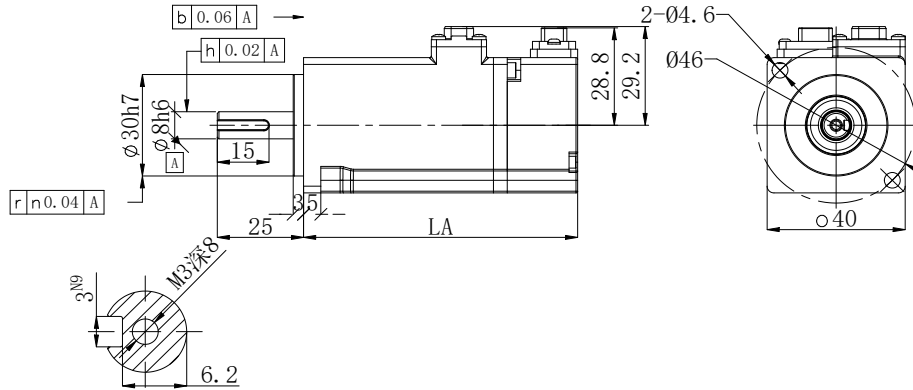
unit: mm



## 2.5 Outline Dimensions of Servo Motor

### ■ Mounting Dimensions for 40 Frame Size Motor

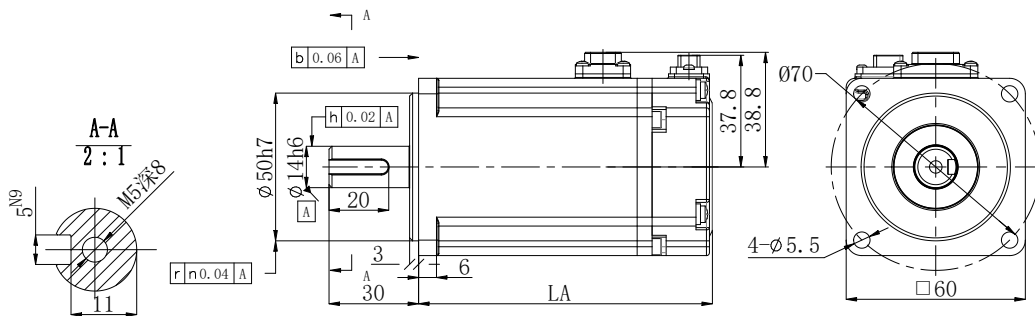
unit: mm



| Motor Model           | LA $\pm 1$ |            | Inertia Class |
|-----------------------|------------|------------|---------------|
|                       | Standard   | With Brake |               |
| MS6H-40CN30B□3-20A5-S | 60.8       | 93.4       | High Inertia  |
| MS6H-40CN30B□3-20P1-S | 77.4       | 110        |               |
| MS6H-40TH30B□3-20A5-S | 62.8       | 95.4       |               |
| MS6H-40TH30B□3-20P1-S | 79.4       | 112        |               |

### ■ Mounting Dimensions for 60 Frame Size Motor

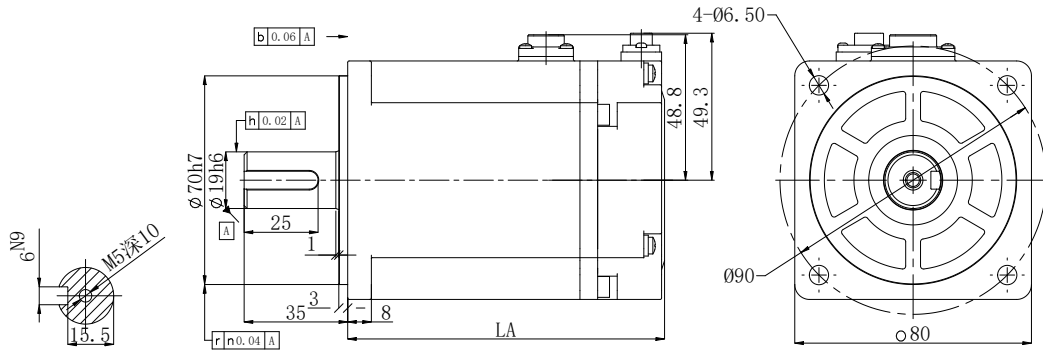
unit: mm



| Motor Model           | LA $\pm 1$ |            | Inertia Class |
|-----------------------|------------|------------|---------------|
|                       | Standard   | With Brake |               |
| MS6H-60CN30B□3-20P2   | 76.4       | 99.15      | High Inertia  |
| MS6H-60CN30B□3-20P2-S | 66.7       | 93.5       |               |
| MS6S-60CN30B□3-20P4   | 98.4       | 121.15     | Low Inertia   |
| MS6S-60CN30B□3-20P4-S | 88.7       | 115.5      |               |
| MS6S-60TH30B□3-20P4   | 97.4       | 121.2      |               |
| MS6S-60TH30B□3-20P4-S | 97.4       | 121.2      |               |
| MS6H-60CN30B□3-20P4   | 98.4       | 121.15     | High Inertia  |
| MS6H-60CN30B□3-20P4-S | 80.2       | 106.95     |               |
| MS6H-60TH30B□3-20P4   | 98.4       | 121.15     |               |
| MS6H-60TH30B□3-20P4-S | 80.2       | 106.95     |               |

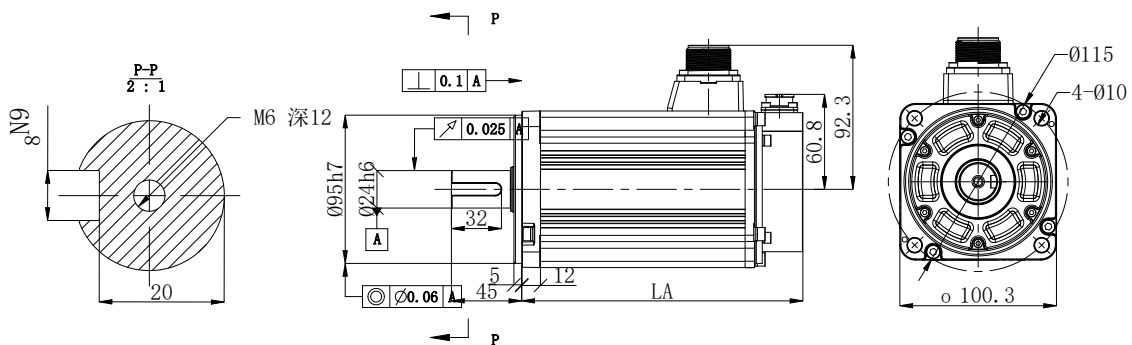
### ■ Mounting Dimensions for 80 Frame Size Motor

unit: mm



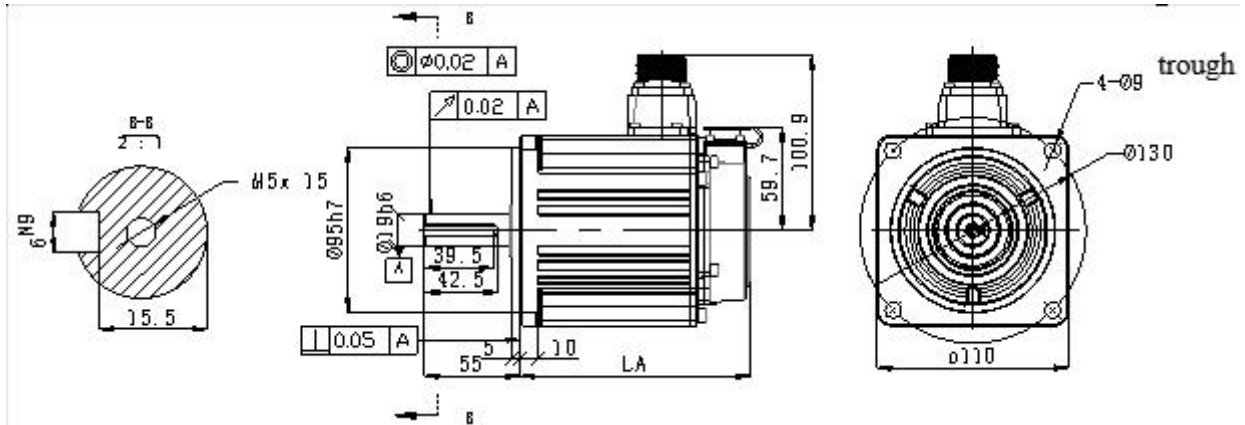
| Motor Model           | LA±1     |            | Inertia Class |
|-----------------------|----------|------------|---------------|
|                       | Standard | With Brake |               |
| MS6S-80CN30B□3-20P7   | 107.1    | 132.1      | Low Inertia   |
| MS6S-80CN30B□3-20P7-S | 95       | 126.9      |               |
| MS6S-80TH30B□3-20P7   | 107.1    | 132.1      |               |
| MS6S-80TH30B□3-20P7-S | 106.1    | 138        |               |
| MS6H-80CN30B□3-20P7   | 107.1    | 132.1      | High Inertia  |
| MS6H-80CN30B□3-20P7-S | 89.2     | 121.1      |               |
| MS6H-80TH30B□3-20P7   | 107.1    | 132.1      |               |
| MS6H-80TH30B□3-20P7-S | 100.3    | 132.2      |               |
| MS6S-80CN30B□3-21P0   | 117.6    | 142.6      | Low Inertia   |
| MS6S-80TH30B□3-21P0   | 117.6    | 142.6      |               |
| MS6H-80CN30B□3-21P0   | 134      | 159        | High Inertia  |
| MS6H-80CN30B□3-21P0-S | 112.5    | 144.4      |               |
| MS6H-80TH30B□3-21P0   | 134      | 159        |               |
| MS6H-80TH30B□3-21P0-S | 123.6    | 155.5      |               |

### ■ Mounting Dimensions for 100 Frame Size Motor



| Motor Model          | LA±1     |            | Inertia Class     |
|----------------------|----------|------------|-------------------|
|                      | Standard | With Brake |                   |
| MS6L-100CN30B□2-□1P5 | 180      | 205        | Ultra-Low Inertia |
| MS6L-100TH30B□2-□1P5 | 193      | 218        |                   |
| MS6L-100CN30B□2-42P5 | 228      | 253        |                   |
| MS6L-100TH30B□2-42P5 | 241      | 266        |                   |

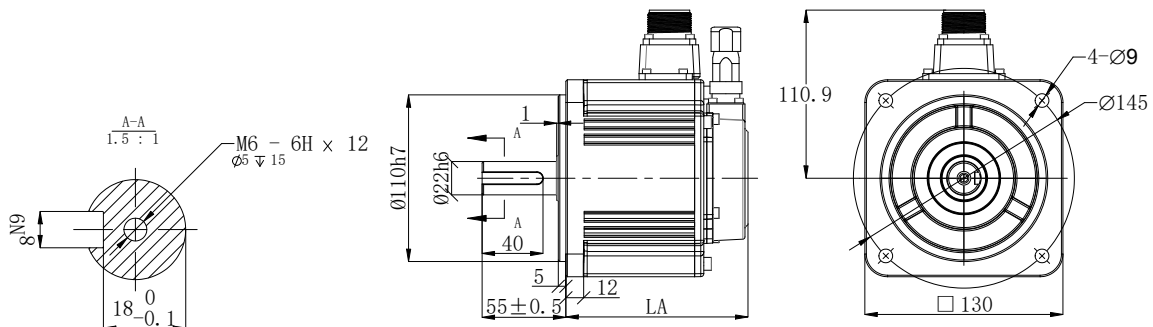
### ■ Mounting Dimensions for 110 Frame Size Motor



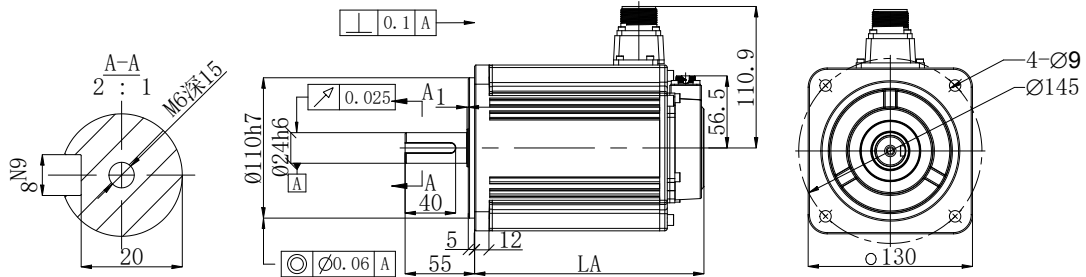
| Motor Model          | LA±1     |            | Inertia Class  |
|----------------------|----------|------------|----------------|
|                      | Standard | With Brake |                |
| MS6G-110CN30B□2-□1P5 | 132.5    | 163.5      | Medium Inertia |
| MS6G-110TH30B□2-□1P5 | 149      | 180        |                |

### ■ Mounting Dimensions for 130 Frame Size Motor

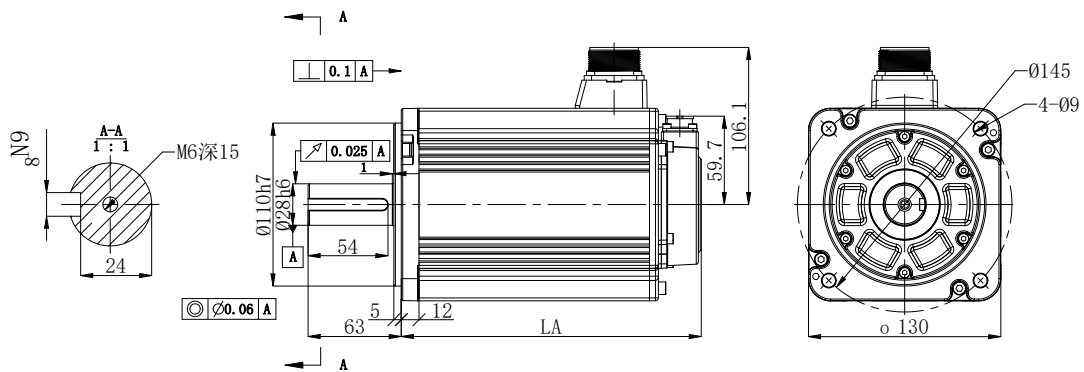
unit: mm



| Motor Model          | LA±1     |            | Inertia Class  |
|----------------------|----------|------------|----------------|
|                      | Standard | With Brake |                |
| MS6G-130CN15B□2-□0P8 | 133.5    | 162.5      | Medium Inertia |
| MS6G-130TH15B□2-□0P8 | 150      | 179        |                |
| MS6G-130CN25B□2-□1P0 | 119.5    | 148.5      |                |
| MS6G-130TH25B□2-□1P0 | 136      | 165        |                |
| MS6G-130CN20B□2-□1P5 | 133.5    | 162.5      |                |
| MS6G-130CN15B□2-□1P5 | 151.5    | 180.5      |                |
| MS6G-130TH20B□2-□1P5 | 150      | 179        |                |
| MS6G-130TH15B□2-□1P5 | 168      | 197        |                |
| MS6G-130CN15E□2-□2P3 | 181.5    | 210.5      |                |
| MS6G-130TH15E□2-□2P3 | 198      | 227        |                |



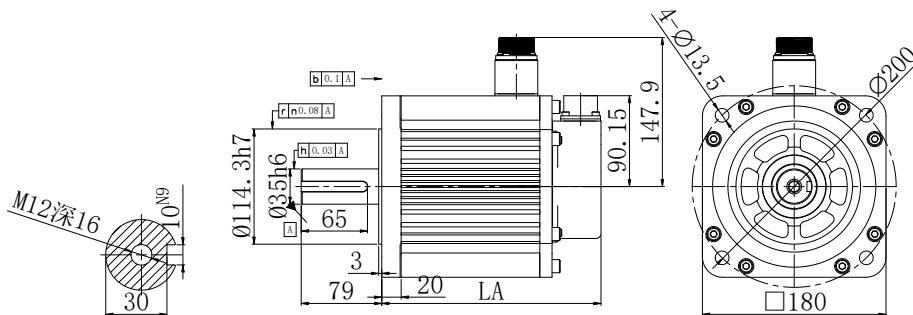
| Motor Model          | LA±1     |            | Inertia Class  |
|----------------------|----------|------------|----------------|
|                      | Standard | With Brake |                |
| MS6G-130CN15B□2-□2P3 | 181.5    | 210.5      | Medium Inertia |
| MS6G-130TH15B□2-□2P3 | 198      | 227        |                |



| Motor Model          | LA±1     |            | Inertia Class |
|----------------------|----------|------------|---------------|
|                      | Standard | With Brake |               |
| MS6S-130CN30B□2-43P0 | 202.8    | 231.8      | Low Inertia   |
| MS6S-130TH30B□2-43P0 | 219.3    | 248.3      |               |
| MS6S-130CN30B□2-45P0 | 257.8    | 298.5      |               |
| MS6S-130TH30B□2-45P0 | 274.3    | 315        |               |
| MS6S-130CN30B□2-47P0 | 321.8    | 362.5      |               |
| MS6S-130TH30B□2-47P0 | 338.3    | 379        |               |

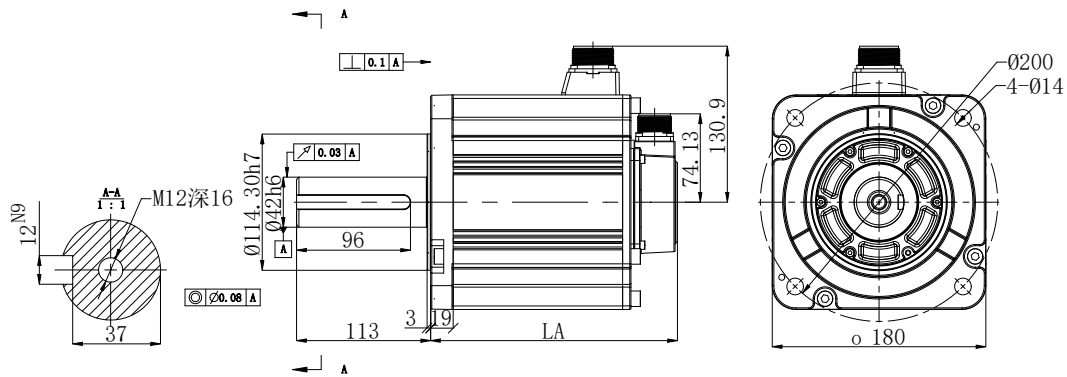
■ Mounting Dimensions for 180 Frame Size Motor

unit: mm





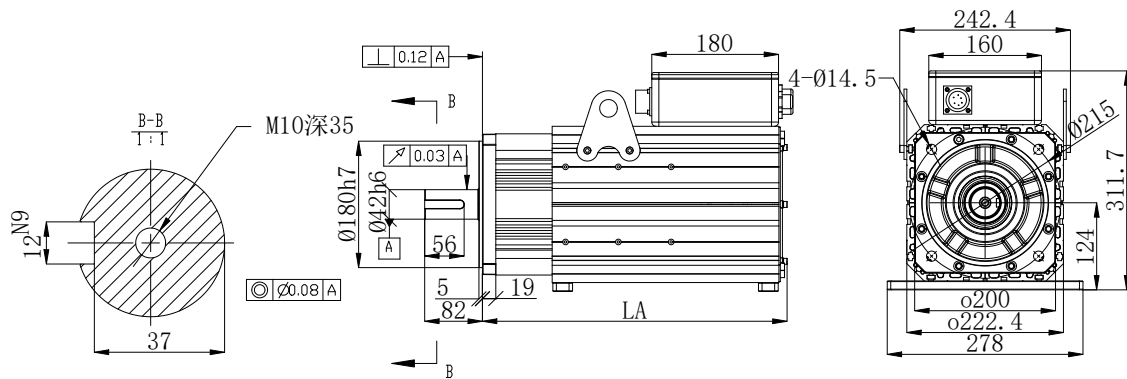
| Motor Model          | LA±1     |            | Inertia Class  |
|----------------------|----------|------------|----------------|
|                      | Standard | With Brake |                |
| MS6G-180CN15B□2-43P0 | 162      | 206.5      | Medium Inertia |
| MS6G-180CN15B□2-44P4 | 185      | 229.5      |                |
| MS6G-180TH15B□2-43P0 | 176.5    | 221        |                |
| MS6G-180TH15B□2-44P4 | 199.5    | 244        |                |



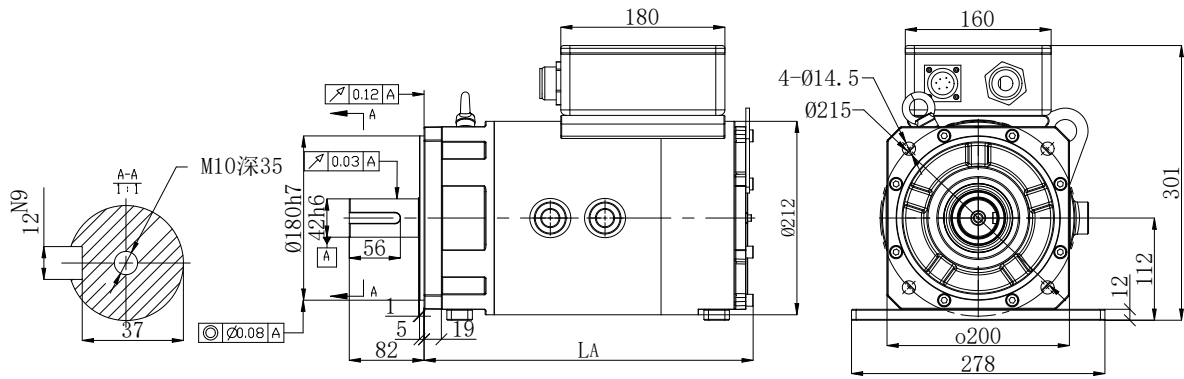
| Motor Model          | LA±1     |            | Inertia Class  |
|----------------------|----------|------------|----------------|
|                      | Standard | With Brake |                |
| MS6G-180CN15B□2-45P5 | 208      | 252.5      | Medium Inertia |
| MS6G-180CN15B□2-47P5 | 256      | 300.5      |                |
| MS6G-180TH15B□2-45P5 | 222.5    | 267        |                |
| MS6G-180TH15B□2-47P5 | 270.5    | 315        |                |

■ Mounting Dimensions for 100 Frame Size Motor

unit: mm



| Motor Model             | LA±1     |            | Inertia Class  |
|-------------------------|----------|------------|----------------|
|                         | Standard | With Brake |                |
| MS6G-200TH17B□2-413P0-F | 433      | 512        | Medium Inertia |
| MS6G-200TH17B□2-417P0-F | 468      | 545.5      |                |
| MS6G-200TH17B□2-421P0-F | 503      | 580.7      |                |
| MS6G-200TH17B2-427P0-F  | 536.4    | 615.7      |                |



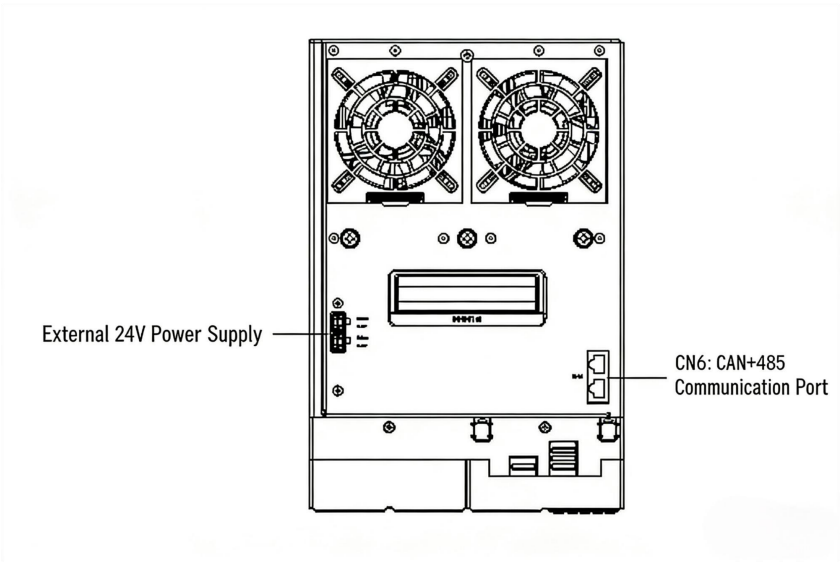
| Motor Model            | LA±1     |            | Inertia Class  |
|------------------------|----------|------------|----------------|
|                        | Standard | With Brake |                |
| MS6G-200TH17B2-413P0-Y | 361      | /          | Medium Inertia |
| MS6G-200TH17B2-417P0-Y | 396      | /          |                |
| MS6G-200TH17B2-421P0-Y | 431      | /          |                |
| MS6G-200TH17B2-427P0-Y | 166      | /          |                |

### 3. Wiring of the Servo System

#### 3.1 Main Circuit Wiring

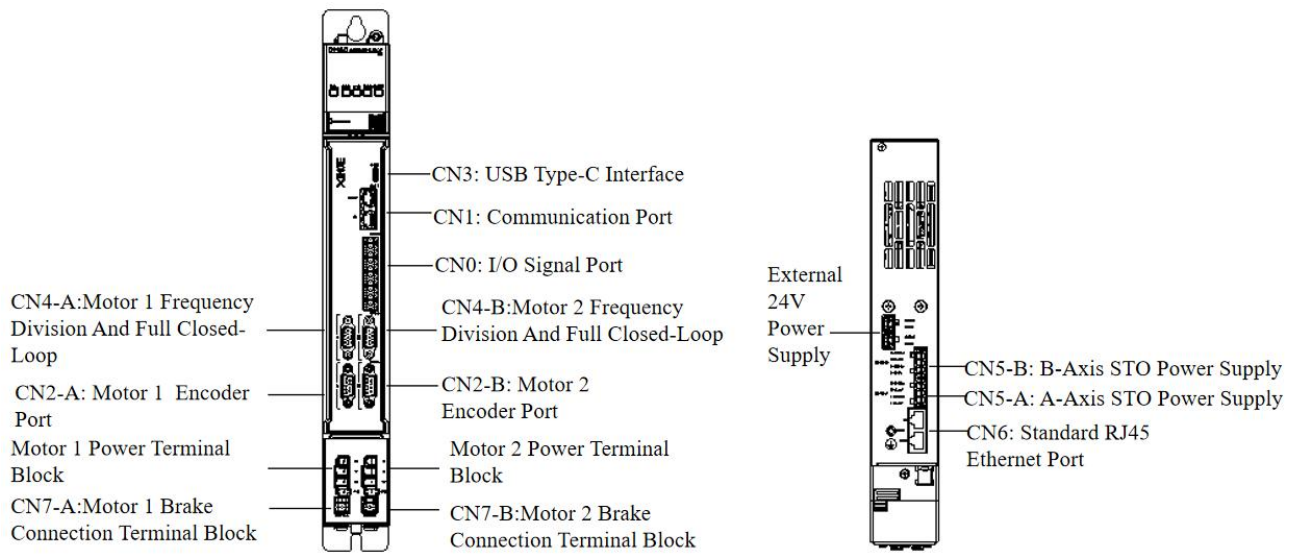
##### 3.1.1 Terminal Arrangement of Servo Driver

- Rectifier unit DM6-4110P0-R





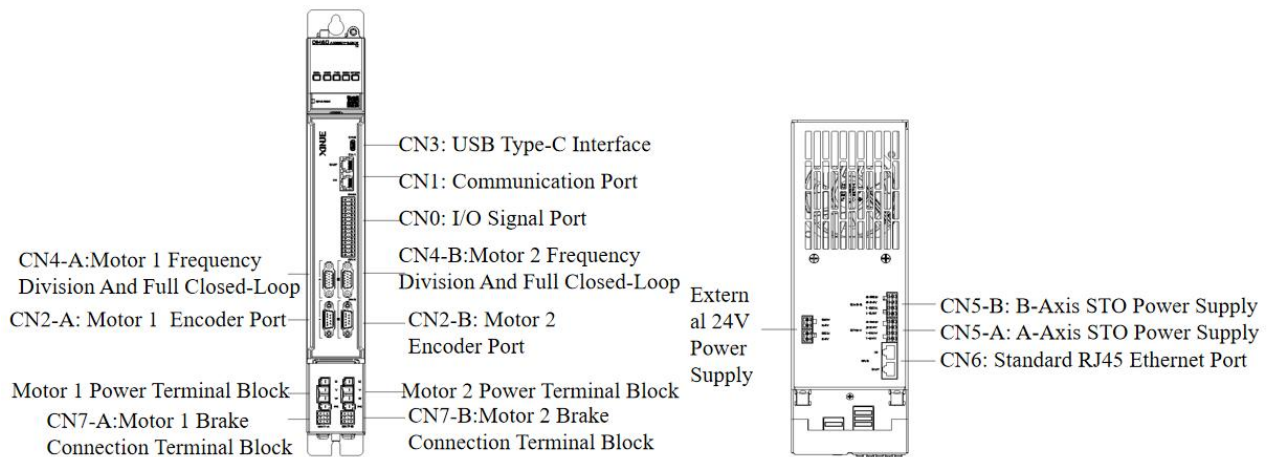
■ DM6C-40P4/40P7/43P0(-S)-M inverter module



First-person perspective, top-down view

First-person perspective, top-down view

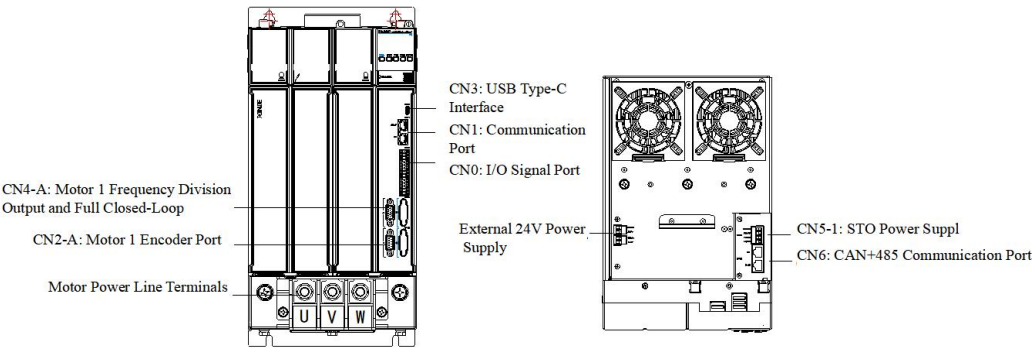
■ DM6C-45P5/47P5/415P0(-S)-M inverter module



First-person perspective, top-down view

First-person perspective, top-down view

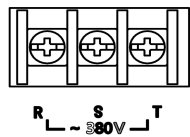
■ DM6C-445P0S/455P0S/475P0S-M Inverter Module



First-person perspective, top-down view

3.1.2 Main Circuit Terminals and Their Descriptions

■ DM6-4110P0-R



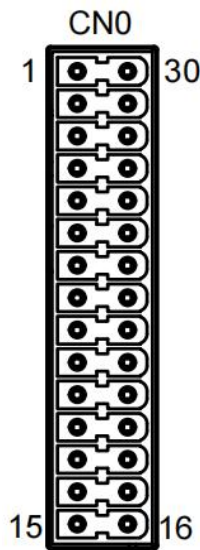
From left to right, the main circuit terminal functions are as follows:

| terminal | function                          | explain                         |
|----------|-----------------------------------|---------------------------------|
| R、S、T    | Main circuit power input terminal | Three-phase AC 380-440V,50/60Hz |

## 3.2 Terminal Description

### 3.2.1 CN0 Terminal Specifications (Input/Output Terminals)

The connector numbers below are in the order from the inverter module panel.

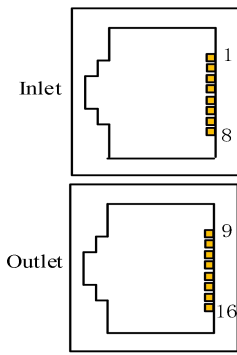


| number | name | explain                       | number | name  | explain                       |
|--------|------|-------------------------------|--------|-------|-------------------------------|
| 1      | SI1+ | Axis A SI1+ (high-speed)      | 16     | SO4-  | Axis B SO4-                   |
| 2      | SI1- | Axis A SI1- (high speed)      | 17     | SO4+  | Axis B SO4+                   |
| 3      | SI2+ | Axis A SI2+ (high speed)      | 18     | COM   | Axis B output terminal ground |
| 4      | SI2- | Axis A SI2- (high-speed)      | 19     | SO3   | Axis B SO3                    |
| 5      | SI3  | Axis A SI3                    | 20     | SO2   | Axis B SO2                    |
| 6      | SI4  | Axis A SI4                    | 21     | SO1   | Axis B SO1                    |
| 7      | SI5  | Axis A SI5                    | 22     | +24VI | Axis B Input +24V             |
| 8      | SI6  | Axis A SI6                    | 23     | SI6   | Axis B SI6                    |
| 9      | +24V | Axis A Input +24V             | 24     | SI5   | Axis B SI5                    |
| 10     | SO1  | Axis A SO1                    | 25     | SI4   | Axis B SI4                    |
| 11     | SO2  | Axis A SO2                    | 26     | SI3   | Axis B SI3                    |
| 12     | SO3  | Axis A SO3                    | 27     | SI2-  | Axis B SI2- (high-speed)      |
| 13     | COM  | Axis A output terminal ground | 28     | SI2+  | Axis B SI2+ (high speed)      |
| 14     | SO4+ | Axis A SO4+                   | 29     | SI1-  | Axis B SI1- (High-speed)      |
| 15     | SO4- | Axis A SO4-                   | 30     | SI1+  | Axis B SI1+ (high-speed)      |



- Input/output terminals: 4 high-speed pulse inputs and 8 standard IO inputs; outputs include 6 standard IO ports and 2 dry contact outputs. Pins 1-4 and 27-30 are dedicated to high-speed pulses (up to 10 Mbit/s), while the remaining pins handle low-speed pulses (up to 10 Kbit/s).
- For inverters rated at 32kW or higher, use single-axis configuration, with only the A-axis terminals (1-15) functional in the driver.

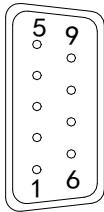
### 3.2.2 Terminal Specifications for CN1 (EtherCAT Communication)



| number | name  | number | name  |
|--------|-------|--------|-------|
| 1      | TX A+ | 9      | TX B+ |
| 2      | TX A- | 10     | TX B- |
| 3      | RX A+ | 11     | RX B+ |
| 4      | -     | 12     | -     |
| 5      | -     | 13     | -     |
| 6      | RX A- | 14     | RX B- |
| 7      | -     | 15     | -     |
| 8      | -     | 16     | -     |

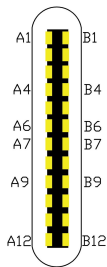
### 3.2.3 Terminal Specifications for CN2 Encoder

- The terminal arrangement of the encoder socket on the CN2 driver body is as follows:



| order number | definition               | order number | definition |
|--------------|--------------------------|--------------|------------|
| 1            | temperature transducer - | 6            | GND        |
| 2            | temperature transducer + | 7            |            |
| 3            | 485-B                    | 8            | +5V        |
| 4            | 485-A                    | 9            |            |
| 5            | shielding layer          | /            | /          |

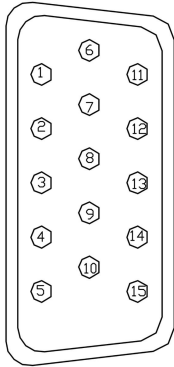
### 3.2.4 Terminal Specifications for CN3 (USB Type-C Interface)



| order number | definition | order number | definition |
|--------------|------------|--------------|------------|
| A1           | GND        | B1           | GND        |
| A4           | USB-VBUS   | B4           | USB-VBUS   |
| A6           | USB-D+     | B6           | USB-D+     |
| A7           | USB-D-     | B7           | USB-D-     |
| A9           | USB-VBUS   | B9           | USB-VBUS   |
| A12          | GND        | B12          | GND        |

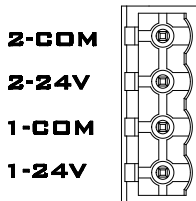
The USB Type-C hardware interface supports dual-sided insertion with a maximum standard transmission distance of 15 meters. Default communication parameters: baud rate 115200bps, 8-bit data, 1-bit stop, and parity check. Hot-swapping is supported.

### 3.2.5 Terminal Specifications for CN4 (Frequency-Divided Output and Full Closed-Loop Signal Terminals)



| number | name   | explain       | number | name | explain               |
|--------|--------|---------------|--------|------|-----------------------|
| 1      | QBH-A+ | Fully         | 9      | FPA+ | Encoder frequency     |
| 2      | QBH-A- | Fully         | 10     | FPA- | Encoder frequency     |
| 3      | GND    | grating ruler | 11     | FPB+ | The encoder outputs a |
| 4      | QBH-B+ | Fully         | 12     | FPB- | Encoder frequency     |
| 5      | QBH-B- | Full          | 13     | FPZ+ | The encoder outputs a |
| 6      | QBH-Z+ | Fully         | 14     | FPZ- | Encoder frequency     |
| 7      | QBH-Z- | Full          | 15     | 5V   | The grating scale is  |
| 8      | GND    | grating ruler | /      | /    | Idle Pin              |

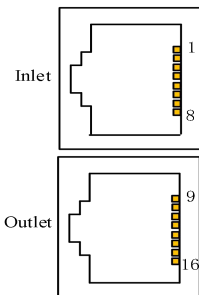
### 3.2.6 Terminal Specifications for CN5 (STO Signal)



| name  | explain  |
|-------|----------|
| 2-COM | STO2-COM |
| 2-24V | STO2-24V |
| 1-COM | STO1-COM |
| 1-24V | STO1-24V |

External 24V input, voltage range: within 21.6V~26.4V,0.5A.

### 3.2.7 Terminal Specifications for CN6 (CAN+485 Communication + Station Number Assignment)



| number | name   | number | name   |
|--------|--------|--------|--------|
| 1      | CANH   | 9      | CANH   |
| 2      | CANL   | 10     | CANL   |
| 3      | GND    | 11     | GND    |
| 4      | 485-A  | 12     | 485-A  |
| 5      | 485-B  | 13     | 485-B  |
| 6      | 485GND | 14     | 485GND |
| 7      | OUT-TX | 15     | OUT-TX |
| 8      | OUT-RX | 16     | OUT-RX |

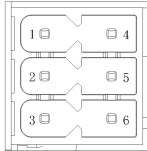
RJ45 male/female connectors compliant with CN6 standard, featuring dual isolated 485 communication channels, dual isolated CAN communication channels, and dual isolated station

number assignment interfaces.

The 485 communication operates at low speed with a baud rate not exceeding 115200 and supports 32 slave stations. By default, CAN communication supports high-speed CAN bus with a maximum baud rate of 1MHz, theoretically supporting a maximum range of 25 meters and 64-axis operation.

To ensure stable communication, a JA-ET terminal resistor can be connected to the CAN communication output port of the last inverter shaft.

### 3.2.8 Terminal Specifications for CN7 (Brake Terminal)



| number | name | number | name |
|--------|------|--------|------|
| 1      | /    | 4      | /    |
| 2      | BK-  | 5      | BK+  |
| 3      | /    | 6      | /    |



45kW/55kW/75kW inverter terminals without brake.

### 3.3 Classification and Function of Signal Terminals

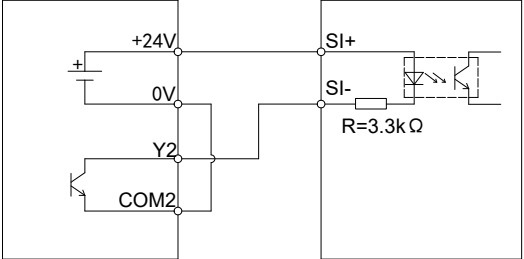
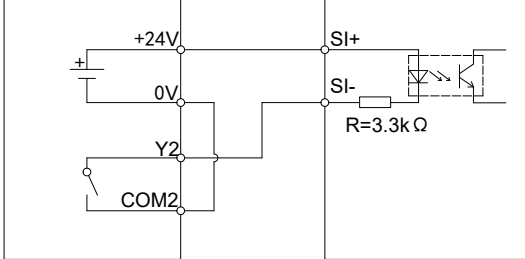
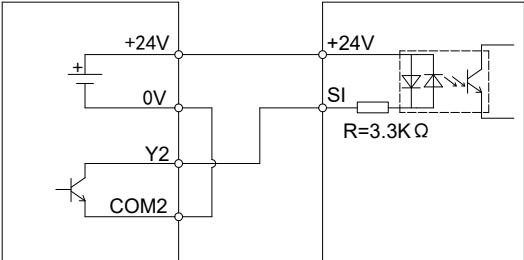
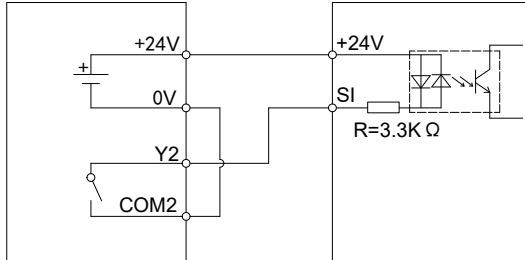
#### 3.3.1 SI input signal

Connect using a relay or a transistor circuit with an open collector. When using a relay, select a low-current relay. If you do not use a low-current relay, poor contact may occur.

| classify     | input terminal | function                              |
|--------------|----------------|---------------------------------------|
| on-off input | SI1 ~ SI6      | Multifunctional input signal terminal |

The factory allocation of input terminals

| terminal | SI1             | SI2                    | SI3                         | SI4                 | SI5~SI6    |
|----------|-----------------|------------------------|-----------------------------|---------------------|------------|
| function | S-ON/<br>enable | ALM-RST/Alarm<br>Reset | P-OT/No<br>forward rotation | N-OT/No<br>reversal | unabsorbed |

| collector open circuit type (SI1\SI2)                                                                                                              | Relay type (SI1\SI2)                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>upper device servo driver<br/>upper device servo driver</p>  | <p>upper device servo driver<br/>upper device servo driver</p>  |
| collector open circuit type (SI3~SI6)                                                                                                              | Relay type (SI3~SI6)                                                                                                                                |
| <p>upper device servo driver<br/>upper device servo driver</p>  | <p>upper device servo driver<br/>upper device servo driver</p>  |



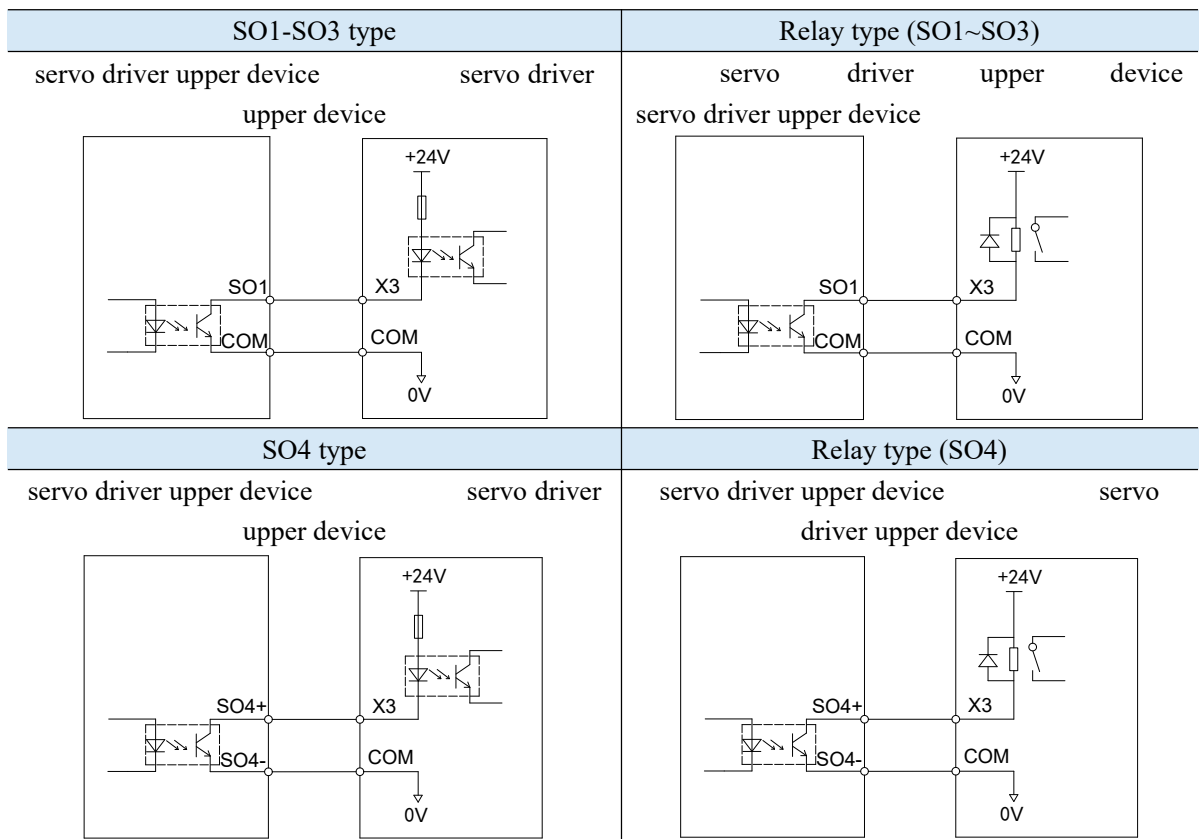
- SI1 and SI2 are high-speed SI inputs with a response time of  $\leq 2\mu\text{s}$ . They support NPN/PNP and 24VDC, with a recommended minimum voltage of 18V and a maximum of 28V.
- Four-channel low-speed SI inputs (SI3, SI4, SI5, SI6) with a response time of  $\leq 2\text{ms}$ , supporting both NPN and PNP configurations.

### 3.3.2 SO output signal

| classify           | leading-out terminal | function                       |
|--------------------|----------------------|--------------------------------|
| optocoupler output | SO1 ~ SO4            | multi-function output terminal |

The factory allocation of output terminals

| terminal | SO1                     | SO2                       | SO3~SO4    |
|----------|-------------------------|---------------------------|------------|
| function | COIN/Location completed | ALM/ report to the police | unabsorbed |

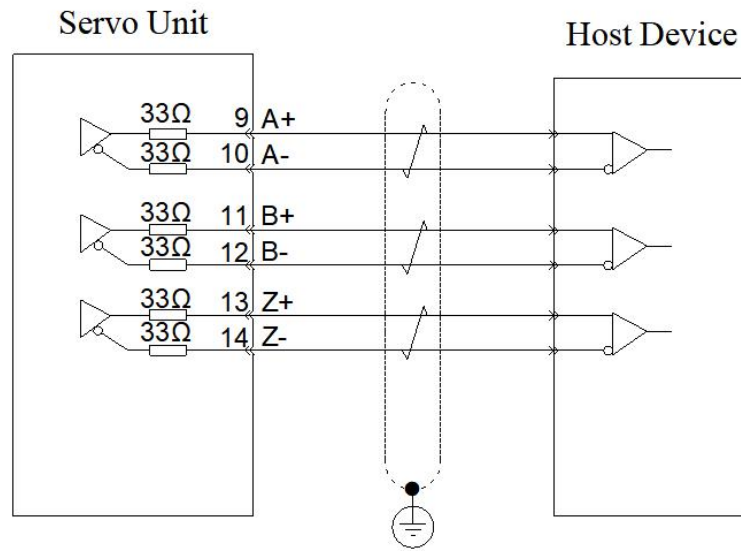


- SO4+ and SO4-labels;
- Maximum load voltage and current:  
Voltage: DC 30V (maximum)  
Maximum load current: 400W or less: SO1 500mA (maximum), SO2~SO4 50mA (maximum)  
750W and above: SO1 to SO4, 50mA (maximum)
- SO1~SO3 supports NPN connection only, while SO4 provides dry contact output with dual NPN/PNP connection options and low-speed SO output.



### 3.3.3 Encoder Feedback Output Signal

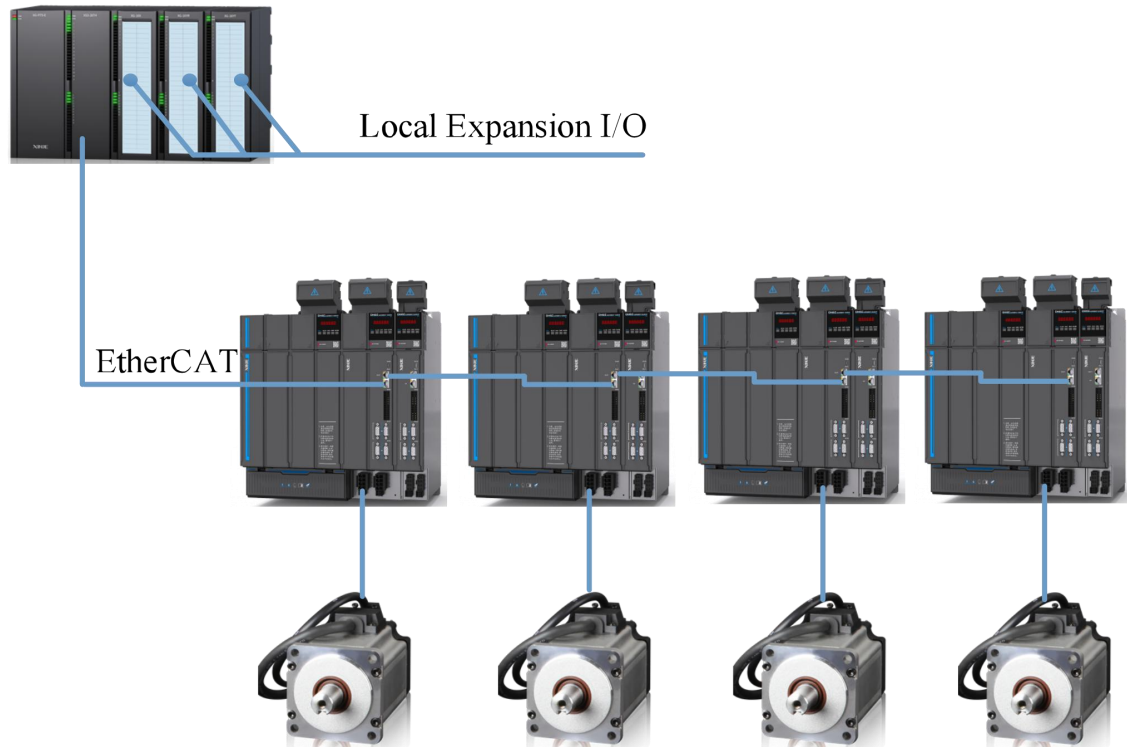
The encoder's frequency division output circuit generates differential signals via a differential driver, providing closed-loop feedback for the host device's position control system. On the host side, differential or optocoupler receiver circuits are used to receive the signals, with a maximum output current of 20mA.



### 3.4 EtherCAT Communication Connection Description

The EtherCAT motion control system features remarkably simple wiring. EtherCAT enables the replacement of Ethernet's star topology with a streamlined linear configuration. For instance, the Sinovent DM6C series servo motors benefit from EtherCAT's elimination of hubs and switches. Both the XG2 series PLC units and DM6C series servo motors come with built-in EtherCAT communication ports, significantly reducing the need for cables and cable trays. This simplifies wiring design and connector calibration, thereby lowering installation costs.

The EtherCAT bus recommends linear wiring. The wiring method is shown in the figure below:



Among the XG2 series PLCs, only LAN2 port supports EtherCAT communication. The two communication ports of the servo driver follow the 'bottom-in, top-out' principle: LAN2 port must connect to the IN port of the first servo, then the OUT port of the first servo connects to the IN port of the second servo, and so on.

Communication signals are inevitably affected by electromagnetic interference during transmission. We recommend using industrial-grade Category 5e cables, available for purchase from our company.

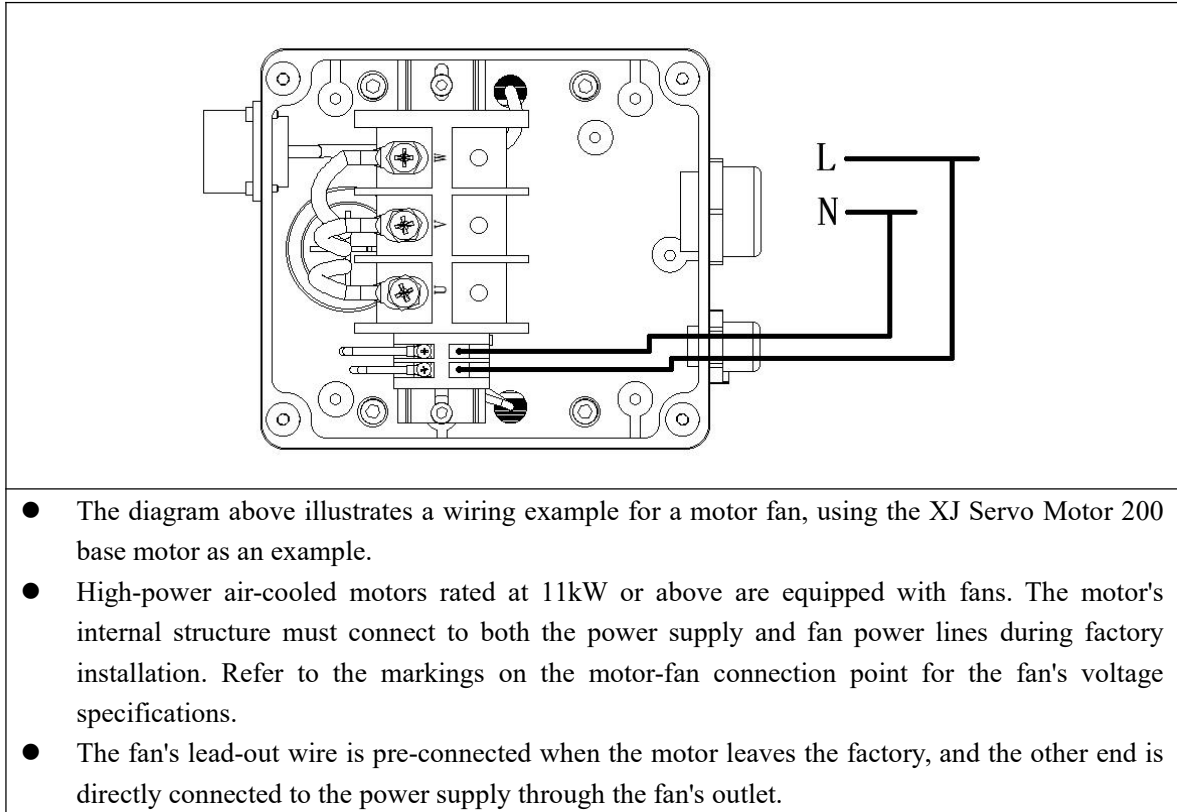
Bus communication connects physical devices to the diagram.



The bus communication follows the rule of "lower in, upper out."

The definition of Ethernet interface pins is specified in Section 3.2.2 under Terminal Specifications for CN1.

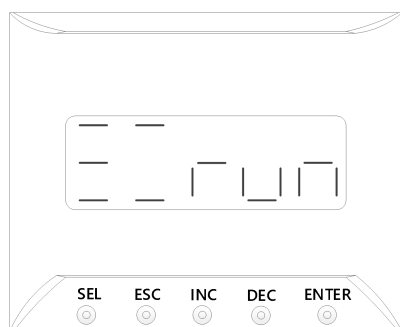
### 3.5 High-power Motor Fan Wiring



## 4. Pre-operation of the Servo System

### 4.1 Basic Operations

#### 4.1.1 Instructions for the Control Panel



| Button name | operation declaration                                                                    |
|-------------|------------------------------------------------------------------------------------------|
| SEL         | Short press: Switch axes, axis numbers appear on the leftmost side                       |
| ESC         | Short press: Switch or return to the status                                              |
| INC         | Short press: Show data in ascending order.<br>Long press: Show data in ascending order   |
| DEC         | Short press: Show data in descending order.<br>Long press: Show data in descending order |
| ENTER       | Short press: Shift;<br>Long press: Set and view parameters                               |

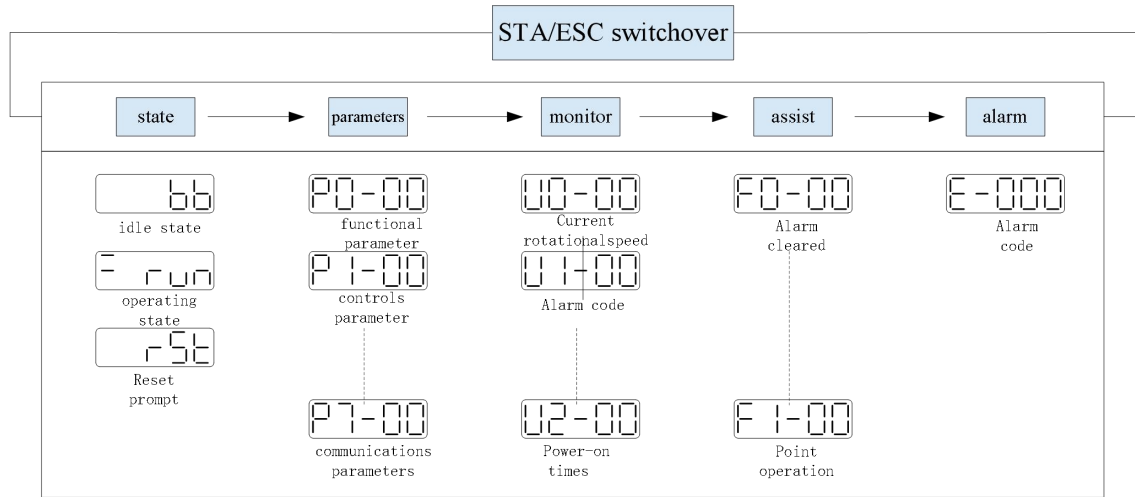


After powering on, the back panel performs a self-check operation, with all display digits and five decimal points illuminated simultaneously for one second.

#### 4.1.2 Key Operations

By switching the basic states of the panel operator, you can display the operating status, set parameters, activate auxiliary functions, and check alarm status. Pressing the ESC key will sequentially switch states in the order shown in the figure below.

Status: bb indicates the servo system is idle; run indicates the servo system is operational; rst indicates the servo system requires a power cycle (the panel status display in this diagram excludes axis numbers).



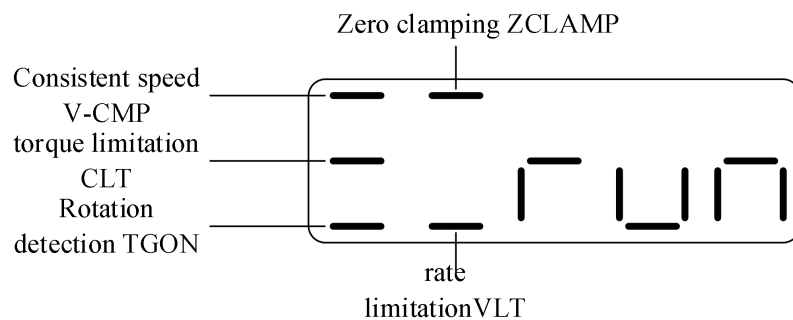
- ◆ Parameter configuration Px-xx: The first x denotes the group number, while the subsequent two x's indicate the parameter sequence number within the group.
- ◆ Monitoring status Ux-xx: The first x denotes the group number, while the subsequent two x represent the parameter sequence number within the group.
- ◆ Auxiliary function Fx-xx: The first 'x' denotes the group number, while the subsequent two 'x' indicate the parameter sequence number within the group.
- ◆ Alarm status E-xxx: The first two x's denote the major alarm category, while the last x indicates the subcategory under that category.

## 4.2 Description of the display status during operation

During power-on, the panel displays according to the P8-25 parameter settings.

| parameter | Signal name           | factory setting | Applicable mode | meaning                                                                                                                                                                                                                    | revise      | come into force              |
|-----------|-----------------------|-----------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------|
| P8-25     | panel display setting | 0               | own             | 0: Normal display. Power-up displays 'bb' or 'run'.<br>1: The panel displays the value of U0-00 and speed feedback in rpm<br>2: The panel displays the value of U0-07 when powered on, with torque feedback in percentage. | at any time | Power off and power on again |

- When the speed and torque control mode is used

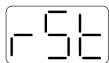
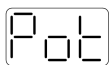
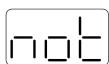
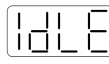


Number of digits

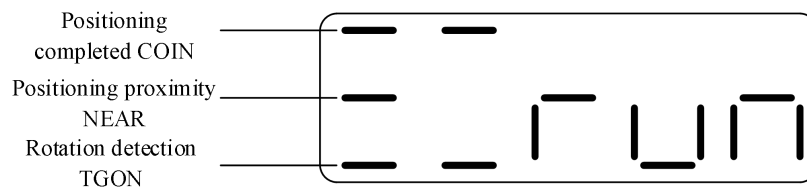
| bit data                         | Show content                                                                                                                                                |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P5-39<br>same speed detection    | The light will be on when the motor's actual speed matches the commanded speed.<br>Detection width of synchronous signal: P5-04 (unit: rpm)                 |
| P5-42<br>torque limit            | The light turns on when the torque exceeds the set value during speed control.<br>Internal forward torque limit: P3-28 Internal reverse torque limit: P3-29 |
| P5-40<br>rotation detection      | The light will turn on when the motor speed exceeds the rotation detection speed.<br>Rotation detection speed: P5-03 (unit: rpm)                            |
| P5-31<br>Zero Clamping (/ZCLAMP) | The light turns on when the zero-clamping signal activates.                                                                                                 |
| P5-43<br>velocity limit          | The light turns on when the speed exceeds the set value during torque control.<br>Forward speed limit during torque control: P3-16; Reverse speed limit:    |

P3-17.

Display content in abbreviated code

| Display content in abbreviated code                                                | Show content                                                            |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|   | In standby mode<br>Servo off state. (The motor is not powered)          |
|   | in service<br>Servo enabled state. (The motor is powered on)            |
|   | Reset state required<br>The server needs to be powered on again         |
|   | Forbidden forward drive state<br>P-OT ON state. Refer to Section 5.3.2. |
|   | Disable reverse drive state<br>N-OT ON state. Refer to Section 5.3.2.   |
|  | Control mode 2 is empty                                                 |

#### ■ When in position control mode



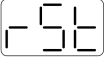
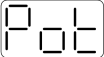
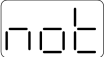
Number of digits

| bit data                            | Show content                                                                                                                                                     |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P5-38<br>End of Positioning (/COIN) | When the position is controlled, the light will turn on if the given position matches the actual position.<br>Positioning width: P5-00 (unit: instruction pulse) |
| P5-36<br>Near (/NEAR)               | When the position is controlled, the light will turn on if the given position matches the actual position.<br>Approach signal width: P5-06                       |
| P5-40<br>rotation detection         | The light will turn on when the motor speed exceeds the rotation detection speed.<br>Rotation detection speed: P5-03 (unit: rpm)                                 |

Display content in abbreviated code

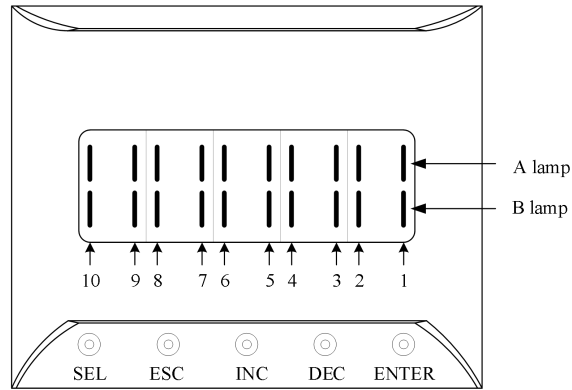
| Display content in | Show content |
|--------------------|--------------|
|--------------------|--------------|



| abbreviated code                                                                  |                                                                         |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|  | In standby mode<br>Servo off state. (The motor is not powered)          |
|  | in service<br>Servo enabled state. (The motor is powered on)            |
|  | Reset state required<br>The server needs to be powered on again.        |
|  | Forbidden forward drive state<br>P-OT ON state. Refer to Section 5.3.2. |
|  | Disable reverse drive state<br>N-OT ON state. Refer to Section 5.3.2.   |
|  | Control mode 2 is empty                                                 |

## 4.3 UX-XX Monitoring Parameters

### ■ U0-21 input signal status



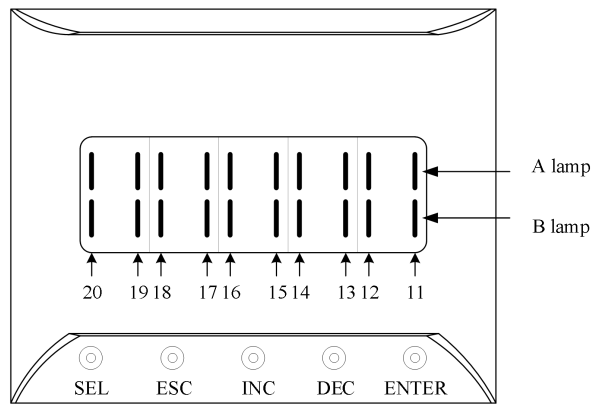
Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

### ■ U0-21 Input Signal 1 Allocation

| block code | explain                                       | block code | explain                                         |
|------------|-----------------------------------------------|------------|-------------------------------------------------|
| 1          | S-ON servo enable signal                      | 2          | P/CON ratio action instruction                  |
| 3          | P-OT prohibition of forward drive             | 4          | N-O-T forbidden inversion drive                 |
| 5          | ALM-RST alarm clearing                        | 6          | external torque limit for P-CL forward rotation |
| 7          | external torque limit of-N / CL reversal side | 8          | /SPD-D Internal speed selection                 |
| 9          | /SPD-A Internal Speed Selection               | 10         | /SPD-B internal speed selection                 |

Note: When reading status via communication, the binary values read from right to left correspond to the /S-ON and /P-CON positions. A value of 0 indicates no input at that position, while 1 indicates input. For example: 0x0001 means input at /S-ON, and 0x0201 means input at both /S-ON and /SPD-B.

### ■ U0-22 input signal status



Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

#### ■ U0-22 Input Signal 2 Allocation

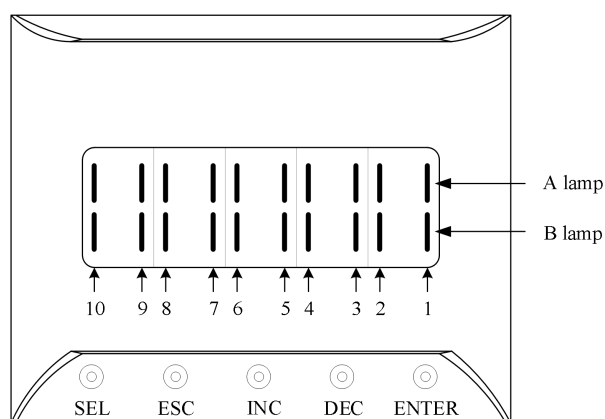
| block code | explain                               | block code | explain              |
|------------|---------------------------------------|------------|----------------------|
| 11         | CSEL mode selection                   | 12         | /ZCLAMP zero clamp   |
| 13         | INHIBIT instruction pulse prohibition | 14         | G/SEL gain switching |
| 15         | CLR pulse clear                       | 16         | /CHGSTP step change  |
| 17         | I-Sel Inertial Switching              | 18         | —                    |
| 19         | —                                     | 20         | —                    |

Note: When reading status via communication, the binary values read from right to left correspond to the /C-SEL and /ZCLAMP positions. A value of 0 indicates no input at that position, while 1 indicates input. For example: 0x0001 means input at /C-SEL, and 0x0009 indicates input at both /C-SEL and /G-SEL.



"—" is reserved for display and does not indicate any signal; this status bit remains at 0.

#### ■ U0-23 output signal status



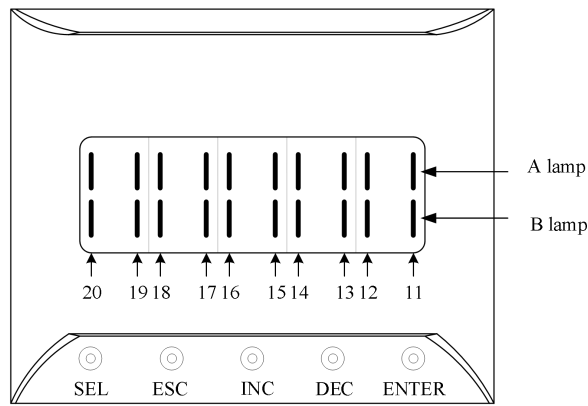
Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

#### ■ U0-23 Output Signal 1 Allocation

| block code | explain                           | block code | explain                    |
|------------|-----------------------------------|------------|----------------------------|
| 1          | Keep Location Complete (/COIN_HD) | 2          | End of Positioning (/COIN) |
| 3          | same speed detection              | 4          | rotation detection         |
| 5          | Ready (S-RDY)                     | 6          | torque limit               |
| 7          | velocity limit detection          | 8          | brake interlock            |
| 9          | Warning (/WARN)                   | 10         | Output Near (/NEAR)        |

Note: When reading the status via communication, the binary values read from right to left correspond to /COIN\_HD and /COIN positions. A value of 0 indicates no output from the signal at that position, while 1 indicates an output. For example: 0x0001 means /COIN\_HD has an output, and 0x0201 means both /COIN\_HD and /NEAR have outputs.

#### ■ U0-24 output signal status



Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

#### ■ U0-24 output signal distribution

| block code | explain                     | block code | explain                    |
|------------|-----------------------------|------------|----------------------------|
| 11         | report to the police (/ALM) | 12         | The speed reaches (/V-RDY) |
| 13         | Custom Output 1             | 14         | Custom Output 2            |
| 15         | /Z Xiang                    | 16         | /MRUN                      |
| 17         | continue to have            | 18         | continue to have           |
| 19         | continue to have            | 20         | continue to have           |

Note: When reading status via communication, the binary value read from right to left corresponds to /ALM and position. A value of 0 indicates no input at that position, while 1 indicates input. For example, 0x0011 means both /ALM and Z phase have output.

#### ■ U0-88 motor code reading status

| U0-88 display status | meaning                                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------------------------------|
|                      | 0001 — Encoder motor parameters read successfully, but P0-33 = 0. Use the motor parameters from the encoder.      |
|                      | 0011 — Encoder motor parameters read successfully (P0-33=0). The motor parameters from the driver are now in use. |
|                      | 0021-Encoder motor parameters detected successfully, but the value is 0. Configure P0-53 before use.              |
|                      | 0031-Encoder motor parameters detected successfully but failed due to CRC error. Use after setting P0-53.         |

| U0-88 display status                                                              | meaning                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------|
|  | 0042-Failed to read encoder motor parameters. Set P0-53 before use. |

#### ■ U4-18 Input Signal Status

| SI1 | SI2 | SI3 | U4-18 display |
|-----|-----|-----|---------------|
| 1   | 0   | 0   | 0x0001        |
| 0   | 1   | 0   | 0x0002        |
| 1   | 1   | 0   | 0x0003        |
| 0   | 0   | 1   | 0x0004        |
| ... | ... | ... | ...           |

Note: U4-18 displays the software activation status of SI terminals. The terminal will only appear on U4-18 when its function is set. For example, SI1 has no assigned function, so even if the hardware sets SI1 to high, the 0th bit of U4-18 will not display 1.

#### ■ U4-19 output signal status

| SO1 | SO2 | SO3 | U4-19 shows |
|-----|-----|-----|-------------|
| 1   | 0   | 0   | 0x0001      |
| 0   | 1   | 0   | 0x0002      |
| 1   | 1   | 0   | 0x0003      |
| 0   | 0   | 1   | 0x0004      |
| ... | ... | ... | ...         |

Note: The U4-19 indicator displays the software activation status of the SO terminal, represented by bit positions.

## 4.4 FX-XX Auxiliary Function Content

### ■ F0-XX

| Function code | explain                                | Function code | explain                                    |
|---------------|----------------------------------------|---------------|--------------------------------------------|
| F0-00         | Clear alarm                            | F0-08         | Panel external command auto-adjustment     |
| F0-01         | Restore parameters to factory settings | F0-09         | panel internal instruction self adjustment |
| F0-02         | Clear positional deviation             | F0-10         | Panel vibration inhibition 1               |
| F0-04         | Clear historical alarm records         | F0-11         | Panel Vibration Suppression 2              |
| F0-07         | panel inertia identification           | F0-12         | Panel Vibration Suppression (Fast FFT)     |

#### 1) Clear alarm (parameter F0-00)

When a fault occurs, the system automatically displays the E-XXX alarm status with the alarm number; otherwise, the alarm status is not visible.

In alarm mode, pressing 1 on the panel to write to F0-00 resets the fault.

When an alarm occurs, first identify the cause before clearing it. If the alarm is triggered by a powered-down servo, no clearing is required.

#### 2) Reset parameters to factory defaults (parameter F0-01)

First, turn off the servo, then perform the factory reset as follows:

Set F0-01 to 1 and press ENTER to confirm. The factory reset is complete, so no power-off is required.

#### 3) Clear deviation (parameter F0-02)

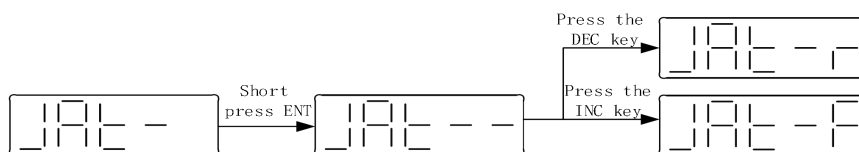
Set F0-02=1 to clear the deviation.

#### 4) Panel Inertia Identification (Parameter F0-07)

Before inertial identification, use the F1-00 point movement function to confirm the servo rotation direction. The initial direction of servo operation is determined by INC or DEC when inertial identification begins.

If the servo jitter is under the adaptive default parameters, switch to the adaptive large inertia mode (P2-03.3=1) first to ensure the basic smooth operation of the servo before the inertia identification!

When the device is in BB mode, the parameter F0-07 displays:



For detailed steps, refer to 9.2.4.

### 5) Panel External Command Self-Adjustment (Parameter F0-08)

For detailed steps, refer to 9.4.5.

### 6) Panel internal command auto-adjustment (parameter F0-09)

For detailed steps, refer to 9.4.4.

### 7) Panel vibration suppression (parameters F0-10, F0-11)

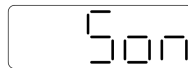
| vibration damping mode | show  | Modified parameters                                          |
|------------------------|-------|--------------------------------------------------------------|
| pattern 1              | vib-1 | Changes vibration suppression parameters only                |
| pattern 2              | Vib-2 | Changes vibration suppression parameters and speed loop gain |

The following explains the steps:

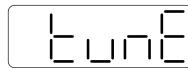
1. In self-adjusting mode, select parameter F0-10 to display vib-1 on the panel, or choose F0-11 to show vib-2.

perhaps 

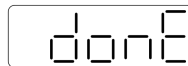
2. Press and hold the ENTER key. The Son panel will flash, requiring manual activation.



3. After enabling the servo, the panel displays 'tune' with a flashing indicator, marking the system's entry into the calibration phase.



4. The upper device initiates pulse command transmission until the 'done' indicator flashes to confirm vibration suppression completion.



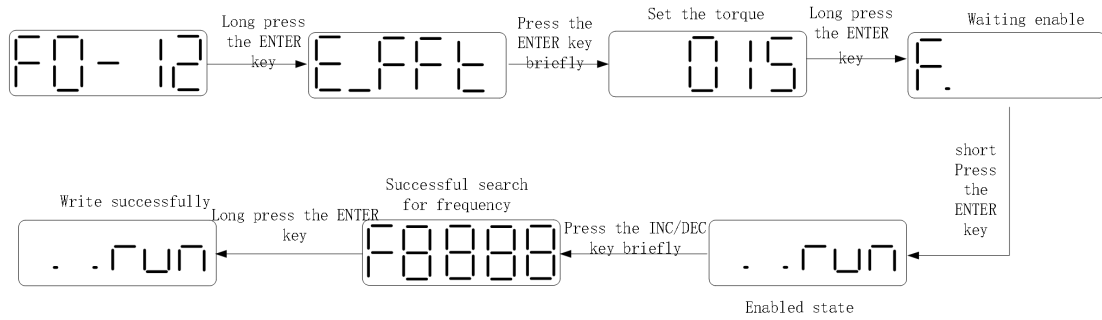
5. Press the STA/ESC keys briefly to exit.

Vibration suppression parameters are automatically written into the first and second notch filters (the second notch filter is prioritized when there is only one vibration point). For details, see Section 8-7-7: Notch Filters.

### 8) Panel vibration suppression (fast FFT) (parameters F0-12)

The mechanical characteristic analysis can be carried out by F0-12 parameters on the servo operation panel, and the mechanical resonance frequency can be found out to realize the vibration suppression.



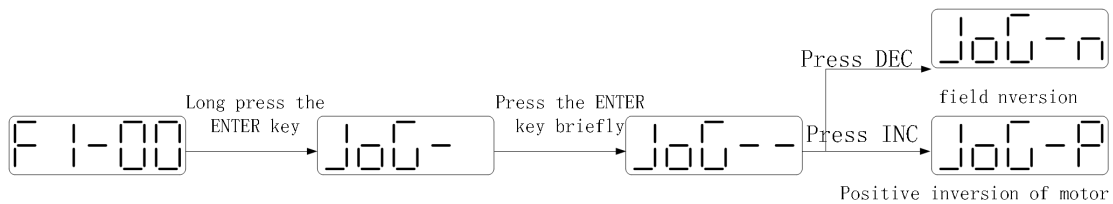


## ■ F1-XX

| Function code | explain                  | Function code | explain                         |
|---------------|--------------------------|---------------|---------------------------------|
| F1-00         | crawl                    | F1-05         | software enablement             |
| F1-01         | pilot run                | F1-06         | Absolute encoder position reset |
| F1-02         | current sampling zeroing | -             | -                               |

### 1) Point operation (Parameter F1-00)

Before entering the stop-and-go mode, ensure the motor shaft is not connected to the machine and the driver is in an idle state!



When performing a point operation, parameters such as gain are involved in the control. You can determine whether the parameter settings are appropriate based on the operational status.

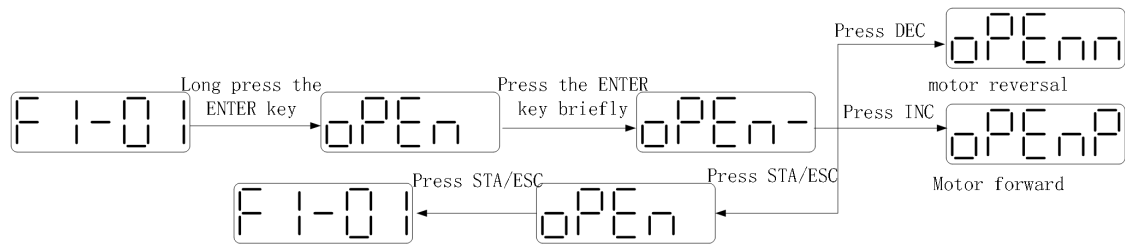
| P3-18 | JOG speed |                 |           |                  |           |                 |
|-------|-----------|-----------------|-----------|------------------|-----------|-----------------|
|       | Set unit  | factory setting | Set range | Applicable mode  | revise    | come into force |
|       | 1rpm      | 100             | 0~1000    | JOG final motion | servo OFF | immediately     |

### 2) Trial run (parameter F1-01)

Ensure the motor shaft is not connected to the machine before entering trial mode.

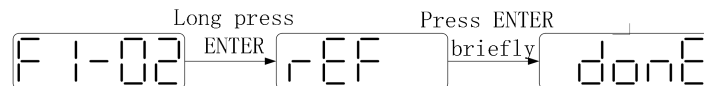
When a servo driver is connected to a non-original encoder or power line, it should first enter trial operation mode to verify the correct connection of the encoder or power terminals.

The trial run checks the power lines and encoder feedback lines to ensure proper connections. Press the button to operate the motor normally in both directions. If the motor shaft shakes or an alarm is triggered, immediately disconnect the power and recheck the wiring.



### 3) Current sampling zero calibration (parameter F1-02)

When the servo driver completes self-renewal or the motor exhibits prolonged instability, users should perform automatic current detection offset adjustment during the driver's idle state (BB).



Press STATUS/ESC to exit this function. Power on again.

### 4) Panel Enable (Parameter F1-05)

| parameter                                                                                                                                          | Signal name | setting     | meaning                                         | revise    | come into force |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------------------------------------------|-----------|-----------------|
| P0-03                                                                                                                                              | enable mode | 0           | Disable                                         | servo OFF | immediately     |
|                                                                                                                                                    |             | 1           | I/O enable/S-0N                                 |           |                 |
|                                                                                                                                                    |             | 2           | Software enablement (F1-05 or communication)    |           |                 |
|                                                                                                                                                    |             | 3 (Default) | Bus enable (for models with motion bus support) |           |                 |
| Set P0-03 to 2:<br>F1-05 = 0: Disable the enable function and restore to the bb idle state.<br>F1-05 = 1: Forces enable, the servo is in RUN mode. |             |             |                                                 |           |                 |



Forced enablement will be disabled after power-on.

To enable the device upon power-up and maintain functionality after power-off in normal mode, set P5-20 to n.0010. (P0-03=1 activates)

### 5) Absolute encoder reset cycles (parameter F1-06)

First, turn off the servo, then perform the absolute encoder reset operation as follows:

- ① The absolute encoder's circle number can be cleared by writing 1 to F1-06 through the panel operation.
- ② To clear the loop count, write 1 to the hexadecimal address 0x2106 via Modbus RTU (the servo BB status will be activated; after clearing, write 0 to 0x2106).

## 4.5 Fault Alarm Handling

When a fault occurs, the system automatically enters an alarm state and displays the alarm number. In normal operation, the alarm state is not visible. To reset the alarm, write 1 to F0-00 via the panel.

If the servo alarm is triggered due to the OFF status of the servo power supply, no alarm clearing is required.



When an alarm occurs, the cause should be eliminated first, and then the alarm should be removed.

## 4.6 Panel Button Operations

For example, the procedure for adjusting parameter P3-09 from 2000 to 3000.

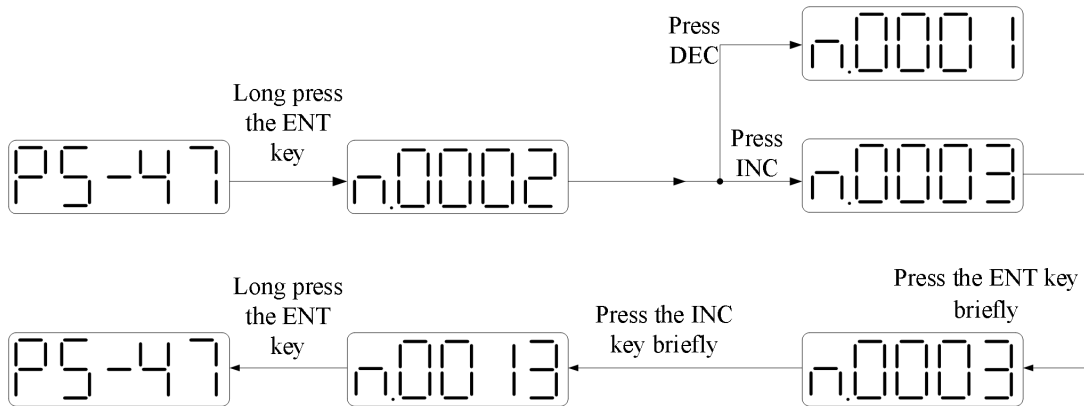
| step | panel display | Keyboard keys                  | concrete operations                                                                                      |
|------|---------------|--------------------------------|----------------------------------------------------------------------------------------------------------|
| 1    |               | AXIS STA/ESC INC DEC ENTER<br> | Switch between axes, with axis numbers displayed on the leftmost side                                    |
| 2    |               | AXIS STA/ESC INC DEC ENTER<br> | No action required                                                                                       |
| 3    |               | AXIS STA/ESC INC DEC ENTER<br> | Press the STA/ESC key to enter the parameter setting function                                            |
| 4    |               | AXIS STA/ESC INC DEC ENTER<br> | Press the INC key to increment by 1. Set the parameter to 3 and display P3-00.                           |
| 5    |               | AXIS STA/ESC INC DEC ENTER<br> | Press the ENTER key briefly to make the last 0 on the panel flash.                                       |
| 6    |               | AXIS STA/ESC INC DEC ENTER<br> | Press INC to add to 9                                                                                    |
| 7    |               | AXIS STA/ESC INC DEC ENTER<br> | Press and hold the ENTER key to access the P3-09 interface for numerical adjustments.                    |
| 8    |               | AXIS STA/ESC INC DEC ENTER<br> | Use the INC, DEC, and ENTER keys to add, subtract, or shift. Hold ENTER to confirm after making changes. |
| 9    | EO            |                                |                                                                                                          |



When the parameter exceeds the set range, the driver will not accept the value and report E-021 (Parameter Out of Range). This typically occurs when the host computer writes parameters to the driver via communication.

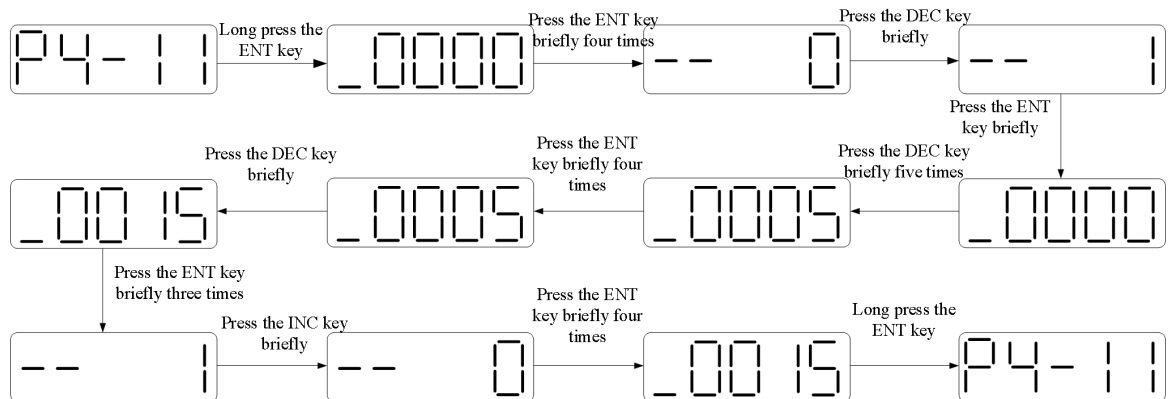
#### 4.6.1 Example of setting SI and SO related P group parameters for input/output

For example, the procedure involves adjusting terminal P5-47 (alarm output terminal) from SO2 to SO3 control, and changing the normally open contact to a normally closed contact.



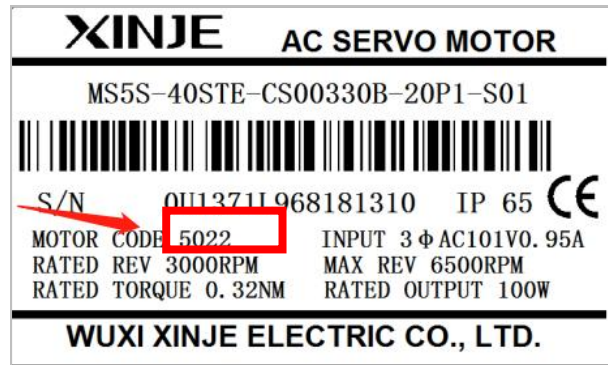
#### 4.6.2 Examples of setting negative values for P-group parameters

For example, set parameter P4-11 (internal position mode pulse count high bit) to -15, meaning the first pulse count is -150000, and follow the corresponding operation steps.



## 4.7 Change motor code

A servo drive can be paired with motors of similar power ratings, with different models identified by the motor code on the nameplate. Before debugging the servo system, verify that the motor code U3-70 matches the one on the nameplate. If discrepancies are found, contact your agent or technical support.



## 5. Setting up basic functions

### 5.1 Absolute Value System

#### 5.1.1 Setting up the absolute value system

To preserve the absolute encoder's position data, a battery unit must be installed.

Install the battery on the battery unit of the encoder cable with the battery unit (internal).

When not using the battery-powered encoder cable, set P0-79 to 1 to convert the multi-turn absolute encoder into an incremental encoder.

| parameter | Signal name              | setting     | meaning                                                                                                                                                     | Set range |
|-----------|--------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| P0-79     | absolute encoder setting | 0           | Use an absolute encoder normally and store the position with the battery                                                                                    | 0~2       |
|           |                          | 1 (Default) | As an incremental encoder, it does not store multi-turn positions.                                                                                          |           |
|           |                          | 2           | Use as an absolute encoder, but ignore the multi-turn overflow alarm. Enable recording the number of turns and overflow counts, and retain power loss data. |           |



If the E-222 alarm is triggered after replacing the multi-turn motor, the system will automatically reset the count of overtrains. Otherwise, severe positional deviation may occur, posing a risk.

#### 5.1.2 Battery Replacement

When replacing the battery, ensure the drive and motor are properly connected and the control power is on. If the control power is off, the data stored in the encoder will be lost.



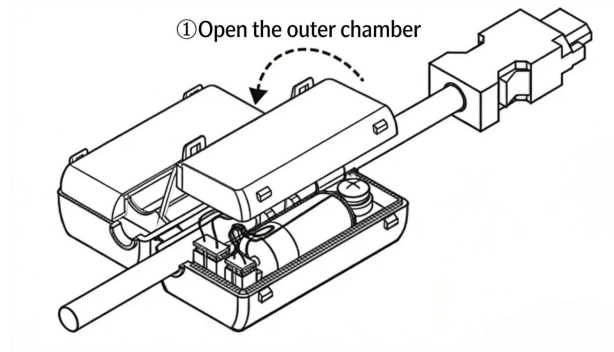
Absolute encoder battery case model (This battery cannot be charged)

- Battery compartment for standard cable: CP-B-BATT
- Tank Chain Line Special Battery Box: CPT-B-BATT

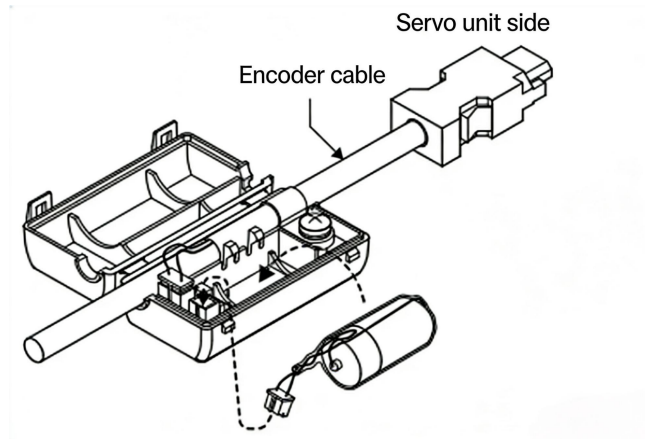
#### Steps for battery replacement

When using encoder cables with battery units

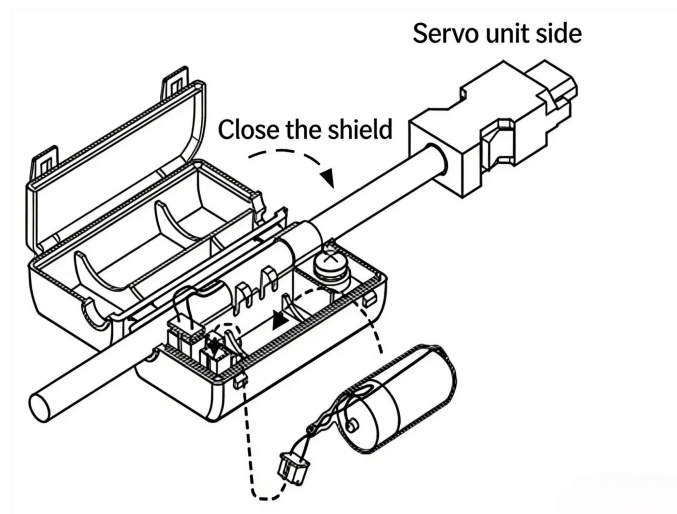
1. Connect only the control power supply to the servo unit;
2. Open the battery compartment cover;



3. Remove the old battery and install a new one.



4. Close the battery compartment cover.



5. After battery replacement, clear the alarm (F0-00=1) to disable the "Encoder Battery Alert (E-222)" display.

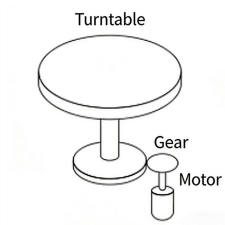
6. Reconnect the power supply to the servo unit;

7. The error display has been cleared, and the servo unit is now functioning properly.

### 5.1.3 Upper limit setting for the number of rotations

The upper limit of the number of rotation can be used for the position control of the rotary table and other rotary bodies.

For example, consider a machine with a rotating table that moves only in one direction, as shown in the figure below.



Because it can only rotate in one direction, after a certain period of time, the number of rotations will always exceed the upper limit of the absolute encoder.

| Servo motor series | resolution ratio<br>(One-round data) | Serial data rotation count<br>output range | Operation beyond the limit                                                                                                                                                                                                               |
|--------------------|--------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CN                 | 19                                   | -32768~32767                               | <p>When exceeding the upper limit of the forward direction (+32767*219):<br/>Rotation serial data=32767*219</p> <p>When it falls below the lower limit of the reversal direction (-32768*219):<br/>Rotation serial data = -32768*219</p> |
| TH                 | 23                                   |                                            | <p>When exceeding the upper limit of the forward direction (+32767*223):<br/>Rotation serial data=32767*223</p> <p>When it falls below the lower limit of the reversal direction (-32768*223):<br/>Rotation serial data = -32767*223</p> |

### 5.1.4 Absolute encoder clearing multiple turns

The encoder's clearance cycles must be completed in the servo BB state. Clearance can be performed via the servo panel or Modbus-RTU communication. Writing 1 to F1-06 resets the multi-cycle absolute current count (U0-91) to zero. The multi-cycle position feedback from absolute encoder U0-57~U0-60 and U0-94~97 will also be cleared, retaining positions within one cycle.

This feature is only available for multi-turn absolute motors. It is not available for single-turn absolute motors.

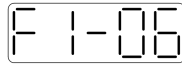
#### 1. Servo drive panel cleared

The servo enters the BB state and displays parameter F1-06:





Press the [INC] key to add to 1 and hold [ENT] to confirm exit:



The F1-06 panel can reset the absolute encoder position count.

## 2. EtherCAT bus communication clearing

In servo mode, write 1 to #0x4106 via EtherCAT bus communication to clear the loop count.

You can also write to it via the bus SDO:



Enter 1 to clear the circle count.

## 5.1.5 Zero Point Calibration of Absolute Encoder

| User parameters | name                                                                                               |
|-----------------|----------------------------------------------------------------------------------------------------|
| F1-06           | Set to 1: Absolute encoder resets to multiple turns<br>Set to 3: Absolute encoder zero calibration |
| U0-94           | Resettable relative encoder feedback value                                                         |
| U0-95           |                                                                                                    |
| U0-96           |                                                                                                    |
| U0-97           |                                                                                                    |

Absolute encoder zero calibration must be performed in servo BB mode and can only be done via the servo panel. When writing 3 to F1-06, the encoder position in the U0-94~97 position feedback will be set to 0.



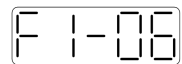
Absolute encoder zero calibration is not supported via SDO communication.

### 1. Servo drive panel calibration

The servo enters the BB state and displays parameter F1-06:



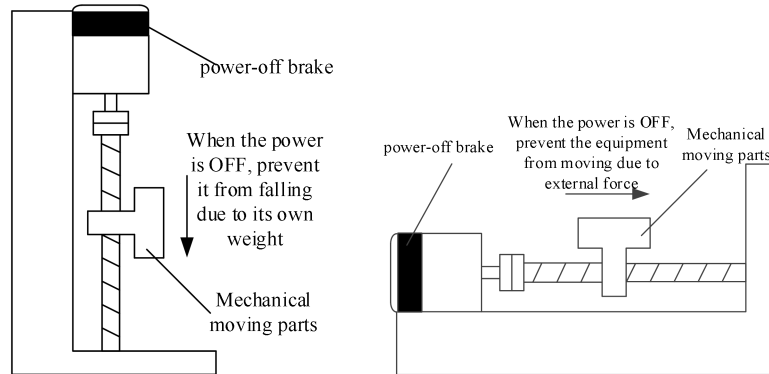
Press the [INC] key to add to 3 and hold [ENT] to confirm exit.



The F1-06 panel calibrates the encoder's current position to zero, while U0-94~97 displays the calibrated position.

## 5.2 Power failure brake (brake engagement)

The purpose of using "servo motor with power loss brake" is to prevent the movable part from moving under the action of its own weight or external force when the power supply of the system is put in "OFF".



The brake built into the servo motor is a fixed special brake without excitation action. It cannot be used for dynamic braking. It should only be used when the servo motor is kept in a stopped state.

- relevant parameter

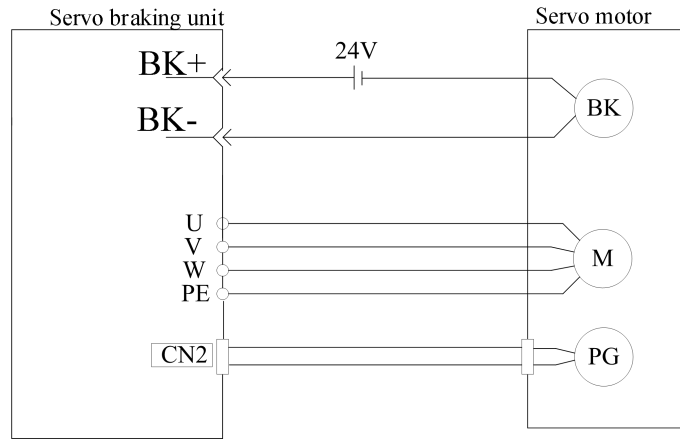
| parameter | meaning                     | factory setting | unit | Set range  | revise         | come into force |
|-----------|-----------------------------|-----------------|------|------------|----------------|-----------------|
| P5-44     | brake interlock             | n.0000          | -    | 0~ffff     | servo<br>bb    | immediately     |
| P5-07     | Servo-off delay time        | 500             | 1ms  | -500~9999  | servo<br>bb    | immediately     |
| P5-08     | brake command output speed  | 30              | rpm  | 20 ~ 10000 | servo<br>bb    | immediately     |
| P5-09     | brake command waiting time  | 500             | ms   | 0 ~ 65535  | servo<br>bb    | immediately     |
| P0-69.2   | Servo control signal source | 0               | -    | 0~1        | at any<br>time | immediately     |



The brake signal terminal of the DM6C series servo driver features an external structure, not integrated into the CN0 signal terminal. The brake signal terminal only outputs a signal when parameter P5-44 is set to any value except 0. To avoid interfering with other SO terminal functions, it is recommended to configure it without occupying the S01~SO4 terminals.

### 1. Hardware connection

The servo unit's sequential output signals "BK" and "Brake Power" form the ON/OFF circuit for the brake. A typical connection example is shown below.



## 2. Software parameter settings

For servo motors with brake, the brake signal terminal of the servo driver must be activated, meaning parameter P5-44 should be set to a value other than 0.

| Parameter settings status | Servo drive state | signal/BK terminal output logic | Servo motor status                                                    |
|---------------------------|-------------------|---------------------------------|-----------------------------------------------------------------------|
| P5-44=n.000□              | servo bb          | of no avail                     | The brake power is disconnected, and the motor is locked in position. |
|                           | servo run         | valid                           | The brake power is activated, and the motor is in a rotatable state.  |
| P5-44=n.001□              | servo bb          | of no avail                     | The brake power is disconnected, and the motor is locked in position. |
|                           | servo run         | valid                           | The brake power is activated, and the motor is in a rotatable state.  |

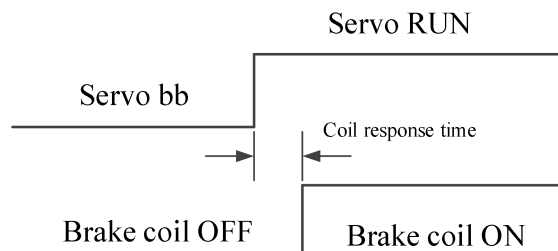


- When the brake signal terminal controls the brake, the servo is enabled (ON), the brake power is activated, and the motor is in a rotatable state.
- If the motor fails to rotate during new machine debugging, check whether the brake is released.

## 3. Timing of Brake Control by Servo Drive

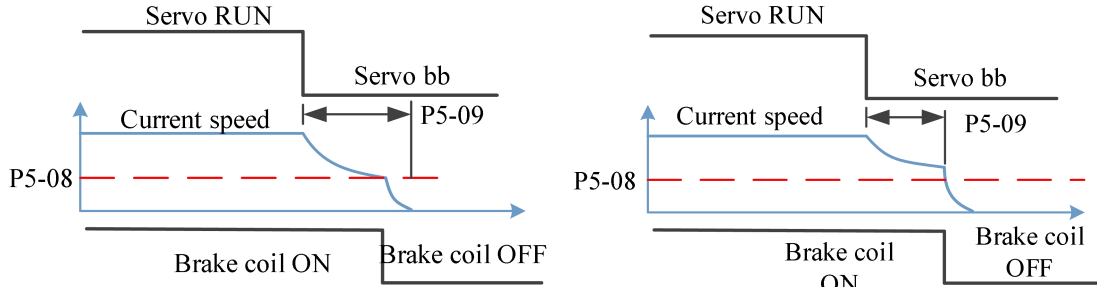
### 1) Brake timing sequence during normal power-on state

The servo motor activation and brake engagement occur simultaneously, with a response time of 50-60ms between the brake terminal output and the brake coil.



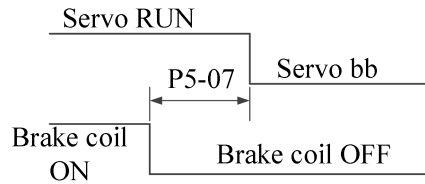
## 2) The timing of deactivating the enable brake during motion

The direct shutdown enable during operation refers to the motor shaft executing shutdown enable operation directly while maintaining rotational speed (motor speed > 0). After enabling shutdown, the motor decelerates. When the motor decelerates to the preset speed P5-08 within the P5-09 time period, the brake is released. As shown in the left diagram, if the motor has not decelerated below the P5-08 speed by the P5-09 time period, the brake is released directly, as illustrated in the right diagram.



## 3) The timing sequence for deactivating the enable brake in the stationary state

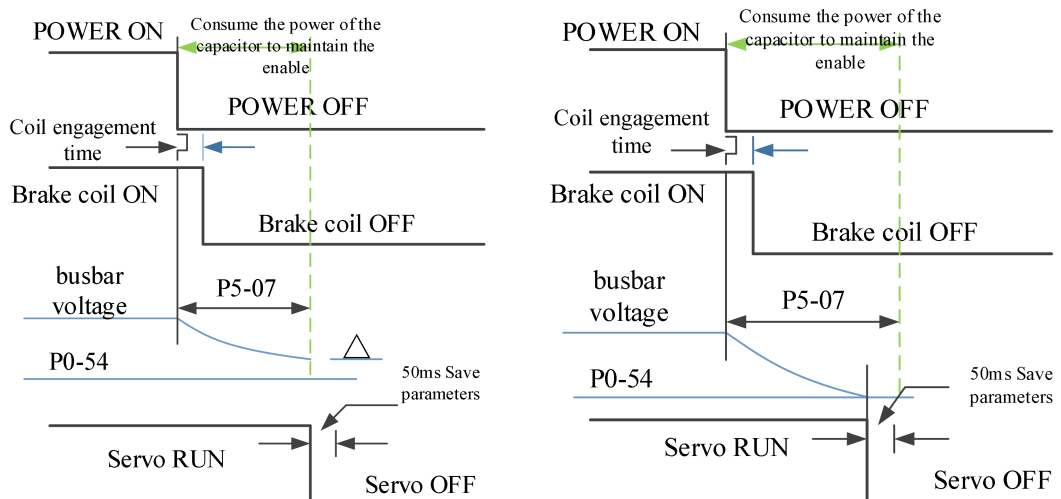
The static state is a special dynamic shutdown mode with zero operating speed. When shutdown operations are performed in this state, the brake will be released P5-07 (absolute value of P5-07) before the shutdown, preventing the system from falling.



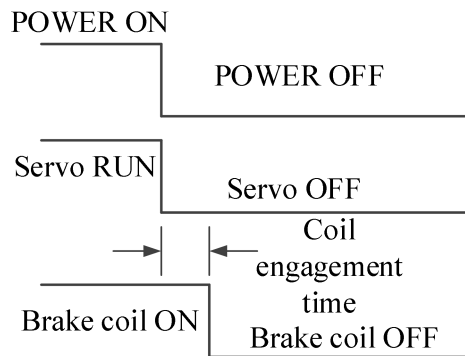
The brake engagement timing reference during alarm (2) and (3).

## 4) The timing sequence for the brake to engage when power is lost after enabling.

- ① When P5-07 is set to a negative value, the brake will be immediately released upon signal loss, which consumes the capacitor's stored energy. The release is delayed by the P5-07 time delay.

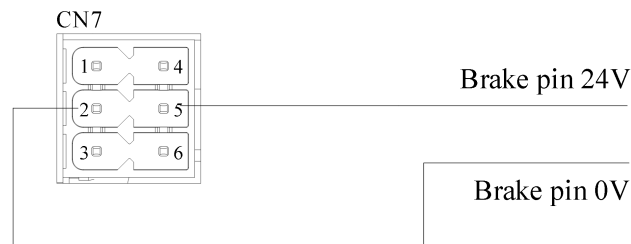


- ② When P5-07 is set to a positive value, the system will immediately release the brake and disable the enable function upon receiving a drop signal (the P5-07 delay time is not activated in this case).



When P0-69.2=1, the drop signal detected at this time is bus voltage P0-54. When P0-54 reaches the set value (default is 140V), the brake is closed with the set value P5-07. The brake timing is referred to 4).

#### 4. Brake connection method



#### 5. If the brake lever drops slightly after a power outage, try these solutions:

- ① The value of P5-07 can be set to a negative number.
- ② Set P0-69.2 directly to 1.

## 5.3 Parking Methods

Servo shutdown is divided into free shutdown and deceleration shutdown.

| shutdown mode            | free stop                                                                                                                                                                     | shut down                                                                                   |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| shutdown principle       | The servo drive is disabled, and the servo motor is not powered, decelerating freely to zero. The deceleration time is affected by mechanical inertia and equipment friction. | The servo driver outputs reverse braking torque, and the motor decelerates rapidly to zero. |
| shutdown characteristics | Advantages: smooth deceleration, less mechanical impact<br>Disadvantages: Slow deceleration                                                                                   | Advantages: Short deceleration time<br>Disadvantages: Mechanical impact                     |

Depending on the scenarios of servo shutdown, it is classified into three types: servo OFF shutdown, alarm shutdown, and overtravel shutdown.

### 5.3.1 Servo OFF and Alarm Shutdown

- relevant parameter

| parameter | meaning                              | factory setting | unit | Set range | revise      | come into force |
|-----------|--------------------------------------|-----------------|------|-----------|-------------|-----------------|
| P0-30     | Stop timeout time                    | 20000           | 1ms  | 0 ~ 65535 | servo bb    | immediately     |
| P5-03     | Rotation detection speed             | 50              | rpm  | 0 ~ 10000 | at any time | immediately     |
| P0-27     | Servo governor enables shutdown mode | 0               | -    | 0/2       | servo bb    | immediately     |
| P0-29     | alarm stop mode                      | 2               | -    | 0/2       | servo bb    | immediately     |

| parameter | numeric value                             | meaning                                                                                    |
|-----------|-------------------------------------------|--------------------------------------------------------------------------------------------|
| P0-27     | 0                                         | Free run stops. After stopping, it resumes free run.                                       |
|           | 2                                         | The deceleration brake stops, and the system remains in free running state after stopping. |
| P0-29     | Enable the attribute alarm for the envoy. |                                                                                            |
|           | 0/2                                       | Free run stops. After stopping, it resumes free run.                                       |
|           | Disable enable attribute alarm            |                                                                                            |
|           | 0                                         | Free run stops. After stopping, it resumes free run.                                       |
|           | 2                                         | The deceleration brake stops, and the system remains in free running state after stopping. |

**explain :**

### 1) Servo shutdown mode (P0-27)

- ① When P0-27=0, if the servo is turned off, the motor will start to stop freely without any alarm;
- ② When P0-27 equals 2, if the servo is turned off, the motor will decelerate to a stop until its speed drops below P5-03, then it will stop freely. The servo will also time the deceleration phase. If the deceleration time exceeds P0-30 but the motor speed hasn't dropped below P5-03, the E-262 alarm will be triggered.

### 2) Servo alarm parking mode (P0-29)

(1) Enable the attribute alarm

- ① When P0-29=0/2, if the servo alarm occurs, the motor will start to rely on free parking;

(2) Disable enable attribute alarm

- ① When P0-29=0, if the servo alarm occurs, the motor will start to rely on free parking;
- ② When P0-29 equals 2, if a servo alarm occurs, the motor will initiate deceleration to stop until its speed drops below 50 rpm, then transition to free stop. The servo simultaneously records the deceleration duration. If the recorded time exceeds P0-30 during deceleration, the servo will immediately execute free stop. In this case, regardless of P0-29's value, the E-262 alarm will not be triggered due to the servo's alarm state. After stopping, the system will maintain free-running mode.

**3) The servo drive's SO terminal is equipped with a brake engagement function, which automatically applies deceleration mode for parking regardless of whether P0-27/P0-29 equals 0 or 2.**

**4) Setting P0-27/29=1/3/4/5 for servo drive is meaningless, as all will park in free parking mode.**

## 5.3.2 Parking Method in Normal Mode When Exceeding the Limit

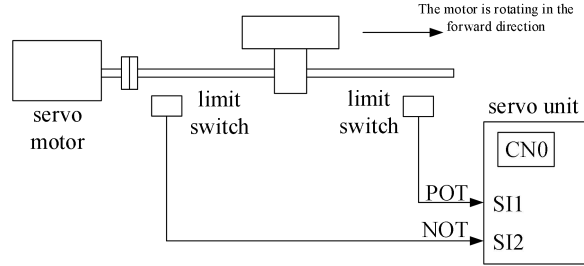
The over travel prevention function of servo unit is a safety function that the servo motor is forced to stop when the movable part of the machine exceeds the designed safe moving range by inputting the signal of limit switch.

### ● relevant parameter

| parameter | meaning                    | factory setting | unit | Set range | revise   | come into force |
|-----------|----------------------------|-----------------|------|-----------|----------|-----------------|
| P0-28     | servo overtravel stop mode | 2               | -    | 0 ~ 3     | servo bb | immediately     |
| P0-30     | Stop timeout time          | 20000           | 1ms  | 0 ~ 65535 | servo bb | immediately     |

|       |                              |        |   |  |             |             |
|-------|------------------------------|--------|---|--|-------------|-------------|
| P5-22 | No forward rotation<br>/P-OT | n.0003 | - |  | at any time | immediately |
| P5-23 | Disable Inversion<br>/N-OT   | n.0000 | - |  | at any time | immediately |

Be sure to press the connection limit switch as shown in the figure below.



For rotary applications such as conical rollers and conveyors, the overtravel prevention function is unnecessary, and the overtravel prevention input signal does not need to be wired.

| Parameter settings status | Signal/POT, terminal input status       | Overrun signal (POT, NOT) terminal logic |
|---------------------------|-----------------------------------------|------------------------------------------|
| P5-22/P5-23=n.0000        | No external terminal input is required. | of no avail                              |
| P5-22/P5-23=n.000□        | No signal input at the SI□ terminal     |                                          |
| P5-22/P5-23=n.001□        | The SI□ terminal has a signal input.    |                                          |
| P5-22/P5-23=n.0010        | No external input terminals required    | valid                                    |
| P5-22/P5-23=n.000□        | The SI□ terminal has a signal input.    |                                          |
| P5-22/P5-23=n.001□        | No signal input at the SI□ terminal     |                                          |

The forward limit signal (POT) and reverse limit signal (NOT) cannot be set to the same terminal input simultaneously.

| Run direction | limiting                | running state                                                           |
|---------------|-------------------------|-------------------------------------------------------------------------|
| corotation    | positive limit is valid | POT, set the servo overtravel stop mode for parking at P0-28            |
|               | limit effective         | Call E-261                                                              |
| reversal      | positive limit is valid | Call E-261                                                              |
|               | limit effective         | Note: Set the servo overtravel stop mode for parking according to P0-28 |



| parameter | numeric value | meaning                                                                                       |
|-----------|---------------|-----------------------------------------------------------------------------------------------|
| P0-28     | 0             | The stop 1 has stopped. The torque in the overtravel direction is 0. The command is received. |
|           | 1             | Free stop. After stopping, the torque in the overtravel direction is 0. Receive the command.  |
|           | 2             | The stop 2 has stopped. No commands are received in the overtravel direction after stopping.  |
|           | 3             | Alert (E-260)                                                                                 |



- When P0-28=0/2, the motor starts to slow down and stop after receiving the overtravel stop signal, and the timeout time during the overtravel processing also plays a role.
- When the motor is stopped by an overtravel signal during position control, position deviation pulses may occur. To clear these pulses, a CLR signal must be input. If the servo unit still receives these pulses, they will accumulate until the servo unit triggers an alarm.
- During torque control, the servo drive's SO terminal is assigned to the brake function, preventing signal allocation through the overtravel terminals P5-22 and P5-23.
- The servo drive's SO terminal is equipped with a brake engagement function, with P0-28 automatically set to 2.

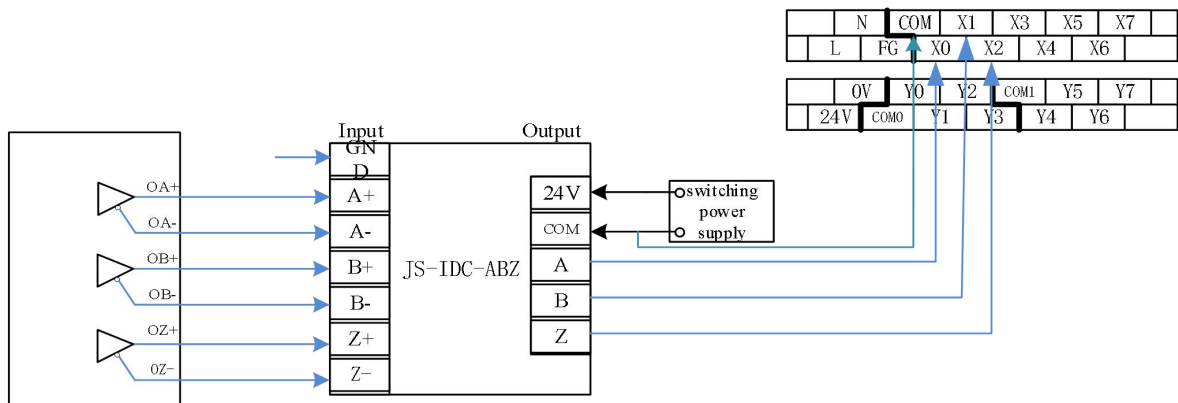
## 5.4 Encoder ABZ Phase Division Output

The servo drive outputs differential signals through the frequency division output circuit and the differential driver, which provides the position signal for the control of the upper computer device or the pulse signal for the driven servo, thus realizing the following control of the master and slave shafts.

### 1. Specifications for the encoder's frequency division output

| Terminal name | Terminal pin number | terminal function                        |
|---------------|---------------------|------------------------------------------|
| FPA+          | 9                   | A-phase frequency division signal output |
| FPA-          | 10                  |                                          |
| FPB+          | 11                  | B-phase frequency division signal output |
| FPB-          | 12                  |                                          |
| FPZ+          | 13                  | Z-phase frequency division signal output |
| FPZ-          | 14                  |                                          |

### 2. Wiring diagram



### 3. Parameter Settings

|       |                                                            |                      |               |                 |          |                 |
|-------|------------------------------------------------------------|----------------------|---------------|-----------------|----------|-----------------|
| P0-17 | frequency division output enable switch                    |                      |               |                 |          |                 |
|       | set value                                                  | function             | factory value | Applicable mode | revise   | come into force |
|       | 0                                                          | Disable split output | 0             | own             | servo bb | immediately     |
|       | 1                                                          | Enable split output  |               |                 |          |                 |
| P0-18 | Number of feedback pulses per encoder revolution (low bit) |                      |               |                 |          |                 |
|       | Set unit                                                   | factory setting      | Set range     | Applicable mode | revise   | come into force |
|       | 1                                                          | 0                    | 0-9999        | own             | P0-17=0  | immediately     |

|       |                                                               |                 |           |                 |             |                 |
|-------|---------------------------------------------------------------|-----------------|-----------|-----------------|-------------|-----------------|
| P0-19 | Number of feedback pulses per encoder revolution (high bit)   |                 |           |                 |             |                 |
|       | Set unit                                                      | factory setting | Set range | Applicable mode | revise      | come into force |
|       | 10000                                                         | 1               | 0-9999    | own             | P0-17=0     | immediately     |
| P0-20 | encoder feedback pulse output frequency division (molecule)   |                 |           |                 |             |                 |
|       | Set unit                                                      | factory setting | Set range | Applicable mode | revise      | come into force |
|       | -                                                             | 1               | 0-65535   | own             | P0-17=0     | immediately     |
| P0-21 | Encoder feedback pulse output frequency divider (denominator) |                 |           |                 |             |                 |
|       | Set unit                                                      | factory setting | Set range | Applicable mode | revise      | come into force |
|       | -                                                             | 1               | 0-65535   | own             | P0-17=0     | immediately     |
| P5-19 | Z phase pulse width                                           |                 |           |                 |             |                 |
|       | Set unit                                                      | factory setting | Set range | Applicable mode | revise      | come into force |
|       | Ms                                                            | 2               | 2-20      | own             | at any time | immediately     |

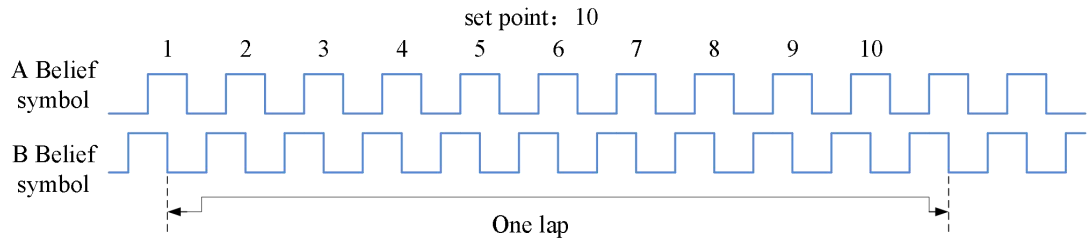
**explain :**

(1) Pulse count per revolution:  $P0-19 \times 10000 + P0-18$ . Parameters P0-18 to P0-21 are encoder feedback parameters, with P0-18 and P0-19 forming one group and P0-20 and P0-21 another. The feedback pulse count for P0-18 and P0-19 has higher priority than the output pulse frequency divider P0-20 and P0-21. The frequency divider P0-20 and P0-21 only activate when both P0-18 and P0-19 are set to 0.

For example, a magnetic absolute encoder motor (CN) requires 10,000 pulses per revolution. The encoder feedback settings can be configured as  $P0-18=0000$  and  $P0-19=0001$ , or alternatively, the encoder feedback division ratio ( $P0-20/P0-21$ ) can be set. To achieve the required resolution of  $10,000/524288$  ( $625/32768$ ) per revolution, the settings should be:  $P0-18 = P0-19 = 0$ ,  $P0-20 = 625$ , and  $P0-21 = 32768$ .

(2) Encoder feedback is output through port CN0. When using single-phase counting, the motor's rotation count equals the set value. With AB-phase counting, the count becomes four times the set value. We recommend using AB-phase counting for the pulse receiver.

(3) When the feedback pulse count per cycle is 10, the encoder's frequency division pulse outputs two signals: Phase A (PAO) and Phase B (PBO), as shown below:

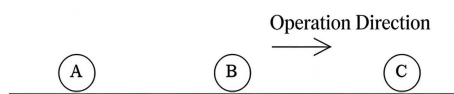


|         |                                             |                                            |               |                 |           |                 |
|---------|---------------------------------------------|--------------------------------------------|---------------|-----------------|-----------|-----------------|
| P0-87.0 | Encoder Feedback Output Direction Selection |                                            |               |                 |           |                 |
|         | set value                                   | function                                   | factory value | Applicable mode | revise    | come into force |
|         | 0                                           | Phase A leads phase B in forward rotation. | 0             | own             | servo OFF | immediately     |
|         | 1                                           | Phase B leads phase A in forward rotation. |               |                 |           |                 |
| P0-87.1 | differential feedback output Z phase mode   |                                            |               |                 |           |                 |
|         | set value                                   | function                                   | factory value | Applicable mode | revise    | come into force |
|         | 0                                           | Do not output Z-phase pulses               | 0             | own             | servo OFF | immediately     |
|         | 1                                           | output Z phase pulse                       |               |                 |           |                 |

## 5.5 Full closed-loop input

### 5.5.1 Overview of the Fully Closed Loop System

The closed-loop system is a system which is installed on the moving machinery by the external position detection device (such as encoder, grating scale, etc.), detects the position of the control object, and gives feedback to the servo unit in real time.

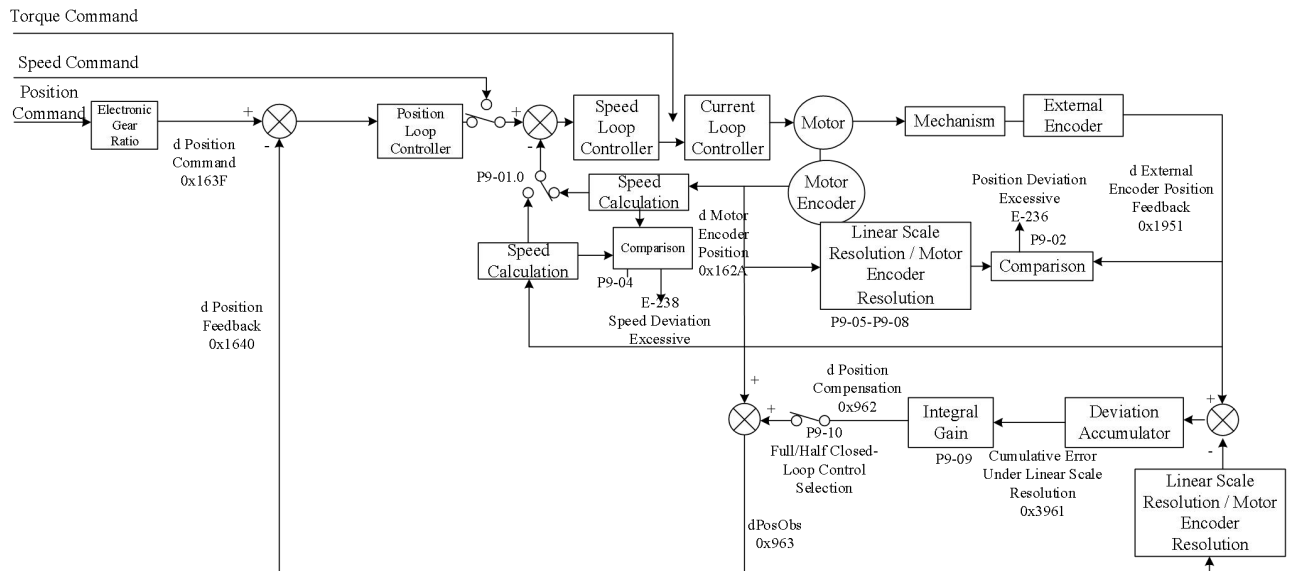


At point A, the host computer issues a pulse command. Assuming the target position is the grating scale's feedback position C, the motor must rotate  $n$  full turns to reach this point. If the motor, due to mechanical deviations or other factors, already completes  $n$  turns and reaches point B during operation, it will continue running until the grating scale feedback confirms the motor has reached the target position C. This fully closed-loop approach ensures control immunity to external mechanical deviations, thereby enhancing control precision.

### 5.5.2 Full closed-loop function wiring and implementation logic

The position feedback signal from the external encoder (grating scale) is transmitted to the servo driver via port CN4.

| Terminal name | Terminal pin number | terminal function                        |
|---------------|---------------------|------------------------------------------|
| QBH-A+        | 1                   | A-phase frequency division signal output |
| QBH-A-        | 2                   |                                          |
| QBJ-B+        | 4                   | B-phase frequency division signal output |
| QBH-B-        | 5                   |                                          |
| QBH-Z+        | 6                   | Z-phase frequency division signal output |
| QBH-Z-        | 7                   |                                          |



### 5.5.3 Full closed-loop debugging

1. For new motors with idle shaft, perform a stop-and-go trial run to verify system operation under semi-closed-loop control.

When the servo motor is in no-load state, perform trial operation and intermittent operation according to Section 4.4 F1 Group procedures. After verification, set the initial control parameters.

2. Confirm the operation of the semi-closed-loop control when the servo motor is mechanically connected.

After connecting with the related mechanical structure, the load inertia ratio is first presumed. Then, according to the operation of 4.4 F0-07, the servo is instructed by the upper computer device to confirm that the mechanism is correctly connected and running normally.

● relevant parameter

| parameter | meaning             | factory setting | unit | Set range | revise      | come into force |
|-----------|---------------------|-----------------|------|-----------|-------------|-----------------|
| P0-07     | first inertia ratio | 200             | %    | 0 ~ 50000 | at any time | immediately     |

3. Confirmation of the counting direction of the grating scale

When the motor is disabled, manually operate the machine by monitoring the raw data from the optical grating scale (U4-11/12) and the motor encoder (U0-10/11) to install the grating scale correctly, or adjust the counting direction of the grating scale via P9-00.1.

If U4-11/12 and U0-10/11 increase or decrease in the same direction, use the grating scale value directly. Otherwise, adjust the grating scale installation direction or P9-00.1=1.

| parameter | parameter | Functionality | factory | Set range | revise | come |
|-----------|-----------|---------------|---------|-----------|--------|------|
|-----------|-----------|---------------|---------|-----------|--------|------|

|         | setting |                                  | setting |                                          |          | into force     |
|---------|---------|----------------------------------|---------|------------------------------------------|----------|----------------|
| P9-00.1 | n.xx□x  | grating scale counting direction | 0       | The grating caliper reading is positive. | servo bb | Power on again |
|         |         |                                  | 1       | The grating caliper reading is reversed. |          |                |

If the direction setting is incorrect (i.e., P9-02 is not set to 0), the system may trigger Alarm E-236 (Excessive motor-load position deviation) during operation, requiring disabling the enable function and a power cycle. If P9-02 is set to 0, Alarm E-237 (Counting direction reversed) will be triggered, necessitating a power cycle and adjustment of the value.

#### 4. Selection of grating scale type

| parameter | parameter setting | Functionality      | factory setting | Set range                                        | revise   | come into force |
|-----------|-------------------|--------------------|-----------------|--------------------------------------------------|----------|-----------------|
| P9-00.2   | n.x□xx            | grating scale type | 0               | AB phase counter                                 | servo bb | Power on again  |
|           |                   |                    | 1               | Incremental serial communication (not supported) |          |                 |
|           |                   |                    | 2               | Absolute serial communication (not supported)    |          |                 |

#### 5. Confirmation of the number of feedback pulses per circle of the grating scale

Method 1: According to the resolution of the grating scale, the upper computer sends a pulse to make the motor rotate one circle, and the feedback pulse number of the grating scale is calculated at this time, which is recorded as the feedback pulse number of the grating scale per circle.

Method 2: The host computer sends a pulse to rotate the motor one full turn. The system monitors the change in raw data from the U4-11/12 optical grating scale, recording the number of feedback pulses per turn. (This method requires compensation for mechanical errors and cannot be used directly.)

#### 6. Mechanical side grating scale frequency division setting

| parameter | meaning                                                              | factory setting | unit  | Set range | revise   | come into force |
|-----------|----------------------------------------------------------------------|-----------------|-------|-----------|----------|-----------------|
| P9-05     | Number of feedback pulses per revolution of the motor encoder / Low  | 0               | PULSE | 0 ~ 9999  | servo bb | Power on again  |
| P9-06     | Number of feedback pulses per revolution of the motor encoder / High | 0               | PULSE | 0 ~ 9999  | servo bb | Power on again  |
| P9-07     | Feedback pulse count per turn of the grating scale/Low               | 0               | PULSE | 0 ~ 9999  | servo bb | Power on again  |

|       |                                                          |   |       |          |          |                |
|-------|----------------------------------------------------------|---|-------|----------|----------|----------------|
| P9-08 | Feedback pulse count per high cycle of the grating scale | 1 | PULSE | 0 ~ 9999 | servo bb | Power on again |
|-------|----------------------------------------------------------|---|-------|----------|----------|----------------|

(1) Mechanical side grating scale frequency division:

$$= \frac{\text{Motor encoder feedback pulses per motor revolution}}{\text{Pulses of external quadrature encoder per motor revolution}}$$

$$= \frac{P9-08*10000+P9-07}{P9-06*10000+P9-05}$$

The feedback pulse count per revolution of the motor encoder is calculated as  $P9-06*10000 + P9-05$ . When the set value is 0, the encoder resolution is automatically read and configured as the frequency division numerator.

The number of feedback pulses per revolution of the grating scale is calculated as  $P9-08*10000 + P9-07 + P9-08*10000 + P9-07$ . The factory default resolution for the grating scale (external encoder) is 10000. Adjust the setting according to the actual resolution of the grating scale.



Enter the complete external grating scale division ratio, and input it after irreducible.

(2) In fully closed-loop mode, it is recommended to set P0-11 and P0-12 to 0 and use the electronic gear ratio of P0-13 and P0-14. P0-11 and P0-12 can also be used if the external grating scale frequency division is correct; otherwise, the E-236 alarm will be triggered.

## 7. Alarm detection parameter settings

| parameter | meaning                                                                  | factory setting | unit  | Set range | revise   | come into force |
|-----------|--------------------------------------------------------------------------|-----------------|-------|-----------|----------|-----------------|
| P9-02     | Alarm threshold for excessive deviation between motor and load positions | 100             | PULSE | 0 ~ 65535 | servo bb | immediately     |

(1) P9-02: Alarm threshold setting for excessive deviations between motor encoder feedback (position) and full-closed-loop grating scale feedback (load position).

If the value exceeds the preset threshold, the E-236 alarm will be triggered, and the alarm will be cleared upon power restoration. If mechanical errors are confirmed to be significant, causing frequent E-236 alarms, the P9-02 value may be appropriately increased under permissible equipment conditions. When P9-02 is set to 0, no alarm is triggered. However, if the motor encoder signal and the optical grating signal count in opposite directions, the E-237 alarm will occur. This issue can be resolved by restarting the system and adjusting P9-00.1.

(2) To prevent motor runaway or damage caused by external grating scale damage or loose wiring, set P9-02 to an appropriate value.

(3) The P9-02 configuration is determined by the user's location command frequency.

| parameter | meaning | factory setting | unit | Set range | revise | come into force |
|-----------|---------|-----------------|------|-----------|--------|-----------------|
|-----------|---------|-----------------|------|-----------|--------|-----------------|



|       |                                                 |   |                  |           |          |                 |
|-------|-------------------------------------------------|---|------------------|-----------|----------|-----------------|
| P9-03 | Motor-load position deviation clearance setting | 0 | shut in<br>a pen | 0 ~ 65535 | servo bb | immedi<br>ately |
|-------|-------------------------------------------------|---|------------------|-----------|----------|-----------------|

(1) When P9-03=n, the motor resets its count to zero after accumulating n full rotations in one direction, clearing the recorded difference between the encoder position feedback and the full-closed-loop grating scale load position feedback.

(2) Setting to 0 means the motor-load position deviation is not cleared; setting a non-zero value clears the deviation after the motor completes n cumulative rotations.

| parameter | meaning                                    | factory setting | unit | Set range | revise    | come into force |
|-----------|--------------------------------------------|-----------------|------|-----------|-----------|-----------------|
| P9-04     | Motor-load speed deviation alarm threshold | 100             | RPM  | 0 ~ 65535 | servo OFF | immedi<br>ately |

P9-04: The motor encoder speed feedback and full-closed-loop grating speed feedback may exhibit deviations. If the actual deviation exceeds the set value, alarm E-238 will be triggered, but this function is only activated when the full-closed-loop speed feedback P9-01.0 is enabled. Setting this parameter to 0 will disable the alarm.

## 8. The switch for the fully closed-loop control mode

The P9-00.0 can be modified during operation and switches between semi-closed loop and full-closed loop modes via SI terminals, EtherCAT bus, or other methods.

| parameter | parameter setting | Functionality                        | Windows default | Set range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | revise      | come into force |
|-----------|-------------------|--------------------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|
| P9-00.0   | n.xxx□            | Full closed-loop control mode switch | 0               | 0: Turn off full closed-loop control;<br>1: Enable full closed-loop control;<br>2: Select the SI terminal method to activate/deactivate the full closed loop. The SI terminals are assigned by P5-56, and the loop's activation/deactivation is determined by the assigned SI terminal status.<br>3: Select to enable/disable full closed-loop via ECAT bus:<br>Set both bit24 of 60FEh 01h and 02h to 1 to enable full closed-loop control.<br>If either bit24 of 60FEh 01h or 02h is set to 0 (or all bits are 0), the full closed loop will be disabled. | at any time | immedi<br>ately |

- relevant parameter

| parameter | parameter | Functionality | Windows | Set | revise | come into |
|-----------|-----------|---------------|---------|-----|--------|-----------|
|-----------|-----------|---------------|---------|-----|--------|-----------|

|       | setting |                                                                                 | default | range   |             | force       |
|-------|---------|---------------------------------------------------------------------------------|---------|---------|-------------|-------------|
| P3-18 | 100     | F1-00 point speed                                                               | 100     | 0~1000  | servo<br>bb | immediately |
| P5-56 | 0       | SI terminal allocation for full closed loop/semi-closed loop function switching | 0       | 0~ffff  | at any time | immediately |
| P9-09 | 500     | Full closed-loop integration time constant                                      | 500     | 0~65535 | servo<br>bb | immediately |

(1) Under the fully closed-loop control mode, perform a stop-and-go operation at point F1-00 (P9-00.0=1) to confirm normal system operation. Perform a stop-and-go operation on the servo motor (via the panel F1-00 or using the host computer, gradually increasing the speed while observing for any abnormalities). P3-18 is the speed configured for the closed-loop stop-and-go operation, which only applies in the two stop-and-go modes; other normal control modes are invalid.

(2) Run the servo system to verify the proper operation of the fully closed-loop system. Send commands via PLC or other upper-level devices to monitor the servo unit's performance. Confirm step by step by gradually increasing the speed from low to the target speed.

(3) P9-09: The integral time constant of the full closed-loop system (unit: 0.01ms) is reduced to enhance response speed. This enables the grating scale position feedback to follow positional commands more promptly, resulting in shorter positioning time. When the transmission mechanism between full and half closed-loop systems lacks sufficient rigidity, increasing the integral time constant improves system stability. No gain switching is required when switching between half closed-loop and full closed-loop modes.

## 5.5.4 All closed-loop function-related parameters

### 1. Speed feedback selection and servo pulse output mode in full closed-loop control

| parameter | Parameter Function | Set unit                                                                          | factory setting | Applicable mode                                            | revise   | come into force |
|-----------|--------------------|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|----------|-----------------|
| P9-01     |                    | -                                                                                 | n.0000          | whole                                                      | servo bb | Power on again  |
|           | parameter setting  | Functionality                                                                     | factory setting | Set Meaning                                                |          |                 |
|           | n. □xxx            | insignificance                                                                    |                 |                                                            |          |                 |
|           | n.x□xx             | The source of the servo pulse output signal for the full closed-loop control      | 0               | 0: Motor encoder ABZ output<br>1: Raster scale ABZ output  |          |                 |
|           | n.xx□x             | The source of the Z-signal in the zeroing process of the full closed-loop control | 0               | 0: Motor encoder Z phase<br>1: Z-axis of the grating scale |          |                 |

|  |        |                                                         |   |                                                              |
|--|--------|---------------------------------------------------------|---|--------------------------------------------------------------|
|  | n.xxx□ | Selection of speed feedback in full closed-loop control | 0 | 0: Use motor encoder speed<br>1: Use the grating scale speed |
|--|--------|---------------------------------------------------------|---|--------------------------------------------------------------|

In full closed-loop control, P9-01.0 is usually set to "use motor encoder speed (P9-01.0 = 0)". When only the direct drive servo motor and high resolution grating scale are connected, it is set to "use grating scale speed (P9-01.0 = 1)".

## 2. Monitoring parameters in the full closed-loop mode

In the full closed-loop mode, all encoder data in the original control loop are replaced by the position data from the optical grating (except for the current loop and mechanical angle feedback).

| parameter | meaning                         | data               |
|-----------|---------------------------------|--------------------|
| U4-11     | Raw data from the grating scale | U4-12*10000+ U4-11 |
| U4-12     |                                 |                    |
| U4-13     | Number of Z-axis grating scales | -                  |
| U4-14     | grating scale feedback data     | U4-15*10000+ U4-14 |
| U4-15     |                                 |                    |

## 3. Sampling channel with full closed-loop control

When the grating scale function is enabled, the position control information in position control mode comes from the grating scale feedback position data. When the grating scale speed feedback is enabled, the motor encoder speed feedback information will also be replaced by the grating scale speed feedback data. That is, the grating scale feedback information obtained from the same channel sampling.

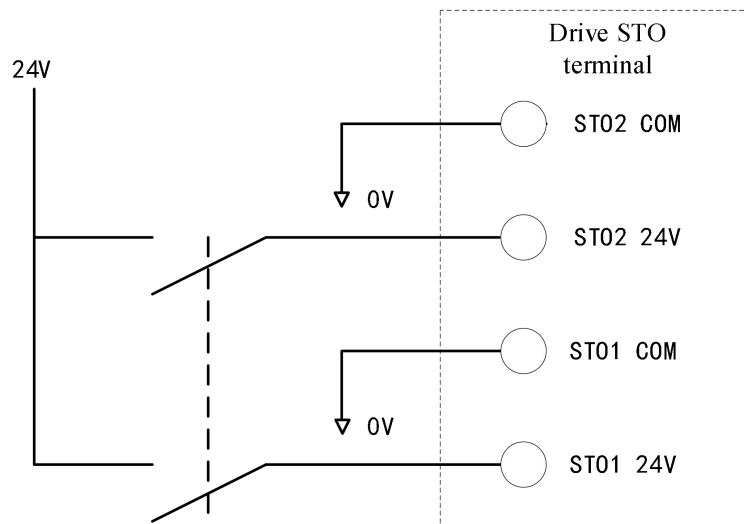
| sampling channel | Sampling                                                                                                                  |
|------------------|---------------------------------------------------------------------------------------------------------------------------|
| 1950             | The original position information of the grating scale;                                                                   |
| 1951             | Grating differential position feedback (grating resolution)                                                               |
| 0953             | Grating Differential Position Feedback (Motor Encoder Resolution)                                                         |
| 0954             | grating speed feedback                                                                                                    |
| 0955             | Error between position feedback of motor encoder and position feedback of grating scale under resolution of grating scale |
| 3961             | The cumulative value of position feedback deviation between grating scale and motor encoder                               |
| 4960             | Total number of grating scale position feedbacks                                                                          |

## 5.6 STO Safe Torque Shutdown

### 5.6.1 Overview of STO Function

STO (Safe Torque Off) function: A safety feature that cuts off motor current through hardware. The STO safety terminal (CN5) features a dual-circuit design with two safety signal inputs (STO1 and STO2). When either terminal is triggered, it activates the STO state, isolating the power module that controls motor current. This prevents the power module from outputting PWM control signals, thereby cutting off the motor current and achieving a torque-free state.

### 5.6.2 STO Wiring Schematic Diagram



### 5.6.3 Settings for STO-related parameters

| parameter | Parameter name                                            | unit  | scope  | Trigger time | function declaration                                    | give tacit consent to |
|-----------|-----------------------------------------------------------|-------|--------|--------------|---------------------------------------------------------|-----------------------|
| P0-88     | STO Synchronization Detection Configuration               | 100us | 0-1000 | immediately  | STO asynchronous alarm detection time                   | 60                    |
| P0-89.0~1 | STO Buffer Circuit Abnormal Alarm Detection and Filtering | 100us | 0-255  | immediately  | STO buffer circuit abnormal alarm detection filter time | 32                    |
| P0-89.2~3 | STO input detection and filtering                         | 100us | 10-30  | immediately  | STO input detection and filtering                       | 12                    |

## 5.6.4 STO Working Principle

### ■ STO detonate by contact

The driver will operate properly only when both STO1 and STO2 terminal input signals are in a valid high-level state. The status specifications are as follows:

| STO1 input | STO2 input | EDM output state | PWM control signal |
|------------|------------|------------------|--------------------|
| H          | H          | no-output        | normal             |
| H          | L          | no-output        | prohibit           |
| L          | H          | no-output        | prohibit           |
| L          | L          | Output           | prohibit           |

When either STO1 or STO2 is at a low level, the servo enters the STO state, at which point:

- ① PWM control signal is prohibited;
- ② The servo shuts down according to the shutdown method of enabling and disabling in P0-29 alarm shutdown mode;
- ③ The servo/S-RDY signal output is 0;
- ④ The panel displays Sto.

If the STO1 and STO2 statuses are inconsistent and the time exceeds the P0-88 set time, the E-340 alarm will be triggered: STO status is out of sync. The alarm is disabled when the value is 0.

When any of the following occurs:

- When STO1 and STO2 inputs are high, the MCU enable level differs from the PWM enable level.
- Both STO1 and STO2 are low, and PWM\_EN is also low.

Alarm E-342: STO input buffer loop malfunction when time exceeds P0-89.0~1. The alarm is disabled when P0 is 0.

The STO1 and STO2 pins must not respond to pulses shorter than 1ms, and must respond to pulses exceeding the threshold set by P0-89.2~3.

When an alarm occurs in the STO state, the panel displays the alert, but the servo remains in STO mode, and the brake configuration is set according to the STO state.

### ■ STO remove

When both STO1 and STO2 terminals are at high level and the enable signal remains inactive, the STO state is released. The servo ready output signal (S-RDY) is output according to the P5-70 configuration, and the brake is activated based on the validity of the enable signal (S-ON).

## 5.6.5 Notes on STO Function

When the STO function is activated, the motor will safely enter a torque-free state, and the servo driver will no longer exert control. Therefore, before using the STO function, please assess the

potential risks that may persist after activation.

- When the STO function is enabled, the servo cannot ensure the motor's movement due to external forces, such as vertical-axis motion.
- The STO function cannot disconnect the servo unit's power supply, leaving the driver's high-voltage section energized. This poses risks of electric shock or other hazards. Always disconnect the power supply and related devices before servicing the servo unit.
- Use the external 24V switch power supply to power the function terminal CN5 to provide the STO signal input. The external power supply voltage range is within 22.8V~25.2V,0.5A.

If the STO function stops the running servo, the motor will gradually stop. If this is unacceptable, the system should use the correct stop mode instead of stopping with the STO function.

All cables compatible with STO functionality must be properly protected, routed, and secured. During installation, ensure cables are free from tension or compression. The required cables are listed in the table below:

| Cable requirements | explain                                                                              |
|--------------------|--------------------------------------------------------------------------------------|
| kind               | Double-shielded or single-shielded twisted pair cable                                |
| extreme length     | The maximum allowable cable length between the drive and safety switch is 30 meters. |
| maximum dimensions | 0.8mm <sup>2</sup> (18 AWG)                                                          |
| lower limit        | 0.3mm <sup>2</sup> (28 AWG)                                                          |

## 5.7 Weak Magnetic Function

### 5.7.1 Overview of the Weak Magnet Function

The control method of weak magnetic field is to reduce the magnetic field of the motor to make the motor run at the rated speed above the maximum voltage and current limit of the inverter.



When using the weak magnetic function, the motor speed must not exceed its maximum speed to prevent motor failure or personal and property damage.

### 5.7.2 Settings for weak magnetic correlation parameters

Servo weak magnetic control switch PE-01.3,0 (default): 0 turns off weak magnetic function, 1 turns on weak magnetic function.

To activate the servo's weak magnetic function, ensure proper motor parameters such as back electromotive force coefficient,  $L_d$ , and  $L_q$  are configured. For specific usage conditions and parameter settings, contact the original manufacturer's technical support.

| parameter | Parameter name                                            | unit  | scope   | Trigger time | give tacit consent to |
|-----------|-----------------------------------------------------------|-------|---------|--------------|-----------------------|
| PE-01.3   | weak magnetic control switch                              | —     | 0-1     | at any time  | 0                     |
| PE-80     | weak magnetic control gain $K_v$                          | Hz    | 10-1000 | at any time  | 30                    |
| PE-81     | The integral time constant $T_i$ of weak magnetic control | %     | 10-1000 | at any time  | 16                    |
| PE-82     | weak magnetic control integral limit                      | %     | 0-200   | at any time  | 60                    |
| PE-83     | Voltage command limit threshold                           | %     | 50-150  | at any time  | 115                   |
| PE-84     | IdRef amplitude limiting                                  | %     | 50-150  | at any time  | 95                    |
| PE-85     | Main loop voltage smoothing filter time                   | 0.1ms | 0-1000  | at any time  | 20                    |

## 5.8 Position Control

### 5.8.1 General Positioning Mode

#### 5.8.1.1 Positioning completion signals (/COIN, /COIN\_HD)

The signal is used to confirm the completion of the servo motor positioning when the position control is performed.

- relevant parameter

| parameter | meaning                      | factory setting | unit             | Set range | revise      | come into force |
|-----------|------------------------------|-----------------|------------------|-----------|-------------|-----------------|
| P5-00     | Positioning completion width | 144             | instruction unit | 1 ~ 65535 | at any time | immediately     |
| P5-01     | Complete detection mode      | 0               | -                | 0 ~ 3     | at any time | immediately     |
| P5-02     | Location completion time     | 0               | ms               | 0 ~ 65535 | at any time | immediately     |

| parameter | Signal name | factory setting | Applicable mode | meaning              | revise      | come into force |
|-----------|-------------|-----------------|-----------------|----------------------|-------------|-----------------|
| P5-37     | /COIN-HD    | n.0000          | 5/6             | Complete positioning | at any time | immediately     |
| P5-38     | /COIN       | n.0001          | 5/6             | Complete positioning | at any time | immediately     |

For details of hardware wiring, refer to Chapter 3.3.2.  
To output a SO2 signal, set P5-37 and P5-38 to n.0002/0012. Note that each SO terminal can only serve one signal function.

#### 1) The conditions for outputting the positioning completion signal

##### (1) /COIN-HD signal output conditions

The positioning completion hold/COIN-HD signal is only outputted when the detection mode P5-01 is set to 3. The COIN-HD signal is outputted after the /COIN signal is held for P5-02 duration.

##### (2) /COIN signal output conditions

Based on the positioning completion detection mode configured by P5-01, the system outputs a positioning completion/COIN signal. The following outlines the prerequisites for this output and its schematic diagram.

| P5-01 Settings | content | diagrammatic sketch |
|----------------|---------|---------------------|
|----------------|---------|---------------------|



| P5-01 Settings | content                                                                                                                                                                                          | diagrammatic sketch |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 0              | The COIN signal is outputted when the absolute value of deviation stays below P5-00.                                                                                                             |                     |
| 1              | After the instruction is completed, if the deviation is below P5-00, the COIN signal is output.                                                                                                  |                     |
| 2              | If the command ends and the motor speed is below the rotation detection speed (P5-03), and the absolute deviation is less than P5-00, the COIN signal is output.                                 |                     |
| 3              | When the instruction completes, the system outputs a COIN signal if the absolute deviation value is below P5-00. If the COIN signal remains active for P5-02, it will output a COIN-HOLD signal. |                     |

## 2) Description of the completed width

(1) The positioning completion width P5-00 varies proportionally with the electronic gear ratio, with a factory default of 11 command units.

The positioning width P5-00 changes proportionally with the number of command pulses required for the motor to complete one revolution.

The output of the positioning completion signal is determined by the width of the signal. The smaller the width, the later the output of the signal, but the signal output does not affect the actual running state of the motor.

(2) The positioning completion width can also be set independently, and its adjustment won't affect the number of command pulses required for the motor to complete one full rotation.

### 5.8.1.2 Near Positioning Signal (/NEAR)

The servo motor detects signals near the positioning completion signal, enabling the device to prepare for the next action in advance.

- relevant parameter

| parameter | meaning                      | factory setting | unit             | Set range | revise      | come into force |
|-----------|------------------------------|-----------------|------------------|-----------|-------------|-----------------|
| P5-06     | Approach signal output width | 655             | instruction unit | 0 ~ 65535 | at any time | immediately     |

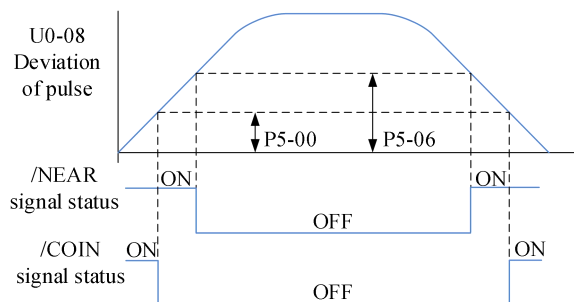
| parameter | Signal name | factory setting | Applicable mode | meaning         | revise      | come into force |
|-----------|-------------|-----------------|-----------------|-----------------|-------------|-----------------|
| P5-46     | /NEAR       | n.0000          | 5/6             | Close proximity | at any time | immediately     |

For details of hardware wiring, refer to Chapter 3.3.2.

To locate the SO2 output signal, set P5-46 to n.0002/0012.

#### 1) The positioning is close to the signal output condition.

When the pulse deviation U0-08 of the servo driver falls below the P5-06 set value, it outputs a proximity signal (/NEAR).



#### 2) Description of the signal output approach

(1) The signal output width P5-06 varies proportionally with the electronic gear ratio, with a factory default of 655 command units.

The width of the signal output P5-06 is proportional to the number of command pulses required to complete one revolution of the motor.

The output of the positioning completion signal is determined by the width of the signal. The smaller the width, the later the output of the signal, but the signal output does not affect the actual running state of the motor.

(2) The approach signal output width can also be set independently, and its adjustment won't affect the number of command pulses required for the motor to complete one full rotation.

(3) Set this parameter to be wider than the completed positioning width.

### 5.8.1.3 Instruction Pulse Inhibition (/INHIBIT)

Position command is disabled, including internal and external position commands. The function of stopping pulse input during position control is disabled. When the /INHIBIT signal is ON, pulse commands are no longer counted.

- relevant parameter

| parameter                                                                                                                                                                                                                               | Signal name | factory setting | Applicable mode | meaning                       | revise      | come into force |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-----------------|-------------------------------|-------------|-----------------|
| P5-32                                                                                                                                                                                                                                   | /INHIBIT    | n.0000          | 5/6             | instruction pulse prohibition | at any time | immediately     |
| The parameter range is n.0000-001A, which is assigned to other input terminals via parameter P5-32. To disable the signal command pulse input from SI2, set P5-32 to n.0002/0012. For detailed hardware wiring, refer to Chapter 3.3.1. |             |                 |                 |                               |             |                 |

#### 1) INHIBIT terminal validity description

| Parameter settings status | Signal/INHIBIT terminal input status    | signal/inhibit terminal logic |
|---------------------------|-----------------------------------------|-------------------------------|
| P5-32=n.0000              | No external terminal input is required. | of no avail                   |
| P5-32=n.000□              | No signal input at the SI□ terminal     |                               |
| P5-32=n.001□              | The SI□ terminal has a signal input.    |                               |
| P5-32=n.0010              | No external input terminals required    | valid                         |
| P5-32=n.000□              | The SI□ terminal has a signal input.    |                               |
| P5-32=n.001□              | No signal input at the SI□ terminal     |                               |

#### 2) Effect of INHIBIT terminal signal on motor operating status

| control model | Motor operating status           |                                       |
|---------------|----------------------------------|---------------------------------------|
|               | /INHIBIT terminal logic is valid | The INHIBIT terminal logic is invalid |

|                                   |                                     |                                                                                                                                                    |
|-----------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 5-Internal Position Control       | Pause the current section           | The INHIBIT signal is ON → OFF. Continue running from the pause point.                                                                             |
| 6-External position pulse control | suspend pulse instruction reception | The INHIBIT signal transitions from ON to OFF. When the signal returns to OFF, the system resumes operation based on the subsequent pulse command. |

#### 5.8.1.4 Error Correction (/CLR)

Position deviation = (position command-position feedback) (encoder unit)

The position deviation clearance function allows the drive to reset its position deviation to zero when the servo is turned off or a /CLR signal is received.

- relevant parameter

| parameter                                                                                                                                                                                                              | Signal name | factory setting | Applicable mode | meaning                     | revise      | come into force |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-----------------|-----------------------------|-------------|-----------------|
| P5-34                                                                                                                                                                                                                  | /CLR        | n.0000          | own             | pulse deviation elimination | at any time | immediately     |
| The parameter range is n.0000-001A, which is assigned to other input terminals via parameter P5-34. To clear signal deviation from SI2, set P5-34 to n.0002/0012. For hardware wiring details, refer to Chapter 3.3.1. |             |                 |                 |                             |             |                 |

##### 1) /CLR signal validity

| Parameter settings status | Signal/CLR terminal input status        | signal/CLR terminal logic |
|---------------------------|-----------------------------------------|---------------------------|
| P5-34=n.0000              | No external terminal input is required. | of no avail               |
| P5-34=n.000□              | No signal input at the SI□ terminal     |                           |
| P5-34=n.001□              | The SI□ terminal has a signal input.    |                           |
| P5-34=n.0010              | No external input terminals required    | valid                     |
| P5-34=n.000□              | The SI□ terminal has a signal input.    |                           |
| P5-34=n.001□              | No signal input at the SI□ terminal     |                           |

##### 2) /CLR signal description

When a pulse is sent to the servo, the execution/CLR input signal activates. The servo then latches the current pulse count, updates the encoder's position to the control feedback, and clears all intermediate values in the position loop, speed loop, and current loop.

The /CLR signal uses edge triggering.

### 3) Other notes on the pulse position deviation clearing signal

The pulse position deviation can be cleared by setting F0-02 to 1.

#### 5.8.1.5 Position Pulse Deviation Setting

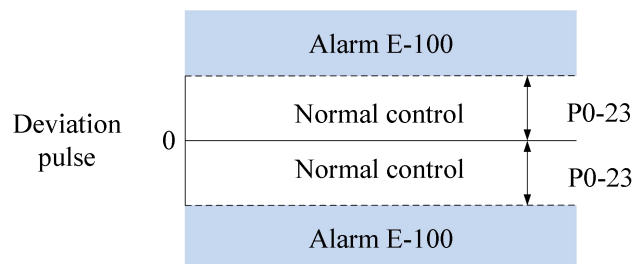
The pulse deviation value refers to the difference between the command pulse of the instruction controller (such as PLC) and the servo unit feedback pulse in the position mode. Its unit is 1 command unit, which is related to the command unit determined by the electronic gear ratio.

When the position control is in operation, the alarm will be triggered if the deviation pulse exceeds a certain threshold, which is called the deviation pulse limit.

- relevant parameter

| parameter | meaning               | factory setting | unit      | Set range | revise      | come into force |
|-----------|-----------------------|-----------------|-----------|-----------|-------------|-----------------|
| P0-23     | pulse deviation limit | 2000            | 0.01 turn | 0 ~ 65535 | at any time | immediately     |

When the deviation pulse limit is 0, the system will not detect the pulse magnitude.

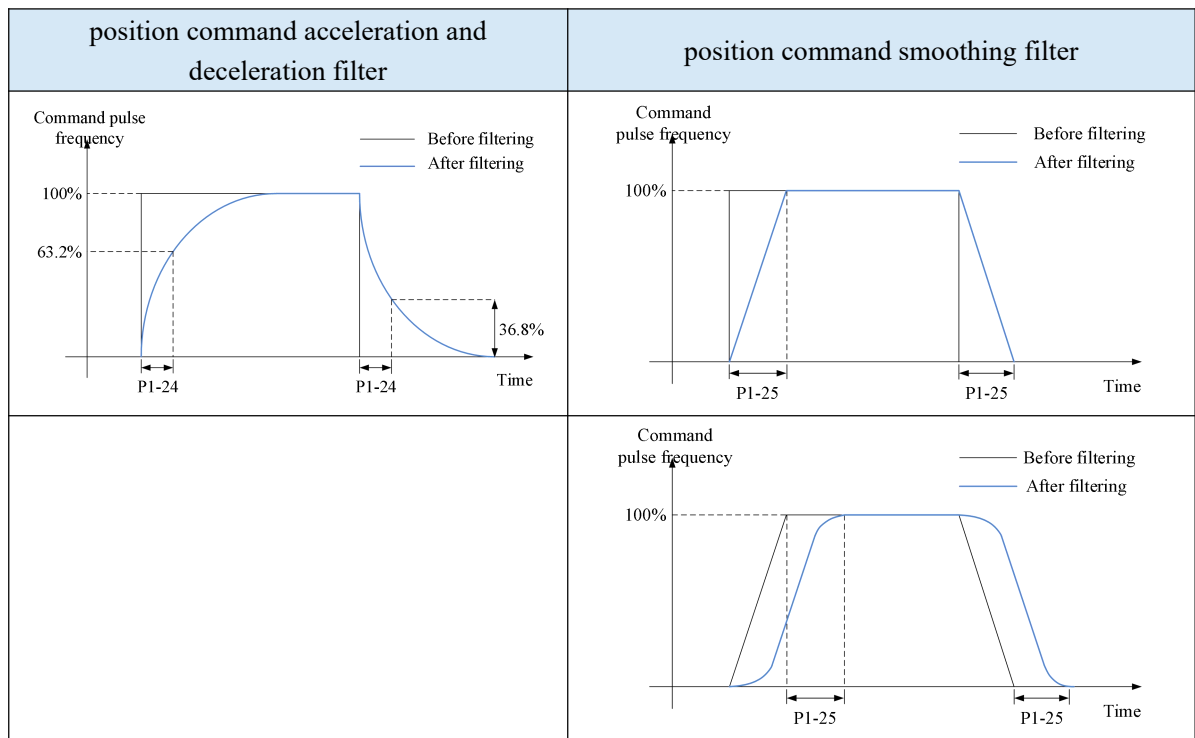


#### 5.8.1.6 Position command filter

- relevant parameter

| parameter | meaning                                                    | factory setting | unit  | Set range | revise      | come into force     |
|-----------|------------------------------------------------------------|-----------------|-------|-----------|-------------|---------------------|
| P1-24     | Position command acceleration and deceleration filter time | 0               | 0.1ms | 0 ~ 65535 | immediately | Servo not activated |
| P1-25     | position command smoothing filter time                     | 0               | 0.1ms | 0 ~ 65535 | immediately | Servo not activated |

|                                                       |                                   |
|-------------------------------------------------------|-----------------------------------|
| position command acceleration and deceleration filter | position command smoothing filter |
|-------------------------------------------------------|-----------------------------------|



### 5.8.1.7 Reference Origin

#### 1) Find the reference origin

This feature determines the physical zero point of the workbench to serve as the coordinate zero point for point control. Users can select either the forward rotation side or the reverse rotation side as the reference origin.

#### 2) Function Settings

| parameter       | meaning         | factory setting | unit | Set range | revise    | come into force |
|-----------------|-----------------|-----------------|------|-----------|-----------|-----------------|
| P4-00<br>n.xx(x | Origin function | 0               | -    | 0 ~ 1     | servo OFF | immediately     |

Note: This feature is available for Location Modes 5 and 6. When this parameter is set to 0, the origin-finding function is disabled. The origin-finding function is only available when set to n.001x. (Set P9-21=0)

#### 3) Signal Settings

| parameter | Signal name | factory setting | meaning                                                                             | revise                                                                                                                      |
|-----------|-------------|-----------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| P5-28     | /SPD-A      | n.0000          | Mode 3: Internal speed selection signal<br>Mode 5: Find origin in forward direction | The parameter range is 0000-0014, assigned to the input interface via parameters P5-28. Setting it to 0001 indicates signal |

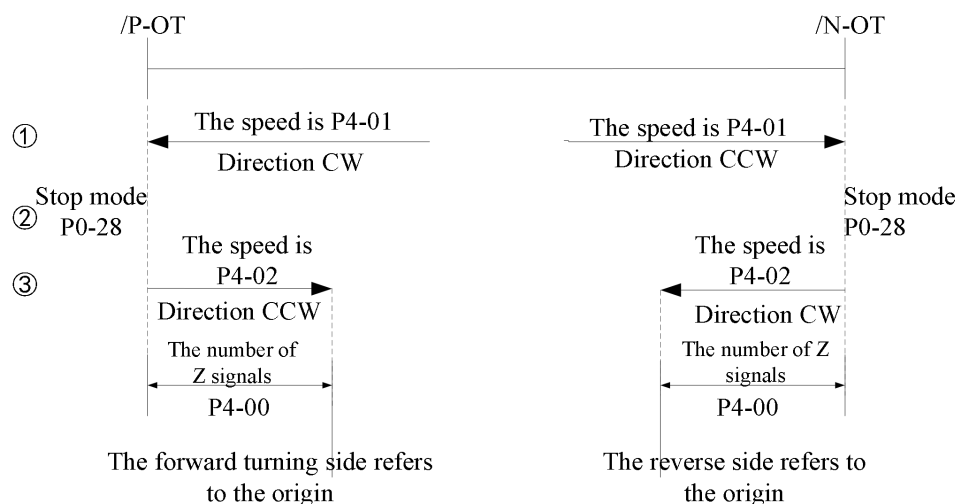
| parameter | Signal name | factory setting | meaning                                                                                 | revise                                                                                                                                                   |
|-----------|-------------|-----------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |                 |                                                                                         | input from the SI1 terminal.                                                                                                                             |
| P5-29     | /SPD-B      | n.0000          | Mode 3: Internal speed selection signal<br>Mode 5: Reverse direction to find the origin | The parameter range is 0000-0014, assigned to the input interface via parameters P5-29. Setting it to 0001 indicates signal input from the SI1 terminal. |

#### 4) Related parameter settings

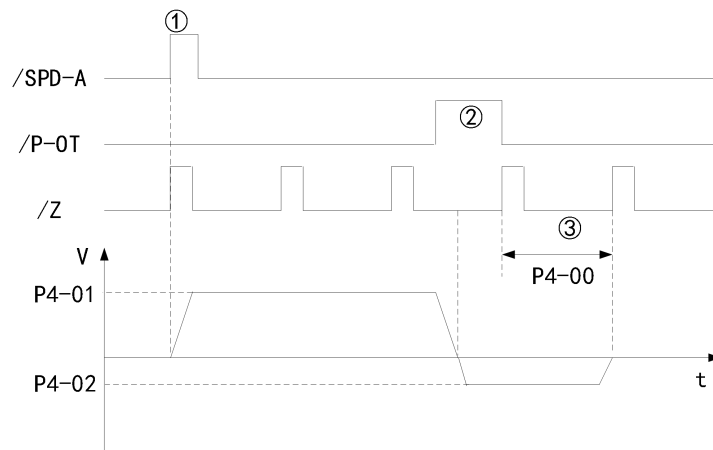
| parameter       | meaning                                   | factory setting | unit       | Set range | revise    | come into force |
|-----------------|-------------------------------------------|-----------------|------------|-----------|-----------|-----------------|
| P4-00<br>n.xxx□ | Z Sign Count                              | 2               | individual | 0 ~ f     | servo OFF | immediately     |
| P4-01           | Collision proximity switch speed          | 600             | rpm        | 0 ~ 65535 | servo OFF | immediately     |
| P4-02           | Speed of approaching the proximity switch | 100             | rpm        | 0 ~ 65535 | servo OFF | immediately     |

Note: The origin-seeking function is only available for single-turn absolute motors (multi-turn absolute motors can also support this function if P0-79=1).

#### 5) Find the reference origin schematic diagram



The sequence for aligning the reference origin of forward and reverse rotation is shown below:



The steps are as follows:

- (1) Install limit switches on the forward and reverse rotation sides. When the /SPD-A signal rises, the motor rotates in the forward direction at the speed set by parameter P4-01 to locate the reference origin on the forward side.
- (2) When the workbench triggers the limit switch, the motor stops according to the P-OT and N-OT settings specified in parameter P0-28.
- (3) Rotate the motor in the direction opposite to the limit switch at the speed set by parameter P4-02. When the motor reaches the n-th position of the photoelectric encoder Z, this position is designated as the coordinate zero point, where n is determined by parameter P4-00.

### 5.8.1.8 New Return to Origin Function

#### 1) Function Description

The return-to-origin function refers to the process where, in position control mode with the servo motor enabled, the system initiates this function. The servo motor then locates the origin to complete positioning, which serves as the reference point for subsequent position control.

During the return-to-origin operation, all other position commands (including the re-triggered return-to-origin signal) are disabled. Once the return-to-origin is completed, the servo driver can respond to other position commands.

After the return to origin is completed, the servo driver outputs a completion signal. Upon receiving this signal, the host computer confirms that the return to origin has been successfully completed.

#### 2) Parameter Settings

| parameter | name | Set range | meaning | Set time | entry-into-force time | 出厂默认 |
|-----------|------|-----------|---------|----------|-----------------------|------|
|-----------|------|-----------|---------|----------|-----------------------|------|



| parameter | name                                                  | Set range | meaning                                                                                                                                                                              | Set time  | entry-into-force time | 出厂默认 |
|-----------|-------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------------|------|
| P9-11.0   | Z phase count                                         | 0~F       | P9-11.0=0: Do not find Z phase<br>P9-11.0=1: Find a Z phase<br>P9-11.0=2: Find 2 Z phases and so on                                                                                  | servo OFF | servo ON              | 0    |
| P9-11.1   | trigger at origin                                     | 0~2       | P9-11.1=0: Do not trigger back to origin<br>P9-11.1=1: Trigger back to origin through SI terminal (P5-28)<br>P9-11.1=2: After the first enable, the system starts back to the origin | servo OFF | servo ON              | 0    |
| P9-11.2   | return to origin mode                                 | 0~7       | P9-11.2=0: Return to origin mode 0<br>P9-11.2=1: Return to Origin Mode 1<br>P9-11.2=2: Return to Origin Mode 2 and so on                                                             | servo OFF | servo ON              | 0    |
| P9-11.3   | deceleration mode when over travel signal is detected | 0、1       | P9-11.3=0: Slow down according to the acceleration and deceleration time set by P9-14<br>P9-11.3=1: Slow down immediately                                                            | servo OFF | servo ON              | 0    |



P9-11.0 can set up to 15 Z phases. P9-11.1=0 is equivalent to the return to origin function cannot be used, this parameter can be understood as the enable bit of the return to origin function. Return to origin mode 1, 3, 5, 7 are the opposite of return to origin mode 0, 2, 4, 6.

| parameter | name | Set range | unit | meaning | setting time | come into force time | leave the factory give tacit consent to |
|-----------|------|-----------|------|---------|--------------|----------------------|-----------------------------------------|
|-----------|------|-----------|------|---------|--------------|----------------------|-----------------------------------------|

| parameter | name                                                      | Set range  | unit | meaning                                                                                                                                                                                                                | setting time | come into force time | leave the factory give tacit consent to |
|-----------|-----------------------------------------------------------|------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|-----------------------------------------|
| P9-12     | return to the origin high speed velocity                  | 0~3000     | rpm  | Return to the origin speed, find the deceleration point, and execute the mechanical offset.                                                                                                                            | servo OFF    | servo ON             | 200                                     |
| P9-13     | Return to the origin at low speed.                        | 0~1000     | rpm  | Set the speed to a low value to find the origin. The low speed should be low enough to avoid mechanical impact when stopping.                                                                                          | servo OFF    | servo ON             | 20                                      |
| P9-14     | acceleration and deceleration time to return to origin    | 0~1000     | ms   | The acceleration and deceleration time here refers to the duration required to reach 1000rpm from 0.                                                                                                                   | servo OFF    | servo ON             | 1000                                    |
| P9-15     | Maximum time allowed to return to the origin              | 0~12000    | 10ms | The system will trigger an alarm if the total time for returning to the origin exceeds the parameter's set time limit. When P9-15 equals zero, the alarm will be triggered for the timeout of returning to the origin. | servo OFF    | servo ON             | 0                                       |
| P9-16     | threshold of stopping and returning to the original speed | 0~1000     | rpm  | This parameter applies only to return-to-origin modes 6 and 7                                                                                                                                                          | servo OFF    | servo ON             | 2                                       |
| P9-17     | threshold of stopping torque                              | 0~300%     | %    | This parameter applies only to return-to-origin modes 6 and 7<br>The base value of the percentage is the rated torque.                                                                                                 | servo OFF    | servo ON             | 100 %                                   |
| P9-18     | touch stop time threshold                                 | 10~1500    | ms   | This parameter applies only to return-to-origin modes 6 and 7                                                                                                                                                          | servo OFF    | servo ON             | 500                                     |
| P9-19     | Quantitative pulse count in the lower bit                 | -9999~9999 | -    | Quantitative pulse count in the lower bit                                                                                                                                                                              | servo OFF    | servo ON             | 0                                       |

| parameter | name                                          | Set range  | unit | meaning                                                                                                                                                                                                                                                       | setting time | come into force time | leave the factory give tacit consent to |
|-----------|-----------------------------------------------|------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|-----------------------------------------|
| P9-20     | Quantitative pulse count high bit             | -9999~9999 | -    | Quantitative pulse count high bit                                                                                                                                                                                                                             | servo OFF    | servo ON             | 0                                       |
| P9-21     | Select the new or old original point function | 0、1        | -    | P9-21=0: Return to origin function<br>P9-21=1: Reset to origin                                                                                                                                                                                                | servo OFF    | again power on       | 0                                       |
| P9-22     | New origin end filter time                    | 50~10000   | ms   | This filtering time is required when returning to the origin is about to end, and the return-to-origin mode will not be fully exited until the motor has completely stopped. The return-to-origin completion signal will be output after this filtering time. | servo OFF    | servo ON             | 500                                     |



The actual mechanical offset is calculated as  $P9-19 + P9-20 \times 10000$ , where P9-19 and P9-20 must share the same sign (either both positive or both negative). This offset represents the absolute position of the servo after returning to the origin.

| parameter | name                           | setting scope | meaning                                       | setting time | come into force time        | leave the factory give tacit consent to |
|-----------|--------------------------------|---------------|-----------------------------------------------|--------------|-----------------------------|-----------------------------------------|
| P5-22     | positive overtravel signal POT | 0~ffff        | Forward limit signal in return-to-origin mode | move setting | immediately come into force | 1                                       |
| P5-23     | Reverse overtravel signal NOT  | 0~ffff        | Reverse Limiting Signal in Origin Return Mode | move setting | immediately come into force | 2                                       |

| parameter | name                                     | setting scope | meaning                                                                                                                                                                                                                                                                     | setting time | come into force time        | leave the factory give tacit consent to |
|-----------|------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------|-----------------------------------------|
| P5-54     | return to origin complete signal         | 0~ffff        | The return-to-origin completion signal is output when the return-to-origin action and state are fully completed. Even if another mode is executed after the return-to-origin, the signal does not disappear. When the return-to-origin is restarted, the signal disappears. | move setting | immediately come into force | 0                                       |
| P5-64     | Origin switch signal                     | 0~ffff        | The process of returning to the origin requires a switch signal at the origin.                                                                                                                                                                                              | move setting | immediately come into force | 0                                       |
| P5-28     | SI terminal starts forward to the origin | 0~ffff        | When P9-11.1=1, after the P5-28 assigns the SI terminal, the terminal can be used to trigger the positive return to the origin                                                                                                                                              | move setting | immediately come into force | 0                                       |

### 3) Selecting the new origin mode

To use the reset function, first set P9-21 to 1, then configure the overtravel switch (POT/NOT) and origin switch. If using mechanical offsets (with P9-19 and P9-20 set), adjust the offset within the travel range to prevent mechanical damage during origin reset.

The Z-axis phase count (P9-11.0) and mechanical offset (P9-19, P9-20) can operate simultaneously. If both are non-zero, the servo first detects the Z-axis phase (P9-11.0) before executing the mechanical offset (P9-19, P9-20). If the Z-axis phase (P9-11.0) is zero but the mechanical offsets (P9-19, P9-20) are non-zero, the servo executes the mechanical offsets (P9-19, P9-20) without detecting the Z-axis phase. If the Z-axis phase count is non-zero but the mechanical offsets are zero, the servo detects the Z-axis phase (P9-11.0) but does not execute the mechanical offsets.

There are 8 total return-to-origin patterns, as follows:

- (1) Positive return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=0)
- (2) Reverse return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=1)
- (3) Positive return to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=2)
- (4) Reverse return to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=3)
- (5) Positive return to zero, the deceleration point is the positive overtravel switch, the origin is the positive overtravel switch or the motor Z signal (P9-11.2=4)
- (6) Reverse return to zero, the deceleration point is the reverse overtravel switch, the origin is the reverse overtravel switch or the motor Z signal (P9-11.2=5)
- (7) Positive return to zero, the deceleration point is the mechanical limit position, the origin is the

mechanical limit position or the motor Z signal (P9-11.2=6)

(8) Reverse return to zero, the deceleration point is the mechanical limit position, the origin is the mechanical limit position or the motor Z signal (P9-11.2=7)

The following provides a detailed analysis of each mode of returning to the origin.

(1) Return to origin mode 0-positive return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=0)

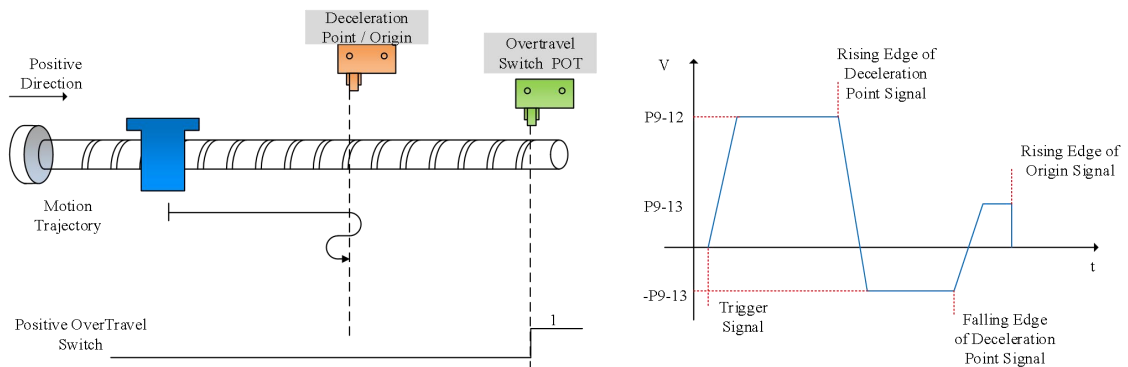
To use this mode, connect the POT, NOT, and origin switches.

1) When the motor starts, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64, 0=invalid, 1=valid), and the forward overtravel switch (POT, P5-22) remains inactive throughout the process.

The servo motor first initiates high-speed forward search for the deceleration point (origin) signal using the P9-12 (high-speed return-to-origin) setting. Upon detecting the rising edge of the deceleration point (origin) signal, it gradually decelerates to P9-13 (low-speed return-to-origin) according to the P9-14 (acceleration-deceleration time for origin return) setting. Subsequently, the servo motor reverses direction upon encountering the falling edge of the deceleration point (origin) signal at P9-13 (low-speed return-to-origin), then continues low-speed search for the deceleration point (origin) signal's rising edge using the P9-13 (low-speed return-to-origin) setting. The subsequent origin return operation involves four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed) signal. Upon detecting the signal rising edge of the deceleration point (origin), it immediately halts.

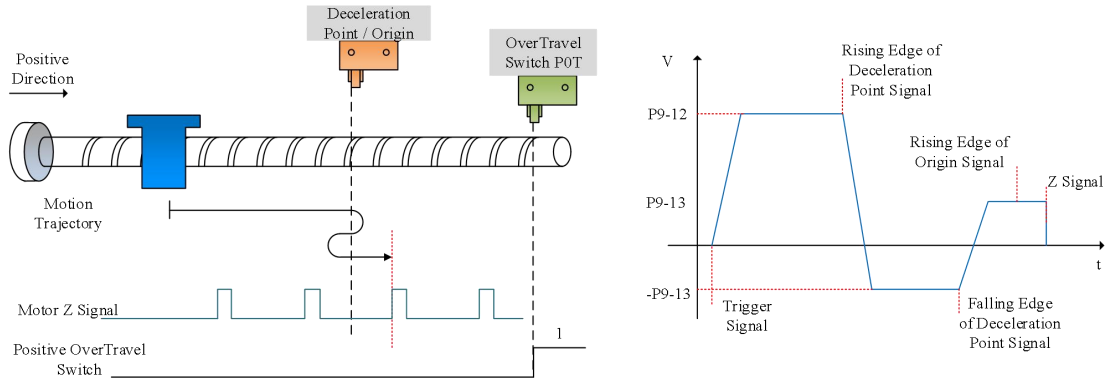


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) using P9-13 (returning to origin at low speed), the system immediately halts upon detecting the signal's rising edge. After the motor has fully stopped, it proceeds with a predetermined number of pulses and direction (positive or negative) based on the set mechanical offset. The motor then travels a fixed distance at the speed specified by P9-12 (returning to origin at high speed), followed by a complete shutdown.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed). Upon encountering the signal rising edge of the deceleration point (origin), it proceeds to locate the first Z signal and immediately stops.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

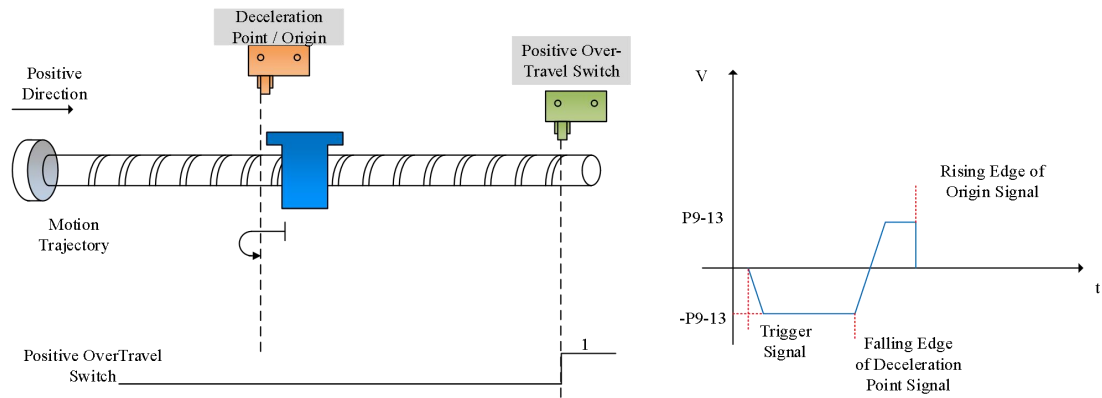
During the low-speed search for the deceleration point (origin) using P9-13 (return to origin at low speed), the system continues operation after detecting the signal's rising edge. Upon identifying the first Z-axis signal, it immediately stops. After the motor has fully ceased, the system then proceeds to execute a fixed pulse sequence (P9-19, P9-20) at the preset mechanical offset pulse count (P9-19, P9-20) and direction (positive or negative). Finally, the motor halts at the speed specified by P9-12 (return to origin at high speed).

2) When the motor starts, the origin switch (reduction point) signal is active (signal terminal assigned by P5-64, 0 = inactive, 1 = active), and the forward overtravel switch (P5-22) remains inactive throughout the process:

The servo motor initiates a low-speed reverse search for the deceleration point (origin) by triggering the P9-13 (origin-low-speed) set value. When the origin signal's falling edge is detected, it reverses direction (to forward) and resumes the low-speed search for the deceleration point (origin) by activating the P9-13 (origin-low-speed) signal. The subsequent return-to-origin operation is categorized into four scenarios:

- ① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During forward acceleration or uniform speed running, the machine will stop immediately when the signal of deceleration point (origin) rises.

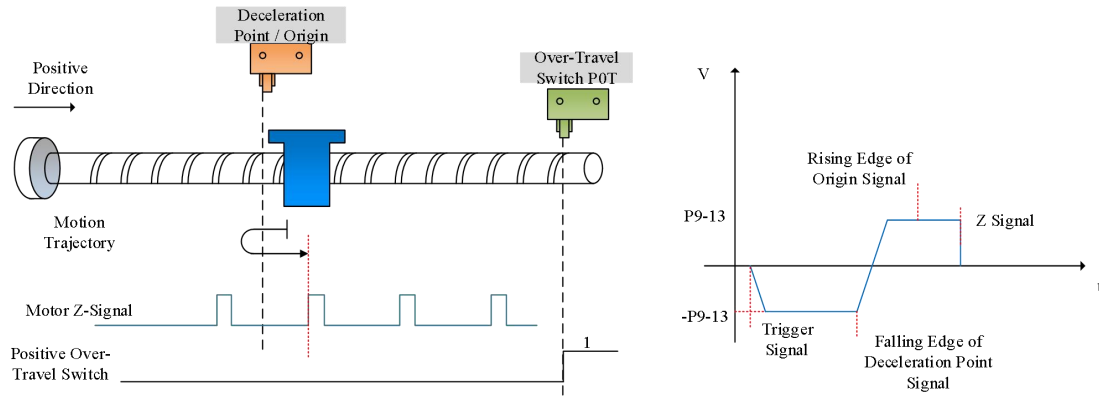


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During forward acceleration or uniform speed operation, the system halts immediately upon encountering the rising edge of the origin signal. After complete motor stoppage, the motor advances a fixed pulse distance (P9-12) at preset speed (high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During forward acceleration or uniform speed running, the machine will continue running after encountering the rising edge of the origin signal, and then stop immediately after finding the first Z signal.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

During forward acceleration or constant-speed operation, the motor resumes movement after encountering the rising edge of the origin signal. Upon detecting the first Z-axis signal, it immediately stops. After complete motor shutdown, the system then drives the motor at the preset high-speed speed (P9-12) for a fixed pulse duration (P9-19, P9-20) based on the mechanical offset pulse count (P9-19, P9-20) and direction (positive/negative). The motor then stops after completing this phase.

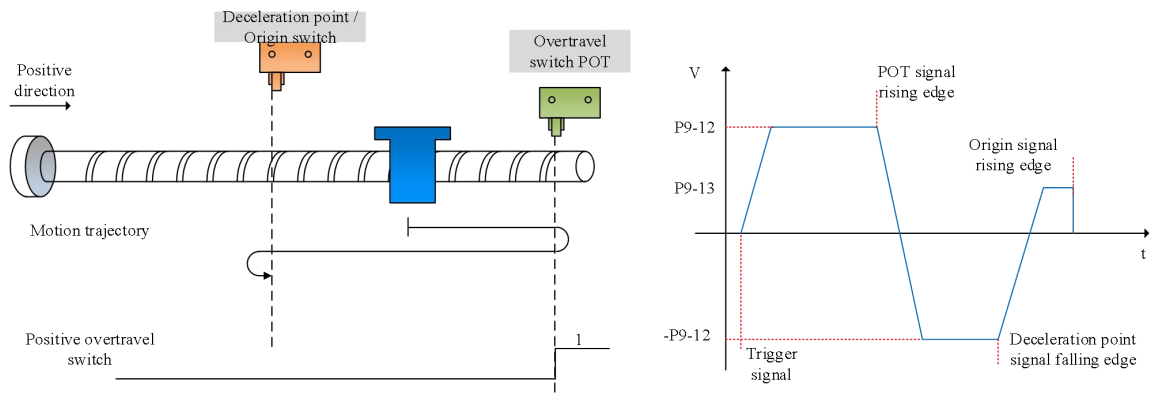
3) When the motor starts, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64, 0 = invalid, 1 = valid). During operation, the forward overtravel switch (P5-22) becomes active.

The servo motor first performs a high-speed forward search for the deceleration point signal using the P9-12 (high-speed return-to-origin) setting. Upon detecting the forward overtravel switch (POT) (P5-22), the driver immediately initiates a high-speed reverse search for the deceleration point (origin) signal's falling edge, based on the P9-14 (acceleration/deceleration time to origin) setting. After identifying the deceleration point (origin) signal's falling edge, the motor decelerates and reverses direction (i.e., returns to forward motion) according to the P9-14 (acceleration/deceleration time to origin) setting. The servo motor then performs a low-speed forward search for the deceleration point (origin) signal's rising edge using the P9-13 (low-speed return-to-origin) setting. The subsequent return-to-origin operation involves four scenarios:

- ① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the forward acceleration or forward uniform speed running, the machine will stop immediately when the signal rising edge of the origin is encountered.



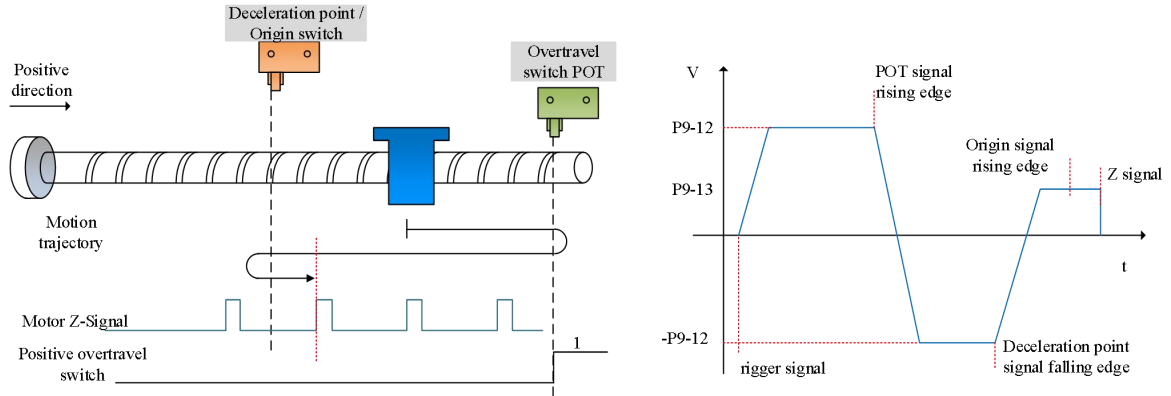


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During forward acceleration or constant-speed operation, the system halts immediately upon detecting the rising edge of the deceleration signal (origin point). After complete motor shutdown, the motor advances a fixed pulse distance (P9-19/P9-20) at preset speed (P9-12, high-speed return to origin) according to the specified mechanical offset pulse count and direction (positive/negative), then stops.

The number of Z phases  $P9-11.0=1$  and the mechanical offset ( $P9-19, P9-20$ ) is 0:

During forward acceleration or uniform speed operation, the system will continue running after encountering the rising edge of the deceleration point (origin) signal, and immediately stop upon detecting the first Z signal.



④ The Z-phase count ( $P9-11.0$ ) equals 1, and the mechanical offsets ( $P9-19$  and  $P9-20$ ) are non-zero:

During forward acceleration or constant-speed operation, the system resumes movement after detecting the rising edge of the deceleration signal (origin point). Upon identifying the first Z-axis signal, it immediately halts. After complete motor shutdown, the system then advances the motor at the preset  $P9-12$  speed (returning to origin at high speed) for a fixed pulse duration ( $P9-19/P9-20$ ), following the specified mechanical offset pulse count and direction (positive/negative). The motor then stops.

(2) Return to origin mode 1--reverse return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal ( $P9-11.2=1$ )

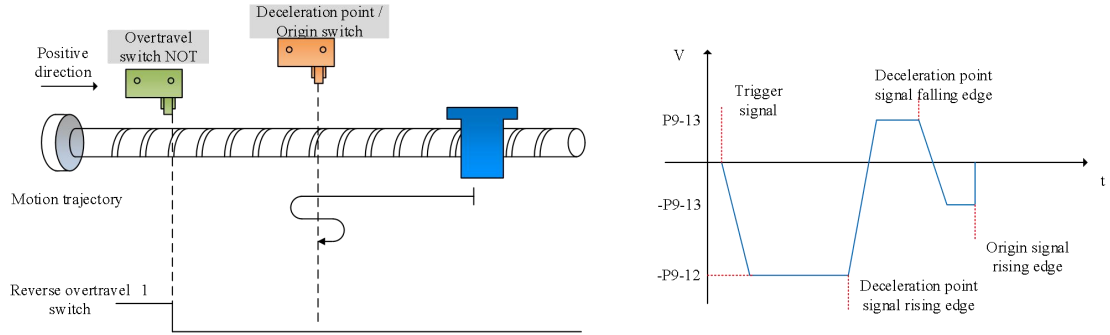
To use this mode, connect the POT, NOT, and origin switches.

1) When the motor starts, the origin switch (reduction point) signal is invalid, and the reverse overtravel switch (NOT) ( $P5-23$ ) remains inactive throughout the process.

The servo motor first performs high-speed reverse search for the deceleration point signal using the  $P9-12$  (high-speed return-to-origin) setting. It continues until encountering the rising edge of the deceleration point signal. Then, according to the  $P9-14$  (acceleration time for return-to-origin), it gradually accelerates to the  $P9-13$  (low-speed return-to-origin) setting. Subsequently, the servo motor searches forward for the deceleration point (origin) signal at the low-speed forward setting ( $P9-13$ ) by detecting the falling edge of the deceleration point (origin) signal. Upon encountering the falling edge, it reverses direction (restores reverse motion) and continues low-speed searching for the deceleration point (origin) signal by detecting the rising edge of the  $P9-13$  (low-speed return-to-origin) setting. The subsequent return-to-origin operation involves four scenarios:

① The Z-phase count ( $P9-11.0$ ) is zero, and the mechanical offset ( $P9-19, P9-20$ ) is zero:

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the  $P9-13$  (origin low-speed speed) signal. Upon detecting the signal rising edge of the deceleration point (origin), it immediately halts.

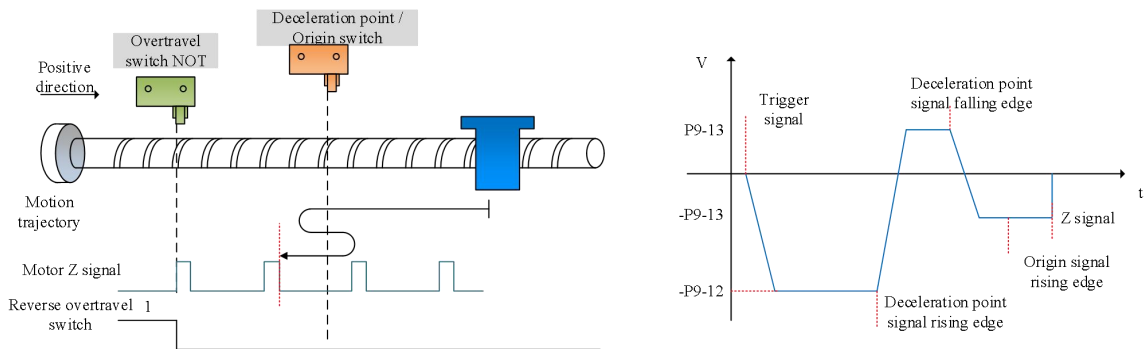


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) using P9-13 (return to origin at low speed), the system immediately halts upon detecting the signal's rising edge. After the motor has fully stopped, it executes a set number of pulses (P9-12, return to origin at high speed) according to the preset mechanical offset quantity and direction (positive or negative). The motor then proceeds at the P9-12 speed for a fixed pulse duration (P9-19, P9-20) before stopping completely.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed). Upon encountering the signal rising edge of the deceleration point (origin), it proceeds to locate the first Z signal and immediately stops.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

During the operation of the signal rising edge for low-speed search deceleration point (origin) using P9-13 (return to origin at low speed), the system continues running after detecting the deceleration point signal. Upon identifying the first Z-axis positive pulse, it immediately stops. After the motor has fully ceased, the system then executes a set number of pulses (P9-12) at the preset mechanical offset direction (positive or negative), followed by a fixed-distance pulse run (P9-19, P9-20) at the P9-12 (return to origin at high speed) speed before final motor shutdown.

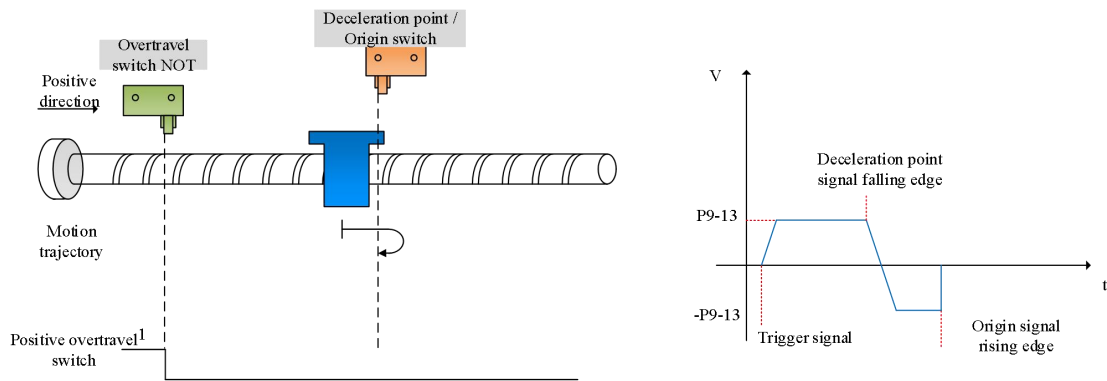
2) When the motor starts, the origin switch (reduction point) signal is active (signal terminal assigned by P5-64, 0 = inactive, 1 = active). Throughout the process, the reverse overtravel switch (NOT) (P5-23)

remains inactive.

The servo motor initiates a low-speed forward search for the deceleration point (origin) by triggering the signal's falling edge of P9-13 (return-to-origin low-speed speed). Upon detecting the deceleration point (origin) signal's falling edge, it reverses direction (i.e., negative) and continues the low-speed search for the deceleration point (origin) signal's rising edge using P9-13 (return-to-origin low-speed speed). The subsequent return-to-origin operation is categorized into four scenarios:

- ① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the negative acceleration or negative uniform speed running, the machine will stop immediately when the signal rising edge of the origin is encountered.

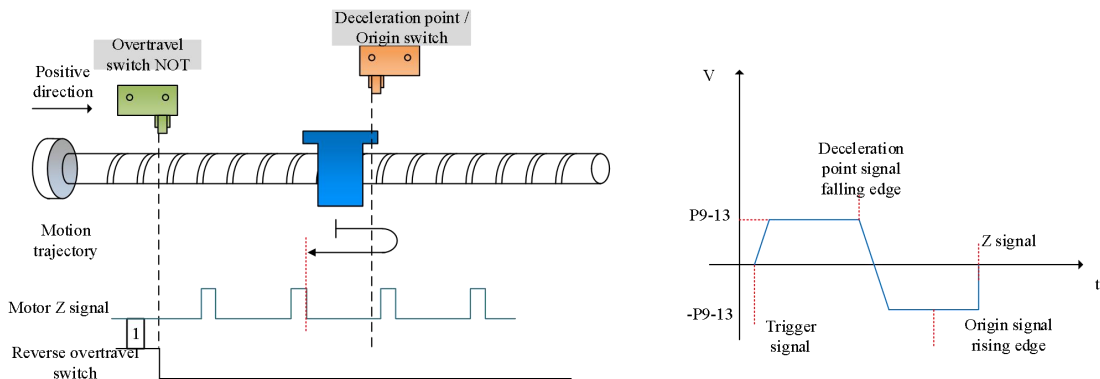


The number of Z phases  $P9-11.0=0$  and the mechanical offset (P9-19, P9-20) is not 0:

During negative acceleration or negative constant-speed operation, the system halts immediately upon encountering the rising edge of the origin signal. After complete motor stoppage, the motor advances a fixed pulse distance (P9-12) at the preset high-speed speed (P9-12) for a predetermined duration, based on the set mechanical offset pulse count and direction (positive or negative), before final shutdown.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the negative acceleration or negative uniform speed operation, the system will continue running after encountering the rising edge of the deceleration point (origin) signal, and immediately stop upon detecting the first Z signal.



The number of Z phases  $P9-11.0=1$  and the mechanical offset (P9-19, P9-20) is not 0:

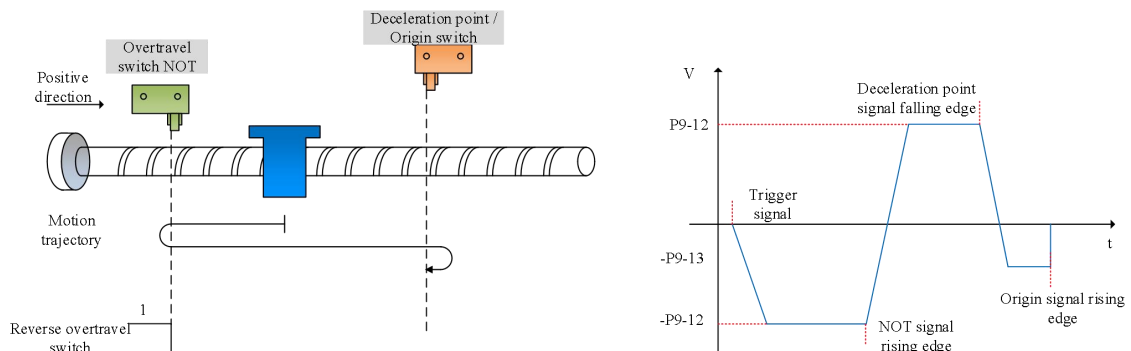
During negative acceleration or negative constant-speed operation, the system resumes movement after detecting the rising edge of the deceleration point (origin) signal. Upon identifying the first Z-axis signal, it immediately halts. After complete motor shutdown, the system then advances the motor at the preset P9-12 speed (returning to origin at high speed) for a fixed pulse duration (P9-19/P9-20), following the specified mechanical offset pulse count and direction (positive/negative). The motor then stops.

3) When the motor starts, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64, 0=invalid, 1=valid). During operation, the reverse overtravel switch (NOT) is triggered (P5-23).

The servo motor first initiates high-speed reverse search for the deceleration point (origin) signal using the-P9-12 (high-speed return-to-origin) setting. Upon detecting the reverse overtravel switch (NOT), the driver immediately decelerates in reverse (i.e., forward) according to the P9-14 (acceleration/deceleration time for return-to-origin) setting. It then rapidly searches for the deceleration point (origin) signal's falling edge with the-P9-12 (high-speed return-to-origin) setting. When the deceleration point (origin) signal's falling edge is detected, the motor decelerates in reverse (i.e., negative) following the P9-14 (acceleration/deceleration time for return-to-origin) setting. The servo motor subsequently searches for the deceleration point (origin) signal's rising edge with the-P9-13 (low-speed return-to-origin) setting. The subsequent return-to-origin operation involves four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the reverse acceleration or reverse constant speed running, the machine will stop immediately when the signal rising edge of the origin is encountered.

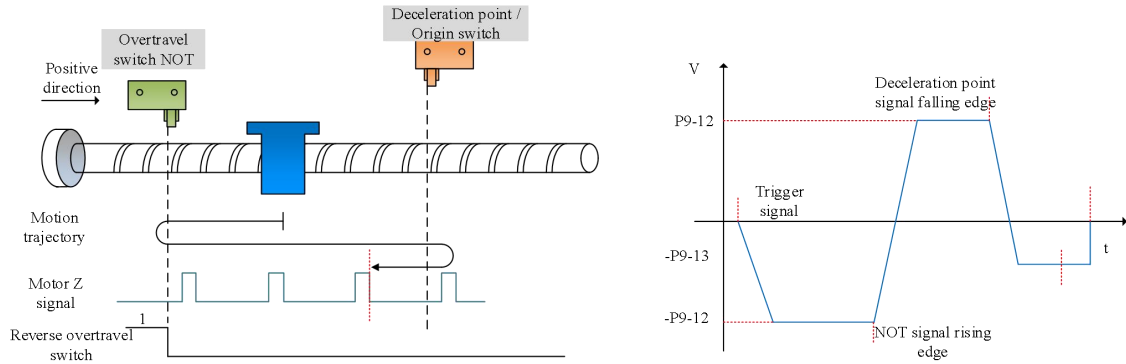


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During reverse acceleration or constant-speed operation, the system halts immediately upon detecting the rising edge of the deceleration signal (origin point). After complete motor shutdown, the motor advances a fixed pulse distance (P9-19/P9-20) at preset speed (P9-12, high-speed return to origin) according to the specified mechanical offset pulse count and direction (positive/negative), then stops.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the reverse acceleration or reverse constant speed operation, the machine will continue running after encountering the rising edge of the origin signal, and then stop immediately upon finding the first Z signal.



The number of Z phases  $P9-11.0=1$  and the mechanical offset ( $P9-19$ ,  $P9-20$ ) is not 0:

During reverse acceleration or constant-speed operation, the system resumes movement after detecting the rising edge of the deceleration signal (origin point). Upon identifying the first Z-axis signal, it immediately halts. After complete motor shutdown, the system then advances the motor at the preset  $P9-12$  speed (returning to origin at high speed) for a fixed pulse duration ( $P9-19/P9-20$ ), following the specified mechanical offset pulse count and direction (positive/negative). The motor then stops.

(3) Return to the origin mode 2-forward return to zero, the deceleration point and the origin are the motor Z signal ( $P9-11.2=2$ )

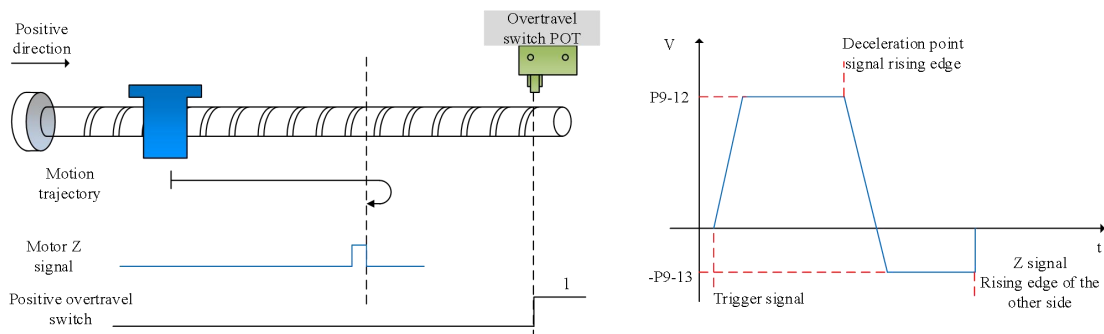
This mode does not count the number of motor Z phases. To use this mode, connect POT and NOT.

1) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by  $P5-64,0$ =invalid,  $1$ =valid), and the forward overtravel switch (POT) remains inactive throughout the process.

The servo motor first performs a high-speed forward search for the Z-axis signal using the  $P9-12$  (return-to-origin high-speed speed) setting. Upon detecting the rising edge of the Z-axis signal, it decelerates and reverses direction according to the  $P9-14$  (return-to-origin acceleration-deceleration time) setting, then accelerates to the  $P9-13$  (return-to-origin low-speed speed) before reversing to perform a low-speed search for the Z-axis signal. The subsequent return-to-origin operation is divided into two scenarios:

① The mechanical offset ( $P9-19$ ,  $P9-20$ ) is 0:

During reverse acceleration or reverse constant speed operation, the motor stops immediately upon encountering the rising edge of the Z signal on the opposite side.



② The mechanical offset (P9-19, P9-20) is not zero:

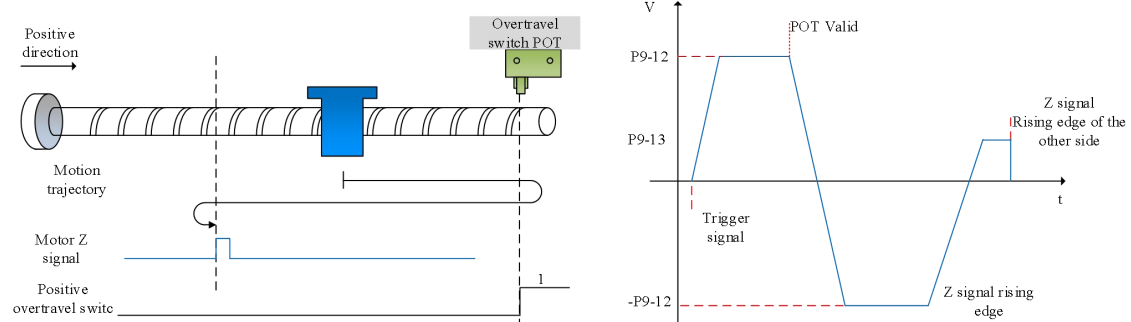
During reverse acceleration or constant-speed operation, the motor halts immediately upon detecting the rising edge of the Z-axis signal on the opposite side. After complete shutdown, the motor advances a fixed distance at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

2) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64, 0=invalid, 1=valid), triggering the forward overtravel switch (POT) (P5-22) during operation.

The servo motor first performs a high-speed forward search for the Z-axis signal using the P9-12 (return-to-origin high-speed speed) setting. Upon encountering the forward overtravel switch, the driver decelerates and reverses direction according to the P9-14 (return-to-origin acceleration/deceleration time) setting, then performs a high-speed reverse search for the Z-axis signal at P9-12 (return-to-origin high-speed speed). This process continues until the Z-axis signal's rising edge is detected, after which the motor gradually decelerates and reverses (i.e., returns to forward motion) based on the P9-14 (return-to-origin acceleration/deceleration time) setting. The servo motor then performs a low-speed forward search for the Z-axis signal on the opposite side of the rising edge using the P9-13 (return-to-origin low-speed speed) setting. The subsequent return-to-origin action involves two scenarios:

① The mechanical offset (P9-19, P9-20) is 0:

During forward acceleration or uniform speed operation, the machine stops immediately upon encountering the rising edge of the Z signal on the opposite side.



② The mechanical offset (P9-19, P9-20) is not zero:

During forward acceleration or constant-speed operation, the motor halts immediately upon encountering the rising edge of the Z-axis signal from the opposite side. After complete motor stoppage, the motor advances a fixed pulse distance at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

(4) Return to the origin mode 3--reverse back to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=3)

This mode does not count the number of motor Z phases. To use this mode, connect POT and NOT.

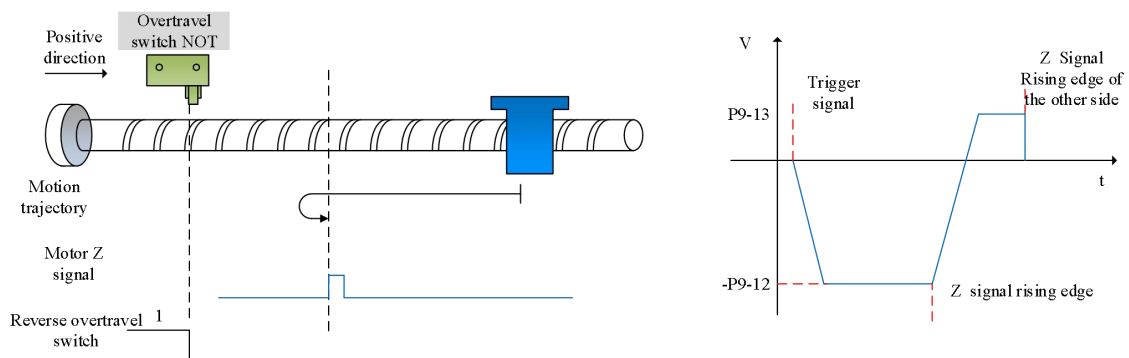
1) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64:0 =

invalid, 1 = valid), and the reverse overtravel switch (NOT) remains inactive throughout the process.

The servo motor first performs a high-speed reverse search for the Z-axis signal using the P9-12 (return-to-origin high-speed speed) setting. Upon detecting the rising edge of the Z-axis signal, it decelerates in reverse according to the P9-14 (return-to-origin acceleration-deceleration time) setting, then accelerates to the P9-13 (return-to-origin low-speed speed) setting for a forward low-speed search. The subsequent return-to-origin operation is divided into two scenarios:

① The mechanical offset (P9-19, P9-20) is 0:

During the forward acceleration or uniform speed running, the motor stops immediately when encountering the rising edge of the Z signal on the other side.



② The mechanical offset (P9-19, P9-20) is not zero:

During forward acceleration or constant-speed operation, the motor halts immediately upon encountering the rising edge of the Z-axis signal on the opposite side. After complete motor stoppage, the motor advances a fixed pulse distance (P9-19, P9-20) at the preset P9-12 speed (returning to the origin at high speed) based on the predefined mechanical offset pulse count and direction (positive or negative), then stops.

2) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64:0 = invalid, 1 = valid). During operation, the NOT switch is triggered.

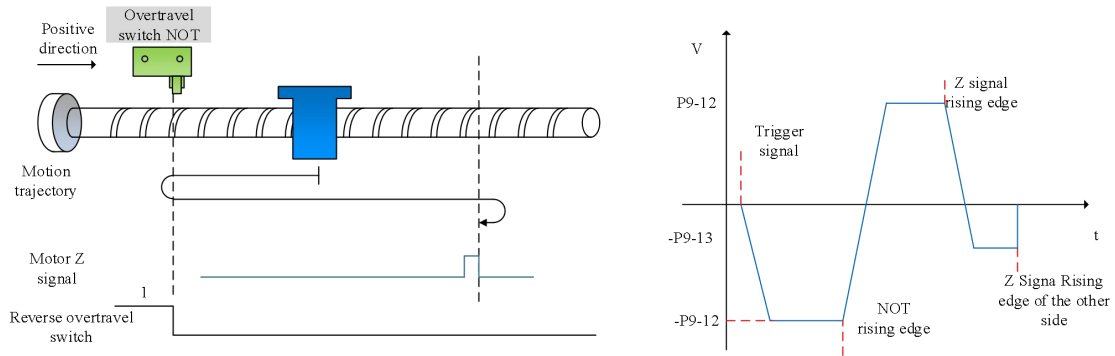
The servo motor first performs a high-speed reverse search for the Z-axis signal using the P9-12 (high-speed return-to-origin) setting. Upon encountering the reverse overtravel switch, the driver decelerates in reverse according to the P9-14 setting, then resumes high-speed forward search with P9-12 (high-speed return-to-origin) until detecting the Z-axis signal's rising edge. Following the P9-14 (return-to-origin acceleration/deceleration time) setting, it gradually decelerates and reverses (i.e., restores reverse motion). The servo motor then performs a low-speed reverse search for the Z-axis signal's opposite rising edge using P9-13 (low-speed return-to-origin). The subsequent return-to-origin



operation proceeds in two scenarios:

- ① The mechanical offset (P9-19, P9-20) is 0:

During reverse acceleration or constant speed operation, the machine stops immediately upon encountering the rising edge of the Z signal on the opposite side.



- ② The mechanical offset (P9-19, P9-20) is not zero:

During reverse acceleration or constant-speed operation, the motor halts immediately upon detecting the rising edge of the Z-axis signal on the opposite side. After complete shutdown, the motor advances a fixed distance at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

- (5) Return to the origin mode 4-forward return to zero, the deceleration point and the origin are the forward overtravel switch POT(P5-22)(P9-11.2=4)

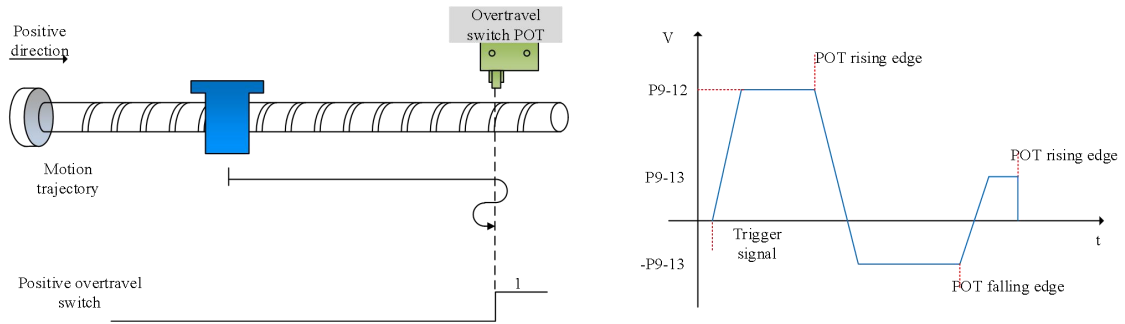
To use this mode, connect NOT and POT.

- 1) The forward overtravel potentiometer (POT) is invalid when the motor starts moving

The servo motor first performs a high-speed forward search for the forward overtravel switch using the P9-12 (high-speed return-to-origin) setting. Upon detecting the rising edge of the forward overtravel switch signal, it gradually decelerates and reverses direction according to the P9-14 (acceleration-deceleration time for return-to-origin). Then, with the low-speed reverse search for the forward overtravel switch signal initiated by the P9-13 (low-speed return-to-origin) setting, the motor detects the falling edge of the signal. The subsequent return-to-origin operation then proceeds through four distinct scenarios:

- ① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., return to forward motion), and use P9-13 (return to origin low-speed) to search for the rising edge of the forward overtravel switch signal at low speed. During forward acceleration or uniform speed operation, immediately stop the machine upon encountering the rising edge of the forward overtravel switch signal.

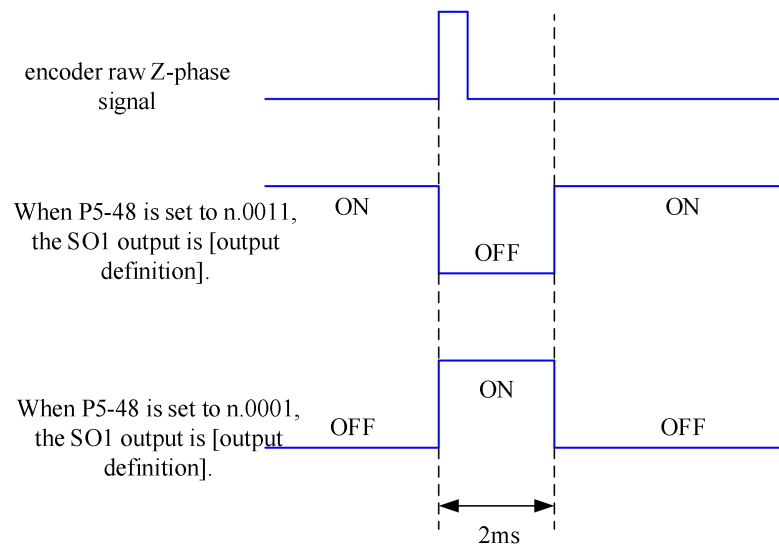


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

Reverse deceleration (i.e., return to forward motion) is initiated using P9-13 (return to origin low-speed speed) to detect the rising edge of the forward overtravel switch signal. During forward acceleration or constant-speed operation, the motor halts immediately upon detecting the signal's rising edge. After complete motor stoppage, the system executes a preset mechanical offset pulse count and direction (strictly negative, i.e., movement between origin switch and NOT) at the P9-12 (return to origin high-speed speed) setting. The motor then proceeds with a fixed pulse sequence before final shutdown.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed reverse operation set at P9-13 (returning to the origin at low speed), then stop immediately upon encountering the first rising edge of the Z signal.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

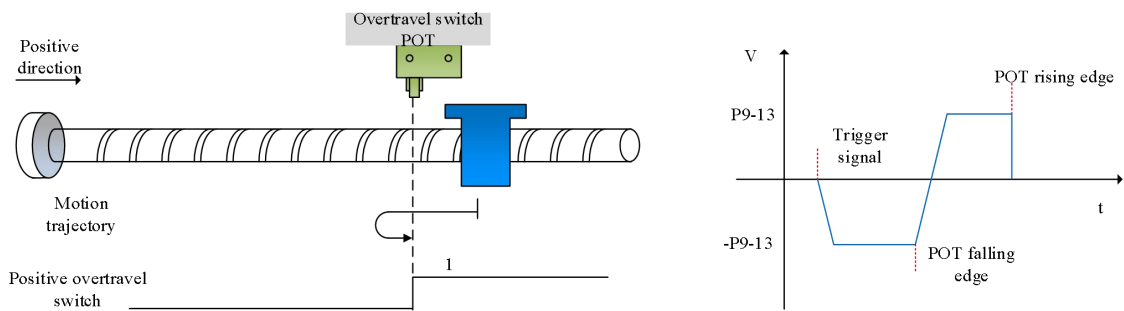
Continue the low-speed reverse operation set by P9-13 (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed number of pulses according to the preset mechanical offset quantity and direction (either negative or positive, but must move between the origin switch and NOT). The motor will then run at the speed set by P9-12 (returning to the origin at high speed) for a predetermined distance before stopping.

- 2) The forward overtravel switch (POT) (P5-22) activates when the motor starts moving

The servo motor reverses to a low speed state using the-P9-13 (return-to-origin low-speed) set value, detecting the falling edge of the forward overtravel switch signal (POT). Upon encountering this signal, the subsequent return-to-origin operation proceeds through four distinct scenarios:

- ① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., return to forward motion) is executed by using P9-13 (return to origin low-speed speed) to detect the rising edge of the POT signal. During forward acceleration or uniform speed operation, the system immediately stops upon detecting the POT rising edge.

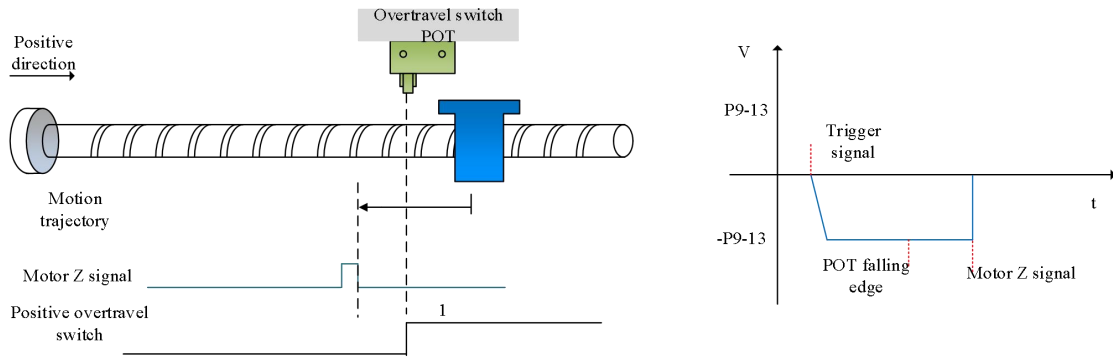


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

Reverse deceleration (i.e., return to forward motion) is executed using P9-13 (return to origin low-speed speed) to detect the rising edge of the POT signal. During forward acceleration or uniform speed operation, the motor halts immediately upon detecting the POT rising edge. After complete motor stoppage, the system then advances the motor at the preset speed (P9-12, return to origin high-speed speed) for a fixed pulse duration (P9-19, P9-20) based on the set mechanical offset pulse count and direction (only negative direction, i.e., movement between the origin switch and NOT). The motor then stops.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed reverse operation set at P9-13 (returning to the origin at low speed), then stop immediately upon encountering the first rising edge of the Z signal.



The number of Z phases  $P9-11.0=1$  and the mechanical offset ( $P9-19$ ,  $P9-20$ ) is not 0:

Continue the low-speed reverse operation at the  $P9-13$  setting (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed pulse sequence ( $P9-19$ ,  $P9-20$ ) at the preset mechanical offset pulse count and direction (either negative or positive, but must move between the origin switch and NOT) according to the  $P9-12$  setting (returning to the origin at high speed), followed by complete motor shutdown.

(6) Return to the origin mode 5-reverse return to zero, the deceleration point and the origin are the reverse overtravel switch NOT( $P5-23$ )( $P9-11.2=5$ )

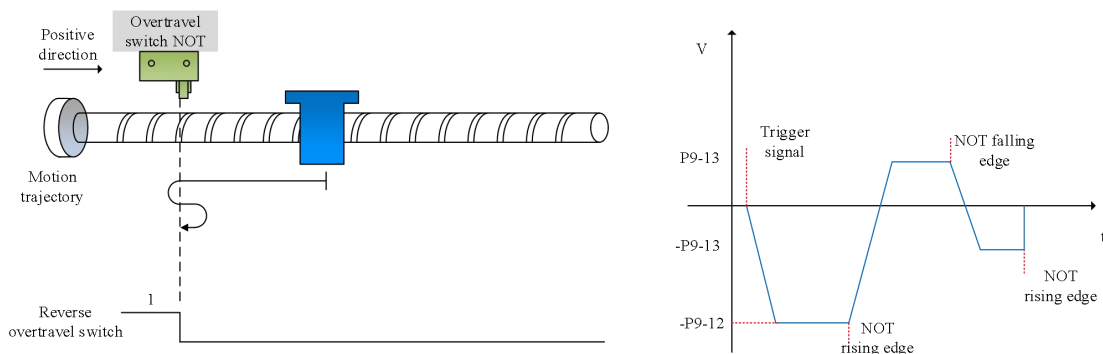
To use this mode, connect POT and NOT.

1) The reverse overtravel switch (NOT) is invalid when the motor starts moving

The servo motor first performs a high-speed reverse search for the NOT switch using the  $P9-12$  (high-speed return-to-origin) setting. Upon detecting the NOT signal's rising edge, it gradually decelerates in reverse according to the  $P9-14$  (acceleration-deceleration time for return-to-origin). Then, the servo motor searches for the NOT signal's falling edge with the low-speed forward movement set by  $P9-13$  (low-speed return-to-origin). After encountering the NOT signal's falling edge, the subsequent return-to-origin operation proceeds through four distinct scenarios:

① The Z-phase count ( $P9-11.0$ ) is zero, and the mechanical offset ( $P9-19$ ,  $P9-20$ ) is zero:

Reverse deceleration (i.e., reverse recovery), and use  $P9-13$  (return to origin low-speed) to perform a reverse low-speed search for the NOT rising edge. During reverse acceleration or reverse constant-speed operation, immediately stop the machine upon encountering the NOT rising edge.

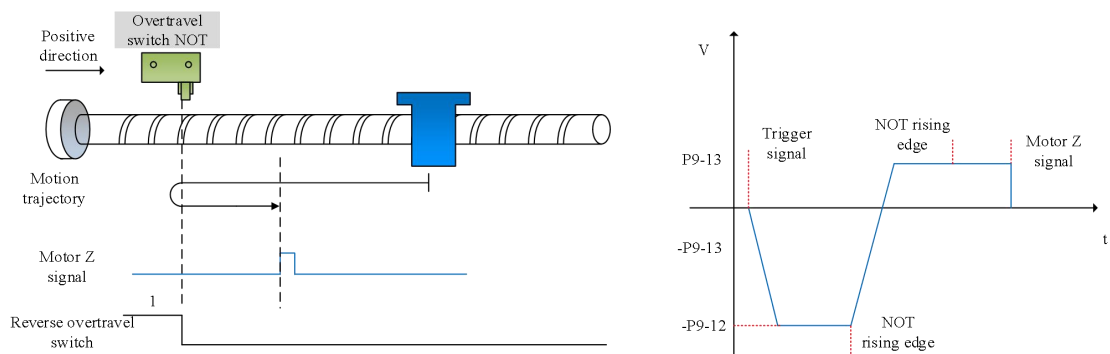


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

The system initiates reverse deceleration (i.e., reverse recovery) by executing the-P9-13 command (returning to the origin at low speed) to detect the NOT signal's rising edge during reverse low-speed operation. Upon detecting the NOT edge during reverse acceleration or constant-speed movement, the motor halts immediately. After complete shutdown, the motor advances a predetermined pulse sequence (P9-19 and P9-20) at the preset speed (P9-12, returning to the origin at high speed) based on the specified mechanical offset quantity and direction (strictly positive, i.e., movement between the origin switch and POT). The motor then stops.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed forward operation set by P9-13, then stop immediately upon encountering the first rising edge of the Z signal.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

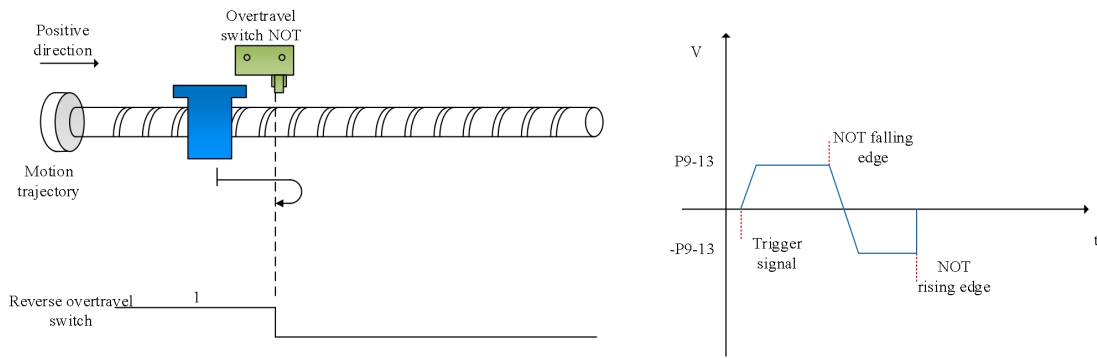
Continue the low-speed forward movement at the P9-13 setting (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed pulse sequence (P9-19, P9-20) at the P9-12 setting (returning to the origin at high speed), following the preset mechanical offset pulse count and direction (positive or negative, but must move between the origin switch and the potentiometer). The motor will then stop.

- 2) The NOT (P5-23) switch for reverse overtravel activation is effective when the motor starts.

The servo motor directly searches for the NOT signal's falling edge at the low-speed return-to-origin setting (P9-13). Upon detecting this NOT signal, the subsequent return-to-origin operation proceeds through four distinct scenarios:

- ① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., reverse recovery) involves using-P9-13 (returning to the origin at low speed) to perform a low-speed reverse search for the NOT rising edge. During reverse acceleration or uniform reverse operation, the system must immediately stop upon detecting the NOT rising edge.

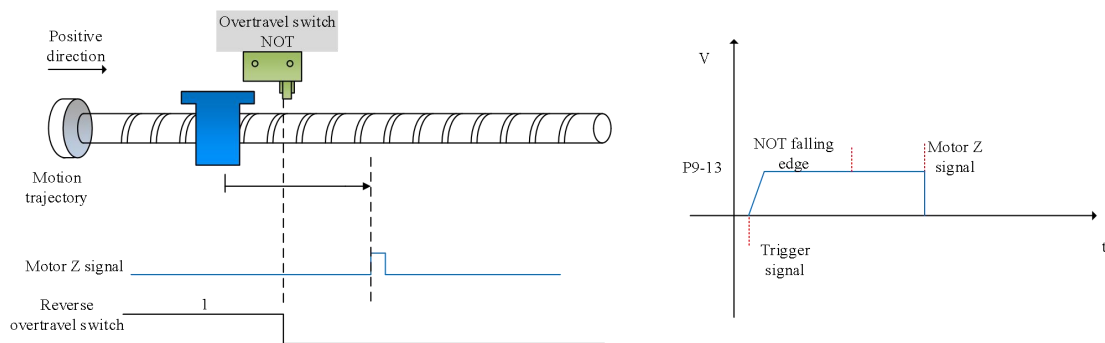


- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

Reverse deceleration (i.e., reverse recovery) involves using P9-13 (returning to the origin at low speed) to search for the NOT rising edge during reverse acceleration or uniform reverse motion. Upon detecting the NOT rising edge, the system immediately stops. After the motor has fully ceased, it proceeds with a predetermined number of pulses and direction (only forward, i.e., movement between the origin switch and POT) according to the set mechanical offset. The motor then travels a fixed distance at the speed set by P9-12 (returning to the origin at high speed) (P9-19, P9-20), after which it stops.

- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed forward movement set at P9-13 (returning to the origin at low speed), then stop immediately upon encountering the first rising edge of the Z signal.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

Continue the low-speed forward movement at the P9-13 setting (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed pulse sequence (P9-19, P9-20) at the P9-12 setting (returning to the origin at high speed), following the preset mechanical offset pulse count and direction (positive or negative, but must move between the origin switch and the potentiometer). The motor will then stop.

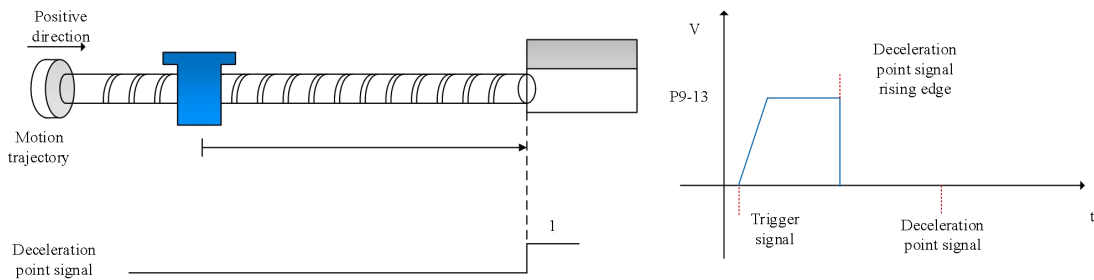
- (7) Return to the origin mode 6-forward return to zero, the deceleration point and the origin are the forward mechanical limit position (P9-11.2=6)

This mode eliminates the need for POT, NOT, or origin switches.

The servo motor initially operates at low speed in the forward direction with the P9-13 (low-speed

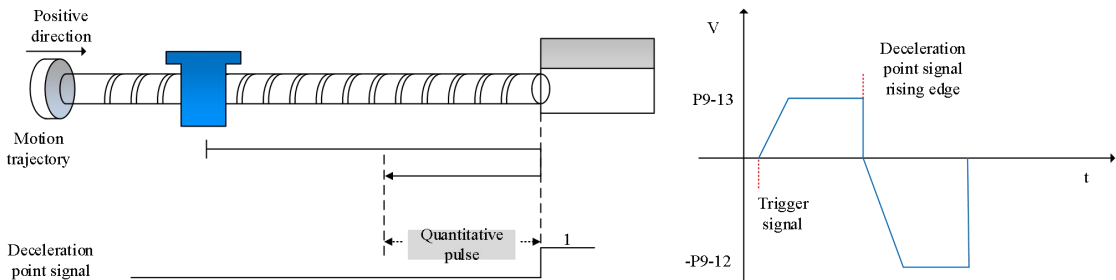
return to origin) setting. Upon reaching the mechanical limit position, if the absolute torque value reaches the P9-17 (touch-stop return-to-origin torque threshold) upper limit while the speed absolute value remains below the P9-16 (touch-stop return-to-origin speed threshold) setting, and this condition persists for the duration specified in the P9-18 (touch-stop return-to-origin time threshold), the system determines the mechanical limit position has been reached. The subsequent return-to-origin action then proceeds through four distinct scenarios:

- ① If the Z-phase count (P9-11.0) is zero and the mechanical offset (P9-19, P9-20) is zero, the machine should be stopped immediately.



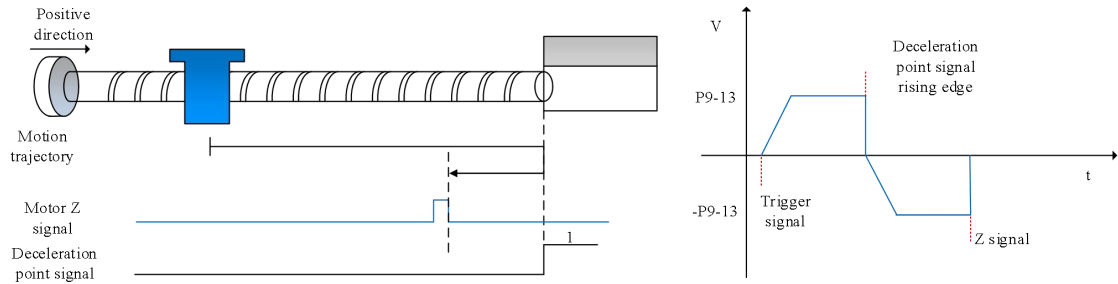
- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

The servo motor halts immediately. After complete stop, it reverses for a fixed pulse duration (P9-19, P9-20) at the-P9-12 speed (returning to the origin at high speed) based on the preset mechanical offset pulse count, then stops.



- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Perform a low-speed reverse operation at-P9-13 (return to origin low-speed speed), then stop immediately upon encountering the first rising edge of the Z signal.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

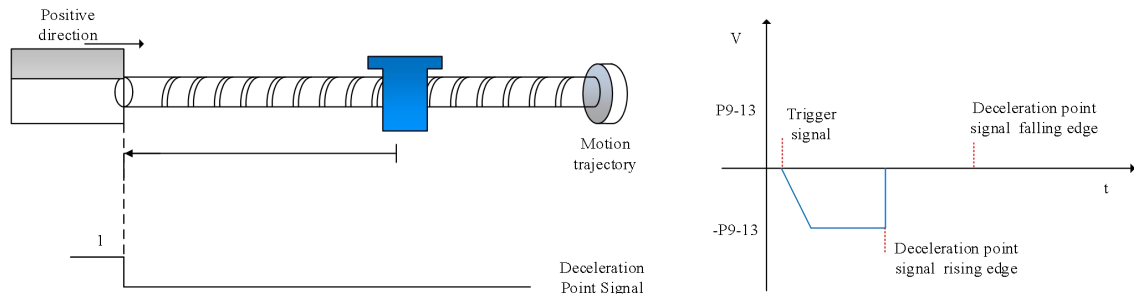
The motor initiates a low-speed reverse run at-P9-13 (returning to the origin at low speed), then halts immediately upon detecting the first rising edge of the Z-axis signal. After complete stoppage, it executes a fixed pulse sequence at-P9-12 (returning to the origin at high speed) based on the preset mechanical offset pulse count. The motor may operate in either positive or negative direction, but must stay within the mechanical limit position range, before final shutdown.

- (8) Return to the origin mode 7--reverse return to zero, the deceleration point and the origin are the reverse mechanical limit position (P9-11.2=7)

This mode eliminates the need for POT, NOT, or origin switches.

The servo motor initially operates in reverse low speed at the-P9-13 setting (returning to origin at low speed). Upon reaching the mechanical limit position, if the absolute torque value reaches the P9-17 (touch-stop origin return torque threshold) upper limit while the absolute speed value remains below the P9-16 (touch-stop origin return speed threshold) set value, and this state persists for the duration specified by the P9-18 (touch-stop origin return time threshold), the system determines the mechanical limit position has been reached. The subsequent origin return action then proceeds through four scenarios:

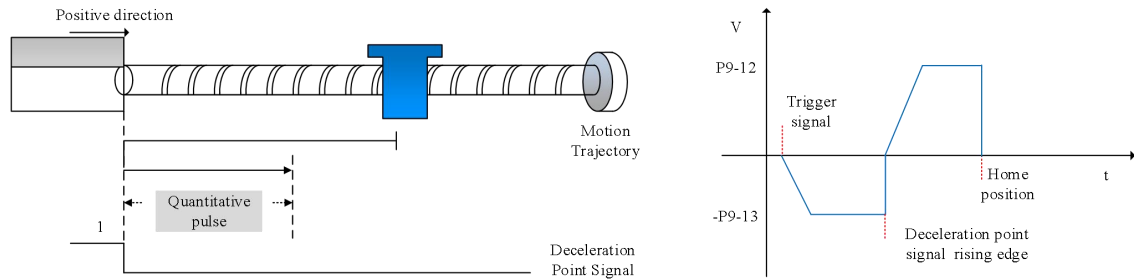
- ① If the Z-phase count (P9-11.0) is zero and the mechanical offset (P9-19, P9-20) is zero, the machine should be stopped immediately.



- ② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

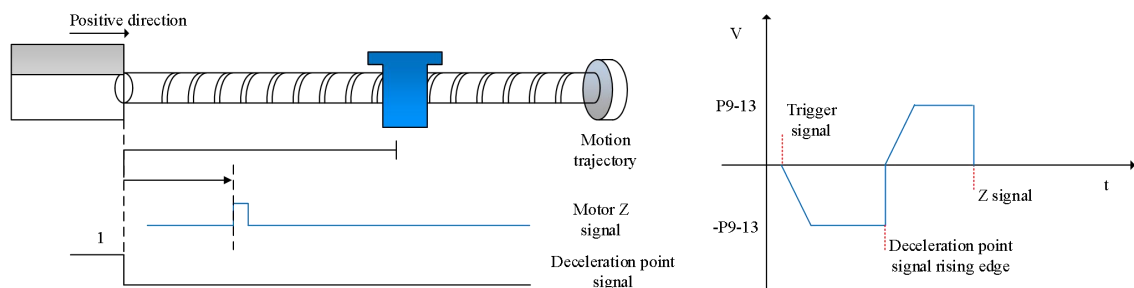
The servo motor halts immediately. After complete stop, it advances forward for a fixed number of pulses (P9-19, P9-20) at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset, then stops.





- ③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

The system operates at low speed in forward direction with P9-13 (return to origin low-speed speed) as the setting, and immediately stops upon encountering the first rising edge of the Z signal.



- ④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

The motor operates forward at a low speed set by P9-13 (return-to-origin low-speed setting). Upon detecting the first rising edge of the Z-axis signal, it immediately stops. After complete shutdown, the motor executes a fixed pulse sequence (P9-19, P9-20) at the speed set by P9-12 (return-to-origin high-speed setting), based on the preset mechanical offset pulse count. This sequence may run in either positive or negative direction, but must stay within the mechanical limit position range. The motor then stops.



- For return-to-origin modes 6 and 7, when these modes are activated, the maximum torque during the return-to-origin process is 1.1 times the set value of P9-17 (the threshold for stop-triggered return-to-origin torque). If both internal forward/reverse torque limits P3-28 and P3-29 are lower than 1.1 times P9-17, the torque limit will be set to P3-28 or P3-29. Similarly, if external forward/reverse torque limits P3-30 and P3-31 are enabled, the actual torque limit will be the minimum among the internal torque limit, the external torque limit, and 1.1 times P9-17.
- Only when both of these two return to origin modes are triggered, the torque limit P9-17 (touch stop return to origin torque threshold) set value of 1.1 times is effective. If only the return to origin is enabled and (return to origin mode) P9-11.2=6 or 7 is triggered but the return to origin is not triggered, the torque limit P9-17 (touch stop return to origin torque threshold) set value of 1.1 times is not effective.

## 5.8.2 Position Control (Internal Position Commands)

| parameter                                                                                                                                                                                                                                                                                                                                                                                                   | essentials                                                                                                                                                                                                                                | Reference chapters                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| P0-01 Control Mode Selection                                                                                                                                                                                                                                                                                                                                                                                | Set to 5: Internal Position Mode                                                                                                                                                                                                          | <a href="#">5.8.2.1 Internal Positioning Patterns</a>                                                              |
| P4-03 Internal Position Given Mode<br>P4-04 Number of valid segments<br>P4-10~P4-254 Internal Position Parameters for Sections 1 to 35                                                                                                                                                                                                                                                                      | The control mode of the internal location pattern is given, including the step change mode, the positioning mode and the adjustment time.<br>Configure the pulse displacement, speed, and acceleration/deceleration time for each section | <a href="#">5.8.2.3 Setting of position parameters for paragraphs 1 to 35</a>                                      |
| P5-35 step signal/GHGSTP<br>P5-32 Pause current segment signal/INHIBIT<br>P5-31 Skip current section number / Z-CLAMP                                                                                                                                                                                                                                                                                       | Common terminal function assignments                                                                                                                                                                                                      | <a href="#">5.8.2.4 Step-change signal (/CHGSTP)</a><br><a href="#">5.8.2.5 Skip the current segment (/ZCLAMP)</a> |
| <a href="#">5.8.2.5 Skip current segment signal (/ZCLAMP)</a><br>P4-00 Number of Z-phase signals after exiting the limit switch. The number of Z-phase signals after the P4-00 signal passes through the limit switch<br>P4-01 The speed of the proximity switch<br>P4-02 Speed of Departure from the Proximity Switch<br>P5-28: Forward rotation side search for reference origin in position mode / SPD-A | P5-29 Reverse-side Reference Origin Search in Position Mode / SPD-B                                                                                                                                                                       | Reset internal location to origin <a href="#">5.8.1.7 reference origin</a>                                         |

### 5.8.2.1 Internal Location Patterns

| parameter | set value | meaning | revise | come into force |
|-----------|-----------|---------|--------|-----------------|
|-----------|-----------|---------|--------|-----------------|

|       |   |                                                                           |          |             |
|-------|---|---------------------------------------------------------------------------|----------|-------------|
| P0-01 | 5 | Position control by using preset values of servo unit's internal register | servo bb | immediately |
|-------|---|---------------------------------------------------------------------------|----------|-------------|

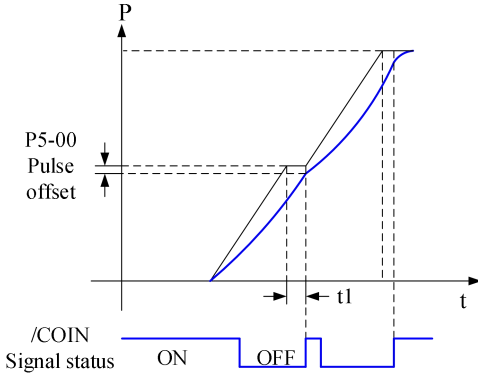
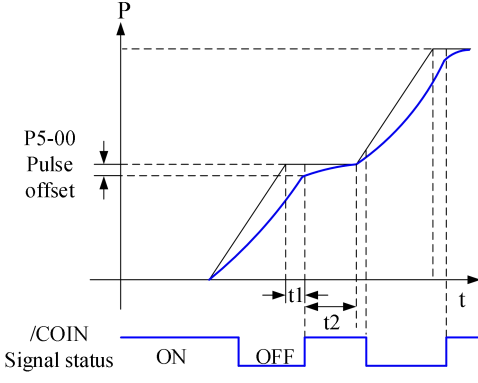
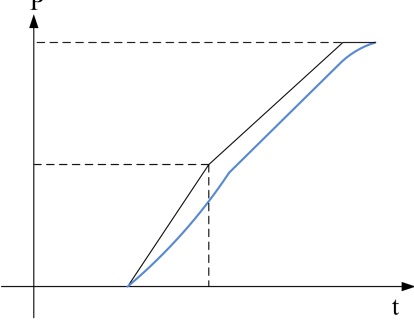
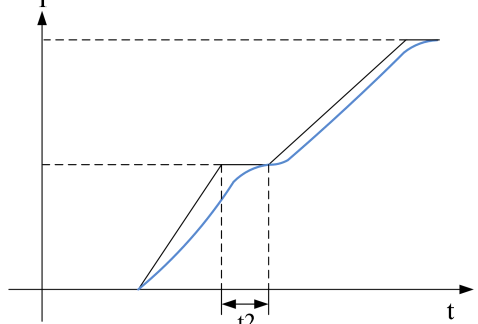
### 5.8.2.2 Internal Location Mode Settings

| parameter | Parameter Function              | Set unit         | factory setting | Applicable mode | revise   | come into force |
|-----------|---------------------------------|------------------|-----------------|-----------------|----------|-----------------|
| P4-03     | Internal Location Mode Settings | —                | n.0000          | 5               | servo bb | immediately     |
|           | parameter setting               | Functionality    | factory setting | Set range       |          |                 |
|           | n.□xxx                          | insignificance   |                 |                 |          |                 |
|           | n.x□xx                          | Waiting mode     | 0               | 0 ~ 1           |          |                 |
|           | n.xx□x                          | step change mode | 0               | 0 ~ 6           |          |                 |
|           | n.xxx□                          | positioning mode | 0               | 0 ~ 1           |          |                 |

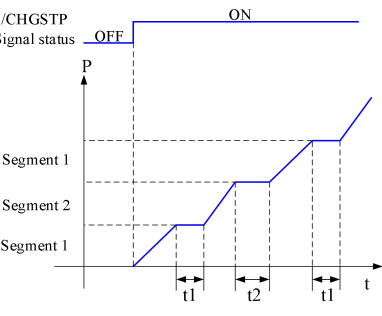
#### 1) Waiting mode

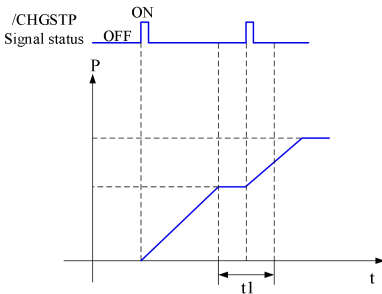
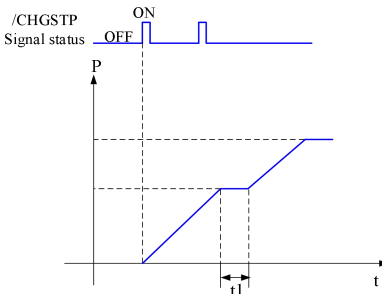
| n.x□xx                                                                                                                                                                                                        | meaning                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| 0                                                                                                                                                                                                             | Waiting for the completion of the location |
| 1                                                                                                                                                                                                             | Do not wait for location to complete       |
| Note: The wait mode determines whether the driver waits for the motor to complete positioning after issuing a position command when the internal position is set. This mode applies to all step-change modes. |                                            |

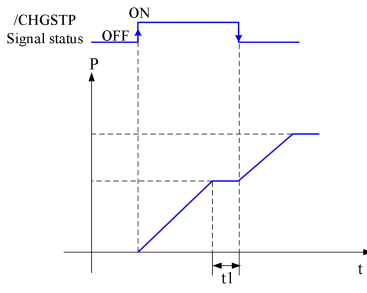
|                                       |                                     |
|---------------------------------------|-------------------------------------|
| Waiting mode: 0, adjustment time: 0ms | Waiting mode=0, adjustment time>0ms |
|---------------------------------------|-------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>After the driver sends a position command, it will wait for the motor to complete positioning and then immediately start the next position command. In the diagram, <math>t_1</math> represents the positioning time, which is the interval between the completion of pulse transmission and the output of the positioning completion signal.</p> |  <p>After issuing a position command, the driver waits for the motor to complete positioning before proceeding to the next command after the adjustment period. In the diagram, <math>t_1</math> denotes the positioning time and <math>t_2</math> the adjustment time, with these values corresponding to parameter P4-16 in this example.</p> |
| Waiting mode=1, adjustment time=0ms                                                                                                                                                                                                                                                                                                                                                                                                    | Waiting mode=1, adjustment time>0ms                                                                                                                                                                                                                                                                                                                                                                                               |
|  <p>After the driver sends a position command, it proceeds to the next one without waiting for the motor to complete its current position.</p>                                                                                                                                                                                                       |  <p>After the driver issues a position command, it does not wait for the motor to complete positioning but initiates the next command after a 'adjustment time'. In this example, <math>t_2</math> represents the adjustment time, corresponding to parameter P4-16.</p>                                                                       |

## 2) Step-change mode

| n.XX□X                                                               | define                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>0</p> <p>When signal ON, step is changed and can be recycled;</p> |  | <p>In the diagram, <math>t_1</math> equals P4-16 and <math>t_2</math> equals P4-23.</p> <ol style="list-style-type: none"> <li>1. If the CHGSTP signal remains ON, the servo unit will continuously cycle through the preset position segments.</li> <li>2. If the /CHGSTP signal is set to OFF during a specific segment, the servo will continue executing that segment without proceeding to the next one.</li> </ol> |

| n.XX□X                                                                                                    | define                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                           |                                                                                     | <p>3. In this mode, the step signal/CHGSTP is triggered by high level.</p> <p>4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the positioning completion was invalid after the shutdown.</p> <p>5. After each segment operation, the positioning completion and positioning approach signals remain valid.</p> <p>6. The adjustment time of each paragraph is valid in this mode.</p>                                                                                                                                                                                                                                                                                                                                                                 |
| <p>1</p> <p>The signal changes step by step on the rising edge;</p>                                       |   | <p>For example, in the two-stage setup, t1 equals P4 minus 16 in the diagram.</p> <p>1. Note that, as shown in the diagram, the preset adjustment time is ineffective in this step-switching mode. The system will immediately proceed to the next instruction upon receiving a new step-switching signal, once the previous position command has been fully executed.</p> <p>2. In this mode, the step signal/CHGSTP is triggered by the rising edge.</p> <p>3. After each segment operation, the positioning completion and positioning approach signals are both valid.</p> <p>4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the positioning completion was invalid after the shutdown.</p> <p>5. Adjustments made in this mode are invalid.</p> |
| <p>2</p> <p>The signal starts on the rising edge and executes all tasks sequentially without looping.</p> |  | <p>Set two bit positions, where t1 in the diagram equals P4-16.</p> <p>1. The /CHGSTP signal prior to the completion of a cycle will not be counted, as shown in the second /CHGSTP signal in the figure.</p> <p>2. In this mode, the step signal/CHGSTP is triggered by the rising edge.</p> <p>3. After each segment operation, the positioning completion and positioning approach signals are both valid.</p> <p>4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the</p>                                                                                                                                                                                                                                                                          |

| n.XX□X                                                                                                                                          | define                                                                                                                                                                                                                                                                                                                                                         |                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------|--------|--------|----------------|----------------|---|---|----------|---|---------------------|---|---------------------|---|---|----------------------|----------------------|---|---|---|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                | positioning completion was invalid after the shutdown.<br>5. The adjustment time is valid in this mode. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 4<br>/CHGSTP<br>bilateral<br>trigger                                                                                                            |                                                                                                                                                                                                                                                                               |                                                                                                         | In the figure, t1 = P4-16.<br>1. The rising edge of /CHGSTP triggers the first segment, while the falling edge triggers the second segment. To ensure full operation of the first segment, the /CHGSTP signal remains ON until the end of the first segment.<br>2. In this mode only, the valid segment count of P4-04 is invalid.<br>3. After each segment operation, the positioning completion and positioning approach signals are both valid.<br>4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the positioning completion was invalid after the shutdown.<br>5. Adjustments made in this mode are invalid.<br>6. Before using this step-switching mode, the P5-35 terminals must be properly assigned; step-switching terminals cannot be assigned during operation of this mode. |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 5<br>/PREFA<br>(P5-57)、<br>Select<br>terminal<br>section<br>numbers<br>/PREFB<br>(P5-58) or<br>/PREFC<br>(P5-59),<br>with<br>options 1<br>to 3. | <table><tr><th>/PREFC</th><th>/PREFB</th><th>/PREFA</th><th>segment number</th></tr><tr><td>0</td><td>0</td><td>0</td><td>not have</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1 (first paragraph)</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 (second paragraph)</td></tr><tr><td>1</td><td>0</td><td>0</td><td>3 (third paragraph)</td></tr></table> |                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      | /PREFC | /PREFB | /PREFA | segment number | 0              | 0 | 0 | not have | 0 | 0                   | 1 | 1 (first paragraph) | 0 | 1 | 0                    | 2 (second paragraph) | 1 | 0 | 0 | 3 (third paragraph) | 1. After each segment runs, the positioning completion and positioning proximity signals are both valid.<br>2. During operation, the servo enable function was disabled, causing the motor to shut down according to the standard shutdown procedure. Consequently, the positioning operation was invalid after the shutdown.<br>3. The adjustment time is valid in this mode.<br>4. The CHGSTP step-change signal is invalid only in this mode.<br>5. The section number selection terminal can be configured to trigger step switching at the edge or remain ON. This mode supports continuous triggering of a specific section. If the terminal stays ON, the motor will stop upon receiving an overtravel signal. In such cases, the terminal must be switched to OFF to prevent the motor from executing the position section after the overtravel signal is cleared. |
| /PREFC                                                                                                                                          | /PREFB                                                                                                                                                                                                                                                                                                                                                         | /PREFA                                                                                                  | segment number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                              | 0                                                                                                       | not have                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                              | 1                                                                                                       | 1 (first paragraph)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                              | 0                                                                                                       | 2 (second paragraph)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                              | 0                                                                                                       | 3 (third paragraph)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                      |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 6<br>/PREFA                                                                                                                                     | <table><tr><th>/PREFD</th><th>/PREFC</th><th>/PREFB</th><th>/PREFA</th><th>segment number</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (first paragraph)</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2 (second paragraph)</td></tr></table>                                                                                         |                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      | /PREFD | /PREFC | /PREFB | /PREFA         | segment number | 0 | 0 | 0        | 0 | 1 (first paragraph) | 0 | 0                   | 0 | 1 | 2 (second paragraph) |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| /PREFD                                                                                                                                          | /PREFC                                                                                                                                                                                                                                                                                                                                                         | /PREFB                                                                                                  | /PREFA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | segment number       |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                              | 0                                                                                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1 (first paragraph)  |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                              | 0                                                                                                       | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2 (second paragraph) |        |        |        |                |                |   |   |          |   |                     |   |                     |   |   |                      |                      |   |   |   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| n.XX□X                                                                                                                                   | define                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |   |   |                                         |
|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|-----------------------------------------|
| (P5-57) 、<br>/PREFB<br><br>(P5-58) 、<br>/PREFC<br><br>(P5-59) 、<br>Select<br>terminal<br>segment<br>number<br>(P5-60)<br>from 1 to<br>16 | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 1 | 0 | 3 (third paragraph)                     |
|                                                                                                                                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 1 | 1 | 4 (position of the fourth paragraph)    |
|                                                                                                                                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 0 | 0 | 5 (Paragraph 5)                         |
|                                                                                                                                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 0 | 1 | 6 (position 6)                          |
|                                                                                                                                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 1 | 0 | 7 (Paragraph 7)                         |
|                                                                                                                                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 1 | 1 | 8 (position of the eighth paragraph)    |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 0 | 0 | 9 (Paragraph 9)                         |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 0 | 1 | 10 (Paragraph 10)                       |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 1 | 0 | 11 (position of the eleventh paragraph) |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 1 | 1 | 12 (Paragraph 12)                       |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 0 | 0 | 13 (position 13)                        |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 0 | 1 | 14 (position 14)                        |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 1 | 0 | 15 (Paragraph 15)                       |
|                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 1 | 1 | 16 (Paragraph 16)                       |
|                                                                                                                                          | <b>Note: The P5-35 step-change signal's rising edge triggers each segment position (the rising edge is invalid during operation).</b><br>1. During operation, the servo enable function was disabled, causing the motor to shut down according to the standard shutdown procedure. Consequently, the positioning operation was invalid after the shutdown.<br>2. Adjustments made in this mode are invalid.<br>3. After each segment operation, the positioning completion and positioning approach signals are both valid.<br>4. After selecting the section number, the position section must be triggered by the rising edge of the P5-35/CHGSTP step-change signal to activate. Triggering during section operation is invalid.<br>5. The paragraph number selection terminal logic is level valid. High input is valid, low input is invalid. |   |   |   |                                         |

Use the following input signals to switch between internal positions 1-3/1-16.

| parameter | Signal name                                                | leave the factory setting | suit pattern | Set range                                                                                               | revise      | come into force |
|-----------|------------------------------------------------------------|---------------------------|--------------|---------------------------------------------------------------------------------------------------------|-------------|-----------------|
| P5-57     | Internal Position First Paragraph Position Selection/PREFA | n.0000                    | 5            | The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-57. | at any time | immediately     |
| P5-58     | Internal Position Second Section Position Selection/PREFB  | n.0000                    | 5            | The parameter range is 0000-0014, which is assigned to other input interfaces via parameters P5-58.     |             |                 |

|       |                                                                    |        |   |                                                                                                                  |  |  |
|-------|--------------------------------------------------------------------|--------|---|------------------------------------------------------------------------------------------------------------------|--|--|
| P5-59 | Internal Position<br>Third Section<br>Position<br>Selection/PREFC  | n.0000 | 5 | The parameter range is<br>0000-0014, which is assigned<br>to other input interfaces<br>through parameters P5-59. |  |  |
| P5-60 | Internal Position<br>Fourth Section<br>Position<br>Selection/PREFD | n.0000 | 5 | The parameter range is<br>0000-0014, which is assigned<br>to other input interfaces via<br>parameters P5-60.     |  |  |

### 3) Location Mode

| n.xxx□                  | meaning                                                                                           |
|-------------------------|---------------------------------------------------------------------------------------------------|
| 0                       | relative localization                                                                             |
| 1                       | absolute fix                                                                                      |
| 0: Relative Positioning | 1: Absolute Positioning (using the "reference origin" as the zero point for absolute positioning) |
|                         |                                                                                                   |

#### 5.8.2.3 Setting of position parameters for paragraphs 1 to 35

| parameter       | meaning                             | factory<br>setting | unit            | Set range         | revise          | come<br>into<br>force |
|-----------------|-------------------------------------|--------------------|-----------------|-------------------|-----------------|-----------------------|
| P4-10+ (n-1) *7 | Pulse count<br>(low bit)            | 0                  | 1 pulse         | -9999 ~<br>9999   | Edit<br>anytime | imme<br>diatel<br>y   |
| P4-11+ (n-1) *7 | Pulse count<br>(high bit)           | 0                  | 10000<br>pulses | -32768 ~<br>32767 | Edit<br>anytime | imme<br>diatel<br>y   |
| P4-12+ (n-1) *7 | speed                               | 0                  | 0.1rpm          | 0 ~ 65535         | Edit<br>anytime | imme<br>diatel<br>y   |
| P4-13+ (n-1) *7 | trapezoidal<br>acceleration<br>time | 0                  | ms              | 0 ~ 65535         | Edit<br>anytime | imme<br>diatel<br>y   |
| P4-14+ (n-1) *7 | trapezoidal<br>deceleration<br>time | 0                  | ms              | 0 ~ 65535         | Edit<br>anytime | imme<br>diatel<br>y   |



| parameter       | meaning             | factory setting | unit | Set range | revise       | come into force |
|-----------------|---------------------|-----------------|------|-----------|--------------|-----------------|
| P4-15+ (n-1) *7 | retention parameter | -               |      |           |              |                 |
| P4-16+ (n-1) *7 | adjust the time     | 0               | ms   | 0 ~ 65535 | Edit anytime | immediately     |

**explain :**

- 1) Calculate the pulse count as (high bit)  $\times$  10000 + (low bit);
- 2) In the formula P4-10+ (n-1) \* 7, n represents the segment number of the internal position, with a range of 1 to 35. Parameters for segments 1 to 12 can be configured via the panel, while those for segments 13 to 35 require parameter writing through communication (RS232 or RS485).
- 3) In the relative positioning mode, if the pulse high is set to 9999 and the pulse low is set to 9999, or the pulse high is set to -9999 and the pulse low is set to -9999, and P4-03.2=1 (do not wait for positioning completion), then it enters the infinite pulse mode. Otherwise, the number of pulses is limited.
- 4) If a segment's speed is set to zero, it will be skipped during execution and the next segment will be processed.
- 5) In the relative positioning mode, if the speed of a segment is set to non-zero but the pulse count is zero, the motor in that segment will not operate during execution. However, the designated waiting mode for that segment remains active, meaning the system will wait until the adjustment period ends before proceeding to the next segment.
- 6) In absolute positioning mode, if the speed setting for a specific segment is not zero but the pulse count is set to zero, the motor will return to the reference origin at the preset speed when executing that segment.
- 7) In absolute positioning mode, if the speed settings for two consecutive segments are both non-zero and the pulse count settings are identical, the motor in the latter segment will not operate, but the waiting mode determined for that segment remains valid.
- 8) In absolute positioning mode, the motor's rotation cycles are limited and cannot be unlimited.
- 9) At present, there are only two kinds of position segments in the internal position mode, i.e. step speed and ramp speed, and no other speed forms. When the trapezoidal acceleration time and trapezoidal deceleration time are set to 0, it is the step speed form. When the trapezoidal acceleration time and trapezoidal deceleration time are greater than 0, it is the ramp speed form.
- 10) The trapezoidal acceleration and deceleration times refer to the duration required to reach the rated speed from zero.
- 11) If the rotational speed in a specified parameter segment is set to 0, the position command for that segment will be ignored under step-change modes 0/1/2. However, under step-change modes 4/5/6, the motor will not rotate when the position in that segment triggers a step change.
- 12) The position commands for setting the high and low pulse levels in the internal position segment parameters remain influenced by the electronic gear ratio. The actual number of motor rotations must be determined by combining the preset pulse commands with the electronic gear ratio.
- 13) In absolute positioning mode, the starting position for each step change is based on the initial position when the step change is first triggered. In relative positioning mode, the starting position for each step change is based on the position at the end of the previous step change.

| parameter                                                                                                                                                                                                             | meaning | factory setting | unit | Set range | revise | come into force |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------|------|-----------|--------|-----------------|
| 14) In relative positioning mode, the 35-position section allows setting of unlimited pulse segments. However, the motor will continue running until it reaches this position, unless the current segment is skipped. |         |                 |      |           |        |                 |

The internal location consists of 35 segments. If you need to switch between running 10 segments and 5 segments due to process requirements, you can set the valid segment count. For example, if all segments 1-10 are parameterized, set the valid segment count for P4-04 to 5, meaning segments 1-5 are valid. If set to 10, then segments 1-10 are valid.

| parameter | meaning                | factory setting | unit | Set range | revise   | come into force |
|-----------|------------------------|-----------------|------|-----------|----------|-----------------|
| P4-04     | Number of valid fields | 0               | -    | 0 ~ 35    | servo bb | immediately     |

P4-08 sets the starting run section number after the first round, with only the step-change mode P4-03.1 being valid when set to 0 or 1. The following explains the configuration: valid settings are available in sections No.1 through No.8.

| parameter | meaning                                           | factory setting | unit | Set range | revise   | come into force |
|-----------|---------------------------------------------------|-----------------|------|-----------|----------|-----------------|
| P4-08     | Internal location pattern starting segment number | 1               | -    | 0 ~ 35    | servo bb | immediately     |

| step change mode | set up                    | parameter setting  | specific phenomenon |
|------------------|---------------------------|--------------------|---------------------|
| P4-03.1=0        | P4-08=0 or P4-08>P4-04    | P4-08=8<br>P4-04=4 |                     |
|                  | $1 \leq P4-08 \leq P4-04$ | P4-08=2<br>P4-04=4 |                     |
| P4-03.1=1        | P4-08=0 or P4-08>P4-04    | P4-08=8<br>P4-04=4 |                     |
|                  | $1 \leq P4-08 \leq P4-04$ | P4-08=2<br>P4-04=4 |                     |

When using the skip current segment function, the SI terminal assigned to P5-31 requires a rising edge

trigger.

#### 5.8.2.4 Step-change signal (/CHGSTP)

| parameter | Signal name        | setting | meaning                                                                                                                                      | Change scope                                                                                                                                            |
|-----------|--------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| P5-35     | step change signal | n.0000  | No terminal input is assigned by default. Refer to Section 5.4.3.2 for the application of step-change signals in the step-change mode table. | Parameter range 0000-0014<br>The parameter P5-35 is assigned to the input interface. When set to 0001, it indicates the signal input from terminal SI1. |

#### 5.8.2.5 Skip current segment signal (/ZCLAMP)

| parameter | Signal name                    | setting | meaning                           | Change scope                                                                                                                                             |
|-----------|--------------------------------|---------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| P5-31     | Skip current section / Z-CLAMP | n.0000  | Default unassigned terminal input | The parameter range is 0000-0014, assigned to the input interface via parameters P5-31. Setting it to 0001 indicates signal input from the SI1 terminal. |

The effect of skipping the current section varies depending on the step change mode, as shown below:

| step change mode<br>P4-03 n.xx□x | Skip current section | Action                                                                                                    |
|----------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------|
| 0                                | /Z-CLAMP             | Cancel the current section and proceed to the next one.                                                   |
| 1                                |                      | Cancel the current section and proceed to the next section when the step change signal is triggered.      |
| 2                                |                      | Cancel the current section and proceed to the next one.                                                   |
| 4                                |                      | Cancel the current segment. The next segment will be executed when the /CHGSTP step signal falls.         |
| 5                                |                      | Cancel the current paragraph. Select another paragraph and execute the corresponding paragraph.           |
| 6                                |                      | Cancel the current segment. The /CHGSTP step signal's rising edge executes the selected position segment. |

#### 5.8.2.6 Movement Start Signal (/MRUN)

| parameter | Signal name          | factory setting | meaning                                                                                                                                 | revise                                                                                                                       |
|-----------|----------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| P5-50     | Start Movement /MRUN | n.0000          | No terminal output is assigned by default. It is only valid in the internal position mode, similar to the positioning completion signal | The parameter range is 0000-0014, assigned to the output interface via parameters P5-50. Setting it to 0001 outputs a signal |

|  |  |  |                                                                                              |                        |
|--|--|--|----------------------------------------------------------------------------------------------|------------------------|
|  |  |  | in the external pulse mode. The motor has an output when running and no output when stopped. | from the SO1 terminal. |
|--|--|--|----------------------------------------------------------------------------------------------|------------------------|

## 5.9 Speed Control

### 5.9.1 General Control of Speed Mode

#### 5.9.1.1 Soft Start

| parameter | meaning                      | factory setting | unit | Set range | revise   | come into force |
|-----------|------------------------------|-----------------|------|-----------|----------|-----------------|
| P3-09     | soft start acceleration time | 200             | ms   | 0 ~ 65535 | servo bb | immediately     |
| P3-10     | soft start deceleration time | 200             | ms   | 0 ~ 65535 | servo bb | immediately     |

Soft start acceleration/deceleration time is applicable to mode 3/4/7; when inputting step speed command or selecting internal set speed, smooth speed control can be performed.

P3-09: Time from shutdown to rated speed;

P3-10: Time from rated speed to complete stop.

#### 5.9.1.2 Zero Clamp Function (/ZCLAMP)

##### 1) Function Overview

This function is used for higher-level devices with speed command input in systems without position loop. It activates the motor stop and servo lock when the speed command is non-zero.

When the zero clamping function is set to ON, the internal temporary position loop is activated, causing the motor to clamp within  $\pm 1$  pulse at this position. Even if external force causes rotation, the motor will return to the zero clamping position.

To activate the zero clamping function, the motor's current speed must be below the clamping threshold to secure the shaft. When this function is enabled, the motor switches from speed control to position control. In position control mode, rotating the shaft and releasing it will return it to its original position. However, in speed control mode, rotation won't reset the shaft to its starting position due to the absence of position feedback.

## 2) Input signal settings

| parameter | Signal name | setting          | meaning                             | Change scope                                                                                     |
|-----------|-------------|------------------|-------------------------------------|--------------------------------------------------------------------------------------------------|
| P5-31     | zero clamp  | n.0000 (default) | Default unassigned output terminals | The parameter range is 0001-0014, and parameters P5-31 can be assigned to other input terminals. |
|           |             | n.0002           | Input signal via SI2 terminal       |                                                                                                  |

## 3) Setting of relevant parameters

| parameter | meaning             | factory setting | unit | Set range | revise   | come into force |
|-----------|---------------------|-----------------|------|-----------|----------|-----------------|
| P3-13     | zero clamping speed | 10              | rpm  | 0 ~ 300   | servo bb | immediately     |
| P3-12     | zero clamping mode  | 0               | -    | 0 ~ 3     | servo bb | immediately     |

| P3-12 Settings | content                                                                                                                                                                                                                                                                                                                                                       |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0              | When the ZCLAMP input signal is ON, the forced speed command is 0. Once the actual speed drops below P3-13, the system switches to position mode control and locks the position servo.                                                                                                                                                                        |
| 1              | When the ZCLAMP input signal is ON, the speed command is forcibly set to 0.                                                                                                                                                                                                                                                                                   |
| 2              | When the ZCLAMP input signal is ON and the feedback speed drops below P3-13, the system switches to position mode control and locks the position servo.<br>Note: When entering zero-clamping mode, the motor will not operate even if the speed exceeds the P3-13 motor's limit. The motor resumes operation only when the ZCLAMP input signal is turned off. |
| 3              | When the ZCLAMP input signal is ON and the set speed is below P3-13, the system switches to position mode control and locks the position servo. If the set speed exceeds P3-13, the motor resumes operation.                                                                                                                                                  |

## 5.9.1.3 Speed arrival signal (/V-RDY)

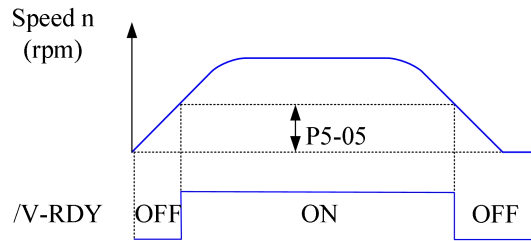
- relevant parameter

| parameter | Signal name               | factory setting | Applicable mode | meaning                 | revise      | come into force |
|-----------|---------------------------|-----------------|-----------------|-------------------------|-------------|-----------------|
| P5-51     | speed of arrival at V-RDY | n.0000          | 3、4、7           | velocity arrival signal | at any time | immediately     |

| parameter | meaning         | factory setting | unit | Set range | revise      | come into force |
|-----------|-----------------|-----------------|------|-----------|-------------|-----------------|
| P5-05     | detection speed | 1000            | rpm  | 0 ~ 10000 | at any time | immediately     |

## 1) The speed reaches the signal output condition.

When the actual motor speed exceeds the detection threshold of P5-05, the speed arrival signal (/V-RDY) is triggered.

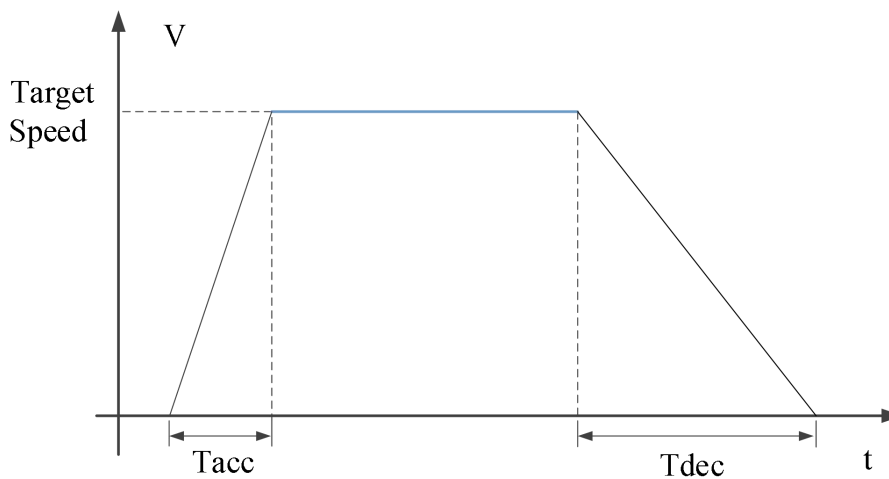


## 5.9.1.4 Speed command filter

- relevant parameter

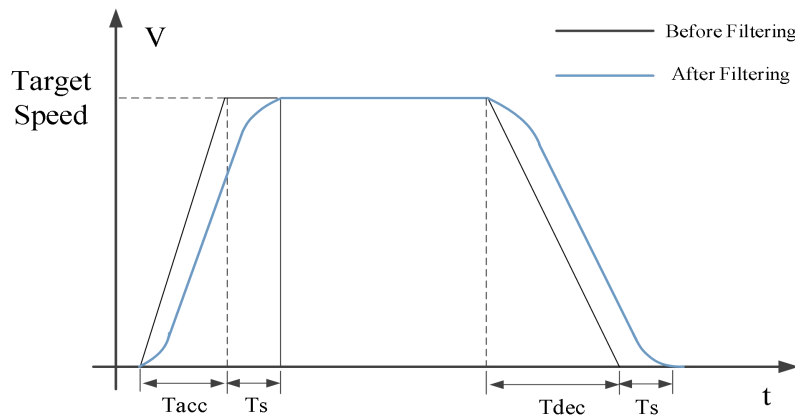
| parameter | meaning                               | factory setting | unit  | Set range | revise   | come into force |
|-----------|---------------------------------------|-----------------|-------|-----------|----------|-----------------|
| P1-23     | velocity command filter time constant | 0               | 0.1ms | 0 ~ 65535 | servo bb | immediately     |
| P3-09     | acceleration time                     | 200             | 1ms   | 0 ~ 65535 | servo bb | immediately     |
| P3-10     | deceleration time                     | 200             | 1ms   | 0 ~ 65535 | servo bb | immediately     |
| P3-11     | Moving average filter time constant   | 0               | 0.1ms | 0 ~ 65535 | servo bb | immediately     |

Firstly, P3-09 and P3-10 are set. The acceleration and deceleration time of the planning speed command is calculated.



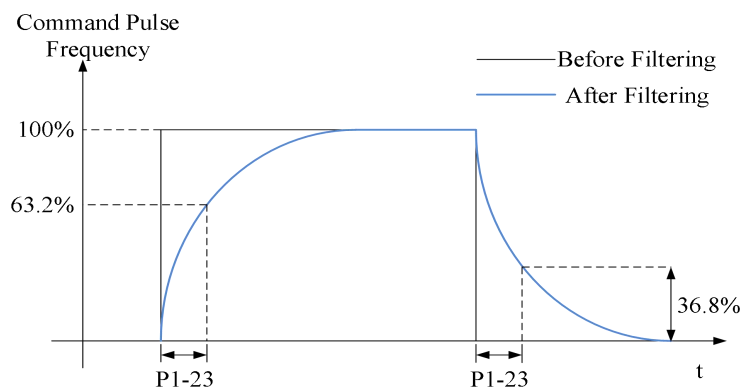
The acceleration time  $T_{acc}$  is calculated as  $(\text{target speed} / \text{rated speed}) \times P3-09[\text{ms}]$ , and the deceleration time  $T_{dec}$  is calculated as  $(\text{target speed} / \text{rated speed}) \times P3-10[\text{ms}]$ .

The appropriate time constant P3-11 (S-type acceleration-deceleration time constant) is set as  $T_s = P3-11 \times 0.1[\text{ms}]$ .



The sliding average filter time constant must meet the requirements,  $T_s < 0.5 \cdot T_{acc}$  and  $T_s < 0.5 \cdot T_{dec}$ . Otherwise, an excessively large sliding average filter time will result in an increased deceleration time, which does not comply with the settings specified in P3-09 and P3-10.

When P3-09 and P3-10 are set to 0, the sliding average filter time setting converts the speed command into a trapezoidal acceleration/deceleration command. Setting P1-23 (speed command filter time constant) and P1-24 (first-order low-pass filter time constant) produces the following effect:



If the acceleration and deceleration are set, the first-order low-pass filter will increase the lag of the speed command.

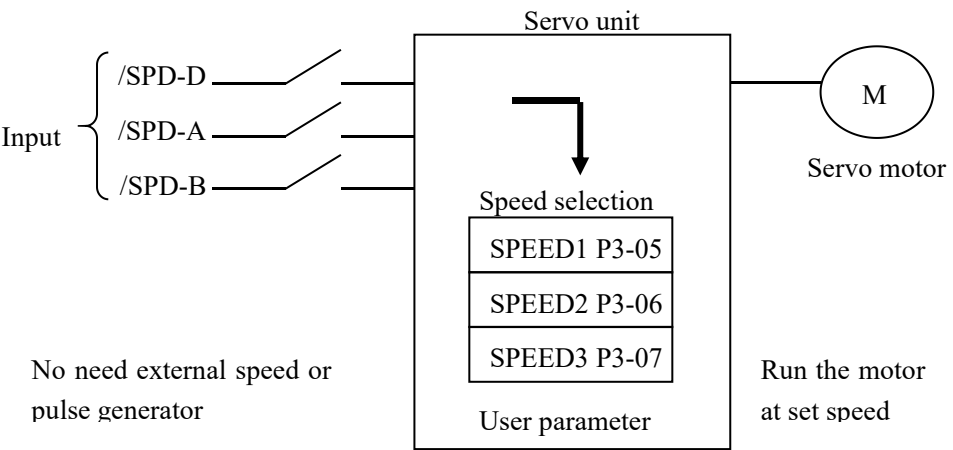
## 5.9.2 Speed Control (Internal Set Speed)

| parameter                                                                                          | essentials                                                               | Reference chapters                          |
|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------|
| P0-01 Control Mode Selection                                                                       | Set to 3: Internal speed control mode                                    | <a href="#">5.9.2.1 Internal speed mode</a> |
| P3-05 Internal setting speed 1<br>P3-06 Internal setting speed 2<br>P3-07 Internal setting speed 3 | Internal 3-speed speed value setting, in rpm                             | <a href="#">5.9.2.1 Internal speed mode</a> |
| P5-28 Internal Speed Selection/SPD-A<br>P5-29 Internal Speed Selection/SPD-B                       | The combination of terminals determines the corresponding segment speed. | <a href="#">5.9.2.1 Internal speed mode</a> |



|                                                                          |                                                                                                                                |                                             |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| P5-27 Internal Speed Direction Selection/SPD-D                           | The default for switching is n.0000.<br>If the commutation is controlled via the SI2 terminal, the P5-27 can be set to n.0002. | <a href="#">5.9.2.1 Internal speed mode</a> |
| P3-09 Soft-start acceleration time<br>P3-10 Soft-start deceleration time | Set acceleration and deceleration time in milliseconds                                                                         | <a href="#">5.9.1.1 Soft Start</a>          |

### 5.9.2.1 Internal speed mode

| parameter                                                                                                                                                                                                                                                                                                                                                                                      | set value | meaning                              | revise   | come into force |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------|----------|-----------------|
| P0-01                                                                                                                                                                                                                                                                                                                                                                                          | 3         | Speed control: Select internal speed | servo bb | immediately     |
| <p>Function Overview: The internal speed selection feature allows users to pre-set three motor speeds via the servo unit's parameters and select the desired speed using external input signals for precise speed control. This eliminates the need for external speed generators or pulse generators.</p>  |           |                                      |          |                 |

#### ● relevant parameter

| parameter | meaning              | factory setting | unit | Set range     | revise      | come into force |
|-----------|----------------------|-----------------|------|---------------|-------------|-----------------|
| P3-05     | Internal set speed 1 | 0               | rpm  | -9999 ~ +9999 | at any time | immediately     |
| P3-06     | Internal set speed 2 | 0               | rpm  | -9999 ~ +9999 | at any time | immediately     |
| P3-07     | Internal set speed 3 | 0               | rpm  | -9999 ~ +9999 | at any time | immediately     |

| parameter | Signal name                        | factory setting | Set range                                                                             | revise      | come into force |
|-----------|------------------------------------|-----------------|---------------------------------------------------------------------------------------|-------------|-----------------|
| P5-27     | internal direction selection/SPD-D | n.0000          | The parameter range is 0000-0014, which is assigned to other input interfaces through | at any time | immediately     |

| parameter | Signal name                    | factory setting | Set range                                                                                               | revise | come into force |
|-----------|--------------------------------|-----------------|---------------------------------------------------------------------------------------------------------|--------|-----------------|
|           |                                |                 | parameters P5-27.                                                                                       |        |                 |
| P5-28     | internal speed selection/SPD-A | n.0000          | The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-28. |        |                 |
| P5-29     | internal speed selection/SPD-B | n.0000          | The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-29. |        |                 |

### 1) The correlation between operating speed and terminal signal

| incoming signal |                |                | running speed                |
|-----------------|----------------|----------------|------------------------------|
| /SPD-D (P5-27)  | /SPD-A (P5-28) | /SPD-B (P5-29) |                              |
| 0<Forward>      | 0              | 0              | internal instruction 0 speed |
|                 | 0              | 1              | P3-05: SPEED1                |
|                 | 1              | 1              | P3-06: SPEED2                |
|                 | 1              | 0              | P3-07: SPEED3                |
| 1<Reverse>      | 0              | 0              | internal instruction 0 speed |
|                 | 0              | 1              | P3-05: SPEED1                |
|                 | 1              | 1              | P3-06: SPEED2                |
|                 | 1              | 0              | P3-07: SPEED3                |



- The SPD-D signal controls direction, and the input SI terminal can be adjusted via P5-27. The motor's direction is determined by the signal validity of the terminal.
- The combination of SPD-A and SPD-B input terminals determines the multi-stage speed.
- The 0/1 in the table above indicates the signal validity. A 0 at the terminal means the input is invalid, while a 1 indicates the input is valid.

### 2) Explanation of terminal validity

The table below uses /SPD-D as an example, with /SPD-A and /SPD-B signals following the same principle.

| Parameter settings status | Signal/SPD-D terminal input status | signal / SPD-D terminal logic |
|---------------------------|------------------------------------|-------------------------------|
|---------------------------|------------------------------------|-------------------------------|

|              |                                         |             |
|--------------|-----------------------------------------|-------------|
| P5-27=n.0000 | No external terminal input is required. | of no avail |
| P5-27=n.000□ | No signal input at the SI□ terminal     |             |
| P5-27=n.001□ | The SI terminal has a signal input.     |             |
| P5-27=n.0010 | No external input terminals required    | valid       |
| P5-27=n.000□ | The SI terminal has a signal input.     |             |
| P5-27=n.001□ | No signal input at the SI□ terminal     |             |

## 5.10 Torque Control

| parameter                                                                                                                                                                                                                | essentials                                                                                                        | Reference chapters                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| P0-01 Control Mode Selection                                                                                                                                                                                             | Set to 1: Internal torque mode                                                                                    | <a href="#">5.10.1 Internal Torque Mode</a>              |
| P3-33 Internal torque command given                                                                                                                                                                                      | The given value is the percentage of the rated torque.                                                            | <a href="#">5.10.1.1 Internal torque command setting</a> |
| Internal Forward Speed Limitation in P3-16 Torque Control<br>Internal Reverse Speed Limitation in P3-17 Torque Control<br>P3-14 Forward maximum speed limit (MAX speed)<br>P3-15 Reverse maximum speed limit (MAX speed) | Speed Limitation in Torque Mode                                                                                   | <a href="#">5.9.2.1 Internal speed mode</a>              |
| P5-27 Speed Direction Switching/SPD-D                                                                                                                                                                                    | The default direction is n.0000. If the direction is set via the SI2 terminal, P5-27 can be configured as n.0002. |                                                          |

### 5.10.1 Torque Control (Internal Settings)

| parameter                                                                                              | set value | meaning                          | revise   | come into force |
|--------------------------------------------------------------------------------------------------------|-----------|----------------------------------|----------|-----------------|
| P0-01                                                                                                  | 1         | torque control: internal setting | servo bb | immediately     |
| Function overview: The system uses the internally set torque as the torque command for torque control. |           |                                  |          |                 |

#### 5.10.1.1 Internal torque command setting

| parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | meaning                       | factory setting | unit            | Set range     | revis e     | come into force |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------|-----------------|---------------|-------------|-----------------|
| P3-33                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | internal torque command given | 0               | 1% rated torque | -1000 ~ +1000 | at any time | immediately     |
| <p>The parameter is set in 1% of the rated torque, and the positive and negative values correspond to the motor's forward and reverse rotation.</p> <p>For example, setting P3-33 to 50 indicates the motor operates at 50% of its rated torque in forward rotation.</p> <p>Setting P3-33 to -20 enables the motor to reverse at 20% of its rated torque.</p> <p>In addition to controlling the direction with torque, the /SPD-D can also be used for directional control.</p> |                               |                 |                 |               |             |                 |

## 5.10.1.2 Internal speed limit during torque control

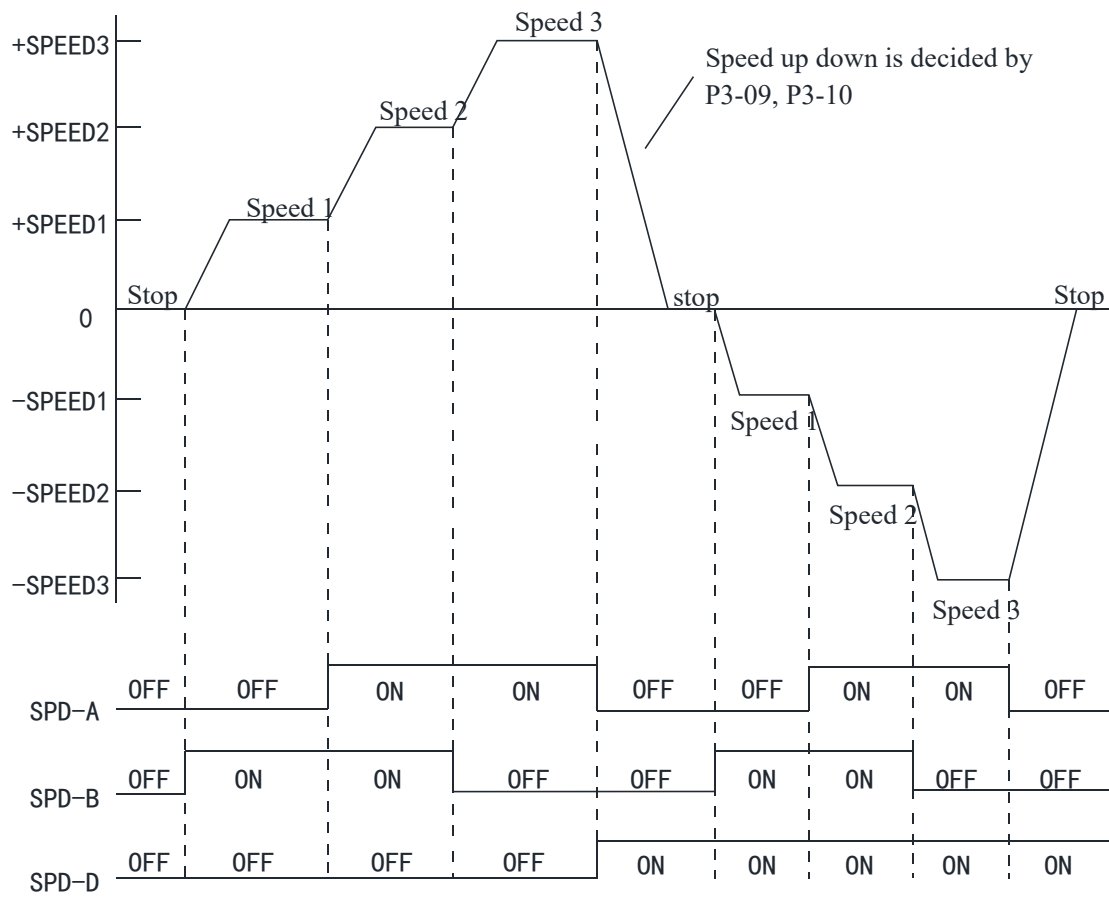
| parameter                                                                                                                                                                                         | meaning                                             | factory setting | unit | Set range | revise      | come into force |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------|------|-----------|-------------|-----------------|
| P3-16                                                                                                                                                                                             | Internal Forward Speed Limitation in Torque Control | motor rated     | rpm  | 5 ~ 10000 | at any time | immediately     |
| P3-17                                                                                                                                                                                             | Internal Reverse Speed Limitation in Torque Control | motor rated     | rpm  | 5 ~ 10000 | at any time | immediately     |
| Note: Even if the set speed of this parameter exceeds the P3-14 speed limit, the actual speed limit applied is the lower value. (The maximum speed is the smaller of P3-14/P3-15 and P3-16/P3-17) |                                                     |                 |      |           |             |                 |

## 5.10.1.3 Speed Limit Detection (/VLT)

In torque mode, if the absolute value of the servo motor's actual speed exceeds the speed limit, the system recognizes the speed as restricted and the servo driver outputs a /VLT signal. Conversely, if neither condition is met, the speed restriction signal is invalid.

| parameter                                                                                                                                                                                                                                             | Signal name | factory setting | Applicable mode | meaning               | revise      | come into force |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-----------------|-----------------------|-------------|-----------------|
| P5-43                                                                                                                                                                                                                                                 | /VLT        | n.0000          | 1、 2            | speed limit detection | at any time | immediately     |
| The default value is unassigned terminals (parameter range: 0000-0014), which are assigned to the output interface via parameter P5-43. Setting it to 0002 enables signal output from the SO2 terminal. The VLT signal is only active in torque mode. |             |                 |                 |                       |             |                 |

## Run an example



## 6. EtherCAT bus communication

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### 6.1 Overview of EtherCAT Technology

This section mainly introduces the basic concept, system composition, communication specification and connection description of EtherCAT.

#### 6.1.1 Overview of EtherCAT

EtherCAT, short for Ethernet for Control Automation Technology, is a real-time Ethernet solution developed by Beckhoff Automation GmbH for open communication between master and slave stations. As a mature industrial Ethernet technology, EtherCAT features high performance, low cost, and ease of use.

The XG2, XDH, or XLH series controllers (master stations) and DM6C servo drives (slave stations) comply with the standard EtherCAT protocol, supporting up to 64-axis slave stations with a 4ms synchronization cycle. They feature Touch Probe functionality and multiple control modes including position, speed, and torque, making them widely applicable across various industries.

#### 6.1.2 System Composition (Master Station and Slave Station)

EtherCAT operates as a linear network system connecting a master station (FA controller) with multiple slave stations.

The number of nodes connected from the station depends on the processing or communication period of the master station and the number of bytes transmitted.

## 6.2 EtherCAT Communication Specifications

This section mainly introduces the frame structure, state machine, ESC, SDO, PDO, SII region, communication synchronization mode and other contents of EtherCAT.

### 6.2.1 List of Communication Specifications

| project                                              | specifications                                         |               |                                                  |
|------------------------------------------------------|--------------------------------------------------------|---------------|--------------------------------------------------|
| physical layer                                       | 100BASE-TX (IEEE802.3)                                 |               |                                                  |
| Baud rate                                            | 100Mbps (full-duplex)                                  |               |                                                  |
| topology                                             | Line                                                   |               |                                                  |
| tie cable                                            | JC-CB/JC-CA twisted pair cable (shielded twisted pair) |               |                                                  |
| cable length                                         | The maximum distance between nodes is 50 meters.       |               |                                                  |
| communication port                                   | 2 Port (RJ45)                                          |               |                                                  |
| Station Alias (ID)                                   | Range: 0 to 65535<br>Set address: 2700h                |               |                                                  |
| Explicit Device ID                                   | nonsupport                                             |               |                                                  |
| Mail Protocol                                        | COE (CANopen Over EtherCAT)                            |               |                                                  |
| SyncManager Synchronization Manager                  | 4                                                      |               |                                                  |
| FMMU                                                 | 3                                                      |               |                                                  |
| Modes of operation control model                     |                                                        | control model |                                                  |
|                                                      | position                                               | Csp           | Cyclic synchronous position mode                 |
|                                                      |                                                        | PP            | Profile position mode                            |
|                                                      |                                                        | Hm            | Homing mode (origin reset position control mode) |
|                                                      | velocity                                               | Csv           | Cyclic synchronous speed control mode            |
|                                                      |                                                        | Pv            | Profile Velocity Mode                            |
|                                                      | torque                                                 | Cst           | Cyclic synchronous torque mode                   |
|                                                      |                                                        | Tq            | Torque Profile Mode                              |
|                                                      | Touch Probe                                            | Route 2       |                                                  |
| concurrent mode                                      | DC (Synchronous Event)                                 |               |                                                  |
| DC communication cycle                               | 250,500,1000,2000,4000,8000,10000[μs]                  |               |                                                  |
| communication object                                 | SDO[Service Data Object], PDO[Process Data Object]     |               |                                                  |
| Maximum number of PDO allocations per single station | TxPDO: 4 [units] RxPDO: 4 [units]                      |               |                                                  |
| Maximum byte count for single-site PDO               | TxPDO: 32[byte] RxPDO: 32[byte]                        |               |                                                  |
| PreOP mode email communication interval              | 1ms                                                    |               |                                                  |
| mail box                                             | SDO requests and SDO information                       |               |                                                  |





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The meanings of SDO and PDO are defined in Section 6.2.3, State Machine ESM.

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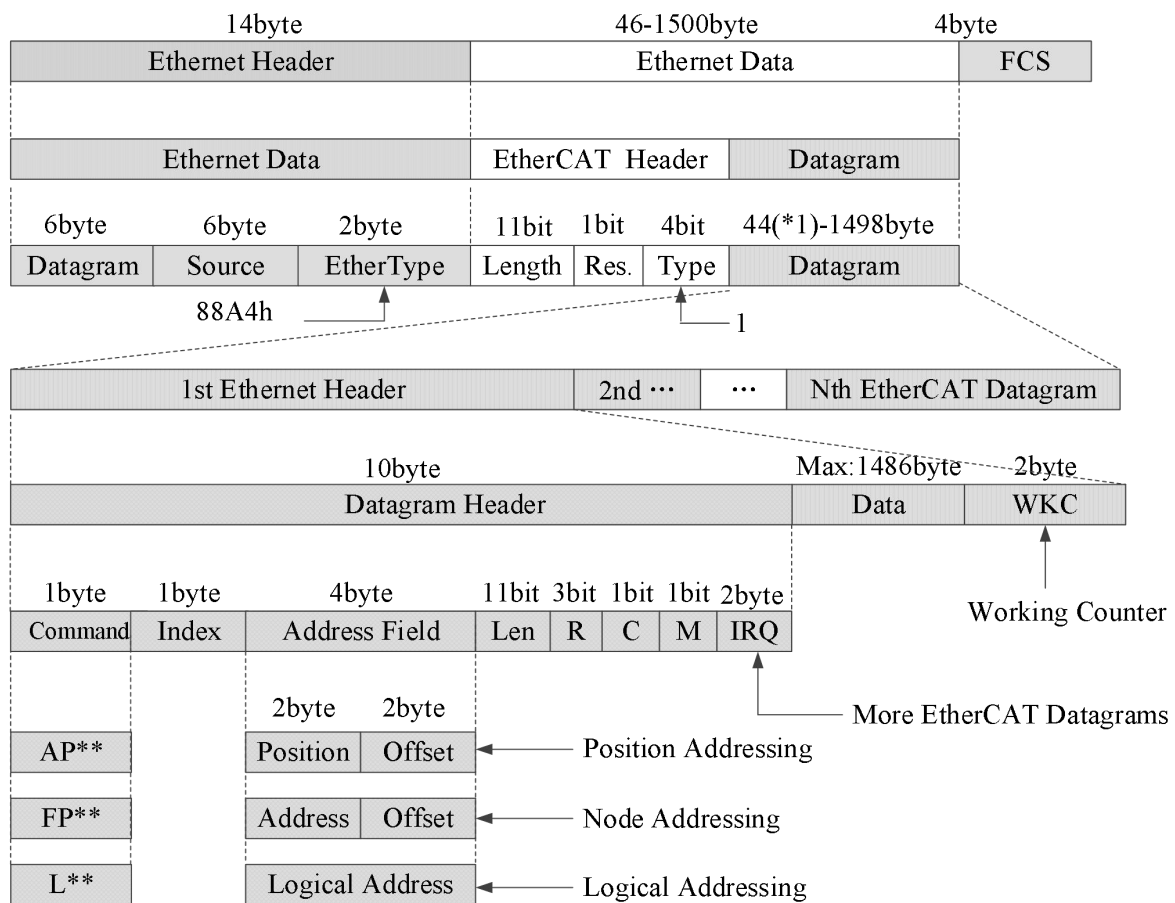
## 6.2.2 EtherCAT Frame Structure

EtherCAT is an industrial communication protocol based on Ethernet that can be controlled in real time. It is an extension of the IEEE 802.3 Ethernet specification without any changes to the basic structure, so it can transfer data in standard Ethernet frames.

Since the Ethernet Header's EtherType is "88A4h", the subsequent Ethernet Data is processed as an EtherCAT frame.

An EtherCAT frame consists of a header and one or more subframes, which are further subdivided. Only EtherCAT frames with Type=1 header are processed according to the ESC protocol.

EtherNet/EtherCAT frame structure

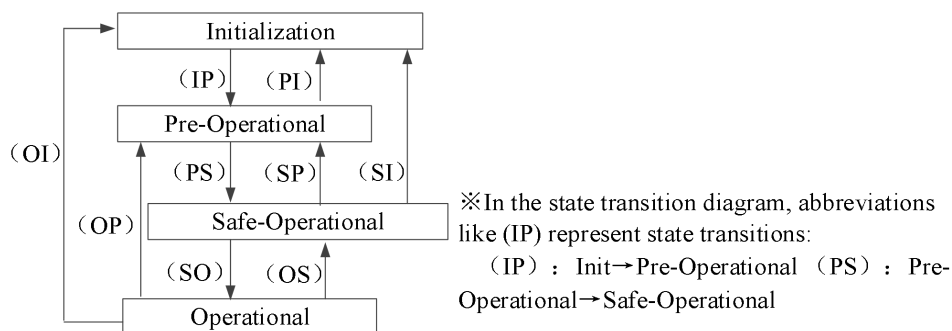


### 6.2.3 State Machine (ESM)

ESM stands for EtherCAT State Machine, which coordinates the state relationships between master and slave applications during initialization and operation.

The master station initiates a state change request and sends it to the application layer service. The application layer service then generates a control event in the slave station. The slave station responds to the application layer control service via its local application layer status write service, depending on whether the state change request succeeds or fails. If the state change fails, the slave station retains its current state and sets an error flag.

**The diagram below illustrates the state transition of ESM:**



Init: Initial state;

Init: Initial state;

Pre-Operational: The system is in a state of readiness for operation.

Safe-Operational: A state of safe operation;

Operational: Running status;

| Station status        | Actions in each state                                                           | Communication action           |                   |                           |
|-----------------------|---------------------------------------------------------------------------------|--------------------------------|-------------------|---------------------------|
|                       |                                                                                 | Send and receive emails in SDO | PDO post a letter | PDO collection of letters |
| initialization state  | Communication initialization: SDO and PDO cannot send or receive messages.      | -                              | -                 | -                         |
| Pre-run state         | Status of SDO transmission and reception only                                   | Yes                            | -                 | -                         |
| Safe operating status | The status of SDO only sending and receiving messages, and PDO sending messages | Yes                            | Yes               | -                         |
| running state         | The state where SDO and PDO can both send and receive messages.                 | Yes                            | Yes               | Yes                       |

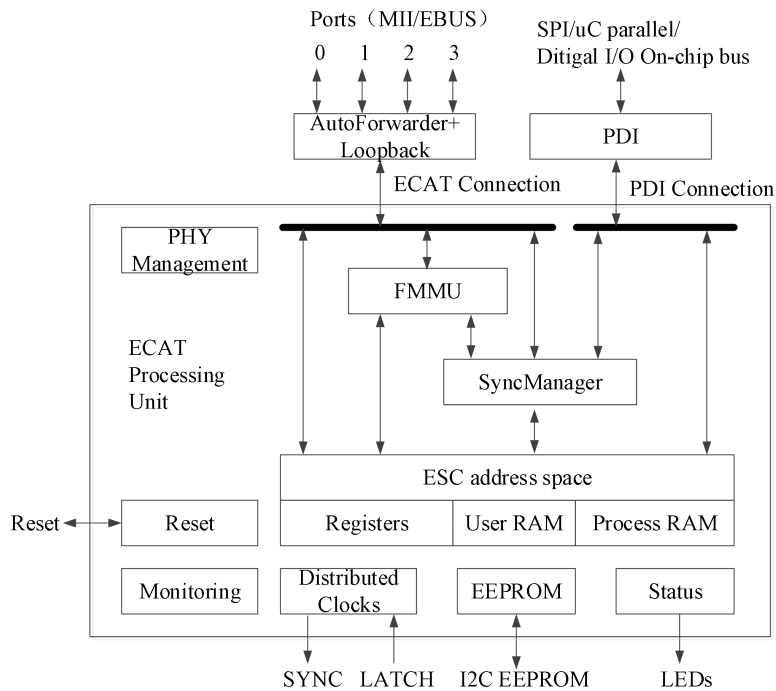


- Access to the ESC register from the master station is independent of the table above and can be performed at any time.
- PDO (Process Data Object) is used to transmit periodic communication data.
- SDO (Service Data Object) is used to transmit non-periodic communication data.
- When the ESM status switches, executing commands or interface operations may trigger communication errors.

## 6.2.4 Slave Controller (ESC)

### 6.2.4.1 Overview of the Principle

ESC stands for EtherCAT Slave Controller. It handles all communication processes and features four data ports, each with a TX and RX unit. These ports can transmit Ethernet data frames in a fixed sequence: port 0 → port 3 → port 1 → port 2 → back to port 0. When an ESC detects a port without an external PHY, it automatically closes that port and reroutes the data through an internal loop to the next port.



### 6.2.4.2 Address Space

The DM6C series features 8Kbyte physical address space.

The first 4Kbyte (0000h ~ 0FFFh) is designated as register space, while the second 4Kbyte (1000h ~ 1FFFh) is allocated as RAM for process data PDO. For register details, refer to the datasheets of IP (ET1810/ET1811/ET1812).

| ESC register address                    | byte length | explain                | Initial value*1 |
|-----------------------------------------|-------------|------------------------|-----------------|
| Information from the station controller |             |                        |                 |
| 0000h                                   | 1           | type                   | 04h             |
| 0001h                                   | 1           | Revision               | 02h             |
| 0002h~0003h                             | 2           | Build                  | 0040h           |
| 0004h                                   | 1           | FMMUs supported        | 03h             |
| 0005h                                   | 1           | SyncManagers supported | 04h             |

| ESC register address       | byte length (Byte) | explain                       | Initial value*1 |
|----------------------------|--------------------|-------------------------------|-----------------|
| 0006h                      | 1                  | RAM Size                      | 08h             |
| 0007h                      | 1                  | Port Descriptor               | 0Fh             |
| 0008h~0009h                | 2                  | ESC Features supported        | 0184h           |
| Site                       |                    |                               |                 |
| 0010h~0011h                | 2                  | Configured Station Address    | -               |
| 0012h~0013h                | 2                  | Configured Station Alias      | -               |
| ...                        |                    |                               |                 |
| data link layer            |                    |                               |                 |
| ...                        |                    |                               |                 |
| 0100h~0103h                | 4                  | ESC DL Control                | -               |
| ...                        |                    |                               |                 |
| 0110h~0111h                | 2                  | ESC DL Status                 | -               |
| application layer          |                    |                               |                 |
| 0120h~0121h                | 2                  | AL Control                    | -               |
| 0130h~0131h                | 2                  | AL Status                     | -               |
| 0134h~0135h                | 2                  | AL Status Code                | -               |
| ...                        |                    |                               |                 |
| PDI process data interface |                    |                               |                 |
| 0140h                      | 1                  | PDI Control                   | 08h             |
| 0141h                      | 1                  | ESC Configuration             | 0Ch             |
| 0150h                      | 1                  | PDI Configuration             | -               |
| 0151h                      | 1                  | SYNC/LATCH PDI Configuration  | 66h             |
| 0152h~153h                 | 2                  | Extend PDI Configuration      | -               |
| ...                        |                    |                               |                 |
| watchdog                   |                    |                               |                 |
| 0400h~0401h                | 2                  | Watchdog Divider              | -               |
| 0410h~0411h                | 2                  | Watchdog Time PDI             | -               |
| 0420h~0421h                | 2                  | Watchdog Time Process Data    | -               |
| 0440h~0441h                | 2                  | Watchdog Status Process Data  | -               |
| 0442h                      | 1                  | Watchdog Counter Process Data | -               |
| 0443h                      | 1                  | Watchdog Counter PDI          | -               |
| ...                        |                    |                               |                 |
| FMMU                       |                    |                               |                 |
| 0600h~062Fh                | 3x16               | FMMUs[2:0]                    | -               |
| +0h~3h                     | 4                  | Logical Start Address         | -               |

| ESC register address                   | byte length (Byte) | explain                                      | Initial value*1 |
|----------------------------------------|--------------------|----------------------------------------------|-----------------|
| +4h~5h                                 | 2                  | Length                                       | -               |
| +6h                                    | 1                  | Logical Start bit                            | -               |
| +7h                                    | 1                  | Logical Stop bit                             | -               |
| +8h~9h                                 | 2                  | Physical Start Address                       | -               |
| +Ah                                    | 1                  | Physical Start bit                           | -               |
| +Bh                                    | 1                  | Type                                         | -               |
| +Ch                                    | 1                  | Activate                                     | -               |
| +Dh~Fh                                 | 3                  | Reserved                                     | -               |
| ...                                    |                    |                                              |                 |
| Distributed Clocks (DC) -SYNC Out Unit |                    |                                              |                 |
| 0981h                                  | 1                  | Activation                                   | -               |
| ...                                    |                    |                                              |                 |
| 0984h                                  | 1                  | Activation Status                            | -               |
| 098Eh                                  | 1                  | SYNCO Status                                 | -               |
| ...                                    |                    |                                              |                 |
| 0990h~0993h                            | 4                  | Start Time Cyclic Operation/Next SYNCO Pulse | -               |
| ...                                    |                    |                                              |                 |
| 09A0h~09A3h                            | 4                  | SYNCO Cycle Time                             | -               |
| ...                                    |                    |                                              |                 |

### 6.2.5 SII region (0000h ~ 003Fh)

In the ESC configuration area (EEPROM word address 0000h-0007h), the Configured Station Alias is automatically read and written into the ESC register after the driver power is powered on. To reflect the updated SII EEPROM values in the ESC register, a power restart is required. Additionally, the initial values of the IP cores (ET1810/ET1811/ET1812) are preconfigured. For detailed specifications, please refer to the datasheets of the IP cores (ET1810/ET1811/ET1812).

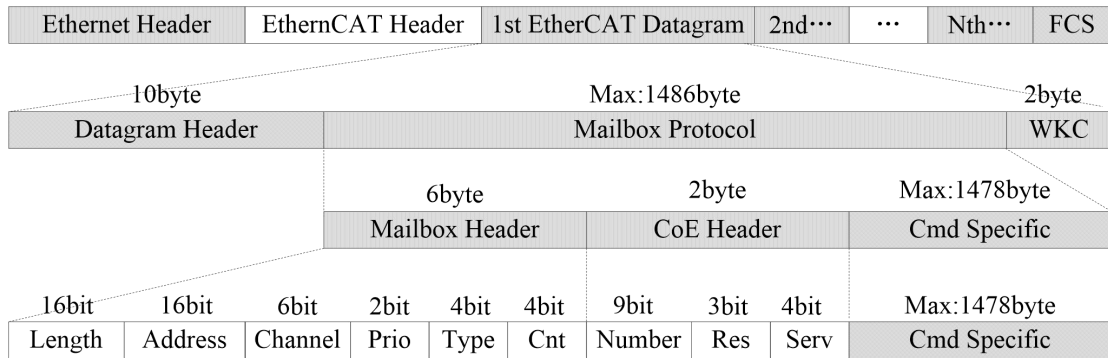
### 6.2.6 SDO (Service Data Object)

The DM6C series supports SDO (Service Data Objects). Since SDO data exchange uses Mailbox communication, the SDO data refresh time becomes unstable.

The master station accesses object dictionary records for data operations, enabling object configuration and slave status monitoring. SDO read/write operations require time to respond. For PDO-renewed objects, avoid SDO refreshes and instead overwrite with PDO values.

### 6.2.6.1 Mailbox Frame Structure

The frame structure of Mailbox/SDO is as follows. For details, please refer to the ETG specifications (ETG1000-5 and ETG1000-6).



| frame portion  | list range             | data type | function                                                                                                                                                                                      |
|----------------|------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MailBox Header | Length                 | WORD      | Mailbox data length                                                                                                                                                                           |
|                | Address                | WORD      | Sender's site address                                                                                                                                                                         |
|                | Channel                | Unsigned6 | (Reserved)                                                                                                                                                                                    |
|                | Priority               | Unsigned2 | Priority                                                                                                                                                                                      |
|                | Type                   | Unsigned4 | Mailbox type<br>00h: Error<br>01h: (Reserved)<br>02h: EoE (Not available)<br>03h: CoE<br>04h: FoE (Not available)<br>05h: SoE (Not available)<br>06h-0Eh: (Reserved)<br>0Fh: VoE (Not mapped) |
|                | Cnt                    | Unsigned3 | Mailbox Counter                                                                                                                                                                               |
|                | Reserved               | Unsigned1 | (Reserved)                                                                                                                                                                                    |
|                |                        |           |                                                                                                                                                                                               |
| CoE Header     | Number                 | Unsigned9 | Reserved                                                                                                                                                                                      |
|                | Reserved               | Unsigned3 | Reserved                                                                                                                                                                                      |
|                | Service                | Unsigned4 | Informational                                                                                                                                                                                 |
| Cmd specific   | Size Indicator         | Unsigned1 | Data Set Size License                                                                                                                                                                         |
|                | Transfer Type          | Unsigned1 | Normal transfer/Expedited transfer option                                                                                                                                                     |
|                | Data Set Size          | Unsigned2 | Specify data size                                                                                                                                                                             |
|                | Complete accessibility | Unsigned1 | Object access method selection (not applicable)                                                                                                                                               |
|                | Command Specfier       | Unsigned3 | Upload/Download Request/Response options                                                                                                                                                      |

| frame portion | list range          | data type | function                           |
|---------------|---------------------|-----------|------------------------------------|
|               | index of matrix     | WORD      | Object index                       |
|               | Sub index of matrix | BYTE      | Subindex of the object             |
|               |                     |           | Object data or Abort message, etc. |

### 6.2.6.2 Mailbox timeout

This servo driver performs the following timeout settings in Mailbox communication.

Mailbox request timeout: 100ms

The master station sends a request to the slave station (driver). If the WKC of the transmitted data in the request frame is updated, the slave station is considered to have received the request normally. The master station retries until the WKC is updated. If the WKC remains unchanged after the set time, the master station times out.

Mailbox response timeout: 10s

The master station receives responses from slave stations (drives). If the WKC is updated, it is considered a normal response. If the WKC update response is not received within the set time, the master station times out.

The maximum time required for the response to complete from the station (driver).

### 6.2.6.3 Information when abnormal alarm occurs

#### 1) Alarm code

The error code returns the same value as 603Fh (Error code).

000h ~ FEFFh is defined according to IEC61800-7-201.

The FF00h ~ FFFFh range is manufacturer-defined, as specified below.

| index of matrix | subindex | name                                                                                                                                                                                                                                                                                                         | scope   | data type | accessibility | PDO   | Op-mode |
|-----------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------|---------------|-------|---------|
|                 | x        |                                                                                                                                                                                                                                                                                                              |         |           |               |       |         |
|                 |          | Error code                                                                                                                                                                                                                                                                                                   | 0-65535 | U16       | ro            | TxPDO | All     |
| 603Fh           | 00h      | <p>The alarm number generated by the servo driver: General Alarm 603F displays the complete error code, while bus-related alarms show the main alarm number. Display 0000h when no alarm occurs.</p> <p>When an alarm is triggered, the alarm (main) number (00h ~ FFh) displays FF**h.</p> <p>example :</p> |         |           |               |       |         |



|  |  |                                                                                                                                                                                                                                                                                                                                                                                                            |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>①When a general alarm (e.g., E-030 overvoltage protection) occurs, 603F = 30d</p> <p>②Bus-related alarms such as E-850 (TxPDO configuration error protection) and E-851 (RxPDO configuration error protection).<br/>603F = FF55h... 55h=85d, meaning either E-850 or E-851 will be affected<br/>As an exception, when E-817 (SyncManager2/3 configuration error) occurs, the system displays A000h.</p> |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 2) Alarm type (status)

The error register returns the same value as 1001h.

| index of matrix                                                                                                                                     | subindex                                  | name                                                                                                                                  | scope                                                 | data type | accessibility | PDO   | Op-mode |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------|---------------|-------|---------|
| 1001h                                                                                                                                               | 00h                                       | Error register                                                                                                                        | 0-65535                                               | U16       | ro            | TxPDO | All     |
|                                                                                                                                                     |                                           | Displays the type of alarm (status) occurring in the servo driver.<br>Display 0000h when no alarm occurs.<br>Do not show the warning. |                                                       |           |               |       |         |
|                                                                                                                                                     |                                           | Bit                                                                                                                                   | content                                               |           |               |       |         |
|                                                                                                                                                     |                                           | 0                                                                                                                                     | nonsupport                                            |           |               |       |         |
|                                                                                                                                                     |                                           | 1                                                                                                                                     |                                                       |           |               |       |         |
|                                                                                                                                                     |                                           | 2                                                                                                                                     |                                                       |           |               |       |         |
|                                                                                                                                                     |                                           | 3                                                                                                                                     |                                                       |           |               |       |         |
|                                                                                                                                                     |                                           | 4                                                                                                                                     | The AL status code defines the alarm occurrence<br>*1 |           |               |       |         |
|                                                                                                                                                     |                                           | 5                                                                                                                                     | nonsupport                                            |           |               |       |         |
|                                                                                                                                                     |                                           | 6                                                                                                                                     | continue to have                                      |           |               |       |         |
| 7                                                                                                                                                   | AL status code undefined alarm occurred*2 |                                                                                                                                       |                                                       |           |               |       |         |
| *1: The term "AL status code-defined alarm" refers to communication-related anomalies in EtherCAT, specifically E-800~7, E-810~7, and E-850~7.      |                                           |                                                                                                                                       |                                                       |           |               |       |         |
| *2: The term "AL status code undefined alarm" refers to EtherCAT communication-related anomalies (E-880~7) and non-communication-related anomalies. |                                           |                                                                                                                                       |                                                       |           |               |       |         |

## 6.2.7 PDO (Process Data Object)

The DM6C series supports PDO (Process Data Object).

The real-time data transfer based on EtherCAT is conducted through PDO (Process Data Object) data exchange.

PDO includes RxPDO for data transfer from master to slave and TxPDO for transmission from slave to master.

|       | Sender        | Recipient     |
|-------|---------------|---------------|
| RxPDO | main station  | slave station |
| TxPDO | slave station | main station  |

### 6.2.7.1 PDO Mapping Objects

PDO mapping refers to the process of mapping from an object dictionary to the application objects of PDO.

The DM6C series PDO mapping table supports mapping objects for RxPDO (1600h ~ 1603h) and

TxPDO (1A00h ~ 1A03h).

The maximum number of application objects a mapping object can map is as follows:

TxPDO: 32[byte]      RxPDO: 32[byte]

The following is an example of PDO mapping configuration.

<Example Settings>

The application objects 6040h, 6060h, 607Ah, and 60B8h are mapped to the target object 1600h (Receive PDO mapping 1: RxPDO\_1).

| index of matrix | Sub | Object contents      |     |
|-----------------|-----|----------------------|-----|
| 1600h           | 00h | 04h                  |     |
|                 | 01h | 6040 00 10 h         |     |
|                 | 02h | 6060 00 08 h         |     |
|                 | 03h | 607A 00 20 h         |     |
|                 | 04h | 60B8 00 10 h         |     |
|                 | 05h | 0000 00 00 h         |     |
|                 | ... |                      |     |
|                 | 18h | 0000 00 00 h         |     |
| 6040h           | 00h | Controlword          | U16 |
| 6060h           | 00h | Mode of operation    | I8  |
| 607Ah           | 00h | Target Position      | I32 |
| 60B8h           | 00h | Touch probe function | U16 |

### 6.2.7.2 PDO Allocation Targets

To enable PDO data exchange, the SyncManager must be assigned a PDO mapping table. The relationship between the PDO mapping table and SyncManager is defined in the PDO allocation object. For the DM6C series, the PDO allocation object can utilize RxPDO (SyncManager2) with 1C12h or TxPDO (SyncManager3) with 1C13h.

The maximum number of application objects a mapping object can map is as follows:

RxPDO: 4 [Table] (1600h ~ 1603h) .

RxPDO: 4 [Table] (1A00h ~ 1A03h) .

Since mapping usually requires only one object, the default setting remains unchanged.

Example of setting PDO allocation objects:

The allocation of mapping object 1600h to allocation object 1C12h (Sync Manager Channel 2).

| index of matrix | Sub | Object contents |
|-----------------|-----|-----------------|
| 1C12h           | 00h | 01h             |
|                 | 01h | 1600h           |
|                 | 02h | 0000h           |
|                 | 03h | 0000h           |
|                 | 04h | 0000h           |

The allocation of mapping object 1A00h to allocation object 1C13h (Sync Manager Channel 3).

| index of matrix | Sub | Object contents |
|-----------------|-----|-----------------|
| 1C13h           | 00h | 01h             |
|                 | 01h | 1A00h           |
|                 | 02h | 0000h           |
|                 | 03h | 0000h           |
|                 | 04h | 0000h           |

### 6.2.8 Communication Synchronization Mode

The DM6C series supports the following synchronization modes.

| Sync mode | content                     | Synchronization method                                            | feature                                                                                                                       |
|-----------|-----------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| DC        | SYNC0 event synchronization | Sync the time information of other slaves with the time on axis 1 | high-accuracy<br>Compensation processing is required on the master site side.                                                 |
| SM2       | SM2 event synchronization   | Synchronize based on the RxPDO's receipt time                     | No transmission delay compensation, low accuracy<br>The controller must maintain transmission time (e.g., dedicated hardware) |
| FreeRun   | nonsynchronous              | nonsynchronous                                                    | Simple to handle                                                                                                              |

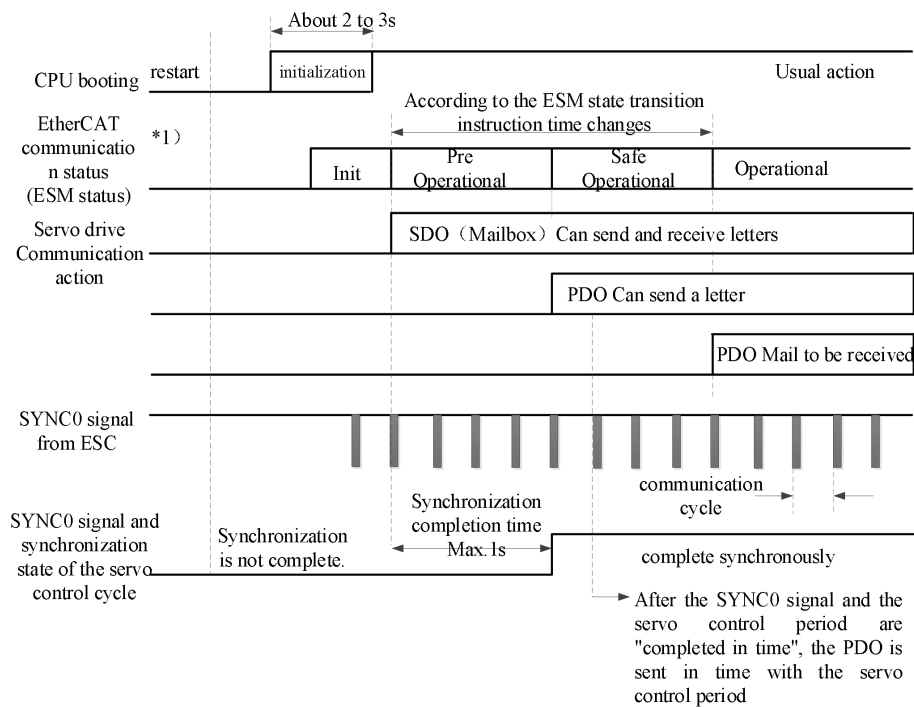
|  |  |                            |
|--|--|----------------------------|
|  |  | Poor real-time performance |
|--|--|----------------------------|

### 6.2.8.1 DC (SYNC0 event synchronization)

The DM6C series features a 64-bit DC (Distributed Clock) system.

EtherCAT communication synchronization is based on this DC. The slave node synchronizes via a shared System Time clock. Its local cycle starts at the SYNC0 event. Since slave processing (servo processing) begins at the SYNC0 event cycle, it remains synchronized with the SYNC0 event.

During communication initialization, the master station requires transmission delay compensation (offset compensation) and periodic deviation compensation. The diagram below illustrates the synchronization process from the control power supply's SYNC0 event input to the slave's processing (servo processing).



### 6.2.8.2 SM2 (SM2 Event Synchronization)

The local period of the station starts from the SM2 event.

Since the processing of the slave station starts at the SM2 event cycle, it is always synchronized with the SM2 event.

Since the SM2 event occurs upon completion of PDO's message reception, it is essential to ensure the master station's scheduled message transmission. Significant deviations in transmission timing may cause synchronization failure or trigger alarms.

If the above issues occur, use DC (SYNC0 event synchronization).

### 6.2.9 LED indicator lights

The XG2 series features two EtherCAT indicator LEDs: L/A IN and L/A OUT.

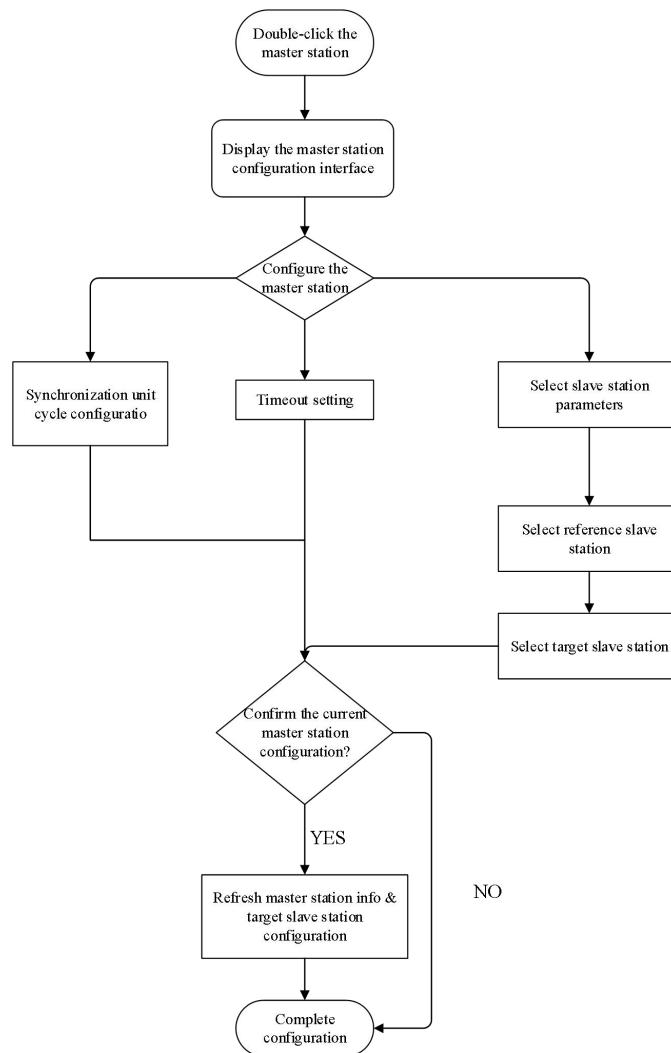
The L/A IN and L/A OUT indicator lights indicate the LINK status and operational status of the physical layer at each port.

The light is green.

| LED state | content                                         |
|-----------|-------------------------------------------------|
| OFF dark  | Link not established                            |
| twinkle   | Link setup with data transmission and reception |
| ON bright | Link established, no data transmission          |

## 7. EtherCAT bus control mode

### 7.1 EtherCAT operation



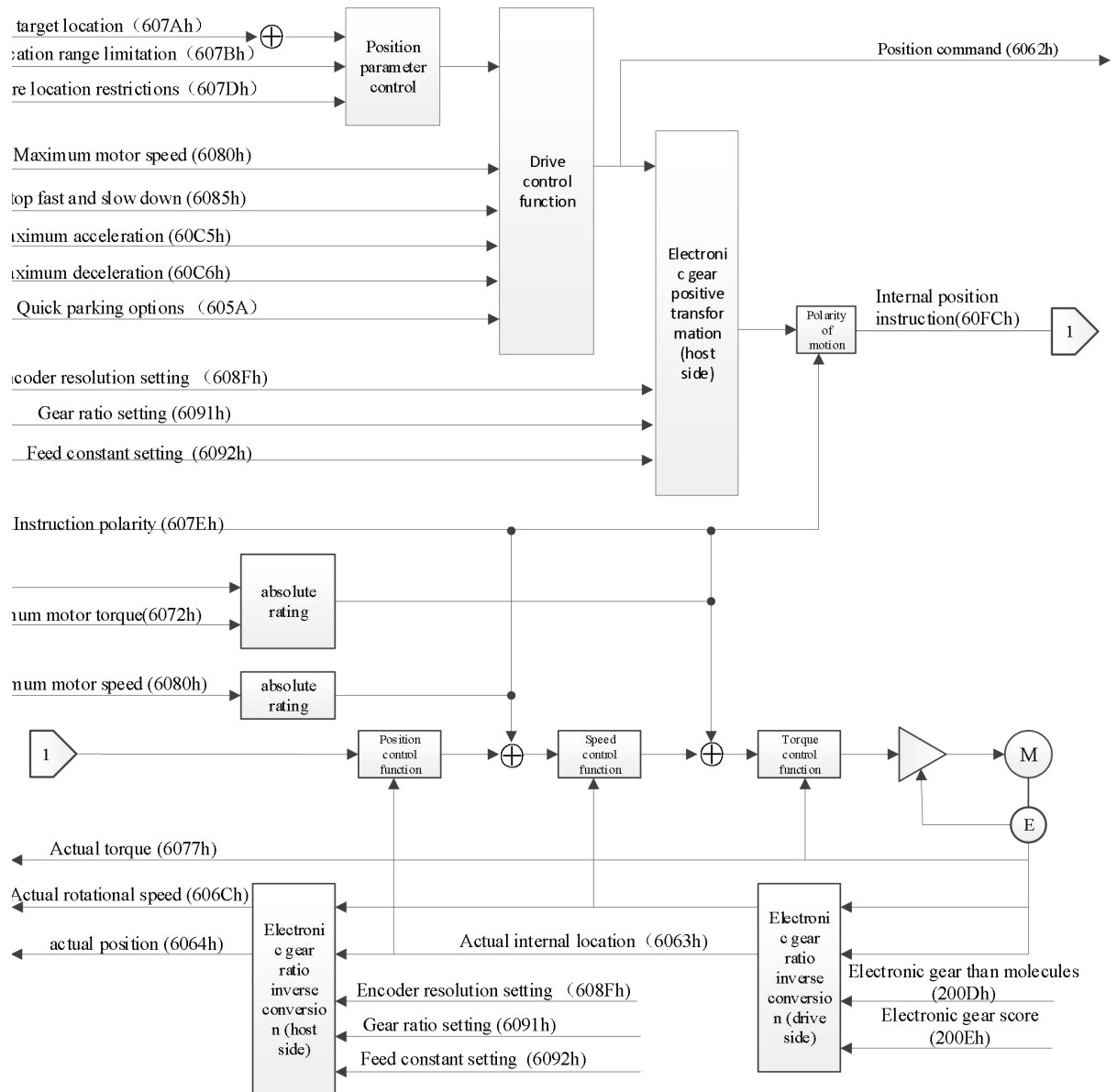
The table below lists the mandatory parameters required for configuration under the CSP, CSV, CST, PP, PV, and TQ modes.

| register      | explain                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RXPDO[0x6040] | Control words must be added to the PDO configuration. They cannot be modified through IO mapping in CSP, CSV, or CST modes and are controlled by the NC module. |
| RXPDO[0x6060] | Mode control words must be added to the PDO configuration and can be modified via IO mapping in task mode.                                                      |
| RXPDO[0x607A] | The target location, which is the program-specified location, must be added to the PDO configuration.                                                           |
| TXPDO[0x6041] | Status characters must be added to PDO configuration                                                                                                            |

|               |                                                             |
|---------------|-------------------------------------------------------------|
| TXPDO[0x6061] | Status characters must be added to PDO configuration        |
| TXPDO[0x6064] | The actual location must be added to the PDO configuration. |
| TXPDO[0x606C] | The actual speed must be added to the PDO configuration.    |

## 7.2CSP pattern

CSP (Cycle Synchronization Positioning Mode) uses a trajectory calculated by the host computer to periodically send target positions to the slave station.



## 7.2.1 Relevant parameters

### 1) CSP control mode associated objects (commands, settings)

| index of matrix | subindex | name         | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|--------------|------|---------|-----------|---------------|-------|
| 6040h           | 00h      | control word | -    | 0~65535 | U16       | rw            | RxPDO |

Other locations control common associated objects.

| index of matrix | son index of matrix | name                                 | unit             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|---------------------|--------------------------------------|------------------|------------------------|-----------|-----------------------|-------|
| 6072h           | 00h                 | maximum torque                       | 0.1%             | 0~65535                | U16       | rw                    | RxPDO |
| 607Ah           | 00h                 | target location                      | instruction unit | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Dh           | -                   | software absolute position limit     | -                | -                      | -         | -                     | -     |
|                 | 00h                 | Indicates the 607Dh sub-index number | -                | 2                      | U8        | ro                    | NO    |
|                 | 01h                 | Minimum position limit               | instruction unit | -2147483648~2147483647 | I32       | rw                    | RxPDO |
|                 | 02h                 | Maximum location limit               | instruction unit | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Fh           | 00h                 | maximum outline velocity             | Command unit/s   | 0~4294967295           | U32       | rw                    | RxPDO |
| 60B1h           | 00h                 | jitter                               | Command unit/s   | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 60B2h           | 00h                 | torque deviation                     | 0.1%             | -32768~32767           | I16       | rw                    | RxPDO |

There are also other related objects with common actions.

| index of matrix | son index of matrix | name                      | unit | scope | data type | Available inquisitive | PDO |
|-----------------|---------------------|---------------------------|------|-------|-----------|-----------------------|-----|
| 605Ah           | 00h                 | Quick Stop Mode Selection | -    | 0~7   | I16       | rw                    | NO  |
| 605Bh           | 00h                 | Close method selection    | -    | 0~1   | I16       | rw                    | NO  |
| 605Ch           | 00h                 | Pause shutdown method     | -    | 0~1   | I16       | rw                    | NO  |
| 605Dh           | 00h                 | Pause option code         | -    | 1~3   | I16       | rw                    | NO  |
| 605Eh           | 00h                 | failure mode and          | -    | 0~2   | I16       | rw                    | NO  |



| index of matrix | son index of matrix | name                                 | unit                                               | scope                  | data type | Avail able inquis itive | PDO   |
|-----------------|---------------------|--------------------------------------|----------------------------------------------------|------------------------|-----------|-------------------------|-------|
|                 |                     | effect code                          |                                                    |                        |           |                         |       |
| 607Dh           | -                   | Software location restrictions       | -                                                  | -                      | -         | -                       | -     |
|                 | 00h                 | Indicates the 607h sub-index number  | -                                                  | 2                      | U8        | ro                      | NO    |
|                 | 01h                 | Minimum position limit               | instruction unit                                   | -2147483648~2147483647 | I32       | rw                      | RxPDO |
|                 | 02h                 | Maximum location limit               | instruction unit                                   | -2147483648~2147483647 | I32       | rw                      | RxPDO |
| 607Ch           | 00h                 | Origin offset                        | instruction unit                                   | -2147483648~2147483647 | I32       | rw                      | RxPDO |
| 607Eh           | 00h                 | Instruction polarity                 | -                                                  | 0~255                  | U8        | rw                      | NO    |
| 6085h           | 00h                 | Quick parking deceleration           | instruction units/s <sup>2</sup>                   | 0~4294967295           | U32       | rw                      | RxPDO |
| 6086h           | 00h                 | Location trajectory planning type    | -                                                  | -32768~32767           | I16       | rw                      | RxPDO |
| 608Fh           | -                   | Position encoder resolution setting  | -                                                  | -                      | -         | -                       | -     |
|                 | 00h                 | Indicates the 608Fh sub-index number | -                                                  | 2                      | U8        | ro                      | NO    |
|                 | 01h                 | Encoder movement amount              | pulse                                              | 1~4294967295           | U32       | ro                      | NO    |
|                 | 02h                 | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295           | U32       | ro                      | NO    |
| 6091h           | -                   | Gear ratio settings                  | -                                                  | -                      | -         | -                       | -     |
|                 | 00h                 | Indicates the 6091h sub-index number | -                                                  | 2                      | U8        | ro                      | NO    |
|                 | 01h                 | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295           | U32       | rw                      | NO    |

| index of matrix | son index of matrix | name                                 | unit             | scope        | data type | Available inquisitive | PDO   |
|-----------------|---------------------|--------------------------------------|------------------|--------------|-----------|-----------------------|-------|
|                 | 02h                 | rotation number                      | r ( axle )       | 1~4294967295 | U32       | rw                    | NO    |
| 6092h           | -                   | Feed constant settings               | -                | -            | -         | -                     | -     |
|                 | 00h                 | Indicates the 6092h sub-index number | -                | 2            | U8        | ro                    | NO    |
|                 | 01h                 | Set the Feed value                   | instruction unit | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h                 | Axis rotation number                 | r ( axle )       | 1~4294967295 | U32       | rw                    | NO    |
| 60B8h           | 00h                 | Probe mode                           | -                | 0~65535      | U16       | rw                    | RxPDO |

Control word (6040h) <cspFunction in control mode>

| index of matrix | subindex | name                                                                          | unit    | scope | data type | PDO   | Op-mode |                                                       |    |    |
|-----------------|----------|-------------------------------------------------------------------------------|---------|-------|-----------|-------|---------|-------------------------------------------------------|----|----|
| 6040h           | 00h      | control word                                                                  | 0~65535 | U16   | Rw        | RxPDO | All     |                                                       |    |    |
|                 |          | Set the control command for the PDS state transition and other servo drivers. |         |       |           |       |         |                                                       |    |    |
|                 |          | bit information                                                               |         |       |           |       |         |                                                       |    |    |
|                 |          | 15                                                                            | 14      | 13    | 12        | 11    | 10      | 9                                                     | 8  |    |
|                 |          | R                                                                             |         |       |           |       |         | om                                                    | h  |    |
|                 |          | 7                                                                             | 6       | 5     | 4         | 3     | 2       | 1                                                     | 0  |    |
|                 |          | fr                                                                            | oms     |       |           |       | eo      | qs                                                    | ev | so |
|                 |          |                                                                               | r       | r     | r         |       |         |                                                       |    |    |
|                 |          | r = reserved (not mapped) fr = fault reset                                    |         |       |           |       |         | r = reserved (not mapped) fr = fault reset            |    |    |
|                 |          | oms = operation mode specific                                                 |         |       |           |       |         | eo = enable operation                                 |    |    |
|                 |          | (The control mode depends on the bit) qs = quick stop                         |         |       |           |       |         | (The control mode depends on the bit) qs = quick stop |    |    |
|                 |          | h = halt                                                                      |         |       |           |       |         | ev = enable voltage                                   |    |    |
|                 |          | h = halt                                                                      |         |       |           |       |         | ev = enable voltage                                   |    |    |
|                 |          | so = switch on                                                                |         |       |           |       |         |                                                       |    |    |

The CSP mode does not utilize the OMS bit.

## 2) Objects associated with the CSP control mode (monitoring type)

| index of matrix | subindex | name       | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|------------|------|---------|-----------|---------------|-------|
| 6041h           | 00h      | Statusword | -    | 0~65535 | U16       | ro            | TxPDO |

There are also other objects with common location control.

| index of matrix | subindex | name                                               | unit             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|----------------------------------------------------|------------------|------------------------|-----------|-----------------------|-------|
| 6062h           | 00h      | position instruction                               | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6063h           | 00h      | Internal actual location                           | pulse            | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6064h           | 00h      | physical location                                  | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6065h           | 00h      | Excessive position deviation threshold             | instruction unit | 0~4294967295           | U32       | rw                    | RxPDO |
| 6066h           | 00h      | Error timeout                                      | 1ms              | 0~65535                | U16       | rw                    | RxPDO |
| 6067h           | 00h      | Location reaches the threshold                     | instruction unit | 0~4294967295           | U32       | rw                    | RxPDO |
| 6068h           | 00h      | Time to reach the position threshold               | 1ms              | 0~65535                | U16       | rw                    | RxPDO |
| 606Ch           | 00h      | actual speed of motor                              | Command unit/s   | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6074h           | 00h      | internal command torque                            | 0.1%             | -32768~32767           | I16       | ro                    | TxPDO |
| 6076h           | 00h      | motor rated torque                                 | Mn·m             | 0~4294967295           | U32       | ro                    | TxPDO |
| 6077h           | 00h      | actual torque                                      | 0.1%             | -32768~32767           | I16       | ro                    | TxPDO |
| 60F4h           | 00h      | indicates positional deviation<br>(= PERR)         | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60FAh           | 00h      | internal instruction speed<br>Position loop output | Command unit/s   | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60FCh           | 00h      | internal location instruction                      | pulse            | -2147483648~2147483647 | I32       | ro                    | TxPDO |

There are also other objects with common action.

| index of matrix | son index of matrix | name                                                         | unit          | scope                   | data type | Available inquisitive | PDO   |
|-----------------|---------------------|--------------------------------------------------------------|---------------|-------------------------|-----------|-----------------------|-------|
| 603Fh           | 00h                 | Error code                                                   | -             | 0~65535                 | U16       | ro                    | TxPDO |
| 60B9h           | 00h                 | Indicates the status of the Touch probe function             | -             | 0~65535                 | U16       | ro                    | TxPDO |
| 60BAh           | 00h                 | Indicates the rising edge clamping position of Touch probe1  | instruct unit | -2147483648 ~2147483647 | I32       | ro                    | TxPDO |
| 60BBh           | 00h                 | Indicates the falling edge clamping position of Touch probe1 | instruct unit | -2147483648 ~2147483647 | I32       | ro                    | TxPDO |
| 60BCh           | 00h                 | Indicates the rising edge clamping position of Touch probe2  | instruct unit | -2147483648 ~2147483647 | I32       | ro                    | TxPDO |
| 60BDh           | 00h                 | Indicates the falling edge clamping position of Touch probe2 | instruct unit | -2147483648 ~2147483647 | I32       | ro                    | TxPDO |

Status word (6041h) <espFunction in control mode>

| index of matrix                                       | subindex | name                                      | scope   | data type       | accessibility | PDO                        | Op-mode |     |      |   |
|-------------------------------------------------------|----------|-------------------------------------------|---------|-----------------|---------------|----------------------------|---------|-----|------|---|
| 6041h                                                 | 00h      | status word                               | 0~65535 | U16             | ro            | TxPDO                      | All     |     |      |   |
|                                                       |          | Indicates the status of the servo driver. |         |                 |               |                            |         |     |      |   |
|                                                       |          | bit information                           |         |                 |               |                            |         |     |      |   |
|                                                       |          | 15                                        | 14      | 13              | 12            | 11                         | 10      | 9   | 8    |   |
|                                                       |          | r                                         |         | oms             |               |                            | ila     | oms | rm   | r |
|                                                       |          |                                           |         | Following error |               | Drive follow Command value |         | r   |      |   |
|                                                       |          | 7                                         | 6       | 5               | 4             | 3                          | 2       | 1   | 0    |   |
|                                                       |          | w                                         | sod     | qs              | Ve            | f                          | oe      | so  | rsto |   |
|                                                       |          | r = reserved (not mapped) w = warning     |         |                 |               |                            |         |     |      |   |
|                                                       |          | r = reserved                              |         |                 |               |                            |         |     |      |   |
|                                                       |          | (not mapped) w = warning                  |         |                 |               |                            |         |     |      |   |
|                                                       |          | sod = switch on disabled                  |         |                 |               |                            |         |     |      |   |
|                                                       |          | oms = operation mode specific             |         |                 |               |                            |         |     |      |   |
|                                                       |          | qs = quick stop                           |         |                 |               |                            |         |     |      |   |
|                                                       |          | oms = operation mode specific             |         |                 |               |                            |         |     |      |   |
| qs = quick stop                                       |          |                                           |         |                 |               |                            |         |     |      |   |
| Control mode depends on the bit: ve = voltage enabled |          |                                           |         |                 |               |                            |         |     |      |   |
| Control mode depends on the bit: ve = voltage enabled |          |                                           |         |                 |               |                            |         |     |      |   |
| ila = internal limit active                           |          |                                           |         |                 |               |                            |         |     |      |   |
| f = fault                                             |          |                                           |         |                 |               |                            |         |     |      |   |
| ila = internal limit active                           |          |                                           |         |                 |               |                            |         |     |      |   |
| f = fault                                             |          |                                           |         |                 |               |                            |         |     |      |   |
| oe = operation enabled                                |          |                                           |         |                 |               |                            |         |     |      |   |
| rm = remote                                           |          |                                           |         |                 |               |                            |         |     |      |   |
| so = switched on                                      |          |                                           |         |                 |               |                            |         |     |      |   |
| rm = remote                                           |          |                                           |         |                 |               |                            |         |     |      |   |
| so = switched on                                      |          |                                           |         |                 |               |                            |         |     |      |   |
| rtso = ready to switch on                             |          |                                           |         |                 |               |                            |         |     |      |   |

bit13,12,10 (operation mode specific) :

| Bit | name             | price | definition                                                                                                                                                                                                                                    |
|-----|------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | continue to have | -     | unused                                                                                                                                                                                                                                        |
| 12  | Confirm settings | 0     | Do not perform actions based on target location                                                                                                                                                                                               |
|     |                  | 1     | Perform actions based on target location                                                                                                                                                                                                      |
| 13  | tracking error   | 0     | 60F4h (instruction deviation) = 6062h (position command) – 6064h (position feedback), provided that the result does not exceed 6065h (over-deviation threshold). Alternatively, if 60F4h exceeds 6065h, the system will not proceed to 6066h. |
|     |                  | 1     | The value of 60F4h (instruction deviation) exceeds the set range of 6065h (excessive position deviation threshold) and has exceeded the time limit of 6066h (follow-up error timeout).                                                        |

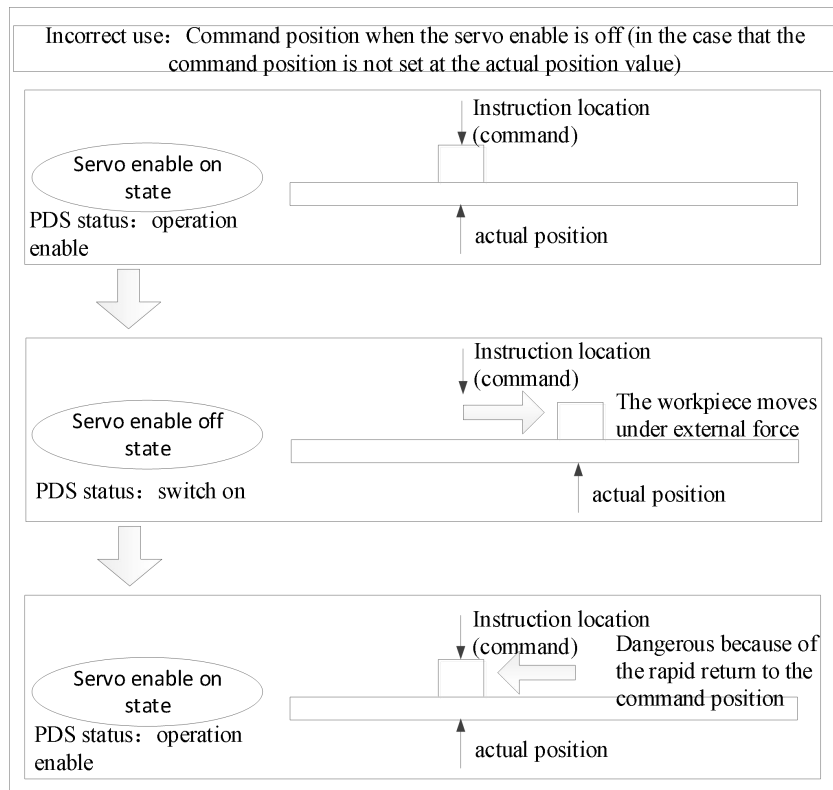


The term "Action based on target location" means that if all the following conditions are met:

- ◆ PDS status initiates the operation.
- ◆ Not in a halt state (Halt, Quickstop, Shutdown, Disable operation, Falut);
- ◆ Not in Halt stop state.

#### CSP control mode action

- The cyclic position control mode generates the action model (orbit) through the host rather than the slave.
- The target position is the sum of 607Ah (position given) and 60B0h (position feedforward), which should be interpreted as the absolute position.
- The update (send) of the operation command requires approximately 100 milliseconds after the operation enabled command is activated.
- 60C2h (Interpolation time period) is the update cycle for two objects: 607Ah (position given) and 60B0h (position feedforward). This value matches the 1C32h-02h (Cycle time). The host must update the target position using the 60C2h cycle.
- When servo enable is disabled, the host system should implement a control scheme combining 607Ah (position setpoint) + 60B0h (position feedforward) with 6064h (actual position). If the motor moves due to external forces during this disabled state, the subsequent activation of servo enable may trigger dangerous return-to-target-position maneuvers. Additionally, when switching from non-CSP control modes to CSP mode, follow-up processing must be executed.

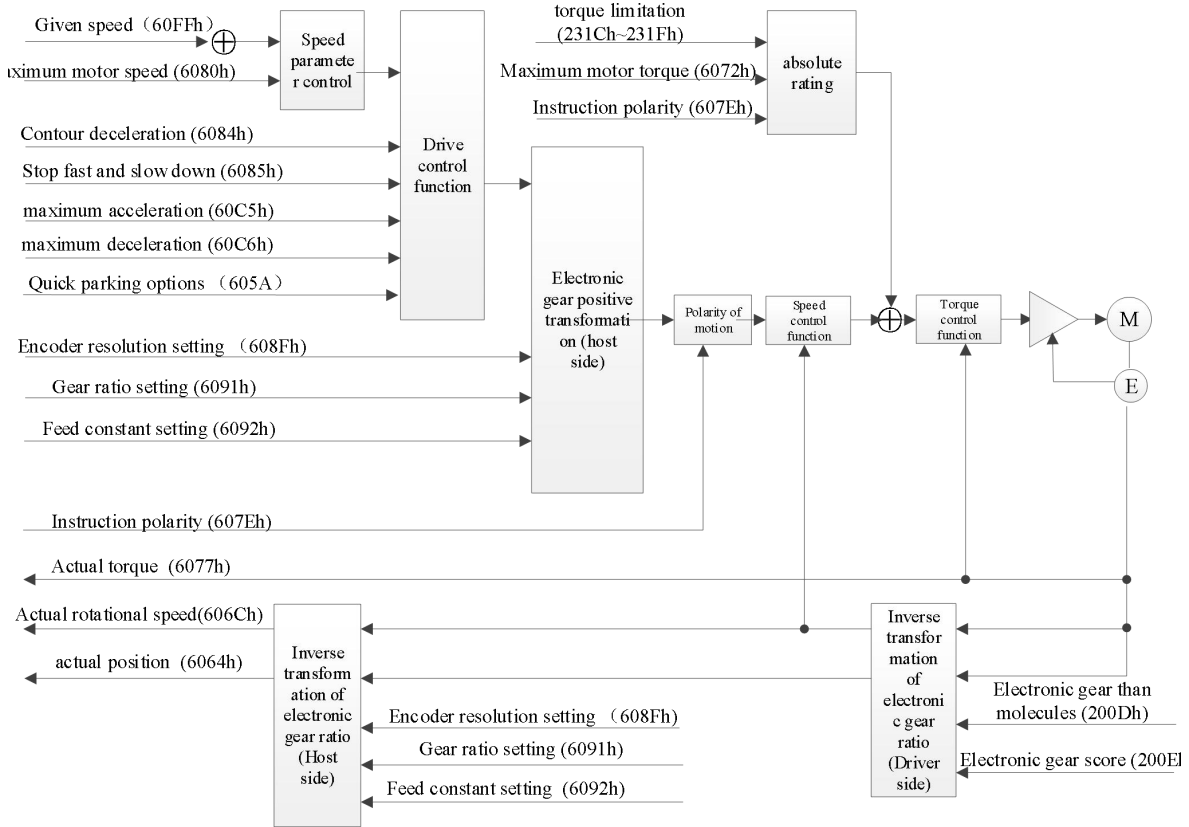


## 7.2.2 Common Parameters

| register      | explain                                                                                                                     | unit             |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|
| RXPDO[0x607A] | When the position is specified, modifications via IO mapping are invalid in CSP mode, as it is controlled by the NC module. | instruction unit |
| TXPDO[0x6064] | Position feedback (actual motor position)                                                                                   | instruction unit |
| TXPDO[0x606C] | rate feedback                                                                                                               | Command unit/s   |
| RXPDO[0x6060] | The control mode is CSP (Cycle Synchronization Position Mode). Set its value to 8.                                          | -                |

## 7.3 CSV pattern

The CSV (Cycle Synchronization Speed Mode) enables the motor to operate at a constant speed by setting the speed through the host computer.



### 7.3.1 Relevant parameters

#### 1) CSV control mode associated objects (commands, settings)

| index of matrix | subindex | name                     | unit           | scope        | data type | accessibility | PDO   |
|-----------------|----------|--------------------------|----------------|--------------|-----------|---------------|-------|
| 6040h           | 00h      | control word             | -              | 0~65535      | U16       | rw            | RxPDO |
| 607Fh           | 00h      | maximum outline velocity | Command unit/s | 0~4294967295 | U32       | rw            | RxPDO |

Other objects with common speed control associations

| index of matrix | subindex | name           | unit  | scope        | data type | accessibility | PDO   |
|-----------------|----------|----------------|-------|--------------|-----------|---------------|-------|
| 6072h           | 00h      | maximum torque | 0.1%  | 0~65535      | U16       | rw            | RxPDO |
| 6080h           | 00h      | Maximum        | r/min | 0~4294967295 | U32       | rw            | RxPDO |

|       |     |                 |                |                        |     |    |       |
|-------|-----|-----------------|----------------|------------------------|-----|----|-------|
|       |     | motor speed     |                |                        |     |    |       |
| 60B1h | 00h | velocity offset | Command unit/s | -2147483648~2147483647 | I32 | rw | RxPDO |
| 60B2h | 00h | torque offset   | 0.1%           | -32768~32767           | I16 | rw | RxPDO |
| 60FFh | 00h | velocity given  | Command unit/s | -2147483648~2147483647 | I32 | rw | RxPDO |

Other objects with shared action relationships

| index of matrix | subindex | name                                 | unit                             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------|------------------------|-----------|-----------------------|-------|
| 605Ah           | 00h      | Quick Stop Mode Selection            | -                                | 0~7                    | I16       | rw                    | NO    |
| 605Bh           | 00h      | Close method selection               | -                                | 0~1                    | I16       | rw                    | NO    |
| 605Ch           | 00h      | Pause shutdown method                | -                                | 0~1                    | I16       | rw                    | NO    |
| 605Dh           | 00h      | Pause option code                    | -                                | 1~3                    | I16       | rw                    | NO    |
| 605Eh           | 00h      | failure mode and effect code         | -                                | 0~2                    | I16       | rw                    | NO    |
| 607Bh           | -        | Location range restrictions          | -                                | -                      | -         | -                     | -     |
|                 | 00h      | Indicates the 607Bh sub-index number | -                                | 2                      | U8        | ro                    | NO    |
|                 | 01h      | Minimum position range limit         | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
|                 | 02h      | Maximum location range limit         | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Ch           | 00h      | origin offset                        | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Eh           | 00h      | command polarity                     | -                                | 0~255                  | U8        | rw                    | NO    |
| 6085h           | 00h      | quick deceleration                   | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw                    | RxPDO |
| 6086h           | 00h      | Location trajectory planning type    | -                                | -32768~32767           | I16       | rw                    | RxPDO |



| index of matrix | subindex | name                                 | unit                                               | scope        | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------------------------|--------------|-----------|-----------------------|-------|
| 608Fh           | -        | Position encoder resolution setting  | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 608Fh sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | Encoder movement distance            | pulse                                              | 1~4294967295 | U32       | ro                    | NO    |
|                 | 02h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | ro                    | NO    |
| 6091h           | -        | gear ratio setting                   | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 6091h sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw                    | NO    |
| 6092h           | -        | Feed constant settings               | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 6092h sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | Set the Feed value                   | instruction unit                                   | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h      | Axis rotation number                 | r ( axle )                                         | 1~4294967295 | U32       | rw                    | NO    |
| 60B8h           | 00h      | Probe mode                           | -                                                  | 0~65535      | U16       | rw                    | RxPDO |

Control word (6040h) &lt;csvFunction in control mode&gt;

| index of matrix                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | subindex | name         | scope   | data type | accessibility | PDO   | Op-mode |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------|---------|-----------|---------------|-------|---------|----|----|----|----|----|----|---|---|---|--|--|--|--|--|-----|---|---|---|---|---|---|---|---|---|----|-----|--|--|--|----|----|----|--|---|---|---|--|--|--|----|
| 6040h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 00h      | control word | 0~65535 | U16       | rw            | RxPDO | All     |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |
| Set the control command for the PDS state transition and other servo drivers.<br>bit information <table border="1"> <tr> <td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr> <tr> <td colspan="6">r</td><td>oms</td><td>h</td></tr> <tr> <td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr> <tr> <td>fr</td><td colspan="4">oms</td><td>eo</td><td>qs</td><td>ev</td></tr> <tr> <td></td><td>r</td><td>r</td><td>r</td><td></td><td></td><td></td><td>so</td></tr> </table> <p>             r = reserved (not mapped) fr = fault reset<br/>             oms = operation mode specific<br/>             (The control mode depends on the bit) qs = quick stop<br/>             h = halt<br/>             h = halt<br/>             so = switch on           </p> <p>             eo = enable operation<br/>             (The control mode depends on the bit) qs = quick stop<br/>             ev = enable voltage<br/>             ev = enable voltage           </p> |          |              |         |           |               |       |         | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | r |  |  |  |  |  | oms | h | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | fr | oms |  |  |  | eo | qs | ev |  | r | r | r |  |  |  | so |
| 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 14       | 13           | 12      | 11        | 10            | 9     | 8       |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |
| r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |              |         |           |               | oms   | h       |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6        | 5            | 4       | 3         | 2             | 1     | 0       |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |
| fr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | oms      |              |         |           | eo            | qs    | ev      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | r        | r            | r       |           |               |       | so      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |     |   |   |   |   |   |   |   |   |   |    |     |  |  |  |    |    |    |  |   |   |   |  |  |  |    |

CSV mode, does not use OMS bit.

## 2) CSV control mode associated objects (monitoring type)

| index of matrix | subindex | name        | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|-------------|------|---------|-----------|---------------|-------|
| 6041h           | 00h      | status word | -    | 0~65535 | U16       | ro            | TxPDO |

There are other common objects associated with speed control.

| index of matrix | subindex | name                              | unit             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|-----------------------------------|------------------|------------------------|-----------|-----------------------|-------|
| 6063h           | 00h      | actual internal position feedback | pulse            | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6064h           | 00h      | position feedback                 | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 606Bh           | 00h      | velocity instruction              | Command unit/s   | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 606Ch           | 00h      | rate feedback                     | Command unit/s   | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6074h           | 00h      | torque command                    | 0.1%             | -32768~32767           | I16       | ro                    | TxPDO |

| index of matrix | subindex | name               | unit | scope        | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------|------|--------------|-----------|-----------------------|-------|
| 6076h           | 00h      | Motor rated torque | Mn·m | 0~4294967295 | U32       | ro                    | TxPDO |
| 6077h           | 00h      | Torque feedback    | 0.1% | -32768~32767 | I16       | ro                    | TxPDO |

There are other objects with common patterns.

| index of matrix | subindex | name                                                         | unit             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------------------------------|------------------|------------------------|-----------|-----------------------|-------|
| 603Fh           | 00h      | Error code                                                   | -                | 0~65535                | U16       | ro                    | TxPDO |
| 60B9h           | 00h      | Indicates the status of the Touch probe function             | -                | 0~65535                | U16       | ro                    | TxPDO |
| 60BAh           | 00h      | Indicates the rising edge clamping position of Touch probe1  | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BBh           | 00h      | Indicates the falling edge clamping position of Touch probe1 | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BCh           | 00h      | Indicates the rising edge clamping position of Touch probe2  | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BDh           | 00h      | Indicates the falling edge clamping position of Touch probe2 | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |

Status word (6041h) <csvControl mode functions>

| index of matrix | subindex | name                                      | scope   | data type | accessibility              | PDO             | Op-mode |                                       |    |      |
|-----------------|----------|-------------------------------------------|---------|-----------|----------------------------|-----------------|---------|---------------------------------------|----|------|
| 6041h           | 00h      | status word                               | 0~65535 | U16       | ro                         | TxPDO           | All     |                                       |    |      |
|                 |          | Indicates the status of the servo driver. |         |           |                            |                 |         |                                       |    |      |
|                 |          | bit information                           |         |           |                            |                 |         |                                       |    |      |
|                 |          | 15                                        | 14      | 13        | 12                         |                 | 11      | 10                                    | 9  | 8    |
|                 |          | r                                         |         | oms       |                            |                 | ila     | oms                                   | rm | r    |
|                 |          |                                           |         | r         | follow drive command vaule |                 |         | r                                     |    |      |
|                 |          | 7                                         | 6       | 5         | 4                          |                 | 3       | 2                                     | 1  | 0    |
|                 |          | w                                         | sod     | qs        | ve                         |                 | f       | oe                                    | so | rsto |
|                 |          | r = reserved (not mapped) w = warning     |         |           |                            |                 |         | r = reserved (not mapped) w = warning |    |      |
|                 |          | sod = switch on disabled                  |         |           |                            |                 |         |                                       |    |      |
|                 |          | oms = operation mode specific             |         |           |                            | qs = quick stop |         | oms =                                 |    |      |

|  |  |                                                  |                  |         |
|--|--|--------------------------------------------------|------------------|---------|
|  |  | operation mode specific                          | qs = quick stop  |         |
|  |  | Control mode dependent bit: ve = voltage enabled |                  | Control |
|  |  | mode dependent bit: ve = voltage enabled         |                  |         |
|  |  | ila = internal limit active                      | f = fault        | ila =   |
|  |  | internal limit active                            | f = fault        |         |
|  |  | oe = operation enabled                           |                  |         |
|  |  | rm = remote                                      | so = switched on |         |
|  |  | rm = remote                                      | so = switched on |         |
|  |  | rtso = ready to switch on                        |                  |         |

bit13,12,10 (operation mode specific) :

| Bit | name             | price | definition                                |
|-----|------------------|-------|-------------------------------------------|
| 10  | continue to have | -     | unused                                    |
| 12  | velocity         | 0     | Action not performed at target speed      |
|     |                  | 1     | Perform actions according to target speed |
| 13  | continue to have | -     | unused                                    |

The so-called "action based on target speed" must meet the following conditions:

- The PDS status is Operation enabled
- Not in a hold state (Halt, Quickstop, Shutdown, Disable operation, Falut)
- Not in Halt stop state
- Torque limit not applied

### 3) Action of the CSV control mode

- In the cyclic speed control mode, the motion model (trajectory) is generated by the master instead of the slave.
- The target speed is 60FFh (target speed)
- The update (send) of the operation command is input approximately 100 ms after the operation enable command is activated.
- 60C2h (Interpolation time period) sets the update cycles for 60FFh (target speed) and 60B1h. This value matches the 1C32h-02h (Cycle time).
- As monitoring data, it provides 606Ch (velocity feedback) and other metrics.
- The 60FFh target speed is limited by the 6080h maximum motor speed.

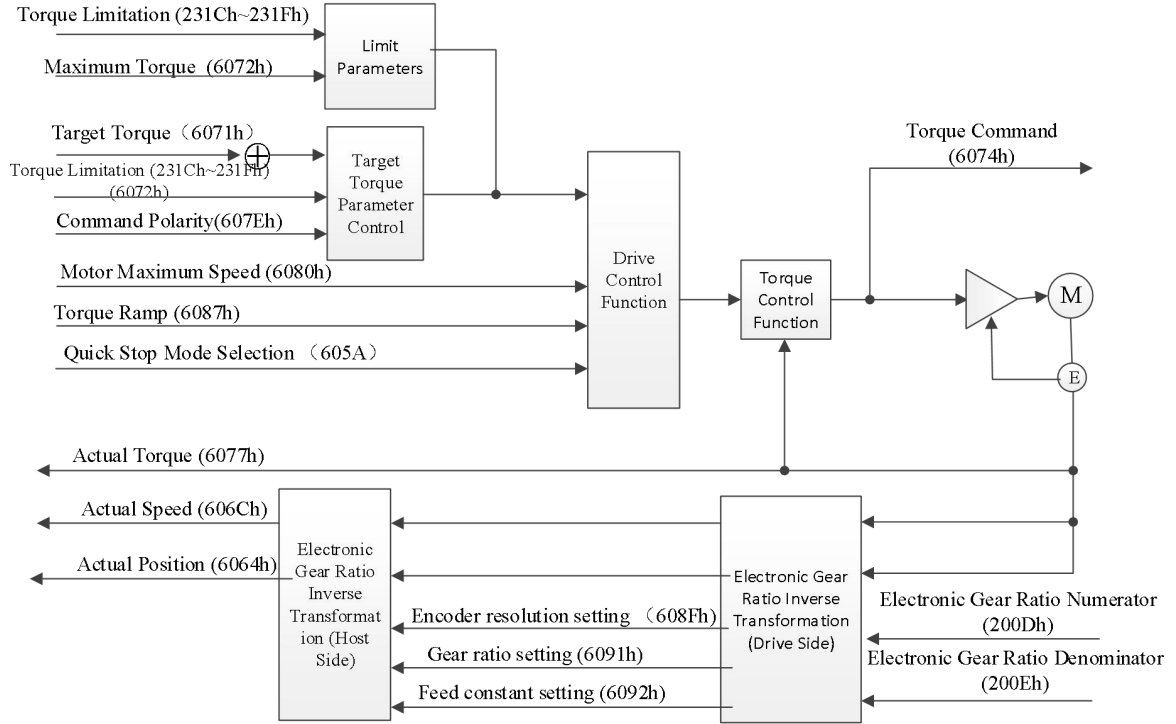
## 7.3.2 Common Parameters

| register      | explain           | unit             |
|---------------|-------------------|------------------|
| RXPDO[0x60FF] | velocity given    | Command unit/s   |
| TXPDO[0x6064] | position feedback | instruction unit |
| TXPDO[0x606C] | rate feedback     | Command unit/s   |

|               |                                                                                                   |       |
|---------------|---------------------------------------------------------------------------------------------------|-------|
| RXPDO[0x6080] | The maximum motor speed can be adjusted via the online COE-Online interface for speed limitation. | r/min |
| RXPDO[0x6060] | Set to 9                                                                                          | -     |

## 7.4CST pattern

The CST (Cycle Synchronous Torque Mode) enables the motor to operate at a constant torque by setting the torque through the host computer.



### 7.4.1 Relevant parameters

1) Objects associated with the CST control mode (commands and settings)

| index of matrix | subindex | name         | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|--------------|------|---------|-----------|---------------|-------|
| 6040h           | 00h      | control word | -    | 0~65535 | U16       | rw            | RxPDO |

There are other related objects which are common to torque control.

| index of matrix | subindex | name                | unit   | scope        | data type | accessibility | PDO   |
|-----------------|----------|---------------------|--------|--------------|-----------|---------------|-------|
| 6071h           | 00h      | Torque given        | 0.1%   | -32768~32767 | I16       | rw            | RxPDO |
| 6072h           | 00h      | maximum torque      | 0.1%   | 0~65535      | U16       | rw            | RxPDO |
| 6080h           | 00h      | Maximum motor speed | r/min  | 0~4294967295 | U32       | rw            | RxPDO |
| 6087h           | 00h      | Torque ramp         | 0.1%/S | 0~4294967295 | U32       | rw            | RxPDO |

|       |     |               |      |              |     |    |       |
|-------|-----|---------------|------|--------------|-----|----|-------|
| 60B2h | 00h | torque offset | 0.1% | -32768~32767 | I16 | rw | RxPDO |
|-------|-----|---------------|------|--------------|-----|----|-------|

There are also other related objects with common actions.

| index of matrix | subindex | name                                 | unit                             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------|------------------------|-----------|-----------------------|-------|
| 605Ah           | 00h      | Quick Stop Mode Selection            | -                                | 0~7                    | I16       | rw                    | NO    |
| 605Bh           | 00h      | Close method selection               | -                                | 0~1                    | I16       | rw                    | NO    |
| 605Ch           | 00h      | Suspended shutdown mode              | -                                | 0~1                    | I16       | rw                    | NO    |
| 605Dh           | 00h      | Pause option code                    | -                                | 1~3                    | I16       | rw                    | NO    |
| 605Eh           | 00h      | failure mode and effect code         | -                                | 0~2                    | I16       | rw                    | NO    |
| 607Bh           | -        | Location range restriction           | -                                | -                      | -         | -                     | -     |
|                 | 00h      | Indicates the 607Bh sub-index number | -                                | 2                      | U8        | ro                    | NO    |
|                 | 01h      | Minimum position range limit         | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
|                 | 02h      | Maximum location range limit         | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Ch           | 00h      | origin offset                        | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Eh           | 00h      | command polarity                     | -                                | 0~255                  | U8        | rw                    | NO    |
| 6085h           | 00h      | quick deceleration                   | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw                    | RxPDO |
| 6086h           | 00h      | Location trajectory planning type    | -                                | -32768~32767           | I16       | rw                    | RxPDO |

| index of matrix | subindex | name                                 | unit                                               | scope        | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------------------------|--------------|-----------|-----------------------|-------|
| 608Fh           | -        | Position encoder resolution setting  | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 608Fh sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | Encoder movement distance            | pulse                                              | 1~4294967295 | U32       | ro                    | NO    |
|                 | 02h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | ro                    | NO    |
| 6091h           | -        | gear ratio setting                   | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 6091h sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw                    | NO    |
| 6092h           | -        | Feed constant settings               | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 6092h sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | Set the Feed value                   | instruction unit                                   | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw                    | NO    |
| 60B8h           | 00h      | probe mode                           | -                                                  | 0~65535      | U16       | rw                    | RxPDO |

Control word (6040h) &lt;cstFunction in control mode&gt;



| index of matrix | subindex | name                                                                          | scope   | data type | accessibility | PDO   | Op-mode |    |                                            |    |
|-----------------|----------|-------------------------------------------------------------------------------|---------|-----------|---------------|-------|---------|----|--------------------------------------------|----|
| 6040h           | 00h      | control word                                                                  | 0~65535 | U16       | Rw            | RxPDO | All     |    |                                            |    |
|                 |          | Set the control command for the PDS state transition and other servo drivers. |         |           |               |       |         |    |                                            |    |
|                 |          | bit information                                                               |         |           |               |       |         |    |                                            |    |
|                 |          | 15                                                                            | 14      | 13        | 12            | 11    | 10      | 9  | 8                                          |    |
|                 |          | R                                                                             |         |           |               |       |         | om | h                                          |    |
|                 |          | 7                                                                             | 6       | 5         | 4             | 3     | 2       | 1  | 0                                          |    |
|                 |          | fr                                                                            | oms     |           |               |       | eo      | qs | ev                                         | so |
|                 |          |                                                                               | r       | R         |               | r     |         |    |                                            |    |
|                 |          | r = reserved (not mapped) fr = fault reset                                    |         |           |               |       |         |    | r = reserved (not mapped) fr = fault reset |    |
|                 |          | oms = operation mode specific                                                 |         |           |               |       |         |    | eo = enable operation                      |    |
|                 |          | (The control mode depends on the bit) qs = quick stop                         |         |           |               |       |         |    |                                            |    |
|                 |          | (The control mode depends on the bit) qs = quick stop                         |         |           |               |       |         |    |                                            |    |
|                 |          | h = halt                                                                      |         |           |               |       |         |    | ev = enable voltage                        |    |
|                 |          | h = halt                                                                      |         |           |               |       |         |    | ev = enable voltage                        |    |
| so = switch on  |          |                                                                               |         |           |               |       |         |    |                                            |    |

The CST mode does not utilize the OMS bit.

## 2) CST torque control associated objects (monitoring type)

| index of matrix | subindex | name            | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|-----------------|------|---------|-----------|---------------|-------|
| 6041h           | 00h      | status word     | -    | 0~65535 | U16       | ro            | TxPDO |
| 6073h           | 00h      | maximum current | 0.1% | 0~65535 | U16       | ro            | NO    |

## Other torque control objects (monitoring type)

| index of matrix | subindex | name                              | unit             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|-----------------------------------|------------------|------------------------|-----------|-----------------------|-------|
| 6063h           | 00h      | actual internal position feedback | pulse            | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6064h           | 00h      | position feedback                 | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 606Ch           | 00h      | rate feedback                     | Command unit/s   | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6074h           | 00h      | torque command                    | 0.1%             | -32768~32767           | I16       | ro                    | TxPDO |
| 6075h           | 00h      | Rated current of the motor        | 1mA              | 0~4294967295           | U32       | ro                    | TxPDO |
| 6076h           | 00h      | motor rated torque                | mNm              | 0~4294967295           | U32       | ro                    | TxPDO |

| index of matrix | subindex | name                 | unit | scope        | data type | Available inquisitive | PDO   |
|-----------------|----------|----------------------|------|--------------|-----------|-----------------------|-------|
| 6077h           | 00h      | torque feedback      | 0.1% | -32768~32767 | I16       | ro                    | TxPDO |
| 6078h           | 00h      | Current actual value | 0.1% | -32768~32767 | I16       | ro                    | TxPDO |

There are other objects with common patterns.

| index of matrix | subindex | name                                                         | unit             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------------------------------|------------------|------------------------|-----------|-----------------------|-------|
| 603Fh           | 00h      | Error code                                                   | -                | 0~65535                | U16       | ro                    | TxPDO |
| 60B9h           | 00h      | Indicates the status of the Touch probe function             | -                | 0~65535                | U16       | ro                    | TxPDO |
| 60BAh           | 00h      | Indicates the rising edge clamping position of Touch probe1  | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BBh           | 00h      | Indicates the falling edge clamping position of Touch probe1 | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BCh           | 00h      | Indicates the rising edge clamping position of Touch probe2  | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BDh           | 00h      | Indicates the falling edge clamping position of Touch probe2 | instruction unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |

Status word (6041h) <Control mode functions>

| index of matrix                                  | subindex | name                                      | scope   | data type | accessibility                 | PDO   | Op-mode |                                       |    |      |
|--------------------------------------------------|----------|-------------------------------------------|---------|-----------|-------------------------------|-------|---------|---------------------------------------|----|------|
| 6041h                                            | 00h      | status word                               | 0~65535 | U16       | ro                            | TxPDO | All     |                                       |    |      |
|                                                  |          | Indicates the status of the servo driver. |         |           |                               |       |         |                                       |    |      |
|                                                  |          | bit information                           |         |           |                               |       |         |                                       |    |      |
|                                                  |          | 15                                        | 14      | 13        | 12                            |       | 11      | 10                                    | 9  | 8    |
|                                                  |          | r                                         |         | oms       |                               |       | ila     | oms                                   | rm | r    |
|                                                  |          |                                           |         | r         | Drive following command vaule |       |         | r                                     |    |      |
|                                                  |          | 7                                         | 6       | 5         | 4                             |       | 3       | 2                                     | 1  | 0    |
|                                                  |          | w                                         | sod     | qs        | ve                            |       | f       | oe                                    | so | rsto |
|                                                  |          | r = reserved (not mapped) w = warning     |         |           |                               |       |         | r = reserved (not mapped) w = warning |    |      |
|                                                  |          | sod = switch on disabled                  |         |           |                               |       |         |                                       |    |      |
|                                                  |          | oms = operation mode specific             |         |           | qs = quick stop               |       |         |                                       |    |      |
|                                                  |          | oms = operation mode specific             |         |           | qs = quick stop               |       |         |                                       |    |      |
| Control mode dependent bit: ve = voltage enabled |          |                                           |         |           |                               |       |         |                                       |    |      |
| Control mode dependent bit: ve = voltage enabled |          |                                           |         |           |                               |       |         |                                       |    |      |

|  |  |                             |                           |
|--|--|-----------------------------|---------------------------|
|  |  | ila = internal limit active | f = fault                 |
|  |  | ila = internal limit active | f = fault                 |
|  |  | oe = operation enabled      | rm = remote               |
|  |  | so = switched on            | rtso = ready to switch on |
|  |  | oe = operation enabled      | rm = remote               |
|  |  | so = switched on            | rtso = ready to switch on |
|  |  | oe = operation enabled      | rm = remote               |
|  |  | so = switched on            | rtso = ready to switch on |
|  |  | oe = operation enabled      | rm = remote               |
|  |  | so = switched on            | rtso = ready to switch on |

bit13,12,10 (operation mode specific) :

| Bit | name             | Value | Definition                                    |
|-----|------------------|-------|-----------------------------------------------|
| 10  | continue to have | -     | unused                                        |
| 12  | torque           | 0     | Do not perform actions based on target torque |
|     |                  | 1     | Act on target torque                          |
| 13  | continue to have | -     | unused                                        |

The so-called "action based on target speed" must meet the following conditions:

- The PDS status is Operation enabled
- Not in a hold state (Halt, Quickstop, Shutdown, Disable operation, Falut)
- Not in Halt stop state

### 3) The action of the CST control mode

- The cyclic torque control mode generates the Profile (track) not on the slave unit but on the master unit.
- The target torque is 6071h
- The torque feedforward is 60B2h. Feedforward is not supported.
- To update the action command (send signal), wait approximately 100ms after the servo is activated before inputting.
- 60C2h (Interpolation time period) sets the update cycles for the 6071h (torque given) and 60B2h objects. This value matches the 1C32h-02h (Cycle time).
- As monitoring data, it provides 6077h (torque feedback) and other parameters.
- The 6071h (torque given) value is subject to the maximum torque limit of 6072h,231Ch (P3-28),231Dh (P3-29), and minimum value restrictions.
- The speed limit is 6080h (maximum motor speed).

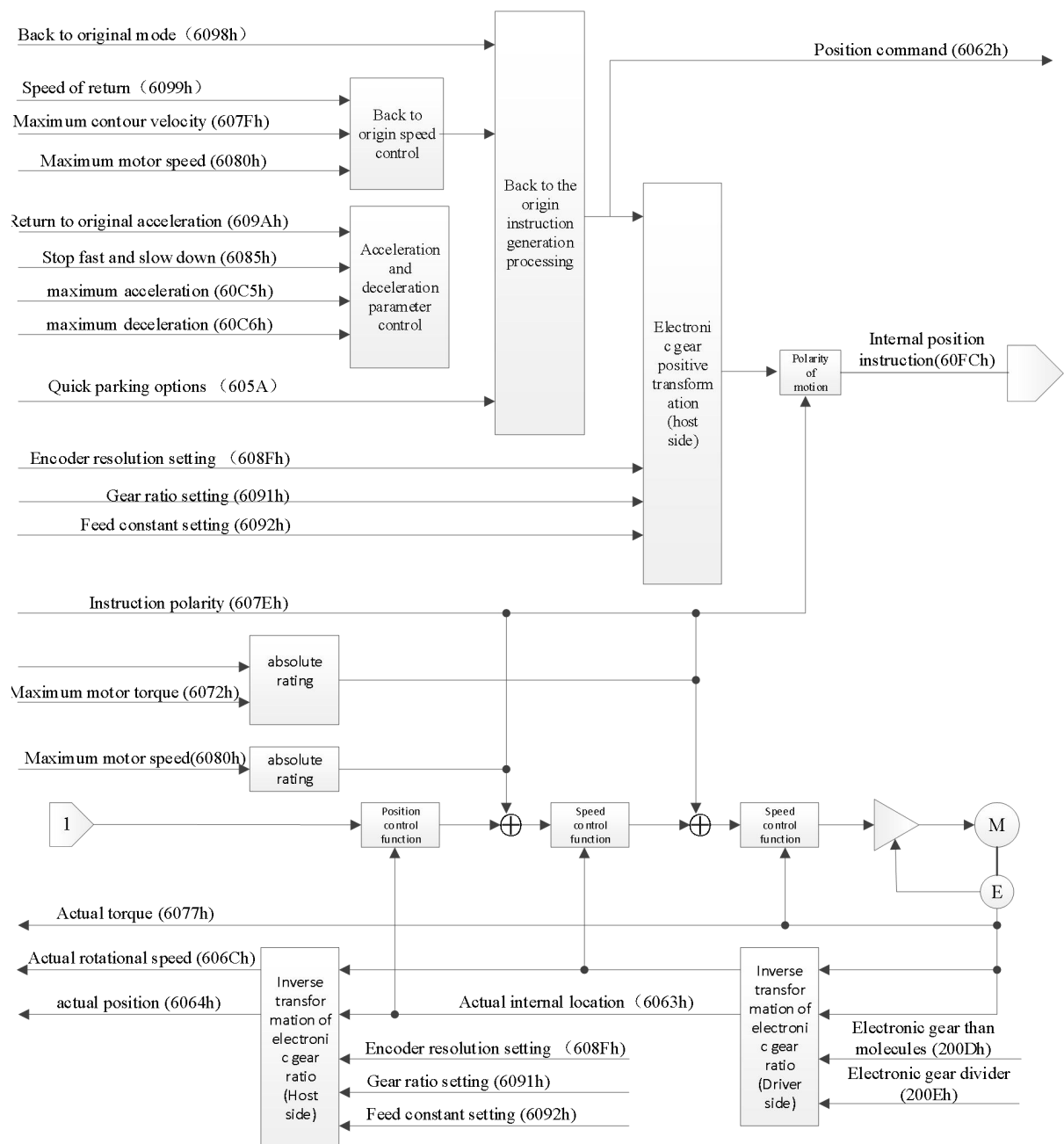
## 7.4.2 Common Parameters

| register      | explain           | unit             |
|---------------|-------------------|------------------|
| RXPDO[0x6071] | torque given      | 0.1%             |
| TXPDO[0x6064] | position feedback | instruction unit |
| TXPDO[0x606C] | rate feedback     | Command unit/s   |

|               |                     |       |
|---------------|---------------------|-------|
| TXPDO[0x6077] | torque feedback     | 0.1%  |
| RXPDO[0x6080] | maximum motor speed | r/min |
| RXPDO[0x6060] | Set to 10           | -     |

## 7.5HM pattern

The HM mode (origin reset mode) is used to initialize the slave's position. This position control mode generates position commands within the servo driver to perform origin reset actions, specifying the action speed. When used in incremental mode, the origin reset action must be executed before position positioning begins after the control power is activated.



## 7.5.1 Relevant parameters

### 1) hm control mode associated objects (commands, settings)

| index of matrix | subindex | name                                     | unit                             | scope        | data type | accessibility | PDO   |
|-----------------|----------|------------------------------------------|----------------------------------|--------------|-----------|---------------|-------|
| 6040h           | 00h      | control word                             | -                                | 0~65535      | U16       | rw            | RxPDO |
| 6098h           | 00h      | return to origin                         | -                                | -128~127     | I8        | rw            | RxPDO |
| 6099h           | -        | Restore to original speed                | -                                | -            | -         | -             | -     |
|                 | 00h      | Number of entries                        | -                                | 2            | U8        | ro            | NO    |
|                 | 01h      | Speed of returning to the original state | Command unit/s                   | 0~4294967295 | U32       | rw            | NO    |
|                 | 02h      | reversion velocity                       | Command unit/s                   | 0~4294967295 | U32       | rw            | NO    |
| 609Ah           | 00h      | return to zero acceleration              | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw            | RxPDO |

There are other objects with common location control.

| index of matrix | subindex | name                     | unit                             | scope                  | data type | accessibility | PDO   |
|-----------------|----------|--------------------------|----------------------------------|------------------------|-----------|---------------|-------|
| 6072h           | 00h      | maximum torque           | 0.1%                             | 0~65535                | U16       | rw            | RxPDO |
| 607Fh           | 00h      | maximum outline velocity | Command unit/s                   | 0~4294967295           | U32       | rw            | RxPDO |
| 60B1h           | 00h      | velocity offset          | Command unit/s                   | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 60B2h           | 00h      | torque offset            | 0.1%                             | -32768~32767           | I16       | rw            | RxPDO |
| 60C5h           | 00h      | maximal acceleration     | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw            | RxPDO |
| 60C6h           | 00h      | maximum deceleration     | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw            | RxPDO |

There are also other related objects with common actions.

| index of matrix | subindex | name            | unit | scope | data type | accessibility | PDO |
|-----------------|----------|-----------------|------|-------|-----------|---------------|-----|
| 605Ah           | 00h      | Quick Stop Mode | -    | 0~7   | I16       | rw            | NO  |

| index of matrix | subindex | name                                 | unit                             | scope                  | data type | accessibility | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------|------------------------|-----------|---------------|-------|
|                 |          | Selection                            |                                  |                        |           |               |       |
| 605Bh           | 00h      | Close method selection               | -                                | 0~1                    | I16       | rw            | NO    |
| 605Ch           | 00h      | Suspended shutdown mode              | -                                | 0~1                    | I16       | rw            | NO    |
| 605Dh           | 00h      | Pause option code                    | -                                | 1~3                    | I16       | rw            | NO    |
| 605Eh           | 00h      | failure mode and effect code         | -                                | 0~2                    | I16       | rw            | NO    |
| 607Dh           | -        | software absolute position limit     | -                                | -                      | -         | -             | -     |
|                 | 00h      | Indicates the 607Dh sub-index number | -                                | 2                      | U8        | ro            | NO    |
|                 | 01h      | Minimum position limit               | instruction unit                 | -2147483648~2147483647 | I32       | rw            | RxPDO |
|                 | 02h      | Maximum location limit               | instruction unit                 | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 607Ch           | 00h      | origin offset                        | instruction unit                 | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 607Eh           | 00h      | command polarity                     | -                                | 0~255                  | U8        | rw            | NO    |
| 6085h           | 00h      | quick deceleration                   | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw            | RxPDO |
| 6086h           | 00h      | Location trajectory planning type    | -                                | -32768~32767           | I16       | rw            | RxPDO |
| 608Fh           | -        | Position encoder resolution setting  | -                                | -                      | -         | -             | -     |
|                 | 00h      | Indicates the 608Fh sub-index number | -                                | 2                      | U8        | ro            | NO    |

| index of matrix | subindex | name                                 | unit                                               | scope        | data type | accessibility | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------------------------|--------------|-----------|---------------|-------|
|                 | 01h      | Encoder movement distance            | Pulse                                              | 1~4294967295 | U32       | ro            | NO    |
|                 | 02h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | ro            | NO    |
| 6091h           | -        | gear ratio setting                   | -                                                  | -            | -         | -             | -     |
|                 | 00h      | Indicates the 6091h sub-index number | -                                                  | 2            | U8        | ro            | NO    |
|                 | 01h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw            | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw            | NO    |
| 6092h           | -        | Feed constant settings               | -                                                  | -            | -         | -             | -     |
|                 | 00h      | Indicates the 6092h sub-index number | -                                                  | 2            | U8        | ro            | NO    |
|                 | 01h      | Set the Feed value                   | instruction unit                                   | 1~4294967295 | U32       | rw            | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw            | NO    |
| 60B8h           | 00h      | probe mode                           | -                                                  | 0~65535      | U16       | rw            | RxPDO |

Control word (6040h) <HMFfunction in control mode>

| index of matrix | subindex | name                                                                          | scope   | data type | accessibility | PDO   | Op-mode |   |
|-----------------|----------|-------------------------------------------------------------------------------|---------|-----------|---------------|-------|---------|---|
| 6040h           | 00h      | control word                                                                  | 0~65535 | U16       | Rw            | RxPDO | All     |   |
|                 |          | Set the control command for the PDS state transition and other servo drivers. |         |           |               |       |         |   |
|                 |          | bit information                                                               |         |           |               |       |         |   |
|                 |          | 15                                                                            | 14      | 13        | 12            | 11    | 10      | 9 |
|                 |          | r                                                                             |         |           |               |       | oms     | h |

| 7  | 6   | 5 | 4            | 3  | 2  | 1  | 0  |
|----|-----|---|--------------|----|----|----|----|
| Fr | oms |   |              | eo | qs | ev | so |
|    | R   | R | start homing |    |    |    |    |

r = reserved (not mapped) fr = fault reset  
 r = reserved (not mapped) fr = fault reset  
 oms = operation mode specific  
 operation mode specific  
 (The control mode depends on the bit) qs = quick stop  
 control mode depends on the bit) qs = quick stop  
 h = halt  
 h = halt  
 so = switch on

eo = enable operation  
 eo = enable operation  
 (The control mode depends on the bit) qs = quick stop  
 control mode depends on the bit) qs = quick stop  
 ev = enable voltage  
 ev = enable voltage

oms = (The control mode depends on the bit) qs = quick stop

bit9,6-4 (operation mode specific) :

| Bit | name                 | price  | definition                    |
|-----|----------------------|--------|-------------------------------|
| 4   | Go back to original  | 0 -> 1 | Start the origin reset action |
| 5   | ( continue to have ) | -      | unused                        |
| 6   | ( continue to have ) | -      | unused                        |
| 9   | ( continue to have ) | -      | unused                        |

After enabling bit4 (initiating reset) for 6040 hours, the system retrieves parameters (reset method, speed, acceleration/deceleration, etc.) associated with the origin reset position control mode (HM), then initiates the operation.

Furthermore, even if a new reset operation is initiated (restarting bit4 at 6040h) during the reset process, the new reset operation will be ignored.

Restore to original (6098h)

| index of matrix | subindex | name                  | scope    | data type | accessibility | PDO   | Op-mode |
|-----------------|----------|-----------------------|----------|-----------|---------------|-------|---------|
| 6098h           | 00h      | return to origin      | -128~127 | I8        | rw            | RxPDO | All     |
|                 |          | origin setting method |          |           |               |       |         |



| price | definition                                |
|-------|-------------------------------------------|
| -2    | back collision                            |
| -1    | positive collision return                 |
| 0     | No original method specified              |
| 1     | -Ve LS & Index Pulse                      |
| 2     | +Ve LS & Index Pulse                      |
| 3     | +Ve HS & Index Pulse direction reversal   |
| 4     | +Ve HS & Index Pulse no direction changed |
| 5     | -Ve HS & Index Pulse direction reversal   |
| 6     | -Ve HS & Index Pulse no direction changed |
| 7     | On +Ve HS -Index Ple                      |
| 8     | On +Ve HS +Index Pulse                    |
| 9     | After +Ve HS reverse +Index Pulse         |
| 10    | After +Ve HS +Index Pulse                 |
| 11    | On -Ve HS -Index Pulse                    |
| 12    | On -Ve HS +Index Pulse                    |
| 13    | After -Ve HS reverse +Index Pulse         |
| 14    | After -Ve HS +Index Pulse                 |
| 15    | Reserved                                  |
| 16    | Reserved                                  |
| 17    | Same as 1 without Index pulse             |
| 18    | Same as 2 without Index pulse             |
| 19    | Same as 3 without Index pulse             |
| 20    | Same as 4 without Index pulse             |
| 21    | Same as 5 without Index pulse             |
| 22    | Same as 6 without Index pulse             |
| 23    | Same as 7 without Index pulse             |
| 24    | Same as 8 without Index pulse             |
| 25    | Same as 9 without Index pulse             |
| 26    | Same as 10 without Index pulse            |
| 27    | Same as 11 without Index pulse            |
| 28    | Same as 12 without Index pulse            |
| 29    | Same as 13 without Index pulse            |
| 30    | Same as 14 without Index pulse            |
| 33    | On Index Pulse +Ve direction              |
| 34    | On Index Pulse -Ve direction              |
| 35    | Current postion = home                    |
| 37    | Current postion = home                    |

## Return to original speed (6099h)

| index of matrix | son index of matrix | name                                                                                                                                                                                                                                                                                                | scope        | data type | accessibility | PDO | Op-mode |
|-----------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|---------------|-----|---------|
| 6099h           | -                   | return to original speed                                                                                                                                                                                                                                                                            | -            | -         | -             | -   | -       |
|                 |                     | The speed when the origin reset position control mode (HM) is set.                                                                                                                                                                                                                                  |              |           |               |     |         |
|                 | 00h                 | Number of entries                                                                                                                                                                                                                                                                                   | 2            | U8        | ro            | NO  | HM      |
|                 |                     | number of subindexes for 6099h (return speed)                                                                                                                                                                                                                                                       |              |           |               |     |         |
|                 | 01h                 | Speed during search                                                                                                                                                                                                                                                                                 | 0~4294967295 | U32       | rw            | NO  | HM      |
|                 |                     | Set the speed of the action triggered by the Switch signal detection.<br>The maximum value is limited by the lower of the two: the internally processed 6080h (maximum motor speed) or 2147483647.                                                                                                  |              |           |               |     |         |
|                 | 02h                 | Speed during search for zero                                                                                                                                                                                                                                                                        | 0~4294967295 | U32       | rw            | NO  | HM      |
|                 |                     | Set the action speed for origin detection.<br>To minimize detection errors, set the edge of the Switch signal as the origin detection position to the smallest possible value.<br>The maximum value is limited by the lower of the internally processed 6080h (maximum motor speed) and 2147483647. |              |           |               |     |         |

## Recovery acceleration (609Ah)

| index of matrix | subindex | name                                                                                                                                                                                                                                                                                                                                     | scope        | data type | accessibility | PDO   | Op-mode |
|-----------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|---------------|-------|---------|
| 609Ah           | 00h      | return to zero acceleration                                                                                                                                                                                                                                                                                                              | 0~4294967295 | U32       | rw            | RxPDO | All     |
|                 |          | Set the acceleration and deceleration at the reset of the origin (hm).<br>The deceleration of origin reset (HM) also applies to this object.<br>When the original return method stops (origin position detected), the servo lockout stops without requiring this object's settings.<br>If set to 0, internal processing is treated as 1. |              |           |               |       |         |

## 2) hm control mode associated objects (monitoring type)

| index of matrix | subindex | name                                 | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|--------------------------------------|------|---------|-----------|---------------|-------|
| 6041h           | 00h      | status word                          | -    | 0~65535 | U16       | ro            | TxPDO |
| 60E3h           | -        | Select the return method             | -    | -       | -         | -             | TxPDO |
|                 | 00h      | Indicates the 60E3h sub-index number | -    | 1~254   | U8        | ro            | TxPDO |
|                 | 01h      | Restore to Method 1                  | -    | 0~32767 | U16       | ro            | TxPDO |
|                 | ..       | ..                                   | ..   | ..      | ..        | ..            | ..    |
|                 | 20h      | Return to Method 32                  | -    | 0~32767 | U16       | ro            | TxPDO |

There are also other objects with common location control.

| index of matrix | subindex | name                                            | unit             | scope                  | data type | accessibility | PDO   |
|-----------------|----------|-------------------------------------------------|------------------|------------------------|-----------|---------------|-------|
| 6062h           | 00h      | position instruction                            | instruction unit | -2147483648~2147483647 | I32       | ro            | TxPDO |
| 6063h           | 00h      | actual internal position feedback               | pulse            | -2147483648~2147483647 | I32       | ro            | TxPDO |
| 6064h           | 00h      | position feedback                               | instruction unit | -2147483648~2147483647 | I32       | ro            | TxPDO |
| 6065h           | 00h      | Excessive position deviation threshold          | instruction unit | 0~4294967295           | U32       | rw            | RxPDO |
| 6066h           | 00h      | Error timeout time                              | 1ms              | 0~65535                | U16       | rw            | RxPDO |
| 6067h           | 00h      | Location reaches the threshold                  | instruction unit | 0~4294967295           | U32       | rw            | RxPDO |
| 6068h           | 00h      | Location to window time                         | 1ms              | 0~65535                | U16       | rw            | RxPDO |
| 606Ch           | 00h      | rate feedback                                   | Command unit/s   | -2147483648~2147483647 | I32       | ro            | TxPDO |
| 6074h           | 00h      | torque command                                  | 0.1%             | -32768~32767           | I16       | ro            | TxPDO |
| 6076h           | 00h      | motor rated torque                              | Mn·m             | 0~4294967295           | U32       | ro            | TxPDO |
| 6077h           | 00h      | torque feedback                                 | 0.1%             | -32768~32767           | I16       | ro            | TxPDO |
| 60F4h           | 00h      | position deviation                              | instruction unit | -2147483648~2147483647 | I32       | ro            | TxPDO |
| 60FAh           | 00h      | internal instruction speed Position loop output | Command unit/s   | -2147483648~2147483647 | I32       | ro            | TxPDO |
| 60FCh           | 00h      | internal location instruction                   | pulse            | -2147483648~2147483647 | I32       | ro            | TxPDO |



The position feedback of HM after returning to its original position (6064h) is reset to zero.

There are also other objects with common action.

| index of matrix | son index of | name | unit | scope | data type | Accessible inquisitive | PDO |
|-----------------|--------------|------|------|-------|-----------|------------------------|-----|
|-----------------|--------------|------|------|-------|-----------|------------------------|-----|

|       | matrix |                                                              |                  |                        |     |    |       |
|-------|--------|--------------------------------------------------------------|------------------|------------------------|-----|----|-------|
| 603Fh | 00h    | Error code                                                   | -                | 0~65535                | U16 | ro | TxPDO |
| 60B9h | 00h    | Indicates the status of the Touch probe function             | -                | 0~65535                | U16 | ro | TxPDO |
| 60BAh | 00h    | Indicates the rising edge clamping position of Touch probe1  | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |
| 60BBh | 00h    | Indicates the falling edge clamping position of Touch probe1 | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |
| 60BCh | 00h    | Indicates the rising edge clamping position of Touch probe2  | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |
| 60BDh | 00h    | Indicates the falling edge clamping position of Touch probe2 | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |

## Status Word (6041h) &lt;Functions in control mode&gt;

| index of matrix                                  | subindex | name                                      | scope   | data type    | accessibility | PDO              | Op-mode        |                                       |      |   |
|--------------------------------------------------|----------|-------------------------------------------|---------|--------------|---------------|------------------|----------------|---------------------------------------|------|---|
| 6041h                                            | 00h      | status word                               | 0~65535 | U16          | ro            | TxPDO            | All            |                                       |      |   |
|                                                  |          | Indicates the status of the servo driver. |         |              |               |                  |                |                                       |      |   |
|                                                  |          | bit information                           |         |              |               |                  |                |                                       |      |   |
|                                                  |          | 15                                        | 14      | 13           | 12            | 11               | 10             | 9                                     | 8    |   |
|                                                  |          | R                                         |         | oms          |               | ila              | oms            |                                       | rm   | r |
|                                                  |          |                                           |         | Homing error |               |                  | Target reached |                                       |      |   |
|                                                  |          | 7                                         | 6       | 5            | 4             | 3                | 2              | 1                                     | 0    |   |
|                                                  |          | W                                         | sod     | Qs           | ve            | f                | oe             | so                                    | rsto |   |
|                                                  |          | r = reserved (not mapped) w = warning     |         |              |               |                  |                | r = reserved (not mapped) w = warning |      |   |
|                                                  |          | sod = switch on disabled                  |         |              |               |                  |                |                                       |      |   |
| oms = operation mode specific                    |          |                                           |         |              |               | qs = quick stop  |                |                                       |      |   |
| oms = operation mode specific                    |          |                                           |         |              |               | qs = quick stop  |                |                                       |      |   |
| Control mode dependent bit: ve = voltage enabled |          |                                           |         |              |               |                  |                |                                       |      |   |
| Control mode dependent bit: ve = voltage enabled |          |                                           |         |              |               |                  |                |                                       |      |   |
| ila = internal limit active                      |          |                                           |         |              |               | f = fault        |                |                                       |      |   |
| ila = internal limit active                      |          |                                           |         |              |               | f = fault        |                |                                       |      |   |
| oe = operation enabled                           |          |                                           |         |              |               |                  |                |                                       |      |   |
| rm = remote                                      |          |                                           |         |              |               | so = switched on |                |                                       |      |   |
| rm = remote                                      |          |                                           |         |              |               | so = switched on |                |                                       |      |   |

|  |  |                           |
|--|--|---------------------------|
|  |  | rtso = ready to switch on |
|--|--|---------------------------|

bit13,12,10 (operation mode specific) :

| Bit | name                                     | price | definition                                         |
|-----|------------------------------------------|-------|----------------------------------------------------|
| 10  | target reached<br>current state          | 0     | In action                                          |
|     |                                          | 1     | state of rest                                      |
| 12  | homing attained<br>Reduction<br>complete | 0     | Origin reset action not completed                  |
|     |                                          | 1     | Origin reset action completed normally             |
| 13  | Return to original<br>error              | 0     | No origin reset exception occurred.                |
|     |                                          | 1     | Origin reset error (origin reset operation failed) |

bit13,12,10 (operation mode specific) :

| Bit13 | Bit12 | Bit10 | definition                                                                   |
|-------|-------|-------|------------------------------------------------------------------------------|
| 0     | 0     | 0     | During the origin reset action                                               |
| 0     | 0     | 1     | The origin reset action was interrupted or not started                       |
| 0     | 1     | 0     | The origin reset action is complete, but the target position is not reached. |
| 0     | 1     | 1     | The origin reset action was completed normally.                              |
| 1     | 0     | 0     | The origin reset anomaly is still active                                     |
| 1     | 0     | 1     | Origin reset error detected. Stopped.                                        |

bit12 (homing attained) is 0 when the state is below this level.

- When the power supply is turned on
- When the ESM state transitions from Init to PreOP
- The origin reset process has begun.

When the motor is not activated during the homing operation (Method 35, Method 37), the homing attained is also set to 0. However, this setting must be maintained for a brief duration (approximately 2 ms).

Restore to original (60E3)

| index<br>of<br>matrix | subindex                                                  | name                           | unit | scope   | data type | accessibility | PDO   |
|-----------------------|-----------------------------------------------------------|--------------------------------|------|---------|-----------|---------------|-------|
| 60E3h                 | -                                                         | Supported Homing<br>method     | -    | -       | -         | -             | TxPDO |
|                       | Supports the original method                              |                                |      |         |           |               |       |
|                       | 00h                                                       | Number of entries              | -    | 1~254   | U8        | ro            | TxPDO |
|                       | Indicates the number of supported homing methods (60E3h). |                                |      |         |           |               |       |
|                       | 01h                                                       | 1st supported Homing<br>method | -    | 0~32767 | U16       | ro            | TxPDO |
|                       | Indicates support for the first original method.          |                                |      |         |           |               |       |
|                       | ..                                                        | ..                             | ..   | ..      | ..        | ..            | ..    |

| index of matrix                                       | subindex | name                         | unit | scope   | data type | accessibility | PDO   |
|-------------------------------------------------------|----------|------------------------------|------|---------|-----------|---------------|-------|
|                                                       | 20h      | 32nd supported Homing method | -    | 0~32767 | U16       | ro            | TxPDO |
| Supports the 32nd way to return to the original state |          |                              |      |         |           |               |       |

| index of matrix | subindex | bit 15~8 | bit 7~0                 |
|-----------------|----------|----------|-------------------------|
|                 |          | Reserved | Supported homing method |
| 60E3            | 01h      | 0        | 1                       |
|                 | 02h      | 0        | 2                       |
|                 | 03h      | 0        | 3                       |
|                 | 04h      | 0        | 4                       |
|                 | 05h      | 0        | 5                       |
|                 | 06h      | 0        | 6                       |
|                 | 07h      | 0        | 7                       |
|                 | 08h      | 0        | 8                       |
|                 | 09h      | 0        | 9                       |
|                 | 0Ah      | 0        | 10                      |
|                 | 0Bh      | 0        | 11                      |
|                 | 0Ch      | 0        | 12                      |
|                 | 0Dh      | 0        | 13                      |
|                 | 0Eh      | 0        | 14                      |
|                 | 0Fh      | 0        | 17                      |
|                 | 10h      | 0        | 18                      |
|                 | 11h      | 0        | 19                      |
|                 | 12h      | 0        | 20                      |
|                 | 13h      | 0        | 21                      |
|                 | 14h      | 0        | 22                      |
|                 | 15h      | 0        | 23                      |
|                 | 16h      | 0        | 24                      |
|                 | 17h      | 0        | 25                      |
|                 | 18h      | 0        | 26                      |
|                 | 19h      | 0        | 27                      |
|                 | 1Ah      | 0        | 28                      |
|                 | 1Bh      | 0        | 29                      |
|                 | 1Ch      | 0        | 30                      |
|                 | 1Dh      | 0        | 33                      |
|                 | 1Eh      | 0        | 34                      |
|                 | 1Fh      | 0        | 35                      |
|                 | 20h      | 0        | 37                      |

For the relationship between the value and the restoration method, refer to 6098h (restoration method).

### 3) The operation of the hm control mode (Homing operation)

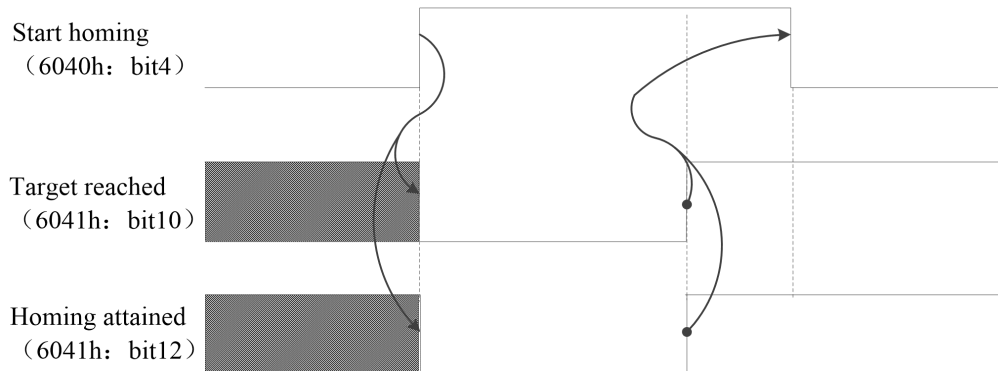
When operating in incremental mode, perform the homing action to initialize the position data prior to

initiating standard operations.

- Once the origin position is detected, it serves as the baseline for initializing the following objects (preset).  
6062h (position command) = 6064h (position feedback) = 607Ch (offset reset)  
6063h (actual internal position feedback) = 60FCh (internal position demand value) = 0
- If the origin reset is executed, the position information is initialized (preset). Therefore, the data obtained based on the previous position information (such as Touch probe position) must be retrieved again.
- The Homing action, whether or not the 607Ch (Home offset) is modified, does not affect the current Homing action. The next Homing action will incorporate this change (with position information initialized upon completion).
- 607Ch is only valid in the mode of returning to the origin 35 and 37.
- When using the edges of Switch signals (T, NOT, HOME) as origin detection points, assign each limit compensation Pin to SI1, SI2, and SI3 respectively. Incorrect assignment will trigger an origin reset error. (Note: For DS5C2 series servos, P5-22 is the positive limit setting address (default 1, corresponding to Servo Terminal SI1); P5-23 is the negative limit NOT setting address (default 2, corresponding to Servo Terminal SI2); P5-27 is the origin setting address (default 3, corresponding to Servo Terminal SI3).)
- In the subsequent Method diagrams, the following terms denote the following meanings.

|                |                                                                            |
|----------------|----------------------------------------------------------------------------|
| Index pulse    | The Z-bit signal of the encoder                                            |
| Home switch    | The theoretical signal state of the near-origin input (ME)                 |
| Positive limit | The theoretical signal state of the positive drive prohibition input (POT) |
| Negative limit | The theoretical signal state of the NOT input for negative drive           |

- After updating the action command (send signal) and enabling the servo command (Operation enabled), wait approximately 100 milliseconds before inputting.
- The following shows the timing of the hm control mode.



- Homing error conditions

The following conditions trigger a homing error (Homing error = 1).

| Homing error conditions              | detailed information                                                                                                                                                              |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Startup outside of enabled operation | Homing cannot be initiated when PDS is in Operation enabled state (except for method35 and 37).                                                                                   |
| start at zero target speed           | When the set values of 6099h-01h and 6099h-02h are 0, the Homing function is activated.<br>(excluding method33,34's 6099h-02h and method35,37's 6099h-01h and 6099h-02h at 00:00) |
| Two limit switches detected          | During homing startup or operation, the system detects two limit switches (Positive/Negative).                                                                                    |

|                                      |                                                                                                                                                                                                    |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use the limit switch                 | In the Method of reversing through the Limit switch, the detection of the Limit switch's falling edge occurs during the deceleration phase of the reversal action after detecting its rising edge. |
| Unassigned Home switch, Limit switch | unallocated IO port                                                                                                                                                                                |

## 7.5.2 Common Parameters

| register      | explain                                                         |
|---------------|-----------------------------------------------------------------|
| RXPDO[0x6040] | Control word, modify control word to return to origin           |
| RXPDO[0x6098] | return to origin method                                         |
| RXPDO[0x609A] | acceleration to origin                                          |
| RXPDO[0x6060] | Set to 6 when the motor is not enabled                          |
| SDO[0x6099]   | Restore speed to origin and modify it online through COE-Online |

Control word (6040h)

Set the sequence to (0x06>0x0F>0x1F), enable the drive, start the motor, and return to the origin.

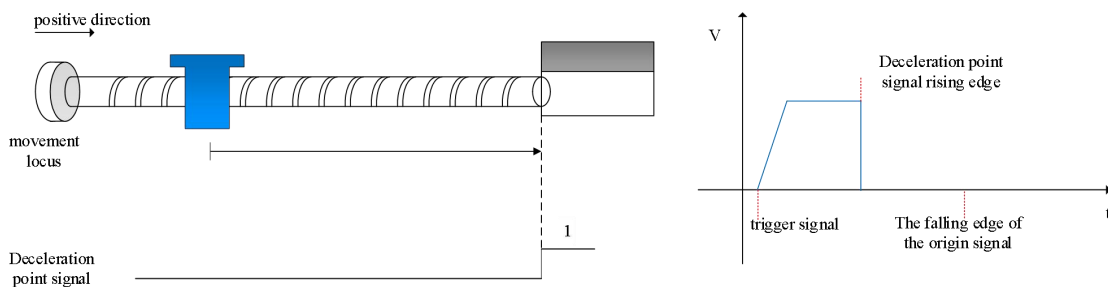
## 7.5.3 Back to Origin Method

The current Xinye DM6C series servo supports the following return-to-origin modes: 1-14, 17~30, 33, 34, 35, 37, -1, and -2. For slave units from other brands, the return-to-origin method should be determined according to the specifications in the respective brand's slave manual.

### ■ Method-1:

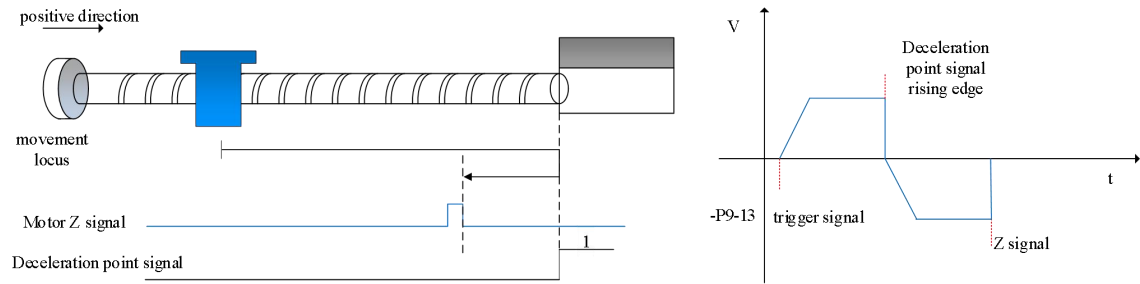
The servo motor initially operates in low-speed forward mode at the preset value 6099h:02 (low-speed return to origin). Upon reaching the mechanical limit position, if the absolute torque value reaches the upper limit of P9-17 (touch-stop return-to-origin torque threshold) while the absolute speed value remains below the preset value of P9-16 (touch-stop return-to-origin speed threshold), and this condition persists for the duration specified in P9-18 (touch-stop return-to-origin time threshold), the system will confirm the mechanical limit position has been reached. Subsequently, two scenarios are distinguished:

- ① When P7-20 equals 0 and the count of quantitative pulses is zero, the machine should be stopped immediately, and this position should be set as the zero point (position reset).

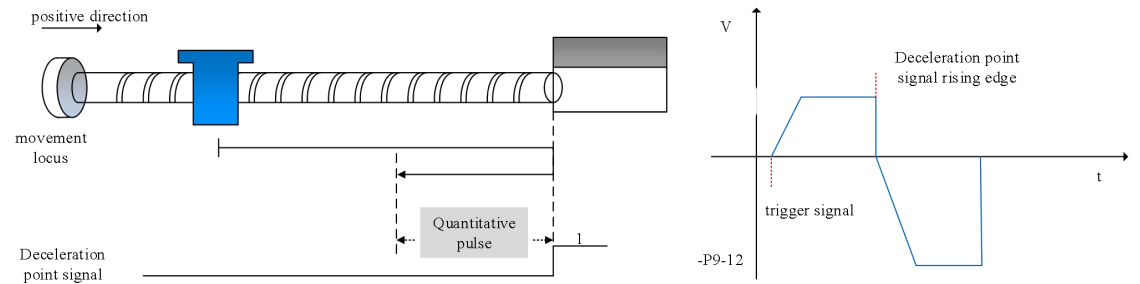




- ② When P7-20 exceeds 0, the system initiates a low-speed reverse run to reset to the origin with zero quantized pulses. Upon detecting P7-20 consecutive rising edges of Z signals, it immediately halts to calibrate the zero point (position reset).



- ③  $P7-20 = 0$ , and the number of quantized pulses is not zero. First, run forward at low speed (6099h:02). After encountering the mechanical point, reverse and return to the origin at high speed (6099h:01) for the length of the quantized pulse, then stop the machine. Mark this position as the zero point (clear the Ecat position).



- ④ When  $P7-20 > 0$  (indicating non-zero quantized pulses), the system first runs forward at low speed (6099h:02). Upon reaching the mechanical point, it reverses to the origin at preset low speed (6099h:02). After detecting P7-20 Z-signal rising edges, it stops. The system then proceeds to the origin at high speed (6099h:01) for the full quantized pulse duration before stopping, followed by zero calibration (Ecat position reset).

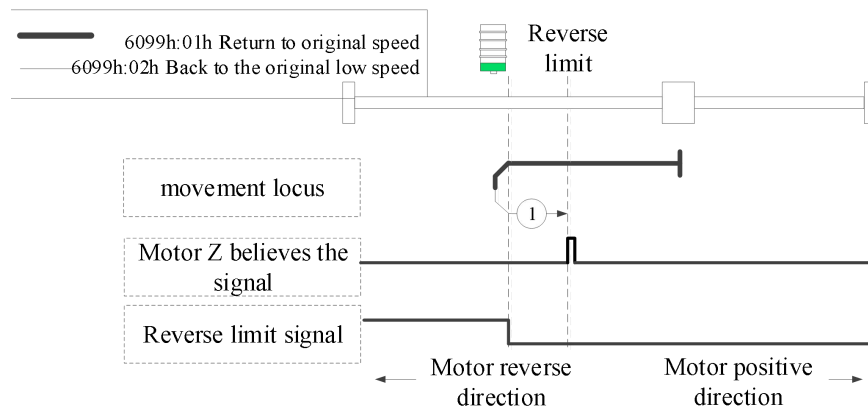
#### ■ Method-2:

Similar to the previous return to origin mode action, but in the opposite direction.

#### ■ Method 1 (6098h=1):

When using this return-to-origin method 1, if the reverse limit switch is in the non-trigger state, the initial movement direction is left. The origin position is the first Z-phase pulse to the right of the position where the negative limit switch becomes invalid.

Mechanical origin: Motor Z positive signal  
reduction point: reverse overtravel switch



Using a negative limit switch to reset the motor's Z-axis signal

- 6098h=1 Action description:

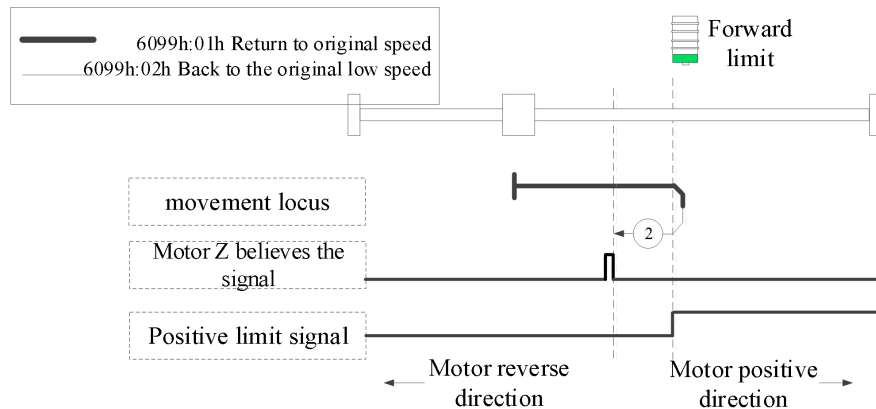
The reverse limit is invalid: When starting the return, the system initiates reverse zeroing at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), it decelerates and reverses direction, then proceeds at low-speed forward return (6099h:02h). After detecting the falling edge of the reverse limit, it stops at the first motor Z signal.

- Method 2 (6098h=2):

When using Method 2, if the forward limit switch remains inactive, the initial movement direction is to the right. The origin is located at the first Z-phase pulse to the left of the position where the forward limit switch becomes invalid.

Mechanical origin: Motor Z positive signal

Reduction point: forward overtravel switch



Using a positive limit switch and the Z-axis signal of the motor to return to the original position

- 6098h=2 Action Description:

The forward limit is invalid: When starting the return to zero, the system initiates the forward return at high speed (6099h:01h). Upon encountering the rising edge of the forward limit (POT), it decelerates and reverses direction, then proceeds at the low-speed return speed (6099h:02h). After detecting the falling edge of the forward limit, it stops at the first motor Z signal.

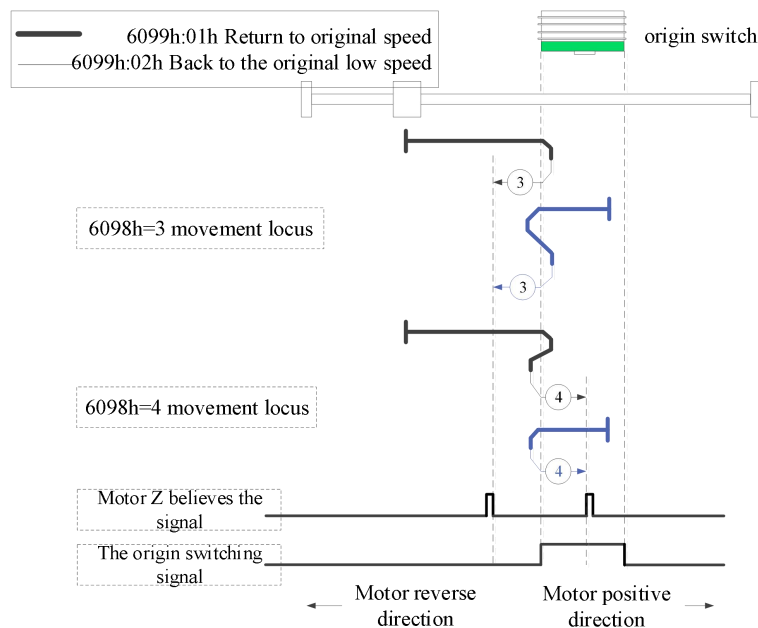
- Methods 3 and 4 (6098h=3, 6098h=4):

The initial direction of the movement is determined by the state of the origin switch. The origin

position is either on the reverse side of the origin switch or at the initial detected Z-phase position in the forward direction.

Mechanical origin: Motor Z positive signal

Reduction point: origin switch



Use the origin switch and motor Z signal to return to the origin.

- 6098h=3 Action Description:

① When the origin switch is invalid, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's rising edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's falling edge.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

- 6098h=4 Action Description:

① When the origin switch is inactive, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's rising edge, it reverses direction and waits for the falling edge before decelerating and reversing again. The system then proceeds forward at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

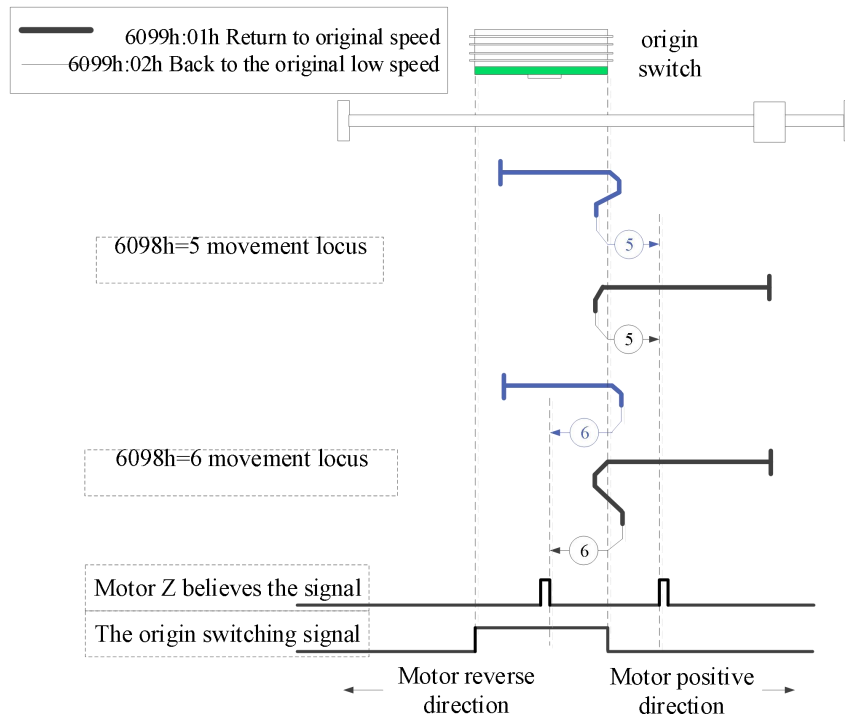
② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The first motor Z signal is detected upon the origin switch's rising edge, triggering an immediate shutdown.

■ Methods 5 and 6 (6098h=5, 6098h=6):

Using method 5 or 6, the initial direction of movement is determined by the state of the origin switch. The origin position is either on the reverse side of the origin switch or at the initial detected Z-phase position in the forward direction.

Mechanical origin: Motor Z positive signal

Reduction point: origin switch



Use the origin switch and motor Z signal to return to the origin.

● 6098h=5 Action Description:

① When the origin switch is invalid, the system initiates reverse return at high speed (6099h:01h).

Upon detecting the origin switch's rising edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. After encountering the origin switch's falling edge, it stops at the first motor Z signal.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

● 6098h=6 Action Description:

① When the origin switch is inactive, the system initiates reverse zeroing at high speed (6099h:01h).

Upon detecting the origin switch's rising edge, it reverses direction and waits for the falling edge to decelerate before reversing again. The system then operates at 6099h:02h speed in reverse mode. When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

■ Method 7~14 (6098h=7~14):

7-14 all use the origin switch and Z signal;

The initial action direction of mode 7 and 8 is negative if the origin switch is activated at the start of the action.

The initialization action direction of mode 9 and 10 is positive if the origin switch is activated at the start of the action.

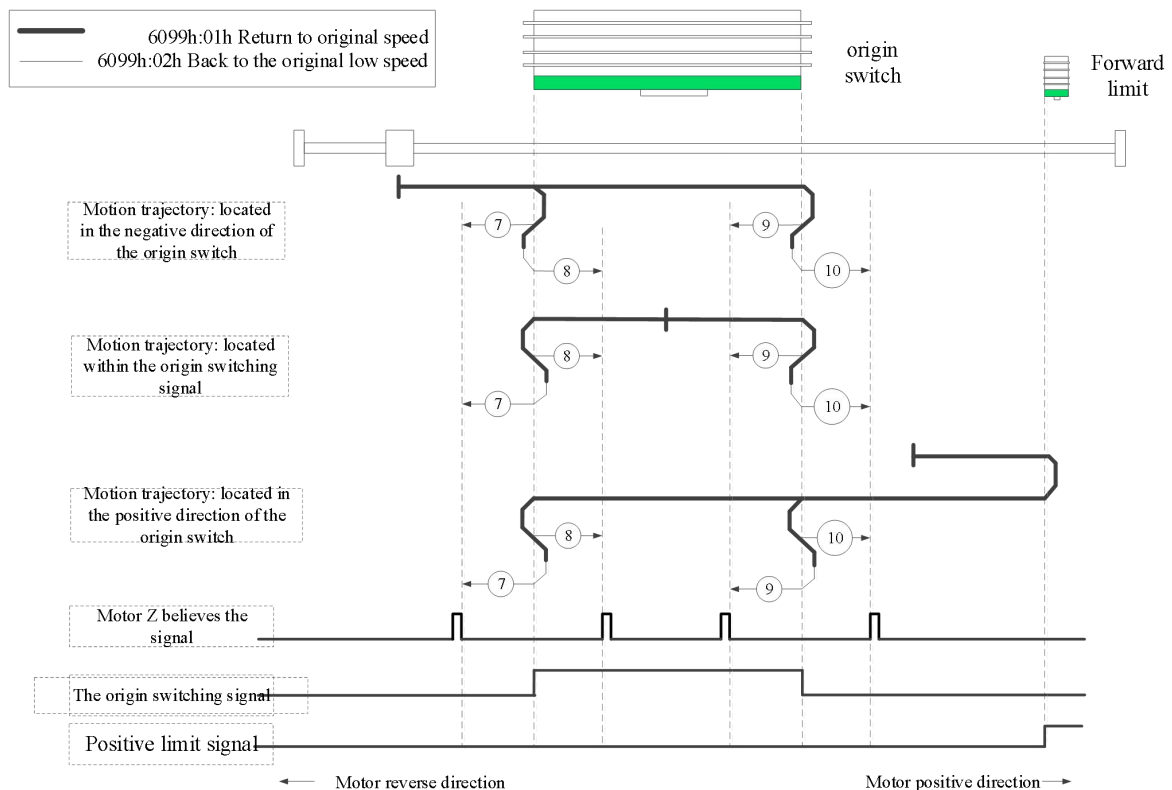
The initialization action direction of mode 11 and 12 is positive if the origin switch is activated at the start of the action.

The initialization action direction of mode 13 and 14 is negative if the origin switch is activated at the start of the action.

The final position of the returning to the origin is the Z-phase signal near the rising or falling edge of the origin switch.

Mechanical origin: Motor Z positive signal

Reduction point: origin switch



Use the origin switch, forward limit signal, and motor Z-axis signal to return to the origin.

● 6098h=7 Action description:

① When the motor is located at the negative direction of the origin switch, the motor starts to return

to the origin at high speed (6099h:01h) in the positive direction. After encountering the rising edge of the origin switch, the motor decelerates and reverses direction, running in the reverse direction at the speed of 6099h:02h. After encountering the falling edge of the origin switch, the motor stops at the first Z signal.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h).

Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, then reverses to locate the next rising edge. The system decelerates and reverses again, executing a reverse return speed of 6099h:02h. Upon detecting the origin switch's falling edge, it stops at the first motor Z signal.

- 6098h=8 Action Description:

① When the motor is initially in reverse, it first reverses to the neutral position at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, it reverses direction and decelerates until it detects the falling edge, then reverses again. The motor then resumes forward operation at 6099h:02h speed. When the origin switch rises again, it stops at the first Z-axis signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h).

Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The first motor Z signal is detected upon the origin switch's rising edge, triggering an immediate shutdown.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward zero return. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, where it decelerates and reverses to maintain the original return speed (6099h:02h) in the forward direction. Upon detecting the origin switch's rising edge again, it stops at the first motor Z signal.

- 6098h=9 Action Description:

① When the origin switch is in the negative position: The system initiates a high-speed (6099h:01h) positive return to zero. Upon detecting the origin switch's rising edge, it accelerates forward until encountering the falling edge, where deceleration and direction reversal occur. Subsequently, it reverses direction at 6099h:02h speed. After detecting the origin switch's rising edge again, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a

reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

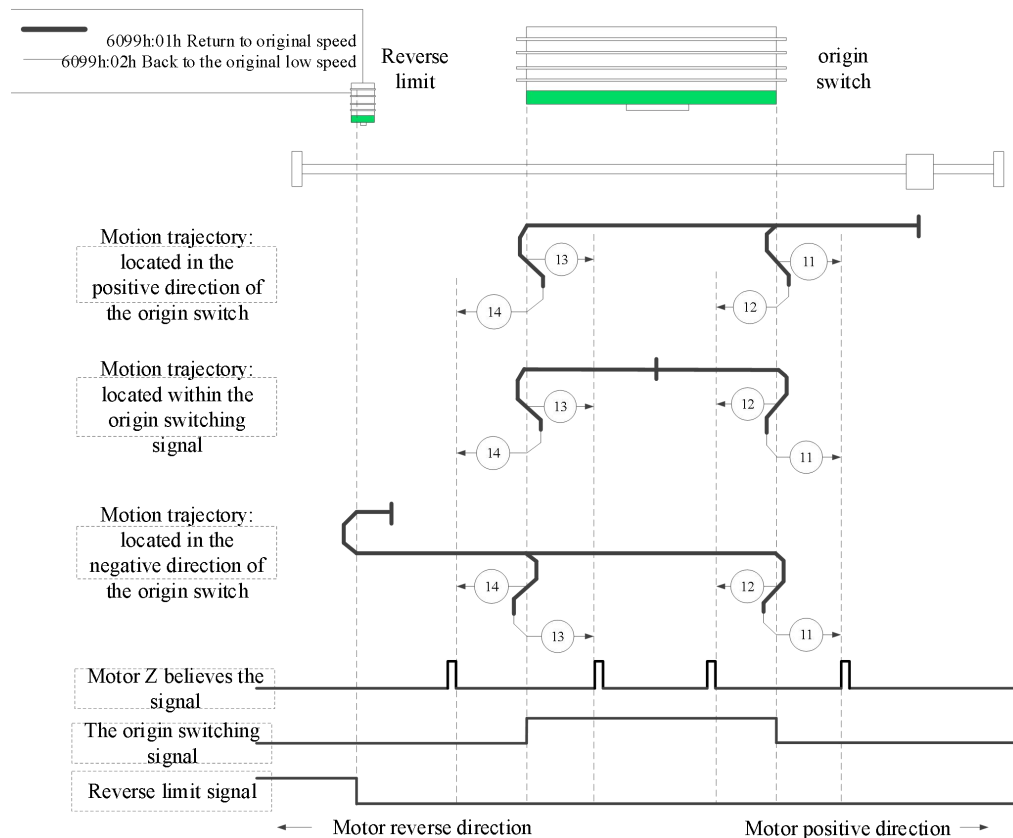
③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) positive return to zero. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it switches direction and searches for the origin switch's falling edge, decelerates, and reverses again. The system then operates in reverse at the original return speed (6099h:02h). Upon detecting the origin switch's rising edge, it stops at the first motor Z signal.

- 6098h=10 Action Description:

① When the origin switch is in the negative position: During initial return, the system initiates a rapid forward reset (6099h:01h). Upon detecting the origin switch's rising edge, it accelerates until encountering the falling edge, then reverses direction. The system then searches for the next rising edge, decelerates, and reverses again. It subsequently returns forward at 6099h:02h speed until the origin switch's falling edge is detected, at which point the first motor Z signal is triggered to halt.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the origin switch is in the forward position: During initial return, the system initiates a rapid forward reset (6099h:01h). Upon reaching the forward limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it decelerates and reverses, then proceeds forward at the reset speed (6099h:02h). When the origin switch's falling edge is detected, it stops at the first motor Z signal.



Use the origin switch, reverse limit signal, and motor Z-axis signal to return to the origin.

- 6098h=11 Action description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, then reverses to locate the next rising edge. The system decelerates and reverses again, then runs forward at the original return speed (6099h:02h). Upon detecting the origin switch's falling edge, it stops at the first motor Z signal.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the motor starts to return to the origin, it first reverses to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and reverses direction, then runs forward at the original return speed (6099h:02h). After detecting the falling edge of the origin switch, it stops at the first Z-axis signal.

- 6098h=12 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically



reverses direction and maintains high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, where it decelerates and reverses direction, operating at the original return speed (6099h:02h). The system then stops at the first motor Z signal upon detecting the origin switch's rising edge.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

③ When the motor starts returning to the origin, it first reverses to zero at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, it reverses direction and decelerates until finding the falling edge. It then reverses again, returning to the origin at 6099h:02h. After encountering the rising edge of the origin switch, it stops at the first Z-axis signal.

- 6098h=13 Action description:

① When the origin switch is in the negative position: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and accelerates. After detecting the origin switch's rising edge, it switches direction to locate the falling edge, decelerates, and reverses again. The system then proceeds forward at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The first motor Z signal is detected upon the origin switch's rising edge, triggering an immediate shutdown.

③ When the origin switch is in the forward position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it accelerates forward until encountering the falling edge, then decelerates and reverses direction. The system resumes forward operation at 6099h:02h speed. After detecting the origin switch's rising edge again, it stops at the first motor Z signal.

- 6098h=14 Action Description:

① When the origin switch is in the negative position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and accelerates. After detecting the origin switch's rising edge, it decelerates and reverses, maintaining the original return speed (6099h:02h) until the falling edge. The system then stops at the first motor Z signal.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When

the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the origin switch is in the forward position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it advances until encountering the falling edge, then reverses direction. The system then searches for the origin switch's rising edge, decelerates, and reverses again. It returns to the origin at 6099h:02h speed. After detecting the origin switch's falling edge, it stops at the first motor Z signal.

#### ■ Method (6098h=17):

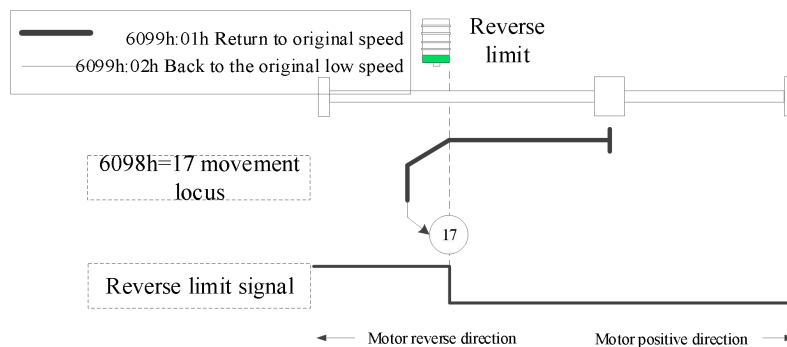
This method is similar to method 1.

The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position change of the reverse limit switch (see figure below).

Homing error = 1 when the reverse limit (NOT) is not allocated.

Mechanical origin: reverse limit switch

reduction point: reverse limit switch



Use the reverse limit signal to return to the original position.

#### ● 6098h=17 Action description:

The reverse limit is invalid: When starting the return, the system initiates reverse zeroing at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), it reverses direction and decelerates, then proceeds at the low-speed return speed (6099h:02h) in the forward direction. The system stops when the falling edge of the reverse limit is detected.

#### ■ Method (6098h=18):

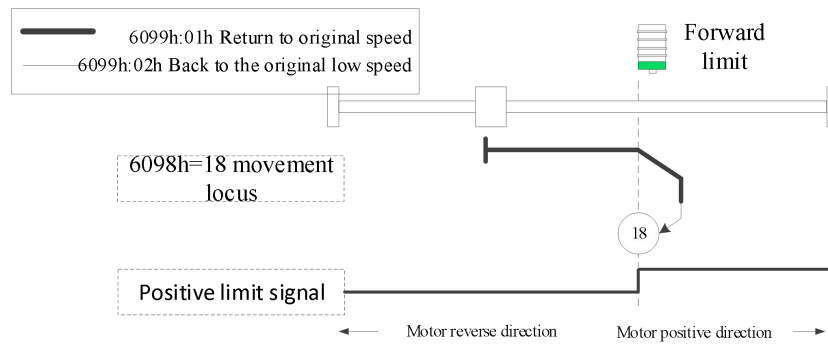
This method is similar to Method 2.

The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position change of the forward limit switch. (Refer to the diagram below)

Homing error = 1 when the positive limit (POT) is not allocated.

Mechanical origin: forward limit switch

Deceleration point: forward limit switch



Use the forward limit signal to return to the original position.

- 6098h=18 Action Description:

When the forward limit is invalid, the system initiates a high-speed (6099h:01h) return to zero. Upon detecting the rising edge of the forward limit (POT), it reverses direction and decelerates, then proceeds at a reduced speed (6099h:02h) in reverse mode until the falling edge of the forward limit is detected, at which point it stops.

- Methods 19 and 20 (6098h=19,6098h=20):

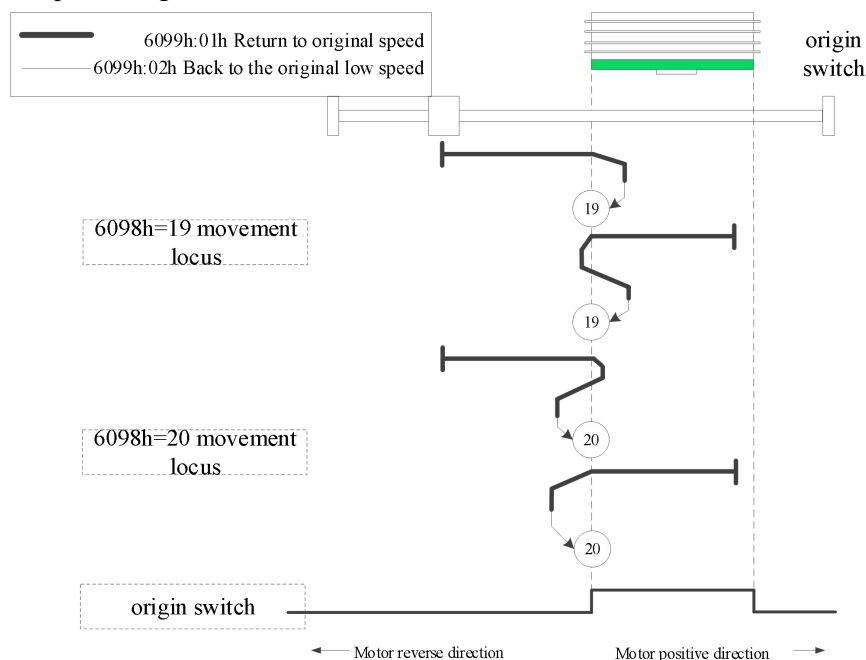
This method is similar to the original method 3,4.

The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch change. (Refer to the figure below)

Homing error = 1 when HOME is not allocated.

Mechanical Origin: Origin Switch

Reduction point: origin switch



Use the origin switch signal to return to the origin.

- 6098h=19 Action description:

- ① The origin switch is invalid: When starting the return, the forward return begins at high speed

(6099h:01h). After encountering the rising edge of the origin switch, the direction is reversed and decelerated, then the return proceeds in reverse at 6099h:02h. The machine stops upon the falling edge of the origin switch signal.

② The origin switch is in the active state: When starting the return to the origin, the reverse return to zero begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then the direction is reversed again, decelerating, and running in reverse at the return speed of 6099h:02h. After encountering the falling edge of the origin switch, the machine stops.

- 6098h=20 Action Description:

① The origin switch is invalid: When starting the return, the forward return begins at high speed (6099h:01h). After encountering the rising edge of the origin switch, the direction is reversed to find the falling edge of the origin switch, then the direction is reversed again, and the speed is reduced. The return proceeds forward at the speed of 6099h:02h until the origin switch's rising edge is encountered, at which point the machine stops.

② When the origin switch is active, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and decelerates, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

- Methods 21 and 22 (6098h=21,6098h=22):

This method is similar to the original method 5,6.

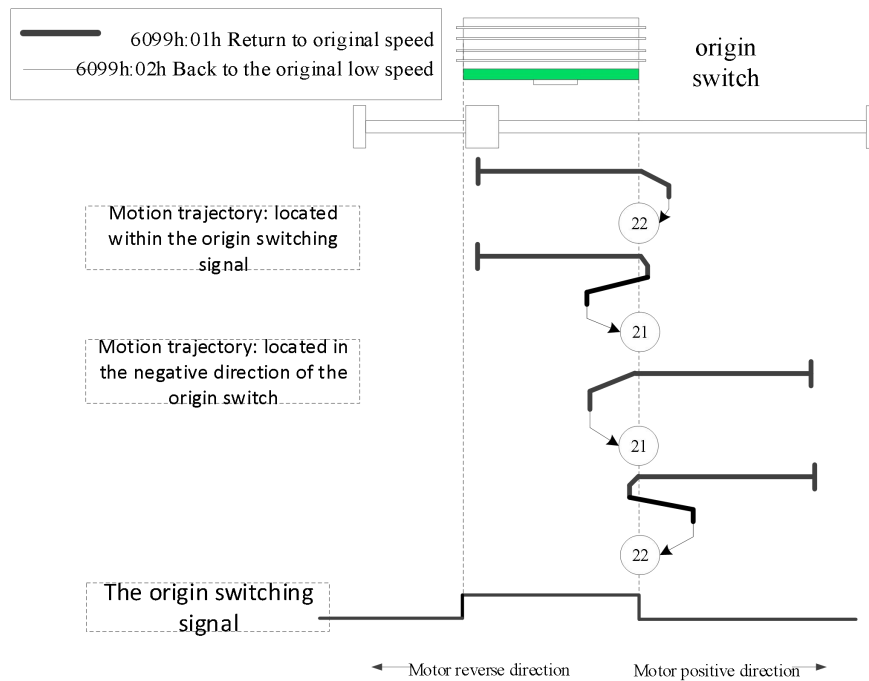
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch's transition.

(See the figure below)

Homing error = 1 when the origin signal is not assigned.

Mechanical Origin: Origin Switch

Reduction point: origin switch



Use the origin switch signal to return to the origin.

- 6098h=21 Action description:

① The origin switch is invalid: When starting the return, reverse the return speed at high speed (6099h:01h). After encountering the rising edge of the origin switch, reverse the direction and slow down. Then, run forward at the return speed of 6099h:02h. After encountering the falling edge of the origin switch, stop.

② When the origin switch is in the active state, the system initiates the return to the origin at high speed (6099h:01h) for a forward return to zero. Upon encountering the falling edge of the origin switch, it reverses direction and searches for the rising edge of the origin switch, then reverses again while decelerating. The system then proceeds forward at the return speed of 6099h:02h until it stops upon encountering the falling edge of the origin switch.

- 6098h=22 Action description:

① The origin switch is invalid: When starting the return, reverse the return speed to 6099h:01h. After encountering the rising edge of the origin switch, reverse direction and find the falling edge of the origin switch, reverse direction again, slow down, reverse the return speed to 6099h:02h, stop after encountering the rising edge of the origin switch.

② When the origin switch is in the active state, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it reverses direction and decelerates, then proceeds backward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

- Method 23-26 (6098h=23,24,25,26):

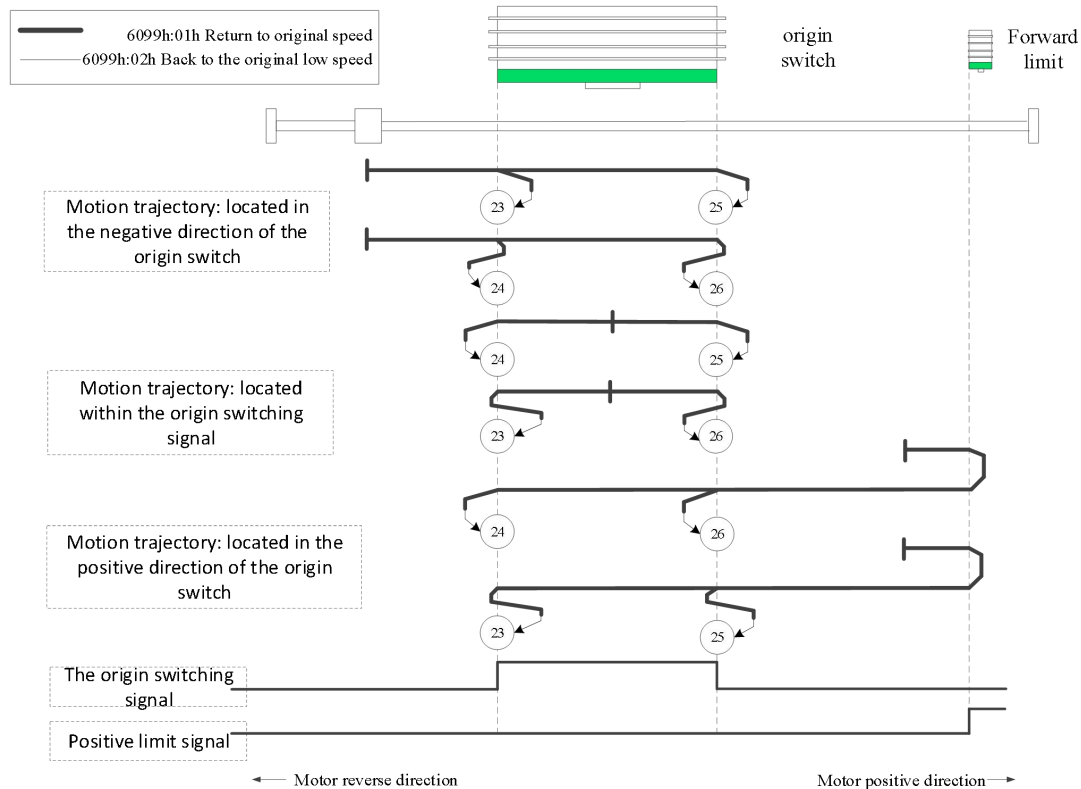
This method is similar to the back-to-origin methods 7, 8, 9, 10.

The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch change. (Refer to the figure below)

Homing error = 1 if the origin signal and forward limit signal are not assigned.

Mechanical Origin: Origin Switch

Reduction point: origin switch



Use the origin switch signal and forward limit signal to return to the origin.

- 6098h=23 Action Description:

① The original point switch is located in the negative direction: when starting to return to the origin, it starts with high speed (6099h:01h) to return to zero in the positive direction. After encountering the rising edge of the original point switch, it decelerates and changes direction, running in reverse with the original point switch speed of 6099h:02h. After encountering the falling edge of the original point switch, it stops.

② The origin switch is in the active state: When starting the return to the origin, the system begins the reverse return at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, it switches direction and searches for the rising edge of the origin switch. The system then decelerates and switches direction again, running in reverse at the return speed of 6099h:02h. It stops the machine upon encountering the falling edge of the origin switch.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the positive limit, it automatically reverses to

high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, then reverses to locate the next rising edge. The system decelerates, reverses again, and executes a reverse return at 6099h:02h speed. It stops upon reaching the origin switch's falling edge.

- 6098h=24 Action Description:

① The system is located at the negative direction of the origin switch. When starting to return to the origin, it starts to return to zero in the positive direction at high speed (6099h:01h). After encountering the rising edge of the origin switch, it changes direction, searches for the falling edge of the origin switch, decelerates, changes direction again, and runs in the positive direction at the return speed of 6099h:02h. After encountering the rising edge of the origin switch, it stops.

② When the origin switch is in the active state, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

③ When positioned at the origin switch's positive direction, the system initiates a high-speed (6099h:01h) return to zero. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, where it decelerates and reverses direction. The system then maintains the original return speed (6099h:02h) in the forward direction until stopping at the origin switch's rising edge.

- 6098h=25 Action Description:

① The original point switch is located in the negative direction: when starting to return to the origin, it begins the positive return at high speed (6099h:01h). After encountering the rising edge of the original point switch, it continues forward until it meets the falling edge, then decelerates and reverses direction, running backward at the original point switch's return speed (6099h:02h). Upon encountering the rising edge of the original point switch again, the machine stops.

② When the origin switch is in the active state, the system initiates the return process at high speed (6099h:01h) for a forward return to zero. Upon detecting the falling edge of the origin switch, it decelerates and reverses direction, then proceeds at the reduced speed (6099h:02h) for a reverse return. The system halts upon detecting the rising edge of the origin switch.

③ When the original point switch is in the forward direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the forward limit, it automatically reverses to high-speed operation. After detecting the rising edge of the original point switch, it switches direction to locate the falling edge, decelerates, and reverses again. The system then returns to the original point at a reduced speed (6099h:02h) and stops upon encountering the rising edge of the original point switch.

- 6098h=26 Action description:

① When the system initiates return to origin, it first performs a high-speed (6099h:01h) forward

return to zero. Upon detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, at which point it reverses direction. The system then searches for the next rising edge of the origin switch, decelerates, and reverses again. It subsequently returns to origin at the speed of 6099h:02h, and stops upon reaching the falling edge of the origin switch.

② The origin switch is in the active state: When starting the return to the origin, the forward return begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return proceeds forward at the speed of 6099h:02h until the origin switch's falling edge is encountered, at which point the machine stops.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reaches the positive limit, then automatically reverses direction and runs at high speed. After the original point switch rises, the system decelerates and reverses direction, and runs forward at the original speed (6099h:02h).

#### ■ Methods 27-30 (6098h=27,28,29,30):

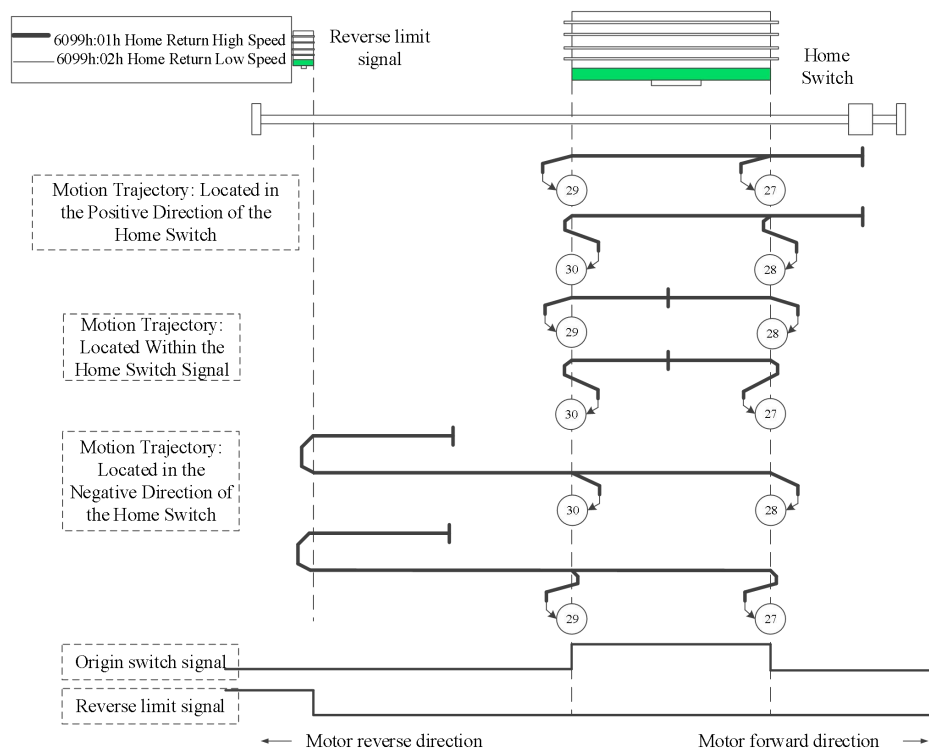
This method is similar to the original method 11,12,13,14.

The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch change. (Refer to the figure below)

Homing error = 1 when the origin switch and negative limit are not allocated.

Mechanical Origin: Origin Switch

Reduction point: origin switch



Use the origin switch signal and reverse limit signal to return to the origin.



- 6098h=27 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, at which point it reverses direction again. The system then decelerates, searches for the next rising edge of the origin switch, and reverses direction once more. It then proceeds forward at the original return speed (6099h:02h) until stopping upon detecting the falling edge of the origin switch.

② The origin switch is in the active state: When starting the return to the origin, the forward return begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return proceeds forward at the speed of 6099h:02h until the origin switch's falling edge is encountered, at which point the machine stops.

③ When the system starts to return to the origin, it first reverses to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and reverses direction, then runs forward at the original return speed (6099h:02h). The system stops when the falling edge of the origin switch is detected.

- 6098h=28 Action Description:

① When positioned at the negative direction of the origin switch, the system initiates a high-speed (6099h:01h) reverse return to zero. Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, where it decelerates and reverses direction again, now operating at the original return speed (6099h:02h). The system then stops upon detecting the rising edge of the origin switch.

② When the origin switch is in the active state, the system initiates the return process at high speed (6099h:01h) for a forward return to zero. Upon detecting the falling edge of the origin switch, it decelerates and reverses direction, then proceeds at the reduced speed (6099h:02h) for a reverse return. The system halts upon detecting the rising edge of the origin switch.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reverses to return to zero. After encountering the rising edge of the original point switch, it changes direction, searches for the falling edge of the original point switch, decelerates, and changes direction again. The system then runs in reverse at the original speed of 6099h:02h until it stops upon encountering the rising edge of the original point switch.

- 6098h=29 Action description:

① When the system initiates return to the origin, it first reverses at high speed (6099h:01h) until

encountering the reverse limit. Upon reaching the origin switch's rising edge, it reverses again to seek the falling edge, decelerates, and reverses once more. The system then proceeds forward at the original return speed (6099h:02h) until stopping at the origin switch's rising edge.

② When the origin switch is in the active state, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reverses to return to zero. After encountering the rising edge of the original point switch, it continues forward until it meets the falling edge of the original point switch, then decelerates and changes direction. The system runs forward at the original return speed (6099h:02h) and stops after encountering the rising edge of the original point switch.

● 6098h=30 Action Description:

① The system is located at the negative direction of the origin switch. When starting to return to the origin, it starts to reverse to zero at high speed (6099h:01h). After encountering the reverse limit, it automatically changes direction and runs at high speed. After encountering the rising edge of the origin switch, it decelerates and changes direction, and runs in reverse at the speed of 6099h:02h. After encountering the falling edge of the origin switch, it stops.

② The origin switch is in the active state: When starting the return to the origin, the system begins the reverse return at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, it switches direction and searches for the rising edge of the origin switch. The system then decelerates and switches direction again, running in reverse at the return speed of 6099h:02h. It stops the machine upon encountering the falling edge of the origin switch.

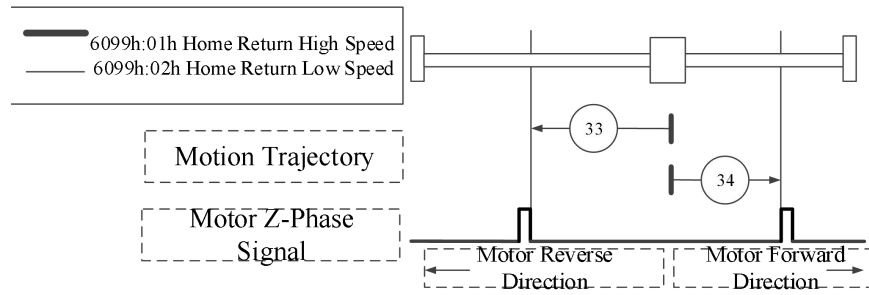
③ When the original point switch is in the forward direction: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the rising edge of the original point switch, it advances until encountering the falling edge, then reverses direction. The system searches for the next rising edge, decelerates, and reverses again. It then returns to the original point switch at the speed of 6099h:02h, stopping when the falling edge is detected.

■ Methods 33 and 34 (6098h=33,34):

Use method 33 or 34, where the direction to the origin is negative or positive, respectively. The original position is near the Z axis in the selected direction.

Mechanical origin: Motor Z positive signal

Deceleration point: None



The origin is on the Z-axis.

- 6098h=33 Action description:

During the initial reset, the system operates in reverse at 6099h:02h speed, stopping at the first motor Z signal.

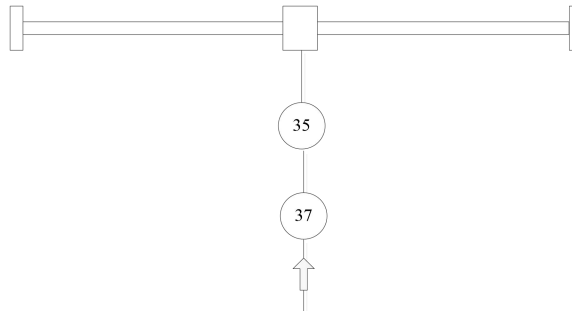
- 6098h=34 Action description:

During the initial return phase, the system operated forward at 6099h:02h speed until encountering the first motor Z signal, which triggered a shutdown.

- Methods 35 (6098h=35) and 37 (6098h=37):

In modes 35 and 37, the current position is reset to the origin after triggering the origin reset action.

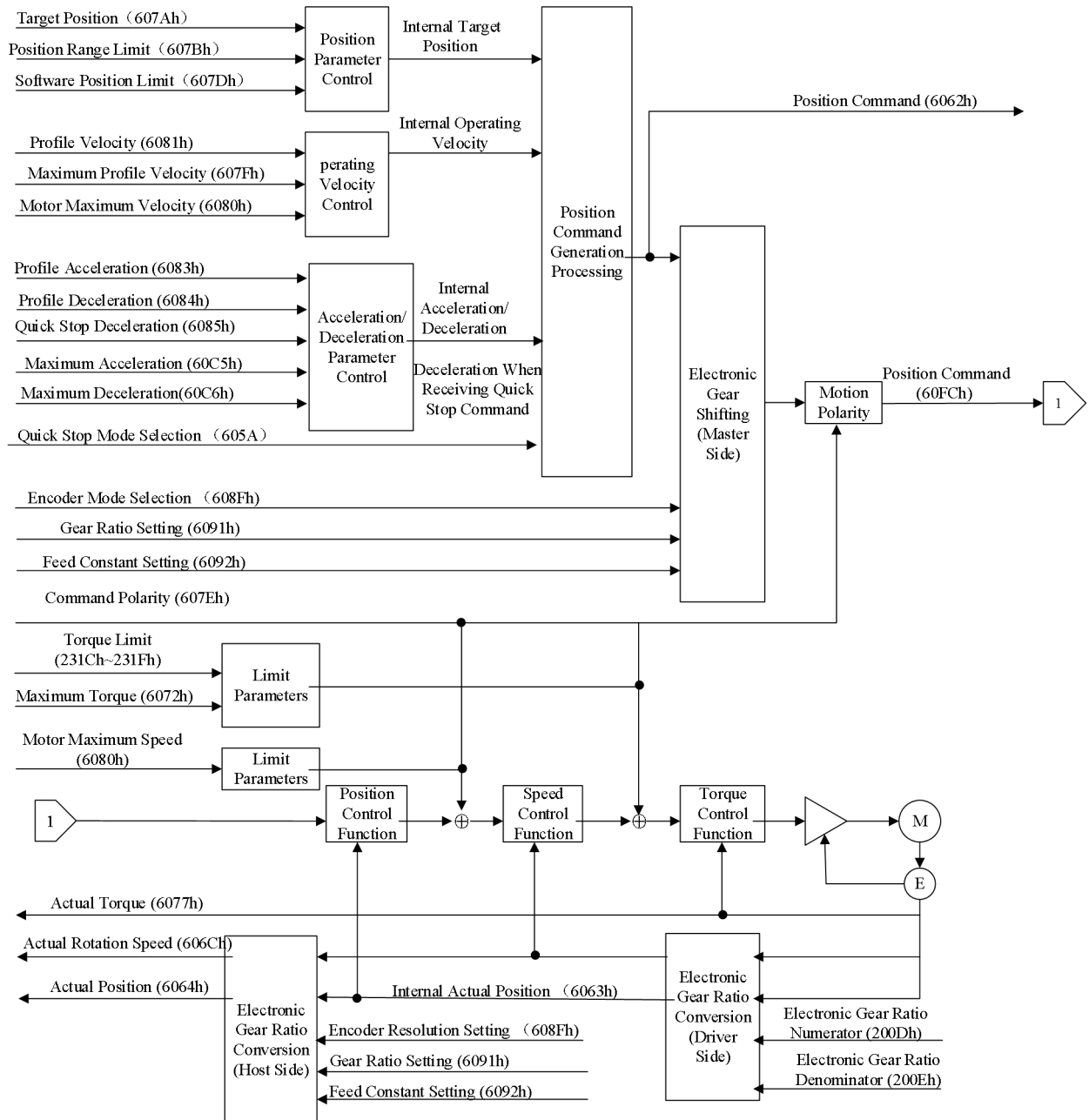
Mechanical origin: Trigger position



All revert methods require the revert action command to trigger before taking effect.

## 7.6 PP pattern

PP (Profile Positioning Mode) is a positioning control method that specifies target position, target speed, and acceleration/deceleration. The servo driver generates position commands and executes them accordingly. This mode should be used when the communication cycle exceeds 500 $\mu$ s.



## 7.6.1 Relevant parameters

### 1) PP control mode associated objects (commands, settings)

| index of matrix | son index of matrix | name                                 | unit                             | scope                  | data type | accessibility | PDO   |
|-----------------|---------------------|--------------------------------------|----------------------------------|------------------------|-----------|---------------|-------|
| 6040h           | 00h                 | control word                         | -                                | 0~65535                | U16       | rw            | RxPDO |
| 6072h           | 00h                 | maximum torque                       | 0.1%                             | 0~65535                | U16       | rw            | RxPDO |
| 607Ah           | 00h                 | target location                      | instruction unit                 | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 607Dh           | -                   | software absolute position limit     | -                                | -                      | -         | -             | -     |
|                 | 00h                 | Indicates the 607Dh sub-index number | -                                | 2                      | U8        | ro            | NO    |
|                 | 01h                 | minimum position limit               | instruction unit                 | -2147483648~2147483647 | I32       | rw            | RxPDO |
|                 | 02h                 | Maximum location limit               | instruction unit                 | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 607Fh           | 00h                 | maximum outline velocity             | Command unit/s                   | 0~4294967295           | U32       | rw            | RxPDO |
| 6081h           | 00h                 | Contour speed                        | Command unit/s                   | 0~4294967295           | U32       | rw            | RxPDO |
| 6083h           | 00h                 | contour acceleration                 | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw            | RxPDO |
| 6084h           | 00h                 | contour deceleration                 | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw            | RxPDO |
| 60B1h           | 00h                 | velocity offset                      | Command unit/s                   | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 60B2h           | 00h                 | torque offset                        | 0.1%                             | -32768~32767           | I16       | rw            | RxPDO |
| 60C5h           | 00h                 | maximal acceleration                 | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw            | RxPDO |
| 60C6h           | 00h                 | maximum deceleration                 | instruction units/s <sup>2</sup> | 0~4294967295           | U3        | rw            | RxPDO |

There are also other related objects with common actions.

| index of matrix | subindex | name                      | unit | scope | data type | accessibility | PDO |
|-----------------|----------|---------------------------|------|-------|-----------|---------------|-----|
| 605Ah           | 00h      | Quick Stop Mode Selection | -    | 0~7   | I16       | rw            | NO  |

| index of matrix | subindex | name                                 | unit                                               | scope                  | data type | accessibility | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------------------------|------------------------|-----------|---------------|-------|
| 605Bh           | 00h      | Close method selection               | -                                                  | 0~1                    | I16       | rw            | NO    |
| 605Ch           | 00h      | Suspended shutdown mode              | -                                                  | 0~1                    | I16       | rw            | NO    |
| 605Dh           | 00h      | Pause option code                    | -                                                  | 1~3                    | I16       | rw            | NO    |
| 605Eh           | 00h      | failure mode and effect code         | -                                                  | 0~2                    | I16       | rw            | NO    |
| 607Dh           | -        | Software location restrictions       | -                                                  | -                      | -         | -             | -     |
|                 | 00h      | Indicates the 607h sub-index number  | -                                                  | 2                      | U8        | ro            | NO    |
|                 | 01h      | Minimum position limit               | instruction unit                                   | -2147483648~2147483647 | I32       | rw            | RxPDO |
|                 | 02h      | Maximum location limit               | instruction unit                                   | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 607Ch           | 00h      | origin offset                        | instruction unit                                   | -2147483648~2147483647 | I32       | rw            | RxPDO |
| 607Eh           | 00h      | command polarity                     | -                                                  | 0~255                  | U8        | rw            | NO    |
| 6085h           | 00h      | quick deceleration                   | instruction units/s <sup>2</sup>                   | 0~4294967295           | U32       | rw            | RxPDO |
| 6086h           | 00h      | Location trajectory planning type    | -                                                  | -32768~32767           | I16       | rw            | RxPDO |
| 608Fh           | -        | Position encoder resolution setting  | -                                                  | -                      | -         | -             | -     |
|                 | 00h      | Indicates the 608Fh sub-index number | -                                                  | 2                      | U8        | ro            | NO    |
|                 | 01h      | Encoder movement distance            | pulse                                              | 1~4294967295           | U32       | ro            | NO    |
|                 | 02h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295           | U32       | ro            | NO    |

| index of matrix | subindex | name                                 | unit                                               | scope        | data type | accessibility | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------------------------|--------------|-----------|---------------|-------|
| 6091h           | -        | gear ratio setting                   | -                                                  | -            | -         | -             | -     |
|                 | 00h      | Indicates the 6091h sub-index number | -                                                  | 2            | U8        | ro            | NO    |
|                 | 01h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw            | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw            | NO    |
| 6092h           | -        | Feed constant settings               | -                                                  | -            | -         | -             | -     |
|                 | 00h      | Indicates the 6092h sub-index number | -                                                  | 2            | U8        | ro            | NO    |
|                 | 01h      | Set the Feed value                   | instruction unit                                   | 1~4294967295 | U32       | rw            | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw            | NO    |
| 60B8h           | 00h      | probe mode                           | -                                                  | 0~65535      | U16       | rw            | RxPDO |

Control word (6040h) <ppFunction in control mode>

| index of matrix | subindex | name                                                                      | scope   | data type              | accessibility | PDO           | Op-mode |    |    |    |
|-----------------|----------|---------------------------------------------------------------------------|---------|------------------------|---------------|---------------|---------|----|----|----|
| 6040h           | 00h      | control word                                                              | 0~65535 | U16                    | rw            | RxPDO         | All     |    |    |    |
|                 |          | Set the control command for PDS state transition and other servo drivers. |         |                        |               |               |         |    |    |    |
|                 |          | bit information                                                           |         |                        |               |               |         |    |    |    |
|                 |          | 15                                                                        | 14      | 13                     | 12            | 11            | 10      | 9  | 8  |    |
|                 |          | r                                                                         |         |                        |               |               |         | om | h  |    |
|                 |          | 7                                                                         | 6       | 5                      |               | 4             | 3       | 2  | 1  | 0  |
|                 |          | fr                                                                        | oms     |                        |               |               | eo      | qs | ev | so |
|                 |          |                                                                           | abs/rel | Change set immediately |               | New set-point |         |    |    |    |
|                 |          | r = reserved (not mapped) fr = fault reset                                |         |                        |               |               |         |    |    |    |
|                 |          | r = reserved (not mapped) fr = fault reset                                |         |                        |               |               |         |    |    |    |
|                 |          | oms = operation mode specific eo = enable operation                       |         |                        |               |               |         |    |    |    |
|                 |          | Specific operation mode: QS = Quick Stop                                  |         |                        |               |               |         |    |    |    |
|                 |          | Specific operation mode: QS = Quick Stop                                  |         |                        |               |               |         |    |    |    |
|                 |          | h = halt (stop) ev = enable voltage (enable voltage)                      |         |                        |               |               |         |    |    |    |

|  |  |                                                                        |
|--|--|------------------------------------------------------------------------|
|  |  | h = halt (stop) ev = enable voltage (enable voltage)<br>so = switch on |
|--|--|------------------------------------------------------------------------|

bit6-4 (operation mode specific) :

| Bit | name                   | price     | definition                                                                                                                                                                                                                                                                                                                                                                                         |
|-----|------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4   | new set-point          | 0 -><br>1 | Trigger for starting the positioning action and updating the set value. Acquire new position determination tasks (607Ah (Target position), 6081h (Profile velocity), etc.).                                                                                                                                                                                                                        |
| 5   | change set immediately | 0         | Complete the current positioning action. If the target position 607A, acceleration 6083, and deceleration 6084 are changed during movement, the control command will not execute according to the new motion parameters. The previous motion must be completed before sending a new command to execute the new motion.                                                                             |
|     |                        | 1         | Immediately halt the current positioning action and initiate the downward positioning action. During motion, adjust target position 607A, acceleration 6083, and deceleration 6084. Then send control commands—such as changing control word 0x6F (111) to 0x7F (127) (relative mode) or 0x2F (47) to 0x3F (63) (absolute mode)—and the system will immediately execute the new motion parameters. |
| 6   | Absolute/Relative      | 0         | 607Ah (target position) is processed as an absolute position.                                                                                                                                                                                                                                                                                                                                      |
|     |                        | 1         | 607Ah (target location) as relative position processing.                                                                                                                                                                                                                                                                                                                                           |



- Do not change acceleration or deceleration during motor operation (\*).  
If the acceleration/deceleration mode is changed, set bit4 (new set-point) from 0 to 1 after the motor stops.  
6083h (Profile acceleration)  
6084h (Profile deceleration)  
60C5h (Maximum Acceleration)  
60C6h (Maximum deceleration)
- If you execute the set-point (bit4 (new set-point) changes from 0 to 1) under the following conditions, note that the positioning task will be canceled.  
Key configuration points for--6081h (Profile speed) when set to 0.
- When the system detects a drive prohibition during deceleration (halt=1), all positioning tasks are canceled.
- Maintain the PP action for at least 2ms between initiating one PP action and the next (when the new set-point transitions from 0 to 1).

## 2) PP control mode associated objects (monitoring type)

| index of matrix | subindex | name         | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|--------------|------|---------|-----------|---------------|-------|
| 6041h           | 00h      | control word | -    | 0~65535 | U16       | ro            | TxPDO |



There are also other objects with common location control.

| index of matrix | son index of matrix | name                                              | unit             | scope                    | data type | Accessible inquisitive | PDO   |
|-----------------|---------------------|---------------------------------------------------|------------------|--------------------------|-----------|------------------------|-------|
| 6062h           | 00h                 | position instruction                              | instruction unit | -2147483648~2147483647   | I32       | ro                     | TxPDO |
| 6063h           | 00h                 | actual internal position feedback                 | pulse            | -2147483648~2147483647   | I32       | ro                     | TxPDO |
| 6064h           | 00h                 | position feedback                                 | instruction unit | -2147483648~2147483647   | I32       | ro                     | TxPDO |
| 6065h           | 00h                 | Excessive threshold for positional deviation      | instruction unit | 0~4294967295             | U32       | rw                     | RxPDO |
| 6066h           | 00h                 | Error timeout                                     | 1ms              | 0~65535                  | U16       | rw                     | RxPDO |
| 6067h           | 00h                 | Location reaches the threshold                    | instruction unit | 0~4294967295             | U32       | rw                     | RxPDO |
| 6068h           | 00h                 | Location to window time                           | 1ms              | 0~65535                  | U16       | rw                     | RxPDO |
| 606Ch           | 00h                 | rate feedback                                     | Command unit/s   | -2147483648~2147483647   | I32       | ro                     | TxPDO |
| 6074h           | 00h                 | torque command                                    | 0.1%             | -32768~32767             | I16       | ro                     | TxPDO |
| 6076h           | 00h                 | Motor rated torque                                | Mn·m             | 0~4294967295             | U32       | ro                     | TxPDO |
| 6077h           | 00h                 | Torque feedback                                   | 0.1%             | -32768~32767             | I16       | ro                     | TxPDO |
| 60F4h           | 00h                 | position deviation                                | instruction unit | -2147483648~2147483647   | I32       | ro                     | TxPDO |
| 60FAh           | 00h                 | internal instruction speed (Position loop output) | Command unit/s   | -2147483648~2147483647   | I32       | ro                     | TxPDO |
| 60FCh           | 00h                 | internal location instruction                     | pulse            | -2147483648 ~ 2147483647 | I32       | ro                     | TxPDO |

There are also other objects with common action.

| index of matrix | subindex | name       | unit | scope   | data type | Accessible inquisitive | PDO   |
|-----------------|----------|------------|------|---------|-----------|------------------------|-------|
| 603Fh           | 00h      | Error code | -    | 0~65535 | U16       | ro                     | TxPDO |

|       |     |                                                              |                  |                        |     |    |       |
|-------|-----|--------------------------------------------------------------|------------------|------------------------|-----|----|-------|
| 60B9h | 00h | Indicates the status of the Touch probe function             | -                | 0~65535                | U16 | ro | TxPDO |
| 60BAh | 00h | Indicates the rising edge clamping position of Touch probe1  | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |
| 60BBh | 00h | Indicates the falling edge clamping position of Touch probe1 | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |
| 60BCh | 00h | Indicates the rising edge clamping position of Touch probe2  | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |
| 60BDh | 00h | Indicates the falling edge clamping position of Touch probe2 | instruction unit | -2147483648~2147483647 | I32 | ro | TxPDO |

Status word (6041h) <ppFunction in control mode>

| index of matrix             | subindex | name                                                  | scope   | data type       | accessibility          | PDO   | Op-mode        |    |      |   |
|-----------------------------|----------|-------------------------------------------------------|---------|-----------------|------------------------|-------|----------------|----|------|---|
| 6041h                       | 00h      | status word                                           | 0~65535 | U16             | ro                     | TxPDO | All            |    |      |   |
|                             |          | Indicates the status of the servo driver.             |         |                 |                        |       |                |    |      |   |
|                             |          | bit information                                       |         |                 |                        |       |                |    |      |   |
|                             |          | 15                                                    | 14      | 13              | 12                     | 11    | 10             | 9  | 8    |   |
|                             |          | r                                                     |         | oms             |                        | ila   | oms            |    | rm   | r |
|                             |          |                                                       |         | Following Error | set- point acknowledge |       | Target Reached |    |      |   |
|                             |          | 7                                                     | 6       | 5               | 4                      | 3     | 2              | 1  | 0    |   |
|                             |          | w                                                     | sod     | Qs              | ve                     | f     | oe             | so | rsto |   |
|                             |          | r = reserved (not mapped) w = warning                 |         |                 |                        |       |                |    |      |   |
|                             |          | r = reserved (not mapped) w = warning                 |         |                 |                        |       |                |    |      |   |
|                             |          | sod = switch on disabled                              |         |                 |                        |       |                |    |      |   |
|                             |          | oms = operation mode specific                         |         |                 |                        |       |                |    |      |   |
|                             |          | qs = quick stop                                       |         |                 |                        |       |                |    |      |   |
|                             |          | oms = operation mode specific                         |         |                 |                        |       |                |    |      |   |
|                             |          | qs = quick stop                                       |         |                 |                        |       |                |    |      |   |
|                             |          | Control mode depends on the bit: ve = voltage enabled |         |                 |                        |       |                |    |      |   |
|                             |          | Control mode depends on the bit: ve = voltage enabled |         |                 |                        |       |                |    |      |   |
| ila = internal limit active |          |                                                       |         |                 |                        |       |                |    |      |   |
| f = fault                   |          |                                                       |         |                 |                        |       |                |    |      |   |
| ila = internal limit active |          |                                                       |         |                 |                        |       |                |    |      |   |
| f = fault                   |          |                                                       |         |                 |                        |       |                |    |      |   |
| oe = operation enabled      |          |                                                       |         |                 |                        |       |                |    |      |   |
| so = switched on            |          |                                                       |         |                 |                        |       |                |    |      |   |
| rm = remote                 |          |                                                       |         |                 |                        |       |                |    |      |   |
| so = switched on            |          |                                                       |         |                 |                        |       |                |    |      |   |
| rtso = ready to switch on   |          |                                                       |         |                 |                        |       |                |    |      |   |

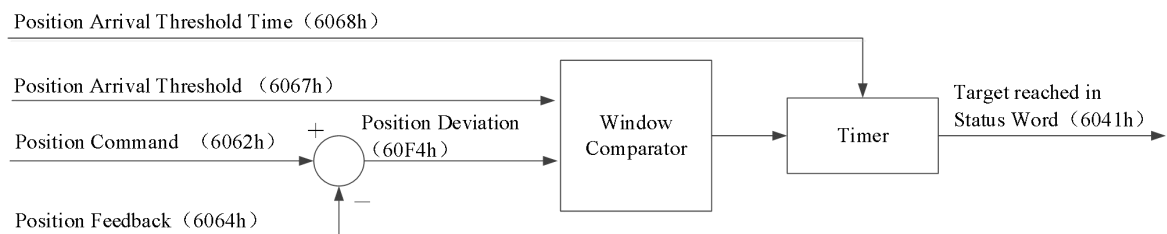
bit13,12,10 (operation mode specific) :

| Bit | name                  | price | definition                                                                                                                                                                                                                                                                                       |
|-----|-----------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | target reached        | 0     | halt=0 (normal): Positioning not completed<br>halt=1 (when halt stops): Axis deceleration                                                                                                                                                                                                        |
|     |                       | 1     | halt=0 (normal): Positioning complete<br>halt=1 (when halt stops): axis stops (axis speed is 0)                                                                                                                                                                                                  |
| 12  | set-point acknowledge | 0     | setpoint is 0, and the buffer is empty after the current target position action is completed (in progress).                                                                                                                                                                                      |
|     |                       | 1     | The new positioning task is loaded into the buffer, which is not empty.                                                                                                                                                                                                                          |
| 13  | following error       | 0     | 60F4h (Following error actual value)<br><br>If the value of (6062h (Position demand value) - 6064h (Position actual value)) does not exceed the 6065h (Following error window) setting range, or if the 60F4h value exceeds the 6065h setting value, the 6066h time setting will not be applied. |
|     |                       | 1     | 60F4h (Following error actual value)<br><br>The value exceeds the set range of 6065h (Following error window). After 6066h (Following error time out), continue.                                                                                                                                 |

bit10: target reached (Position reached)

When the servo enable is active (operation valid) and all set-points have generated completion commands, the difference between 6062h (target position value) and 6064h (position feedback) must remain within the range defined by 6067h (position arrival threshold). If the time specified in 6068h (position arrival time window) has elapsed, the bit10 (target achieved) in 6041h (state word) will be set to 1.

| Bit | name           | price | definition                                                                                      |
|-----|----------------|-------|-------------------------------------------------------------------------------------------------|
| 10  | Target reached | 0     | halt=0 (normal): Positioning not completed<br>halt=1 (when halt stops): Axis deceleration       |
|     |                | 1     | halt=0 (normal): Positioning complete<br>halt=1 (when halt stops): axis stops (axis speed is 0) |



Location to Destination Diagram

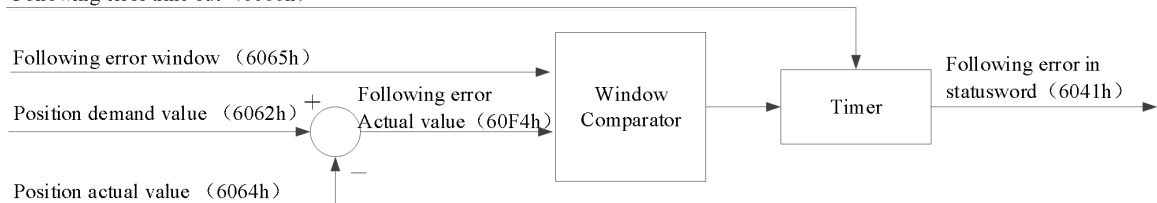
| index of matrix | subindex | name                                                                                                                                                                                                                                                                                                                                                  | unit             | scope        | data type | Accessible inquisitive | PDO   | OP-mode |
|-----------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|-----------|------------------------|-------|---------|
| 6067h           | 00h      | Location reaches the threshold                                                                                                                                                                                                                                                                                                                        | instruction unit | 0~4294967295 | U32       | rw                     | RxPDO | PP      |
|                 |          | The difference between 6062h (position command) and 6064h (position feedback) must stay within the parameter's set range. When the 6068h (position arrival time window) time period is reached, set the bit10 (target achieved) of 6041h (status word) to 1 as the threshold.<br>If the difference is not set by this parameter, bit10 of 6041h is 0. |                  |              |           |                        |       |         |
| 6068h           | 00h      | Location arrival time window                                                                                                                                                                                                                                                                                                                          | 1ms              | 0~65535      | U16       | rw                     | RxPDO | PP      |
|                 |          | The difference between 6062h (position command) and 6064h (position feedback) indicates the duration during which the bit10 (target reached) in 6041h (state word) is set to 1, within the range defined by 6067h (position threshold).                                                                                                               |                  |              |           |                        |       |         |

### bit13: Follow error

When the 60F4h (position deviation) value exceeds the 6065h (over-deviation threshold) range, and the 6066h (error timeout) time limit is exceeded, the bit13 of the 6041h (status word) becomes 1.

| Bit | name                            | price | definition                                                                                                                                                                                                                                                                                   |
|-----|---------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | following error<br>Follow error | 0     | 60F4h (Position Deviation)<br>The value of (6062h (position command) - 6064h (position feedback)) must not exceed the set range of 6065h (position deviation threshold). Alternatively, if the value of 60F4h exceeds the set value of 6065h, the time setting of 6066h will not be applied. |
|     |                                 | 1     | 60F4h (Position Deviation)<br>The value exceeds the set range of 6065h (position deviation threshold) and remains beyond the 6066h (error timeout) time limit. Continue                                                                                                                      |

Following error time out (6066h)



Schematic diagram of the follow-error function

| index of matrix | son index of matrix | name | unit | scope | data type | Accessible inquisitive | PDO | OP-mode |
|-----------------|---------------------|------|------|-------|-----------|------------------------|-----|---------|
|-----------------|---------------------|------|------|-------|-----------|------------------------|-----|---------|

|       |     |                                                                                                                                                                                                                                                               |                  |              |     |    |       |        |
|-------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|-----|----|-------|--------|
| 6065h | 00h | Excessive threshold for positional deviation                                                                                                                                                                                                                  | instruction unit | 0~4294967295 | U32 | rw | RxPDO | PP CSP |
|       |     | When the value of 60F4h (Following error actual value) deviates from the preset value, the threshold is set to 6041h (state word) bit13 (following error) with a value of 1.                                                                                  |                  |              |     |    |       |        |
| 6066h | 00h | Error timeout                                                                                                                                                                                                                                                 | 1ms              | 0~65535      | U16 | rw | RxPDO | PP CSP |
|       |     | When the 60F4h (position deviation) value exceeds the 6065h (over-deviation threshold) range, the system will set this parameter above its preset value. If the process continues, the 13th bit of the 6041h (status word) will be set to 1 as the threshold. |                  |              |     |    |       |        |

### 3) The action of the PP control mode

#### Example 1: (Basic set-point)

(1) On the master station, after setting the value of 607Ah (target position), change bit4 (new set-point) of 6040h (control word) from 0 to 1. At this point, also set 6081h (profile speed).

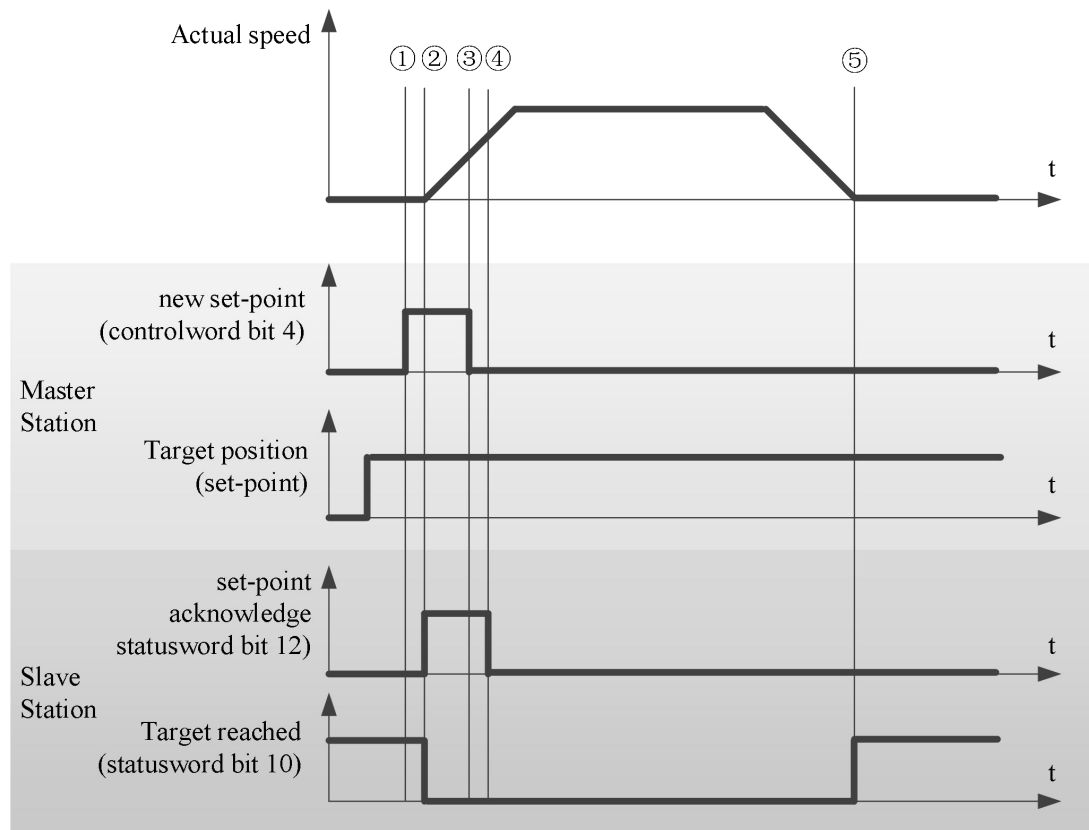
The motor remains inactive when the contour speed (6081h) reaches zero.

(2) The slave node detects the rising edge (0→1) of bit4 (new set-point) at 6040h, with 607Ah (target position) as the starting point for positioning. Simultaneously, it updates bit12 (set-point acknowledge) in 6041h (status word) from 0 to 1.

(3) The master station confirms that the bit12 (set-point acknowledge) at 6041h has transitioned from 0 to 1, and the bit4 (new set-point) at 6040h has reset to 0.

(4) At the slave station, verify that bit4 (new set-point) of 6040h is set to 0, and bit12 (set-point acknowledge) of 6041h is also set to 0.

(5) When the target position is reached, bit10 (target reached) of 6041h changes from 0 to 1.



&lt; Set-point example &gt;



- The 6081h (profile speed) is limited by the lower of 607Fh (maximum profile speed) and 6080h (maximum motor speed).
- Changes to the 607Fh or 6080h settings in the action will not be reflected.

#### Example 2: (Action data change without buffer: single set-point)

When the bit5 (change set immediately) of 6040h is set to 1, if the change in positioning action data during the current action has been detected, the current positioning action will be interrupted and the next positioning action will be initiated immediately.

(1) At the master station, verify that bit12 (set-point acknowledge) of 6041h is 0. After modifying the value of 607Ah (target position), set bit4 (new set-point) of 6040h from 0 to 1.



Do not change the acceleration or deceleration at this time.

(2) The slave node detects the rising edge (0→1) of bit4 (new set-point) at 6040h, and immediately updates 607Ah as the new target position. Simultaneously, bit12 (set-point acknowledge) at 6041h transitions from 0 to 1.

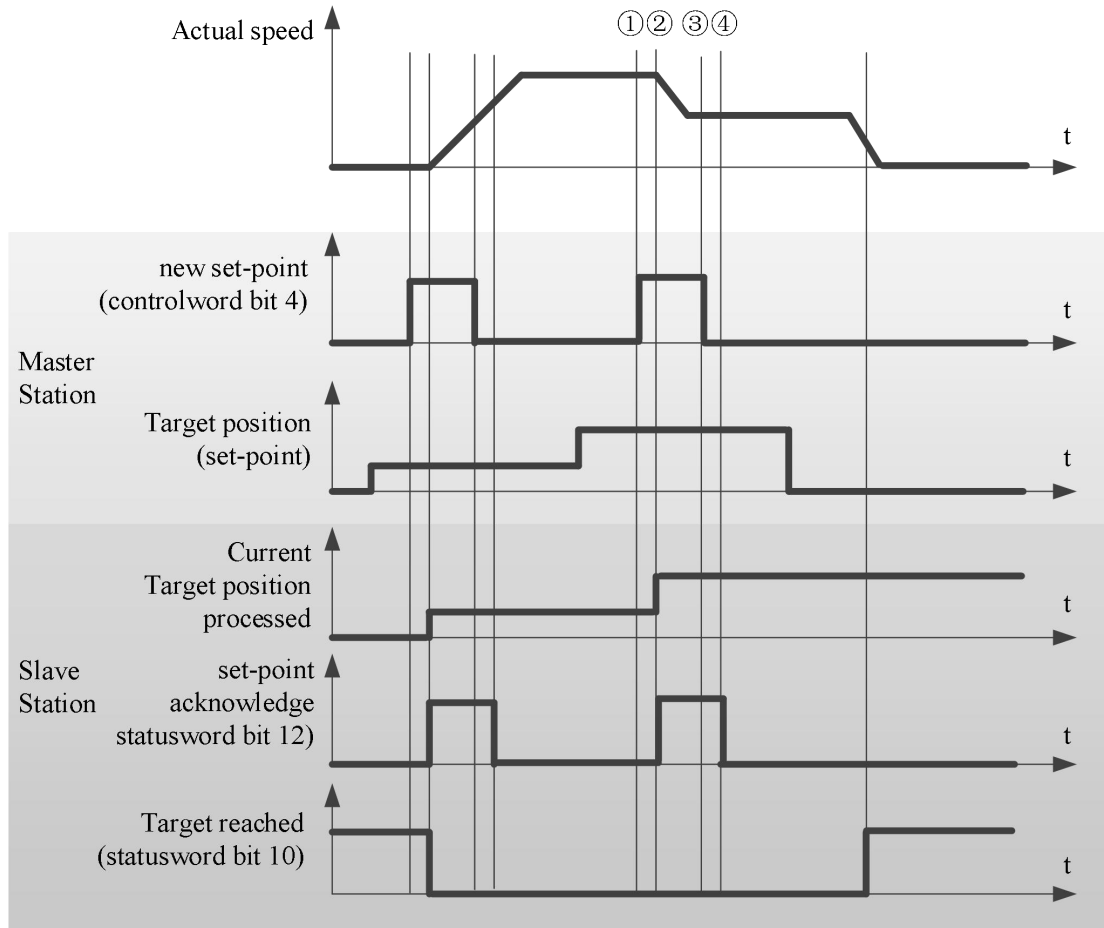
(3) The master station confirms that the bit12 (set-point acknowledge) at 6041h has transitioned from 0 to 1, and the bit4 (new set-point) at 6040h has reset to 0.

(4) At the slave station, verify that bit4 (new set-point) of 6040h is 0 and bit12 (set-point acknowledge) of 6041h is 0.



The same procedure (1)–(4) can adjust the contour speed (6081h).

After modifying 607Ah (target position) and 6081h (profile speed), update both 607Ah and 6081h simultaneously according to steps (1) to (4) above.



< handshaking procedure for the single set-point method >

## 7.6.2 Common Parameters

PP control mode associated objects (commands, settings)

| register      | explain                   | unit                             |
|---------------|---------------------------|----------------------------------|
| RXPDO[0x6040] | control word              | -                                |
| RXPDO[0x6060] | Set to 1                  | -                                |
| RXPDO[0x607A] | Position given            | instruction unit                 |
| RXPDO[0x6072] | maximum torque            | 0.1%                             |
| RXPDO[0x607F] | maximum internal velocity | Command unit/s                   |
| RXPDO[0x6081] | internal speed given      | Command unit/s                   |
| RXPDO[0x6083] | internal acceleration     | instruction units/s <sup>2</sup> |
| RXPDO[0x6084] | internal deceleration     | instruction units/s <sup>2</sup> |

| register      | explain                                 | unit                             |
|---------------|-----------------------------------------|----------------------------------|
| RXPDO[0x60C5] | maximal acceleration                    | instruction units/s <sup>2</sup> |
| RXPDO[0x60C6] | maximum deceleration                    | instruction units/s <sup>2</sup> |
| RXPDO[0x6065] | Set the number of trailing pulse counts | instruction unit                 |
| RXPDO[0x6066] | Follow error timeout time               | ms                               |
| RXPDO[0x6067] | Location reaches the threshold          | instruction unit                 |
| RXPDO[0x6068] | Location to window time                 | ms                               |



- The 6081h (contour velocity) is limited by the 607Fh (maximum internal velocity).
- When modifying the 607Fh (maximum internal speed) setting in the action, the change will not be reflected in the action.

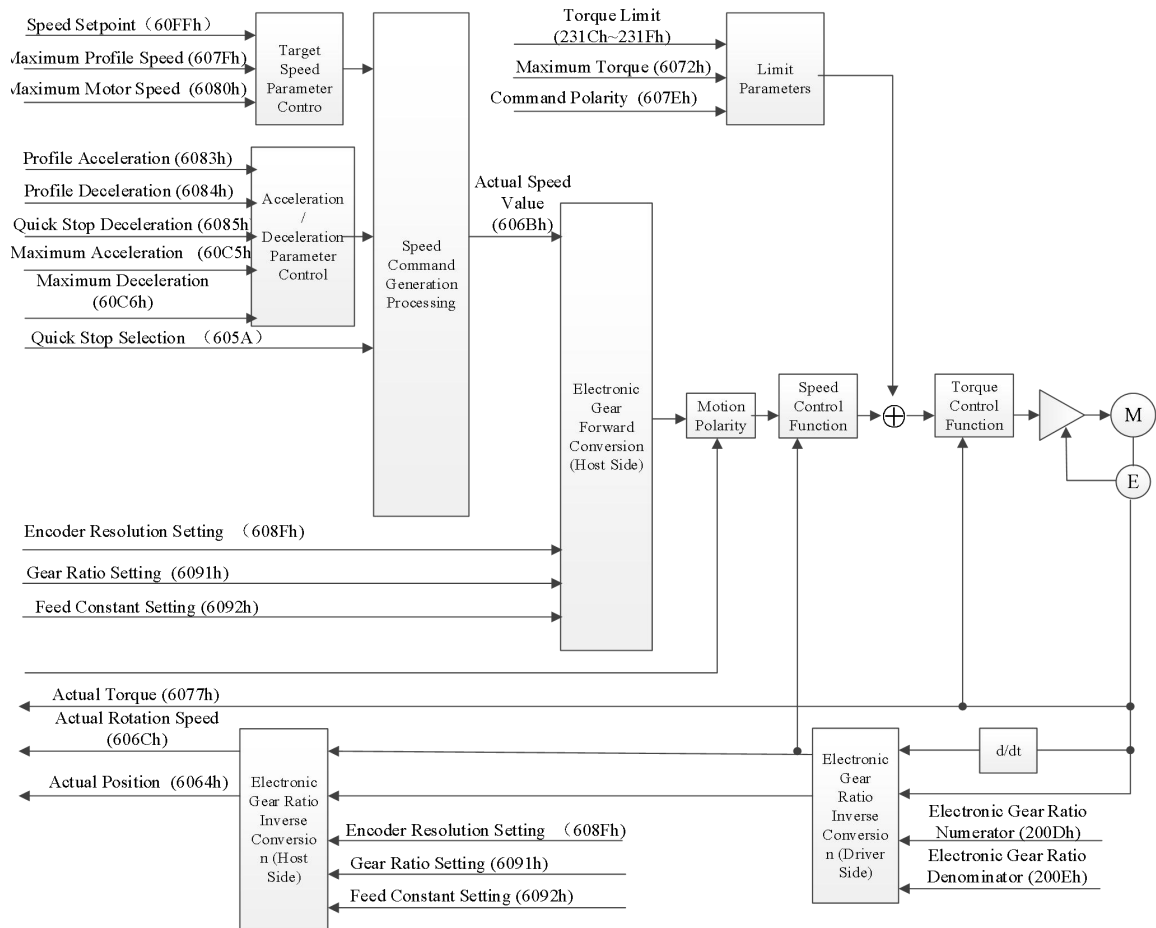
PP control mode associated objects (commands, monitoring type)

| register      | explain                                   | unit             |
|---------------|-------------------------------------------|------------------|
| TXPDO[0x6041] | status word                               | -                |
| TXPDO[0x6063] | Internal actual location                  | instruction unit |
| TXPDO[0x6064] | Position feedback (actual motor position) | instruction unit |
| TXPDO[0x606C] | rate feedback                             | Command unit/s   |
| TXPDO[0x6077] | actual torque                             | 0.1%             |
| TXPDO[0x60F4] | actual following error                    | instruction unit |



## 7.7PV pattern

PV (Profile speed control mode) is a speed control mode that sets target speed, acceleration, and deceleration, and generates position commands internally in the servo driver. This control mode should be used with a communication cycle of 500  $\mu$ s or longer.



### 7.7.1 Relevant parameters

#### 1) PV control mode associated objects (commands, settings)

| index of matrix | subindex | name                     | unit                             | scope        | data type | Accessible inquisitive | PDO   |
|-----------------|----------|--------------------------|----------------------------------|--------------|-----------|------------------------|-------|
| 6040h           | 00h      | control word             | -                                | 0~65535      | U16       | rw                     | RxPDO |
| 607Fh           | 00h      | maximum outline velocity | Command unit/s                   | 0~4294967295 | U32       | rw                     | RxPDO |
| 6083h           | 00h      | Outline acceleration     | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw                     | RxPDO |

|       |     |                      |                                     |              |     |    |       |
|-------|-----|----------------------|-------------------------------------|--------------|-----|----|-------|
| 6084h | 00h | Contour deceleration | instruction<br>units/s <sup>2</sup> | 0~4294967295 | U32 | rw | RxPDO |
| 60C5h | 00h | maximal acceleration | instruction<br>units/s <sup>2</sup> | 0~4294967295 | U32 | rw | RxPDO |
| 60C6h | 00h | maximum deceleration | instruction<br>units/s <sup>2</sup> | 0~4294967295 | U32 | rw | RxPDO |

There are other objects with common association of speed control.

| index of matrix | subindex | name                | unit           | scope                  | data type | Accessible inquisitive | PDO   |
|-----------------|----------|---------------------|----------------|------------------------|-----------|------------------------|-------|
| 6072h           | 00h      | maximum torque      | 0.1%           | 0~65535                | U16       | rw                     | RxPDO |
| 6080h           | 00h      | Maximum motor speed | r/min          | 0~4294967295           | U32       | rw                     | RxPDO |
| 60B1h           | 00h      | velocity offset     | Command unit/s | -2147483648~2147483647 | I32       | rw                     | RxPDO |
| 60B2h           | 00h      | torque offset       | 0.1%           | -32768~32767           | I16       | rw                     | RxPDO |
| 60FFh           | 00h      | target speed        | Command unit/s | 0~4294967295           | U32       | rw                     | RxPDO |

There are also other related objects with common actions.

| index of matrix | subindex | name                         | unit | scope | data type | accessibility | PDO |
|-----------------|----------|------------------------------|------|-------|-----------|---------------|-----|
| 605Ah           | 00h      | Quick Stop Mode Selection    | -    | 0~7   | I16       | rw            | NO  |
| 605Bh           | 00h      | Close method selection       | -    | 0~1   | I16       | rw            | NO  |
| 605Ch           | 00h      | Suspended shutdown mode      | -    | 0~1   | I16       | rw            | NO  |
| 605Dh           | 00h      | Pause option code            | -    | 1~3   | I16       | rw            | NO  |
| 605Eh           | 00h      | failure mode and effect code | -    | 0~2   | I16       | rw            | NO  |

|       |     |                                      |                                                    |                        |     |    |       |
|-------|-----|--------------------------------------|----------------------------------------------------|------------------------|-----|----|-------|
| 607Bh | -   | Location range restriction           | -                                                  | -                      | -   | -  | -     |
|       | 00h | Indicates the 607Bh sub-index number | -                                                  | 2                      | U8  | ro | NO    |
|       | 01h | Minimum position range limit         | instruction unit                                   | -2147483648~2147483647 | I32 | rw | RxPDO |
|       | 02h | Maximum location range limit         | instruction unit                                   | -2147483648~2147483647 | I32 | rw | RxPDO |
| 607Ch | 00h | origin offset                        | instruction unit                                   | -2147483648~2147483647 | I32 | rw | RxPDO |
| 607Eh | 00h | command polarity                     | -                                                  | 0~255                  | U8  | rw | NO    |
| 6085h | 00h | quick deceleration                   | instruction units/s <sup>2</sup>                   | 0~4294967295           | U32 | rw | RxPDO |
| 608Fh | -   | Position encoder resolution setting  | -                                                  | -                      | -   | -  | -     |
|       | 00h | Indicates the 608Fh sub-index number | -                                                  | 2                      | U8  | ro | NO    |
|       | 01h | Encoder movement distance            | pulse                                              | 1~4294967295           | U32 | ro | NO    |
|       | 02h | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295           | U32 | ro | NO    |
| 6091h | -   | motor rotation number                | -                                                  | -                      | -   | -  | -     |
|       | 00h | gear ratio setting                   | -                                                  | 2                      | U8  | ro | NO    |
|       | 01h | Indicates the 6091h sub-index number | r ( any power-generating or power-driven machine ) | 1~4294967295           | U32 | rw | NO    |

|       |     |                                      |                  |              |     |    |       |
|-------|-----|--------------------------------------|------------------|--------------|-----|----|-------|
|       | 02h | motor rotation number                | r ( axle )       | 1~4294967295 | U32 | rw | NO    |
| 6092h | -   | rotation number                      | -                | -            | -   | -  | -     |
|       | 00h | Feed constant settings               | -                | 2            | U8  | ro | NO    |
|       | 01h | Indicates the 6092h sub-index number | instruction unit | 1~4294967295 | U32 | rw | NO    |
|       | 02h | Set the Feed value                   | r ( axle )       | 1~4294967295 | U32 | rw | NO    |
| 60B8h | 00h | rotation number                      | -                | 0~65535      | U16 | rw | RxPDO |

## Control Word (6040h) &lt;Functions in PV Control Mode&gt;

| index of matrix | subindex | name                                                                      | scope   | data type | accessibility | PDO                   | Op-mode |    |                                                       |    |
|-----------------|----------|---------------------------------------------------------------------------|---------|-----------|---------------|-----------------------|---------|----|-------------------------------------------------------|----|
| 6040h           | 00h      | control word                                                              | 0~65535 | U16       | rw            | RxPDO                 | All     |    |                                                       |    |
|                 |          | Set the control command for PDS state transition and other servo drivers. |         |           |               |                       |         |    |                                                       |    |
|                 |          | bit information                                                           |         |           |               |                       |         |    |                                                       |    |
|                 |          | 15                                                                        | 14      | 13        | 12            | 11                    | 10      | 9  | 8                                                     |    |
|                 |          | r                                                                         |         |           |               |                       |         | om | h                                                     |    |
|                 |          | 7                                                                         | 6       | 5         | 4             | 3                     | 2       | 1  | 0                                                     |    |
|                 |          | fr                                                                        | oms     |           |               |                       | eo      | qs | ev                                                    | so |
|                 |          |                                                                           | r       | r         |               | r                     |         |    |                                                       |    |
|                 |          | r = reserved (not mapped) fr = fault reset                                |         |           |               |                       |         |    | r = reserved (not mapped) fr = fault reset            |    |
|                 |          | oms = operation mode specific                                             |         |           |               | eo = enable operation |         |    |                                                       |    |
|                 |          | (The control mode depends on the bit) qs = quick stop                     |         |           |               |                       |         |    | (The control mode depends on the bit) qs = quick stop |    |
|                 |          | h = halt                                                                  |         |           |               | ev = enable voltage   |         |    |                                                       |    |
|                 |          | h = halt                                                                  |         |           |               | ev = enable voltage   |         |    |                                                       |    |
|                 |          | so = switch on                                                            |         |           |               |                       |         |    |                                                       |    |

In PV mode, the OMS bit is not used.

## Speed class

| index of matrix | son index of matrix | name | unit | scope | data type | Accessibl e inquisitive | PDO | OP-mode |
|-----------------|---------------------|------|------|-------|-----------|-------------------------|-----|---------|
|-----------------|---------------------|------|------|-------|-----------|-------------------------|-----|---------|

|       |     |                                                                                                                                                                                                                                                                               |                |              |     |    |       |                        |
|-------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|-----|----|-------|------------------------|
| 607Fh | 00h | Max profile velocity<br>maximum outline velocity                                                                                                                                                                                                                              | Command unit/s | 0~4294967295 | U32 | rw | RxPDO | PP<br>PV<br>HM         |
|       |     | Speed limits for Profile position mode (pp), zero position reset mode (hm), and Profile speed mode (pv).<br>The maximum value is limited by the internal processing using 6080h (maximum motor speed).                                                                        |                |              |     |    |       |                        |
| 6080h | 00h | Max motor speed<br>maximum motor speed                                                                                                                                                                                                                                        | r/min          | 0~4294967295 | U32 | rw | RxPDO | PV<br>TQ<br>CSV<br>CST |
|       |     | Set the motor's maximum speed.<br>When the power supply is controlled, the maximum speed read from the motor is set.<br>The maximum value is limited by the maximum speed read from the motor.<br>When using tq or CST, the speed is limited by the set value of this object. |                |              |     |    |       |                        |

acceleration and deceleration class

| index of matrix | son index of matrix | name                                                                        | unit                             | scope        | data type | Accessible inquisitive | PDO   | OP-mode        |
|-----------------|---------------------|-----------------------------------------------------------------------------|----------------------------------|--------------|-----------|------------------------|-------|----------------|
| 6083h           | 00h                 | Profile acceleration<br>contour acceleration                                | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw                     | RxPDO | PP<br>PV       |
|                 |                     | Set Profile acceleration.<br>Set to 0, internal processing is treated as 1. |                                  |              |           |                        |       |                |
| 6084h           | 00h                 | Profile deceleration<br>contour deceleration                                | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw                     | RxPDO | PP<br>PV       |
|                 |                     | Set Profile deceleration.<br>Set to 0, internal processing is treated as 1. |                                  |              |           |                        |       |                |
| 60C5h           | 00h                 | Max acceleration<br>maximum acceleration                                    | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw                     | RxPDO | PP<br>PV<br>HM |
|                 |                     | Set maximum acceleration.<br>Set to 0, internal processing is treated as 1. |                                  |              |           |                        |       |                |
| 60C6h           | 00h                 | Min deceleration<br>maximum deceleration                                    | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw                     | RxPDO | PP<br>PV<br>HM |
|                 |                     | Set maximum deceleration.<br>Set to 0, internal processing is treated as 1. |                                  |              |           |                        |       |                |

## 2) PV control mode associated objects (monitoring type)

| index of matrix | subindex | name                                         | unit           | scope        | data type | accessibility | PDO   |
|-----------------|----------|----------------------------------------------|----------------|--------------|-----------|---------------|-------|
| 6041h           | 00h      | status word                                  | -              | 0~65535      | U16       | ro            | TxPDO |
| 6065h           | 00h      | Excessive threshold for positional deviation | Command unit/s | 0~4294967295 | U32       | rw            | RxPDO |
| 6066h           | 00h      | Error timeout                                | 1ms            | 0~65535      | U16       | rw            | RxPDO |
| 6067h           | 00h      | Speed threshold                              | Command unit/s | 0~4294967295 | U32       | rw            | RxPDO |
| 6068h           | 00h      | Time to reach the speed threshold            | 1ms            | 0~65535      | U16       | rw            | RxPDO |

There are other common objects associated with speed control.

| index of matrix | subindex | name                              | unit             | scope                  | data type | Accessible inquisitive | PDO   |
|-----------------|----------|-----------------------------------|------------------|------------------------|-----------|------------------------|-------|
| 6063h           | 00h      | actual internal position feedback | pulse            | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 6064h           | 00h      | position feedback                 | instruction unit | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 606Bh           | 00h      | velocity instruction              | Command unit/s   | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 606Ch           | 00h      | rate feedback                     | Command unit/s   | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 6074h           | 00h      | torque command                    | 0.1%             | -32768~32767           | I16       | ro                     | TxPDO |
| 6076h           | 00h      | motor rated torque                | Mn·m             | 0~4294967295           | U32       | ro                     | TxPDO |
| 6077h           | 00h      | torque feedback                   | 0.1%             | -32768~32767           | I16       | ro                     | TxPDO |

There are other objects with common patterns.

| index of matrix | son index of matrix | name                                    | unit | scope   | data type | Accessible inquisitive | PDO   |
|-----------------|---------------------|-----------------------------------------|------|---------|-----------|------------------------|-------|
| 603Fh           | 00h                 | Error code                              | -    | 0~65535 | U16       | ro                     | TxPDO |
| 60B9h           | 00h                 | Indicates the status of the Touch probe | -    | 0~65535 | U16       | ro                     | TxPDO |

| index of matrix | son index of matrix | name                                                         | unit             | scope                  | data type | Accessible inquisitive | PDO   |
|-----------------|---------------------|--------------------------------------------------------------|------------------|------------------------|-----------|------------------------|-------|
|                 |                     | function                                                     |                  |                        |           |                        |       |
| 60BAh           | 00h                 | Indicates the rising edge clamping position of Touch probe1  | instruction unit | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 60BBh           | 00h                 | Indicates the falling edge clamping position of Touch probe1 | instruction unit | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 60BCh           | 00h                 | Indicates the rising edge clamping position of Touch probe2  | instruction unit | -2147483648~2147483647 | I32       | ro                     | TxPDO |
| 60BDh           | 00h                 | Indicates the falling edge clamping position of Touch probe2 | instruction unit | -2147483648~2147483647 | I32       | ro                     | TxPDO |

Status word (6041h) <pvControl mode functions>

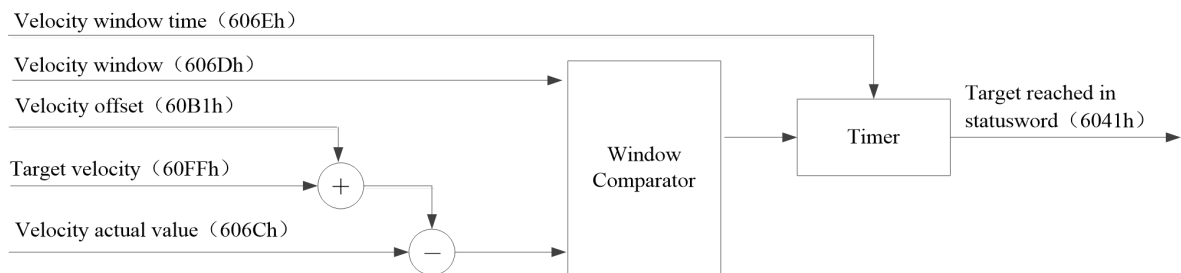
| index of matrix        | subindex | name                                             | scope   | data type | accessibility | PDO   | Op-mode          |    |                                       |   |
|------------------------|----------|--------------------------------------------------|---------|-----------|---------------|-------|------------------|----|---------------------------------------|---|
| 6041h                  | 00h      | status word                                      | 0~65535 | U16       | ro            | TxPDO | All              |    |                                       |   |
|                        |          | Indicates the status of the servo driver.        |         |           |               |       |                  |    |                                       |   |
|                        |          | bit information                                  |         |           |               |       |                  |    |                                       |   |
|                        |          | 15                                               | 14      | 13        | 12            | 11    | 10               | 9  | 8                                     |   |
|                        |          | r                                                |         | oms       |               | ila   | oms              |    | rm                                    | r |
|                        |          |                                                  |         | r         | speed         |       | Target reached   |    |                                       |   |
|                        |          | 7                                                | 6       | 5         | 4             | 3     | 2                | 1  | 0                                     |   |
|                        |          | w                                                | sod     | qs        | ve            | f     | oe               | so | rsto                                  |   |
|                        |          | r = reserved (not mapped) w = warning            |         |           |               |       |                  |    | r = reserved (not mapped) w = warning |   |
|                        |          | sod = switch on disabled                         |         |           |               |       |                  |    |                                       |   |
|                        |          | oms = operation mode specific                    |         |           |               |       |                  |    | qs = quick stop                       |   |
|                        |          | oms = operation mode specific                    |         |           |               |       |                  |    | qs = quick stop                       |   |
|                        |          | Control mode dependent bit: ve = voltage enabled |         |           |               |       |                  |    |                                       |   |
|                        |          | Control mode dependent bit: ve = voltage enabled |         |           |               |       |                  |    |                                       |   |
|                        |          | ila = internal limit active                      |         |           |               |       |                  |    | f = fault                             |   |
|                        |          | ila = internal limit active                      |         |           |               |       |                  |    | f = fault                             |   |
| oe = operation enabled |          |                                                  |         |           |               |       |                  |    |                                       |   |
| rm = remote            |          |                                                  |         |           |               |       | so = switched on |    |                                       |   |

|  |  |                                          |                  |
|--|--|------------------------------------------|------------------|
|  |  | rm = remote<br>rtso = ready to switch on | so = switched on |
|--|--|------------------------------------------|------------------|

(1) bit10 (target reached (Velocity reached) ) :

The difference between the combined values of 60FFh (speed given) and 60B1h (speed offset) and 606Ch (speed feedback) falls within the range set by 606Dh (speed threshold). If the time specified by 606Eh (speed threshold time) has elapsed, bit10 of 6041h (state word) becomes 1.

| Bit | name           | Value | Definition                                                                                         |
|-----|----------------|-------|----------------------------------------------------------------------------------------------------|
| 10  | Target reached | 0     | halt=0 (normal): Speed control not completed<br>halt=1 (when halt stops): Axis deceleration        |
|     |                | 1     | halt=0 (normal): speed control completed<br>halt=1 (when halt stops): axis stops (axis speed is 0) |



| index of matrix | son index of matrix | name                                                                                                                                                                                                                                                                                                                                                   | unit             | scope        | data type | Accessible inquisitive | PDO   | OP-mode |
|-----------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|-----------|------------------------|-------|---------|
| 606Dh           | 00h                 | Speed reaches the threshold                                                                                                                                                                                                                                                                                                                            | instruction unit | 0~4294967295 | U32       | rw                     | RxPDO | PV      |
|                 |                     | The combined value of 60FFh (speed given) and 60B1h (speed offset) minus 606Ch (speed feedback) must stay within the parameter's set range. After the 606Eh (speed threshold time) period, set bit10 (target reached) to 1 at 6041h as the threshold. If the speed deviation exceeds the set value of this parameter, bit10 of 6041h will be set to 0. |                  |              |           |                        |       |         |
| 606Eh           | 00h                 | Time to reach the speed threshold                                                                                                                                                                                                                                                                                                                      | 1ms              | 0~65535      | U16       | rw                     | RxPDO | PV      |
|                 |                     | The time when the combined value of 60FFh (speed given) and 60B1h (speed offset) minus 606Ch (speed feedback) reaches the set value of 606Dh (speed arrival threshold), the bit10 (target reached) of 6041h is set to 1.                                                                                                                               |                  |              |           |                        |       |         |

(2) bit12 (speed) :

The 606Ch (velocity feedback) is set according to the 606Fh (velocity threshold) value. If the value exceeds the 6070h (velocity threshold time) threshold, the bit12 of 6041h is set to 0.

If 606Ch (speed feedback) is lower than the set value of 606Fh (speed threshold), bit12 of 6041h becomes 1, indicating the motor stops.

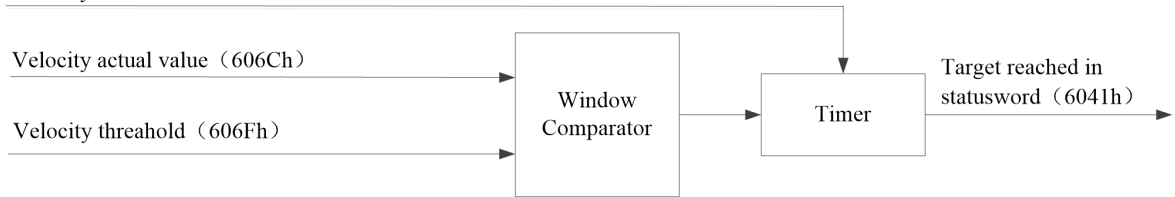


| Bit | name  | price | definition       |
|-----|-------|-------|------------------|
| 10  | speed | 0     | Motor in motion  |
|     |       | 1     | Motor is stopped |

Velocity threshold (6070h)

Velocity actual value (606Ch)

Velocity threshold (606Fh)



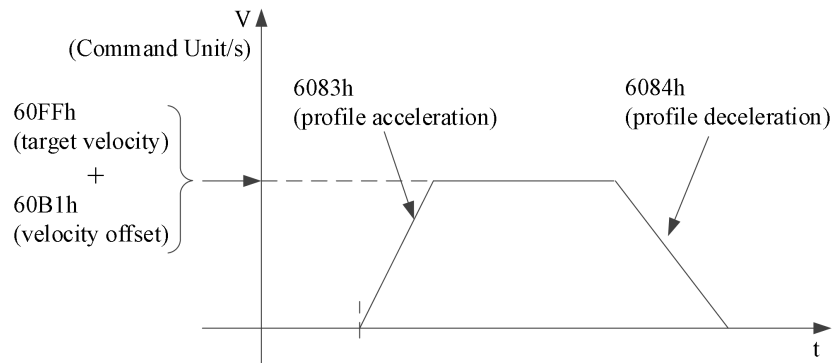
< Speed (functional overview) >

| index of matrix | son index of matrix | name                                                                                                                                                                                                                                                         | unit             | scope        | data type | Accessible inquisitive | PDO   | OP-mode |
|-----------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|-----------|------------------------|-------|---------|
| 606Fh           | 00h                 | Speed threshold                                                                                                                                                                                                                                              | instruction unit | 0~4294967295 | U32       | rw                     | RxPDO | PV      |
|                 |                     | When 606Ch (velocity feedback) exceeds the preset threshold, after the 6070h (velocity threshold time) period, the bit12 (speed) in 6041h (status word) is reset to 0.<br>If the speed is below the set value of this parameter, bit12 of 6041h is set to 1. |                  |              |           |                        |       |         |
| 6070h           | 00h                 | Speed threshold time                                                                                                                                                                                                                                         | 1ms              | 0~65535      | U16       | rw                     | RxPDO | PV      |
|                 |                     | When 606Ch (velocity feedback) exceeds the set value of 606Fh (velocity setpoint), the time when bit12 of 6041h is reset to 0 is determined.                                                                                                                 |                  |              |           |                        |       |         |

### 3) The action of the PV control mode

The Profile speed control mode generates speed command values based on the following parameters.

- Fixed speed (60FFh)
- Speed offset (60B1h)
- Outline acceleration (6083h)
- Contour deceleration (6084h)
- The target speed is 60FFh (Target velocity).
- Velocity offset 60B1h is not supported.
- The update (send) of the action command requires approximately 100ms after the servo enable is activated before input.
- As detection data, it provides 606Ch (Velocity actual value speed feedback) and other parameters.



- The 60FFh (speed given) is limited by the 607Fh (maximum internal speed) and 6080h (maximum motor speed).

## 7.7.2 Common Parameters

pv control mode associated objects (commands, settings)

| register      | explain                                                                     | unit                             |
|---------------|-----------------------------------------------------------------------------|----------------------------------|
| RXPDO[0x6040] | control word                                                                | -                                |
| RXPDO[0x6060] | The control mode is PV (Profile Velocity Control mode). Set its value to 3. | -                                |
| RXPDO[0x60FF] | velocity given                                                              | Command unit/s                   |
| RXPDO[0x6072] | maximum torque                                                              | 0.1%                             |
| RXPDO[0x607F] | maximum internal velocity                                                   | Command unit/s                   |
| RXPDO[0x6080] | maximum motor speed                                                         | r/min                            |
| RXPDO[0x6083] | internal acceleration                                                       | instruction units/s <sup>2</sup> |
| RXPDO[0x6084] | internal deceleration                                                       | instruction units/s <sup>2</sup> |
| RXPDO[0x60C5] | maximal acceleration                                                        | instruction units/s <sup>2</sup> |
| RXPDO[0x60C6] | maximum deceleration                                                        | instruction units/s <sup>2</sup> |
| RXPDO[0x606D] | Speed reaches the threshold                                                 | Command unit/s                   |
| RXPDO[0x606E] | Speed limit exceeded                                                        | ms                               |
| RXPDO[0x606F] | Speed threshold                                                             | Command unit/s                   |
| RXPDO[0x6070] | Speed threshold time                                                        | ms                               |

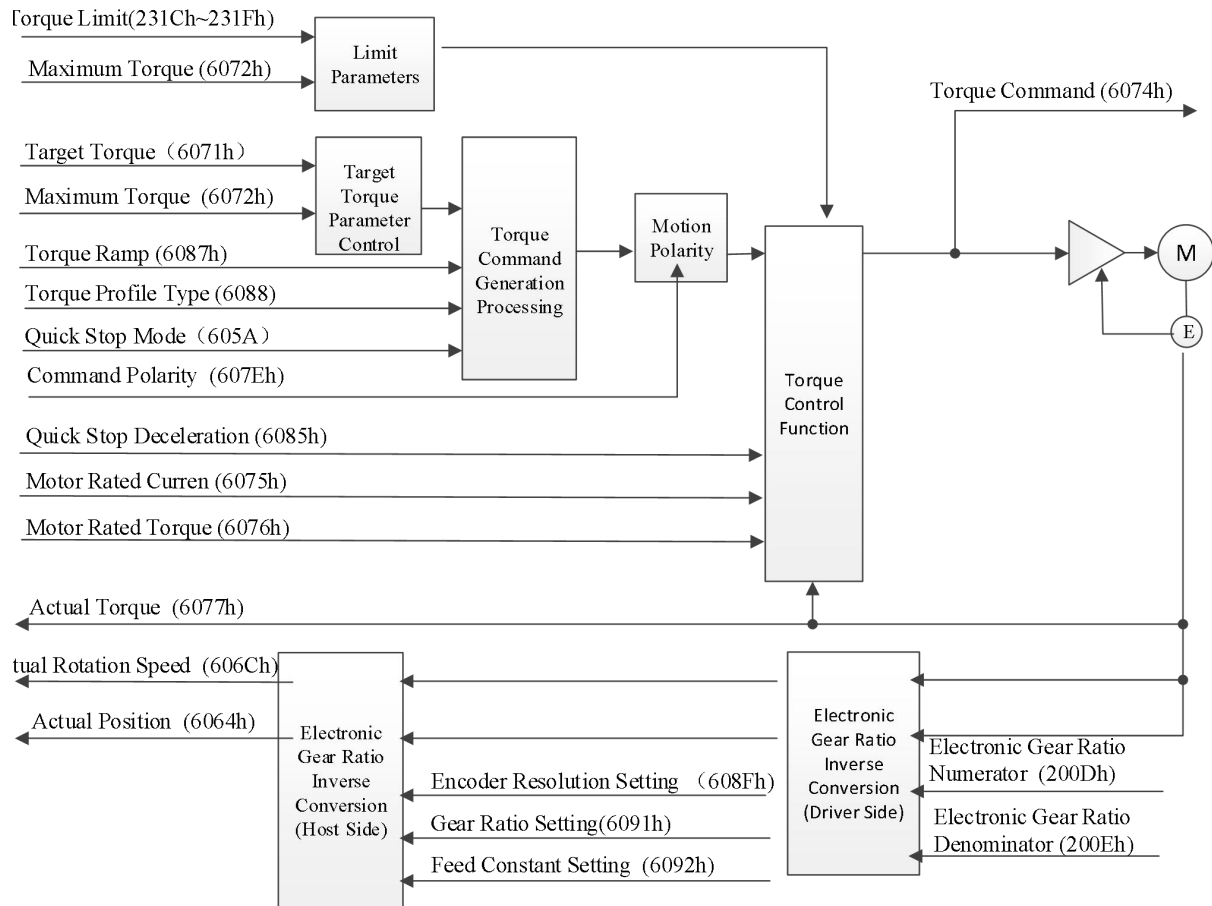
pv control mode associated objects (command, monitoring type)

| register | explain | unit |
|----------|---------|------|
|----------|---------|------|

|               |                                           |                   |
|---------------|-------------------------------------------|-------------------|
| TXPDO[0x6041] | status word                               | -                 |
| TXPDO[0x6064] | Position feedback (actual motor position) | instruction unit  |
| TXPDO[0x606C] | rate feedback                             | Command<br>unit/s |
| TXPDO[0x6077] | actual torque                             | 0.1%              |

## 7.8TQ pattern

TQ (Profile Torque Control Mode) is a torque control method that generates position commands within the servo driver to achieve target torque and acceleration/deceleration. This mode should be used when the communication cycle exceeds 500  $\mu$ s.



### 7.8.1 Relevant parameters

#### 1) TQ control mode associated objects (commands, settings)

| index of matrix | subindex | name                 | unit | scope        | data type | accessibility | PDO   |
|-----------------|----------|----------------------|------|--------------|-----------|---------------|-------|
| 6040h           | 00h      | control word         | -    | 0~65535      | U16       | rw            | RxPDO |
| 6088h           | 00h      | Torque planning type | -    | -32768~32767 | I16       | rw            | RxPDO |

There are other related objects which are common to torque control.

| index<br>of<br>matrix | subindex | name                      | unit   | scope        | data type | accessibility | PDO   |
|-----------------------|----------|---------------------------|--------|--------------|-----------|---------------|-------|
| 6071h                 | 00h      | Torque<br>given           | 0.1%   | -3276~32767  | I16       | rw            | RxPDO |
| 6072h                 | 00h      | maximum<br>torque         | 0.1%   | 0~65535      | U16       | rw            | RxPDO |
| 6080h                 | 00h      | Maximum<br>motor<br>speed | r/min  | 0~4294967295 | U32       | rw            | RxPDO |
| 6087h                 | 00h      | Torque<br>ramp            | 0.1%/S | 0~4294967295 | U32       | rw            | RxPDO |
| 60B2h                 | 00h      | torque<br>offset          | 0.1%   | -32768~32767 | I16       | rw            | RxPDO |

There are also other related objects with common actions.

| index of matrix | subindex | name                                 | unit                             | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------|------------------------|-----------|-----------------------|-------|
| 605Ah           | 00h      | Quick Stop Mode Selection            | -                                | 0~7                    | I16       | rw                    | NO    |
| 605Bh           | 00h      | Close method selection               | -                                | 0~1                    | I16       | rw                    | NO    |
| 605Ch           | 00h      | Suspended shutdown mode              | -                                | 0~1                    | I16       | rw                    | NO    |
| 605Dh           | 00h      | Pause option code                    | -                                | 1~3                    | I16       | rw                    | NO    |
| 605Eh           | 00h      | failure mode and effect code         | -                                | 0~2                    | I16       | rw                    | NO    |
| 607Bh           | -        | Location range restriction           | -                                | -                      | -         | -                     | -     |
|                 | 00h      | Indicates the 607Bh sub-index number | -                                | 2                      | U8        | ro                    | No    |
|                 | 01h      | Minimum position range limit         | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
|                 | 02h      | Maximum location range limit         | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Ch           | 00h      | origin offset                        | instruction unit                 | -2147483648~2147483647 | I32       | rw                    | RxPDO |
| 607Eh           | 00h      | command polarity                     | -                                | 0~255                  | U8        | rw                    | NO    |
| 6085h           | 00h      | quick deceleration                   | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | rw                    | RxPDO |
| 6086h           | 00h      | Location trajectory planning type    | -                                | -32768~32767           | I16       | rw                    | RxPDO |
| 608Fh           | -        | Position encoder resolution setting  | -                                | -                      | -         | -                     | -     |
|                 | 00h      | Indicates the 608Fh sub-index number | -                                | 2                      | U8        | ro                    | NO    |

| index of matrix | subindex | name                                 | unit                                               | scope        | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------|----------------------------------------------------|--------------|-----------|-----------------------|-------|
|                 | 01h      | Encoder movement distance            | pulse                                              | 1~4294967295 | U32       | ro                    | NO    |
|                 | 02h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | ro                    | NO    |
| 6091h           | -        | gear ratio setting                   | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 6091h sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | motor rotation number                | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw                    | NO    |
| 6092h           | -        | Feed constant settings               | -                                                  | -            | -         | -                     | -     |
|                 | 00h      | Indicates the 6092h sub-index number | -                                                  | 2            | U8        | ro                    | NO    |
|                 | 01h      | Set the Feed value                   | instruction unit                                   | 1~4294967295 | U32       | rw                    | NO    |
|                 | 02h      | rotation number                      | r ( axle )                                         | 1~4294967295 | U32       | rw                    | NO    |
| 60B8h           | 00h      | probe mode                           | -                                                  | 0~65535      | U16       | rw                    | RxPDO |

Control word (6040h) &lt;Functions in TQ control mode&gt;

| index of matrix | subindex | name                                                                                      | scope   | data type | accessibility | PDO   | Op-mode |   |   |
|-----------------|----------|-------------------------------------------------------------------------------------------|---------|-----------|---------------|-------|---------|---|---|
| 6040h           | 00h      | control word                                                                              | 0~65535 | U16       | rw            | RxPDO | All     |   |   |
|                 |          | Set the control command for PDS state transition and other servo drivers. bit information |         |           |               |       |         |   |   |
|                 |          | 15                                                                                        | 14      | 13        | 12            | 11    | 10      | 9 | 8 |
|                 |          | R                                                                                         |         |           |               |       | om      | h |   |

| 7  | 6   | 5 | 4 | 3  | 2  | 1  | 0  |
|----|-----|---|---|----|----|----|----|
| fr | oms |   |   | eo | qs | ev | so |
|    | r   | r | r |    |    |    |    |

r = reserved (not mapped) fr = fault reset  
 r = reserved (not mapped) fr = fault reset  
 oms = operation mode specific      eo = enable operation  
 (The control mode depends on the bit) qs = quick stop  
 (The control mode depends on the bit) qs = quick stop  
 h = halt      ev = enable voltage  
 h = halt      ev = enable voltage  
 so = switch on

TQ mode does not use the OMS bit.

torque class

| index of matrix | subindex | name                                                                                                                                                                                                   | unit  | scope        | data type | Available inquisitive | PDO   | OP-mode   |
|-----------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|-----------|-----------------------|-------|-----------|
| 6087h           | 00h      | Torque slope<br>torque ramp                                                                                                                                                                            | 0.1 % | 0~4294967295 | U32       | rw                    | RxPDO | tq<br>cst |
|                 |          | The parameter value is set to give the torque command.<br>The cyclic synchronous torque mode (CST) is only active during deceleration and stopping phases.<br>If set to 0, internal processing uses 1. |       |              |           |                       |       |           |
| 6088h           | 00h      | Torque profile type<br>Torque planning type                                                                                                                                                            | -     | -32768~32767 | I16       | rw                    | RxPDO | tq        |
|                 |          | Set the torque Profile type to change torque.<br>0: Straight slope<br>1: Not supported                                                                                                                 |       |              |           |                       |       |           |

## 2) TQ control mode associated objects (monitoring type)

| index of matrix | subindex | name            | unit | scope   | data type | accessibility | PDO   |
|-----------------|----------|-----------------|------|---------|-----------|---------------|-------|
| 6041h           | 00h      | status word     | -    | 0~65535 | U16       | ro            | TxPDO |
| 6073h           | 00h      | maximum current | 0.1% | 0~65535 | U16       | ro            | NO    |

Other torque control objects with common associations (monitoring type)

| index of matrix | subindex | name                              | unit        | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|-----------------------------------|-------------|------------------------|-----------|-----------------------|-------|
| 6063h           | 00h      | actual internal position feedback | pulse       | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 6064h           | 00h      | position                          | instruction | -2147483648~           | I32       | ro                    | TxPDO |



|       |     |                               |                   |                            |     |    |       |
|-------|-----|-------------------------------|-------------------|----------------------------|-----|----|-------|
|       |     | feedback                      | unit              | 2147483647                 |     |    |       |
| 606Ch | 00h | rate feedback                 | Command<br>unit/s | -2147483648~<br>2147483647 | I32 | ro | TxPDO |
| 6074h | 00h | torque<br>command             | 0.1%              | -32768~32767               | I16 | ro | TxPDO |
| 6075h | 00h | Rated current<br>of the motor | 1mA               | 0~4294967295               | U32 | ro | TxPDO |
| 6076h | 00h | motor rated<br>torque         | mNm               | 0~4294967295               | U32 | ro | TxPDO |
| 6077h | 00h | torque<br>feedback            | 0.1%              | -32768~32767               | I16 | ro | TxPDO |
| 6078h | 00h | Current actual<br>value       | 0.1%              | -32768~32767               | I16 | ro | TxPDO |

There are other objects with common patterns.

| index<br>of<br>matrix | son<br>index<br>of<br>matrix | name                                                               | unit             | scope                      | data<br>type | Available<br>inquisitive | PDO   |
|-----------------------|------------------------------|--------------------------------------------------------------------|------------------|----------------------------|--------------|--------------------------|-------|
| 603Fh                 | 00h                          | Error code                                                         | -                | 0~65535                    | U16          | ro                       | TxPDO |
| 60B9h                 | 00h                          | Indicates the status of the<br>Touch probe function                | -                | 0~65535                    | U16          | ro                       | TxPDO |
| 60BAh                 | 00h                          | Indicates the rising edge<br>clamping position of<br>Touch probe1  | instruct<br>unit | -2147483648~<br>2147483647 | I32          | ro                       | TxPDO |
| 60BBh                 | 00h                          | Indicates the falling edge<br>clamping position of<br>Touch probe1 | instruct<br>unit | -2147483648~<br>2147483647 | I32          | ro                       | TxPDO |
| 60BCh                 | 00h                          | Indicates the rising edge<br>clamping position of<br>Touch probe2  | instruct<br>unit | -2147483648~<br>2147483647 | I32          | ro                       | TxPDO |
| 60BDh                 | 00h                          | Indicates the falling edge<br>clamping position of<br>Touch probe2 | instruct<br>unit | -2147483648~<br>2147483647 | I32          | ro                       | TxPDO |

Status word (6041h) <tg Control mode functions>

| index<br>of<br>matrix | subinde<br>x | name           | scope   | data type | accessibility | PDO   | Op-mod<br>e |
|-----------------------|--------------|----------------|---------|-----------|---------------|-------|-------------|
| 6041h                 | 00h          | status<br>word | 0~65535 | U16       | ro            | TxPDO | All         |

Indicates the status of the servo driver.

bit information

|    |     |     |    |     |                |    |      |
|----|-----|-----|----|-----|----------------|----|------|
| 15 | 14  | 13  | 12 | 11  | 10             | 9  | 8    |
| r  |     | oms |    | ila | oms            | rm | r    |
|    |     | r   | r  |     | target reached |    |      |
| 7  | 6   | 5   | 4  | 3   | 2              | 1  | 0    |
| w  | sod | qs  | ve | f   | oe             | so | rsto |

r = reserved (not mapped) w = warning

mapped) w = warning

sod = switch on disabled

oms = operation mode specific

oms = operation mode specific

Control mode dependent bit: ve = voltage enabled

Control mode dependent bit: ve = voltage enabled

ila = internal limit active

ila = internal limit active

oe = operation enabled

oe = operation enabled

so = switched on

so = switched on

r = reserved (not mapped) w = warning

qs = quick stop

qs = quick stop

f = fault

f = fault

rm = remote

rm = remote

rtso = ready to switch on

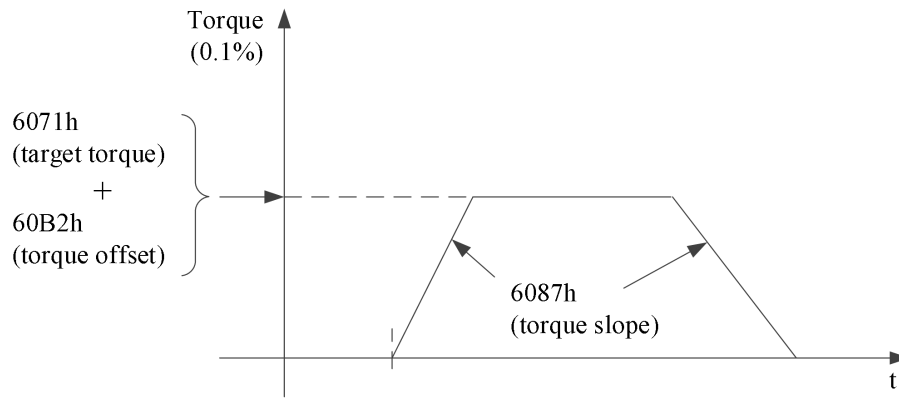
rtso = ready to switch on

bit13,12,10 (operation mode specific) :

| Bit | name           | price | definition                                                                                                                           |
|-----|----------------|-------|--------------------------------------------------------------------------------------------------------------------------------------|
| 10  | target reached | 0     | halt=0 (normal mode): 6074h (Torque demand) has not reached the target torque<br>halt=1 (when halt stops): during shaft deceleration |
|     |                | 1     | halt=0 (normal mode): 6074h (Torque demand) reaches target torque<br>halt=1 (when halt stops): axis stops (axis speed is 0)          |
| 12  | reserved       | -     | unused                                                                                                                               |
| 13  | reserved       | -     | unused                                                                                                                               |

### 3) The action of the tq control mode

- The Profile torque control mode generates torque command values based on the following parameters.
- Target torque is set (6071h)
- Torque offset (60B2h) (not supported)
- Torque slope (6087h)
- Update the action command (send). After enabling the servo, wait approximately 100ms before entering it.
- As monitoring data, it provides 6077h (Torque actual value, torque feedback) and other parameters.



- The target torque (6071h) is set to the maximum torque (6072h), 231Ch (P3-28), and 231Dh (P3-29), with a minimum value limit.
- The speed is limited by the 6080h (Maximum Motor Speed).

## 7.8.2 Common Parameters

tq control mode associated objects (commands, settings)

| register      | explain                                                                   | unit   |
|---------------|---------------------------------------------------------------------------|--------|
| RXPDO[0x6040] | control word                                                              | -      |
| RXPDO[0x6060] | The control mode is tq (Profile Torque Control Mode). Set its value to 4. | -      |
| RXPDO[0x6071] | target torque given                                                       | 0.1%   |
| RXPDO[0x6072] | maximum torque                                                            | 0.1%   |
| RXPDO[0x6080] | maximum motor speed                                                       | r/min  |
| RXPDO[0x6087] | Set torque slope                                                          | 0.1%/S |
| RXPDO[0x6088] | Set the torque Profile type to be used                                    | -      |

tq control mode associated objects (command, monitoring type)

| register      | explain                                   | unit                |
|---------------|-------------------------------------------|---------------------|
| TXPDO[0x6041] | status word                               | -                   |
| TXPDO[0x6064] | Position feedback (actual motor position) | instruction<br>unit |
| TXPDO[0x606C] | rate feedback                             | Command<br>unit/s   |
| TXPDO[0x6077] | actual torque                             | 0.1%                |

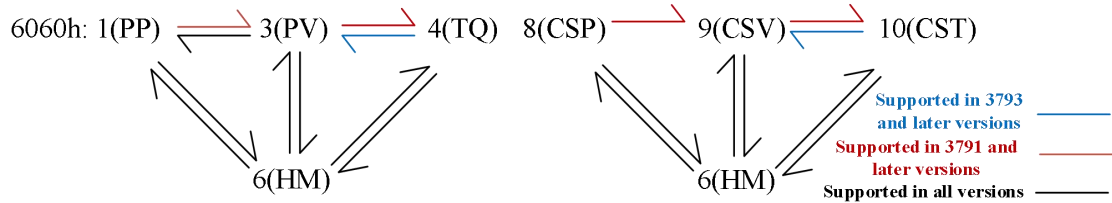
TQ mode, without using OMS bits.

By changing control word 6040 (6→15), the slave can be enabled.

## 7.9 Common Modes and Functions

### 7.9.1 Mode Switching Function

This model supports mode switching during operation with a switching time of 2ms. When the servo is enabled, it allows switching between position mode and speed mode, position mode and torque mode, or speed mode and torque mode, enabling users to achieve multi-mode switching control in engineering projects.



### 7.9.2 Parking Methods

PDS is a motor deceleration stop method that activates when the system is in Operation-enabled mode (servo enable), designed to handle scenarios such as main power interruption or alarm activation.

The deceleration function (selection code) defined by CoE (CiA402) will be combined with the servo (DS5C1) side deceleration function (free run stop, deceleration stop).

PDS selection code list

| index of matrix | subindex | name                         | unit | scope | data type | accessibility | PDO |
|-----------------|----------|------------------------------|------|-------|-----------|---------------|-----|
| 605Ah           | 00h      | Quick Stop Mode Selection    | -    | 0~7   | I16       | rw            | NO  |
| 605Bh           | 00h      | Close method selection       | -    | 0~1   | I16       | rw            | NO  |
| 605Ch           | 00h      | Pause shutdown method        | -    | 0~1   | I16       | rw            | NO  |
| 605Dh           | 00h      | Pause option code            | -    | 1~3   | I16       | rw            | NO  |
| 605Eh           | 00h      | failure mode and effect code | -    | 0~2   | I16       | rw            | NO  |

List of associated objects

| index of matrix | son index of matrix | name                 | unit                             | scope        | data type | Available inquisitive | PDO   | OP-mode        |
|-----------------|---------------------|----------------------|----------------------------------|--------------|-----------|-----------------------|-------|----------------|
| 6084h           | 00h                 | Profile deceleration | instruction units/s <sup>2</sup> | 0~4294967295 | U32       | rw                    | RxPDO | PP<br>PV<br>HM |

| index of matrix | son index of matrix | name                                                                                                                                                                                                                                                                                                                                                                           | unit                                | scope            | data type | Available inquisitive | PDO   | OP-mode                      |
|-----------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------------|-----------|-----------------------|-------|------------------------------|
|                 |                     |                                                                                                                                                                                                                                                                                                                                                                                |                                     |                  |           |                       |       | CSP<br>CSV                   |
|                 |                     | Set Profile deceleration.<br>Set to 0, internal processing is treated as 1.                                                                                                                                                                                                                                                                                                    |                                     |                  |           |                       |       |                              |
| 6085h           | 00h                 | Quick stop deceleration<br>quick deceleration                                                                                                                                                                                                                                                                                                                                  | instruction<br>units/s <sup>2</sup> | 0~<br>4294967295 | U32       | rw                    | RxPDO | PP<br>PV<br>HM<br>CSP<br>CSV |
|                 |                     | If the 605Ah (Quick stop option code) is '2' or '6', set the motor deceleration parameters for Quick stop operation.<br>The codes 605Dh (Halt option code) and 605Eh (Fault reaction option code) are also used when the value is 2.                                                                                                                                           |                                     |                  |           |                       |       |                              |
| 6087h           | 00h                 | Torque slope                                                                                                                                                                                                                                                                                                                                                                   | 0.1%                                | 0~<br>4294967295 | U32       | rw                    | RxPDO | TQ<br>CST                    |
|                 |                     | The parameter value is set to give the torque command.<br>The cyclic synchronous torque mode (CST) is only effective during deceleration and stopping phases.                                                                                                                                                                                                                  |                                     |                  |           |                       |       |                              |
| 609Ah           | 00h                 | Homing acceleration                                                                                                                                                                                                                                                                                                                                                            | instruction<br>units/s <sup>2</sup> | 0~<br>4294967295 | U32       | rw                    | RxPDO | HM                           |
|                 |                     | Set the acceleration and deceleration values for the origin reset position control mode (HM).<br>The deceleration function of the Origin Reset Position Control Mode (HM) is also applied to this object.<br>When the original method reaches its final stop (i.e., when the origin position is detected), the servo lock stops without using the preset value of this object. |                                     |                  |           |                       |       |                              |
| 60C6h           | 00h                 | Max deceleration<br>maximal acceleration                                                                                                                                                                                                                                                                                                                                       | instruction<br>units/s <sup>2</sup> | 0~<br>4294967295 | U32       | rw                    | RxPDO | PP<br>HM<br>CSP              |
|                 |                     | Set maximum deceleration.<br>If set to 0, internal processing is treated as an 1 operation.                                                                                                                                                                                                                                                                                    |                                     |                  |           |                       |       |                              |

## 1) Quick parking mode selection (605Ah)

Set the motor deceleration stop method for the PDS command "Quick Stop" during reception.

| index of matrix | subindex | name                                                                                                  | unit | scope | data type | accessibility | PDO | OP-mode |
|-----------------|----------|-------------------------------------------------------------------------------------------------------|------|-------|-----------|---------------|-----|---------|
| 605Ah           | 00h      | Quick stop option code                                                                                | -    | 0~7   | I16       | rw            | NO  | ALL     |
|                 |          | pp, csp, csv, pv<br>0: After the servo-side motor stops (Sequence at Servo-off), transition to Switch |      |       |           |               |     |         |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>on disabled.</p> <p>1: After the motor stops at 6084h (Profile deceleration), switch to 'Switch on disabled'.</p> <p>2: After the motor stops via 6085h (Quick stop deceleration), switch to 'Switch on disabled'.</p> <p>3: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to the 'Switch on disabled' mode.</p> <p>5: After the motor stops at 6084h (Profile deceleration), switch to Quick Stop Active mode.</p> <p>6: After the motor stops via 6085h (Quick stop deceleration), switch to Quick stop active.</p> <p>7: After the motor stops at 60°C6h (maximum deceleration), switch to Quick Stop Active mode.</p> <p>hm</p> <p>0: After the servo-side motor stops (Sequence at Servo-off), transition to Switch on disabled.</p> <p>1: After the 609Ah (Homing acceleration) motor stops, the system switches to Switch on disabled mode.</p> <p>2: After the motor stops via 6085h (Quick stop deceleration), switch to 'Switch on disabled'.</p> <p>3: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to the 'Switch on disabled' mode.</p> <p>5: After the 609Ah (Homing acceleration) motor stops, the system switches to Quick Stop Active mode.</p> <p>6: After the motor stops via 6085h (Quick stop deceleration), switch to Quick stop active.</p> <p>7: After the motor stops at 60°C6h (maximum deceleration), switch to Quick Stop Active mode.</p> <p>cst, tq</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switch on disabled.</p> <p>1,2: After the motor stops at 6087h (Torque slope), switch to 'Switch on disabled'.</p> <p>3: After the torque 0 motor stops, switch to 'Switch on disabled'.</p> <p>5,6: After the motor stops at 6087h (Torque slope), the system switches to Quick Stop Active mode.</p> <p>7: After the torque 0 motor stops, switch to Quick Stop Active.</p> |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Example of using the Quick Stop command to slow down and stop:

A: When bit2 (Control word: quick stop) transitions from 1 to 0 at 6040Hz, the system initiates deceleration and stops.

During deceleration, the PDS status transitions to Quick Stop Active.

B: The motor stops when the detected speed falls below 10 r/min.

After stopping, the PDS status becomes either Switch on disabled or Quick stop active.

## 2) Power-off option code (605Bh)

Set the motor deceleration and stop method when receiving PDS commands "Shutdown" and "Disable voltage".

| index of matrix | subindex | name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | unit | scope | data type | Available inquisitive | PDO   | OP-mode |
|-----------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|-----------------------|-------|---------|
| 605Bh           | 00h      | Shutdown option code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -    | 0~1   | I8        | rw                    | RxPDO | ALL     |
|                 |          | <p>Sets the timing for receiving PDS commands "Shutdown" and "Disable voltage", which varies according to the control mode definition.</p> <p>Prohibited except for the following values.</p> <p>(1) When the PDS command "Shutdown" is received</p> <p>pp, csp, csv, pv</p> <p>0: After the servo-side motor (Sequence at Servo-off) stops, transition to Ready to switch on.</p> <p>1: After the motor stops at 6084h (Profile deceleration), transition to Ready to switch on.</p> <p>hm</p> <p>0: After the servo-side motor (Sequence at Servo-off) stops, transition to Ready to switch on.</p> <p>1: After the 609Ah (Homing acceleration) motor stops, transition to Ready to switch on.</p> <p>cst, tq</p> <p>0: After the servo-side motor (Sequence at Servo-off) stops, transition to Ready to switch on.</p> <p>1: After the motor stops at 6087h (Torque slope), transition to Ready to switch on.</p> <p>(2) When the PDS command "Disable voltage" is received</p> <p>pp, csp, csv, pv</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switch on disabled.</p> <p>1: After the motor stops at 6084h (Profile deceleration), switch to 'Switch on disabled'.</p> <p>hm</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switch on disabled.</p> <p>1: After the 609Ah (Homing acceleration) motor stops, the system switches to Switch on disabled mode.</p> <p>cst, tq</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switch on disabled.</p> <p>1: After the motor stops at 6087h (Torque slope), switch to the 'Switch on disabled' state.</p> |      |       |           |                       |       |         |

Example of deceleration stop action triggered by shutdown command:

A: If the PDS command "Shutdown" is received, the system will begin to slow down and stop.  
The PDS status remains Operation enabled during deceleration.  
B: The motor stops when the detected actual speed is below 10 r/min.  
The PDS status after stopping is Ready to switch on.

### 3) Disable operation option code (605Ch)

Set the motor deceleration and stop method when receiving the PDS command "Disable operation".

| index of matrix | son index of matrix | name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | unit | scope | data type | Available inquisitive | PDO   | OP-mode |
|-----------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|-----------------------|-------|---------|
| 605Ch           | 00h                 | Disable operation option code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -    | 0~1   | I8        | rw                    | RxPDO | ALL     |
|                 |                     | <p>Sets the timing for receiving the PDS command "Disable operation". The timing varies depending on the control mode.<br/>Prohibited except for the following values.</p> <p>pp, csp, csv, pv</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switched on.<br/>1: After the motor stops at 6084h (Profile deceleration), the system transitions to the Switched on state.</p> <p>hm</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switched on.<br/>1: After the 609Ah (Homing acceleration) motor stops, the system transitions to the Switched on state.</p> <p>cst, tq</p> <p>0: After the motor stops at the Servo-off sequence, transition to Switched on.<br/>1: After the motor stops at 6087h (Torque slope), switch to Switched on.</p> |      |       |           |                       |       |         |

An example of stopping the deceleration action using the Disable operation command.

A: When the PDS command "Disable operation" is received, the system initiates deceleration and stops.  
The PDS status remains Operation enabled during deceleration.  
B: The motor will stop when the detected speed drops below 10 r/min.  
The PDS status bit is switched on after stopping.

### 4) Halt option code (605Dh)

When bit8 (Halt) of control word 6040h is set to 1, the motor deceleration stop method is activated.

| index of matrix | subindex | name             | unit | scope | data type | accessibility | PDO | OP-mode |
|-----------------|----------|------------------|------|-------|-----------|---------------|-----|---------|
| 605Dh           | 00h      | Halt option code | -    | 1~3   | I16       | rw            | NO  | ALL     |



|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>Sets the timing for receiving the PDS command "Disable operation". The timing varies depending on the control mode.</p> <p>Prohibited except for the following values.</p> <p>Set the timing for the Halt action, which varies depending on the control mode definition.</p> <p>Prohibited except for the following values.</p> <p>pp, csp, csv, pv</p> <p>1: After the motor stops at 6084h (Profile deceleration), keep Operation enabled.</p> <p>2: After the motor stops via 6085h (Quick stop deceleration), keep Operation enabled.</p> <p>3: After the motor stops at 6072h (Maximum Torque) and 60C6h (Maximum Deceleration), the Operation enabled state remains.</p> <p>hm</p> <p>1: After the 609Ah (Homing acceleration) motor stops, the system remains in Operation enabled mode.</p> <p>2: After the motor stops via 6085h (Quick stop deceleration), keep Operation enabled.</p> <p>3: After the motor stops at 6072h (maximum torque) and 60C6h (maximum deceleration), the Operation enabled state remains.</p> <p>cst, tq</p> <p>1,2: After the motor stops at 6087h (Torque slope), keep Operation enabled.</p> <p>3: After the torque 0 motor stops, keep Operation enabled.</p> |
|--|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Example of stopping motion with Halt function

A: When 6040h:bit8 (Controlword: halt) transitions from 0 to 1, the system initiates deceleration and halts. The PDS state during deceleration remains Operation enabled.

B: The motor will stop when the detected actual speed falls below 10 r/min. The PDS status remains Operation enabled after stopping.

#### 5) Fault reaction option code (605Eh)

Set the method of motor stop when alarm occurs.

| index of matrix | subindex | name                                                                                                                                                                                                                          | unit | scope | data type | accessibility | PDO | OP-mode |
|-----------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|---------------|-----|---------|
|                 |          | Fault reaction option code                                                                                                                                                                                                    | -    | 0~2   | I16       | rw            | NO  | ALL     |
| 605Eh           | 00h      | <p>Set the timing for alarm triggers, which varies by control mode.</p> <p>Do not set beyond the specified value.</p> <p>(1) When Err80.0 ~ 80.7, 81.0 ~ 81.7, 85.0 ~ 85.7, or 88.0 ~ 88.7 occurs</p> <p>pp, csp, csv, pv</p> |      |       |           |               |     |         |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>0: After the servo-side (Sequence at alarm) motor stops, the system transitions to Fault mode.</p> <p>1: After the motor stops at 6084h (Profile deceleration), the system transitions to Fault mode.</p> <p>2: After the motor stops via 6085h (Quick stop deceleration), the system transitions to Fault mode.</p> <p>hm</p> <p>0: After the servo-side (Sequence at alarm) motor stops, the system transitions to Fault mode.</p> <p>1: After the 609Ah (Homing acceleration) motor stops, the system transitions to Fault mode.</p> <p>2: After the motor stops via 6085h (Quick stop deceleration), the system transitions to Fault mode.</p> <p>cst, tq</p> <p>0: After the servo-side (Sequence at alarm) motor stops, the system transitions to Fault mode.</p> <p>1,2: After the motor stops at 6087h (Torque slope), the system transitions to Fault mode.</p> <p>(2) When an alarm occurs that is not specified in the above (1) section:</p> <p>0,1,2: After the servo-side (Sequence at alarm) motor stops, transition to Fault.</p> |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Example of the action of deceleration and stopping according to the alarm

A: If an alarm is triggered, the system will begin decelerating and eventually stopping. During deceleration, the PDS status remains 'Fault reaction active'.

B: The motor will stop when the detected speed is below 10 r/min. The PDS status will be set to Fault after stopping.

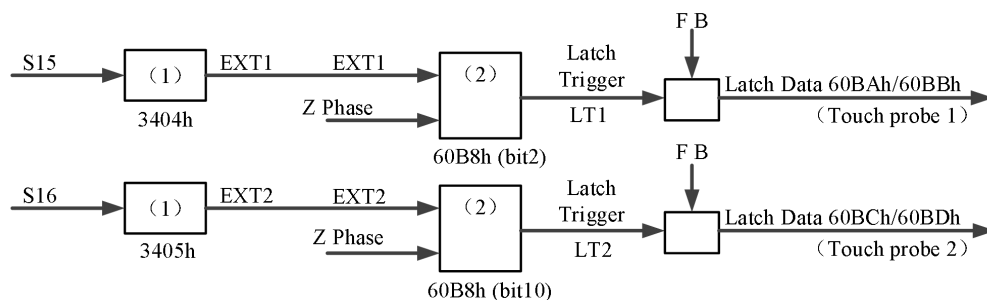
### 7.9.3 Probe Function (Position Clamping Request/Release)

The probe function is a position latch function. When the trigger condition (EXT1/EXT2) is met, the probe function is activated and the motor encoder value at the trigger point is latched. Depending on the setting of the probe control word 60B8, single or multiple triggers can be achieved.



- Probe function is not supported in hm mode.
- Only external signals can be used as trigger sources.

#### 1) The composition of probe functions



60B8h: Touch probe function

60BAh: Touch probe position 1 (the rising edge clamping position of Touch probe1)

60BBh: Touch probe 1's falling edge clamping position

60BCh: Touch probe 2's rising edge clamping position

60BDh: Touch probe 2's falling edge clamping position

If the trigger position is at the same point of the motor rotation, the difference between the two latch probe values should be the number of pulses emitted by the motor encoder in one cycle.

It should be noted that there is a certain time from the generation of the external trigger signal to the driver receiving the signal and executing the latch operation. Therefore, the value latched by the probe will inevitably have an error compared to the actual value. The magnitude of this error is related to the motor's speed, hardware performance, and software processing.

#### Function usage notes:

(1) The clamping trigger signal uses external inputs (EXT1/EXT2), with P5-62 and P5-63 designated for Touch Probe1 and Touch Probe2 respectively. The default driver probe parameters are listed in the table below.

| product model | 出厂默认值 |       | Probe function settings |                  |
|---------------|-------|-------|-------------------------|------------------|
|               | P5-62 | P5-63 | P5-62 (Terminal)        | P5-63 (Terminal) |
| DM6C          | 0     | 0     | 1 (SI1)                 | 2 (SI2)          |

| 60B8h (probe function) |         |      |         |
|------------------------|---------|------|---------|
| Bit10                  | LT2     | Bit2 | LT1     |
| 0                      | EXT2    | 0    | EXT1    |
| 1                      | Z Xiang | 1    | Z Xiang |

(2) If the Touch probe is executed on an unallocated port, E-883 (abnormal operation protection) will be triggered.

(3) When the clamping trigger signal is an external input (EXT1/EXT2), acquisition errors may occur. Keep the speed near the clamping signal input as low as possible.

(4) The ON and OFF durations of the clamping trigger signal input must each exceed 2ms.

(5) The touch probe is invalid (canceled) in the following cases. (The value of 60B9h is cleared).

① ESM status is Init

② Switching to HM mode

(6) Do not set both rising and falling edges for the same Touch Probe. This may cause the device to fail to respond when both edges are configured simultaneously.

(7) It should be noted that there is a certain time from the generation of the external trigger signal to the driver receiving the signal and performing the latch operation. Therefore, the value latched by the probe will inevitably have an error compared to the actual value, and the magnitude of this error is related to the motor's speed, hardware performance, and software processing.

## 2) Probe-related objects

| index of matrix | subindex | name                                                         | unit          | scope                  | data type | Available inquisitive | PDO   |
|-----------------|----------|--------------------------------------------------------------|---------------|------------------------|-----------|-----------------------|-------|
| 60B8h           | 00h      | Probe function settings                                      | -             | 0~65535                | U16       | rw                    | RxPDO |
| 60B9h           | 00h      | Indicates the status of the Touch probe function             | -             | 0~65535                | U16       | ro                    | TxPDO |
| 60BAh           | 00h      | Indicates the rising edge clamping position of Touch probe1  | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BBh           | 00h      | Indicates the falling edge clamping position of Touch probe1 | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BCh           | 00h      | Indicates the rising edge clamping position of Touch probe2  | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |
| 60BDh           | 00h      | Indicates the falling edge clamping position of Touch probe2 | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO |

## 3) Probe function settings (60B8h)

| index of matrix | subindex | name                             | unit | scope   | data type | accessibility | PDO   | OP-mode |
|-----------------|----------|----------------------------------|------|---------|-----------|---------------|-------|---------|
| 60B8h           | 00h      | Touch probe function             | -    | 0~65535 | U16       | rw            | RxPDO | ALL     |
|                 |          | Set up the Touch probe function. |      |         |           |               |       |         |

corresponding bit description

| bit | price | annotate                                              |                                            |
|-----|-------|-------------------------------------------------------|--------------------------------------------|
| 0   | 0     | Switch off touch probe 1                              | Touch Probe 1                              |
|     | 1     | Enable touch probe 1                                  | Run/Stop                                   |
| 1   | 0     | Trigger first event                                   | Touch Probe 1                              |
|     | 1     | Continuous                                            | event mode selection                       |
| 2   | 0     | Trigger with touch probe 1 input                      | Touch Probe 1                              |
|     | 1     | Trigger with zero impulse signal of position encoder  | Trigger selection (external input/Z phase) |
| 3   | -     | Reserved                                              | unused                                     |
| 4   | 0     | Switch off sampling at positive edge of touch probe 1 | Touch Probe 1                              |
|     | 1     | Enable sampling at positive edge of touch probe 1     | rising edge selection                      |
| 5   | 0     | Switch off sampling at negative edge of touch probe 1 | Touch Probe 1                              |
|     | 1     | Enable sampling at negative edge of touch probe 1     | falling edge selection                     |
| 6-7 | -     | Not Supported                                         | unused                                     |
| 8   | 0     | Switch off touch probe 2                              | Touch Probe 2                              |

| bit   | price | annotate                                              |                                            |
|-------|-------|-------------------------------------------------------|--------------------------------------------|
|       | 1     | Enable touch probe 2                                  | Run/Stop                                   |
| 9     | 0     | Trigger first event                                   | Touch Probe 2                              |
|       | 1     | Continuous                                            | event mode selection                       |
| 10    | 0     | Trigger with touch probe 2 input                      | Touch Probe 2                              |
|       | 1     | Trigger with zero impulse signal of position encoder  | Trigger selection (external input/Z phase) |
| 11    | -     | Reserved                                              | unused                                     |
| 12    | 0     | Switch off sampling at positive edge of touch probe 2 | Touch Probe 2                              |
|       | 1     | Enable sampling at positive edge of touch probe 2     | rising edge selection                      |
| 13    | 0     | Switch off sampling at negative edge of touch probe 2 | Touch Probe 2                              |
|       | 1     | Enable sampling at negative edge of touch probe 2     | falling edge selection                     |
| 14-15 | -     | Not Supported                                         | unused                                     |



Do not set both rising and falling edges under the same probe.

#### 4) Probe function status (60B9h)

| index of matrix | subindex | name                                              | unit | scope   | data type | accessibility | PDO   | OP-mode |
|-----------------|----------|---------------------------------------------------|------|---------|-----------|---------------|-------|---------|
| 60B9h           | 00h      | Touch probe status                                | -    | 0~65535 | U16       | ro            | TxPDO | ALL     |
|                 |          | Indicates the status of the Touch probe function. |      |         |           |               |       |         |

corresponding bit description

| bit | price | annotate                                    |                                                        |
|-----|-------|---------------------------------------------|--------------------------------------------------------|
| 0   | 0     | Touch probe 1 is switch off                 | Touch Probe 1 action stopped                           |
|     | 1     | Touch probe 1 is enabled                    | Touch Probe 1 is in action                             |
| 1   | 0     | Touch probe 1 no positive edge value stored | The rising edge of Touch Probe 1 is incomplete         |
|     | 1     | Touch probe 1 positive edge value stored    | Completion status of the rising edge on Touch Probe 1  |
| 2   | 0     | Touch probe 1 no negative edge value stored | The falling edge of Touch Probe 1 is incomplete        |
|     | 1     | Touch probe 1 negative edge value stored    | Completion status of the falling edge on Touch Probe 1 |
| 3-5 | -     | Reserved                                    | unused                                                 |
| 6-7 | -     | Not Supported                               | unused                                                 |
| 8   | 0     | Touch probe 2 is switch off                 | Touch Probe 2 action stopped                           |
|     | 1     | Touch probe 2 is enabled                    | Touch Probe 2 is in action                             |
| 9   | 0     | Touch probe 2 no positive edge value stored | The rising edge of Touch Probe 2 is incomplete         |
|     | 1     | Touch probe 2 positive edge value stored    | Completion status of the rising edge on Touch Probe 2  |

| bit   | price | annotate                                    |                                                        |
|-------|-------|---------------------------------------------|--------------------------------------------------------|
| 10    | 0     | Touch probe 2 no negative edge value stored | The falling edge of Touch Probe 2 is incomplete        |
|       | 1     | Touch probe 2 negative edge value stored    | Completion status of the falling edge on Touch Probe 2 |
| 11-13 | -     | Reserved                                    | unused                                                 |
| 14-15 | -     | Not Supported                               | unused                                                 |

#### 5) Obtained clamp positions (0x60BA~0x60BD)

| index of matrix | son index of matrix | name                                                                 | unit          | scope                  | data type | Available inquisitive | PDO   | OP-mode |
|-----------------|---------------------|----------------------------------------------------------------------|---------------|------------------------|-----------|-----------------------|-------|---------|
| 60BAh           | 00h                 | Touch probe pos1 pos value                                           | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO | ALL     |
|                 |                     | Indicates the rising edge clamping position of Touch probe1.         |               |                        |           |                       |       |         |
| 60BBh           | 00h                 | Touch probe pos1 neg value                                           | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO | ALL     |
|                 |                     | Indicates the clamping position of the falling edge of Touch probe1. |               |                        |           |                       |       |         |
| 60BCh           | 00h                 | Touch probe pos2 pos value                                           | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO | ALL     |
|                 |                     | Indicates the rising edge clamping position of Touch probe2.         |               |                        |           |                       |       |         |
| 60BDh           | 00h                 | Touch probe pos2 neg value                                           | instruct unit | -2147483648~2147483647 | I32       | ro                    | TxPDO | ALL     |
|                 |                     | Indicates the clamping position of the falling edge of Touch probe2. |               |                        |           |                       |       |         |

#### 6) Start of probe action

During the transition from '0 (stop) to 1 (start)' for bit0/8 (Touch probe execution/stop) in 60B8h (probe function setting), the system acquires various configuration parameters (60B8h: bit1-7 and bit9-15) and initiates the Touch probe operation.

To activate changes in various settings, set bit0 and bit8 to "0 (stop)" and then switch to "1 (start)".

To switch control mode and use the probe function, set bit0 and bit8 to 0 (stop) and then to 1 (start).

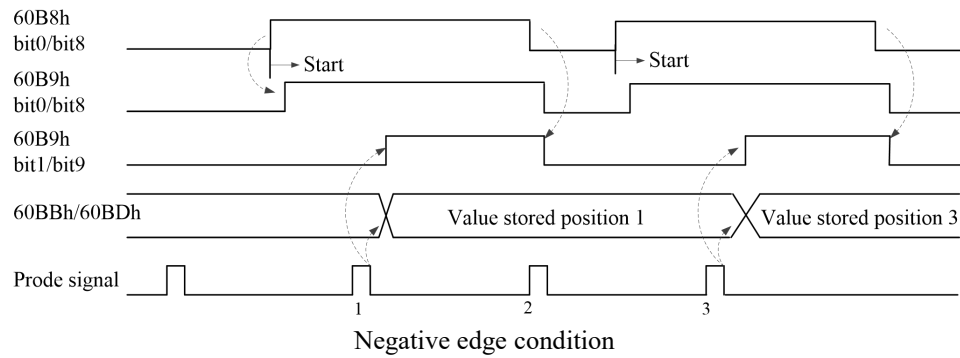
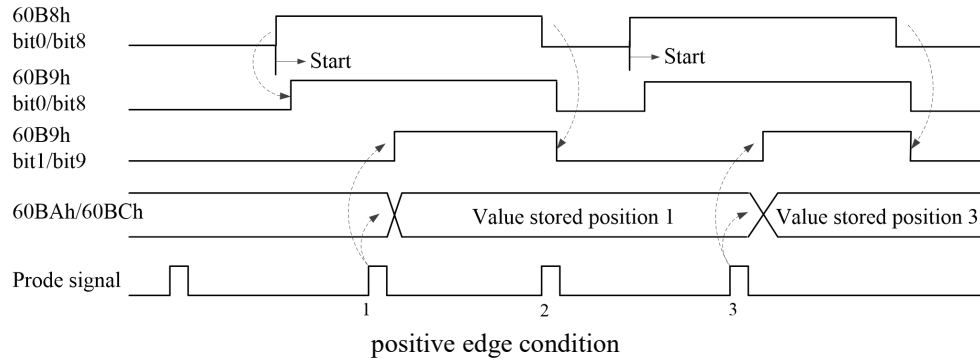
#### 7) Event pattern of probe

Based on the bit1 and bit9 (event mode selection) of 60B8h (probe function setting), you can select either "0 (Trigger first event mode)" or "1 (Continuous mode)".

(1) <Trigger first event mode> (60B8h: bit1=0 / bit9=0)

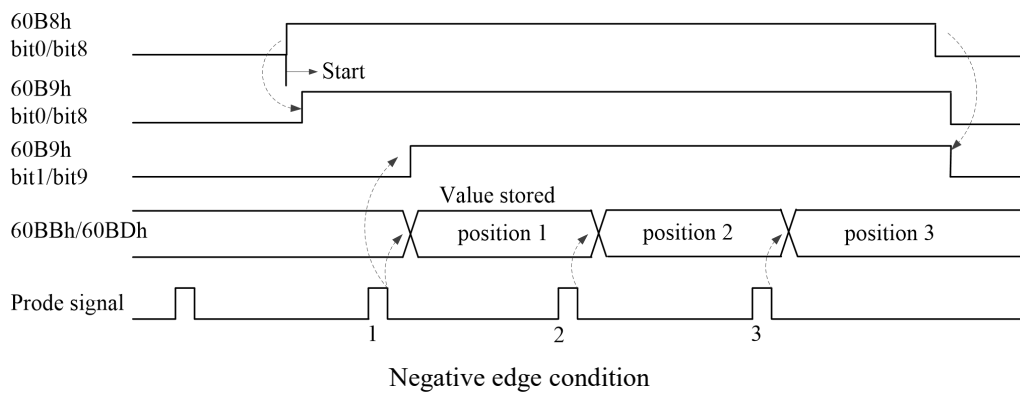
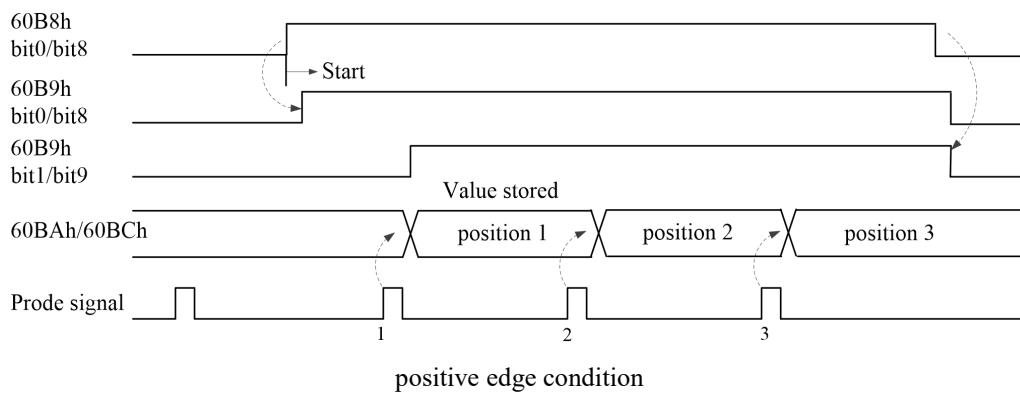
After startup, the mode is set only by the first trigger signal. To retrieve it again, you must restart the

## Touch probe.



## (2) &lt;Continuous mode&gt; (60B8h: bit1=1 / bit9=1)

After startup, this mode triggers the bit set signal each time. The obtained value is retained until the next Probe signal.



## 7.9.4 Digital Input (60FDh)

The 60FDh digital input's bits are assigned functional signals through parameters P5-22 (POT setting address), P5-23 (NOT setting address), P5-27 (HOME origin setting address), P5-62 (Probe 1 setting address), and P5-63 (Probe 2 setting address) of the DM6C series servo, representing the input states of the positive limit switch (POT), negative limit switch (NOT), home switch (HOME), Touch probe 1, and Touch probe 2 respectively.

Digital input (60FDh)

| index of matrix                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | son index of matrix | name           | scope        | data type | accessibility | PDO   | Op-mode |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|--------------|-----------|---------------|-------|---------|----|----|----|----|----|----|----|----|---|--|--|--|--|--|--|--|----|----|----|----|----|----|----|----|---|--|--|--|------|------|------|------|----|----|----|----|----|----|---|---|---|--|--|--|--|--|--|--|---|---|---|---|---|---|---|---|---|--|-----|-----|-----|----|-----|-----|
| 60FDh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 00h                 | Digital inputs | 0~4294967295 | U32       | ro            | TxPDO | All     |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| It represents the theoretical input state of the external input signal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| bit information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| <table border="1"> <tr> <td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td></tr> <tr> <td colspan="8">r</td></tr> <tr> <td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td></tr> <tr> <td colspan="4">r</td><td>ris4</td><td>ris3</td><td>ris2</td><td>ris1</td></tr> <tr> <td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr> <tr> <td colspan="8">r</td></tr> <tr> <td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr> <tr> <td colspan="2">r</td><td>Zos</td><td>tp2</td><td>tp1</td><td>hs</td><td>pls</td><td>nls</td></tr> </table> |                     |                |              |           |               |       |         | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | r |  |  |  |  |  |  |  | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | r |  |  |  | ris4 | ris3 | ris2 | ris1 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | r |  |  |  |  |  |  |  | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | r |  | Zos | tp2 | tp1 | hs | pls | nls |
| 31                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 30                  | 29             | 28           | 27        | 26            | 25    | 24      |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| 23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 22                  | 21             | 20           | 19        | 18            | 17    | 16      |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                |              | ris4      | ris3          | ris2  | ris1    |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 14                  | 13             | 12           | 11        | 10            | 9     | 8       |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 6                   | 5              | 4            | 3         | 2             | 1     | 0       |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | Zos            | tp2          | tp1       | hs            | pls   | nls     |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| r = reserved (not mapped)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| pls= positive limit switch (positive limit switch)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| nls = Negative Limit Switch (NLS)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| hs=home switch (origin switch)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| tp1=Touch Probe 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| tp2=Touch probe 2 (Probe 2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| zos: zero impulse signal output (Z-phase output)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| ris1= remote input state1 (Remote SI Input State 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| ris2= remote input state2 (Remote SI Input State 2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| ris3= remote input state3 (Remote SI Input State 3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |
| ris4= remote input state4 (Remote SI Input State 4)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |                |              |           |               |       |         |    |    |    |    |    |    |    |    |   |  |  |  |  |  |  |  |    |    |    |    |    |    |    |    |   |  |  |  |      |      |      |      |    |    |    |    |    |    |   |   |   |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |  |     |     |     |    |     |     |

Details of each Bit are as follows:

| numeric value | description    |
|---------------|----------------|
| 0             | input mode OFF |
| 1             | input mode ON  |

The 60FD's digital input configuration specifies: bit0 (reverse overtravel switch), bit1 (forward overtravel switch), bit2 (origin switch), bit3 (probe 1), bit4 (probe 2), bit5 (Z-phase output), bit16 (remote SI input 1), bit17 (remote SI input 2), bit18 (remote SI input 3), and bit19 (remote SI input 4) as signal states for positive drive limit, negative drive limit, near-origin input, probe 1 input, probe 2 input, Z-phase output, and remote SI inputs 1-4 respectively.



The Z-phase output hold time is adjusted via driver parameters.

| parameter | meaning                  | factory setting | unit | Set range | revise      | come into force |
|-----------|--------------------------|-----------------|------|-----------|-------------|-----------------|
| P5-19     | Z phase output hold time | 2               | ms   | 1 ~ 65535 | at any time | immediately     |

The output of Z phase is affected by the EtherCAT communication cycle and its own software processing, resulting in poor consistency.

## 7.9.5 Digital Output (60FEh)

In digital output 60FEh, bit0 in sub-object word 1 indicates the zero-crossing Z-phase output status bit, while bit0 in sub-object word 2 indicates the zero-crossing Z-phase output enable bit. When the encoder crosses zero, setting the Z-phase output enable bit to 1 causes the Z-phase output status bit to transition from 0 to 1. After the hold time specified by P5-19, the Z-phase output status bit returns to 0. If the Z-phase output enable bit is set to 0, no Z-phase output status is generated, and the Z-phase output status bit remains at 0.

Digital output (60FEh)

| index of matrix | subindex | name                                                                              | scope        | data type | accessibility | PDO   | Op-mode |      |    |
|-----------------|----------|-----------------------------------------------------------------------------------|--------------|-----------|---------------|-------|---------|------|----|
| 60FEh           | 00h      | Number of entries                                                                 | 2            | U8        | ro            | NO    | All     |      |    |
|                 |          | The number of sub-indexes with 60FEh.                                             |              |           |               |       |         |      |    |
|                 | 01h      | Physical outputs                                                                  | 0~4294967295 | U32       | rw            | RxPDO | All     |      |    |
|                 |          | Indicates the output status of an external output signal.                         |              |           |               |       |         |      |    |
|                 |          | bit information                                                                   |              |           |               |       |         |      |    |
|                 |          | 31                                                                                | 30           | 29        | 28            | 27    | 26      | 25   | 24 |
|                 |          | r                                                                                 |              |           |               |       |         |      |    |
|                 |          | 23                                                                                | 22           | 21        | 20            | 19    | 18      | 17   | 16 |
|                 |          | r                                                                                 |              |           |               | ros3  | ros2    | ros1 |    |
|                 |          | 15                                                                                | 14           | 13        | 12            | 11    | 10      | 9    | 8  |
|                 |          | r                                                                                 |              |           |               |       |         |      |    |
|                 |          | 7                                                                                 | 6            | 5         | 4             | 3     | 2       | 1    | 0  |
|                 |          | r                                                                                 |              |           |               |       |         |      |    |
|                 |          | r = reserved (not mapped)                                                         |              |           |               |       |         |      |    |
|                 |          | ros1= remote output state1 (Remote SO Output State 1)                             |              |           |               |       |         |      |    |
|                 |          | ros2= Remote Output State 2 (Remote SO Output Status 2)                           |              |           |               |       |         |      |    |
|                 |          | ros3 = Remote Output State 3 (Remote SO Output Status 3)                          |              |           |               |       |         |      |    |
| 60FEh           | 02h      | Bit mask                                                                          | 0~4294967295 | U32       | rw            | RxPDO | All     |      |    |
|                 |          | It indicates the function of the output host for setting external output signals. |              |           |               |       |         |      |    |
|                 |          | bit information                                                                   |              |           |               |       |         |      |    |
|                 |          | 31                                                                                | 30           | 29        | 28            | 27    | 26      | 25   | 24 |
|                 |          | r                                                                                 |              |           |               |       |         |      |    |
|                 |          | 23                                                                                | 22           | 21        | 20            | 19    | 18      | 17   | 16 |
|                 |          | r                                                                                 |              |           |               | roe3  | roe2    | roe1 |    |
|                 | 15       | 14                                                                                | 13           | 12        | 11            | 10    | 9       | 8    |    |

|  |  |                                                         |   |   |   |   |   |   |   |
|--|--|---------------------------------------------------------|---|---|---|---|---|---|---|
|  |  | r                                                       |   |   |   |   |   |   |   |
|  |  | 7                                                       | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|  |  | r                                                       |   |   |   |   |   |   |   |
|  |  | r = reserved (not mapped)                               |   |   |   |   |   |   |   |
|  |  | roe1= remote output enable1 (Remote SO Output Enable 1) |   |   |   |   |   |   |   |
|  |  | roe2= remote output enable2 (Remote SO Output Enable 2) |   |   |   |   |   |   |   |
|  |  | roe3 = Remote Output Enable 3                           |   |   |   |   |   |   |   |

Details of each Bit are as follows:

Subindex 01h: Physical outputs

| bit | name                         | numeric value | description              |
|-----|------------------------------|---------------|--------------------------|
| 16  | Remote SO1 output status bit | 0             | Remote SO1 status is OFF |
|     |                              | 1             | Remote SO1 status ON     |
| 17  | Remote SO2 output status bit | 0             | Remote SO2 status is OFF |
|     |                              | 1             | Remote SO2 status ON     |
| 18  | Remote SO3 output status bit | 0             | Remote SO3 status OFF    |
|     |                              | 1             | Remote SO3 status ON     |

Subindex 02h: Bit mask

| bit | name                         | numeric value | description                   |
|-----|------------------------------|---------------|-------------------------------|
| 16  | Remote SO1 output enable bit | 0             | Remote SO1 output enabled OFF |
|     |                              | 1             | Remote SO1 output enabled ON  |
| 17  | Remote SO2 output enable bit | 0             | Remote SO2 output enabled OFF |
|     |                              | 1             | Remote SO2 output enabled ON  |
| 18  | Remote SO3 output enable bit | 0             | Remote SO3 output enabled OFF |
|     |                              | 1             | Remote SO3 output enabled     |

In digital output 60FEh, Subindex 01h (subobject word 1) has bits 16,17, and 18 representing the remote SO1 output status bits, while Subindex 02h (subobject word 2) contains bits 16,17, and 18 indicating the remote SO1, SO2, and SO3 output enable bits respectively.

## 7.9.6 Location Information

### 1) The initialization time for location information

This servo driver initializes the position-related object under the following timing sequence.

- Initialization sequence (conditions)
  - ◆ When the power supply is turned on
  - ◆ Communication establishment (ESM state Init→OP migration)
  - ◆ When the origin reset is completed
  - ◆ When the absolute multi-turn reset is performed
- Initialize object
  - ◆ 6062h (Position demand value)
  - ◆ 6063h (Position Actual Internal Value feedback)
  - ◆ 6064h (Position Actual Value Position Feedback)
  - ◆ 60FCh (Position Demand Internal Value)

The system utilizes actual internal position feedback (6063h) from the motor's feedback mechanism.

The electronic gear function subsequently adjusts Home offset based on polarity change signals, with all parameters preconfigured during initial communication setup.

Furthermore, adjustments to electronic gear ratios, polarity settings (Polarity command), and home offset values are implemented according to the timing sequence detailed in the latter part of this chapter.



For details on using absolute encoders, refer to Section 4 'Initialization of Absolute Encoders' in this chapter.

## 2) Electronic gear ratio

### (1) Function Description

The electronic gear multiplies the position command from the upper input with the electronic gear ratio set by the object, which functions as the position command of the position control unit. By using this function, the motor rotation or movement amount of each command unit can be set arbitrarily.

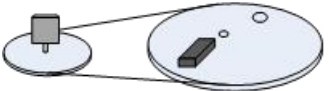
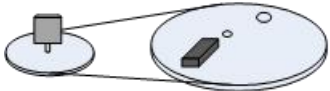
### (2) Method of setting electronic gear ratio of DM6C series

Method 1: Set the electronic gear ratio according to the internal parameters of the servo.

The so-called "electronic gear" function has two main applications:

(1) Determine the number of command pulses required for the motor to complete one full rotation, ensuring the motor reaches the target speed.

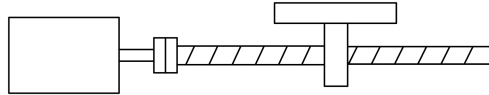
The following example uses a 19-bit encoder motor, with the PLC host computer sending pulses at 200kHz.

| Set the pulse count per revolution to 10000<br>The electronic gear ratio is set to 524288:10000                                                                                                                                                                                                                                                                                          | Set the pulse count per revolution to 5000<br>The electronic gear ratio is set to 524288:5000                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The ratio of the radii of the large and small discs is 2:1. When the large disc rotates one full circle, the small disc rotates by the same amount as 1/2 circle. For every one circle of the large disc, 10000 pulses need to be sent.</p>  <p>The maximum speed of the workpiece is 400 rpm.</p> | <p>If the ratio of the radii of the large and small discs remains 2:1, then to make the large disc rotate one full circle, only 10,000 pulses need to be sent.</p>  <p>The maximum rotational speed of the workpiece is 1200 rpm.</p> |

(2) In the precise positioning, the physical unit length corresponding to the 1 instruction pulse is set to

facilitate calculation.

As shown in the figure, if a unit pulse is designated to move the workpiece by  $1\mu\text{m}$ , the load axis requires 6000 command pulses ( $6\text{mm}/1\mu\text{m}$ ) to complete one full rotation. For a 1:1 reduction ratio, the system can directly set the pulse count per revolution as  $P0-11=6000$  and  $P0-12=0$ . The host computer then issues 6000 pulses to move the workpiece by 6mm (refer to steps 1-6 for detailed calculation).



Encoder: 524288 (19 bits) Screw pitch: 6mm

| Do not change the electronic gear ratio                                                                                                                                                                                                                                                                                                                                                                                                               | Change the electronic gear ratio                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Without adjustment, the electronic gear ratio motor completes 524,288 pulses per rotation (<math>P0-11=0</math>, <math>P0-12=0</math>).</p> <p>For a motor rotation of 1 full turn moving the workpiece by 6mm, 524288 pulses are required. To move the workpiece by 10mm, <math>10/6 \times 524288 = 873813.333</math> pulses are needed.</p> <p>However, rounding down the actual pulse count during transmission causes measurement errors.</p> | <p>By adjusting the electronic gear ratio, the motor requires 6000 pulses to complete one full rotation.</p> <p>For a motor with a 6000-pulse-per-turn capacity, a 6mm workpiece movement requires 6000 pulses. When moving the workpiece 10mm, the required pulses increase to 10000 (<math>10/6 \times 6000</math>). Since actual pulse transmission avoids decimal precision, this eliminates measurement errors.</p> |

● relevant parameter

| parameter | meaning                                                        | factory setting | unit | Set range | revise                           | come into force |
|-----------|----------------------------------------------------------------|-----------------|------|-----------|----------------------------------|-----------------|
| P0-11     | Pulses per revolution*1                                        | 0               | pul  | 0 ~ 9999  | servo OFF                        | immediately     |
| P0-12     | Pulses per revolution × 10000                                  | 0               | pul  | 0 ~ 9999  | servo OFF                        | immediately     |
| P0-13     | electronic gear ratio                                          | 1               | -    | 0 ~ 65535 | servo OFF                        | immediately     |
| P0-14     | Electronic gear ratio (denominator)                            | 1               | -    | 0 ~ 65535 | servo OFF                        | immediately     |
| P0-92     | Second set of electronic gear ratios (molecule) low position*1 | 1               | -    | 1 ~ 9999  | ○ ( pattern<br>5)<br>√ ( pattern | immediately     |

| parameter | meaning                                                             | factory setting | unit | Set range | revise                           | come into force |
|-----------|---------------------------------------------------------------------|-----------------|------|-----------|----------------------------------|-----------------|
|           |                                                                     |                 |      |           | 6) )                             |                 |
| P0-93     | Second set of electronic gear ratios (molecule) high position*10000 | 0               | -    | 1 ~ 65535 | ○ ( pattern 5)<br>√ ( pattern 6) | immediately     |
| P0-94     | Second set of electronic gear ratios (denominator) lower bit*1      | 1               | -    | 1 ~ 9999  | servo OFF                        | immediately     |
| P0-95     | Second set of electronic gear ratios (denominator) high*10000       | 0               | -    | 1 ~ 65535 | servo OFF                        | immediately     |



- The parameters P0-11 to P0-14 are all related to the electronic gear ratio. P0-11 and P0-12 form one group, while P0-13 and P0-14 form another. However, the priority of the pulse count per revolution for P0-11 and P0-12 is higher than that of the electronic gear ratio P0-13 and P0-14. The electronic gear ratio P0-13 and P0-14 will only be activated when both P0-11 and P0-12 are set to 0.
- When P0-11, P0-12, P0-13, and P0-14 are all set to 0, P0-92, P0-93, P0-94, and P0-95 will be activated.

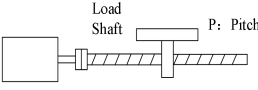
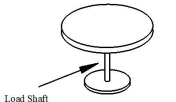
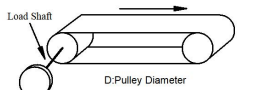
#### Calculation of Pulse Count per Revolution and Electronic Gear Ratio

| step | content                                                                                                  | explain                                                                                                                                              |                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Confirm the mechanical specifications                                                                    | Verify the reduction ratio n:m (where the servo motor rotates m turns and the load shaft rotates n turns), ball screw pitch, pulley diameter, etc.   |                                                                                                                                       |
| 2    | Verify encoder pulse count                                                                               | Confirm the encoder resolution of the servo motor used.                                                                                              |                                                                                                                                       |
| 3    | decision unit                                                                                            | One pulse of the decision command controller corresponds to the actual running distance or angle.                                                    |                                                                                                                                       |
| 4    | Instruction count for one rotation of the load shaft                                                     | Calculate the command quantity N for one full rotation of the load shaft based on the decision unit.                                                 |                                                                                                                                       |
| 5    | Pulse Count M for One Revolution of Computer Shaft                                                       | The number of command pulses for a full rotation of the motor shaft is $M = N/(m/n)$ .                                                               |                                                                                                                                       |
| 6    | Set the pulse count per revolution (P0-11/P0-12) or the electronic gear ratio (P0-13/P0-14) / (P0-92~95) | $P0-11=M\%10000$ $P0-12=M/10000$ $\frac{P0-13}{P0-14} = \frac{\text{Encoder Resolution}}{M} = \frac{\text{Encoder Resolution} \times m}{N \times n}$ | <div style="text-align: center;">             High<br/>             ↓<br/>             Priority<br/>             Low           </div> |



- In Step 6, the pulse count per revolution determines the activation priority. When the pulse count per revolution exceeds the electronic gear ratio, the system activates P0-13~P0-14 only if P0-11~P0-12 are all zero. In special cases where the calculated pulse count per revolution is a decimal value, the electronic gear ratio should be considered.
- When P0-13 and P0-14 exceed the preset range, reduce the electronic gear ratio's numerator and denominator. If the ratio still exceeds the parameters after reduction, activate the second gear ratio set (P0-92 ~ P0-95). The second gear ratio only takes effect when P0-11 ~ 14=0.
- The DM6C series servo motor encoders offer resolution options of 524288 (19-bit) and 8388608 (23-bit).
- The command unit does not equate to machining precision. Refining the command unit based on mechanical precision can enhance the servo's positioning accuracy. For example, when using a lead screw, the mechanical precision can reach 0.01mm. In this case, a 0.01mm command unit is more precise than a 0.1mm command unit.

#### Example of setting electronic gear

| step | name                                                 | ball screw                                                                                                               | circular truncated cone                                                                                                      | belt and pulley                                                                                                                                |
|------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                      |  <p>1 Rotation = P / Command Unit</p> |  <p>1 Rotation = 360° / Command Unit</p> |  <p>1 Rotation = (π × Pulley Diameter) / Command Unit</p> |
| 1    | Confirm the mechanical specifications                | Ball screw pitch 6mm<br>Mechanical gear ratio: 1:1                                                                       | 1 rotation per 360 degrees, 1:3 reduction ratio                                                                              | The pulley diameter is 100mm.<br>Reduction ratio: 1:2                                                                                          |
| 2    | Verify encoder pulse count                           | Encoder resolution: 131072                                                                                               | Encoder resolution: 131072                                                                                                   | Encoder resolution: 131072                                                                                                                     |
| 3    | decision unit                                        | 1 instruction unit: 0.001mm                                                                                              | 1 instruction unit: 0.1 degree                                                                                               | 1 instruction unit: 0.02mm                                                                                                                     |
| 4    | Instruction count for one rotation of the load shaft | 6mm/0.001mm=6000                                                                                                         | 360/0.1=3600                                                                                                                 | 314mm/0.02mm=15700                                                                                                                             |
| 5    | Pulse Count M for One Revolution of Computer Shaft   | M = 6000/(1/1)=6000                                                                                                      | M=3600/(3/1)=1200                                                                                                            | M=15700/(2/1)=7850                                                                                                                             |
| 6    | Set the number of pulses per cycle P0-11/P0-12       | P0-11=6000<br>P0-12=0                                                                                                    | P0-11=1200<br>P0-12=0                                                                                                        | P0-11=7850<br>P0-12=0                                                                                                                          |

|  |                                                |                                                                          |                                                                         |                                                                                                                                                        |
|--|------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | set the gear ratio<br>(P0-13/P0-14)/(P0-92~95) | P0-13=131072<br>P0-14=6000<br>After reduction<br>P0-13=8192<br>P0-14=375 | P0-13=131072<br>P0-14=1200<br>After reduction<br>P0-13=8192<br>P0-14=75 | P0-13=131072<br>P0-14=7850<br>After reduction<br>P0-13=65536<br>P0-14=3925<br>Convert to second gear ratio<br>P0-92=5536 P0-93=6<br>P0-94=3925 P0-95=0 |
|--|------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|

Method 2: Set the electronic gear ratio according to the CoE (CiA402) specifications for Object 608Fh (Position Encoder Resolution), 6091h (Gear Ratio), and 6092h (Feed Constant).

The following section details the configuration of electronic gear ratios based on CoE (CiA402) standards.

The relationship between user-defined units (instruction units) and internal units (pulses) is calculated using the following equation.

Formula for calculating electronic gear ratios:

$$\text{Electronic gear ratio} = \frac{\text{Position encoder resolution} \times \text{Gear ratio}}{\text{Feed constant}}$$

$$\text{Position encoder resolution} = \frac{608F: 01 (\text{encoder increments})}{608F: 02 (\text{motor revolutions})}$$

$$\text{Gear ratio} = \frac{6091: 01 (\text{Motor revolutions})}{6091: 02 (\text{Shaft revolutions})}$$

$$\text{Feed constant} = \frac{6092: 01 (\text{Feed})}{6092: 02 (\text{Shaft revolutions})}$$

$$\text{Position demand value (6062h)} \times \text{Electronic gear ratio} = \text{Position demand internal value (60FCh)}$$



- The electronic gear ratio is effective in the range of 8000 to 1/1000.  
If a value outside the range saturates within the range, E-883 (abnormal operation protection) occurs.
- 608Fh-01h (Encoder increments) is automatically set according to the encoder resolution. The factory default value of 6092h-01h (Feed) is also determined by the encoder resolution.
- The setting of electronic gear ratio is reflected by the following timing.
  - ◆ When the power supply is turned on
  - ◆ Communication establishment (ESM state Init→OP migration)
  - ◆ When the origin reset is completed
  - ◆ When the absolute multi-turn reset is performed
- This does not reflect changes in the set values of associated objects. Please note.
- ◆ For absolute mode initialization of position information during Init⇒Op, the absolute encoder position value (pulse/unit) or electronic gear ratio must be set within the range of -2<sup>31</sup> (-2147483648) to +2<sup>31</sup>-1 (2147483647). Operations outside this range cannot be guaranteed.

- ◆ Check the position range and gear ratio of the absolute encoder.
- Use the electronic gear ratio setting in Cia402 protocol as much as possible.

- relevant parameter

Position encoder resolution (608Fh)

| index of matrix | subindex | name                                                                                              | unit                                                        | scope            | data type | Available inquisitive | PDO | OP-mode |
|-----------------|----------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------------|-----------|-----------------------|-----|---------|
| 608Fh           | -        | Position encoder resolution                                                                       | -                                                           | -                | -         | -                     | -   | -       |
|                 |          | The encoder resolution is automatically set.                                                      |                                                             |                  |           |                       |     |         |
|                 | 00h      | Highest sub-index supported                                                                       | -                                                           | 2                | U8        | ro                    | NO  | ALL     |
|                 |          | The number of subindexes for 608Fh.                                                               |                                                             |                  |           |                       |     |         |
|                 | 01h      | Encoder increments                                                                                | Pulse                                                       | 1~4294967<br>295 | U32       | ro                    | NO  | ALL     |
|                 |          | Represents the encoder movement amount. The value is automatically set by the encoder resolution. |                                                             |                  |           |                       |     |         |
| 608Fh           | 02h      | Motor revolutions                                                                                 | r ( any<br>power-generating or<br>power-driven<br>machine ) | 1~4294967<br>295 | U32       | ro                    | NO  | ALL     |
|                 |          | Indicates the motor rotation count. The value is fixed to 1.                                      |                                                             |                  |           |                       |     |         |

This object defines the encoder resolution per motor rotation.

Position encoder resolution = Encoder increments (608Fh-01h) / Motor revolutions (608Fh-02h)

This object is automatically set based on the information read from the motor connected to the servo driver.

Example: 17-bit/r encoder connection scenario

608Fh-01h (Encoder increments) = 130172



608Fh-02h (Motor revolutions) = 1

Position encoder resolution = 131072 / 1 = 131072

Gear ratio (6091h)

| index of matrix | subindex | name                                | unit                                               | scope        | data type | accessibility | PDO | OP-mode |
|-----------------|----------|-------------------------------------|----------------------------------------------------|--------------|-----------|---------------|-----|---------|
| 6091h           | -        | Gear ratio                          | -                                                  | -            | -         | -             | -   | -       |
|                 |          | Set the gear ratio.                 |                                                    |              |           |               |     |         |
|                 | 00h      | Highest sub-index supported         | -                                                  | 2            | U8        | ro            | NO  | ALL     |
|                 |          | The number of subindexes for 6091h. |                                                    |              |           |               |     |         |
|                 | 01h      | Motor revolutions                   | Pulse                                              | 1~4294967295 | U32       | rw            | NO  | ALL     |
|                 |          | Set the motor rotation speed.       |                                                    |              |           |               |     |         |
|                 | 02h      | Shaft revolutions                   | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw            | NO  | ALL     |
|                 |          | Set the axis rotation number.       |                                                    |              |           |               |     |         |

This object defines the motor speed and the shaft speed after the gearbox output.

Gear ratio = Motor shaft revolutions (6091h-01h) / Driving shaft revolutions (6091h-02h)

Feed constant (6092h)

| index of matrix | subindex | name                                | unit                                               | scope        | data type | accessibility | PDO | OP-mode |
|-----------------|----------|-------------------------------------|----------------------------------------------------|--------------|-----------|---------------|-----|---------|
| 6092h           | -        | Feed constant                       | -                                                  | -            | -         | -             | -   | -       |
|                 |          | Set the feed constant.              |                                                    |              |           |               |     |         |
|                 | 00h      | Highest sub-index supported         | -                                                  | 2            | U8        | ro            | NO  | ALL     |
|                 |          | The number of subindexes for 6092h. |                                                    |              |           |               |     |         |
|                 | 01h      | Feed                                | command unit                                       | 1~4294967295 | U32       | rw            | NO  | ALL     |
|                 |          | Set the feed amount.                |                                                    |              |           |               |     |         |
|                 | 02h      | Shaft revolutions                   | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | rw            | NO  | ALL     |
|                 |          | Set the axis rotation number.       |                                                    |              |           |               |     |         |

This object represents the action amount of the gear box output shaft per rotation.

Feed constant = Feed (6092h-01h) / Driving shaft revolutions (6092h-02h)

### 3) Instruction polarity (607Eh) Polarity

For position, speed, torque commands and their offsets, the polarity (motor rotation direction) can be set. The DS5C2 series executes rotation direction setting according to the object polarity command (607Eh) specified in CoE (CiA402). However, the object polarity command (607Eh) in CoE (CiA402) changes with the rotation direction set by parameter P0-05. For example, when P0-05 is set to 1, the object word 607Eh in CiA402 becomes 0xE0, allowing the driver to perform reverse motion. When P0-05 is set to 0, the object word 607Eh becomes 0, and the driver returns to the default forward motion.

Furthermore, the object polarity instruction (607Eh) does not directly replace parameter P0-05 (rotation direction setting). This applies when the CoE (CiA402) processing unit and motor control unit exchange object data as specified in the table below.

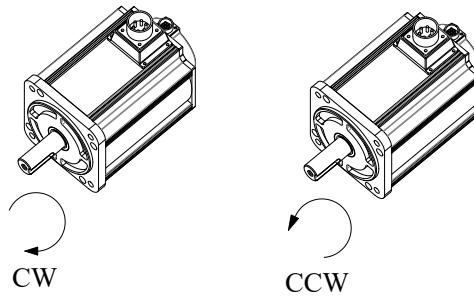
| index of matrix                                     | subindex | name                                                                                                                                                                                                                                                                                                                                          | unit | scope                                                     | data type | accessibility | PDO | OP-mode |
|-----------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|-----------|---------------|-----|---------|
| 607Eh                                               | 00h      | Polarity instruction polarity                                                                                                                                                                                                                                                                                                                 | -    | 0~255                                                     | U8        | rw            | NO  | ALL     |
|                                                     |          | Set the polarity of the position command, speed command, torque command, position offset, speed offset (speed addition), torque offset (torque addition) values from the object to the internal processing, and set the polarity of the position feedback, speed feedback, torque feedback values from the internal processing to the object. |      |                                                           |           |               |     |         |
|                                                     |          | Note: For this object, set the position, speed, and torque polarity to 0 (bit7-5=all 0) or 224 (bit7-5=all 1).                                                                                                                                                                                                                                |      |                                                           |           |               |     |         |
|                                                     |          | Actions under other settings cannot be guaranteed.                                                                                                                                                                                                                                                                                            |      |                                                           |           |               |     |         |
|                                                     |          | set value                                                                                                                                                                                                                                                                                                                                     |      | content                                                   |           |               |     |         |
|                                                     |          | 0                                                                                                                                                                                                                                                                                                                                             |      | The signs of position, speed, and torque are not reversed |           |               |     |         |
|                                                     |          | 224                                                                                                                                                                                                                                                                                                                                           |      | The signs of position, speed, and torque are reversed     |           |               |     |         |
|                                                     |          | Above                                                                                                                                                                                                                                                                                                                                         |      | Not supported (do not set)                                |           |               |     |         |
|                                                     |          | bit7: Position polarity<br>0: No reversal 1: Reversal                                                                                                                                                                                                                                                                                         |      |                                                           |           |               |     |         |
|                                                     |          | bit6: speed polarity<br>0: No reversal 1: Reversal                                                                                                                                                                                                                                                                                            |      |                                                           |           |               |     |         |
| bit5: Torque polarity<br>0: No reversal 1: Reversal |          |                                                                                                                                                                                                                                                                                                                                               |      |                                                           |           |               |     |         |
| bit4-0: Reserved. Set to 0                          |          |                                                                                                                                                                                                                                                                                                                                               |      |                                                           |           |               |     |         |
| Object <Directive·Setting Class>                    |          |                                                                                                                                                                                                                                                                                                                                               |      |                                                           |           |               |     |         |
| ·607Ah (Target position)                            |          |                                                                                                                                                                                                                                                                                                                                               |      |                                                           |           |               |     |         |
| ·60B0h (Position offset)                            |          |                                                                                                                                                                                                                                                                                                                                               |      |                                                           |           |               |     |         |
| ·60FFh (Target velocity)                            |          |                                                                                                                                                                                                                                                                                                                                               |      |                                                           |           |               |     |         |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |
|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | ·60B1h (Velocity offset)<br><br>·6071h (Target torque set)<br><br>·60B2h (Torque offset)<br><Monitoring Category><br>·6062h (Position demand value)<br><br>·6064h (Position Actual Value Position Feedback)<br><br>·606Bh (Velocity demand value)<br><br>·606Ch (Velocity actual value speed feedback)<br><br>·6074h (Torque demand)<br><br>·6077h (Torque actual value)<br><br>·6078h (Current actual value) |
|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

No symbol reversal: The motor rotates counterclockwise (CCW) when the command is in the forward direction.

The symbol is reversed: the motor rotates clockwise (CW) when the command is in the forward direction.

The rotation direction of the motor is defined as clockwise (CW) and counterclockwise (CCW) when viewed from the load-side shaft end.



#### 4) Initialization of absolute encoders

In position control mode, absolute encoders require no origin reset (except when used as incremental encoders). After battery installation, the multi-turn data must be reset during the initial startup of the device.

##### (1) Absolute data

The absolute encoder reads two types of data: single-turn data representing the motor's internal rotation count per full revolution, and multi-turn data that increments with each rotation. The multi-turn data, being an electrical count, requires battery backup. Both data types accumulate when the motor rotates counterclockwise from the shaft end. An E-228 alarm (absolute encoder overflow protection) is triggered when multi-turn data overflows.

## (2) Mapping absolute data to 32-bit data

The servo driver initializes position data. For a 23-bit encoder, single-turn data occupies 23 bits while multi-turn data requires 16 bits, resulting in a synthesized position signal with 39-bit width. However, the target value for position information is set to 32-bit width. The 6063h model exclusively uses the lower 32 bits of absolute encoder data for position setting, reducing the valid bit length of multi-turn data to 9 bits (eliminating the upper 7 bits of the 16-bit encoding). The 6064h model calculates position information using the following formula, yielding a 32-bit width. Consequently, the valid bit length of multi-turn data varies according to the electronic gear inverse transformation value.

|                                         |                                                                     |
|-----------------------------------------|---------------------------------------------------------------------|
| 607Eh (instruction polarity)            | position information                                                |
| 0 (CCW is positive)                     | 6063h=M*217+S                                                       |
|                                         | 6064h= (6063h × inverse transform value of electronic gear) + 607Ch |
| 224 scenario (CW is positive direction) | 6063h= - (M*217+S)                                                  |
|                                         | 6064h= (6063h × inverse electronic gear value) -607Ch               |

M: Multiple loops data

S: Single loop data

## 5) Position range limit (607Bh)

The DM6C series driver does not support wrap-around.

The infinite rotation mode operates internally as 607Bh-01h=80000000h and 607Bh-02h=7FFFFFFFh.

Modifying this object does not affect the rotation.

## 6) Return to original offset (607Ch) Home offset

Set the offset from the mechanical origin to the mechanical zero point. If set to 0, the mechanical origin will coincide with the mechanical zero point. The origin offset can be set to a positive or negative number, indicating a left or right deviation from the mechanical origin.



The DM6C series driver does not support this parameter, so the modification is invalid. The following describes the effects when this parameter is valid.

This object can be updated at any time, but the actual location information must be reflected through the following time sequence.

- When the power supply is turned on
- When communication is established (ESM status is Init→OP migration)
- When the origin reset is completed

Use the position under the specified time sequence as the reference to initialize the following objects.

- When the origin position is detected
 

6063h (Actual internal position feedback) = 60FCh (Position demand internal value) = 0

6062h (Position demand value) = 6064h (Position actual value) = 607Ch (Home offset)
- Initialization (preset) at a time other than when the origin position is detected

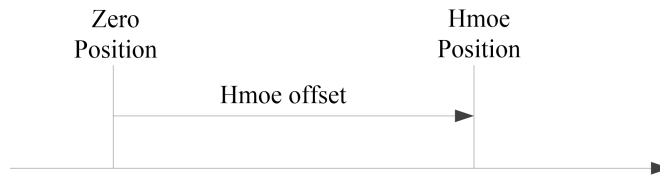
6063h (Actual internal position feedback) = 60FCh (Required internal position value)

6062h (Position demand value) = 6064h (Position actual value)

=6063h (Position actual internal value) + 607Ch (Home offset)



The above describes the situation of the electronic gear ratio 1:1 and the non-polar reversal.



Home offset definition

Home position: The index pulse position (origin position)

Zero position: In incremental systems, it equals 0 (either the position when power is applied, or the position obtained by subtracting the Home offset from the index pulse detected in the HM).

Absolute system time = absolute encoder zero point position.

### 7.9.7 Overrun function in bus mode

| parameter | meaning                                                                                                                                                            | leave the factory setting | unit | setting scope | revise | come into force |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|---------------|--------|-----------------|
| P0-28.0   | 0: Direct alarm activation with servo-based deceleration and shutdown;<br>1: Alarm triggered upon deceleration shutdown in 605Ah mode;<br>2: Do not use over-range | 2                         | -    | 0~3           | ○      | 1 3 4 8 9 10    |

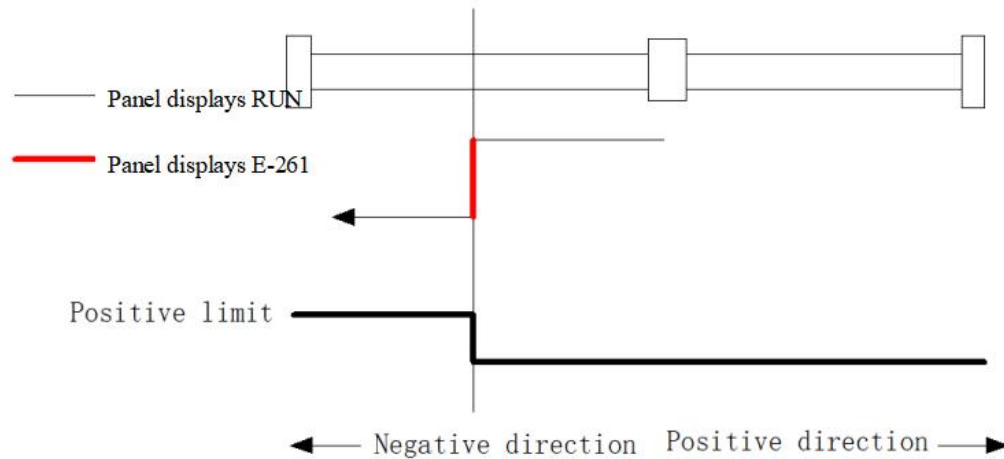
#### 1) Prohibited status

- Scenario 1: When the servo is either enabled (non-moving) or disabled, and the reverse limit switch is triggered, the panel displays 'NOT' to cancel the reverse limit signal, after which it returns to its previous state.
- Scenario 2: When the servo is either enabled (non-moving) or disabled, and the forward limit switch is triggered, the panel displays POT. The forward limit signal is canceled, and the panel returns to its previous state.
- Scenario 3: When the servo is either enabled (non-moving) or disabled, and both the forward and reverse limit switches are activated, the servo will trigger an E-261 error. If both limit signals are cleared, the panel will revert to its previous state. If only one limit signal is cleared, the panel will display the remaining signal. To restore the previous state, the remaining limit signal must also be cleared.

#### 2) Normal motion state

##### (1) Initial movement direction: left

The initial movement direction is left. When the forward limit switch is triggered, the servo will display E-261. If the forward limit switch is disabled first and the alarm is cleared afterward, the axis returns to its non-enabled state, allowing both forward and reverse movement. However, if the alarm is cleared first and the axis reverts to its non-enabled state while the panel still shows POT, the axis remains restricted by the forward limit switch. To remove the forward overtravel prohibition, the forward limit signal must be disabled.



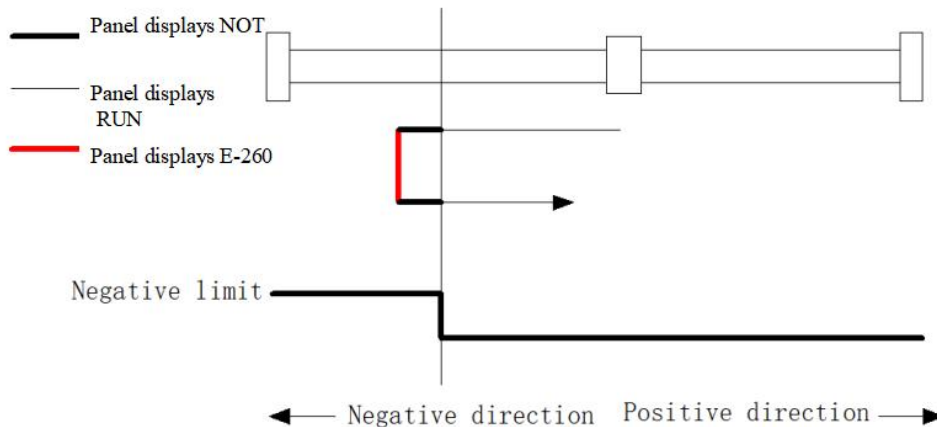
### 3) Overtravel state

Set P0-28 to 1 (alarm, deceleration, and stop)

**(1) The initial movement direction is left, and the out-of-range signal has not triggered an out-of-position condition.**

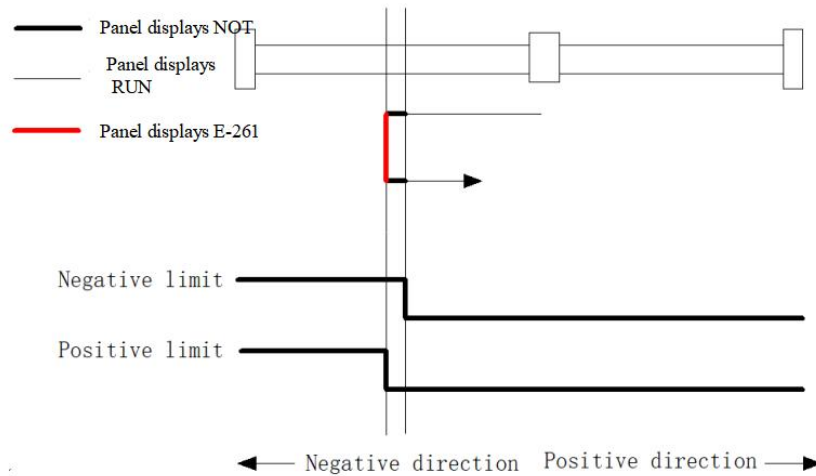
Scenario 1: The forward limit switch was not activated

The initial movement starts leftward. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering reverse overtravel deceleration and stopping the shaft at the switch. The servo then triggers E-260. To resolve this, clear the alarm and allow the shaft to move forward. Upon detecting the falling edge of the reverse limit switch, the panel will switch back to RUN, thereby lifting the reverse overtravel restriction.



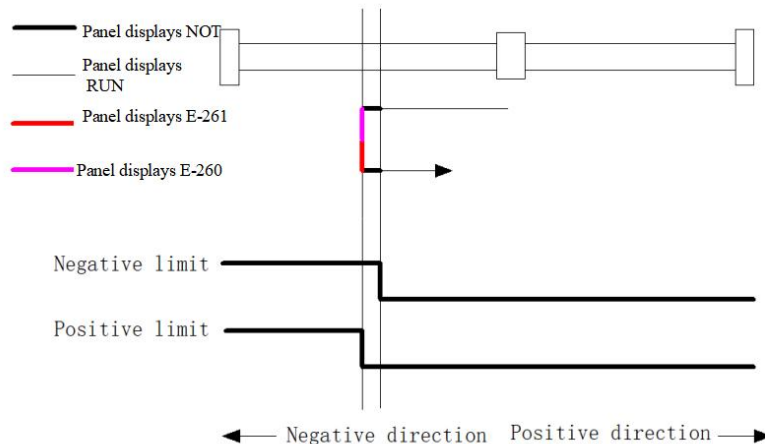
Scenario 2: Before the shaft deceleration stops, the forward limit switch is triggered.

The initial movement starts leftward. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. Before the shaft stops, if the forward limit switch is triggered, the servo will display E-261. To clear the E-261 alarm, the forward limit switch must be released; otherwise, the alarm remains. Subsequently, the shaft resumes forward movement. Upon detecting the falling edge of the reverse limit switch, the panel switches from NOT to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 3: The shaft stops at the negative limit switch and triggers the positive limit switch.

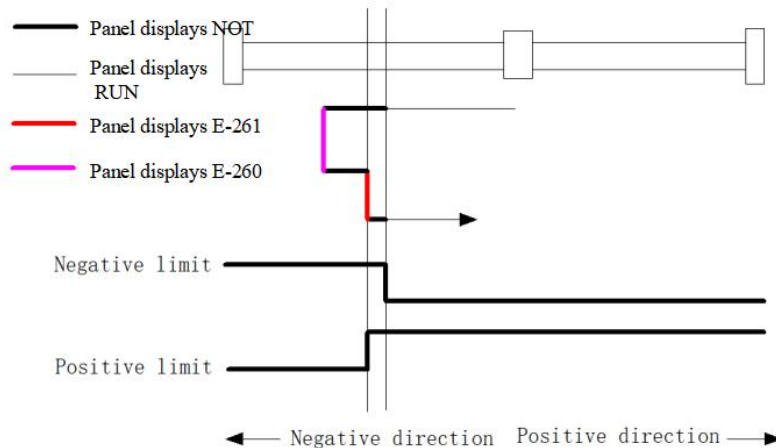
The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. If the shaft stops at the reverse limit switch, the servo will report E-260. Upon detecting the forward limit switch, the servo will report E-261. To clear the E-261 alarm, the forward limit switch must be released; otherwise, the alarm cannot be cleared. Subsequently, the shaft moves forward and detects the falling edge of the reverse limit switch. The panel then changes from NOT to RUN, lifting the reverse overtravel prohibition.



Scenario 4: During forward axial movement, the forward limit switch is triggered.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. If the shaft stops at the reverse limit switch, the servo will report E-260. After clearing the alarm and allowing the shaft to move forward, the panel detects the forward limit switch. The servo then reports E-261. To clear the E-261 alarm, the forward limit switch must be released; otherwise, the alarm will persist. Continuing

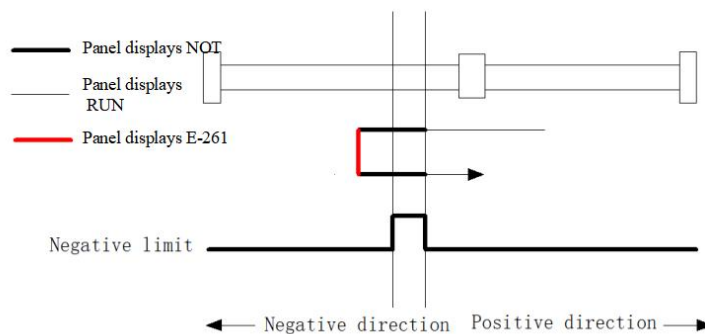
forward movement causes the panel to detect the falling edge of the reverse limit switch, changing from NOT to RUN, thereby lifting the reverse overtravel prohibition.



**(2) The initial movement direction is left, triggering the overtravel signal for out-of-range detection.**

Scenario 1: When offside occurs, the forward limit switch remains unactivated.

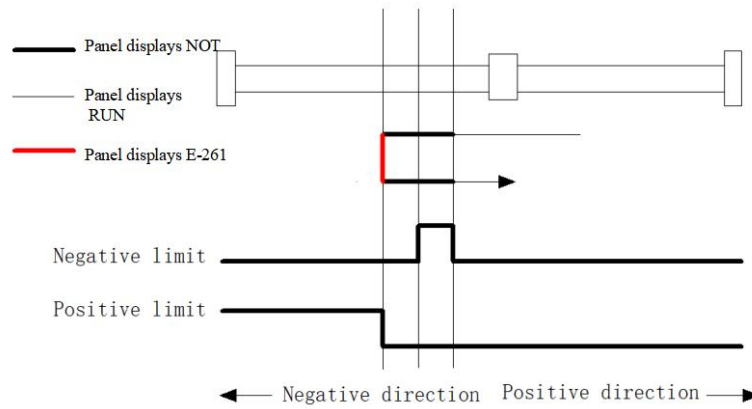
The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, if the shaft exceeds the limit switch, the falling edge of the reverse limit switch is triggered again, causing the shaft to stop outside the limit. The servo will then report E-260. To resume normal shaft movement, the alarm must be cleared. Upon re-detected edges of the reverse limit switch (rising/falling), the panel will return to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 2: When offside occurs, the forward limit switch must be triggered before the shaft deceleration stops completely.

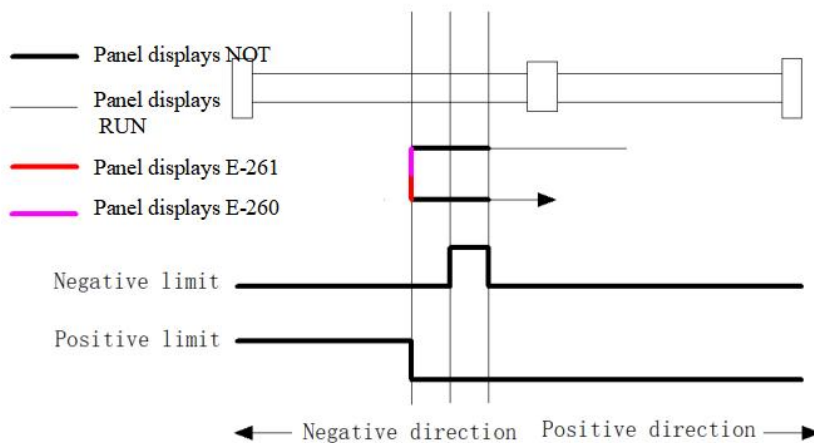
The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, the shaft passes through the reverse limit switch, which then triggers its falling edge. Before the shaft stops, it touches the forward limit switch. The servo will display E-261, requiring the forward limit switch to be canceled to clear the E-261 alarm. Otherwise, the alarm cannot be cleared. The shaft then resumes forward movement, touching both the rising and falling edges of the reverse limit switch again. Only then does the panel change from NOT to RUN, lifting the reverse overtravel prohibition.





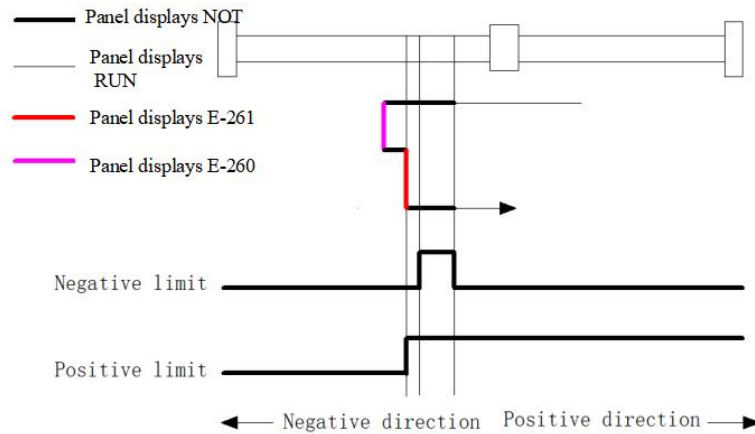
Scenario 3: When in an offside position, the shaft stops and touches the forward limit switch.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, as the shaft passes the reverse limit switch, the falling edge of the reverse limit switch is triggered. Upon shaft stoppage, the servo triggers E-260. At this point, the forward limit switch is activated, causing the servo to report E-261. To clear the E-261 alarm, the forward limit switch must be deactivated; otherwise, the alarm persists. The shaft then resumes forward movement, triggering the rising and falling edges of the reverse limit switch again. Only then does the panel change from NOT to RUN, lifting the reverse overtravel prohibition.



Scenario 4: When in an offside position, contact the forward limit switch during axial forward movement.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, the shaft crosses the reverse limit switch, which then triggers its falling edge. Upon shaft stoppage, the servo reports E-260. After clearing the alarm and allowing the shaft to move forward, it contacts the forward limit switch. The servo then reports E-261, requiring the forward limit switch to be canceled to clear the E-261 alarm. Otherwise, the alarm persists. Continuing forward movement causes the shaft to contact the reverse limit switch again, triggering both rising and falling edges. The panel then changes from NOT to RUN, lifting the reverse overtravel prohibition.



## 7.9.8 Remote I/O Function

### ● General Parameters

| order number | parameter | meaning           | give tacit consent to | setting                                                                                                                                                                                                                                                                         |
|--------------|-----------|-------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | P5-72     | Remote SI Input 1 | 0                     | 0: Invalid<br>1: Input positive signal from SI1<br>2: Input positive signal from SI2<br>3: Input positive signal from SI3<br>10: Always set to valid<br>11: Input the inverse signal from SI1<br>12: Input the inverse signal from SI2<br>13: Input the inverse signal from SI3 |
| 2            | P5-73     | Remote SI Input 2 | 0                     | 0: Invalid<br>1: Input positive signal from SI1<br>2: Input positive signal from SI2<br>3: Input positive signal from SI3<br>10: Always set to valid<br>11: Input the inverse signal from SI1<br>12: Input the inverse signal from SI2<br>13: Input the inverse signal from SI3 |
| 3            | P5-74     | Remote SI Input 3 | 0                     | 0: Invalid<br>1: Input positive signal from SI1<br>2: Input positive signal from SI2<br>3: Input positive signal from SI3<br>10: Always set to valid<br>11: Input the inverse signal from SI1<br>12: Input the inverse signal from SI2<br>13: Input the inverse signal from SI3 |
| 4            | P5-75     | Remote SI Input 4 | 0                     | 0: Invalid<br>1: Input positive signal from SI1                                                                                                                                                                                                                                 |

| order number | parameter | meaning            | give tacit consent to | setting                                                                                                                                                                                                                                                                      |
|--------------|-----------|--------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |           |                    |                       | 2: Input positive signal from SI2<br>3: Input positive signal from SI3<br>10: Always set to valid<br>11: Input the inverse signal from SI1<br>12: Input the inverse signal from SI2<br>13: Input the inverse signal from SI3                                                 |
| 5            | P5-76     | Remote SO Output 1 | 0                     | 0: Do not output to terminal<br>1: Output positive signal from SO1<br>2: Send a positive signal for SO2 output<br>3: Send positive signal from SO3<br>11: Output the inverse signal from SO1<br>12: From SO2 output reverse signal<br>13: Output the reverse signal from SO3 |
| 6            | P5-77     | Remote SO Output 2 | 0                     | 0: Do not output to terminal<br>1: Output positive signal from SO1<br>2: Send a positive signal for SO2 output<br>3: Send positive signal from SO3<br>11: Output the inverse signal from SO1<br>12: From SO2 output reverse signal<br>13: Output the reverse signal from SO3 |
| 7            | P5-78     | Remote SO Output 3 | 0                     | 0: Do not output to terminal<br>1: Output positive signal from SO1<br>2: Send a positive signal for SO2 output<br>3: Send positive signal from SO3<br>11: Output the inverse signal from SO1<br>12: From SO2 output reverse signal<br>13: Output the reverse signal from SO3 |

● remote I/O related dictionary object

| order number | target   | meaning          | unit | explain                                                                                                                                                                                                                                   |
|--------------|----------|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | 60FDh    | Digital inputs   | -    | Bit0: N-OT signal<br>Bit1: P-OT signal<br>Bit2: SPDD signal<br>Bit3: Probe 1 signal<br>Bit4: Probe 2 signal<br>Bit5: Z Sign Output<br>Keep Bit6~Bit15<br>Bit16: Remote SI Input 1<br>Bit17: Remote SI Input 2<br>Bit18: Remote SI Input 3 |
| 2            | 60FEh:01 | Physical outputs | -    | Bit0~Bit15 reserved<br>Bit16: Remote SO output 1<br>Bit17: Remote SO Output 2                                                                                                                                                             |

| order number | target   | meaning  | unit | explain                                                            |
|--------------|----------|----------|------|--------------------------------------------------------------------|
|              |          |          |      | Bit18: Remote SO Output 3                                          |
| 3            | 60Feh:02 | Bit mask | -    | When using, set the corresponding positions 1 to 18 of Bit16~Bit18 |

For details on 60FDh, please refer to Section 7.9.4 Digital Input (60FDh).

For details on 60FEh, please refer to Section 7.9.5 Digital Output (60FEh).

### 7.9.9 Cascading Alarm Function

The DM6C supports an external terminal emergency alarm function. When this function is enabled, the driver will generate an alarm E-320 if the terminal signal is active. The driver can be used in series by connecting the alarm output to the corresponding function terminal of the next driver, enabling cascaded alarms.

Add new function parameter P5-68, which is set to 0 by default:

| parameter | meaning                           | factory setting | unit | Set range | revise      | come into force |
|-----------|-----------------------------------|-----------------|------|-----------|-------------|-----------------|
| P5-68     | Terminal emergency alarm function | 0               | -    | 00~ff     | at any time | immediately     |

## 8. Object Dictionary Details

This chapter mainly introduces object dictionary area allocation, COE communication area, driver profile area and so on.

### 8.1 Object Dictionary Area Allocation

All objects are configured in the object dictionary of each group through a 16-bit index configuration address represented by a 4-digit hexadecimal.

The object dictionaries for CoE (CANopen over EtherCAT) specified in CiA402 and the DM6C series are defined as follows:

| CiA402 object dictionary |                            | Object Dictionary of DM6C Series |                        |
|--------------------------|----------------------------|----------------------------------|------------------------|
| index of matrix          | content                    | index of matrix                  | content                |
| 0000h ~ 0FFFh            | Data Type Area             | 0000h ~ 0FFFh                    | Data Type Area         |
| 1000h ~ 1FFFh            | COE communication area     | 1000h ~ 1FFFh                    | COE communication area |
| 2000h ~ 5FFFh            | Manufacturer Custom Region | 2000h ~ 2FFFh                    | servo parameter area   |
|                          |                            | 3000h ~ 3FFFh                    | continue to have       |
|                          |                            | 4000h ~ 4FFFh                    | continue to have       |
|                          |                            | 5000h ~ 5FFFh                    | continue to have       |
| 6000h ~ 9FFFh            | Profile region             | 6000h ~ 6FFFh                    | Drive Profile Area     |
|                          |                            | 7000h ~ 9FFFh                    | continue to have       |
| A000h ~ FFFFh            | continue to have           | A000h ~ FFFFh                    | continue to have       |

## 8.2 COE Communication Region (0x1000-0x1FFF)

### 8.2.1 List of objects

#### 1) Device information object

| index of matrix | subindex | name                                         |
|-----------------|----------|----------------------------------------------|
| 1000h           | 00h      | device class                                 |
| 1001h           | 00h      | Types of alarms that are currently occurring |
| 1008h           | 00h      | device name                                  |
| 1009h           | 00h      | Hardware version                             |
| 100Ah           | 00h      | software release                             |
| 1018h           | -        | Factory information                          |
|                 | 00h      | subindex number                              |
|                 | 01h      | manufacturer ID                              |
|                 | 02h      | Product code                                 |
|                 | 03h      | version number                               |
|                 | 04h      | serial number                                |

#### 2) RxPDO object mapping

| index of matrix | subindex | name                                              |
|-----------------|----------|---------------------------------------------------|
| 1600h           | -        | RxPDO1 mapping object                             |
|                 | 00h      | The number of mapping objects supported by RxPDO1 |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |
| 1601h           | -        | RxPDO2 mapping object                             |
|                 | 00h      | The number of mapping objects supported by RxPDO2 |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |
| 1602h           | -        | RxPDO3 mapping object                             |

| index of matrix | subindex | name                                              |
|-----------------|----------|---------------------------------------------------|
|                 | 00h      | The number of mapping objects supported by RxPDO3 |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |
| 1603h           | -        | RxPDO4 mapping object                             |
|                 | 00h      | The number of mapping objects supported by RxPDO4 |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |

### 3) TxPDO object mapping

| index of matrix | subindex | name                                              |
|-----------------|----------|---------------------------------------------------|
| 1A00h           | -        | TxPDO1-supported mapping objects                  |
|                 | 00h      | Number of mapped objects supported by TxPDO1      |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |
| 1A01h           | -        | TxPDO2-supported mapping objects                  |
|                 | 00h      | The number of mapping objects supported by TxPDO2 |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |
| 1A02h           | -        | TxPDO3-supported mapping objects                  |
|                 | 00h      | The number of mapping objects supported by TxPDO3 |

| index of matrix | subindex | name                                              |
|-----------------|----------|---------------------------------------------------|
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |
| 1A03h           | -        | TxPDO4-supported mapping objects                  |
|                 | 00h      | The number of mapping objects supported by TxPDO4 |
|                 | 01h      | First mapping object                              |
|                 | 02h      | Second mapping object                             |
|                 | 03h      | Third mapping object                              |
|                 | 04h      | The fourth mapping object                         |
|                 | 05h      | Fifth mapping object                              |
|                 | ...      | ...                                               |
|                 | 18h      | The twenty-fourth mapping object                  |

## 4) PDO object allocation

| index of matrix | subindex | name                   |
|-----------------|----------|------------------------|
| 1C12h           | -        | RxPDO distribution     |
|                 | 00h      | RxPDO allocation       |
|                 | 01h      | Assigned RxPDO 1       |
|                 | 02h      | Assigned RxPDO 2       |
|                 | 03h      | Assigned RxPDO 3       |
|                 | 04h      | Assigned RxPDO 4       |
| 1C13h           | -        | TxPDO distribution     |
|                 | 00h      | TxPDO allocation count |
|                 | 01h      | Assigned TxPDO 1       |
|                 | 02h      | Assigned TxPDO 2       |
|                 | 03h      | Assigned TxPDO 3       |
|                 | 04h      | Assigned TxPDO 4       |

## 5) PDO synchronous management channel

| index of matrix | subindex | name                                           |
|-----------------|----------|------------------------------------------------|
| 1C32h           | -        | Sync Manager 2 Synchronization Channel 2       |
|                 | 00h      | Number of sub-objects                          |
|                 | 01h      | Sync mode                                      |
|                 | 02h      | Cycle time                                     |
|                 | 03h      | Shift time                                     |
|                 | 04h      | Sync modes supported: Set supported sync types |



| index of matrix | subindex | name                                                                                                                       |
|-----------------|----------|----------------------------------------------------------------------------------------------------------------------------|
|                 | 05h      | Minimum cycle time: The minimum value of the communication cycle that can be set                                           |
|                 | 06h      | Calculate and copy the time from SM2 event, SYNC0 event to ESC read completion time                                        |
|                 | 08h      | Command (not supported)                                                                                                    |
|                 | 09h      | Delay time (not supported)                                                                                                 |
|                 | 0Ah      | Sync0 cycle time<br>The value in register 09A0h of the ESC is set when DC SYNC0 (1C32h-01h=02h). It is set to 0 otherwise. |
|                 | 0Bh      | Cycle time is too short (not supported)                                                                                    |
|                 | 0Ch      | SM event missed (not supported)                                                                                            |
|                 | 0Dh      | Shift time is too short (not supported)                                                                                    |
|                 | 0Eh      | RxPDO toggle failed (not supported)                                                                                        |
|                 | 20h      | Sync error                                                                                                                 |
| 1C33h           | -        | Sync Manager 3 Synchronization Channel 3                                                                                   |
|                 | 00h      | Number of sub-objects                                                                                                      |
|                 | 01h      | Sync mode                                                                                                                  |
|                 | 02h      | Cycle time                                                                                                                 |
|                 | 03h      | Shift time                                                                                                                 |
|                 | 04h      | Sync modes supported: Set supported sync types                                                                             |
|                 | 05h      | Minimum cycle time: The minimum value of the communication cycle that can be set                                           |
|                 | 06h      | Calculate and copy the time from SM2 event, SYNC0 event to ESC read completion time                                        |
|                 | 08h      | Command (not supported)                                                                                                    |
|                 | 09h      | Delay time (not supported)                                                                                                 |
|                 | 0Ah      | Sync0 cycle time<br>The value in register 09A0h of the ESC is set when DC SYNC0 (1C32h-01h=02h). It is set to 0 otherwise. |
|                 | 0Bh      | Cycle time is too short (not supported)                                                                                    |
|                 | 0Ch      | SM event missed (not supported)                                                                                            |
|                 | 0Dh      | Shift time is too short (not supported)                                                                                    |
|                 | 0Eh      | RxPDO toggle failed (not supported)                                                                                        |
|                 | 20h      | Sync error                                                                                                                 |

## 8.2.2 Equipment Information

This section describes the device information.

| index of matrix | son<br>index of matrix | name        | scope        | data type | Available inquisitive | PDO | Op-mode |
|-----------------|------------------------|-------------|--------------|-----------|-----------------------|-----|---------|
| 1000h           | 00h                    | Divece type | 0~4294967295 | U32       | ro                    | NO  | All     |

| index of matrix                                                                                                                                     | son index of matrix | name                                                                                                                                         | scope                                          | data type | Available inquisitive | PDO   | Op-mode |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-----------|-----------------------|-------|---------|
|                                                                                                                                                     |                     | Indicates the device type. For a servo driver, the value is fixed to 04020192h.                                                              |                                                |           |                       |       |         |
| 1001h                                                                                                                                               | 00h                 | error register                                                                                                                               | 0~65535                                        | U16       | ro                    | TxPDO | All     |
|                                                                                                                                                     |                     | Displays the type of alarm (status) occurring in the servo driver.<br>Display 0000h when no alarm occurs.<br>Do not show the warning.        |                                                |           |                       |       |         |
|                                                                                                                                                     |                     | Bit                                                                                                                                          | content                                        |           |                       |       |         |
|                                                                                                                                                     |                     | 0                                                                                                                                            | nonsupport                                     |           |                       |       |         |
|                                                                                                                                                     |                     | 1                                                                                                                                            |                                                |           |                       |       |         |
|                                                                                                                                                     |                     | 2                                                                                                                                            |                                                |           |                       |       |         |
|                                                                                                                                                     |                     | 3                                                                                                                                            |                                                |           |                       |       |         |
|                                                                                                                                                     |                     | 4                                                                                                                                            | AL status code defines the alarm occurrence*1) |           |                       |       |         |
|                                                                                                                                                     |                     | 5                                                                                                                                            | nonsupport                                     |           |                       |       |         |
|                                                                                                                                                     |                     | 6                                                                                                                                            | continue to have                               |           |                       |       |         |
|                                                                                                                                                     |                     | 7                                                                                                                                            | AL status code undefined alarm occurred*2)     |           |                       |       |         |
|                                                                                                                                                     |                     | *1) The term "AL status code alarm" refers to communication-related anomalies in EtherCAT, specifically codes E-800~7, E-810~7, and E-850~7. |                                                |           |                       |       |         |
| *2) The term "AL status code undefined alarm" refers to EtherCAT communication-related anomalies (E-880~7) and non-communication-related anomalies. |                     |                                                                                                                                              |                                                |           |                       |       |         |
| 1008h                                                                                                                                               | 00h                 | Manufacturer Device Name                                                                                                                     | -                                              | -         | ro                    | TxPDO | All     |
| Displays the device name.                                                                                                                           |                     |                                                                                                                                              |                                                |           |                       |       |         |
| 1009h                                                                                                                                               | 00h                 | Manufacturer Hardware version                                                                                                                | -                                              | -         | ro                    | TxPDO | All     |
| Indicates the hardware version.                                                                                                                     |                     |                                                                                                                                              |                                                |           |                       |       |         |
| 1018h                                                                                                                                               | 00h                 | Number of entries                                                                                                                            | 0~255                                          | U8        | ro                    | TxPDO | All     |
|                                                                                                                                                     |                     | Indicates the sub-index number of this object. The value is fixed to 04h.                                                                    |                                                |           |                       |       |         |
|                                                                                                                                                     | 01h                 | vendor ID                                                                                                                                    | 0~4294967295                                   | U32       | ro                    | TxPDO | All     |
|                                                                                                                                                     |                     | The manufacturer ID of EtherCAT. The value is fixed to 00000556h.                                                                            |                                                |           |                       |       |         |
|                                                                                                                                                     | 02h                 | product code                                                                                                                                 | 0~4294967295                                   | U32       | ro                    | TxPDO | All     |
|                                                                                                                                                     |                     | Indicates the product code. The value is 10305080h.                                                                                          |                                                |           |                       |       |         |
|                                                                                                                                                     | 03h                 | Revision umber                                                                                                                               | 0~4294967295                                   | U32       | ro                    | TxPDO | All     |
|                                                                                                                                                     |                     | Indicates the product version number.                                                                                                        |                                                |           |                       |       |         |
|                                                                                                                                                     | 04h                 | Divece type                                                                                                                                  | 0~4294967295                                   | U32       | ro                    | TxPDO | All     |
|                                                                                                                                                     |                     | Indicates the product serial number. The value is 00000000h.                                                                                 |                                                |           |                       |       |         |

### 8.2.3 Synchronization Manager Communication Type (1C00h)

The action mode assigned to each SyncManager is configured via the 1C00h object.

The value is fixed for the servo driver.

| index of matrix | subindex | name | scope | data type | Available inquisitive | PDO | Op-mode |
|-----------------|----------|------|-------|-----------|-----------------------|-----|---------|
|-----------------|----------|------|-------|-----------|-----------------------|-----|---------|

| index<br>of<br>matrix | subindex | name                                                                                                                                                                                                                                                                         | scope | data<br>type | Available<br>inquisitive | PDO   | Op-mode |
|-----------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|--------------------------|-------|---------|
| 1C00h                 | 00h      | Number of used sync manager channels                                                                                                                                                                                                                                         | 0~255 | U8           | ro                       | TxPDO | All     |
|                       |          | Indicates the sub-index number of this object. The value is fixed to 04h.                                                                                                                                                                                                    |       |              |                          |       |         |
|                       | 01h      | Communication type sync manager 0                                                                                                                                                                                                                                            | 0~4   | U8           | ro                       | TxPDO | All     |
|                       |          | Set the purpose of Sync Manager 0.<br>0: Unused<br>1: Mailbox incoming (master → slave)<br>2: Mailbox sending (slave to master)<br>3: RxPDO (master → slave)<br>4: TxPDO (slave→master)<br>Since Sync Manager0 uses Mailbox for receiving messages, the value is fixed to 1. |       |              |                          |       |         |
|                       |          | Communication type sync manager 1                                                                                                                                                                                                                                            | 0~4   | U8           | ro                       | TxPDO | All     |
|                       | 02h      | Set the purpose of Sync Manager 1.<br>0: Unused<br>1: Mailbox incoming (master → slave)<br>2: Mailbox sending (slave to master)<br>3: RxPDO (master → slave)<br>4: TxPDO (slave→master)<br>Since Sync Manager1 uses Mailbox for sending emails, the value is fixed at 2.     |       |              |                          |       |         |
|                       |          | Communication type sync manager 2                                                                                                                                                                                                                                            | 0~4   | U8           | ro                       | TxPDO | All     |
|                       |          | Set the purpose of Sync Manager 2.<br>0: Unused<br>1: Mailbox incoming (master → slave)<br>2: Mailbox sending (slave to master)<br>3: RxPDO (master → slave)<br>4: TxPDO (slave→master)<br>Since Sync Manager2 employs Process Data Output (RxPDO), the value is fixed at 3. |       |              |                          |       |         |
|                       | 04h      | Communication type sync manager 3                                                                                                                                                                                                                                            | 0~4   | U8           | ro                       | TxPDO | All     |
|                       |          | Set the purpose of Sync Manager 3.<br>0: Unused<br>1: Mailbox incoming (master → slave)                                                                                                                                                                                      |       |              |                          |       |         |

| index<br>of<br>matrix | subindex | name                                                                                                                                                                              | scope | data<br>type | Available<br>inquisitive | PDO | Op-mode |
|-----------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|--------------------------|-----|---------|
|                       |          | 2: Mailbox sending (slave to master)<br>3: RxPDO (master → slave)<br>4: TxPDO (slave→master)<br>Since Sync Manager2 employs Process Data Output (RxPDO), the value is fixed at 4. |       |              |                          |     |         |

## 8.2.4 PDO Mapping

### 1) PDO allocation object (1C12h ~ 1C13h)

SyncManager assigns PDO mapping tables through object configuration from 1C12h to 1C13h.

| index<br>of<br>matrix | subindex | name                                                                      | scope       | data type | accessibility | PDO | Op-mode |
|-----------------------|----------|---------------------------------------------------------------------------|-------------|-----------|---------------|-----|---------|
| 1C12h                 | 00h      | Number of assigned PDOs                                                   | 0~4         | U8        | rw            | NO  | All     |
|                       |          | Indicates the sub-index number of this object.                            |             |           |               |     |         |
|                       | 01h      | Assigned RxPDO 1                                                          | 1600h~1603h | U16       | rw            | NO  | All     |
|                       |          | Specify the RxPDO mapping object to use.                                  |             |           |               |     |         |
|                       | 02h      | Assigned RxPDO 2                                                          | 1600h~1603h | U16       | rw            | NO  | All     |
|                       |          | Specify the RxPDO mapping object to use.                                  |             |           |               |     |         |
|                       | 03h      | Assigned RxPDO 3                                                          | 1600h~1603h | U16       | rw            | NO  | All     |
|                       |          | Specify the RxPDO mapping object to use.                                  |             |           |               |     |         |
|                       | 04h      | Assigned RxPDO 4                                                          | 1600~1603   | U16       | rw            | NO  | All     |
|                       |          | Specify the RxPDO mapping object to use.                                  |             |           |               |     |         |
| 1C13h                 | 00h      | Number of assigned PDOs                                                   | 0~4         | U8        | rw            | NO  | All     |
|                       |          | Indicates the sub-index number of this object. The value is fixed to 04h. |             |           |               |     |         |
|                       | 01h      | Assigned TxPDO 1                                                          | 1A00h~1A03h | U16       | rw            | NO  | All     |
|                       |          | Specify the TxPDO mapping object.                                         |             |           |               |     |         |
|                       | 02h      | Assigned TxPDO 2                                                          | 1A00h~1A03h | U16       | rw            | NO  | All     |
|                       |          | Specify the TxPDO mapping object.                                         |             |           |               |     |         |
|                       | 03h      | Assigned TxPDO 3                                                          | 1A00h~1A03h | U16       | rw            | NO  | All     |
|                       |          | Specify the TxPDO mapping object.                                         |             |           |               |     |         |
|                       | 04h      | Assigned TxPDO 4                                                          | 1A00h~1A03h | U16       | rw            | NO  | All     |
|                       |          | Specify the TxPDO mapping object.                                         |             |           |               |     |         |

The 1C12h and 1C13h sub-index 01h-04h can only be modified when the ESM status is PreOP and sub-index 00h=0. In all other states, the port code (06010003h) is returned.

After the configuration change, the Sub index number using Sub index 00h is set, and the PDO allocation object configuration is reflected by converting the ESM status to SafeOP.

## 2) PDO mapping objects (1600h ~ 1603h, 1A00h ~ 1A03h)

The table for PDO mapping can use objects from 1600h to 1603h for RxPDO and from 1A00h to 1A03h for TxPDO. Sub-index 01h onward indicates information about the mapped application layer objects.

| index of matrix | subindex | name                                                                                                   | scope        | data type       | accessibility | PDO | Op-mode |
|-----------------|----------|--------------------------------------------------------------------------------------------------------|--------------|-----------------|---------------|-----|---------|
| 1600h           | 00h      | Number of entries                                                                                      | 0~4294967295 | U8              | rw            | NO  | All     |
|                 |          | Indicates the sub-index number of this object.                                                         |              |                 |               |     |         |
|                 | 01h      | 1st receive PDO mapped                                                                                 | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | Set the first mapping object.                                                                          |              |                 |               |     |         |
|                 |          | bit                                                                                                    | 31 ...16     | 15 ....8        | 7 ....0       |     |         |
|                 |          |                                                                                                        | Index number | Subindex number | bit length    |     |         |
|                 | 02h      | 2nd receive PDO mapped                                                                                 | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The method is the same as for Sub-index 01h.                                                           |              |                 |               |     |         |
|                 | 03h      | 3rd receive PDO mapped                                                                                 | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                               |              |                 |               |     |         |
|                 | 04h      | 4th receive PDO mapped                                                                                 | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                               |              |                 |               |     |         |
|                 | 05h      | 5th receive PDO mapped                                                                                 | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                               |              |                 |               |     |         |
|                 | 06h      | 6th receive PDO mapped                                                                                 | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                               |              |                 |               |     |         |
|                 | ...      | ...                                                                                                    |              |                 |               |     |         |
|                 | 18h      | 24th receive PDO mapped                                                                                | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                               |              |                 |               |     |         |
| 1601h           | -        | The specifications for PDO mapping 2, Sub-index, and other components are identical to those of 1600h. |              |                 |               |     |         |
| 1602h           | -        | The specifications for PDO mapping 3, Sub-index, and other components are identical to those of 1600h. |              |                 |               |     |         |
| 1603h           | -        | The specifications for PDO mapping 4, Sub-index, and other components are identical to those of 1600h. |              |                 |               |     |         |

Do not map duplicate objects. Changes to duplicate settings are not guaranteed.

The Sub-index 01h-18h (1600h-1603h) can only be modified when the ESM status is PreOP and

Sub-index 00h=0. In all other states, the system returns the Abort Code (06010003h).

After the configuration change, the Sub index number using Sub index 0h is set, and the PDO mapping object configuration is reflected by converting the ESM status to SafeOP.

| index of matrix | subindex | name                                                                                                           | scope        | data type       | accessibility | PDO | Op-mode |
|-----------------|----------|----------------------------------------------------------------------------------------------------------------|--------------|-----------------|---------------|-----|---------|
| 1A00h           | 00h      | Number of entries                                                                                              | 0~4294967295 | U8              | rw            | NO  | All     |
|                 |          | Indicates the sub-index number of this object.                                                                 |              |                 |               |     |         |
|                 | 01h      | 1st transmit PDO mapped                                                                                        | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | Set the object for the first mapping.                                                                          |              |                 |               |     |         |
|                 |          | bit                                                                                                            | 31 ...16     | 15 ....8        | 7 ... 0       |     |         |
|                 |          |                                                                                                                | Index number | Subindex number | bit length    |     |         |
|                 | 02h      | 2nd transmit PDO mapped                                                                                        | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The method is the same as for Subindex 01h.                                                                    |              |                 |               |     |         |
|                 | 03h      | 3rd transmit PDO mapped                                                                                        | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                                       |              |                 |               |     |         |
|                 | 04h      | 4th transmit PDO mapped                                                                                        | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                                       |              |                 |               |     |         |
|                 | 05h      | 5th transmit PDO mapped                                                                                        | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                                       |              |                 |               |     |         |
|                 | 06h      | 6th transmit PDO mapped                                                                                        | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                                       |              |                 |               |     |         |
|                 | ...      | ...                                                                                                            |              |                 |               |     |         |
|                 | 18h      | 24th transmit PDO mapped                                                                                       | 0~4294967295 | U32             | rw            | NO  | All     |
|                 |          | The setting method is the same as that of Sub-index 01h.                                                       |              |                 |               |     |         |
| 1A01h           | -        | The specifications for Transmit PDO mapping 2, Subindex, and other parameters are identical to those of 1600h. |              |                 |               |     |         |
| 1A02h           | -        | The specifications for Transmit PDO mapping 3, Subindex, and other parameters are identical to those of 1600h. |              |                 |               |     |         |
| 1A03h           | -        | The specifications for Transmit PDO mapping 4, Subindex, and other parameters are identical to those of 1600h. |              |                 |               |     |         |

Do not map duplicate objects.

No guarantee is provided for changes in the already repeated settings.

The Sub-index 01h-18h (1A00h-1A03h) can only be modified when the ESM status is PreOP and Sub-index 00h=0.

Otherwise, the system returns an Abort Code (06010003h).

After the configuration change, the Sub index number using Sub index 0h is set, and the PDO mapping object configuration is reflected by converting the ESM status to SafeOP.

## 8.2.5 Synchronous Manager 2/3 (1C32h,1C33h)

The configuration of Sync Manager 2 is executed according to 1C32h (Sync Manager 2 synchronization).

The configuration of Sync Manager 3 is executed according to 1C33h (Sync Manager 3 synchronization).

### Sync Manager 2 (1C32h)

| index of matrix | subindex | name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | scope        | data type | accessibility | PDO | Op-mode |
|-----------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|---------------|-----|---------|
| 1C32            | 00h      | Number of entries                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0~20h        | U8        | ro            | NO  | All     |
|                 |          | The Sub index number for this object. The value is fixed to 20h.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |           |               |     |         |
|                 | 01h      | Sync mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0-65535      | U16       | rw            | NO  | All     |
|                 |          | Set the Sync Manager 2 synchronization mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |           |               |     |         |
|                 |          | 00h: FreeRun (not synchronized)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |           |               |     |         |
|                 |          | 01h: SM2 (synchronized with SM 2 Event)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |           |               |     |         |
|                 |          | 02h: DC SYNC0 (synchronized with Sync0 Event)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |           |               |     |         |
|                 | 02h      | Cycle time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0~4294967295 | U32       | rw            | NO  | All     |
|                 |          | Set the Sync Manager period (in ns).<br>Select one of the following values: 1,000,000 (1ms), 2,000,000 (2ms), 4,000,000 (4ms), 8,000,000 (8ms), or 10,000,000 (10ms). Setting any other value will trigger E-810 (Synchronization Cycle Setting Error Protection).                                                                                                                                                                                                                                                                                                    |              |           |               |     |         |
|                 | 03h      | Shift time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0~4294967295 | U32       | rw            | NO  | All     |
|                 |          | offset time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |           |               |     |         |
|                 | 04h      | Sync modes supported                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | Set supported sync types.<br>BIT0: FreeRun mode is supported<br>0: Not supported; 1: FreeRun mode is supported<br>This servo driver is set to 1.<br>BIT1: SM synchronization mode supports<br>0: Not supported; 1: SM2 event synchronization is supported<br>This servo driver is set to 1.<br>BIT4-2: DC synchronization mode is supported<br>000b: Not supported<br>001b: DC sync0 event support<br>This servo driver is set to 001b.<br>BIT6-5: Output offset support<br>00b: Not supported<br>01b: Local clock offset support<br>This servo driver is set to 00b. |              |           |               |     |         |

| index of matrix | subindex | name                                                                                                                         | scope        | data type | accessibility | PDO | Op-mode |
|-----------------|----------|------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|---------------|-----|---------|
|                 |          | BIT15-7: Reserved                                                                                                            |              |           |               |     |         |
| 1C32            | 05h      | Minimum cycle time                                                                                                           | 0~4294967295 | U32       | ro            | NO  | All     |
|                 |          | The minimum value of the communication period that can be set.                                                               |              |           |               |     |         |
|                 | 06h      | Calc and copy time                                                                                                           | 0~4294967295 | U32       | ro            | NO  | All     |
|                 |          | From the SM2 event and SYNC0 event to the ESC read completion time.<br>If the signal is off, this time can also be extended. |              |           |               |     |         |
|                 | 08h      | Command                                                                                                                      | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                   |              |           |               |     |         |
|                 | 09h      | Delay time                                                                                                                   | 0~4294967295 | U32       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                   |              |           |               |     |         |
|                 | 0Ah      | Sync0 cycle time                                                                                                             | 0~4294967295 | U16       | ro            | NO  | All     |
|                 |          | When DC SYNC0 (1C32h-01h=02h), the value in the ESC register 09A0h is set.<br>Set to 0 when DC SYNC0 is not active.          |              |           |               |     |         |
|                 | 0Bh      | Cycle time too small                                                                                                         | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                   |              |           |               |     |         |
|                 | 0Ch      | SM-event missed                                                                                                              | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                   |              |           |               |     |         |
|                 | 0Dh      | Shift time too short                                                                                                         | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                   |              |           |               |     |         |
|                 | 0Eh      | RxPDO toggle failed                                                                                                          | 0~65535      | U16       | rw            | NO  | All     |
|                 |          | nonsupport                                                                                                                   |              |           |               |     |         |
|                 | 20h      | Sync error                                                                                                                   | 0~1          | BOOL      | ro            | NO  | All     |
|                 |          | Sync error                                                                                                                   |              |           |               |     |         |

This setting is a reference value and not a guarantee.

### Sync Manager 3 (1C33h)

| index of matrix | subindex | name                                                                           | scope   | data type | accessibility | PDO | Op-mode |
|-----------------|----------|--------------------------------------------------------------------------------|---------|-----------|---------------|-----|---------|
| 1C33h           | 00h      | Number of entries                                                              | 0~20h   | U8        | ro            | NO  | All     |
|                 |          | The Sub index number for this object. The value is fixed to 20h.               |         |           |               |     |         |
|                 | 01h      | Sync mode                                                                      | 0~65535 | U16       | rw            | NO  | All     |
|                 |          | Set the Sync Manager 3 synchronization mode.                                   |         |           |               |     |         |
|                 |          | 00h: FreeRun (not synchronized)<br><br>01h: SM2 (synchronized with SM 2 Event) |         |           |               |     |         |



| index of matrix | subindex | name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | scope        | data type | accessibility | PDO | Op-mode |
|-----------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|---------------|-----|---------|
|                 |          | 02h: DC SYNC0 (synchronized with Sync0 Event)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |           |               |     |         |
|                 | 02h      | Cycle time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0~4294967295 | U32       | rw            | NO  | All     |
|                 |          | Set the Sync Manager period (in ns).<br>Select one of the following values: 1,000,000 (1ms), 2,000,000 (2ms), 4,000,000 (4ms), 8,000,000 (8ms), or 10,000,000 (10ms). Setting any other value will trigger E-810 (Synchronization Cycle Setting Error Protection).                                                                                                                                                                                                                                                                                                                         |              |           |               |     |         |
|                 | 03h      | Shift time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0~4294967295 | U32       | rw            | NO  | All     |
|                 |          | offset time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |           |               |     |         |
|                 | 04h      | Sync modes supported                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | Set supported sync types.<br>BIT0: FreeRun mode supports<br>0: Not supported; 1: FreeRun mode is supported<br>This servo driver is set to 1.<br>BIT1: SM synchronization mode supports<br>0: Not supported; 1: SM2 event synchronization is supported<br>This servo driver is set to 1.<br>BIT4-2: DC synchronization mode is supported<br>000b: Not supported<br>001b: DC sync0 event support<br>This servo driver is set to 001b.<br>BIT6-5: Output offset support<br>00b: Not supported<br>01b: Local clock offset support<br>This servo driver is set to 00b.<br><br>BIT15-7: Reserved |              |           |               |     |         |
|                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |           |               |     |         |
|                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |           |               |     |         |
|                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |           |               |     |         |
|                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |           |               |     |         |
|                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |           |               |     |         |
|                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |           |               |     |         |
| 1C33h           | 05h      | Minimum cycle time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0~4294967295 | U32       | ro            | NO  | All     |
|                 |          | The minimum value of the communication period that can be set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |           |               |     |         |
|                 | 06h      | Calc and copy time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0~4294967295 | U32       | ro            | NO  | All     |
|                 |          | From the SM2 event and SYNC0 event to the completion of ESC reading.<br>If the signal is off, this time can also be extended.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |           |               |     |         |
|                 | 08h      | Command                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |           |               |     |         |
|                 | 09h      | Delay time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0~4294967295 | U32       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |           |               |     |         |
|                 | 0Ah      | Sync0 cycle time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0~4294967295 | U16       | ro            | NO  | All     |
|                 |          | The same value as 1C32h-0Ah.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |           |               |     |         |
|                 | 0Bh      | Cycle time too small                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |           |               |     |         |
|                 | 0Ch      | SM-event missed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |           |               |     |         |
|                 | 0Dh      | Shift time too short                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0~65535      | U16       | ro            | NO  | All     |
|                 |          | nonsupport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |           |               |     |         |
|                 | 0Eh      | RxPDO toggle failed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0~65535      | U16       | rw            | NO  | All     |

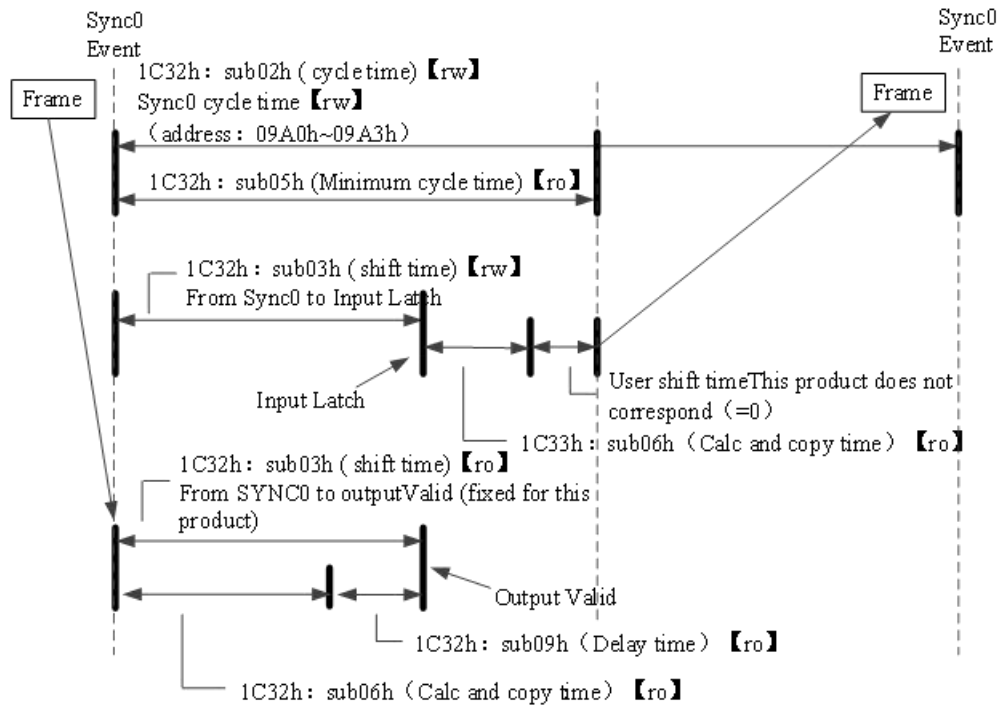
| index of matrix | subindex | name       | scope | data type | accessibility | PDO | Op-mode |
|-----------------|----------|------------|-------|-----------|---------------|-----|---------|
|                 |          | nonsupport |       |           |               |     |         |
|                 | 20h      | Sync error | 0~1   | BOOL      | ro            | NO  | All     |
|                 |          | Sync error |       |           |               |     |         |

This setting is a reference value and not a guarantee.

- DC (SYNC0 event synchronization)

| Synchronization method                                                                             | feature                                                                       |
|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Use the time on the first axis as the reference.<br>Synchronize time information from other slaves | high-accuracy<br>Compensation processing is required on the master site side. |

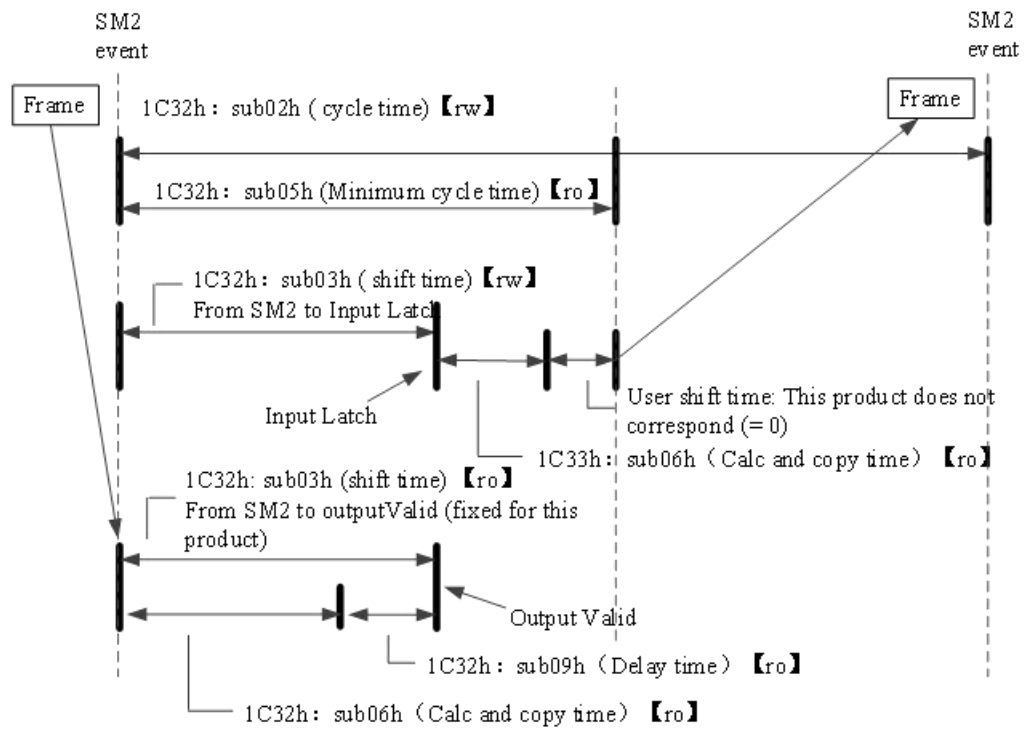
The DC synchronous mode specifications for this servo driver are as follows:



- SM2 (SM2 Event Synchronization)

| Synchronization method                | feature                                                                                                                                             |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Synchronize with RxPDO's receipt time | The compensation accuracy for transmission delay is poor.<br>The transmission time must be confirmed on the master side (e.g., dedicated hardware). |

The SM2 synchronous mode specifications for this servo driver are as follows:



## 8.3 Servo Parameter Area (0x2000~0x5FFF)

### 8.3.1 List of objects

Objects with 2000h to 5FFFh are assigned servo parameters. (For detailed names of servo parameters, refer to the appendix of this book.)

| index of matrix | subindex | name  |
|-----------------|----------|-------|
| 2000h           | 00h      | P0-00 |
| 2001h           | 00h      | P0-01 |
| 2002h           | 00h      | P0-02 |
| 2003h           | 00h      | P0-03 |
| ...             | ...      | ...   |
| 205Fh           | 00h      | P0-95 |
|                 |          |       |
| 2100h           | 00h      | P1-00 |
| 2101h           | 00h      | P1-01 |
| 2102h           | 00h      | P1-02 |
| 2103h           | 00h      | P1-03 |
| ...             | ...      | ...   |
| 214Ah           | 00h      | P1-74 |
|                 |          |       |
| 2200h           | 00h      | P2-00 |
| 2201h           | 00h      | P2-01 |
| 2202h           | 00h      | P2-02 |
| 2203h           | 00h      | P2-03 |
| ...             | ...      | ...   |
| 2263h           | 00h      | P2-99 |
|                 |          |       |
| 2300h           | 00h      | P3-00 |
| 2301h           | 00h      | P3-01 |
| 2302h           | 00h      | P3-02 |
| 2303h           | 00h      | P3-03 |
| ...             | ...      | ...   |
| 232Eh           | 00h      | P3-46 |

| index of matrix | subindex | name  |
|-----------------|----------|-------|
| 3000h           | 00h      | U0-00 |
| 3001h           | 00h      | U0-01 |
| 3002h           | 00h      | U0-02 |
| ...             | ...      | ...   |
| 3061h           | 00h      | U0-97 |

| index of matrix | subindex | name |
|-----------------|----------|------|
|-----------------|----------|------|

| index of matrix | subindex | name  |
|-----------------|----------|-------|
| 2500h           | 00h      | P5-00 |
| 2501h           | 00h      | P5-01 |
| 2502h           | 00h      | P5-02 |
| 2503h           | 00h      | P5-03 |
| ...             | ...      | ...   |
| 2547h           | 00h      | P5-71 |
|                 |          |       |
| 2700h           | 00h      | P7-00 |
| 2701h           | 00h      | P7-01 |
| 2702h           | 00h      | P7-02 |
| 2703h           | 00h      | P7-03 |
| ...             | ...      | ...   |
| 2715h           | 00h      | P7-21 |
|                 |          |       |
| 2800h           | 00h      | P8-00 |
| 2801h           | 00h      | P8-01 |
| 2802h           | 00h      | P8-02 |
| 2803h           | 00h      | P8-03 |
| ...             | ...      | ...   |
| 281Ah           | 00h      | P8-26 |

| index of matrix | subindex | name  |
|-----------------|----------|-------|
| 3100h           | 00h      | U1-00 |
| 3101h           | 00h      | U1-01 |
|                 |          |       |

|       |     |       |
|-------|-----|-------|
| 4000h | 00h | F0-00 |
|       |     |       |
| 4106h | 00h | F1-06 |

| index of matrix | subindex | name                                                          | unit | data area                   | data type | sign | PDO   |
|-----------------|----------|---------------------------------------------------------------|------|-----------------------------|-----------|------|-------|
| 5000h           | 00h      | Encode Single Position<br>Encoder single-turn position        | -    | -2147483648<br>~ 2147483647 | I32       | ro   | TxPDO |
| 5001h           | 00h      | Encode MultRevolutions<br>Encoder multi-turn position         | -    | -2147483648~<br>2147483647  | I32       | ro   | TxPDO |
| 5002h           | 00h      | ModeSwitch Deceleration time<br>Mode switch deceleration time | -    | 0~65535                     | U16       | rw   | RxPDO |

### 8.3.2 Object Overview

For example, the P1-04 parameter is assigned the EtherCAT code 2104h.

The P3-10 parameters specify an EtherCAT capacity of 230Ah.

12-15 bits: 2 indicates the servo parameter area. 12-15 bits: 2 indicates the servo parameter area.

8-11 bits: 0-F indicates the parameter group number in Group P. 8-11 bits: 0-F indicates the parameter group number in Group P.

0-7 bits: 00-FF indicates the parameter under a specific group in the P group. 0-7 bits: 00-FF indicates the parameter under a specific group in the P group.

## 8.4 Profile region (0x6000~0x6FFF)

### 8.4.1 List of objects

| index of matrix | subindex | name                                                                              |
|-----------------|----------|-----------------------------------------------------------------------------------|
| 603Fh           | 00h      | Abort connection option code                                                      |
| 6040h           | 00h      | Control word                                                                      |
| 6041h           | 00h      | Status word                                                                       |
| 605Ah           | 00h      | Quick stop option code                                                            |
| 605Bh           | 00h      | Shutdown option code                                                              |
| 605Bh           | 00h      | Disable operation option code                                                     |
| 605Bh           | 00h      | Halt option code                                                                  |
| 605Eh           | 00h      | Fault reaction option code                                                        |
| 6060h           | 00h      | Mode of operation                                                                 |
| 6061h           | 00h      | Control mode display                                                              |
| 6062h           | 00h      | Position demand value                                                             |
| 6063h           | 00h      | Actual internal value position feedback                                           |
| 6064h           | 00h      | Position actual value position feedback                                           |
| 6065h           | 00h      | Following error window                                                            |
| 6066h           | 00h      | Error timeout                                                                     |
| 6067h           | 00h      | Position window position reaches the threshold                                    |
| 6068h           | 00h      | Position window time: The time when the position arrives at the window.           |
| 6069h           | 00h      | Actual value of the velocity sensor                                               |
| 606Bh           | 00h      | Velocity demand value; speed instruction                                          |
| 606Ch           | 00h      | Actual velocity value; speed feedback                                             |
| 606Dh           | 00h      | Velocity window: Speed reaches the threshold                                      |
| 606Eh           | 00h      | Velocity window time: The time it takes for a speed to reach a certain threshold. |
| 606Fh           | 00h      | Velocity threshold                                                                |
| 6070h           | 00h      | Velocity threshold time                                                           |
| 6071h           | 00h      | target torque                                                                     |
| 6072h           | 00h      | Maximum torque                                                                    |
| 6073h           | 00h      | Max current                                                                       |
| 6074h           | 00h      | torque demand                                                                     |
| 6075h           | 00h      | Rated current of the motor                                                        |
| 6076h           | 00h      | Rated torque of the motor                                                         |
| 6077h           | 00h      | torque feedback                                                                   |
| 6078h           | 00h      | Current actual value                                                              |
| 6079h           | 00h      | DC link circuit voltage; bus voltage                                              |
| 607Ah           | 00h      | Target position                                                                   |
| 607Bh           | -        | Position range limit                                                              |
|                 | 00h      | Number of entries                                                                 |
|                 | 01h      | Min position range limit                                                          |
|                 | 02h      | Max position range limit                                                          |

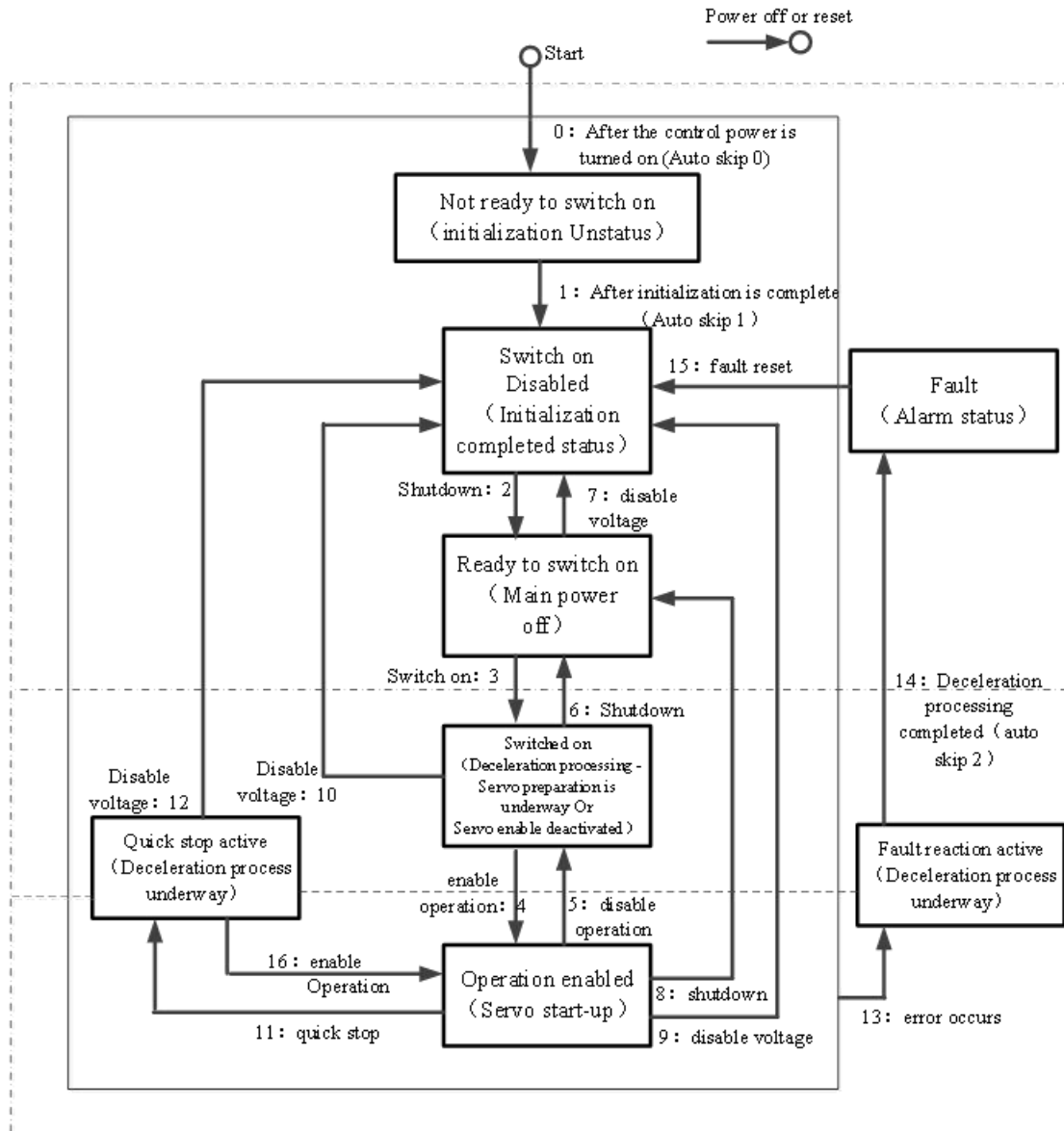
| index of matrix | subindex | name                                                           |
|-----------------|----------|----------------------------------------------------------------|
| 607Ch           | 00h      | Home offset                                                    |
| 607Dh           | -        | Software position limit: Absolute position limit for software. |
|                 | 00h      | Number of entries                                              |
|                 | 01h      | Minimum position limit                                         |
|                 | 02h      | Maximum position limit                                         |
| 606Eh           | 00h      | Polarity instruction polarity                                  |
| 607Fh           | 00h      | Maximum Profile Velocity                                       |
| 6080h           | 00h      | Maximum motor speed                                            |
| 6081h           | 00h      | Profile velocity                                               |
|                 |          |                                                                |
| 6083h           | 00h      | Profile acceleration                                           |
| 6084h           | 00h      | Profile deceleration                                           |
| 6085h           | 00h      | Quick stop deceleration                                        |
| 6086h           | 00h      | Motion profile type: Position trajectory planning type         |
| 6087h           | 00h      | Torque slope                                                   |
| 6088h           | 00h      | Torque profile type                                            |
| 608Fh           | -        | Position encoder resolution                                    |
|                 | 00h      | Number of entries                                              |
|                 | 01h      | Encoder increment                                              |
|                 | 02h      | Motor revolutions                                              |
| 6091h           | -        | Gear ratio                                                     |
|                 | 00h      | Number of entries                                              |
|                 | 01h      | Motor revolutions                                              |
|                 | 02h      | Shaft revolutions                                              |
| 6092h           | -        | Constant Feed Constant                                         |
|                 | 00h      | Number of entries                                              |
|                 | 01h      | Feed                                                           |
|                 | 02h      | Shaft revolutions                                              |
| 6098h           | 00h      | Homing method Return to origin method                          |
| 6099h           | -        | Homing speeds; return to original speed                        |
|                 | 00h      | Number of entries                                              |
|                 | 01h      | Speed during search for switch                                 |
|                 | 02h      | Speed during the zero return process                           |
| 609Ah           | 00h      | homing acceleration                                            |
| 60A3h           | 00h      | Profile jerk use                                               |
| 60A4h           | -        | profile jerk                                                   |
|                 | 00h      | Number of entries                                              |
|                 | 01h      | Profile jerk1 Profile jerk1                                    |
|                 | 02h      | Profile jerk2 Profile jerk2                                    |
| 60B0h           | 00h      | Position offset feedforward                                    |
| 60B1h           | 00h      | velocity offset speed feedforward                              |
| 60B2h           | 00h      | Torque offset feedforward                                      |
| 60B8h           | 00h      | touch probe function                                           |
| 60B9h           | 00h      | Touch probe status                                             |
| 60BAh           | 00h      | Touch probe pos1 positive value                                |
| 60BBh           | 00h      | Touch probe pos1 negative value                                |

| index of matrix | subindex | name                                                  |
|-----------------|----------|-------------------------------------------------------|
| 60BCh           | 00h      | Touch probe pos2 positive value                       |
| 60BDh           | 00h      | Touch probe pos2 negative value                       |
| 60C2h           | -        | Interpolation time period                             |
|                 | 00h      | Number of entries                                     |
|                 | 01h      | Interpolation time period value                       |
|                 | 02h      | Interpolation time index                              |
| 60C5h           | 00h      | Maximum acceleration                                  |
| 60C6h           | 00h      | Maximum deceleration                                  |
| 60E3h           | -        | Supported Homing method                               |
|                 | 00h      | Number of entries                                     |
|                 | 01h      | 1st supported Homing method Return to origin method 1 |
|                 | ..       | ..                                                    |
|                 | 20h      | 32nd supported Homing method 32                       |
| 60F2h           | 00h      | Positioning option code                               |
| 60F4h           | 00h      | Follow error actual value                             |
| 60FAh           | 00h      | control effect                                        |
| 60FCh           | 00h      | Position Demand Internal Value                        |
| 60FDh           | 00h      | Digital inputs                                        |
| 60FEh           | -        | Digital outputs                                       |
|                 | 00h      | Number of entries                                     |
|                 | 01h      | Physical outputs                                      |
|                 | 02       | bit mask                                              |
| 60FFh           | 00h      | Target velocity                                       |
| 6502h           | 00h      | Supported drive modes                                 |

### 8.4.2 PDS (Power Drive Systems) Specifications

The PDS status transition of the servo driver's power control is defined as shown in the figure below, based on user commands or abnormal detection.





After migrating to Operation enabled, increase the time to over 100ms and enter the action command. The table below outlines the PDS state transition events (transition conditions) and the actions during the transition.

During PDS migration, the system performs state transition while establishing the handshake (using 6041h: Statusword to confirm the state change before sending the next migration command).

| PDS change |                   | event                                                           | movement                                                                    |
|------------|-------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------|
| 0          | Auto skip 0       | Automatic migration after power-on or application layer reset.  | Automatic migration after power-on or application layer reset.              |
| 1          | Auto skip 1       | Auto-transform after initialization.                            | Communication is established.                                               |
| 2          | Shut down         | The shutdown command is received.                               | No special.                                                                 |
| 3          | Switch on         | When the power supply is ON, it receives the Switch on command. | No special.                                                                 |
| 4          | Enable operation  | The Enable operation command is accepted.                       | The drive function is active. All previous set point data has been cleared. |
| 5          | Disable operation | Enable the Disable operation command.                           | The drive function is invalid.                                              |

| PDS change |                  | event                                                                                                                                                                                                                                                                                                                            | movement                                              |
|------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 6          | Shutdown         | When the power supply is ON, the system receives a shutdown command.<br>The power supply is detected to be in the OFF state.                                                                                                                                                                                                     | No special.                                           |
| 7          | Disable voltage  | Disable the voltage command.<br>The scenario of receiving the Quick Stop command.<br>The ESM state is the scenario where the system transitions to Init during PreOP, SafeOP, or OP.                                                                                                                                             | No special.                                           |
| 8          | Shutdown         | The power supply is in the ON state when receiving a Shutdown command.                                                                                                                                                                                                                                                           | The drive function is invalid                         |
| 9          | Disable voltage  | Disable the voltage command.                                                                                                                                                                                                                                                                                                     | The drive function is invalid                         |
| 10         | Disable voltage  | Disable the voltage command.<br>The scenario of receiving the Quick Stop command.<br>The ESM state refers to the scenario where the system transitions to the Init state during PreOP, SafeOP, or OP phases.                                                                                                                     | No special.                                           |
| 11         | Quick stop       | The situation where the Quick Stop command is received.                                                                                                                                                                                                                                                                          | Run the Quick Stop function.                          |
| 12         | Disable voltage  | When the Quick stop selection code is set to 1, 2, or 3, and the Quick stop action is completed.<br>The Quick stop function is triggered when the selected code is 5, 6, or 7, and upon completion of the Quick stop action, upon receiving the Disable voltage command.<br>The power supply is detected to be in the OFF state. | The drive function is disabled.                       |
| 13         | Error occurs     | Abnormal detection.                                                                                                                                                                                                                                                                                                              | Execute the Fault reaction function.                  |
| 14         | Auto skip 2      | After the exception detection and reduction processing is completed, the system will automatically migrate.                                                                                                                                                                                                                      | The drive function is invalid                         |
| 15         | Fault reset      | When the fault causes are resolved, the system receives a fault reset command.                                                                                                                                                                                                                                                   | No Fault condition exists.<br>Reset the Fault status. |
| 16         | Enable operation | The Quick Stop function activates when the selected code is 5, 6, or 7, upon receiving the Enable operation command.                                                                                                                                                                                                             | Drive function is effective.                          |

### 8.4.3 Control Word (6040h)

The PDS status transition and commands for the slave device (servo driver) are configured via the 6040h control word.

|  | subindex | name | scope | data type | accessibility | PDO | Op-mode |
|--|----------|------|-------|-----------|---------------|-----|---------|
|--|----------|------|-------|-----------|---------------|-----|---------|

|                 |     |                                                                       |         |     |                       |                     |     |                                                       |    |                                                       |
|-----------------|-----|-----------------------------------------------------------------------|---------|-----|-----------------------|---------------------|-----|-------------------------------------------------------|----|-------------------------------------------------------|
| index of matrix |     |                                                                       |         |     |                       |                     |     |                                                       |    |                                                       |
| 6040h           | 00h | Controlword                                                           | 0~65535 | U16 | rw                    | RxPDO               | All |                                                       |    |                                                       |
|                 |     | Set control commands for servo drives, such as PDS state transitions. |         |     |                       |                     |     |                                                       |    |                                                       |
|                 |     | bit information                                                       |         |     |                       |                     |     |                                                       |    |                                                       |
|                 |     | 15                                                                    | 14      | 13  | 12                    | 11                  | 10  | 9                                                     | 8  |                                                       |
|                 |     | R                                                                     |         |     |                       |                     | oms | h                                                     |    |                                                       |
|                 |     | 7                                                                     | 6       | 5   | 4                     | 3                   | 2   | 1                                                     | 0  |                                                       |
|                 |     | fr                                                                    | R       |     |                       | eo                  | qs  | ev                                                    | so |                                                       |
|                 |     | r = reserved (not mapped) fr = fault reset                            |         |     |                       |                     |     | r = reserved (not mapped) fr = fault reset            |    |                                                       |
|                 |     | oms = operation mode specific                                         |         |     | eo = enable operation |                     |     | (The control mode depends on the bit) qs = quick stop |    | (The control mode depends on the bit) qs = quick stop |
|                 |     | h = halt                                                              |         |     | ev = enable voltage   |                     |     | ev = enable voltage                                   |    |                                                       |
| h = halt        |     |                                                                       |         |     |                       | ev = enable voltage |     |                                                       |    |                                                       |
| so = switch on  |     |                                                                       |         |     |                       |                     |     |                                                       |    |                                                       |

| Command                      | bits of the controlword |                  |            |                |           | PDS change   |
|------------------------------|-------------------------|------------------|------------|----------------|-----------|--------------|
|                              | bit7                    | bit3             | bit2       | bit1           | bit0      |              |
|                              | Fault reset             | Enable operation | quick stop | Enable voltage | Switch on |              |
| Shutdown                     | 0                       | -                | 1          | 1              | 0         | 2, 6, 8      |
| Switch on                    | 0                       | 0                | 1          | 1              | 1         | 3            |
| Switch on + Enable operation | 0                       | 1                | 1          | 1              | 1         | 3+4          |
| Enable operation             | 0                       | 1                | 1          | 1              | 1         | 4, 16        |
| Disable voltage              | 0                       | -                | -          | 0              | -         | 7, 9, 10, 12 |
| Quick stop                   | 0                       | -                | 0          | 1              | -         | 7, 10, 11    |
| Disable operation            | 0                       | 0                | 1          | 1              | 1         | 5            |
| Fault reset                  | 0->1                    | -                | -          | -              | -         | 13           |

The bit logic of the quick stop instruction is valid when it is 0.

Please note to perform other bit logic and reverse operations.

When bit8 (halt) is set to 1, the motor will be decelerated and paused via the 605Dh (Halt selection code).

After pausing, you must disable the restart action.

bit9,6-4 (operation mode specific) :

This describes the changes in the OMS bit inherent to the control mode (Op-mode). (For details, refer to the relevant section for each control mode.)

| Op-mode | Bit9                | Bit6               | Bit5                   | Bit4          |
|---------|---------------------|--------------------|------------------------|---------------|
| pp      | change on set-point | absolute /relative | change set immediately | new set-point |
| pv      | -                   | -                  | -                      | -             |
| tq      | -                   | -                  | -                      | -             |
| hm      | -                   | -                  | -                      | start homing  |
| csp     | -                   | -                  | -                      | -             |
| csv     | -                   | -                  | -                      | -             |
| cst     | -                   | -                  | -                      | -             |

#### 8.4.4 Status Word (6041h)

The PDS status transition and commands for the slave device (servo driver) are configured via the 6040h control word.

| index of matrix           | subindex | name                                             | scope   | data type | accessibility | PDO   | Op-mode |    |      |
|---------------------------|----------|--------------------------------------------------|---------|-----------|---------------|-------|---------|----|------|
| 6041h                     | 00h      | Statusword                                       | 0~65535 | U16       | ro            | TxPDO | All     |    |      |
|                           |          | Indicates the status of the servo driver.        |         |           |               |       |         |    |      |
|                           |          | bit information                                  |         |           |               |       |         |    |      |
|                           |          | 15                                               | 14      | 13        | 12            | 11    | 10      | 9  | 8    |
|                           |          | r                                                |         | oms       |               | ila   | oms     | rm | r    |
|                           |          | 7                                                | 6       | 5         | 4             | 3     | 2       | 1  | 0    |
|                           |          | w                                                | sod     | qs        | ve            | f     | oe      | so | rsto |
|                           |          | r = reserved (not mapped) w = warning            |         |           |               |       |         |    |      |
|                           |          | mapped) w = warning                              |         |           |               |       |         |    |      |
|                           |          | sod = switch on disabled                         |         |           |               |       |         |    |      |
|                           |          | oms = operation mode specific                    |         |           |               |       |         |    |      |
|                           |          | operation mode specific                          |         |           |               |       |         |    |      |
|                           |          | Control mode dependent bit: ve = voltage enabled |         |           |               |       |         |    |      |
|                           |          | mode dependent bit: ve = voltage enabled         |         |           |               |       |         |    |      |
|                           |          | ila = internal limit active                      |         |           |               |       |         |    |      |
|                           |          | internal limit active                            |         |           |               |       |         |    |      |
|                           |          | oe = operation enabled                           |         |           |               |       |         |    |      |
|                           |          | rm = remote                                      |         |           |               |       |         |    |      |
| rm = remote               |          |                                                  |         |           |               |       |         |    |      |
| rtso = ready to switch on |          |                                                  |         |           |               |       |         |    |      |

bit6,5,3-0 (switch on disabled/quick stop/fault/operation enabled/switched on/ready to switch on): This bit indicates the PDS status. The following lists the states and their corresponding bits.

| StatusWord            | PDS State              |                                  |
|-----------------------|------------------------|----------------------------------|
| xxxx xxxx x0xx 0000 b | Not ready to switch on | Incomplete initialization status |
| xxxx xxxx x1xx 0000 b | Switch on disabled     | Initialization completed         |

| StatusWord            | PDS State             |                                  |
|-----------------------|-----------------------|----------------------------------|
| xxxx xxxx x01x 0001 b | Ready to switch on    | Initialization completion status |
| xxxx xxxx x01x 0011 b | Switched on           | Servo enable off / Servo ready   |
| xxxx xxxx x01x 0111 b | Operation enabled     | Enable servo                     |
| xxxx xxxx x00x 0111 b | Quick stop active     | Stop now                         |
| xxxx xxxx x0xx 1111 b | Fault reaction active | Abnormal (Alarm) Detection       |
| xxxx xxxx x0xx 1000 b | Fault                 | Abnormal (Alarm) Status          |

When bit4 (voltage enabled) is set to 1, the power supply voltage is applied to PDS.

The bit5 (quick stop) signal: A value of 0 indicates the PDS has received a quick stop request. The logic of the quick stop bit is active when the bit is at 0. Note that other bit logic operations and their inverse actions should be executed accordingly.

When bit7 (warning) is set to 1, it indicates an ongoing warning. During this state, the PDS status remains unchanged and the motor continues to operate.

When bit9 (remote) is 0 (local), it indicates the 6040 (Controlword) is unresponsive. When bit9 (remote) is 1, it means the 6040 (Controlword) is responsive. The ESM status is set to 1 when transitioning to PreOP or higher states.

bits 13,12, and 10 (operation mode specific): These indicate the OMS bit variations inherent to the control mode. (For details, refer to the relevant sections for each control mode.)

| Op-mode | bit13           | bit12                       | Bit10          |
|---------|-----------------|-----------------------------|----------------|
| pp      | following error | set-point acknowledge       | target reached |
| pV      | -               | speed                       | target reached |
| tq      | -               | -                           | target reached |
| hm      | homing error    | homing attained             | target reached |
| csp     | following error | drive follows command value | -              |
| csv     | -               | drive follows command value | -              |
| cst     | -               | drive follows command value | -              |

bit11 (internal limit active): The internal limit is triggered when the bit11 (internal limit active) in the 6041h status word becomes 1.

bits 15 and 14 (reserved): These bits remain unused (fixed at 0).

## 8.5 Control Mode Settings

### 8.5.1 Supported driving modes (6502h)

The servo driver can confirm the supported control mode according to 6502h.

| index of matrix | subindex | name                                                                                                                       | scope                                    | data type | accessibility | PDO   | Op-mode |              |               |
|-----------------|----------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------|---------------|-------|---------|--------------|---------------|
| 6502h           | 00h      | Supported drive modes                                                                                                      | 0~4294967295                             | U32       | ro            | TxPDO | All     |              |               |
|                 |          | Indicates the supported control mode (Mode of operation).<br>A value of 1 indicates the supported mode.<br>bit information |                                          |           |               |       |         |              |               |
|                 |          | 31...16                                                                                                                    |                                          | 15...10   |               |       | 9       | 8            |               |
|                 |          | r                                                                                                                          |                                          | r         |               |       | cst     | csv          |               |
|                 |          | 0                                                                                                                          |                                          | 0         |               |       | 1       | 1            |               |
|                 |          | 7                                                                                                                          | 6                                        | 5         | 4             | 3     | 2       | 1            | 0             |
|                 |          | csp                                                                                                                        | r                                        | hm        | r             | tq    | pv      | r            | pp            |
|                 |          | 1                                                                                                                          | 0                                        | 1         | 0             | 1     | 1       | 0            | 1             |
|                 |          | bit                                                                                                                        | Mode of operation                        |           |               |       |         | abbreviation | corresponding |
|                 |          | 0                                                                                                                          | Profile position mode                    |           |               |       |         | pp           | YES           |
|                 |          | 2                                                                                                                          | Profile Velocity Mode                    |           |               |       |         | pv           | YES           |
|                 |          | 3                                                                                                                          | Torque Profile Mode                      |           |               |       |         | tq           | YES           |
|                 |          | 5                                                                                                                          | Homing mode (origin reset position mode) |           |               |       |         | hm           | YES           |
|                 |          | 7                                                                                                                          | Cyclic synchronous position mode         |           |               |       |         | csp          | YES           |
|                 |          | 8                                                                                                                          | Cyclic synchronous speed control mode    |           |               |       |         | csv          | YES           |
|                 |          | 9                                                                                                                          | Cyclic synchronous torque mode           |           |               |       |         | cst          | YES           |

### 8.5.2 Control Mode (6060h)

The control mode is set through 6060h (control mode).

| index of matrix | subindex | name              | scope    | data type | accessibility | PDO   | Op-mode |
|-----------------|----------|-------------------|----------|-----------|---------------|-------|---------|
| 6060h           | 00h      | Mode of operation | -128~127 | I8        | rw            | RxPDO | All     |

| Set the control mode of servo driver.<br>Non-corresponding control mode is disabled. |                                                                                         |              |               |
|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------|---------------|
| bit                                                                                  | Mode of operation                                                                       | abbreviation | corresponding |
| -128~-1                                                                              | Reserved                                                                                | -            | -             |
| 0                                                                                    | No mode changed/No mode assigned<br>No control mode change / No control mode assignment | -            | -             |
| 1                                                                                    | Profile position mode                                                                   | pp           | YES           |
| 3                                                                                    | Profile Velocity Mode                                                                   | pv           | YES           |
| 4                                                                                    | Torque Profile Mode                                                                     | tq           | YES           |
| 6                                                                                    | Homing mode (origin reset position mode)                                                | hm           | YES           |
| 8                                                                                    | Cyclic synchronous position mode                                                        | csp          | YES           |
| 9                                                                                    | Cyclic synchronous speed control mode                                                   | csv          | YES           |
| 10                                                                                   | Cyclic synchronous torque mode                                                          | cst          | YES           |
| 11~127                                                                               | Reserved                                                                                | -            | -             |

The 6060h (Modes of operation) control mode defaults to 0 (No mode change/no mode assigned). After power-on, always set the appropriate control mode value. If both 6060h and 6061h settings are 0, migrating the PDS status to Operation enabled will trigger E-881 (Control mode setting exception protection).

If no control mode is set for 6060h, the E-881 (Control Mode Setting Abnormal Protection) will be triggered.

When the initial state 6060h=0 (No mode assigned) is converted to a supported control mode (pp, pv, tq, hm, CSP, CSV, CST), resetting 6060h=0 again as 'No mode changed' will prevent the control mode switch from being executed (the previous control mode will be maintained).

### 8.5.3 Current Control Mode (6061h)

The servo driver's internal control mode is confirmed via the 6061h (Modes of operation display). After configuring 6060h (Modes of operation), verify through testing whether the target action is feasible.

| index of matrix | son index of matrix | name                                | scope                                                                        | data type | accessibility | PDO          | Op-mode       |
|-----------------|---------------------|-------------------------------------|------------------------------------------------------------------------------|-----------|---------------|--------------|---------------|
| 6061h           | 00h                 | Mode of operation display           | -128~127                                                                     | I8        | ro            | TxPDO        | All           |
|                 |                     | Indicates the current control mode. |                                                                              |           |               |              |               |
|                 |                     | bit                                 | Mode of operation                                                            |           |               | abbreviation | corresponding |
|                 |                     | -128~-1                             | Reserved                                                                     |           |               | -            | -             |
|                 |                     | 0                                   | No mode changed/No mode assigned<br>No control mode change / No control mode |           |               | -            | -             |

|  |  |        |                                                                                 |     |     |
|--|--|--------|---------------------------------------------------------------------------------|-----|-----|
|  |  |        | assignment                                                                      |     |     |
|  |  | 1      | Profile position mode                                                           | pp  | YES |
|  |  | 3      | Profile Velocity Mode                                                           | pv  | YES |
|  |  | 4      | Torque Profile Mode                                                             | tq  | YES |
|  |  | 6      | Homing mode (origin reset position mode)                                        | hm  | YES |
|  |  | 8      | Cyclic synchronous position mode<br>Cycle Synchronization Position Control Mode | csp | YES |
|  |  | 9      | Cyclic synchronous velocity mode<br>(Cycle synchronization speed control mode)  | csv | YES |
|  |  | 10     | Cyclic synchronous torque mode                                                  | cst | YES |
|  |  | 11~127 | Reserved                                                                        | -   | -   |



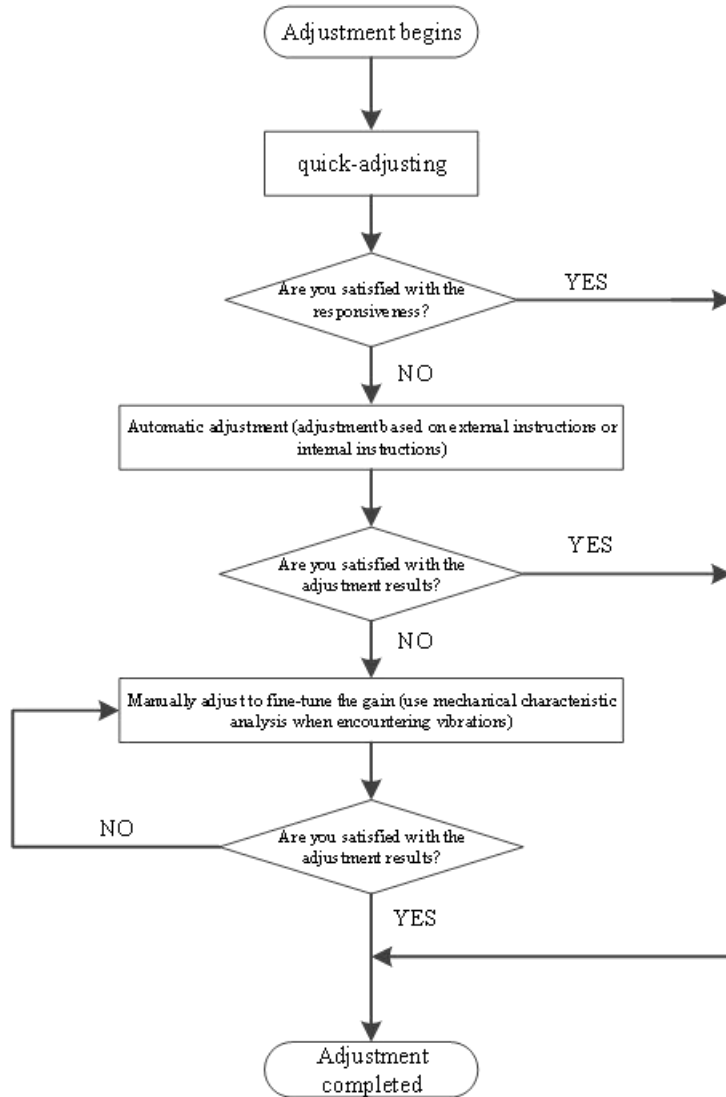
## 9. Adjustment of servo gain

### 9.1 Overview of Servo Gain Adjustment

#### 9.1.1 Overview and Process

Servo driver needs to drive the motor as fast and accurate as possible to follow the command from the upper computer or the internal setting. In order to meet this requirement, the servo gain must be adjusted properly.

The following is the basic workflow for gain adjustment. Adjust according to the current machine status and operating conditions.



### 9.1.2 Differences between several adjustments

The adjustment methods are divided into adaptive and self-adjusting, with their control algorithms and parameters being independent. The self-adjusting mode includes three functions: fast adjustment, automatic adjustment, and manual adjustment. These three functions share the same core principle but differ in implementation methods. For details, refer to the corresponding sections.

| Adjustment method | classify         | controlling parameter | rigidity | reactive mode | The main relevant control parameters                                                                                                                                                                                                        |
|-------------------|------------------|-----------------------|----------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| self-adaption     | autoadaptation   | P2-01.0=1             | centre   | 150ms level   | P2-05 Adaptive Speed Loop Gain<br>P2-10 adaptive speed loop integration<br>P2-11 adaptive position loop gain<br>P2-07 Adaptive Inertia Ratio Gain of P2-08 adaptive velocity observer<br>P2-12 Adaptive Stability and Maximum Inertia Ratio |
| self-tuning       | rapid adjustment | P2-01.0=0             | Gao      | 10-50ms       | P0-07 First Inertia Ratio<br>P1-00 speed loop gain                                                                                                                                                                                          |
|                   | self-correcting  |                       | Gao      | 10ms level    | P1-01 Velocity loop integral<br>P1-02 position loop gain                                                                                                                                                                                    |
|                   | hand regulation  |                       | Gao      | parameterized | P2-35 torque command filter time constant 1<br>P2-49 model loop gain                                                                                                                                                                        |

## 9.2 Estimation of Rotational Inertia

### 9.2.1 Overview

The rotational inertia estimation is the function of driving the internal automatic operation (through forward and reverse rotation) of the driver to estimate the rotational inertia of the load during operation.

The ratio of the load inertia to the motor inertia is the reference parameter for the gain adjustment, and it must be set to the correct value.

| parameter | meaning             | factory setting | unit | Set range | revise      | come into force |
|-----------|---------------------|-----------------|------|-----------|-------------|-----------------|
| P0-07     | first inertia ratio | 200             | %    | 0 ~ 50000 | at any time | immediately     |

### 9.2.2 Notes

Cases where the inertia cannot be inferred

- Mechanical system can only run in one direction.

Inertial estimation is prone to failure in certain situations

- The load has too large rotational inertia.
- The operating range is narrow, with a stroke of less than 0.5 turns.
- The moment of inertia changes greatly in the running process.
- The mechanical rigidity is low, and the vibration is produced when the inertia is presumed.

Inertial estimation considerations

- The device can rotate in both directions within the set range. Check the movement range or direction, and ensure the load operates within the safe travel distance.
- If the system runs with jitter when the default parameters are used to estimate inertia, it indicates that the current load inertia is too large. You can also set the initial inertia to about twice the current value and run the process again under a higher load.
- The maximum recognition limit for the drive's inertia ratio is 500x (parameter upper limit: 50000). If the estimated inertia ratio is exactly 50000, it means the limit has been reached and the drive cannot be used. Replace the motor with a rotor that has a higher inertia ratio.

Other notes

- Inertia switching is not supported. The second inertia ratio is invalid.

## 9.2.3 Operating Tools

The tool to deduce the load moment of inertia is the driver panel and XinJeServo upper computer software.

| Tools                             | Restriction                                        |
|-----------------------------------|----------------------------------------------------|
| drive panel                       | The driver firmware requires version 4200 or later |
| XinJeServo Host Computer Software | All versions of the host software support          |



The driver firmware version is displayed in U2-07.

## 9.2.4 Operating Procedures

### 1. Step of estimating the inertia of the drive panel

#### 1. Parameter configuration

| parameter | meaning                                                                     | factory setting | unit      | Set range | revise      | come into force |
|-----------|-----------------------------------------------------------------------------|-----------------|-----------|-----------|-------------|-----------------|
| P2-15     | inertia configuration stroke                                                | 100             | 0.01 turn | 1 ~ 300   | at any time | immediately     |
| P2-17     | Inertia Identification and Self-adjusting Maximum Speed of Internal Command | 0               | rpm       | 0 ~ 65535 | at any time | immediately     |
| P2-18     | Initial inertia ratio for inertia identification                            | 500             | %         | 1 ~ 20000 | at any time | immediately     |

The recommended operating speed for P2-17 is 500rpm or higher. If the command speed is too low, the inertia ratio may be misidentified.

#### 2. Inertia identification execution

Before inertial identification, use the F1-00 point movement function to confirm the servo rotation direction. The initial direction of servo operation is determined by INC or DEC when inertial identification begins.

If the servo jitter is under the adaptive default parameters, switch to the adaptive large inertia mode (P2-03.3=1) first to ensure the basic smooth operation of the servo before the inertia identification!

The servo enters the F0-07 parameter display in BB mode:

JA E -

Press and hold the ENTER key to enable the servo. The panel displays:

JA E - -

Press the INC key to run forward or the DEC key to run backward (choose one). The display will

show:



When the system initiates under P0-05=0 (initial positive direction), a short press of INC first triggers forward rotation followed by reverse rotation, while a short press of DEC reverses first then forwards. Upon successful inertia identification, the system displays the load-inertia ratio after several forward/reverse cycles and automatically writes it to P0-07. If the identification fails, an error code is displayed. Pressing the STA/ESC keys briefly terminates the panel's inertia identification operation.

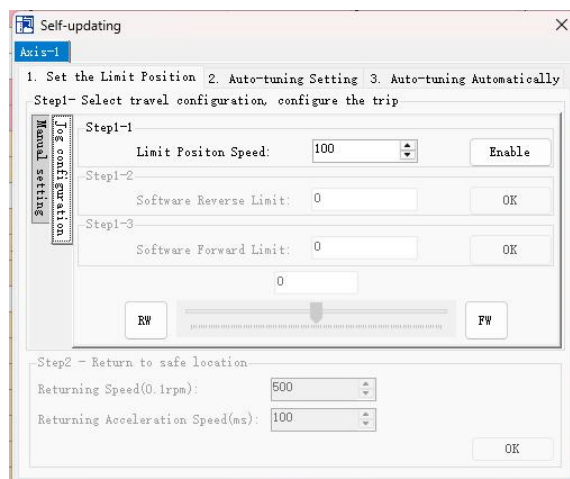
- Panel inertia identification error alarm

| error code | meaning                                        | Possible reasons and solutions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Err-1      | motor torque saturation                        | ① The initial inertia is too small; in the adaptive mode, switch to the large inertia mode P2-03.3=1; in the self-adjusting mode, the initial inertia of inertia identification is P2-18, and adjust to the current 2 times.<br>② The maximum speed is too high (P2-17), but it is recommended not to drop below 500 rpm, as an excessively low speed would result in inaccurate inertia ratio identification.<br>③ The torque limit is too small (P3-28/29).                                                 |
| Err-2      | The calculated inertia value has a large error | ① The maximum speed limit is too low (P2-17), but it is recommended not to set it below 500 rpm, as an excessively low command speed may result in inaccurate inertia ratio identification.<br>② The presumed inertia travel is too small. It is recommended that the minimum P2-15 inertia travel should not be less than 50 (0.5 circle). Too small travel will result in inaccurate identification of the pushed inertia.<br>③ The friction of the mechanism is too big;<br>④ The overtravel has occurred. |
| Err-3      | Internal travel calculation error in the drive | ① The presumed inertia travel is too small. It is recommended that the minimum P2-15 inertia travel should not be less than 50 (0.5 circle). Too small travel will result in inaccurate identification of the push-out inertia.                                                                                                                                                                                                                                                                               |
| Err-4      | Location integration feature used              | ① During torque-inertia identification, the system should operate in PI control mode. The configuration was mistakenly changed to P control. Please verify whether the P5-21 proportional action command is enabled. When this function is activated, it will automatically switch to P/PI control, which may trigger the Err-4                                                                                                                                                                               |

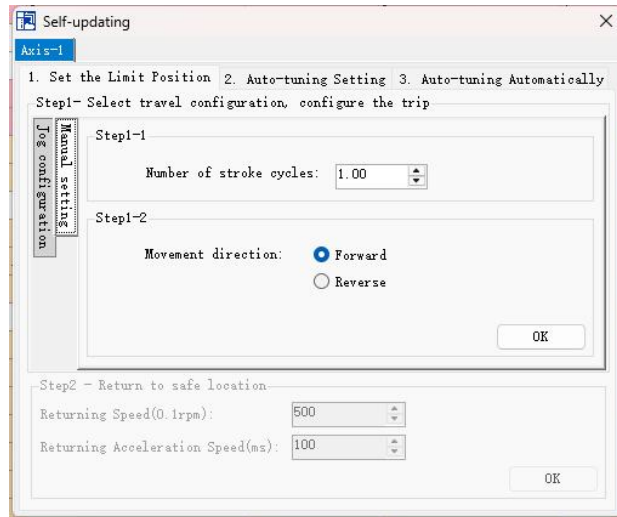
| error code | meaning                                                           | Possible reasons and solutions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                                                                   | <p>alarm during inertia push execution.</p> <p>② The motor's load and inertia are significantly mismatched, preventing the driver from accurately estimating inertia. Consider replacing the motor with one that matches the inertia requirements, or manually increase P0-07 (though this won't enable inertia identification).</p> <p>③ The inertia of the shaft is estimated. The inertia identification should be carried out under load.</p> <p>④ Power line phase sequence is incorrect. Check the power line phase sequence and wiring.</p> |
| Err-5      | Unrestrained Vibration in Inertial Identification Process         | Unhandleable vibration occurred                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Err-6      | The drive is not in bb mode                                       | <p>① The enable function is activated. P5-20 can be initially set to 0.</p> <p>② The driver alarm will appear. Press ESC to exit the setting interface and check for alarms.</p>                                                                                                                                                                                                                                                                                                                                                                   |
| Err-7      | The driver alarm occurs during the inertia identification process | The driver triggers an alarm. Press ESC to exit the configuration interface and check the alarm code. Resolve the alarm before proceeding with inertia estimation.                                                                                                                                                                                                                                                                                                                                                                                 |

## 2. XinJeServo Presumed Inertia Step

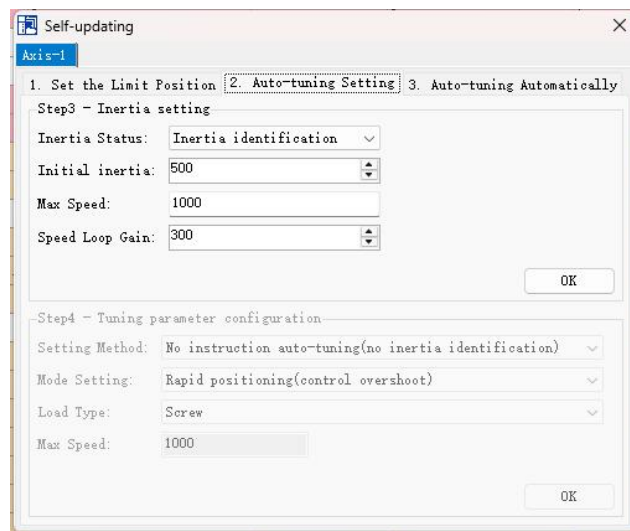
### 1. On the XinJeServo main menu screen, select [Self-Adjust].



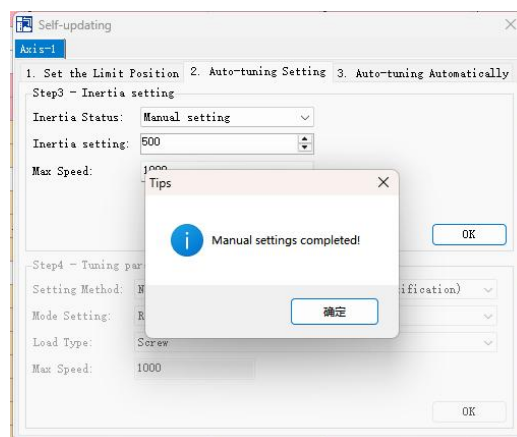
2. Select [Point Motion Configuration] or [Manual Setting] to configure the inertia estimation travel.



3. Set the configuration interface.



4. Click [Confirm] to start the inertia calculation.



- If the self-adjustment interface is closed directly, the driver will only configure the inertia ratio parameter.
- For detailed instructions on using XinJeServo's estimated inertia, refer to the XinJeServo help documentation.

## 9.3 Quick Adjustment

### 9.3.1 Overview

To perform quick adjustment, set the load inertia first. If the inertia is mismatched, an oscillation alarm will occur. The gain parameters for quick adjustment are in self-tuning mode.

### 9.3.2 Quick adjustment steps

1. Estimate the load inertia using either the driver panel or XinJeServo's host software, as specified in Section 9.2 for rotational inertia estimation.
2. Disable adaptive mode and set P2-01.0 to 0;
3. Set the required rigidity level P0-04.



P2-01.0 is the rightmost digit of the P2-01 parameter, as shown below:

P2-01=n. 0 0 1 0  
└─ P2-01.0

### 9.3.3 The gain parameters corresponding to the rigid level

The rigidity level should be set based on actual load conditions. A higher P0-04 value indicates greater servo gain. If vibration occurs during the increase of rigidity level, further increases should be avoided. However, if vibration is eliminated through vibration suppression, additional increases may be attempted. The following recommended rigidity levels for specific loads are provided for reference only.

Supports three rigid level types selected via P6-00.0:

- P6-00.0 = 0: Standard mode [Default]

Rigidity level P0-04, associated with four parameters: P1-00, P1-01, P1-02, and P2-35.

- P6-00.0 = 1: Positioning mode, also known as soft mode

By implementing gain switching while maintaining responsiveness, the system achieves minimal overshoot at positioning completion. The rigid level P0-04 involves seven parameters: P1-00, P1-01, P1-02, P2-35, P1-05, P1-06, and P1-07, with P1-14 set to 0x00A1 to enforce mandatory gain switching.

- P6-00.0 = 2: Quick positioning mode

Enable the model loop and disturbance observer Dob, with rigidity level P0-04 and five parameters: P1-00, P1-01, P1-02, P2-35, and P2-49. Force binding for P2-00.0 and P2-41 in the disturbance observer Dob, and P2-47.0 and P2-49 in the model loop.



■ Standard rigid grade table (P6-00.0=0)

| rigidity class<br>P0-04 | speed loop gain<br>P1-00 | integral of velocity<br>time constant<br>P1-01 | position loop gain<br>P1-02 | torque command<br>filtering<br>Time constant 1<br>P2-35 |
|-------------------------|--------------------------|------------------------------------------------|-----------------------------|---------------------------------------------------------|
| 0                       | 15                       | 50000                                          | 24                          | 1326                                                    |
| 1                       | 20                       | 39789                                          | 32                          | 995                                                     |
| 2                       | 25                       | 31831                                          | 40                          | 796                                                     |
| 3                       | 30                       | 26526                                          | 48                          | 663                                                     |
| 4                       | 35                       | 22736                                          | 56                          | 568                                                     |
| 5                       | 45                       | 17684                                          | 72                          | 442                                                     |
| 6                       | 60                       | 13263                                          | 96                          | 332                                                     |
| 7                       | 75                       | 10610                                          | 120                         | 265                                                     |
| 8                       | 90                       | 8842                                           | 144                         | 221                                                     |
| 9                       | 110                      | 7234                                           | 176                         | 181                                                     |
| 10                      | 140                      | 5684                                           | 224                         | 142                                                     |
| 11                      | 180                      | 4421                                           | 288                         | 111                                                     |
| 12                      | 250                      | 3183                                           | 400                         | 80                                                      |
| 13                      | 300                      | 2653                                           | 480                         | 66                                                      |
| 14                      | 350                      | 2274                                           | 560                         | 57                                                      |
| 15                      | 400                      | 1989                                           | 640                         | 50                                                      |
| 16                      | 500                      | 1592                                           | 800                         | 40                                                      |
| 17                      | 600                      | 1326                                           | 960                         | 33                                                      |
| 18                      | 750                      | 1061                                           | 1200                        | 27                                                      |
| 19                      | 900                      | 884                                            | 1440                        | 22                                                      |
| 20                      | 1150                     | 692                                            | 1840                        | 17                                                      |
| 21                      | 1400                     | 568                                            | 2240                        | 14                                                      |
| 22                      | 1700                     | 468                                            | 2720                        | 12                                                      |
| 23                      | 2100                     | 379                                            | 3360                        | 9                                                       |
| 24                      | 2500                     | 318                                            | 4000                        | 8                                                       |
| 25                      | 2800                     | 284                                            | 4480                        | 7                                                       |
| 26                      | 3100                     | 257                                            | 4960                        | 6                                                       |
| 27                      | 3400                     | 234                                            | 5440                        | 6                                                       |
| 28                      | 3700                     | 215                                            | 5920                        | 5                                                       |
| 29                      | 4000                     | 199                                            | 6400                        | 5                                                       |
| 30                      | 4500                     | 177                                            | 7200                        | 5                                                       |
| 31                      | 5000                     | 159                                            | 8000                        | 5                                                       |
| 32                      | 5500                     | 145                                            | 8800                        | 3                                                       |
| 33                      | 6000                     | 133                                            | 9600                        | 3                                                       |
| 34                      | 6500                     | 123                                            | 10400                       | 3                                                       |
| 35                      | 7000                     | 114                                            | 11200                       | 0                                                       |
| 36                      | 7500                     | 106                                            | 12000                       | 0                                                       |
| 37                      | 8000                     | 100                                            | 12800                       | 0                                                       |
| 38                      | 8500                     | 94                                             | 13600                       | 0                                                       |
| 39                      | 9000                     | 88                                             | 14400                       | 0                                                       |

| rigidity class<br>P0-04 | speed loop gain<br>P1-00 | integral of velocity<br>time constant<br>P1-01 | position loop gain<br>P1-02 | torque command<br>filtering<br>Time constant 1<br>P2-35 |
|-------------------------|--------------------------|------------------------------------------------|-----------------------------|---------------------------------------------------------|
| 40                      | 9500                     | 84                                             | 15200                       | 0                                                       |
| 41                      | 10000                    | 80                                             | 16000                       | 0                                                       |

■ Rigid grade table for positioning mode (P6-00.0=1)

| rigidity<br>grade<br>P0-04 | speed<br>loop<br>gain<br>P1-00 | integral of<br>velocity<br>time constant<br>P1-01 | position<br>loop gain<br>P1-02 | Filtering time<br>constant of<br>torque<br>command 1/2<br>P2-35/P2-36 | second<br>speed loop<br>gain<br>P1-05 | second speed<br>loop integral<br>time constant<br>P1-06 | second<br>position<br>loop gain<br>P1-07 |
|----------------------------|--------------------------------|---------------------------------------------------|--------------------------------|-----------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------|------------------------------------------|
| 0                          | 15                             | 50000                                             | 24                             | 1326                                                                  | 15                                    | 51200                                                   | 40                                       |
| 1                          | 20                             | 39789                                             | 32                             | 995                                                                   | 20                                    | 51200                                                   | 48                                       |
| 2                          | 25                             | 31831                                             | 40                             | 796                                                                   | 25                                    | 51200                                                   | 56                                       |
| 3                          | 30                             | 26526                                             | 48                             | 663                                                                   | 30                                    | 51200                                                   | 72                                       |
| 4                          | 35                             | 22736                                             | 56                             | 568                                                                   | 35                                    | 51200                                                   | 96                                       |
| 5                          | 45                             | 17684                                             | 72                             | 442                                                                   | 45                                    | 51200                                                   | 120                                      |
| 6                          | 60                             | 13263                                             | 96                             | 332                                                                   | 60                                    | 51200                                                   | 144                                      |
| 7                          | 75                             | 10610                                             | 120                            | 265                                                                   | 75                                    | 51200                                                   | 176                                      |
| 8                          | 90                             | 8842                                              | 144                            | 221                                                                   | 90                                    | 51200                                                   | 224                                      |
| 9                          | 110                            | 7234                                              | 176                            | 181                                                                   | 110                                   | 51200                                                   | 288                                      |
| 10                         | 140                            | 5684                                              | 224                            | 142                                                                   | 140                                   | 51200                                                   | 400                                      |
| 11                         | 180                            | 4421                                              | 288                            | 111                                                                   | 180                                   | 51200                                                   | 480                                      |
| 12                         | 250                            | 3183                                              | 400                            | 80                                                                    | 250                                   | 51200                                                   | 560                                      |
| 13                         | 300                            | 2653                                              | 480                            | 66                                                                    | 300                                   | 51200                                                   | 640                                      |
| 14                         | 350                            | 2274                                              | 560                            | 57                                                                    | 350                                   | 51200                                                   | 800                                      |
| 15                         | 400                            | 1989                                              | 640                            | 50                                                                    | 400                                   | 51200                                                   | 960                                      |
| 16                         | 500                            | 1592                                              | 800                            | 40                                                                    | 500                                   | 51200                                                   | 1200                                     |
| 17                         | 600                            | 1326                                              | 960                            | 33                                                                    | 600                                   | 51200                                                   | 1440                                     |
| 18                         | 750                            | 1061                                              | 1200                           | 27                                                                    | 750                                   | 51200                                                   | 1840                                     |
| 19                         | 900                            | 884                                               | 1440                           | 22                                                                    | 900                                   | 51200                                                   | 2240                                     |
| 20                         | 1150                           | 692                                               | 1840                           | 17                                                                    | 1150                                  | 51200                                                   | 2720                                     |
| 21                         | 1400                           | 568                                               | 2240                           | 14                                                                    | 1400                                  | 51200                                                   | 3360                                     |
| 22                         | 1700                           | 468                                               | 2720                           | 12                                                                    | 1700                                  | 51200                                                   | 4000                                     |
| 23                         | 2100                           | 379                                               | 3360                           | 9                                                                     | 2100                                  | 51200                                                   | 4480                                     |
| 24                         | 2500                           | 318                                               | 4000                           | 8                                                                     | 2500                                  | 51200                                                   | 4960                                     |
| 25                         | 2800                           | 284                                               | 4480                           | 7                                                                     | 2800                                  | 51200                                                   | 5440                                     |
| 26                         | 3100                           | 257                                               | 4960                           | 6                                                                     | 3100                                  | 51200                                                   | 5920                                     |
| 27                         | 3400                           | 234                                               | 5440                           | 6                                                                     | 3400                                  | 51200                                                   | 6400                                     |
| 28                         | 3700                           | 215                                               | 5920                           | 5                                                                     | 3700                                  | 51200                                                   | 7200                                     |
| 29                         | 4000                           | 199                                               | 6400                           | 5                                                                     | 4000                                  | 51200                                                   | 8000                                     |
| 30                         | 4500                           | 177                                               | 7200                           | 5                                                                     | 4500                                  | 51200                                                   | 8000                                     |
| 31                         | 5000                           | 160                                               | 8000                           | 5                                                                     | 5000                                  | 51200                                                   | 8000                                     |

| rigidity grade<br>P0-04 | speed loop gain<br>P1-00 | integral of velocity<br>time constant<br>P1-01 | position loop gain<br>P1-02 | Filtering time constant of torque command 1/2<br>P2-35/P2-36 | second speed loop gain<br>P1-05 | second speed loop integral time constant<br>P1-06 | second position loop gain<br>P1-07 |
|-------------------------|--------------------------|------------------------------------------------|-----------------------------|--------------------------------------------------------------|---------------------------------|---------------------------------------------------|------------------------------------|
| 32                      | 5500                     | 145                                            | 8800                        | 3                                                            | 5500                            | 51200                                             | 8000                               |
| 33                      | 6000                     | 133                                            | 9600                        | 3                                                            | 6000                            | 51200                                             | 8000                               |
| 34                      | 6500                     | 123                                            | 10400                       | 3                                                            | 6500                            | 51200                                             | 8000                               |
| 35                      | 7000                     | 114                                            | 11200                       | 0                                                            | 7000                            | 51200                                             | 8000                               |
| 36                      | 7500                     | 106                                            | 12000                       | 0                                                            | 7500                            | 51200                                             | 8000                               |
| 37                      | 8000                     | 100                                            | 12800                       | 0                                                            | 8000                            | 51200                                             | 8000                               |
| 38                      | 8500                     | 94                                             | 13600                       | 0                                                            | 8500                            | 51200                                             | 8000                               |
| 39                      | 9000                     | 88                                             | 14400                       | 0                                                            | 9000                            | 51200                                             | 8000                               |
| 40                      | 9500                     | 84                                             | 15200                       | 0                                                            | 9500                            | 51200                                             | 8000                               |
| 41                      | 10000                    | 80                                             | 16000                       | 0                                                            | 10000                           | 51200                                             | 8000                               |

■ Quick Location Mode Rigid Grade Table (P6-00.0=2)

| rigidity class<br>P0-04 | speed loop gain<br>P1-00 | Integral Time Constant P1-01<br>for Velocity Loop | position loop gain<br>P1-02 | Torque command filter time constant<br>P2-35 | model loop gain<br>P2-49 |
|-------------------------|--------------------------|---------------------------------------------------|-----------------------------|----------------------------------------------|--------------------------|
| 0                       | 71                       | 50000                                             | 24                          | 20                                           | 24                       |
| 1                       | 80                       | 39789                                             | 32                          | 20                                           | 32                       |
| 2                       | 89                       | 31831                                             | 40                          | 20                                           | 40                       |
| 3                       | 100                      | 26526                                             | 48                          | 20                                           | 48                       |
| 4                       | 112                      | 22736                                             | 56                          | 20                                           | 56                       |
| 5                       | 125                      | 17684                                             | 72                          | 20                                           | 72                       |
| 6                       | 140                      | 13263                                             | 96                          | 20                                           | 96                       |
| 7                       | 157                      | 10610                                             | 120                         | 20                                           | 120                      |
| 8                       | 176                      | 8842                                              | 144                         | 20                                           | 144                      |
| 9                       | 198                      | 7234                                              | 176                         | 20                                           | 176                      |
| 10                      | 221                      | 5684                                              | 224                         | 20                                           | 224                      |
| 11                      | 248                      | 4421                                              | 288                         | 20                                           | 288                      |
| 12                      | 278                      | 3183                                              | 400                         | 20                                           | 400                      |
| 13                      | 311                      | 2653                                              | 480                         | 20                                           | 480                      |
| 14                      | 349                      | 2274                                              | 560                         | 20                                           | 560                      |
| 15                      | 390                      | 1989                                              | 640                         | 20                                           | 640                      |
| 16                      | 437                      | 1592                                              | 800                         | 20                                           | 800                      |
| 17                      | 490                      | 1326                                              | 960                         | 20                                           | 960                      |
| 18                      | 549                      | 1061                                              | 1200                        | 20                                           | 1200                     |
| 19                      | 615                      | 884                                               | 1440                        | 20                                           | 1440                     |
| 20                      | 689                      | 692                                               | 1840                        | 20                                           | 1840                     |
| 21                      | 771                      | 568                                               | 2240                        | 20                                           | 2240                     |
| 22                      | 864                      | 468                                               | 2720                        | 20                                           | 2720                     |
| 23                      | 968                      | 379                                               | 3360                        | 20                                           | 3360                     |

| rigidity<br>class<br>P0-04 | speed loop<br>gain<br>P1-00 | Integral Time<br>Constant P1-01<br>for Velocity Loop | position loop<br>gain<br>P1-02 | Torque<br>command filter<br>time constant<br>P2-35 | model loop<br>gain<br>P2-49 |
|----------------------------|-----------------------------|------------------------------------------------------|--------------------------------|----------------------------------------------------|-----------------------------|
| 24                         | 1084                        | 318                                                  | 4000                           | 8                                                  | 4000                        |
| 25                         | 1214                        | 284                                                  | 4480                           | 7                                                  | 4480                        |
| 26                         | 1360                        | 257                                                  | 4960                           | 6                                                  | 4960                        |
| 27                         | 1523                        | 234                                                  | 5440                           | 6                                                  | 5440                        |
| 28                         | 1705                        | 215                                                  | 5920                           | 5                                                  | 5920                        |
| 29                         | 1910                        | 199                                                  | 6400                           | 5                                                  | 6400                        |
| 30                         | 2139                        | 177                                                  | 7200                           | 5                                                  | 7200                        |
| 31                         | 2396                        | 160                                                  | 8000                           | 5                                                  | 8000                        |
| 32                         | 2684                        | 145                                                  | 8800                           | 3                                                  | -                           |
| 33                         | 3006                        | 133                                                  | 9600                           | 3                                                  | -                           |
| 34                         | 3367                        | 211                                                  | 10400                          | 3                                                  | -                           |
| 35                         | 3771                        | 189                                                  | 11200                          | 0                                                  | -                           |
| 36                         | 4223                        | 168                                                  | 12000                          | 0                                                  | -                           |
| 37                         | 4730                        | 150                                                  | 12800                          | 0                                                  | -                           |
| 38                         | 5298                        | 134                                                  | 13600                          | 0                                                  | -                           |
| 39                         | 5934                        | 107                                                  | 14400                          | 0                                                  | -                           |
| 40                         | 6646                        | 95                                                   | 15200                          | 0                                                  | -                           |
| 41                         | 6646                        | 95                                                   | 16000                          | 0                                                  | -                           |

### 9.3.4 Notes

- The gain parameters corresponding to the rigid level can be adjusted independently in the fast adjustment mode.
- The Quick Adjustment mode defaults to a rigid level. If the gain does not meet mechanical requirements, adjust it gradually.
- In order to ensure stability, the model ring gain is given small in low rigidity level, and the value of this parameter can be increased separately when high response is required.
- To quickly address vibration issues, adjust the torque command filter P2-35. If ineffective, perform mechanical characteristic analysis and set the relevant notch parameters (refer to Section 9.7 Vibration Suppression).

## 9.4 Automatic Adjustment

### 9.4.1 Overview

Automatic adjustment is divided into internal instruction self-adjustment and external instruction self-adjustment.

Automatic adjustment (internal command self-adjustment) is a function where the servo unit automatically operates (forward and reverse reciprocating motion) without commands from the upper device, adjusting according to mechanical characteristics during operation.

Automatic adjustment (external command self-adjustment) is a function that automatically optimizes the operation based on commands from the higher-level device.

Auto-adjustments are as follows:

- load moment of inertia
- Gain parameters (velocity loop, position loop, model loop gain)
- Filter (notch filter, torque command filter)

### 9.4.2 Notes

When adjustments cannot be made

- Mechanical system can only run in one direction.

Conditions in which adjustments are likely to fail

- The load has too large rotational inertia;
- The moment of inertia changes greatly in the running process;
- The low mechanical rigidity causes vibration during operation, and the detection and positioning fail.
- The running distance is small, within 0.5 circles.

Preparation work before setting

- Use location mode;
- The drive is in BB mode.
- The drive has no alarm.
- The coordination between the number of pulses per revolution and the width of the completed positioning is reasonable.

### 9.4.3 Operating Tools

Both internal and external command self-adjustment can be performed through the driver panel and XinJeServo upper computer software.

| set mode | Tools | Restriction |
|----------|-------|-------------|
|----------|-------|-------------|

|                                      |                                   |                                           |
|--------------------------------------|-----------------------------------|-------------------------------------------|
| internal instruction self adjustment | XinJeServo Host Computer Software | All versions of the host software support |
| external command auto setting        | drive panel                       | All DM6C driver inverter modules support  |



The driver firmware version is displayed in U2-07.

## 9.4.4 Internal instructions for self-adjustment operation steps

### 1. Self-adjustment steps for the drive panel

1. Perform inertia identification by following the driver panel estimation procedure in step 9.2.4 of rotational inertia estimation.

2. Enter the parameter F0-09 to display 'iat-'.

iat -

3. Press and hold the ENTER key, the panel will display 'iat--', indicating the servo is now enabled.

iat - -

4. Press and hold INC or DEC to activate the adjustment mode, where the panel displays 'tune' with a flashing indicator.

tune

5. The driver automatically sends pulse commands internally. If the setup is successful, it displays 'done' and flashes.

done

6. Press and hold the STA/ESC keys to exit the internal command auto-adjustment.



During the calibration process, a short press of STA/ESC will terminate the operation and revert to the original gain settings. If calibration fails, always reinitialize the driver before attempting it again.

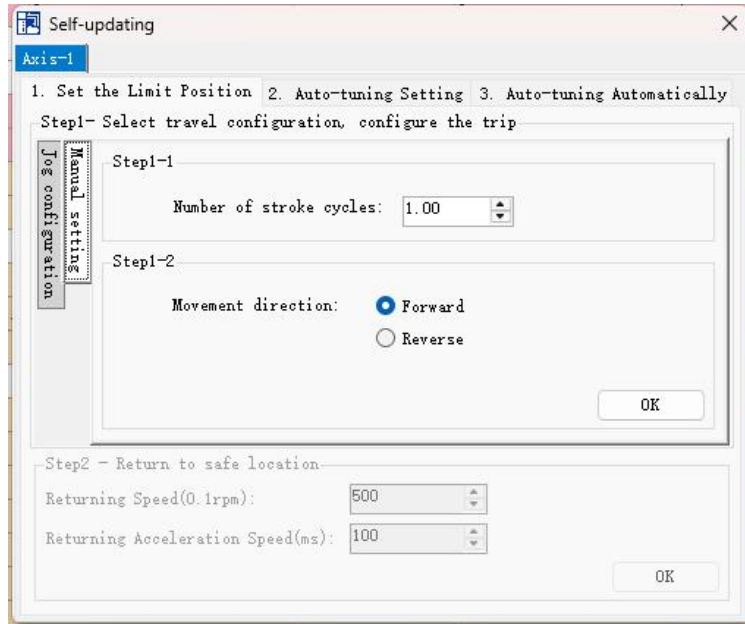
### ● Self-tuning process panel error alarm

| error code | meaning                                                             | Possible reasons                                           |
|------------|---------------------------------------------------------------------|------------------------------------------------------------|
| Err-1      | Failed to find the optimal gain                                     | The inertia ratio is too large; the mechanism is too weak  |
| Err-2      | Excessive range/alarm during self-tuning                            | Ensure the trip has no over-trip or alarm before resetting |
| Err-6      | The drive is not in the "bb" state when the operation is performed. | Check the current status of the drive                      |
| Err-7      | The driver generates an alarm during the                            | The drive has an alarm                                     |

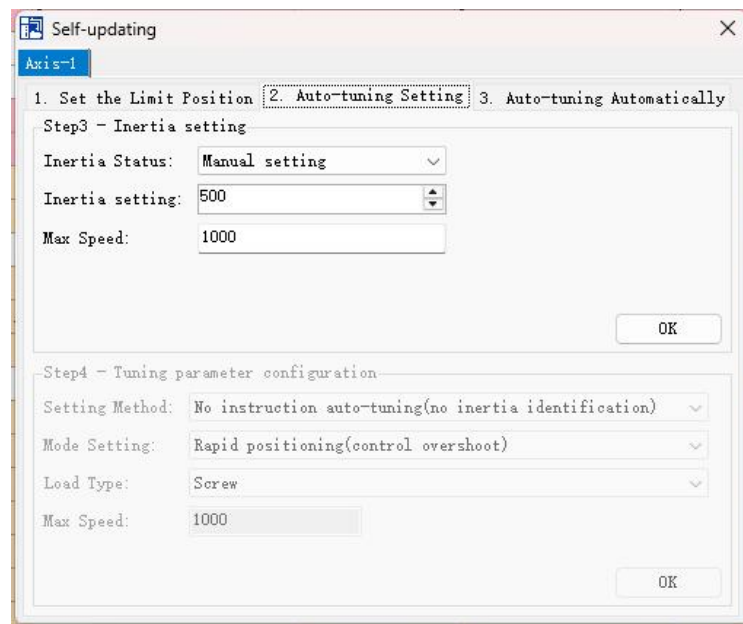
|  |                      |  |
|--|----------------------|--|
|  | calibration process. |  |
|--|----------------------|--|

## 2. XinJeServo self-tuning procedure

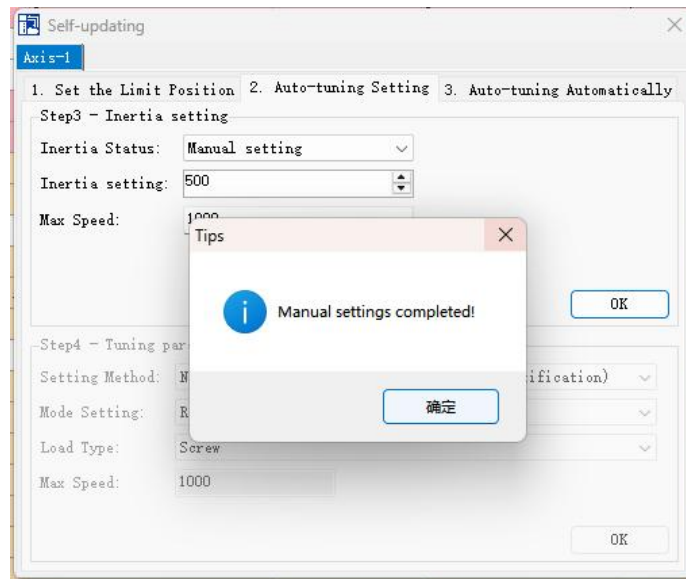
1. On the XinJeServo main menu screen, select [Self-Adjust].
2. Select [Point Motion Configuration] or [Manual Setting] to configure the inertia estimation travel.



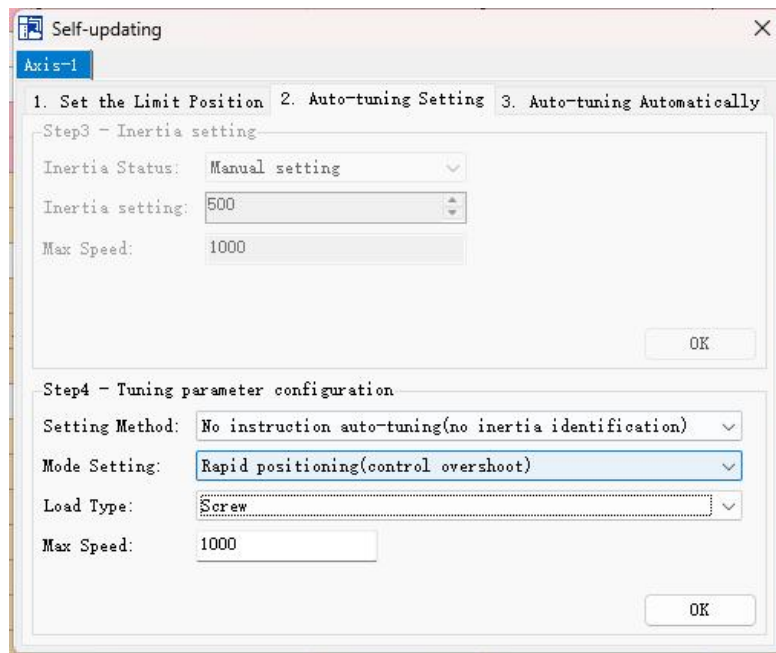
## 3. Set the configuration interface.



4. Click [Confirm] to start the inertia calculation.



#### 5. Setting parameters.

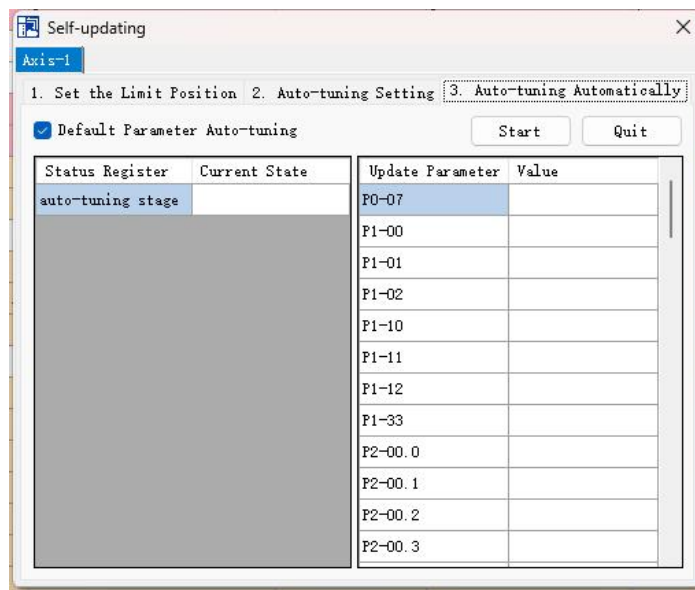


| adjustment method | explain                                                                                                                          |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------|
| soft              | Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.                        |
| quick positioning | Adjusts for positioning purposes. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter. |
| quick             | In the purpose of positioning, the adjustment focuses on avoiding overshoot. In                                                  |

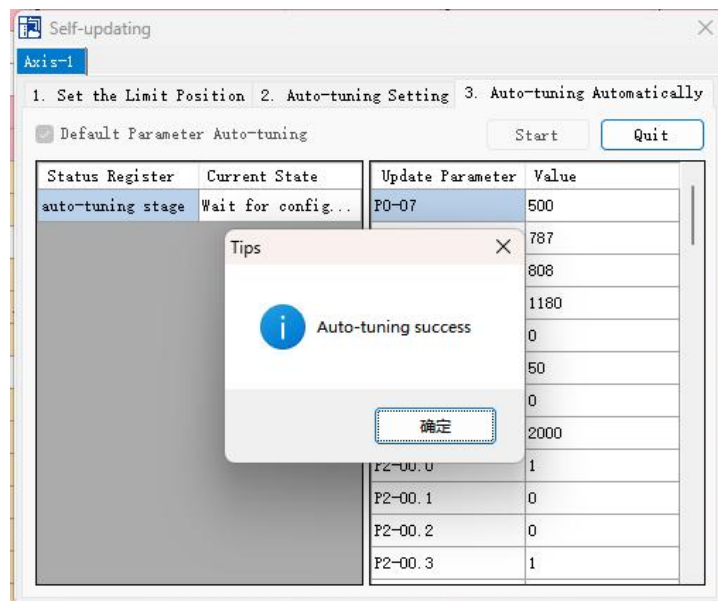


|                                           |                                                                                                                                 |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| positioning<br>(overshoot<br>control)     | addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.                                   |
| rigidity class                            | explain                                                                                                                         |
| locking-in<br>range on<br>synchronization | The adjustment is suitable for the lower rigidity mechanism such as the synchronous belt mechanism.                             |
| lead screw                                | Adjust for high-rigidity mechanisms such as ball screw mechanisms. Select this type if no corresponding mechanism is available. |
| fixed joint                               | The adjustment is suitable for rigid body system and other rigid mechanism.                                                     |

6. Start the adjustment.



7. Wait for the adjustment to complete.



## 9.4.5 External Command Self-Adjustment Operation Steps

### 1. Self-adjustment steps for the drive panel

1. Perform inertia identification by following the driver panel estimation procedure in step 9.2.4 of rotational inertia estimation.
2. When entering parameter F0-08, the system displays Eat- (External Reference Auto-tuning);

Eat-

3. Press and hold the ENTER key. If the enable function is not enabled, the panel will display 'Son' and flash, then wait for the enable function to activate. If the enable function is already enabled, skip this step.

Son

4. Activate the servo, the panel displays 'tune' with a flashing indicator, and the system enters the calibration phase.

tune

5. The upper device initiates pulse command transmission. Upon successful calibration, it displays 'done' with a flashing indicator.

done

6. Press and hold the STA/ESC keys to exit the external command auto-adjustment.



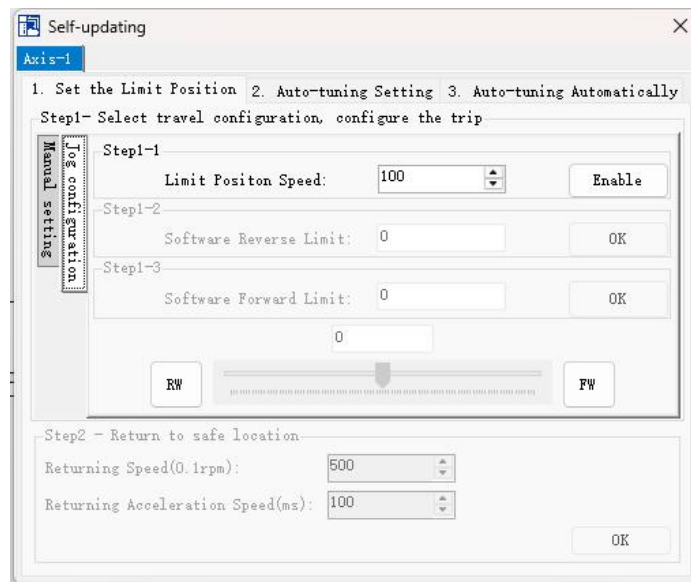
During the calibration process, a short press of STA/ESC will terminate the operation and revert to the original gain settings.

#### ● Self-tuning process panel error alarm

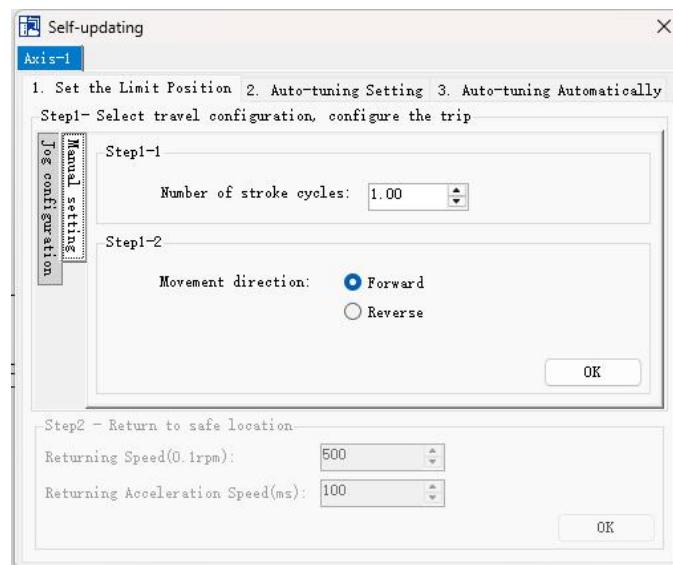
| error code | meaning                                                                                                                                                                      | Possible reasons                                                                                                             |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Err-1      | Failed to find the optimal gain                                                                                                                                              | The inertia ratio is too large; the mechanism is too weak                                                                    |
| Err-2      | ① During the self-adjustment process, an over-range or alarm occurred.<br>② External command setting/vibration suppression mode: Servo is enabled during the setting process | Ensure the trip has no over-trip or alarm before resetting<br>Confirm that enabling is not disabled during the setup process |
| Err-3      | Current non-position control mode                                                                                                                                            | Set the location mode to auto-adjust                                                                                         |
| Err-4      | Adaptive feature is not turned off                                                                                                                                           | Set P2-01.0 to 0 before performing self-tuning                                                                               |
| Err-7      | The driver generates an alarm during the calibration process.                                                                                                                | The drive has an alarm.                                                                                                      |
| Err-8      | The positioning signal is unstable                                                                                                                                           | The command interval is too short                                                                                            |

### 2. XinJeServo self-tuning procedure

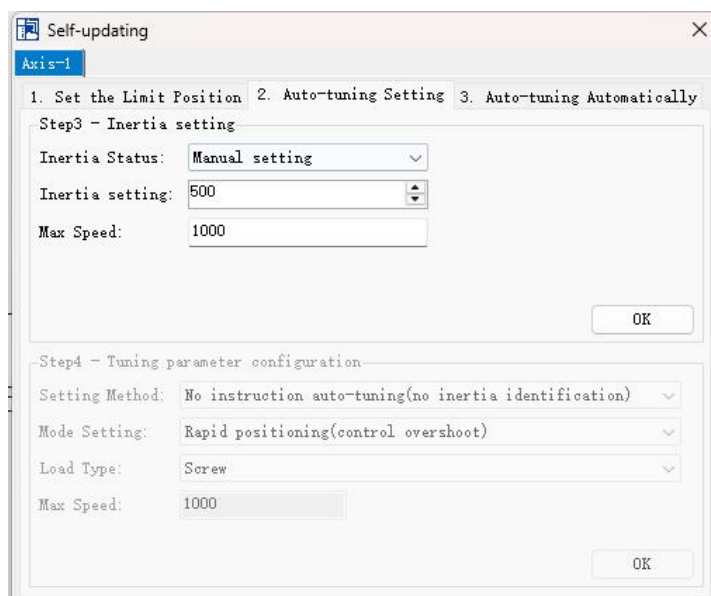
1. In the XinJeServo main menu, select [Self-Adjust].



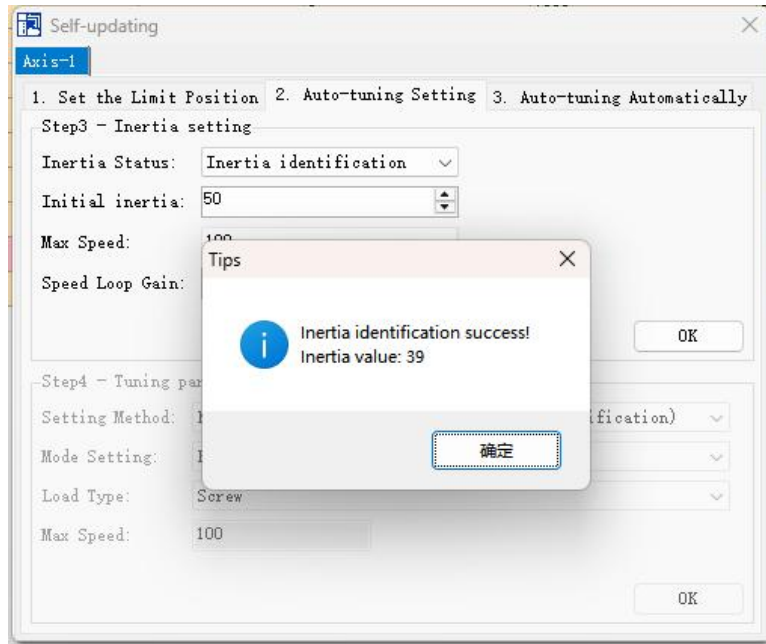
2. Select [Point Motion Configuration] or [Manual Setting] to configure the inertia estimation travel.



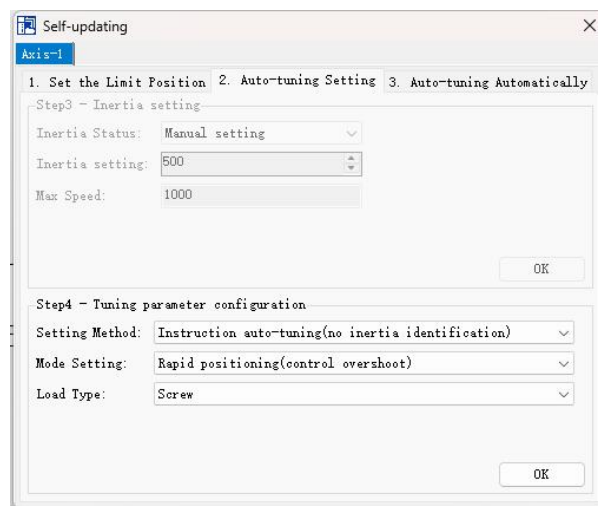
3. Set the configuration interface;



4. Click [Confirm] to start calculating the presumed inertia;



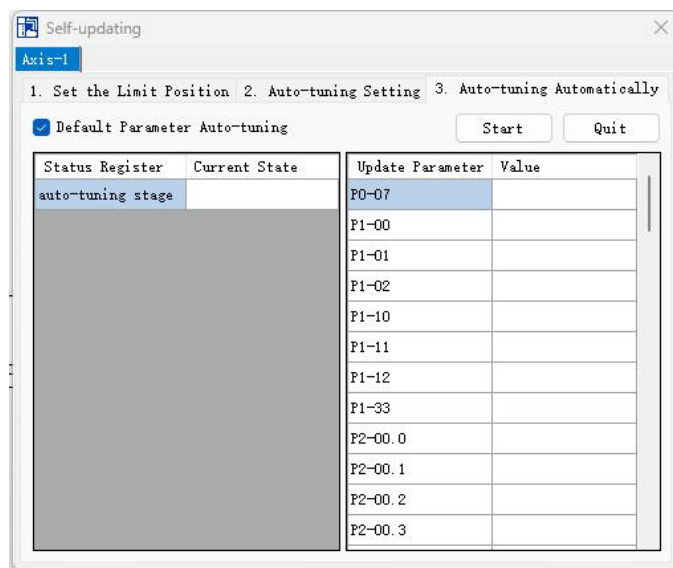
5. Set the parameters;



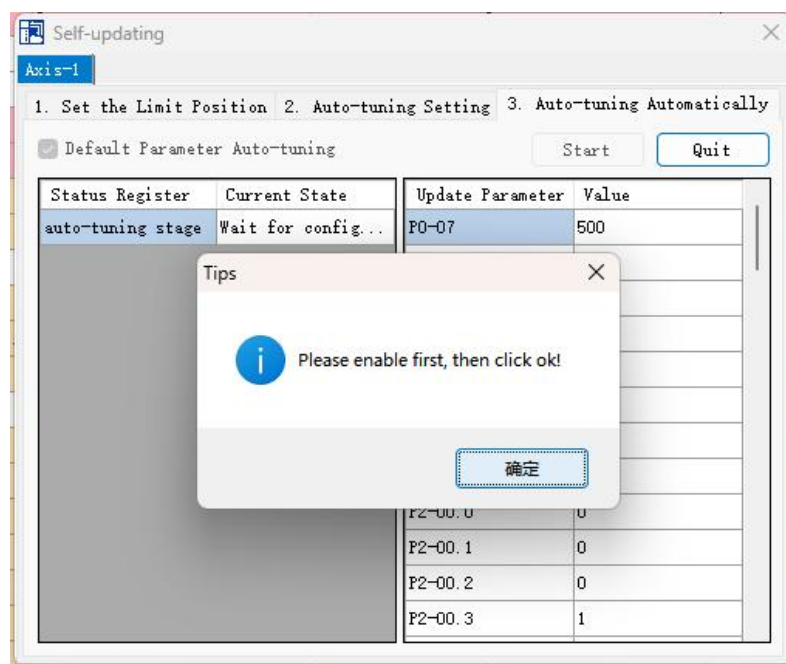
| adjustment method                     | explain                                                                                                                                                                       |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| soft                                  | Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.                                                                     |
| quick positioning                     | Adjusts for positioning purposes. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.                                              |
| quick positioning (overshoot control) | In the purpose of positioning, the adjustment focuses on avoiding overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted. |
| rigidity class                        | explain                                                                                                                                                                       |
| locking-in range on                   | Adjustment for the lower rigidity mechanism such as synchronous belt mechanism                                                                                                |

|                 |                                                                                                                                  |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------|
| synchronization |                                                                                                                                  |
| lead screw      | Adjust for high-rigidity mechanisms such as ball screw mechanisms. If no corresponding mechanism is available, select this type. |
| fixed joint     | Adjustment Suitable for Rigid System and Other Rigid Mechanism                                                                   |

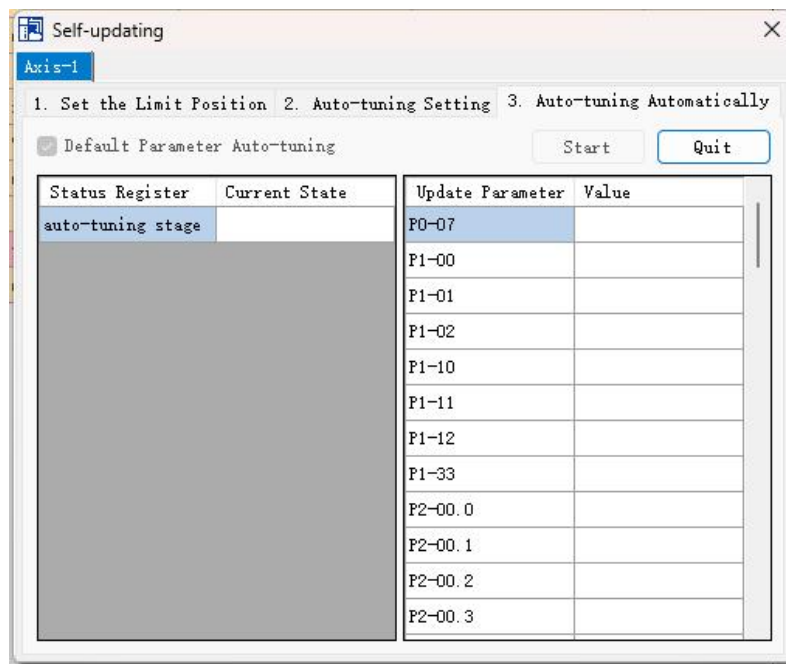
6. Start the adjustment process;



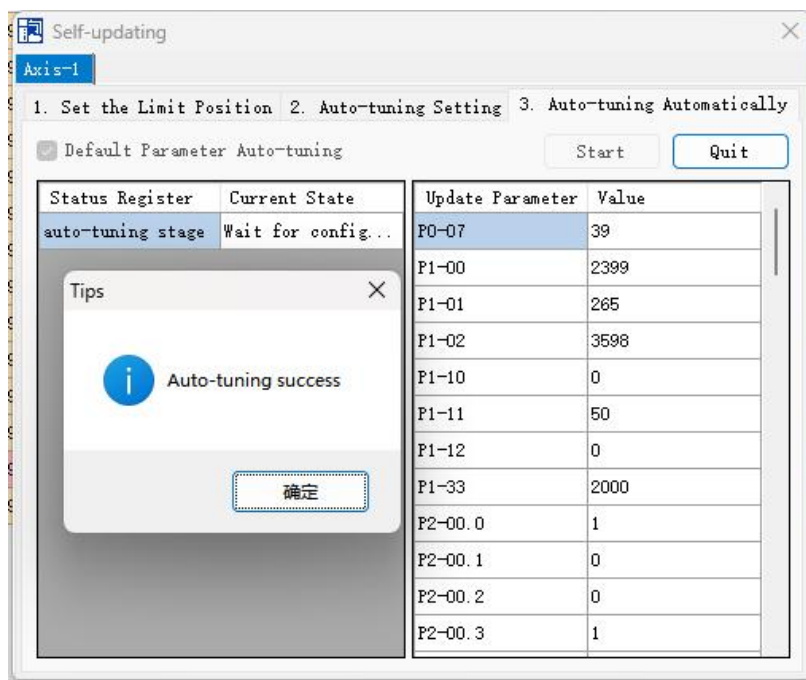
7. After enabling the servo, click OK.



8. The upper device initiates pulse command transmission and awaits the completion of calibration.



9. Complete the adjustment and click OK.



#### 9.4.6 Relevant parameters

The following parameters may be modified during automatic adjustment. Do not change them manually.

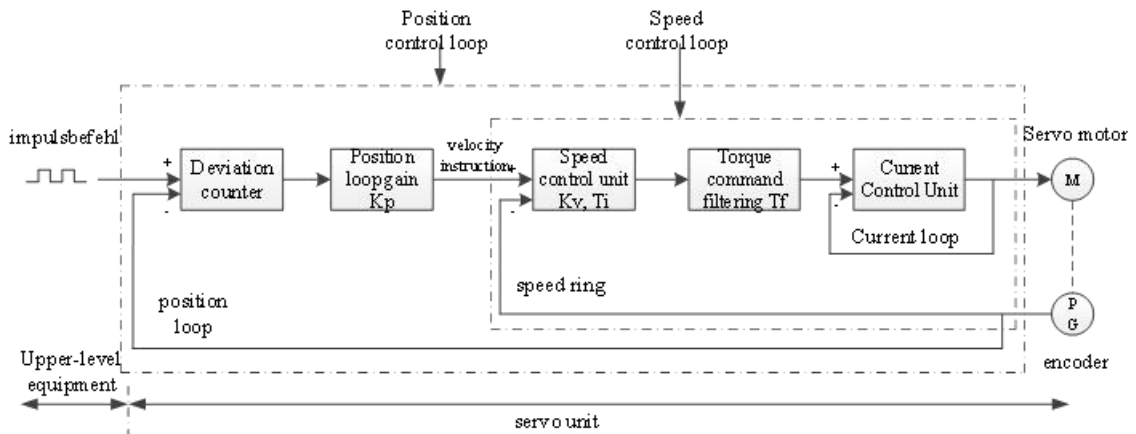
| parameter | name                                                                        | parameter attribute         | The effect of the numerical value on the gain after the adjustment is finished |
|-----------|-----------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------|
| P0-07     | first inertia ratio                                                         | gain performance parameter  | have                                                                           |
| P1-00     | first speed loop gain                                                       |                             |                                                                                |
| P1-01     | first speed loop integral time constant                                     |                             |                                                                                |
| P1-02     | first position loop gain                                                    |                             |                                                                                |
| P2-00.0   | perturbation observer switch                                                |                             |                                                                                |
| P2-01.0   | adaptive mode switch                                                        |                             |                                                                                |
| P2-35     | Torque command filter time constant 1                                       |                             |                                                                                |
| P2-41     | perturbation observer gain                                                  |                             |                                                                                |
| P2-47.0   | model loop switch                                                           |                             |                                                                                |
| P2-49     | model loop gain                                                             |                             |                                                                                |
| P2-55     | model speed feedforward gain                                                |                             |                                                                                |
| P2-60.0   | active vibration suppression switch                                         |                             |                                                                                |
| P2-61     | active vibration damping frequency                                          |                             |                                                                                |
| P2-62     | active vibration damping gain                                               |                             |                                                                                |
| P2-63     | active vibration damping                                                    |                             |                                                                                |
| P2-64     | Active vibration suppression filter time 1                                  |                             |                                                                                |
| P2-65     | Active vibration suppression filtering time 2                               |                             |                                                                                |
| P2-66     | The second group uses active vibration damping and damping techniques.      |                             |                                                                                |
| P2-67     | The second group has an active vibration suppression frequency.             |                             |                                                                                |
| P2-69.0   | first notch switch                                                          |                             |                                                                                |
| P2-69.1   | second notch switch                                                         |                             |                                                                                |
| P2-71     | first notch frequency                                                       |                             |                                                                                |
| P2-72     | first notch attenuation                                                     |                             |                                                                                |
| P2-73     | first notch bandwidth                                                       |                             |                                                                                |
| P2-74     | second notch frequency                                                      |                             |                                                                                |
| P2-75     | second notch attenuation                                                    |                             |                                                                                |
| P2-76     | second notch bandwidth                                                      |                             |                                                                                |
| P2-17     | Inertia Identification and Self-adjusting Maximum Speed of Internal Command | set configuration parameter | not have                                                                       |
| P2-86     | fixed point motion mode                                                     |                             |                                                                                |
| P2-87     | minimum limit of set motion                                                 |                             |                                                                                |
| P2-88     | Maximum limit of the set motion                                             |                             |                                                                                |
| P2-89     | maximum speed of the set motion                                             |                             |                                                                                |
| P2-90     | set acceleration and deceleration time                                      |                             |                                                                                |



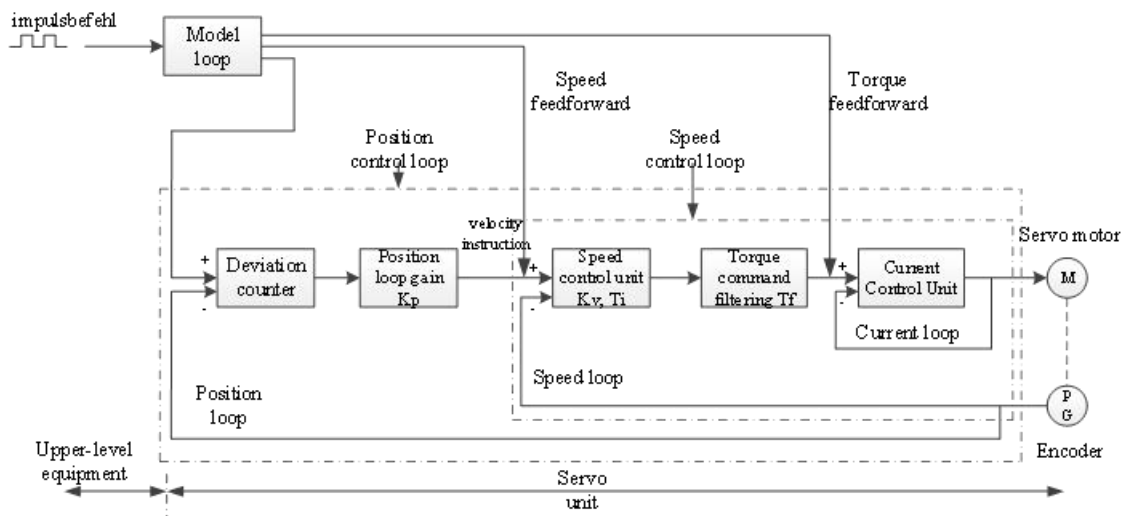
P2-60 ~ P2-63 are automatically adjusted during the self-tuning process and cannot be modified manually by users, as manual adjustments may cause system instability.

## 9.5 Manual adjustment

### 9.5.1 Overview



Position control (model loop off) control block diagram



Position control (enable model loop) control block diagram

The servo unit consists of three feedback loops (from inner to outer: current loop, speed loop, position loop). The inner loop requires higher responsiveness. Failure to adhere to this principle may result in reduced responsiveness or vibration. The current loop parameters are fixed values that ensure adequate responsiveness, eliminating the need for user adjustment.

Use manual adjustment in the following situations:

- When the desired effect cannot be achieved through rapid gain adjustment
- When automatic gain adjustment fails to achieve the desired effect



## 9.5.2 Example of adjustment steps

If the self-adjustment is selected in the gentle mode (P2-02.0=1) in the position mode, the model loop function is turned off; the position loop gain is invalid in the speed mode.

Improve response time

1. Decrease the torque command filter time constant (P2-35)
2. Boost the speed loop gain (P1-00)
3. Reduce the integral time parameter of the speed loop (P1-01)
4. Enhance the position loop gain (P1-02)
5. Improving the model loop gain (P2-49)

Reduce response, prevent vibration and overshoot

1. Reduce the speed loop gain (P1-00)
2. Increase the integral time constant of the speed loop (P1-01)
3. Reduce the position loop gain (P1-02)
4. Increase the torque command filter time constant (P2-35)
5. Reduce the model loop gain (P2-49)

## 9.5.3 Adjusted gain parameters

The gain parameters to be adjusted are generally:

P1-00 Speed loop gain

P1-01 Integral Time Constant of Speed Loop

P1-02 Position loop gain

P2-35 Torque command filter time constant

P2-49 model loop gain

- speed loop gain

When the speed loop is slow, it will be a delay element of the outer position loop, and the overshoot or the vibration of the speed command will occur. Therefore, in the range that the mechanical system does not vibrate, the larger the set value is, the more stable and responsive the servo system is.

| parameter | meaning         | factory setting | unit  | Set range  | revise      | come into force |
|-----------|-----------------|-----------------|-------|------------|-------------|-----------------|
| P1-00     | speed loop gain | 300             | 0.1Hz | 10 ~ 20000 | at any time | immediately     |

- integral time constant of velocity loop

In order to make the servo system respond to the small input, the speed loop contains an integral element. Because the integral element is a delay element for the servo system, when the time constant is set too large, overshoot will occur or the positioning time will be prolonged, and the responsiveness will be reduced.

The speed loop gain and the speed loop integral time constant satisfy the following relation:

$$P1-00 \times P1-01 = 636620$$

| parameter | meaning                                 | factory setting | unit   | Set range  | revise      | come into force |
|-----------|-----------------------------------------|-----------------|--------|------------|-------------|-----------------|
| P1-01     | integral time constant of velocity loop | 2653            | 0.01ms | 15 ~ 51200 | at any time | immediately     |

- position loop gain

When the model loop is invalid (P2-47.0=0), the responsiveness of the servo unit's position loop is determined by the position loop gain. The higher the position loop gain, the more responsive it is, and the shorter the positioning time. Generally, the position loop gain should not be increased beyond the range of the natural frequencies of the mechanical system. Therefore, to set a higher position loop gain, the rigidity of the machine must be increased, and the natural frequencies of the machine must be raised.

| parameter | meaning            | factory setting | unit  | Set range  | revise      | come into force |
|-----------|--------------------|-----------------|-------|------------|-------------|-----------------|
| P1-02     | position loop gain | 480             | 0.1/s | 10 ~ 20000 | at any time | immediately     |

- torque command filter time constant

If the machine vibrates due to servo drive, adjusting the torque command filter time parameter may eliminate the vibration. A smaller value enables better responsiveness, but it is limited by the machine's condition. When vibration occurs, reduce this parameter. The recommended adjustment range is 10 to 150.

| parameter | meaning                               | factory setting | unit   | Set range | revise      | come into force |
|-----------|---------------------------------------|-----------------|--------|-----------|-------------|-----------------|
| P2-35     | Torque command filter time constant 1 | 66              | 0.01ms | 0 ~ 65535 | at any time | immediately     |
| P2-36     | Torque command filter time constant 2 | 100             | 0.01ms | 0 ~ 65535 | at any time | immediately     |



When the first set of gain parameters is used, P2-35 takes effect; when the second set is used, P2-36 takes effect.

- model loop gain

When the model loop is active (P2-47.0=1), the responsiveness of the servo system is determined by the model loop gain. If the model loop gain is increased, the responsiveness increases and the positioning time is reduced. In this case, the responsiveness of the servo system depends on this parameter, not P1-02 (position loop gain). The model loop gain is only effective for the position mode.

| parameter | meaning         | factory setting | unit  | Set range  | revise      | come into force |
|-----------|-----------------|-----------------|-------|------------|-------------|-----------------|
| P2-49     | model loop gain | 480             | 0.1Hz | 10 ~ 20000 | at any time | immediately     |

## 9.6 Adaptive adjustments

### 9.6.1 Overview

Adaptive function is the function that can get stable response by automatic adjustment no matter the machine type and load fluctuation.

### 9.6.2 Notes

- When the servo unit is installed on the machine, it may emit a brief sound during initial startup. This is due to the automatic notch filter setup, not a malfunction. The sound will not occur during subsequent startups.
- The motor may vibrate when operating beyond its allowable load inertia. Adjust the adaptive parameters to match the current load inertia.
- To ensure safety in adaptive operations, enable adaptive functions with emergency stop or shutdown capabilities available at any time.

### 9.6.3 Operating Procedures

Factory settings are adaptive and effective without modifying other parameters. The adaptive effect is controlled by the following parameters.

| parameter |        | meaning            | factory setting | revise   | come into force |
|-----------|--------|--------------------|-----------------|----------|-----------------|
| P2-01     | n.□□□0 | adaptive shutdown  | n.□□□0          | servo bb | Power on again  |
|           | n.□□□1 | Open automatically |                 |          |                 |

### 9.6.4 Inertial Mode and Related Parameters

The adaptive default setting is set to low inertia mode. If the load inertia significantly exceeds the motor's allowable load inertia (e.g., 60 times the inertia of a 60 motor), you can activate the adaptive high inertia mode.

| parameter |        | meaning                     | factory setting | revise   | come into force |
|-----------|--------|-----------------------------|-----------------|----------|-----------------|
| P2-03     | n.0□□□ | adaptive small inertia mode | n.0□□□          | servo bb | Power on again  |
|           | n.1□□□ | adaptive large inertia mode |                 |          |                 |

| parameter | meaning                                                              | factory setting | revise         | come into force     |
|-----------|----------------------------------------------------------------------|-----------------|----------------|---------------------|
| P2-05     | adaptive speed loop gain                                             | 400             | servo bb       | Power on again      |
| P2-10     | adaptive velocity loop integration                                   | 500             | servo bb       | Power on again      |
| P2-11     | adaptive position loop gain                                          | 100             | servo bb       | Power on again      |
| P2-07     | adaptive inertia ratio                                               | 0               | servo bb       | Power on again      |
| P2-08     | Gain of adaptive velocity observer                                   | 60              | servo bb       | Power on again      |
| P2-12     | adaptive stability maximum inertia ratio                             | 30              | servo bb       | Power on again      |
| P2-16     | Adaptive control of motor rotor inertia coefficient                  | 100             | servo bb       | Power on again      |
| P2-19     | adaptive control bandwidth                                           | 50              | Change anytime | Instantly effective |
| P6-05     | Gain of adaptive large inertia mode speed loop                       | 200             | servo bb       | Power on again      |
| P6-07     | adaptive large inertia mode inertia ratio                            | 50              | servo bb       | Power on again      |
| P6-08     | Gain of adaptive large inertia mode speed observer                   | 40              | servo bb       | Power on again      |
| P6-12     | Adaptive Large Inertia Mode Stabilization with Maximum Inertia Ratio | 50              | servo bb       | Power on again      |

### 9.6.5 Recommended Inertia Ratio Parameters

Adaptive default parameters only ensure stable operation of the load under a certain moment of inertia. If the load has a large moment of inertia, some parameters still need to be adjusted. The recommended parameters are as follows (all modified parameters are based on the default settings).

| motor base          | inertia                     | parameter                                                                   |
|---------------------|-----------------------------|-----------------------------------------------------------------------------|
| 40 ~ 90 engine base | Within 20 times the inertia | Adaptive small inertia mode (default)                                       |
|                     | 20 to 30 times the inertia  | Change P2-08 to 50 and P2-12 to 40                                          |
|                     | 30 to 40 times the inertia  | Change P2-08 to 50, P2-12 to 40, and P2-07 to 10                            |
|                     | 40 to 50 times the inertia  | Change P2-08 to 50, P2-12 to 40, and P2-07 to 30                            |
|                     | 50 to 80 times the inertia  | Switch to adaptive high-inertia mode or adjust P2-08=40, P2-12=50, P2-07=50 |
| 110/130 Engine      | Within 10 times the inertia | Adaptive small inertia mode (default)                                       |

| motor base         | inertia                    | parameter                                                                   |
|--------------------|----------------------------|-----------------------------------------------------------------------------|
| Base               | 10 to 15 times the inertia | Change P2-08 to 50 and P2-12 to 40                                          |
|                    | 15 to 20 times the inertia | Switch to adaptive high-inertia mode or adjust P2-08=40, P2-12=50, P2-07=50 |
| 180 and above base | Within 5 times the inertia | Adaptive small inertia mode (default)                                       |
|                    | 5 to 10 times the inertia  | Change P2-08 to 50 and P2-12 to 40                                          |
|                    | 10 to 20 times the inertia | Switch to adaptive high-inertia mode or adjust P2-08=40, P2-12=50, P2-07=50 |



The parameters with large inertia can still carry the load with small inertia, for example, the parameters with 50 times inertia are used in the mechanism with 20 times load inertia, but the responsiveness will be worse.

### 9.6.6 Effects of adaptive correlation parameters

| parameter small inertia / large inertia | name                                                   | Windows default | Reference tilt Section range | effect                                                                                                                                                                              |
|-----------------------------------------|--------------------------------------------------------|-----------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P2-05/P6-05                             | Gain of Velocity Loop in Adaptive Mode                 | 400/200         | 200 ~ 400                    | Reducing the value improves inertia capacity but decreases responsiveness, significantly affecting responsiveness.                                                                  |
| P2-07/P6-07                             | Load Inertia Ratio in Adaptive Mode                    | 0/50            | 0 ~ 200                      | The increase of the inertia capacity can be greatly improved, and the response is not affected, but the excessive increase is easy to produce oscillation.                          |
| P2-08/P6-08                             | velocity observer gain                                 | 60/40           | 30 ~ 60                      | Reducing P2-08 while increasing P2-12 can significantly enhance the inertia carrying capacity, but it will reduce responsiveness, which has a significant impact on responsiveness. |
| P2-12/P6-12                             | Adaptive Mode Stabilization with Maximum Inertia Ratio | 30/50           | 30 ~ 60                      |                                                                                                                                                                                     |
| P2-10                                   | Adaptive mode speed loop integral time coefficient     | 500             | 200 or more                  | Adjust as needed, usually increase                                                                                                                                                  |
| P2-11                                   | Adaptive mode position loop gain coefficient           | 100             | 50 ~ 200                     | Adjust as needed to increase response speed and decrease response time                                                                                                              |

| parameter<br>small inertia /<br>large inertia | name                                                            | Windows<br>default | Reference<br>tilt<br>Section<br>range | effect                                                                                                                                    |
|-----------------------------------------------|-----------------------------------------------------------------|--------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| P2-16                                         | Inertia<br>Coefficient of<br>Rotor in<br>Adaptive Mode<br>Motor | 100                | 100 ~ 200                             | Increase the servo rigidity and enhance the anti-disturbance capability to solve the operation jitter.                                    |
| P2-19                                         | adaptive control<br>bandwidth                                   | 50 ~ 70            | 40 ~ 80                               | Increasing the magnitude slightly enhances the inertia capacity with minimal impact on responsiveness, serving as an auxiliary parameter. |

### 9.6.7 Adaptive parameters that become invalid when their validity period expires

The parameters that become invalid when the adaptive function is effective (P2-01.0=1) are shown in the following table:

| project    | parameter | Parameter name                           |
|------------|-----------|------------------------------------------|
| gain class | P1-00     | first speed loop gain                    |
|            | P1-05     | second speed loop gain                   |
|            | P1-01     | first speed loop integral time constant  |
|            | P1-06     | second speed loop integral time constant |
|            | P1-02     | first position loop gain                 |
|            | P1-07     | second position loop gain                |
|            | P2-49     | model loop gain                          |
|            | P0-07     | first inertia ratio                      |
|            | P0-08     | second moment of inertia ratio           |
|            | P5-36     | I-Sel Inertial Ratio Switching           |

## 9.7 Vibration Suppression

### 9.7.1 Overview

Mechanical system has a certain resonance frequency, when the servo gain is increased, it may produce continuous vibration near the mechanical resonance frequency, generally in 400Hz~1000Hz, which leads to the gain can not be increased further, the vibration can be eliminated by automatic detection or manual setting of vibration frequency, after the vibration is eliminated, if the response is needed to be increased, the gain can be increased further.



- After the vibration suppression operation, the servo responsiveness will change.
- Before performing vibration suppression, set the moment of inertia ratio and gain parameters correctly. Otherwise, the control will not function properly.

### 9.7.2 Operating Tools

| Adjustment method         | Tools                                            | control model    | Refer to the operation steps                         | Restriction                               |
|---------------------------|--------------------------------------------------|------------------|------------------------------------------------------|-------------------------------------------|
| adaptive mode             | Mechanical Characteristic Analysis of XinJeServo | In position mode | 9.7.4 Vibration Suppression (Host Computer Software) | All versions of the host software support |
| self-tuning mode          | Panel vibration inhibition operation             |                  | 9.7.3 Vibration Suppression (Panel)                  | not have                                  |
|                           | Mechanical Characteristic Analysis of XinJeServo |                  | 9.7.4 Vibration Suppression (Host Computer Software) | All versions of the host software support |
| self-tuning/adaptive mode | Panel vibration inhibition operation             |                  | 9.7.6 Vibration Suppression (easyFFT)                | not have                                  |

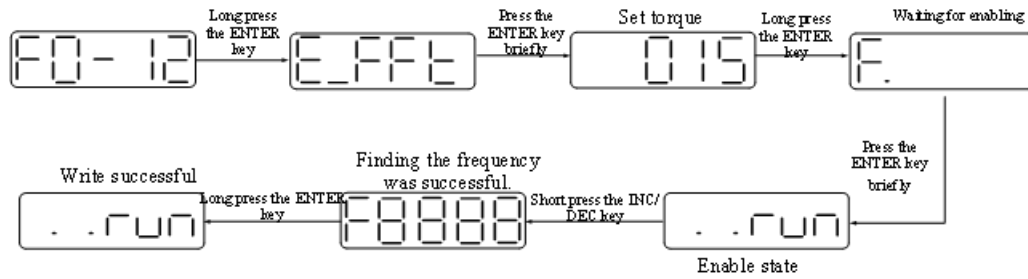


The driver firmware version is displayed in U2-07.

### 9.7.3 Vibration Suppression (Fast FFT)

The mechanical characteristic analysis can be carried out by F0-12 parameters on the servo operation panel, and the mechanical resonance frequency can be found out to realize the vibration suppression.

The complete process is shown below:



The following explains the steps:

1. Press and hold [ENT] on the F0-12 panel to activate the Quick FFT mode, displaying "E\_FFt".

E\_FFt

2. Press [ENT] to access the torque setting interface, where the current torque value (P6-89) is displayed. To adjust the torque command, press [▲] or [▼] for increment or decrement. When increasing the torque command, it is recommended to do so incrementally to prevent severe equipment vibration.

015

3. After setting the torque command, press and hold [ENT] to enter the 'Preparation for Enablement' phase, where the interface displays 'F.'.

F.

4. Press [ENT] to enable and display "...run";

...run

5. Press [▲] and [▼] to rotate the device in both directions to identify the resonant frequency. During operation, the interface will flash "E\_FFt". If the resonant frequency is detected, the interface will display "Fxxxx", where "xxxx" represents the resonant frequency. If the search fails, the interface will show "F----".

F8888

6. Whether displaying "Fxxxx" or "F----", continue pressing [▲] and [▼] to locate the resonant frequency. Once identified, hold [ENT] to transfer the displayed frequency to the driver's notch filter.

...run

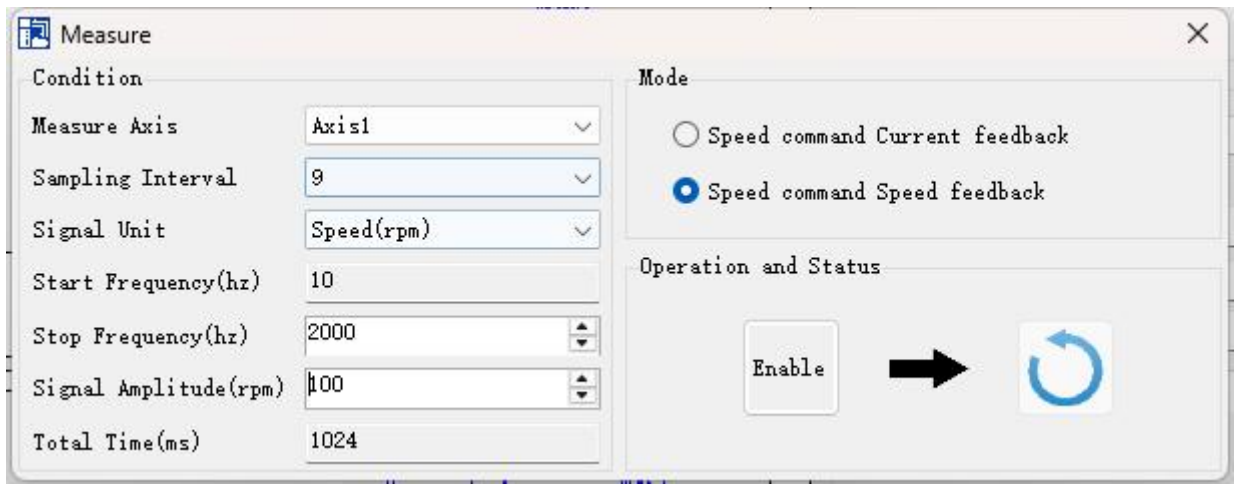


Press the STA/ESC keys to return to the previous step. Press [STA] to exit.

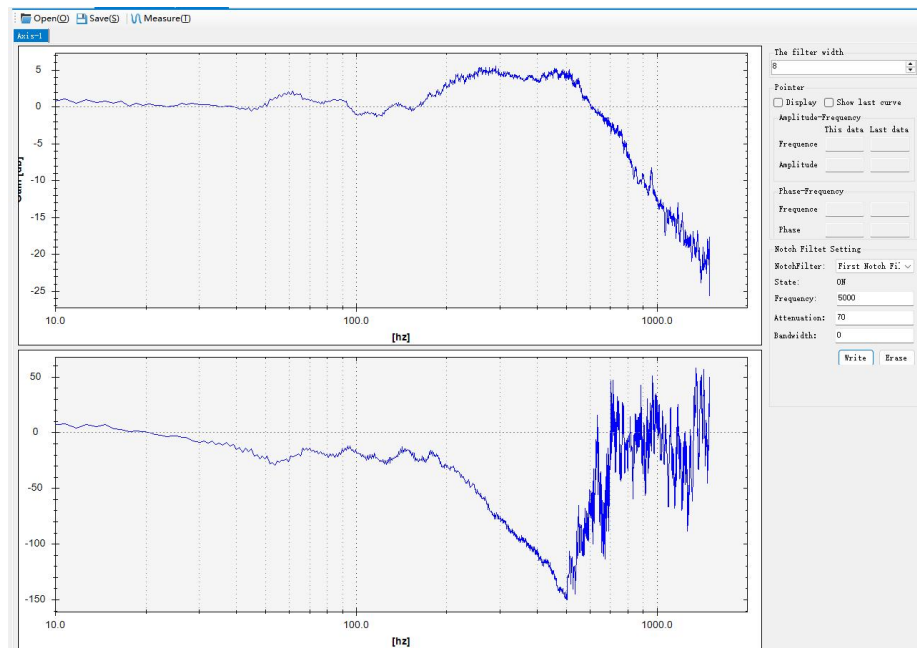
## 9.7.4 Vibration Suppression (Host Computer Software)

1. Launch the XinJeServo host software and select the mechanical properties.
2. Click [Measure];





3. Configure test conditions, then click [Execute];
4. Select [Amplitude and Phase];



5. Set the filter width (to clearly identify the resonance frequency) and determine the resonance frequency.

6. The band-stop filter parameters require manual configuration. For details, refer to Section 9.7.6 on band-stop filters.

As shown in the figure above, mechanical analysis indicates a resonance frequency of 328Hz. The third notch filter can be used with the following parameters:

P2-69=n.1000 P2-77=328



Whether in adaptive or self-tuning mode, mechanical characteristic analysis is equivalent to manual notch setting. If multiple resonance points exist, configure the third to fifth notchers sequentially.

### 9.7.5 Vibration Suppression (Manual Settings)

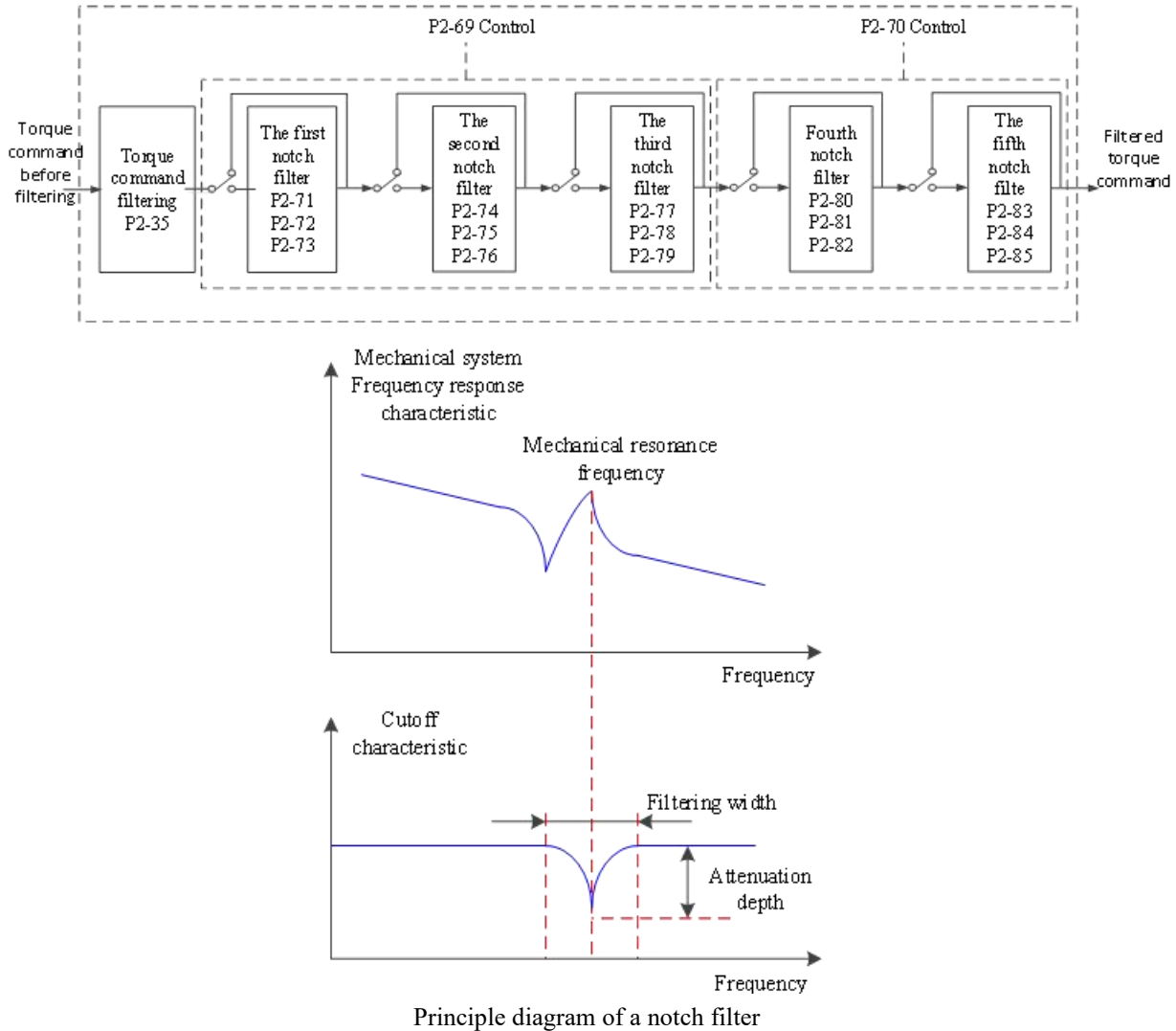
To eliminate vibration by manually setting the vibration frequency when the resonance frequency of the

mechanical system is known, configure the third to fifth notch filters. For related parameters, see 9.7.6 Notch Filters.

## 9.7.6 Bandpass Filter

The mechanical resonance can be suppressed by reducing the gain at a specific frequency. After the proper setting of the notch, the vibration can be effectively suppressed, and the servo gain can be increased.

The schematic diagram of the notch filter is shown below:



The servo driver has 5 groups of notch filter, each group has 3 parameters, namely notch frequency, notch attenuation, notch bandwidth. The first and second notch filter are automatically set, the third, fourth and fifth are manually set.

The torque command filter and notch filter are in series in the system, as shown in the figure below, where the switch of the notch filter is controlled by P2-69 and P2-70.

| parameter | meaning | factory setting | revise | come into force |
|-----------|---------|-----------------|--------|-----------------|
|-----------|---------|-----------------|--------|-----------------|

| parameter |        | meaning                     | factory setting | revise      | come into force |
|-----------|--------|-----------------------------|-----------------|-------------|-----------------|
| P2-69     | n.□□□0 | first notch is off          | n.□□□0          | at any time | immediately     |
|           | n.□□□1 | The first notch is opened   |                 |             |                 |
|           | n.□□0□ | second choke is off         | n.□□0□          | at any time | immediately     |
|           | n.□□1□ | The second choke is open    |                 |             |                 |
|           | n.0□□□ | third choke is off          | n.0□□□          | at any time | immediately     |
|           | n.1□□□ | The third choke is open     |                 |             |                 |
| P2-70     | n.□□□0 | fourth notch is off         | n.□□□0          | at any time | immediately     |
|           | n.□□□1 | The fourth notch is opened. |                 |             |                 |
|           | n.□□0□ | Fifth notch is closed       | n.□□0□          | at any time | immediately     |
|           | n.□□1□ | The fifth notch is opened.  |                 |             |                 |

| parameter | meaning                    | factory setting | unit  | Set range | revise      | come into force |
|-----------|----------------------------|-----------------|-------|-----------|-------------|-----------------|
| P2-71     | first notch frequency      | 8000            | Hz    | 50 ~ 8000 | at any time | immediately     |
| P2-72     | first notch attenuation    | 71              | 0.1dB | 50 ~ 1600 | at any time | immediately     |
| P2-73     | first notch bandwidth      | 0               | Hz    | 0 ~ 1000  | at any time | immediately     |
| P2-74     | second notch frequency     | 8000            | Hz    | 50 ~ 8000 | at any time | immediately     |
| P2-75     | second notch attenuation   | 71              | 0.1dB | 50 ~ 1600 | at any time | immediately     |
| P2-76     | second notch bandwidth     | 0               | Hz    | 0 ~ 1000  | at any time | immediately     |
| P2-77     | third notch frequency      | 8000            | Hz    | 50 ~ 8000 | at any time | immediately     |
| P2-78     | third stoppage attenuation | 71              | 0.1dB | 50 ~ 1600 | at any time | immediately     |
| P2-79     | third stopband             | 0               | Hz    | 0 ~ 1000  | at any time | immediately     |
| P2-80     | fourth notch frequency     | 8000            | Hz    | 50 ~ 8000 | at any time | immediately     |
| P2-81     | fourth notch attenuation   | 71              | 0.1dB | 50 ~ 1600 | at any time | immediately     |

| parameter | meaning                 | factory setting | unit  | Set range | revise      | come into force |
|-----------|-------------------------|-----------------|-------|-----------|-------------|-----------------|
| P2-82     | fourth notch bandwidth  | 0               | Hz    | 0 ~ 1000  | at any time | immediately     |
| P2-83     | fifth notch frequency   | 8000            | Hz    | 50 ~ 8000 | at any time | immediately     |
| P2-84     | fifth notch attenuation | 71              | 0.1dB | 50 ~ 1600 | at any time | immediately     |
| P2-85     | fifth notch bandwidth   | 0               | Hz    | 0 ~ 1000  | at any time | immediately     |



- The second notch filter is automatically configured when the vibration is detected in adaptive mode.
- In the auto-tuning mode, the system automatically configures the second and first notch filters upon detecting vibration, with the second filter being prioritized when a single vibration point is detected.
- Whether in adaptive or self-tuning mode, if mechanical characteristic analysis is used, it is considered manual notch setting. Configure the third to fifth notchers.

## 9.8 Gain adjustment application function

### 9.8.1 Model Ring Control

In self-tuning mode, the system incorporates model loop gain alongside speed and position loop gains, with the model loop gain being particularly influential on servo responsiveness. When the model loop is disabled, the position loop gain governs the servo response, whereas when enabled, the model loop gain takes over. Functioning as a feedforward mechanism in the driver control loop, the model loop's specific role is detailed in Section 9.5: Manual Adjustment.

The model loop function automatically turns off when the auto-tuning mode is set to Soft, and turns on when the auto-tuning mode is set to Fast Positioning or Fast Positioning (Control Overshoot).

self-tuning mode

| parameter |        | meaning                               | factory setting | revise      | come into force |
|-----------|--------|---------------------------------------|-----------------|-------------|-----------------|
| P2-02     | n.□□□1 | soft                                  | n.□□□3          | at any time | immediately     |
|           | n.□□□2 | quick positioning                     |                 |             |                 |
|           | n.□□□3 | Quick positioning (overshoot control) |                 |             |                 |

Selection of self-tuning mode:

P2-02.0=1: Softness

The method does not open the model loop gain, and the operation is soft, which is suitable for the occasions of insufficient mechanical rigidity and low responsiveness.

P2-02.0=2: Fast positioning

The response of the parameters is the fastest, but the overshoot is not suppressed.

③ Fast positioning (control overshoot) (P2-02.0=3):

The method has the advantage of fast response and can suppress overshoot.

| loadtype                            | explain                                                                                                                         |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| locking-in range on synchronization | The adjustment is suitable for the lower rigidity mechanism such as the synchronous belt mechanism.                             |
| lead screw                          | Adjust for high-rigidity mechanisms such as ball screw mechanisms. Select this type if no corresponding mechanism is available. |
| fixed joint                         | The adjustment is suitable for rigid body system and other rigid mechanism.                                                     |

| self-tuning mode | explain                                                                                                   |
|------------------|-----------------------------------------------------------------------------------------------------------|
| soft             | Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted. |
| quick            | Adjusts for positioning purposes. In addition to gain adjustment, it automatically                        |

|                                       |                                                                                                                                                                               |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| positioning                           | adjusts the model loop gain and notch filter.                                                                                                                                 |
| quick positioning (overshoot control) | In the purpose of positioning, the adjustment focuses on avoiding overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted. |

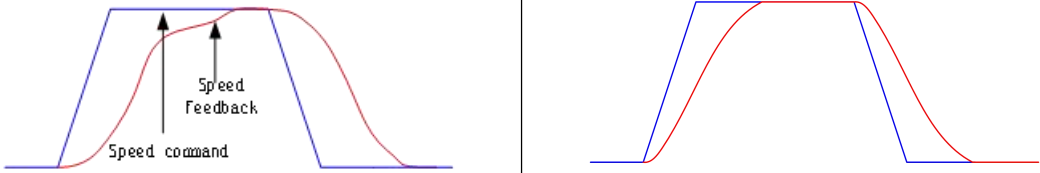
| parameter |        | meaning                               | factory setting | revise      | come into force |
|-----------|--------|---------------------------------------|-----------------|-------------|-----------------|
| P2-02     | n.□□□1 | soft                                  | n.□□□3          | at any time | immediately     |
|           | n.□□□2 | quick positioning                     |                 |             |                 |
|           | n.□□□3 | Quick positioning (overshoot control) |                 |             |                 |

model loop function switch

| parameter |        | meaning           | factory setting | revise      | come into force |
|-----------|--------|-------------------|-----------------|-------------|-----------------|
| P2-47     | n.□□□0 | Model loop closed | n.□□□0          | at any time | immediately     |
|           | n.□□□1 | Model loop open   |                 |             |                 |

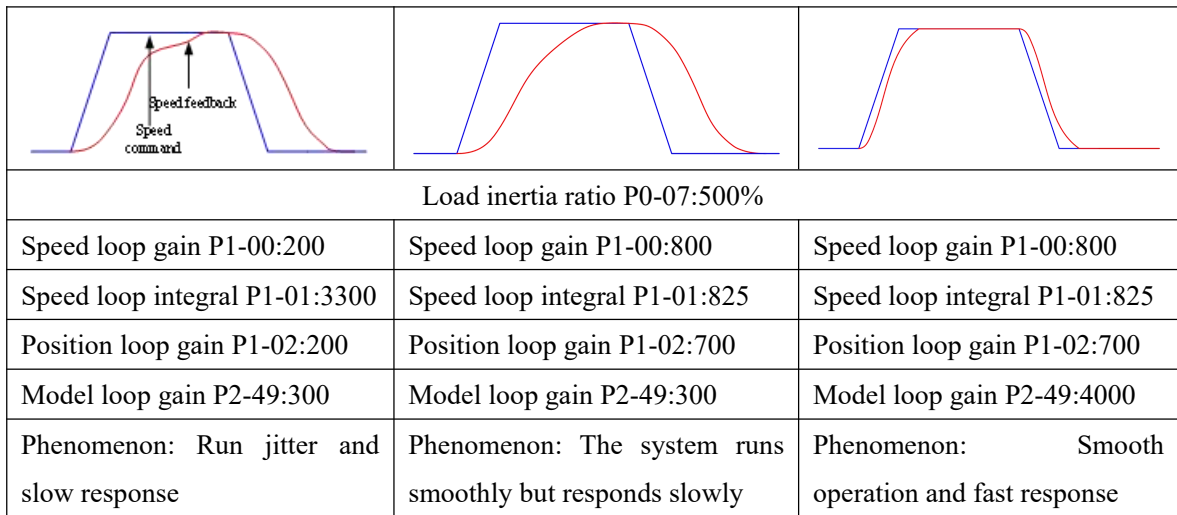
Using the DM6C series servo self-tuning mode as an example, with a 750W servo system operating at five times the load inertia:

- Model loop function off (soft mode)

| low rigidity, low response                                                           | high rigidity, medium response                      |
|--------------------------------------------------------------------------------------|-----------------------------------------------------|
|  |                                                     |
| Load inertia ratio P0-07:500%                                                        |                                                     |
| Speed loop gain P1-00:200                                                            | Speed loop gain P1-00:800                           |
| Speed loop integral P1-01:3300                                                       | Speed loop integral P1-01:825                       |
| Position loop gain P1-02:200                                                         | Position loop gain P1-02:700                        |
| Phenomenon: Run jitter and slow response                                             | Phenomenon: Running smoothly and responding quickly |

- Enable model loop function (Quick Positioning or Quick Positioning (Control Overshoot))

|                            |                             |                              |
|----------------------------|-----------------------------|------------------------------|
| low rigidity, low response | high rigidity, low response | high rigidity, high response |
|----------------------------|-----------------------------|------------------------------|



The above curve diagram only shows the parameter effect and does not represent the actual running curve.

## 9.8.2 Torque disturbance observation

The disturbance observer detects and estimates the external disturbance torque of the system, and compensates the torque command, which can reduce the influence of external disturbance on the servo and improve the disturbance resistance.

Selecting the Soft Mode in self-tuning mode automatically turns off the disturbance observer without changing its gain. If you select Fast Tracking or Fast Tracking (Control Overshoot), the disturbance observer is automatically enabled with its gain set to 85. These parameters require no manual adjustment.

| parameter |        | meaning                         | factory setting | revise   | come into force |
|-----------|--------|---------------------------------|-----------------|----------|-----------------|
| P2-00     | n.□□□0 | disruptive observer shutdown    | n.□□□0          | servo bb | immediately     |
|           | n.□□□1 | Enable the disturbance observer |                 |          |                 |

| parameter | meaning                    | factory setting | unit | Set range | revise      | come into force |
|-----------|----------------------------|-----------------|------|-----------|-------------|-----------------|
| P2-41     | perturbation observer gain | 85              | %    | 0 ~ 100   | at any time | immediately     |

## 9.8.3 Gain adjustment parameters

| parameter | meaning               | factory setting | unit  | Set range | revise   | come into force |
|-----------|-----------------------|-----------------|-------|-----------|----------|-----------------|
| P1-00     | first speed loop gain | <=20P7: 300     | 0.1Hz | 10~20000  | servo bb | immediately     |

| parameter | meaning                                 | factory setting                                | unit   | Set range | revise   | come into force |
|-----------|-----------------------------------------|------------------------------------------------|--------|-----------|----------|-----------------|
|           |                                         | $\geq 21P0$ : 200                              |        |           |          |                 |
| P1-01     | first speed loop integral time constant | $\leq 20P7$ :<br>2122<br>$\geq 21P0$ :<br>3183 | 0.01ms | 15~51200  | servo bb | immediately     |
| P1-02     | first position loop gain                | $\leq 20P7$ : 300<br>$\geq 21P0$ : 200         | 0.1/s  | 10~20000  | servo bb | immediately     |
| P1-05     | second speed loop gain                  | 200                                            | 0.1Hz  | 10~20000  | servo bb | immediately     |
| P1-06     | second speed loop integral constant     | 3300                                           | 0.01ms | 15~51200  | servo bb | immediately     |
| P1-07     | second position loop gain               | 200                                            | 0.1/s  | 10~20000  | servo bb | immediately     |

#### 9.8.4 Gain Switching

| parameter |        | meaning                                                                                                                                                                                                                                                                                                                                                                                                                         | factory setting | revise   | come into force |
|-----------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|
| P1-14     | n.□□□0 | 0: SI terminal gain switching is active (gain switching condition parameters are not active)<br>1: Perform gain switching according to the gain switching conditions<br>2: Reserve                                                                                                                                                                                                                                              | 0               | servo bb | immediately     |
|           | n.□□□1 | n.□□X□: Gain switch condition selection<br>0: The first gain is fixed<br>1: Switch using external SI terminals<br>2: The torque command is large.<br>3: Speed command is large<br>4: Speed commands vary significantly<br>5: Speed command high-low threshold (not supported)<br>6: Large positional deviation<br>7: Position command<br>8: Location completed<br>9: Actual speed is high<br>A: Position command + actual speed |                 |          |                 |
| P1-15     |        | gain switching delay                                                                                                                                                                                                                                                                                                                                                                                                            | 5               | servo bb | immediately     |

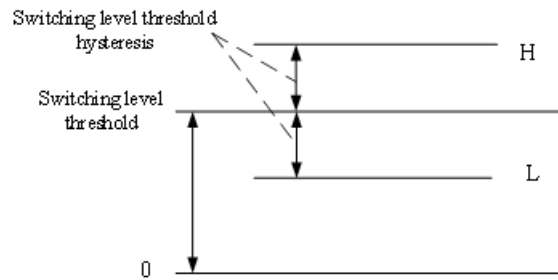


|       |                                                   |    |          |             |
|-------|---------------------------------------------------|----|----------|-------------|
| P1-16 | gain switching level threshold                    | 50 | servo bb | immediately |
| P1-17 | Hysteresis Loop of Gain Switching Level Threshold | 30 | servo bb | immediately |
| P1-18 | position loop gain switching time                 | 2  | servo bb | immediately |

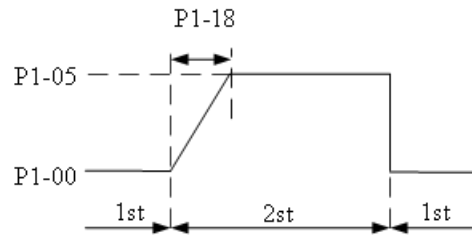
**explain :**

① Gain switch wait time, only during the process of switching from the second gain to the first gain

② The definition of "gain switching level threshold hysteresis" is illustrated in the figure below:



③ "Position gain switching time" explanation:

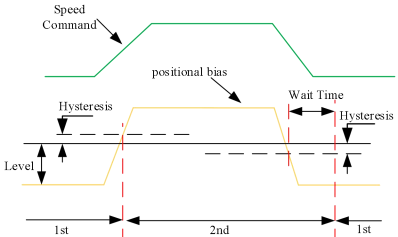
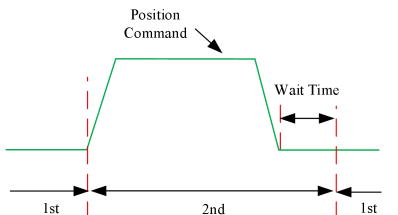


④ Explanation of the gain switching conditions

| gain switching condition setting |                        |                     |                                                                                                                                    | relevant parameter |                       |                            |
|----------------------------------|------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|----------------------------|
| P1-14.1                          | condition              | diagrammatic sketch | remarks                                                                                                                            | P1-15 wait time    | P1-16 grade threshold | P1-17 threshold hysteresis |
| 0                                | first gain fixed       | -                   | -                                                                                                                                  | of no avail        | of no avail           | of no avail                |
| 1                                | terminal changing-over |                     | Use G-SEL signals for gain switching:<br>G-SEL signal invalid, gain of group 1<br>G-SEL signal is valid, gain for the second group | valid              | of no avail           | of no avail                |

| gain switching condition setting |                      |                     |                                                                                                                                                                                                                                                                                                                                                                                                 | relevant parameter |                       |                            |
|----------------------------------|----------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|----------------------------|
| P1-14.1                          | condition            | diagrammatic sketch | remarks                                                                                                                                                                                                                                                                                                                                                                                         | P1-15 wait time    | P1-16 grade threshold | P1-17 threshold hysteresis |
| 2                                | torque instruction   |                     | <p>When the absolute value of the torque command exceeds (level + hysteresis) [%] during the first gain phase, the system switches to the second gain.</p> <p>When the absolute value of the torque command during the last second gain cycle was below the threshold of [level-hysteresis], and the P1-15 sensor maintained this condition, the system reverted to the first gain setting.</p> | valid              | valid (%)             | valid (%)                  |
| 3                                | velocity instruction |                     | <p>When the absolute value of the speed command exceeds (level + hysteresis) [rpm] during the first gain phase, the system switches to the second gain.</p> <p>When the absolute value of the speed command during the last second gain period was below (level-hysteresis) [rpm], and P1-15 remained in this state, the system returned to the first gain setting.</p>                         | valid              | valid                 | valid                      |

| gain switching condition setting |                                                  |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                      | relevant parameter |                       |                            |
|----------------------------------|--------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|----------------------------|
| P1-14.1                          | condition                                        | diagrammatic sketch | remarks                                                                                                                                                                                                                                                                                                                                                                                                                                              | P1-15 wait time    | P1-16 grade threshold | P1-17 threshold hysteresis |
| 4                                | rate of change of speed command                  |                     | <p>When the absolute value of the speed command rate change exceeds (level + hysteresis) [10 rpm/s] during the first gain adjustment, the system switches to the second gain.</p> <p>When the absolute value of the speed command rate change during the last 2nd gain period is below (level-hysteresis) [10 rpm/s], and P1-15 remains in this state, the system returns to the first gain setting.</p>                                             | valid              | valid (10rpm/s)       | valid (10rpm/s)            |
| 5                                | Speed command high-low threshold [not supported] |                     | <p>When the absolute value of the speed command exceeds (level-hysteresis) [rpm] during the first gain phase, the system switches to the second gain phase. The gain gradually adjusts until the absolute value reaches (level + hysteresis) [rpm], at which point the gain fully transitions to the second level.</p> <p>During the second gain phase, when the absolute value of the speed command falls below (level + hysteresis) [rpm], the</p> | of no avail        | valid (rpm)           | valid (rpm)                |

| gain switching condition setting |                      |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | relevant parameter |                       |                            |
|----------------------------------|----------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|----------------------------|
| P1-14.1                          | condition            | diagrammatic sketch                                                                 | remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                           | P1-15 wait time    | P1-16 grade threshold | P1-17 threshold hysteresis |
|                                  |                      |                                                                                     | system initiates the first gain phase. The gain value then gradually adjusts until the absolute value reaches (level-hysteresis) [rpm], at which point the gain fully returns to the first setting.                                                                                                                                                                                                                                                               |                    |                       |                            |
| 6                                | position bias        |  | <p>Only in location mode (other modes fixed at gain 1)</p> <p>When the absolute value of positional deviation exceeds (level + hysteresis) [encoder units] during the first gain adjustment, switch to the second gain.</p> <p>When the absolute value of positional deviation during the last second gain cycle was below (level-hysteresis) [encoder units], and the P1-15 state remained in this condition, the system reverted to the first gain setting.</p> | valid              | valid Encoder unit    | valid Encoder unit         |
| 7                                | position instruction |  | <p>Only in location mode (other modes fixed at gain 1)</p> <p>When the first gain is applied, if the position command is not zero, switch to the second</p>                                                                                                                                                                                                                                                                                                       | valid              | of no avail           | of no avail                |

| gain switching condition setting |                           |                     |                                                                                                                                                                                                                                                                                                                                                                                                                        | relevant parameter |                       |                            |
|----------------------------------|---------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|----------------------------|
| P1-14.1                          | condition                 | diagrammatic sketch | remarks                                                                                                                                                                                                                                                                                                                                                                                                                | P1-15 wait time    | P1-16 grade threshold | P1-17 threshold hysteresis |
|                                  |                           |                     | gain.<br>During the second gain phase, if the position command remains at zero for the entire waiting period P1-15, the system will revert to the first gain state.                                                                                                                                                                                                                                                    |                    |                       |                            |
| 8                                | fixed position accomplish |                     | <p>Only in location mode (other modes fixed at gain 1)</p> <p>If the positioning is not completed during the first gain, switch to the second gain.</p> <p>If the positioning completion status remains unchanged during the waiting period P1-15 during the second gain phase, the system will revert to the first gain phase.</p> <p>[Note] Set the positioning mode for detection completion according to P5-01</p> | valid              | of no avail           | of no avail                |
| 9                                | real-time velocity        |                     | <p>Only in location mode (other modes fixed at gain 1):</p> <p>When the absolute value of the actual speed exceeds (level + hysteresis) [rpm] during the first gain adjustment, the system switches to the second gain.</p> <p>During the last second</p>                                                                                                                                                              | valid              | valid (rpm)           | valid (rpm)                |

| gain switching condition setting |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | relevant parameter |                       |                             |
|----------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|-----------------------------|
| P1-14.1                          | condition                       | diagrammatic sketch                                                                                                                                                                                                                                                                                                                                                                                                                          | remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | P1-15 wait time    | P1-16 grade threshold | P1-17 thresh old hysteresis |
|                                  |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                              | gain cycle, when the absolute value of the relative speed remains below the threshold (level-hysteresis) [rpm] and P1-15 maintains this condition, the system returns to the first gain setting.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |                       |                             |
| A                                | position command + actual speed | <pre> graph TD     A[First Gain at Rest] -- "With Command Pulse" --&gt; B[Second Gain During Operation]     B -- "No Command Pulse Continuous Delay Time" --&gt; C[Second Gain During Stabilization]     C -- " Actual Speed  &lt; (Switching Level - Switching Hysteresis)" --&gt; A     C -- " Actual Speed  &lt; Switching Level" --&gt; D["Near Rest (Speed Integral Only) - Second Gain / First Gain for Others"]     D --&gt; A </pre> | <p>Only in location mode (other modes fixed at gain 1):</p> <p>When the first gain is applied, if the position command is not zero, switch to the second gain.</p> <p>During the second gain phase, the system maintains the second gain setting when the position command is 0 for the duration of P1-15.</p> <p>When the position command is 0 and the waiting time P1-15 is reached, if the absolute value of the actual speed is below (hysteresis level) [rpm], the speed integral time constant is fixed at the second speed loop integral time constant (P1-06), and the system returns to the first gain setting.</p> <p>If the actual speed's</p> | valid              | valid (rpm)           | valid (rpm)                 |

| gain switching condition setting |           |                     |                                                                                                                                             | relevant parameter |                       |                            |
|----------------------------------|-----------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|----------------------------|
| P1-14.1                          | condition | diagrammatic sketch | remarks                                                                                                                                     | P1-15 wait time    | P1-16 grade threshold | P1-17 threshold hysteresis |
|                                  |           |                     | absolute value falls below (hysteresis level) [rpm], the speed integral also resets to the first speed loop integral time constant (P1-02). |                    |                       |                            |

## 9.8.5 Speed Loop P-PI Mode Switching

### 1) Speed control mode switching

| parameter |        | meaning                                                                                                                                                                                                                                        | factory setting        | revise   | come into force |
|-----------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------|-----------------|
| P1-26     | n.□□□0 | 0: Do not use mode switching<br>1: Use internal torque command as switching condition<br>2: Use speed command as switching condition<br>3: Use acceleration as the switching condition<br>4: Use position deviation as the switching condition | <=22P6: 1<br>Others: 0 | servo bb | immediately     |
|           | n.□□0□ | 0: Clear 0asr points<br>1: Keep the speed loop integral constant without accumulation                                                                                                                                                          | 1                      |          |                 |
| P1-27     |        | Mode switch-torque command threshold                                                                                                                                                                                                           | 200                    | servo bb | immediately     |
| P1-28     |        | Mode switch-speed command threshold                                                                                                                                                                                                            | 0                      | servo bb | immediately     |
| P1-29     |        | Mode switch-Acceleration threshold                                                                                                                                                                                                             | 0                      | servo bb | immediately     |
| P1-30     |        | Mode switch-Position deviation threshold                                                                                                                                                                                                       | 0                      | servo bb | immediately     |

For power stages up to 22P6, the Asr P/PI mode switching is enabled by default (i.e., P1-26.0 = 1), with the switch initiated when the torque command from P1-27 exceeds 200%.

### 2) IP control selection

| parameter | meaning | factory setting | revise | come into force |
|-----------|---------|-----------------|--------|-----------------|
|-----------|---------|-----------------|--------|-----------------|

|       |        |                                 |     |          |                   |
|-------|--------|---------------------------------|-----|----------|-------------------|
| P2-03 | n.□0□□ | 0: PI control<br>1: IP control  | 0   | servo bb | Power on<br>again |
| P1-31 |        | I-P control switching threshold | 100 | servo bb | Power on<br>again |



When P1-31=0, the speed loop is equivalent to PI control; when P1-31=100, the speed loop is equivalent to IP control.



## 9.9 Gain adjustment related

### 9.9.1 When load shaking occurs

The following reasons may cause load wobbling:

- Insufficiently smooth command under excessive load inertia

Countermeasures: ① Use position instruction smoothing filter P1-25;

② Optimize the command of the upper device to reduce the command acceleration;

③ Replace the motor with larger inertia.

- The servo gain is too low, resulting in insufficient rigidity.

Countermeasures: ① Increase the gain parameter and rigidity to enhance the anti-disturbance ability.

- The mechanism is too stiff, and the equipment is shaking.

Countermeasures: ① Reduce the gain parameter;

② Optimize the instruction of the upper device to reduce the instruction acceleration.

### 9.9.2 When vibration occurs

The following reasons may cause machine vibration:

- Vibration caused by improper servo gain

Countermeasures: Reduce the gain

- mechanical resonance point

Countermeasures: Mechanical characteristic analysis or manual setting of notch parameters

### 9.9.3 When noise occurs

In adaptive mode:

- caused by inappropriate servo gain

Countermeasure: Reduce the adaptive control bandwidth (P2-19).

In self-tuning mode:

- caused by inappropriate servo gain

Countermeasures: In the mode of rapid adjustment, the rigid level should be reduced.

Auto-adjust mode: Reduce model loop gain P2-49

- noise produced by mechanical resonance

Solution: Refer to Section 9.7 'Vibration Suppression' and apply vibration treatment.

## 10. Police report analysis

### 10.1 EtherCAT Communication Abnormal Alarm

| Alarm code | cause of error                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                              | resolvent                                                                                                                                                                   |
|------------|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E-800      | Incorrect ESM request for exception protection            | <p>Accept conversion requests from states that cannot be converted from the current state:</p> <p>Init→Safeop</p> <p>Init→OP</p> <p>PreOP→OP</p> <p>Error status of ESM: Stays in the current state (Init, PreOP, SafeOP) when it occurs, and transitions to SafeOP during operation.</p> <p>ESC register AL Status Code: 0011h</p>                                                                                                          | <p>Confirm the state transition requirements of the upper device.</p> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p> |
| E-801      | ESM requirements are not defined for exception protection | <p>Accept state transition requests except those specified below:</p> <p>1: Request Init State</p> <p>2: Request Pre-Operational State</p> <p>3: Request Bootstrap State</p> <p>4: Reauest Safe-operational State</p> <p>8: Request Operational State</p> <p>Error status of ESM: Stays in the current state (Init, PreOP, SafeOP) when it occurs, and transitions to SafeOP during operation.</p> <p>ESC register AL Status Code: 0012h</p> | <p>Confirm the state transition requirements of the upper device.</p> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p> |
| E-802      | The guidance state requires exception protection.         | <p>Accept the following state transition requirements:</p> <p>3: Request Bootstrap State</p>                                                                                                                                                                                                                                                                                                                                                 | <p>Confirm the state transition requirements of the upper device.</p>                                                                                                       |

| Alarm code | cause of error                      |                                                                                                                                                                                                                                                                                                                                  | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                                     | <p>Error status of ESM: Init</p> <p>ESC register AL Status Code: 0013h</p>                                                                                                                                                                                                                                                       | <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| E-803      | PLL incomplete exception protection | <p>After 1 second of synchronization, the phase combination between communication and servo (PLL lock) still cannot be completed.</p> <p>Error status of ESM: PreOP</p> <p>ESC register AL Status Code: 002Dh</p>                                                                                                                | <p>Verify the DC settings and ensure propagation delay compensation and deviation compensation are correct.</p> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| E-804      | PDO watchdog exception protection   | <p>During PDO communication (SafeOP or OP state), the bit10 of time 0220 (AL Event Request) is not ON when setting the ESC register addresses 0400 (Watchdog Divider) and 0420 (Watchdog Time Process Data).</p> <p>Error status: Safe OP</p> <p>ESC register AL Status Code: 001Bh</p> <p>PDO communication connection lost</p> | <ol style="list-style-type: none"> <li>1. Verify if the PDO's transmission time from the upper device is fixed or interrupted;</li> <li>2. The PDO watchdog detected an excessively large delay value;</li> <li>3. Check for wiring issues in the EtherCAT communication cable and excessive noise on the cable. Replace with a high-quality network cable.</li> <li>4. Reconnect the communication cables, leaving the network cable unconnected and separated from the power line.</li> <li>5. Before restarting the equipment, ensure all welding machine-related interference devices are turned off.</li> </ol> <p>To eliminate interference;</p> <ol style="list-style-type: none"> <li>6. Cross-test to identify the fault point;</li> </ol> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p> |
| E-806      | PLL exception protection            | <p>The ESM state occurs when the phase (PLL lock) between communication and servo fails to synchronize during SafeOP or OP states.</p>                                                                                                                                                                                           | <p>Verify the DC settings and ensure propagation delay compensation and deviation compensation are correct.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Alarm code | cause of error                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | resolvent                                                                                                                                                                                                                  |
|------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                                                     | Error status of ESM: SafeOP<br>ESC register AL Status Code: 0032h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | You can clear the alarm or reset the system by disconnecting the power supply through the servo panel F0-00=1.                                                                                                             |
| E-807      | simultaneous signal abnormality protection          | After the synchronization process completes, the SYNC0 or IRQ interrupt handler is triggered when the value exceeds the preset threshold.<br>Error status of ESM: SafeOP<br>ESC register AL Status Code: 002Ch                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Verify the DC settings and ensure propagation delay compensation and deviation compensation are correct.<br>You can clear the alarm or reset the system by disconnecting the power supply through the servo panel F0-00=1. |
| E-810      | Synchronization period setting exception protection | Unsupported sync cycles:<br>The synchronization period setting is outside 500us, 1ms, 2ms, and 4ms.<br>Error status of ESM: PreOP<br>ESC register AL Status Code: 0035h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Set the synchronization period correctly<br>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.                                                                                 |
| E-811      | Set up email exception protection                   | Incorrect SM0/1 settings in the email:<br>The email sending/receiving area overlaps with SM2/3, and the sending/receiving area address is odd.<br>The starting address of the mailbox is outside the range of SyncManager0: 1000h~10FFh and SyncManager1: 1200h~12FFh.<br>Incorrect SyncManager0/1 length (ESC registers: 0802h,0803h/080Ah, 080Bh) setting:<br>SyncManager0: out of range (32~256 bytes)<br>SyncManager1: out of range (40~256 bytes)<br>Incorrect configuration of SyncManager0/1's Control Register (ESC register: 0804h/080Ch):<br>Set 100110b to 0804h: bit5-0<br>Set 100110b to 080Ch: bit5-0<br>Error status of ESM: Init<br>ESC register AL Status Code: 0016h | Set SyncManager correctly according to the ESI file description<br>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.                                                          |
| E-814      | PDO watchdog setting                                | PDO watchdog configuration is incorrect.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Set the watchdog timeout correctly                                                                                                                                                                                         |

| Alarm code | cause of error                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | resolvent                                                                                                                                                                                                            |
|------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | exception protection                          | <p>The PDO watchdog is active (SyncManager: bit6 of register 0804h is 1). The timeout thresholds detected by the PDO watchdog (registers 0400h and 0402h) do not meet the requirement of 'communication cycle * 2'.</p> <p>Error status of ESM: PreOP</p> <p>ESC register AL Status Code: 001Fh</p>                                                                                                                                                                                                                                                                                   | To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.                                                                                                                       |
| E-815      | DC setting abnormal protection                | <p>The DC setting error.</p> <p>The bit2-0 of the ESC register 0981h (Activation) must be set to any value except those specified below.</p> <p>bit2-0=000b; bit2-0=011b</p> <p>Error status of ESM: PreOP</p> <p>ESC register AL Status Code: 0030h</p>                                                                                                                                                                                                                                                                                                                              | <p>Confirm DC settings</p> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p>                                                                                     |
| E-816      | SM event pattern setting exception protection | <p>The unsupported SM time mode is set. The 1C32/1C33-01 chip sets values other than 00,01, or 02.</p> <p>The bit2-0 of the ESC register 0981 is set to 000b, and only the SM2 configurations 1C32h-01h and 1C33h-01h are enabled.</p> <p>Error status of ESM: PreOP</p> <p>ESC register AL Status Code: 0028h</p>                                                                                                                                                                                                                                                                    | <p>Confirm that the settings for 1C32h-01h and 1C33h-01h are identical and the values are 00h,01h, or 02h.</p> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p> |
| E-817      | SyncManager 2/3 setting exception protection  | <p>SM2/3 is set to an incorrect value</p> <p>Incorrect physical address configuration for SM2/3 (ESC register: 0810h/0818h): The transmission/reception area overlaps with SM2/3, the starting address is odd, and the destination address is out of range.</p> <p>SM2/3 length configuration (ESC register: 0812h/081A) differs from RxPDO and TxPDO</p> <p>The control register (ESC register: 0814h/081Ch) of SM2/3 is improperly configured.</p> <p>Set all bits from 5 to 0 except 100110b</p> <p>Error status of ESM: PreOP</p> <p>ESC register AL Status Code: 001Dh/001Eh</p> | <p>Set SyncManager2/3 correctly according to the ESI file description</p> <p>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.</p>                                      |
| E-850      | TxPDO                                         | The data size mapped by TxPDO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Ensure the TxPDO mapping                                                                                                                                                                                             |

| Alarm code | cause of error                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | resolvent                                                                                                                                                            |
|------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | allocation exception protection                    | exceeds 24 bytes<br>Error status of ESM: PreOP<br>ESC register AL Status Code: 0024h                                                                                                                                                                                                                                                                                                                                                                                                                           | data size is set to 24 bytes or less<br><br>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.                           |
| E-851      | RxPDO allocation exception protection              | The RxPDO mapping exceeds 24 bytes<br>Error status of ESM: PreOP<br>ESC register AL Status Code: 0025h                                                                                                                                                                                                                                                                                                                                                                                                         | Confirm the RxPDO mapping data size is set to 24 bytes or less<br><br>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel. |
| E-881      | Control mode setting exception protection          | When both the 6060h and 6061h settings are set to 0, the PDS status transitions to 'Operation enabled'.<br>The control mode corresponding to 6060h is not set.<br>Error after ESM status: Stopped at the current ESM status<br>ESC register AL Status Code: 0000h                                                                                                                                                                                                                                              | Confirm the 6060h setting<br><br>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.                                      |
| E-882      | ESM requires exception protection during operation | When the PDS status is either 'Operation enabled' or 'Quick stop active', it receives commands to transition to other ESM states.<br>ESM status after error: Based on the status transition request from the host computer<br>ESC register AL Status Code: 0000h                                                                                                                                                                                                                                               | Verify the status transition request from the parent device<br><br>To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.    |
| E-883      | Abnormal movement protection                       | When the input signals EXT1/EXT2 are not assigned, the external trigger is selected via the Touch probe function.<br>The calculation results of electronic gear ratio are outside the range of 1/1000 to 1000 times;<br>The calculation process of electronic gear ratio, when the denominator or numerator has no sign and exceeds 64 bits;<br>The final calculation result of electronic gear ratio, where the denominator or numerator without sign exceeds 32 bits;<br>Error after ESM status: Stop in the | To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.                                                                       |

| Alarm<br>code | cause of error |                                                          | resolvent |
|---------------|----------------|----------------------------------------------------------|-----------|
|               |                | current ESM status<br>ESC register AL Status Code: 0000h |           |



## 10.2 EtherCAT Communication Non-Related Abnormal Alarm

The DM6C alarm code follows the E-XX□ format, where 'XX' indicates the alarm's category and '□' specifies the exact subcategory.

| big class | small class | confirm code | explain                             | Possible reasons                                                                                                                                                                    | resolvent                                                                                                                                                                                                                                                |
|-----------|-------------|--------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EEEE      | 1           | EEEE1        | Panel communication error with CPU  | The power supply voltage fluctuates significantly, and the low voltage causes the panel to fail to refresh. The panel program is damaged.<br><br>③ Communication enters a dead loop | ①Stable power supply, ensure the stability of power supply voltage;<br><br>②If the alarm persists after power-off and power-on, contact the authorized dealer or manufacturer.<br><br>③Unplug the communication terminal and run the program to confirm. |
|           | 2           | EEEE2        |                                     |                                                                                                                                                                                     |                                                                                                                                                                                                                                                          |
|           | 3           | EEEE3        |                                     |                                                                                                                                                                                     |                                                                                                                                                                                                                                                          |
|           | 4           | EEEE4        |                                     |                                                                                                                                                                                     |                                                                                                                                                                                                                                                          |
| 01        | 0           | E-010        | The firmware version does not match | The downloaded firmware version is incorrect                                                                                                                                        | Contact the agent or manufacturer                                                                                                                                                                                                                        |
|           | 3           | E-013        | FPGA loading error                  | The program is corrupted.<br><br>② The device is damaged.                                                                                                                           | Contact the agent or manufacturer                                                                                                                                                                                                                        |
|           | 4           | E-014        | FPGA access error                   | The program is corrupted.<br><br>② Hardware damage<br><br>③ The intensity of external interference is too high.                                                                     | Contact the agent or manufacturer                                                                                                                                                                                                                        |
|           | 5           | E-015        | Program error                       | Program error                                                                                                                                                                       | Contact the agent or manufacturer                                                                                                                                                                                                                        |
|           | 7           | E-017        | Processor operation timed out       | Program error                                                                                                                                                                       | Contact the agent or manufacturer                                                                                                                                                                                                                        |
|           | 9           | E-019        | Incorrect system password           | Program error                                                                                                                                                                       | Contact the agent or manufacturer                                                                                                                                                                                                                        |

| big class | small class | confirm code | explain                                                                                              | Possible reasons                                                              | resolvent                                                                                                                                                                                                         |
|-----------|-------------|--------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02        | 0           | E-020        | Parameter loading error                                                                              | Parameter self-check failed                                                   | Powering on again will restore the default settings. If the issue persists, contact your agent or manufacturer.                                                                                                   |
|           | 1           | E-021        | Parameter range exceeded                                                                             | The value is not within the specified range                                   | Check parameters and reset                                                                                                                                                                                        |
|           | 2           | E-022        | Parameter conflict                                                                                   | TREF or VREF function settings conflict                                       | ① Check whether the parameter settings meet the requirements;<br>② When P0-01 equals 4, setting P3-00 to 1 will trigger an alarm.                                                                                 |
|           | 3           | E-023        | Sampling channel configuration error                                                                 | The custom output trigger channel or data monitoring channel is misconfigured | Check if the settings are correct                                                                                                                                                                                 |
|           | 4           | E-024        | Parameter lost                                                                                       | The grid voltage is too low.                                                  | ① For single-phase 220V power supply, connect L1 and L3;<br>② If power is restored immediately after a power outage, the E-024 alarm will be triggered;<br>Reset parameters                                       |
|           | 5           | E-025        | erase FLASH error                                                                                    | Parameter save failed during power loss                                       | Contact the agent or manufacturer                                                                                                                                                                                 |
|           | 6           | E-026        | FLASH initialization error                                                                           | Unstable power supply for FLASH chip                                          | Contact the agent or manufacturer                                                                                                                                                                                 |
|           | 8           | E-028        | EEPROM write error                                                                                   | Voltage instability or chip malfunction                                       | Contact the agent or manufacturer                                                                                                                                                                                 |
| 03        | 0           | E-030        | The busbar voltage U0-05 exceeds the preset threshold. 220V power supply machine (U0-05 $\geq$ 402V) | The grid voltage is too high.                                                 | Check the power grid voltage fluctuations. The 220V driver operates within 200V-240V, while the 380V driver requires 360V-420V. For significant voltage variations, use the correct voltage source and regulator. |
|           |             |              | 380V power supply machine (U0-05 $\geq$ 780V)                                                        | Excessive load moment of inertia (insufficient braking capacity)              | ① Increase the acceleration and deceleration time;<br>② Reduce the load inertia;<br>③ Reduce the start-stop                                                                                                       |

| big class | small class | confirm code | explain                                                                                                                                                         | Possible reasons                                             | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------|-------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                                                                                                                                                 |                                                              | frequency;<br>④Replace with a higher power driver and motor                                                                                                                                                                                                                                                                                                                                                                                                                           |
|           |             |              |                                                                                                                                                                 | The acceleration and deceleration time is too short          | extend acceleration and deceleration time                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|           |             |              |                                                                                                                                                                 | Hardware fault of the internal sampling circuit of the drive | Use the AC range of a multimeter to measure the input voltage of the servo LN (R/S/T). The normal value is 220V $\pm 10\%$ . If the measured value exceeds 220V $\pm 10\%$ (380V $\pm 10\%$ ), check the supply voltage. If the supply voltage is normal, the servo is in BB status. Monitor U0-05. If the voltage measured by the multimeter (1.414 times the measured value) is less than U0-05 (within 10V error), the servo driver is faulty and needs to be returned for repair. |
| 04        | 0           | E-040        | The busbar voltage U0-05 is lower than the preset threshold. 220V power supply machine (U0-05 $\leq$ 150V)<br><br>380V power supply machine (U0-05 $\leq$ 300V) | Alarm for low grid voltage during normal power-on            | ① Monitor power grid fluctuations. The 220V driver operates within a normal voltage range of 200V to 240V. If significant voltage fluctuations occur, a voltage stabilizer is recommended.<br><br>②Replace the transformer with a larger capacity                                                                                                                                                                                                                                     |
|           |             |              |                                                                                                                                                                 | Instant power outage                                         | Wait for the voltage to stabilize before powering on again                                                                                                                                                                                                                                                                                                                                                                                                                            |
|           |             |              |                                                                                                                                                                 | Hardware fault of the internal sampling circuit of the drive | Use the AC range of a multimeter to measure the input voltage of the servo LN (R/S/T). The normal value is 220V $\pm 10\%$ . If                                                                                                                                                                                                                                                                                                                                                       |

| big class | small class | confirm code | explain                                                                                                                                               | Possible reasons                                           | resolvent                                                                                                                                                                                                                                                                                                   |
|-----------|-------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                                                                                                                                       |                                                            | the measured value is $<220V \pm 10\%$ ( $380V \pm 10\%$ ), check the supply voltage. If the supply voltage is normal, the servo is in BB status. Monitor U0-05. If the multimeter reading is 1.414 times the U0-05 voltage (within 10V error), the servo driver is faulty and must be returned for repair. |
|           | 1           | E-041        | Power failure of the drive                                                                                                                            | The drive power is disconnected.                           | Check the power supply                                                                                                                                                                                                                                                                                      |
|           | 3           | E-043        | Busbar voltage charging failed                                                                                                                        | Alarm for low grid voltage during normal power-on          | Alarm for low grid voltage during normal power-on                                                                                                                                                                                                                                                           |
|           |             |              |                                                                                                                                                       | Hardware damage                                            | When powering on the drive, check for any relay engagement sound.                                                                                                                                                                                                                                           |
| 06        | 0           | E-060        | The module temperature is too high.<br>Alarm for module temperature<br>$U0-06 \geq 90^{\circ}\text{C}$<br>$U0-06 \geq 70^{\circ}\text{C}$<br>Warning) | Long-term operation under heavy load                       | Re-evaluate the motor capacity and monitor the U0-02 torque during operation to check if it remains above 100 for extended periods. If so, consider using a higher-capacity motor or reducing the load.                                                                                                     |
|           |             |              |                                                                                                                                                       | The ambient temperature is too high.                       | ① Enhance ventilation measures to lower ambient temperature;<br>② Check if the fan rotates during servo enable; if module temperature U0-06 reaches or exceeds $45^{\circ}\text{C}$ , the fan will activate                                                                                                 |
|           |             |              |                                                                                                                                                       | Fan damage                                                 | Replace the fan                                                                                                                                                                                                                                                                                             |
|           | 1           | E-061        | motor overheating                                                                                                                                     | Alarm when motor temperature exceeds $140^{\circ}\text{C}$ | ① Check if the motor fan is functioning properly;<br>② Contact the manufacturer for technical support.                                                                                                                                                                                                      |

| big class | small class | confirm code | explain                                                                                                                                           | Possible reasons                                                                                                                                         | resolvent                                                                                                                                                                                                                                                                                                                                           |
|-----------|-------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | 3           | E-063        | thermocouple breakage alarm                                                                                                                       | <p>Thermocouple break in motor with power of 11kW or above</p> <p>② Alarm for incorrect activation of motor below 11kW due to detected wire breakage</p> | <p>Check the external thermocouple connection.</p> <p>Shielded thermocouple break alarm: P0-69.1=1</p>                                                                                                                                                                                                                                              |
| 08        | 0           | E-080        | <p>Over-speed (actual speed <math>\geq</math> P3-21/P3-22)</p> <p>The maximum forward speed is P3-21, and the maximum reverse speed is P3-22.</p> | Motor code does not match                                                                                                                                | Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor label match. If they do not, adjust them to match and power on again.                                                                                                                                                                                        |
|           |             |              |                                                                                                                                                   | UVW wiring error                                                                                                                                         | Check the UVW wiring of the motor and connect it according to the phase sequence.                                                                                                                                                                                                                                                                   |
|           |             |              |                                                                                                                                                   | The motor is running too fast.                                                                                                                           | <p>① The maximum speed limit P3-21/P3-22 is reduced;</p> <p>② Check if any external force causes the motor to rotate too fast, if the pulse input frequency is too high, or if the electronic gear ratio is excessive.</p>                                                                                                                          |
|           |             |              |                                                                                                                                                   | encoder fault                                                                                                                                            | <p>① Check the encoder wire or replace the encoder wire;</p> <p>② Set the servo driver to the bb mode and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify the normal value change of U0-10, which should show an increasing value in one direction and a decreasing value in the other (displaying a 0-9999 cycle).</p> |
|           |             |              |                                                                                                                                                   | parameter setting                                                                                                                                        | An alarm will be triggered if the actual speed exceeds the P3-21/P3-22 ratio.                                                                                                                                                                                                                                                                       |

| big class | small class | confirm code | explain                                                         | Possible reasons                                                                                                      | resolvent                                                                                                                                                             |
|-----------|-------------|--------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | 2           | E-082        | Encoder zero position deviation protection 1                    | ① UVW phase sequence misalignment<br>② Zero position deviation of the motor encoder                                   | ① Check whether the three-phase power lines are connected in the UVW sequence.<br>② Check the encoder zero position.<br>Contact the manufacturer's technical support. |
|           | 3           | E-083        | speed command exceeded                                          | Speed command in position mode exceeds the set value of $1.3 \times P3-21/P3-22$                                      | ① Check the set values of P3-21/P3-22;<br>② Position command is abnormal;                                                                                             |
| 09        | 2           | E-092        | The analog signal Tref has exceeded the zero calibration limit. | Error in analog zeroing operation                                                                                     | Set the zero point without applying analog voltage                                                                                                                    |
|           | 3           | E-093        | The analog signal Vref calibration zero exceeds the limit.      | Error in analog zeroing operation                                                                                     | Set the zero point without applying analog voltage                                                                                                                    |
| 10        | 0           | E-100        | Excessive positional deviation                                  | When position control is active, the difference between the given position and the actual position exceeds the limit. | ① Observe whether the motor is locked;<br>② reduce the position given speed;<br>③ Increase the pulse limit value P0-23                                                |
|           | 1           | E-101        | position command mutation                                       | The position command deviation at every 1/6 synchronization cycle exceeds the limit set by P0-70.                     | ① Check the modification procedure;<br>② Set the appropriate P0-70 value                                                                                              |
| 11        | 0           | E-110        | During self-check, an external UVW                              | No motor code found                                                                                                   | Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor                                                                                |

| big class | small class | confirm code | explain                                                                                                    | Possible reasons                                                   | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------|-------------|--------------|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              | short circuit was detected (the 15KW model lacks E-110 alarm protection, while the 3KW model supports it). |                                                                    | label match. If they do not, adjust them to match and power on again.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|           |             |              |                                                                                                            | U, V, W wiring error                                               | Check the motor's UVW wiring and ensure it is connected in the correct phase sequence (brown U, black V, blue W).                                                                                                                                                                                                                                                                                                                                                                                                 |
|           |             |              |                                                                                                            | The driver's UVW output is short-circuited or the motor is faulty. | <p>① Check if the UVW phase resistance of the motor is balanced. Replace the motor if the resistance is unbalanced.</p> <p>② Check for short circuits between the motor's UVW and PE terminals. Replace the motor if a short circuit is detected.</p> <p>③ Measure the driver-side UVW output using a multimeter (diode mode): connect the black probe to P+ and the red probe to UVW; or use the reverse probes (red to P-, black to UVW). Replace the driver if any of the six voltage drop values is zero.</p> |
|           |             |              |                                                                                                            | The load part is stuck in place.                                   | Run the motor with the shaft idle to troubleshoot the load issue                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|           |             |              |                                                                                                            | Instant alarm for high-speed start/stop                            | Increase acceleration and deceleration time                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|           |             |              |                                                                                                            | encoder problem                                                    | <p>① Check the encoder wire or replace the encoder wire;</p> <p>② Set the servo driver to the bb mode and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify the normal value change of U0-10, which should show an increasing value in one direction and a decreasing value in the other (displaying a 0-9999 cycle).</p>                                                                                                                                                               |

| big class | small class | confirm code            | explain                                    | Possible reasons                                                 | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------|-------------|-------------------------|--------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11        | 2<br>3<br>4 | E-112<br>E-113<br>E-114 | U/V/W phase current overcurrent protection | U, V, W wiring error                                             | Check the UVW wiring of the motor, ensuring correct phase sequence (brown U, black V, blue W).                                                                                                                                                                                                                                                                                                                                  |
|           |             |                         |                                            | The driver UVW output is short-circuited or the motor is faulty. | ① Check if the UVW phase resistance of the motor is balanced. If unbalanced, replace the motor.<br><br>② Check for short circuits between the motor's UVW and PE terminals. Replace the motor if a short circuit is detected.<br><br>③ Measure the driver-side UVW output using a multimeter (diode mode): connect the black probe to P+ and the red probe to P-. If any of the 6 voltage drop values is 0, replace the driver. |
|           |             |                         |                                            | The load part is stuck in place.                                 | Run the motor with the shaft idle to troubleshoot the load issue                                                                                                                                                                                                                                                                                                                                                                |
|           |             |                         |                                            | Instant alarm for high-speed start/stop                          | Increase acceleration and deceleration time                                                                                                                                                                                                                                                                                                                                                                                     |
|           |             |                         |                                            | encoder problem                                                  | ① Check the encoder wire or replace the encoder wire;<br><br>② Set the servo driver to the bb state and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify normal value changes in U0-10, with one direction increasing and the other decreasing (displaying a 0-9999 cycle).                                                                                                                          |
|           |             |                         |                                            | 11                                                               | 5<br>6<br>7                                                                                                                                                                                                                                                                                                                                                                                                                     |



| big class | small class | confirm code | explain          | Possible reasons                                                       | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------|-------------|--------------|------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                  | U, V, W wiring error                                                   | Check the motor's UVW wiring and ensure it is connected in the correct phase sequence (brown U, black V, blue W).                                                                                                                                                                                                                                                                                                                                                                                                 |
|           |             |              |                  | The driver's UVW output is short-circuited or the motor is faulty.     | <p>① Check if the UVW phase resistance of the motor is balanced. Replace the motor if the resistance is unbalanced.</p> <p>② Check for short circuits between the motor's UVW and PE terminals. Replace the motor if a short circuit is detected.</p> <p>③ Measure the driver-side UVW output using a multimeter (diode mode): connect the black probe to P+ and the red probe to UVW; or use the reverse probes (red to P-, black to UVW). Replace the driver if any of the six voltage drop values is zero.</p> |
|           |             |              |                  | The load part is stuck in place.                                       | Run the motor with the shaft idle to troubleshoot the load issue                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|           |             |              |                  | Instant alarm for high-speed start/stop                                | Increase acceleration and deceleration time                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|           |             |              |                  | encoder problem                                                        | <p>① Check the encoder wire or replace the encoder wire;</p> <p>② Set the servo driver to the bb mode and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify the normal value change of U0-10, which should show an increasing value in one direction and a decreasing value in the other (displaying a 0-9999 cycle).</p>                                                                                                                                                               |
| 13        | 0           | E-150        | Power line break | The drive unit, cable, or motor experiences a broken power line in any | Unplug the driver's power supply and check the power line connection. It is recommended to                                                                                                                                                                                                                                                                                                                                                                                                                        |

| big class | small class | confirm code | explain                                    | Possible reasons                                                                                                                                                                                                                                                                                                   | resolvent                                                                                                                                                                                                                                                                                                                 |
|-----------|-------------|--------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                            | of the U/V/W three-phase system.                                                                                                                                                                                                                                                                                   | use a multimeter to test the conduction. After troubleshooting, power the device again.                                                                                                                                                                                                                                   |
| 16        | 1           | E-161        | overload of the thermal power of the drive | Motor code does not match                                                                                                                                                                                                                                                                                          | Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor label match. If they do not, adjust them to match and power on again.                                                                                                                                                              |
|           |             |              |                                            | The motor is overloaded, with actual operating torque exceeding the rated torque and sustained continuous operation. (Monitor U0-02 for actual operating torque. If the motor operates normally without stalling or vibration, and U0-02 remains consistently above 100, this indicates improper motor selection.) | Increase the capacity of the drive and motor. Extend the acceleration and deceleration time, and reduce the load. Monitor U0-00 to check for overspeed operation.                                                                                                                                                         |
|           |             |              |                                            | The machine is hit, the machine suddenly becomes heavy, or the machine twists.                                                                                                                                                                                                                                     | Eliminate mechanical distortion and reduce load                                                                                                                                                                                                                                                                           |
|           |             |              |                                            | The motor activates when the brake is not released.                                                                                                                                                                                                                                                                | Measure the voltage of the brake terminal to determine the opening of the brake.<br>The braking control method should be determined, and it is recommended to use the servo BK brake signal for control. If servo control is not used, the timing between brake opening and motor operation must be carefully considered. |
|           |             |              |                                            | The encoder and power lines are miswired, or there are broken wires or                                                                                                                                                                                                                                             | Check the wiring of the U, V, and W power lines to ensure correct phase sequence.                                                                                                                                                                                                                                         |

| big class | small class | confirm code | explain                                                                                                                                                                                                                 | Possible reasons                                                                                                                                                                       | resolvent                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------|-------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                                                                                                                                                                                                         | loose connectors with pin shrinkage.                                                                                                                                                   | Use a multimeter to check if all encoder wires are properly connected and if any are broken. Check for loose connectors, machine vibrations, and any pin shrinkage, poor soldering, or damage to the connectors.                                                                                                                                                                           |
|           |             |              |                                                                                                                                                                                                                         | In multi-machine wiring, the motor wire was mistakenly connected to another shaft, resulting in incorrect wiring.                                                                      | Check the servo wiring and connect the motor and encoder cables to their respective shafts.                                                                                                                                                                                                                                                                                                |
| 16        | 1           | E-161        | overload of the thermal power of the drive                                                                                                                                                                              | Gain adjustment issues cause motor vibration, back-and-forth movement, and abnormal noise.                                                                                             | re-adjust the gain parameter                                                                                                                                                                                                                                                                                                                                                               |
|           |             |              |                                                                                                                                                                                                                         | Hardware failure in the drive or motor                                                                                                                                                 | On-site servo cross-test indicates either motor shaft misalignment or motor shaft idle, causing F1-01 trial run and F1-00 stop-motion to fail in achieving uniform rotation. Replace the faulty drive or motor, and return the defective unit to the manufacturer for repair.                                                                                                              |
|           | 5           | E-165        | Anti-rotation alarm<br>If the motor's output torque exceeds the forward/reverse torque limit, and the duration reaches P0-74 (in milliseconds) while the speed remains below P0-75 (1 rpm), an alarm will be triggered. | ① the machine is impacted, the machine suddenly becomes heavy, the machine twists;<br>② The motor operates when the brake is not released;<br>③ The parameter setting is unreasonable. | ① eliminate the mechanical distortion factors and reduce the load;<br>② Measure the voltage at the brake terminal to confirm the brake is released;<br>The braking control mode should be determined, and it is recommended to use the servo BK brake signal for control. If servo control is not used, the timing between brake opening and motor operation must be carefully considered. |

| big class | small class | confirm code | explain                                          | Possible reasons                                                                                                                    | resolvent                                                                                                                                                                                                                                                                                                                                                                      |
|-----------|-------------|--------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                                  |                                                                                                                                     | ③ Monitor the actual output torque range of U0-02 and verify the proper configuration of the torque limit value for P3-38/39.                                                                                                                                                                                                                                                  |
| 22        | 0           | E-220        | Absolute value servo encoder communication error | Motor mismatch                                                                                                                      | Check if the motor matches correctly                                                                                                                                                                                                                                                                                                                                           |
|           |             |              |                                                  | The encoder wire is not connected or has poor contact.                                                                              | Check if the U0-54 value rises rapidly. If so, the encoder circuit is likely disconnected.<br>Unplug the drive power and check the encoder cable connections for loose wires. Test the continuity with a multimeter. After troubleshooting, power on the device again.<br><br>① Hot swapping is strictly prohibited.<br><br>② For tank chains, use dedicated cables.           |
|           |             |              |                                                  | The received encoder data is incorrect, and the number of errors exceeds the value in the P0-56 register for encoder error retries. | Check if the value of U0-54 increases and the value of U0-79 rises. If so, the encoder is likely to be interfered with.<br>Do not route encoder wires through the same conduit as high-voltage circuits. Install a power filter on the servo driver's input side. Use magnetic ferrite cores for encoder wiring. Avoid welding machines and other high-interference equipment. |
|           | 1           | E-221        | Too many CRC errors in encoder communication     | The received encoder data is incorrect, and the number of errors exceeds the value in the P0-56 register for encoder error retries. | The encoder is jammed. Isolate the jamming source.                                                                                                                                                                                                                                                                                                                             |
|           | 2           | E-222        | Absolute servo encoder battery low voltage       | The battery voltage in the encoder line battery box is below 2.75V.                                                                 | To prevent encoder position errors, replace the battery while keeping the servo drive powered                                                                                                                                                                                                                                                                                  |

| big class | small class | confirm code | explain                                                                   | Possible reasons                                                                    | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------|-------------|--------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              | alarm (this alarm can be disabled)                                        |                                                                                     | on. Battery specifications: AA battery, 3.6V (model CP-B-BATT).<br><br>CPT-B-BATT)                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|           |             |              |                                                                           | Power-on alarm for the new device                                                   | ① The absolute position memory of the motor during power failure relies on the battery in the encoder cable. If the encoder cable and motor are disconnected and power supply is lost, the current position of the motor will be lost, triggering alarm 222. To restore normal operation, simply clear this alarm by setting F0-00=1.<br><br>② Using P0-79 can disable this alarm. When P0-79 is set to 1, the motor operates as an incremental type, stops multi-turn counting, and the current position is not remembered during power-off. |
|           | 3           | E-223        | Absolute value servo encoder data access alarm                            | The multi-turn absolute value motor does not use encoder cables with battery boxes. | ① Use the encoder cable with its built-in battery compartment;<br><br>② Power off and power on again (ensure the driver panel is fully extinguished). If the alarm persists, contact the agent or manufacturer.                                                                                                                                                                                                                                                                                                                               |
|           |             |              |                                                                           | The encoder is faulty or the power supply is unstable.                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|           | 7           | E-227        | The multi-turn signal data of the Shanghai Electric encoder is incorrect. | The issue is usually with the encoder itself or its unstable power supply.          | This alarm may occur when the encoder cable is disconnected during a battery-free state.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|           | 8           | E-228        | Absolute value servo encoder value overflow                               | The motor runs in one direction, and the encoder data value is                      | ① Set F1-06 to 1 and reset the absolute encoder's multi-turn                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| big class | small class | confirm code | explain                                       | Possible reasons                                                                                                                                         | resolvent                                                                                                                                                                                                                        |
|-----------|-------------|--------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                               | too large, causing overflow.                                                                                                                             | count;<br>② P0-79=2 can block the alarm.                                                                                                                                                                                         |
| 24        | 0           | E-240        | Timing error in reading encoder position data | ① The number of consecutive errors in encoder data update timing exceeds the value in P0-68<br>② CPU timer fluctuates                                    | ① Restart the drive;<br>② Check the wiring arrangement of the transmission cables to ensure the separation of high-voltage and low-voltage circuits;<br>③ The high-current equipment is supplied separately;<br>④ Good grounding |
|           | 1           | E-241        | The encoder responds with corrupted data.     | The received encoder data is incorrect, and the number of errors exceeds the value in the P0-56 register for encoder error retries.                      | ① Check the wiring arrangement of the transmission cables to ensure the separation of high-voltage and low-voltage circuits;<br>② The high-current equipment is supplied separately;<br>③ Good grounding                         |
| 26        | 0           | E-260        | overtravel alarm                              | An out-of-range signal was detected, and the out-of-range processing mode is configured to trigger an alarm.                                             | To avoid immediate alarm when exceeding the limit, you can modify the signal processing method.                                                                                                                                  |
|           | 1           | E-261        | Out-of-range signal connection error          | ① When the motor is running forward, it encounters a reverse overtravel signal.<br>② When the motor reverses, it encounters a forward overtravel signal. | Check the overtravel signal connection and terminal allocation.                                                                                                                                                                  |

| big class | small class | confirm code | explain                           | Possible reasons                                                                                                                                                  | resolvent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------|-------------|--------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | 2           | E-262        | Control stop timeout              | <p>① The inertia is too large.</p> <p>The timeout for stopping is too short</p> <p>③ The brake torque is set too low.</p>                                         | <p>① Reduce inertia or use brake motor;</p> <p>② Increase the stop timeout time P0-30;</p> <p>③ Increase the braking torque P3-32</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|           | 4           | E-264        | Excessive vibration               | <p>oscillation caused by external force</p> <p>② Large load inertia and incorrect load inertia ratio or too small gain lead to oscillation during positioning</p> | <p>① Check the source of external forces and inspect the mechanical installation for any issues;</p> <p>② Increase the servo gain to improve the anti-disturbance ability;</p> <p>③ the analysis of the collection speed curve;<br/>When the first three peaks and troughs of the pulse command are in a convergent state (<math>0.8 *  \text{first peak}  &gt;  \text{second peak} </math> and <math>0.8 *  \text{second peak}  &gt;  \text{third peak} </math>), the driver should not trigger an alarm. In such cases, the relevant thresholds can be adjusted. If the three peak speed values of the pulse command are not less than 300rpm for three times, the drive alarm will be triggered.</p> <p>④ Contact the manufacturer for technical support.</p> |
|           | 5           | E-265        | The motor is running excessively. | The machine is vibrating.                                                                                                                                         | Check the motor installation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 28        | 0           | E-280        | Failed to read motor parameters   | Failed to read EEPROM                                                                                                                                             | Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| big class | small class | confirm code | explain                                                     | Possible reasons                                   | resolvent                                                                                                                                                                                               |
|-----------|-------------|--------------|-------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                                             |                                                    | alarm) and configuring P0-33 as the motor code.                                                                                                                                                         |
|           | 1           | E-281        | An error occurred while writing data to the encoder EEPROM. | Failed to write to EEPROM                          | Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.     |
|           | 2           | E-282        | Station number assignment timeout                           | The cable for station number assignment is broken. | ① Check if there are any issues with the connection between the rectifier module and the inverter module;<br>② Contact the manufacturer for technical support.                                          |
|           | 3           | E-283        | The rectifier module is overheated.                         | Long-term operation under heavy load               | Re-evaluate the motor capacity and monitor the U0-02 torque during operation to check if it remains above 100 for extended periods. If so, consider using a higher-capacity motor or reducing the load. |
|           |             |              |                                                             | The ambient temperature is too high.               | ① Enhance ventilation measures to lower ambient temperature;<br>② Check if the fan rotates during servo enable; if module temperature U0-06 reaches or exceeds 45 °C, the fan will activate             |
|           |             |              |                                                             | Fan damage                                         | Replace the fan                                                                                                                                                                                         |
|           | 5           | E-285        | rectifier module P-overcurrent                              | Breakdown of P-end Protected Discharge Tube        | Contact the manufacturer's technical support                                                                                                                                                            |
| 31        | 0           | E-310        | The drive and motor power are mismatched                    | For example, a 750W drive with a 200W motor        | Match the correct motor and driver, and set the P0-33 motor code correctly before use.                                                                                                                  |
|           | 1           | E-311        | The motor parameters read                                   | Motor code not set                                 | Once the driver and motor are professionally matched and                                                                                                                                                |



| big class | small class | confirm code | explain                                                                                     | Possible reasons                                                        | resolvent                                                                                                                                                                                                                                                                                                                                              |
|-----------|-------------|--------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              | during automatic motor code reading are 0, and the driver P0-33=0                           |                                                                         | compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.                                                                                                                                                                                                             |
|           | 2           | E-312        | The motor parameters have been corrupted.                                                   | CRC check failed                                                        | Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.                                                                                                                                                    |
|           | 3           | E-313        | The encoder software version is not compatible                                              | The encoder software version is not compatible                          | ① Update the driver firmware to optimize the motor's performance with current parameters;<br>② By setting P0-53=1 (to disable automatic motor parameter readout alarm) and configuring P0-33 motor code correctly, the motor parameters will be stored in the driver for normal operation, though this may affect certain performance characteristics. |
|           | 4           | E-314        | The motor code does not match the software version                                          | The encoder hardware version is higher than the driver firmware version | Contact technical support to update the driver firmware                                                                                                                                                                                                                                                                                                |
|           | 5           | E-315        | The motor parameters read during automatic motor code reading are 0, and the driver P0-33=0 | The motor code is 0                                                     | Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.                                                                                                                                                    |
|           | 6           | E-316        | Auto-code reading error                                                                     | The motor code read automatically does not match the one set in P0-33.  | Check the MOTOR CODE on the U3-70 and motor housing nameplates.<br>①If two values match, update the P0-33 motor code or set P0-33 to 0 to automatically retrieve the motor code;                                                                                                                                                                       |

| big class | small class | confirm code | explain                           | Possible reasons                                                                            | resolvent                                                                                                                                                                        |
|-----------|-------------|--------------|-----------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |             |              |                                   |                                                                                             | ②If the values differ, contact the manufacturer's technical support                                                                                                              |
| 34        | 0           | E-340        | STO status inconsistency          | The input states of STO1 and STO2 are inconsistent, and the time exceeds the P0-88 setting. | ① Ensure simultaneous disconnection of STO1 and STO2;<br>② If a STO circuit remains high after disconnecting the 24V power supply, contact the manufacturer's technical support. |
|           | 2           | E-342        | STO buffer circuit error          | STO buffer circuit malfunction                                                              | Check if the 24V power supply for STO1 and STO2 is stable. If stable, contact the manufacturer's technical support.                                                              |
| 40        | 0           | E-400        | Connection error from the station | Communication timeout between rectifier unit and inverter module                            |                                                                                                                                                                                  |

## 10.3 Abnormal (Alarm) Readout

000h ~ FFFFh is defined according to IEC61800-7-201.

The FF00h ~ FFFFh range can be customized by users as specified below.

The lower 8 bits of the defined value (FF00h ~ FFFFh) represent the primary code for alarm numbers indicating servo system abnormalities (alarms). (The secondary code of the alarm number is not read.) In addition, the main code of the alarm number is expressed by 16-ary number.

| index of matrix                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | subindex | name       | scope   | data type | accessibility | PDO   | Op-mode |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|---------|-----------|---------------|-------|---------|
| 603Fh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 00h      | Error code | 0~65535 | U16       | ro            | TxPDO | All     |
| <p>The alarm number generated by the servo driver: General Alarm 603F displays the complete error code, while bus-related alarms show the main alarm number. Display 0000h when no alarm occurs.</p> <p>When an alarm is triggered, the alarm (main) number (00h ~ FFh) displays FF**h.</p> <p>example :</p> <p>①When a general alarm (e.g., E-030 overvoltage protection) occurs, 603F = 30d</p> <p>②Bus-related alarms such as E-850 (TxPDO configuration error protection) and E-851 (RxPDO configuration error protection).</p> <p>603F = FF55h... 55h=85d, meaning either E-850 or E-851 will be affected</p> <p>As an exception, when E-817 (SyncManager2/3 configuration error) occurs, the system displays A000h.</p> |          |            |         |           |               |       |         |

Alternatively, alarms can be read via SDO read commands. The U1-00 object dictionary corresponds to 0x3100, with the following command:



Read the value from the slave object dictionary 0x3100 (station number 0) in register D0, using the code 00 (current alarm code). (See the user manual for the XDH/XLH/XG2 series programmable controllers, 'Advanced Motion Control' section, for detailed instructions.)

## 10.4 Reset Alarm

Reset method for EtherCAT-associated protection functions with alarm reset capability

Methods ①, ②, ③, and ④ can all reset the alarm.

For protection functions not related to EtherCAT, please refer to the Basic Function Specifications section in the technical documentation.

Method ①: Set bit4 (Error Ind Ack) of AL Control to "1".

Subsequently, the bit7 of 6040h (Controlword) is set from 0 to 1 (sending a Fault reset command), thereby completing the reset of the fault alarm.

After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ②: The servo driver automatically resets the alarm (panel F0-00) via the host computer software.

After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ③: The external alarm reset input (A-CLR) of the servo driver transitions from OFF to ON.

After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ④: Clear the alarm by writing a command via SDO. The object dictionary corresponding to F0-00 is 0x3000. The command is as follows:



When an alarm occurs, write 1 to D0 to clear the alarm. (For detailed instructions, refer to the User Manual for XDH/XLH/XG2 Series Programmable Controllers [Advanced Motion Control Section])

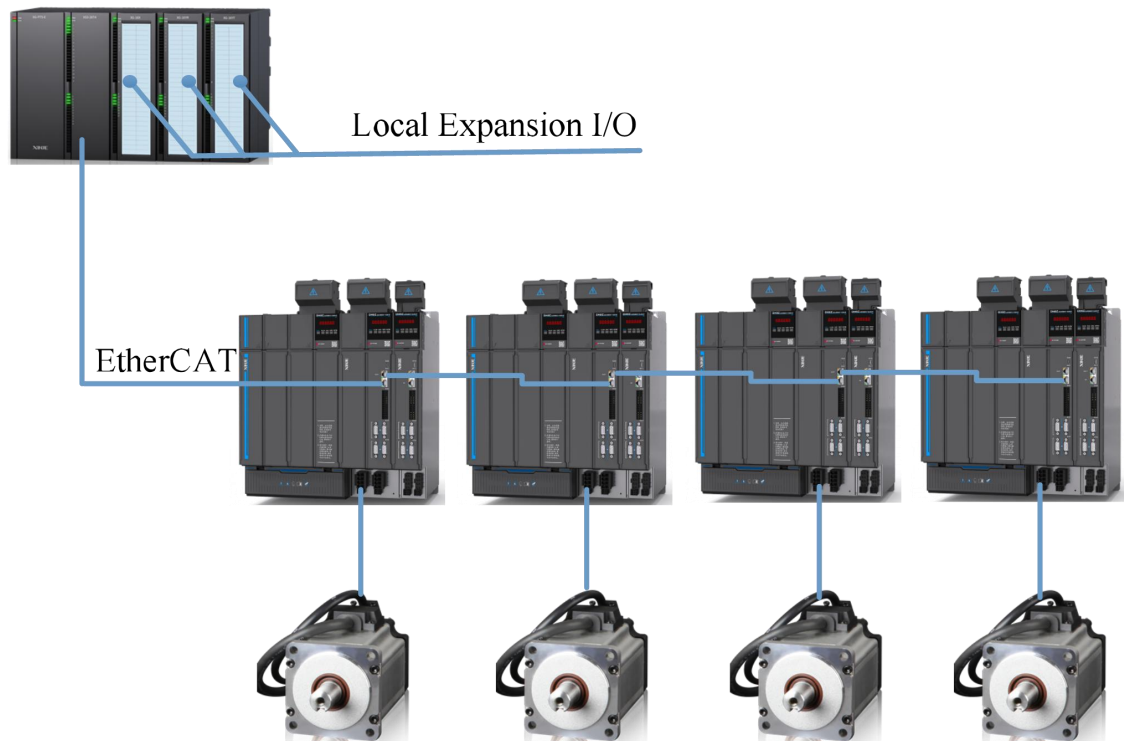
# 11. Communication Cases

## 11.1 XJX XG2/XDH and XJX DM6C Servo EtherCAT Communication Example

### 11.1.1 System Configuration

| name                    | Model/Specification                  | quantity  | remarks                            |
|-------------------------|--------------------------------------|-----------|------------------------------------|
| motion control software | Xinjie PLC Programming Tool Software | 1         |                                    |
| Servo of XJ             | DM6-4110P0-R                         | 1         |                                    |
| parvicostellae          | JC-CA-3                              | a surname | Connects the computer to the servo |

### 11.1.2 System Topology

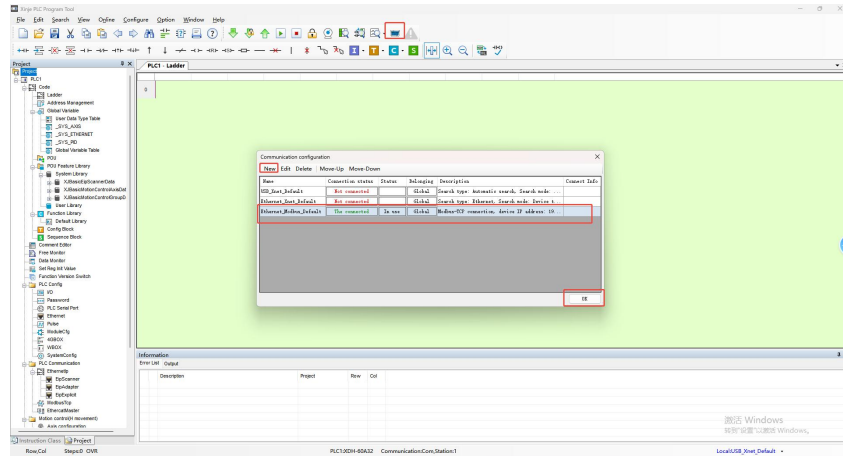


The DM6C driver's EtherCAT network port wiring follows a bottom-up standard: the master station's network cable connects to the first driver's IN port, while the first driver's OUT port cable connects to the second driver's IN port, and so on.

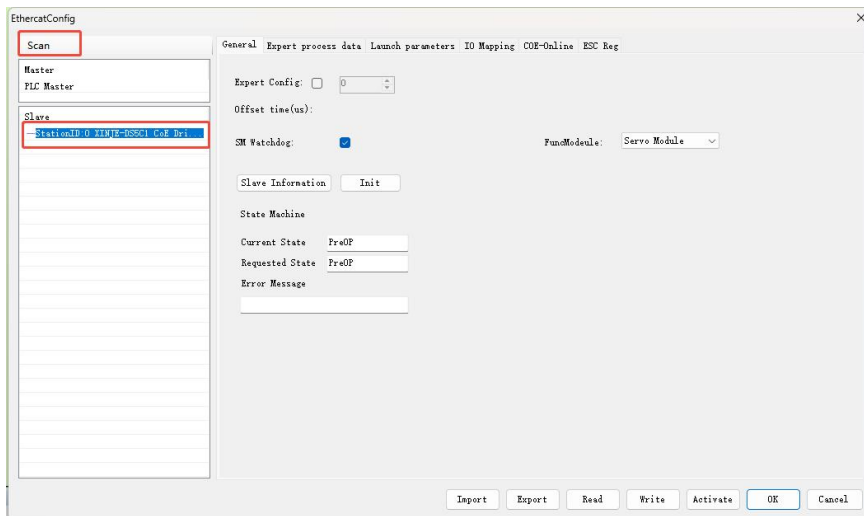
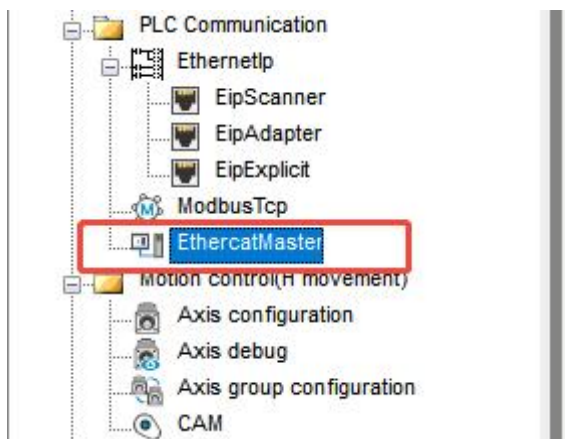
### 11.1.3 Debugging Steps

Using H motion as an example, debug each EtherCAT bus control mode (the default in PLC programming software version 3.7.14 and above is H motion, with SFD811=1).

#### 1、 linkage PLC.



#### 2. Configure Ethercat.



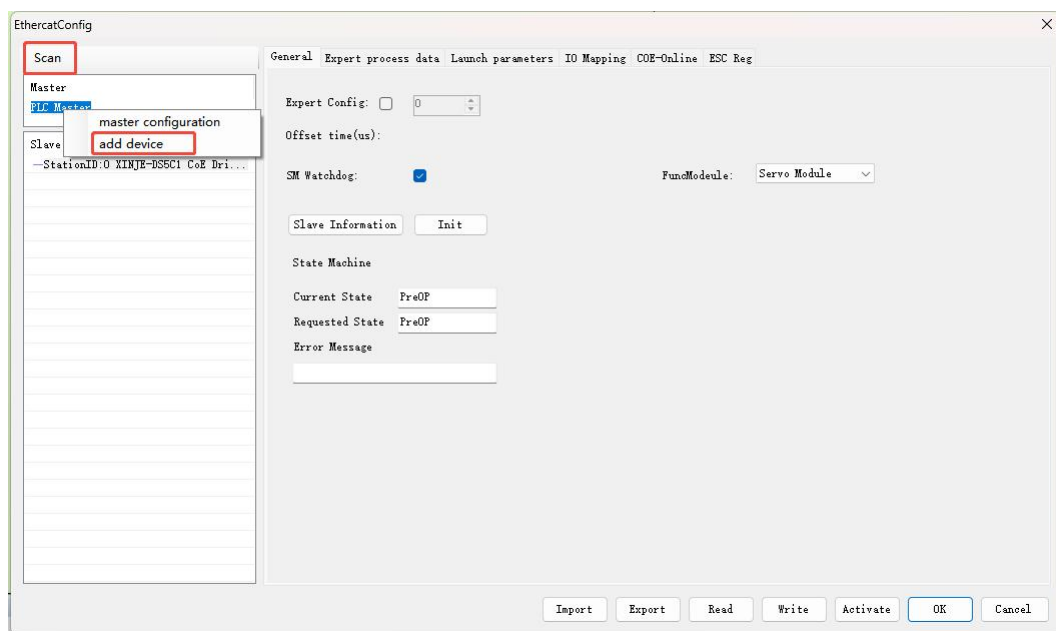
#### 3. Confirm the PDO to be configured in this mode in Expert Engineering Data.

## 1) Example of CSP mode operation

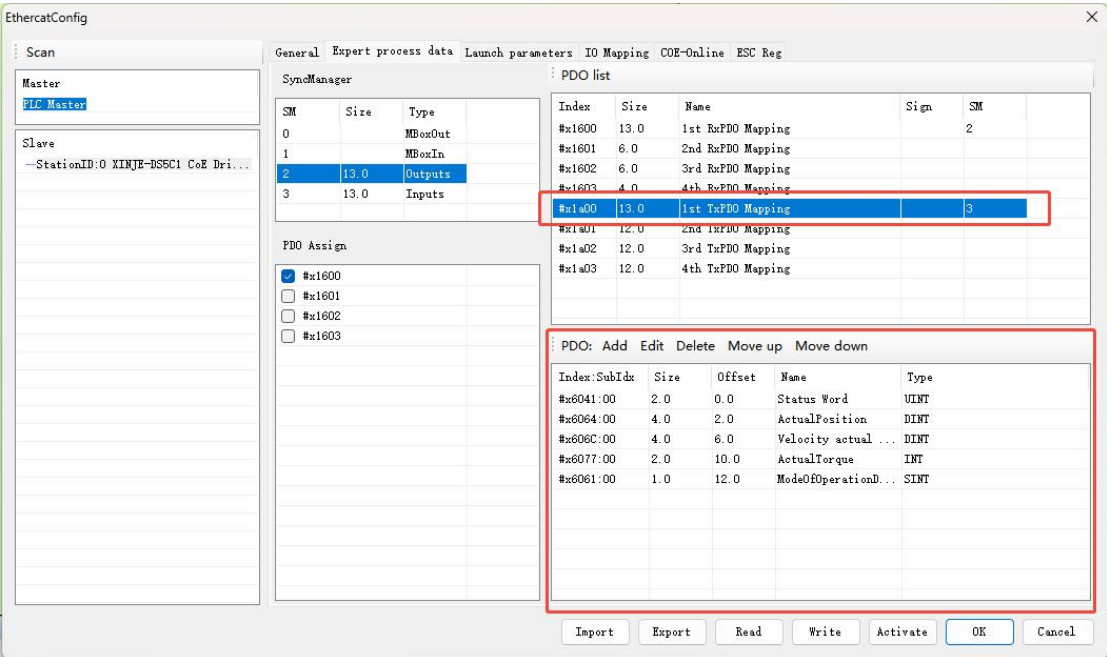
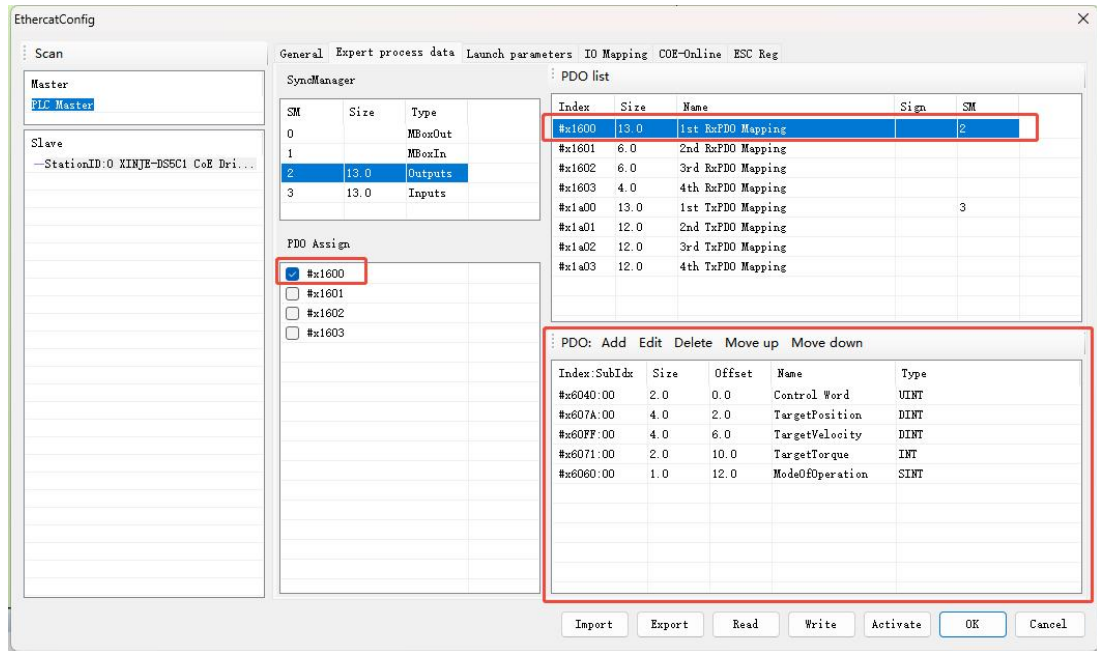
CSP control mode associated object

| register      | explain                                                                                                                     | unit             |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|
| RXPDO[0x607A] | When the position is specified, modifications via IO mapping are invalid in CSP mode, as it is controlled by the NC module. | instruction unit |
| TXPDO[0x6064] | Position feedback (actual motor position)                                                                                   | instruction unit |
| TXPDO[0x606C] | rate feedback                                                                                                               | Command unit/s   |
| RXPDO[0x6060] | The control mode is CSP (Cycle Synchronization Position Mode). Set its value to 8.                                          | -                |

① On the EtherCAT interface, select [Scan] or [Add Device] for slave devices, and use the default configuration in the [General] interface.

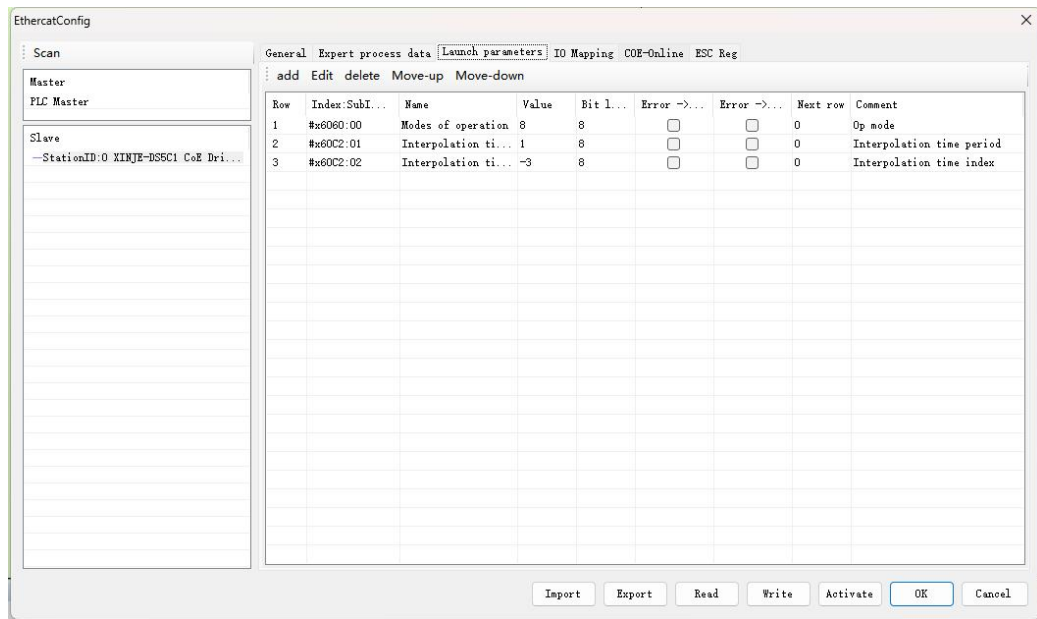


② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00. (The default configuration meets CSP's basic requirements. Additional PDO parameters can be added if needed.)



- ③ Verify that the 6060h value in [Start Parameters] is set to 8.

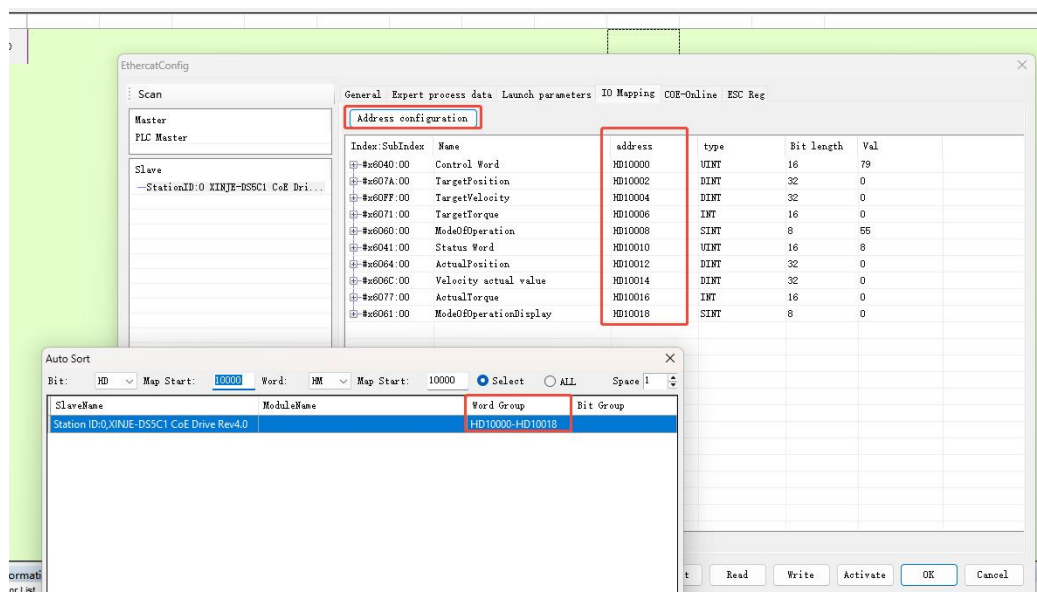




The startup parameters include three default configurations: 6060h (slave mode, default value 8 for CSP mode); 60C2-1 and 60C2-2 (synchronization unit period), where 60C2-1 specifies the period value and 60C2-2 its unit. For example, the default synchronization unit period is  $100 \times 10^{-5}$  seconds (1000 microseconds). This parameter automatically adjusts to the master station's synchronization period configuration, eliminating manual modification.

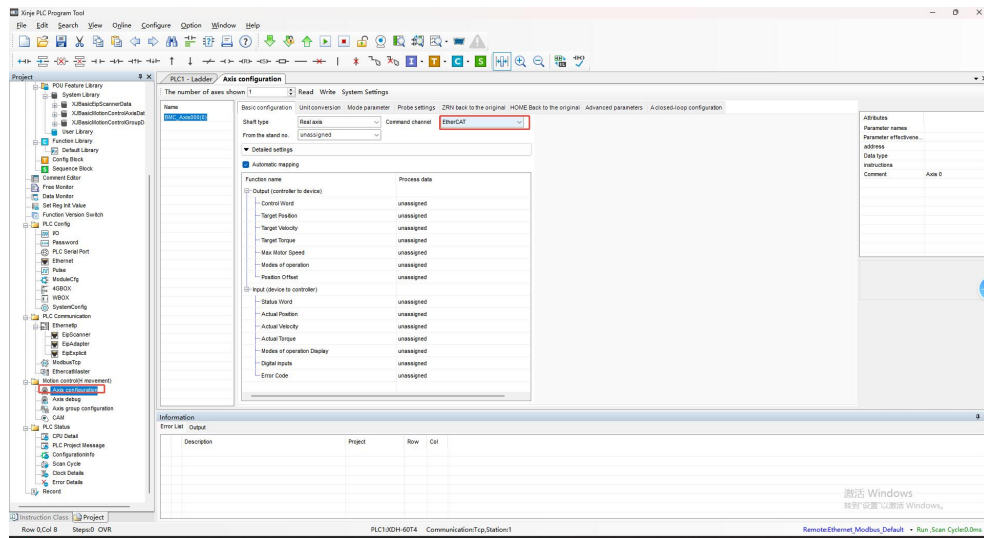
④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

- ⑦ Verify that the instruction channel (SFD8001+300\*N) in the axis configuration parameters is set to Ethercat (with the register value set to 0).



- ⑧ In the CSP mode, the current position can be monitored via HD10002 (607Ah mapping), the actual motor position via HD10012 (6064h mapping), and the actual speed via HD10014 (606Ch mapping).



| PLC1-FreeMonitor1 |               |       |              |                                                                            |  |
|-------------------|---------------|-------|--------------|----------------------------------------------------------------------------|--|
| Moni-Window       |               |       |              |                                                                            |  |
| Name              | Monitor value | type  | Map-Adres... | Comment                                                                    |  |
| M0                | ON            | BIT   | Bit          | Enable                                                                     |  |
| M20               | OFF           | BIT   | Bit          | Run With Cycle Position                                                    |  |
| HD300             | 131072        | LREAL | QWord        | Cycle Position                                                             |  |
| HD10002           | 131072        | DINT  | DWord        | Station ID:0, #x607A:0, Target position                                    |  |
| HD10008           | 8             | INT   | SWord        | Station ID:0, #x6060:0, Modes of operation                                 |  |
| HD10012           | 131072        | DINT  | DWord        | Station ID:0, #x6064:0, Position actual value                              |  |
| HD10004           | 0             | DINT  | DWord        | Station ID:0, #x60FF:0, Target velocity                                    |  |
| SFD811            | 1             | INT   | SWord        | Motion control function: 0-simple type; 1-introductory and practical type; |  |

- When the M20 is switched from OFF to ON, it performs periodic position control on the designated axis of HD300. Upon successful execution, the M21 is set to ON, indicating the axis has entered periodic control mode. The axis is then controlled by periodically assigning values to HD300.
- Before triggering the instruction, ensure the HD300 value matches the current position; otherwise, a step will occur.
- Periodic position control requires writing the target position value into the register periodically. The position change should not be too large to avoid the shaft's flyout caused by a significant difference between the given period position and the previous one.

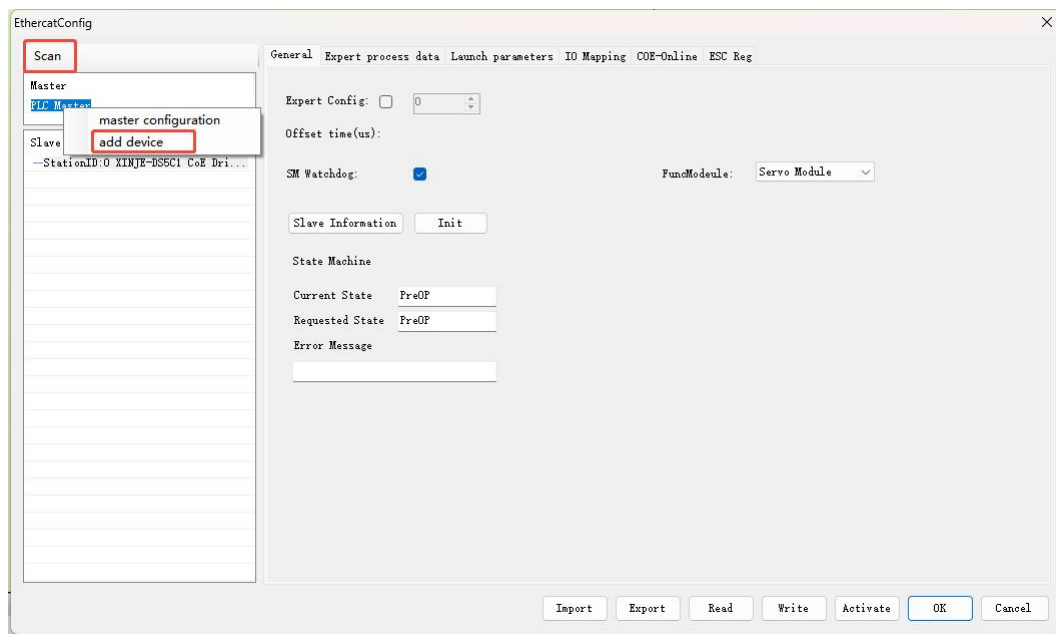
## 2) CSV mode operation example

CSV control mode associated object

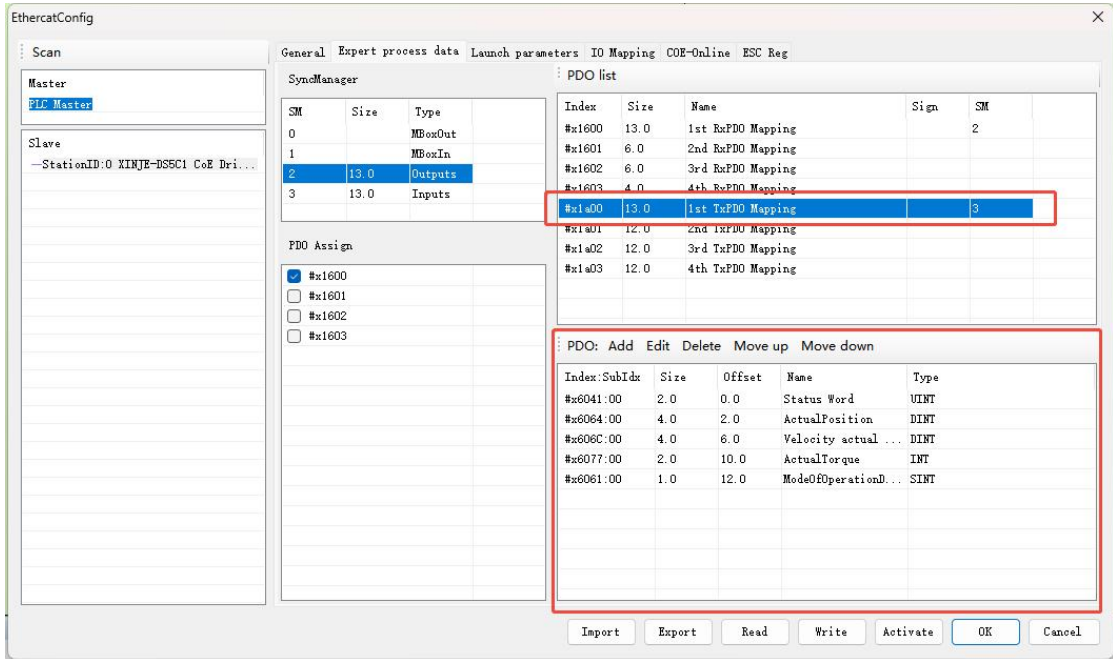
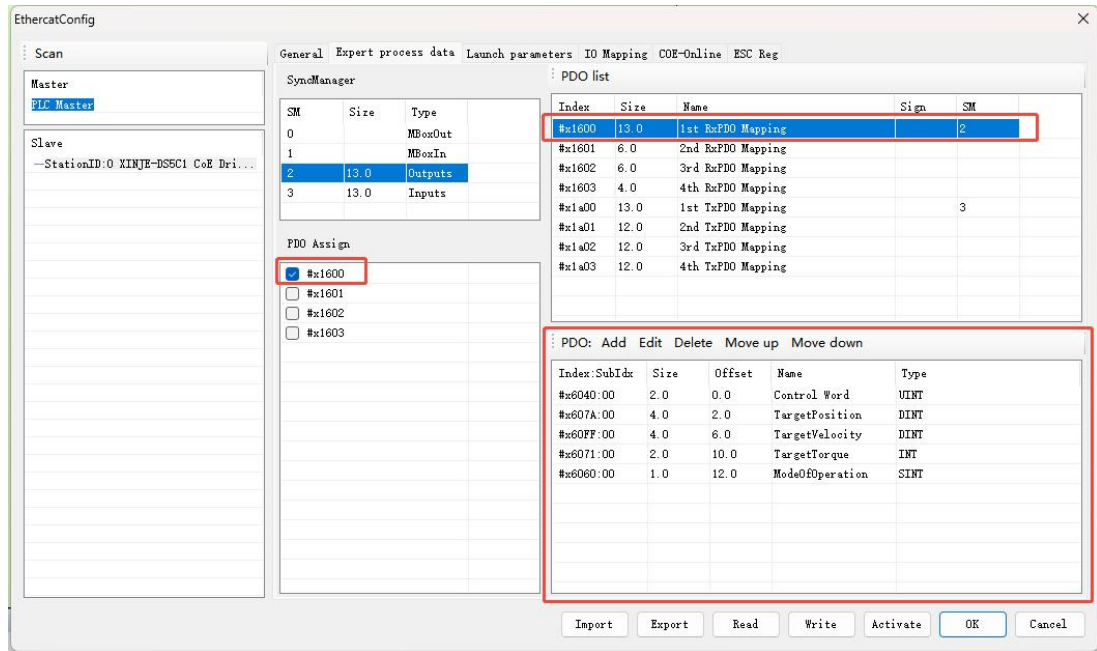
| register | explain | unit |
|----------|---------|------|
|----------|---------|------|

|               |                                                                                    |                  |
|---------------|------------------------------------------------------------------------------------|------------------|
| RXPDO[0x60FF] | velocity given                                                                     | Command unit/s   |
| TXPDO[0x6064] | position feedback                                                                  | instruction unit |
| TXPDO[0x606C] | rate feedback                                                                      | Command unit/s   |
| RXPDO[0x6080] | The maximum motor speed can be adjusted via the online COE-Online interface.       | r/min            |
| RXPDO[0x6060] | The control mode is CSV (periodic synchronization speed mode). Set its value to 9. | -                |

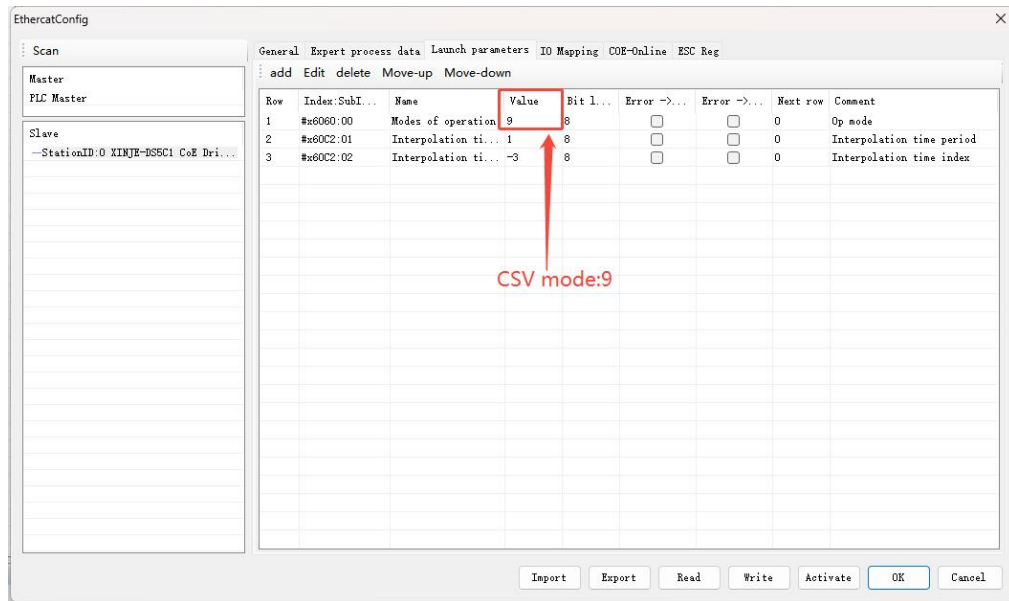
① On the Ethercat interface, select [Scan] or [Add Device] for slave devices, and use the default configuration on the [General] interface.



② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00. (The default configuration meets basic CSV requirements. Additional PDO parameters can be added if needed.)

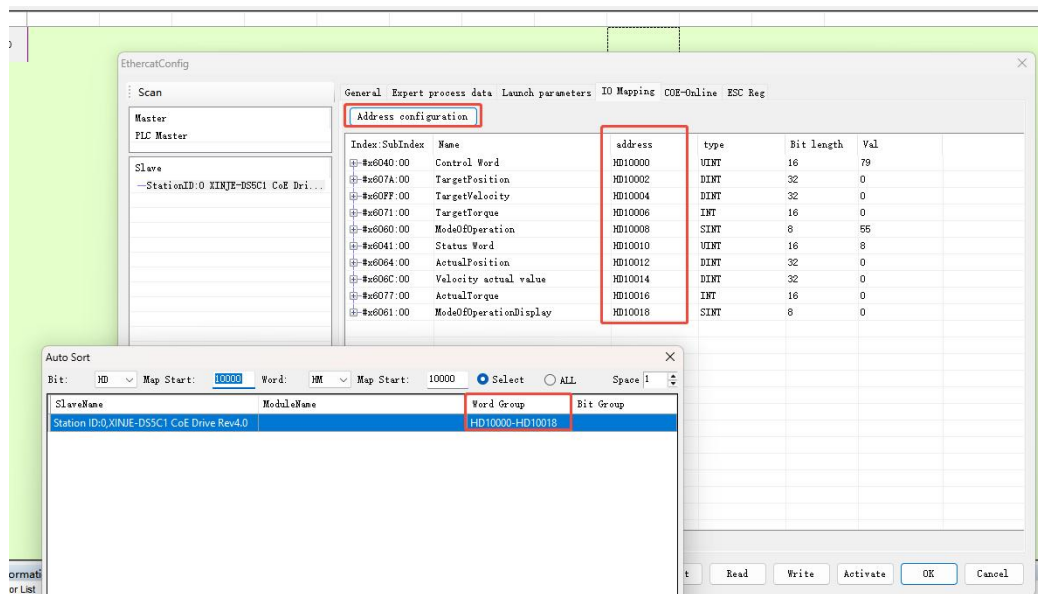


- ③ Verify that the 6060h value in [Start Parameters] is 9.



④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

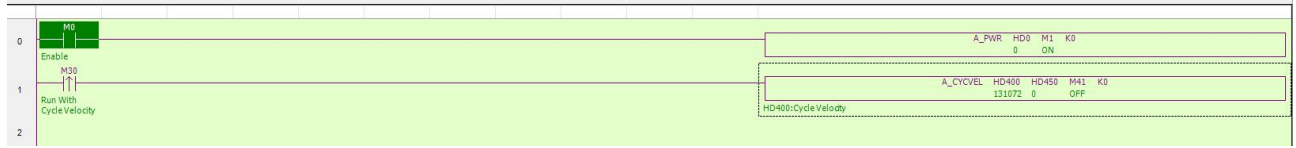
⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station status machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit/receive signals. After switching to OP, the maximum motor speed (6080h) can be adjusted via COE-Online.

⑦ When the enable bit is set to ON, HD10000 (mapped to 6040h) will transition from 6 to 7 and then to 15, indicating the slave enable state. This can be achieved by assigning a value to HD10004 (mapped to 60FFh) as the target speed in CSV mode. Real-time speed interpolation can be implemented by modifying HD1004 during I9900 interrupts.

- ⑧ In CSV mode, the system monitors the current speed via HD10004 (60FFh mapping), the actual motor position via HD10012 (6064h mapping), and the actual speed via HD10014 (606Ch mapping).



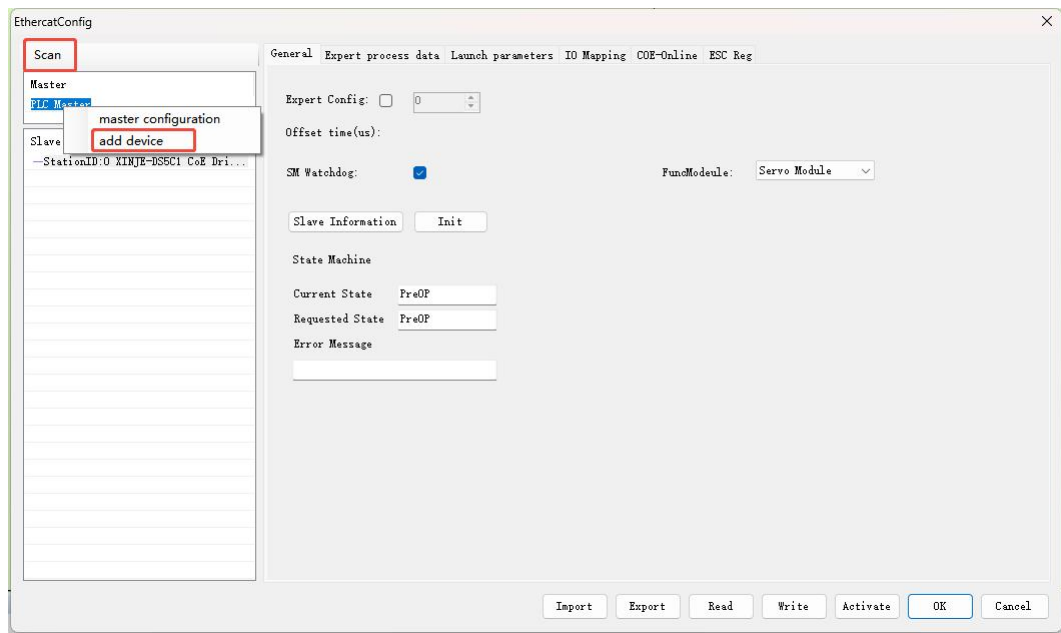
| PLC1-FreeMonitor1                                                   |               |       |                |                                               |  |
|---------------------------------------------------------------------|---------------|-------|----------------|-----------------------------------------------|--|
| Moni-Window ▾ Add Edit Delete Delete All Upword Downword Top Bottom |               |       |                |                                               |  |
| Name                                                                | Monitor value | type  | Map-Address... | Comment                                       |  |
| M0                                                                  | ON            | BIT   | Bit            | Enable                                        |  |
| M30                                                                 | OFF           | BIT   | Bit            | Run With Cycle Velocity                       |  |
| HD400                                                               | 131072        | LREAL | QWord          | Cycle Velocity                                |  |
| HD10002                                                             | 43691646      | DINT  | DWord          | Station 1D:0, #x607A:0, Target position       |  |
| HD10004                                                             | 131072        | DINT  | DWord          | Station 1D:0, #x60FF:0, Target velocity       |  |
| HD10008                                                             | 9             | INT   | SWord          | Station 1D:0, #x6060:0, Modes of operation    |  |
| HD10014                                                             | 130722        | DINT  | DWord          | Station 1D:0, #x606C:0, Velocity actual value |  |
| HD10012                                                             | 43691122      | DINT  | DWord          | Station 1D:0, #x6064:0 Position actual value  |  |

### 3) Example of operating the CST mode

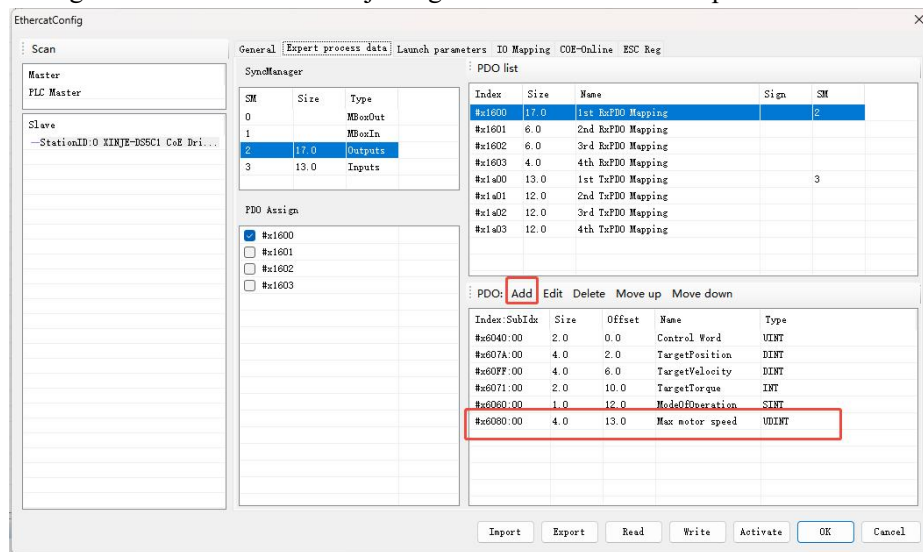
CST control mode associated object

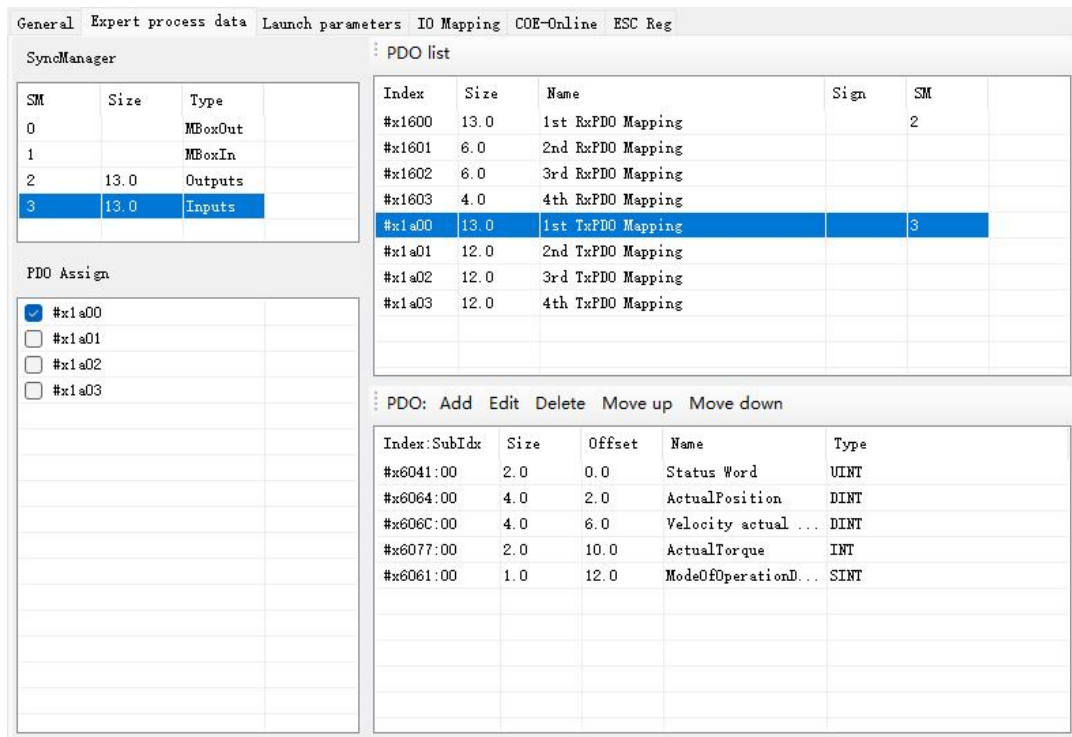
| register      | explain                                                                       | unit             |
|---------------|-------------------------------------------------------------------------------|------------------|
| RXPDO[0x6071] | torque given                                                                  | 0.1%             |
| TXPDO[0x6064] | position feedback                                                             | instruction unit |
| TXPDO[0x606C] | rate feedback                                                                 | Command unit/s   |
| TXPDO[0x6077] | torque feedback                                                               | 0.1%             |
| RXPDO[0x6080] | maximum motor speed                                                           | r/min            |
| RXPDO[0x6060] | The control mode is CST (Cycle Synchronous Torque Mode). Set its value to 10. | -                |

- ① On the Ethercat interface, select [Scan] or [Add] slave station, and use the default configuration on the [General] interface.

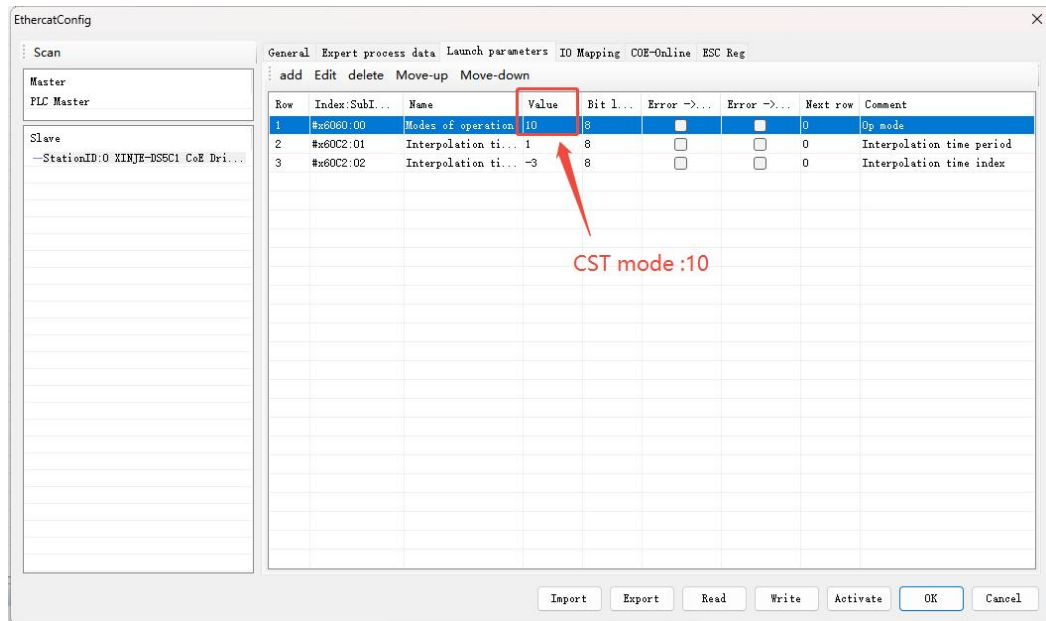


② In the [Expert Process Data] → [PDO Allocation] section, select 1600 and 1A00. The default configuration meets CST's basic requirements. Additional PDO parameters can be added if needed for example, adding 6080h to 1600 allows adjusting the motor's maximum speed to control torque.





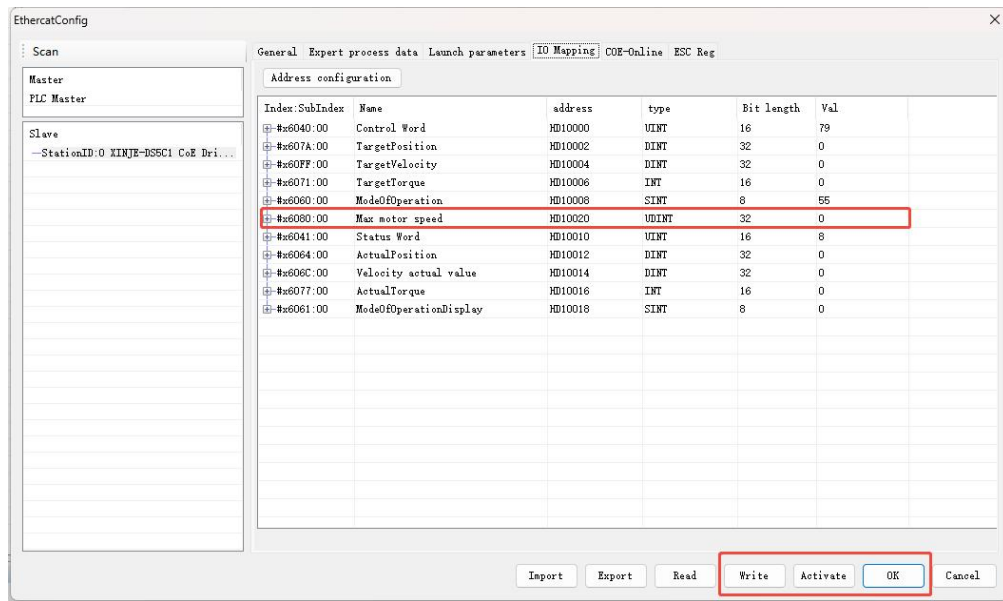
③ Verify that the 6060h value in [Start Parameters] is set to 10.



④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.

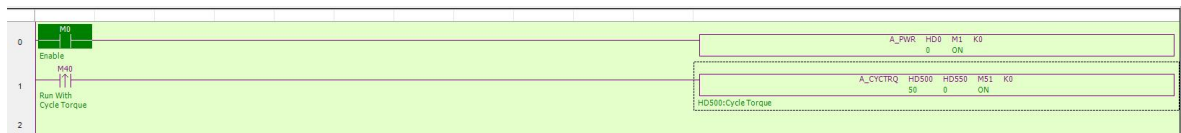




⑥ Upon activation, the station state machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ When the enable bit is set to ON, HD10000 (mapped to 6040h) will transition from 6 to 7 and then to 15, indicating the slave enable state. This can be achieved by assigning a value to HD10006 (mapped to 6071h) as the specified torque in CST mode.

⑧ In CST mode, the system monitors the current torque via HD10006 (mapping to 6071h), the actual position via HD10012 (mapping to 6064h), the actual speed via HD10014 (mapping to 606Ch), and the actual torque via HD10016 (mapping to 6077h). The maximum motor speed can be restricted at 6080h (Note: After adding the speed limit parameter, ensure the speed remains within the appropriate range during operation).



| PLC1-FreeMonitor1                                                   |               |       |               |                                                                            |  |
|---------------------------------------------------------------------|---------------|-------|---------------|----------------------------------------------------------------------------|--|
| Moni-Window ▾ Add Edit Delete Delete All Upword Downword Top Bottom |               |       |               |                                                                            |  |
| Name                                                                | Monitor value | type  | Map-Addres... | Comment                                                                    |  |
| M0                                                                  | ON            | BIT   | Bit           | Enable                                                                     |  |
| M40                                                                 | OFF           | BIT   | Bit           | Run With Cycle Torque                                                      |  |
| HD500                                                               | 50            | LREAL | QWord         | Cycle Torque                                                               |  |
| HD10020                                                             | 10            | DINT  | DWord         | Station ID:0, #x6080:0, Max motor speed                                    |  |
| HD10002                                                             | 3150984       | DINT  | DWord         | Station ID:0, #x607A:0, Target position                                    |  |
| HD10004                                                             | 0             | DINT  | DWord         | Station ID:0, #x607F:0, Target velocity                                    |  |
| HD10008                                                             | 10            | INT   | SWord         | Station ID:0, #x6060:0, Modes of operation                                 |  |
| HD10014                                                             | 21816         | DINT  | DWord         | Station ID:0, #x606C:0, Velocity actual value                              |  |
| HD10012                                                             | 3150939       | DINT  | DWord         | Station ID:0, #x6064:0, ActualPosition                                     |  |
| SFD811                                                              | 1             | DINT  | DWord         | Motion control function: 0-simple type; 1-introductory and practical type; |  |

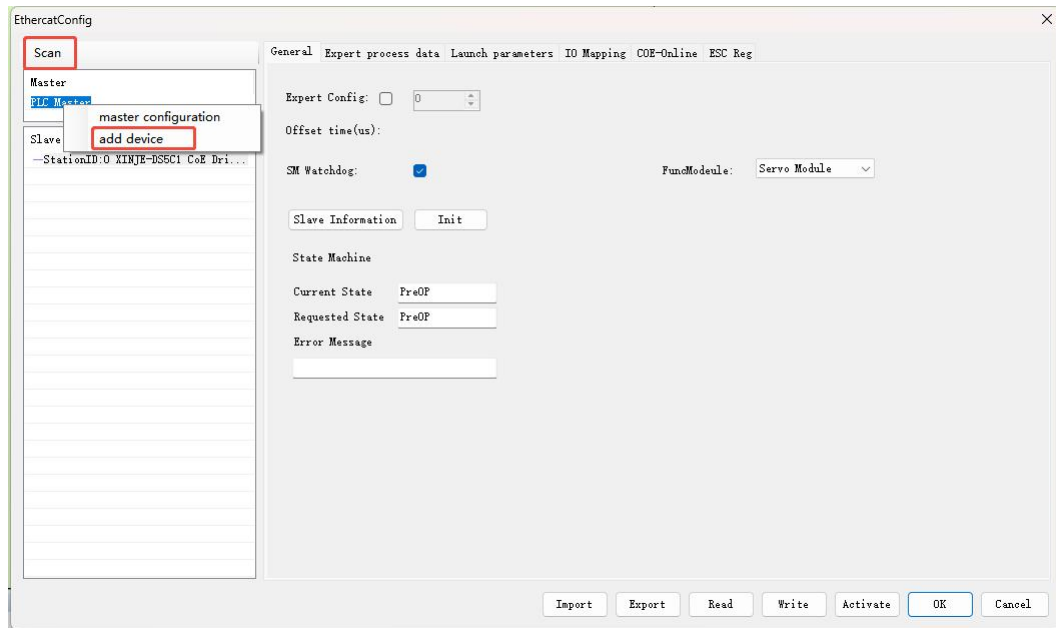
#### 4) Examples of HM mode operations

HM control mode associated object

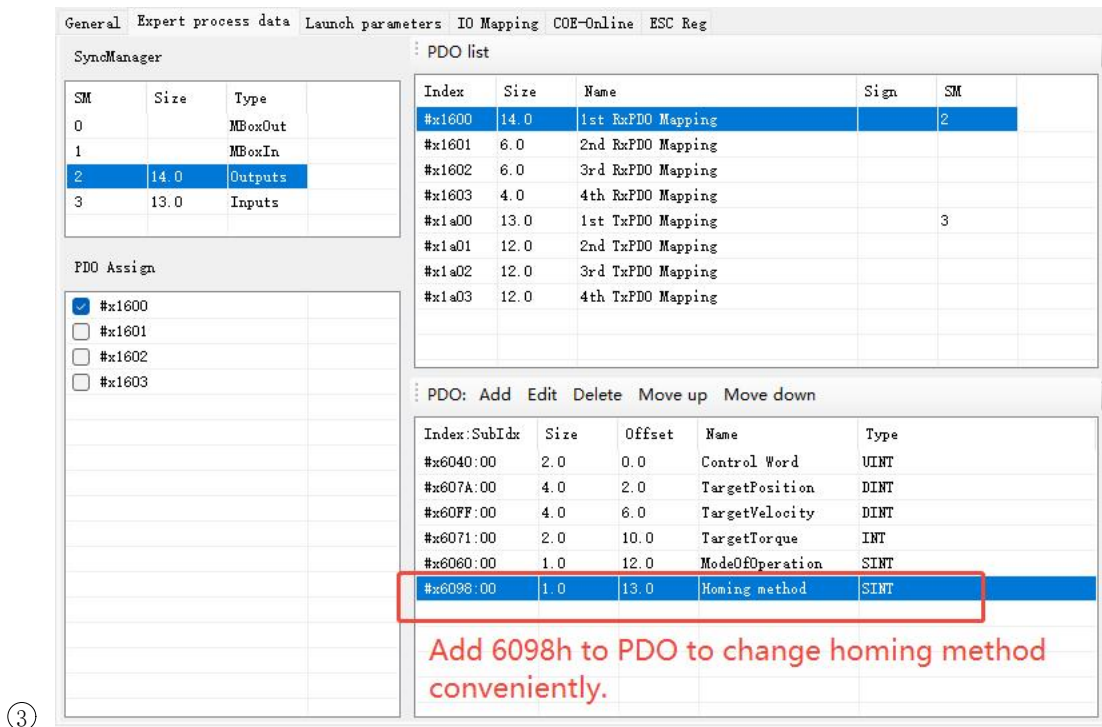
| register      | explain                                                                                                | unit                                |
|---------------|--------------------------------------------------------------------------------------------------------|-------------------------------------|
| RXPDO[0x6040] | Control word, modify control word to return to origin                                                  | -                                   |
| RXPDO[0x6098] | return to origin method                                                                                | -                                   |
| RXPDO[0x609A] | acceleration to origin                                                                                 | instruction<br>units/s <sup>2</sup> |
| RXPDO[0x6060] | The control mode is HM mode (return to origin mode). Set its value to 6 when the motor is not enabled. | -                                   |
| SDO[0x6099]   | Restore speed to origin and modify it online through COE-Online                                        | Command<br>unit/s                   |

① Perform terminal assignment. P5-22 is the positive limit setting address, with default value 1 corresponding to servo terminal SI1; P5-23 is the negative limit NOT setting address, default value 2 corresponding to servo terminal SI2; P5-27 is the origin setting address, default value 3 corresponding to servo terminal SI3.

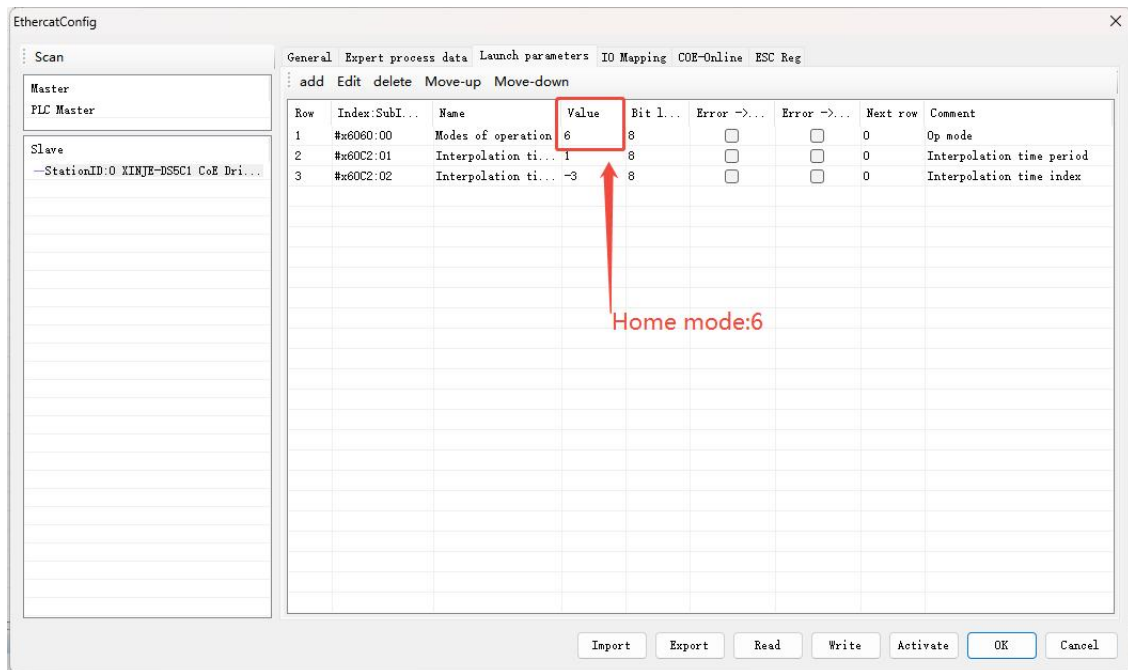
② On the Ethercat interface, select [Scan] or [Add Device] for slave devices, and use the default configuration on the [General] interface.



② In [Expert Process Data] → [PDO Allocation], select 1600 and 1A00, then add 6098h to 1600.

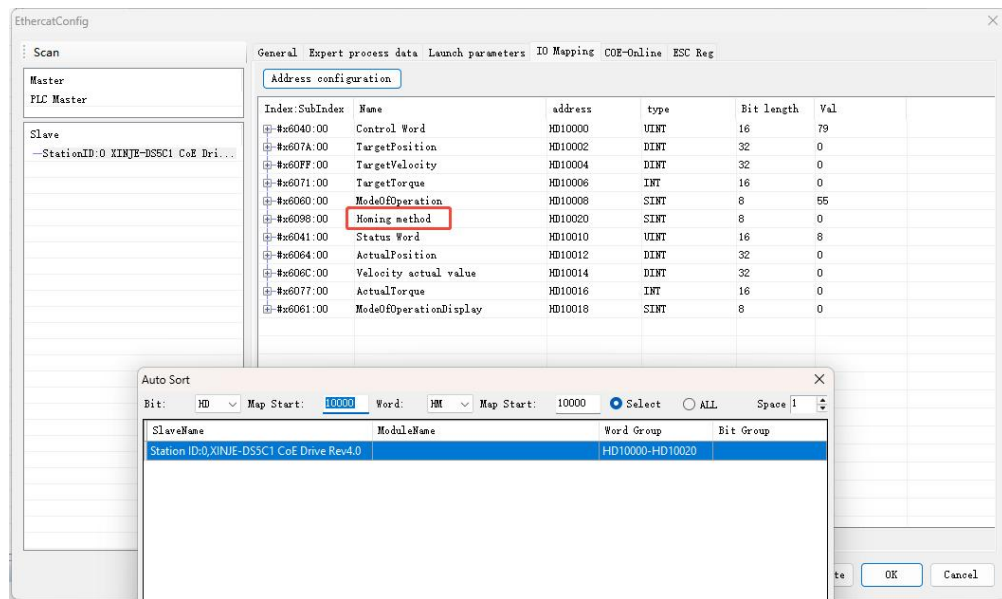


- ④ Verify that the 6060h value in [Start Parameters] is 6.



- ⑤ [IO Mapping] The default starting address is HD10000, which can be adjusted as needed.

- ⑥ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑦ Upon activation, the slave status machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑧ After the system transitions to OP mode, the original speed and acceleration values can be adjusted via COE-Online.

| Index:SubIndex | Name                           | Flag | Value  | Communication error message |
|----------------|--------------------------------|------|--------|-----------------------------|
| #x6086:00      | Motion profile type            | rw   | 0      |                             |
| #x6087:00      | Torque slope                   | rw   | 1000   |                             |
| #x6088:00      | Torque profile type            | rw   | 0      |                             |
| #x608F:00      | Position encoder resolution    | ro   | >2<    |                             |
| #x6091:00      | Gear ratio                     | ro   | >2<    |                             |
| #x6092:00      | Feed constant                  | ro   | >2<    |                             |
| #x6098:00      | Homing method                  | rw   | 0      |                             |
| #x6099:00      | Homing speeds                  | ro   | >2<    |                             |
| 01             | Speed during search for switch | rw   | 131072 |                             |
| 02             | Speed during search for zero   | rw   | 65536  |                             |
| #x609A:00      | Homing acceleration            | rw   | 262144 |                             |
| #x60A3:00      | Profile jerk use               | rw   | 0      |                             |
| #x60A4:00      | Profile jerk                   | ro   | >2<    |                             |
| #x60B0:00      | Position offset                | rw   | 0      |                             |
| #x60B1:00      | Velocity offset                | rw   | 0      |                             |
| #x60B2:00      | Torque offset                  | rw   | 0      |                             |
| #x60B8:00      | Touch Probe Function           | rw   | 0      |                             |
| #x60B9:00      | Touch Probe Status             | ro   | 0      |                             |
| #x60BA:00      | Touch Probe Pos1 Pos Value     | ro   | 0      |                             |
| #x60BB:00      | Touch Probe Pos1 Neg Value     | ro   | 0      |                             |
| #x60BC:00      | Touch Probe Pos2 Pos Value     | ro   | 0      |                             |
| #x60BD:00      | Touch Probe Pos2 Neg Value     | ro   | 0      |                             |
| #x60C0:00      | Interpolation sub mode select  | rw   | 0      |                             |
| #x60C1:00      | Interpolation data record      | ro   | >2<    |                             |

⑨ Set the origin return mode (6098h).

This setting ranges from -2 to 37 (currently supports -2 to 14, 17 to 30, 33, 34, 35, and 37).

⑩ After enabling the ON state, HD10000 (6040h mapping) will transition from 6 → 7 → 15 to indicate the slave enable status, then reset to 15 → 31 to return to the origin. During this reset process, if the

origin signal is triggered, the system will decelerate and stop according to the predefined reset procedure. To initiate another reset, first change 6040h to 15, then execute the HD10000 (6040h mapping) 15→31 sequence.

#### 5) Examples of PP Mode operations

PP control mode associated objects (commands, settings)

| register      | explain                                                                     | unit                             |
|---------------|-----------------------------------------------------------------------------|----------------------------------|
| RXPDO[0x6040] | control word                                                                | -                                |
| RXPDO[0x6060] | The control mode is PP (Profile Position Control Mode). Set its value to 1. | -                                |
| RXPDO[0x607A] | Position given                                                              | instruction unit                 |
| RXPDO[0x6072] | maximum torque                                                              | 0.1%                             |
| RXPDO[0x607F] | maximum internal velocity                                                   | Command unit/s                   |
| RXPDO[0x6080] | maximum motor speed                                                         | r/min                            |
| RXPDO[0x6081] | internal speed given                                                        | Command unit/s                   |
| RXPDO[0x6083] | internal acceleration                                                       | instruction units/s <sup>2</sup> |
| RXPDO[0x6084] | internal deceleration                                                       | instruction units/s <sup>2</sup> |
| RXPDO[0x60C5] | maximal acceleration                                                        | instruction units/s <sup>2</sup> |
| RXPDO[0x60C6] | maximum deceleration                                                        | instruction units/s <sup>2</sup> |
| RXPDO[0x6065] | Set the number of trailing pulse counts                                     | instruction unit                 |
| RXPDO[0x6066] | Follow-up error timeout time                                                | ms                               |
| RXPDO[0x6067] | Location reaches the threshold                                              | instruction unit                 |
| RXPDO[0x6068] | Location to window time                                                     | ms                               |

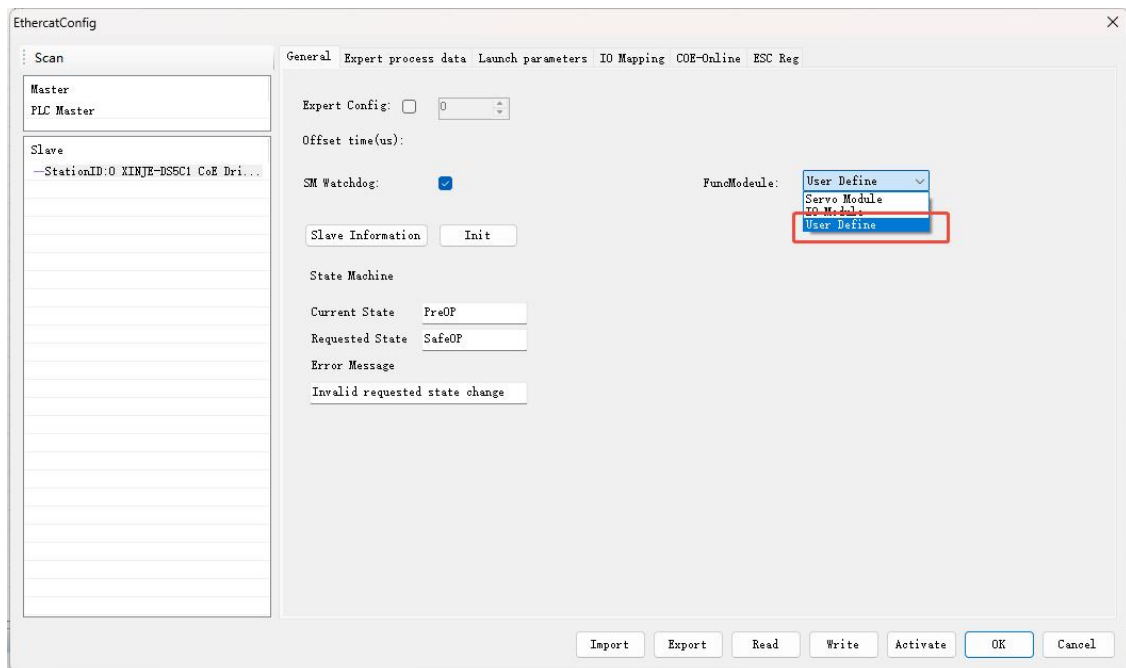
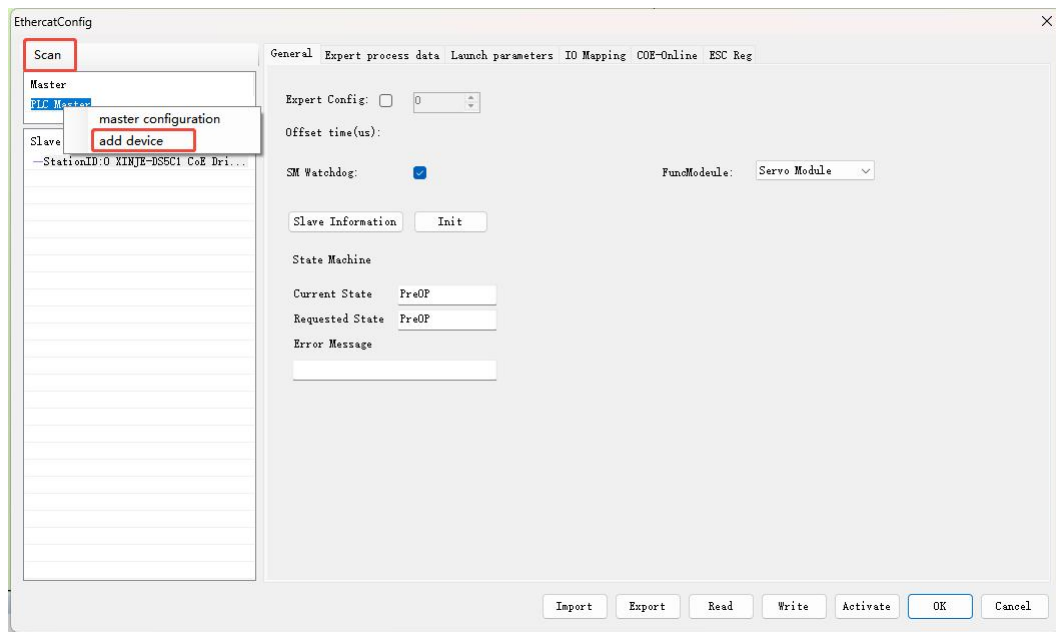


- The 6081h (profile speed) is limited by the lower of 607Fh (maximum internal speed) and 6080h (maximum motor speed).
- If you modify the set values of 607Fh (maximum internal speed) or 6080h (maximum motor speed) during operation, these changes will not be reflected in the action and will not take effect.

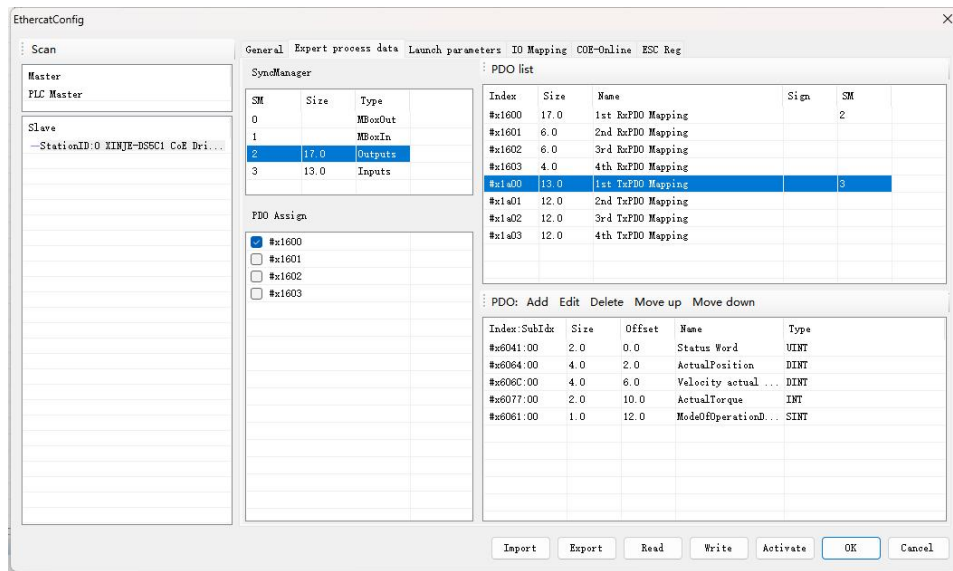
PP control mode associated objects (commands, monitoring type)

| register      | explain                                   | unit             |
|---------------|-------------------------------------------|------------------|
| TXPDO[0x6041] | status word                               | -                |
| TXPDO[0x6063] | Internal actual location                  | instruction unit |
| TXPDO[0x6064] | Position feedback (actual motor position) | instruction unit |
| TXPDO[0x606C] | rate feedback                             | Command unit/s   |
| TXPDO[0x6077] | actual torque                             | 0.1%             |
| TXPDO[0x60F4] | actual following error                    | instruction unit |

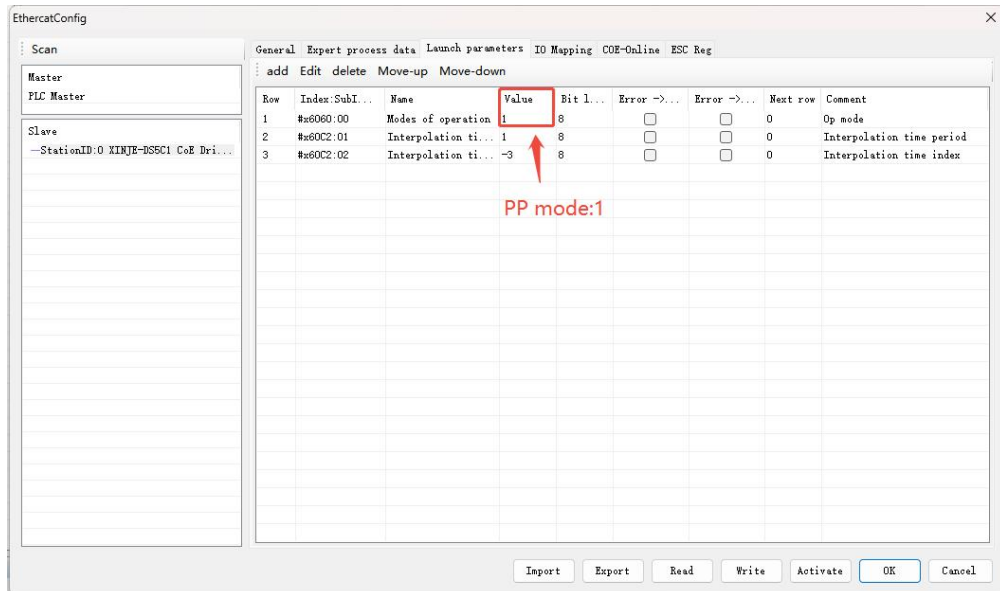
- ① In the EtherCAT interface, select the [Scan] or [Add Device] slave node, then choose User Defined as the [Common] interface function block.



- ② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00 to add PDO parameters linked to the mode (each parameter cannot exceed 32 bytes).

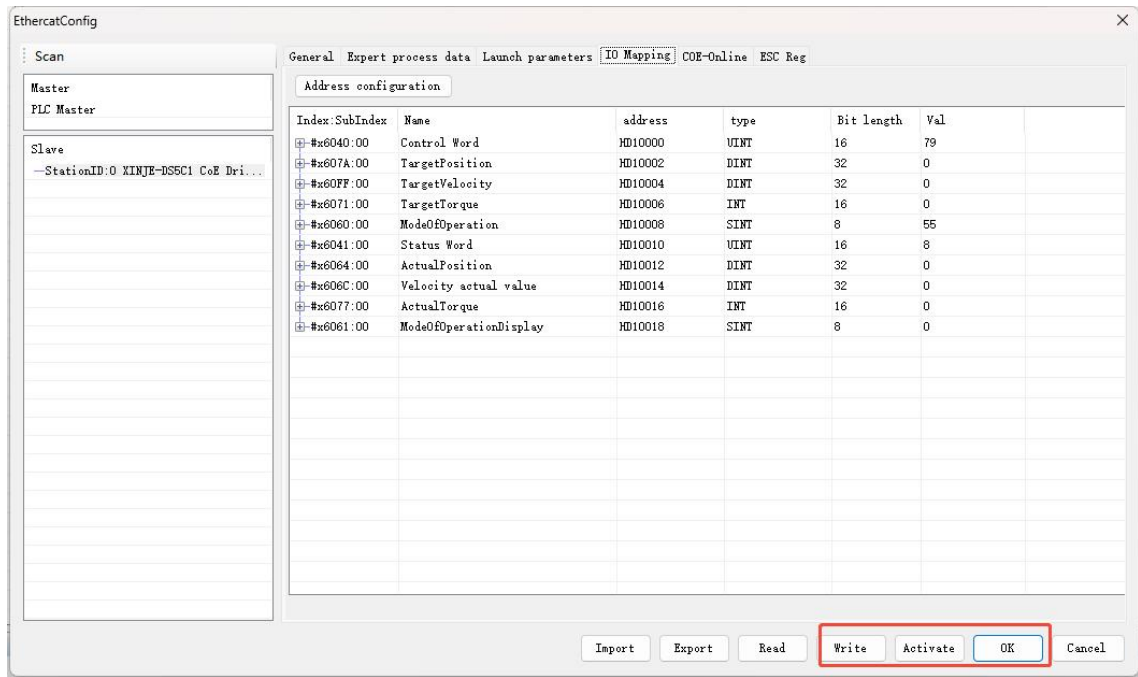


- ③ Verify that the 6060h value in [Start Parameters] is set to 1.



- ④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

- ⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ Modify control word 6040h (absolute mode: 6 → 15 → 31; relative mode: 6 → 79 → 95) to enable the slave, then set parameters like target position, target speed, and acceleration/deceleration to control the motor.

⑧ In PP mode, I/O mapping addresses can be configured and monitored. For example, the control word of Axis 1 can be modified via HD10000 (mapping to 6040h) to enable or disable the motor, while the current position of Axis 1 can be monitored through HD10002 (mapping to 607Ah).

## 6) Example of operating the PV mode

pv control mode associated objects (commands, settings)

| register      | explain                                                                     | unit                                |
|---------------|-----------------------------------------------------------------------------|-------------------------------------|
| RXPDO[0x6040] | control word                                                                | -                                   |
| RXPDO[0x6060] | The control mode is PV (Profile Velocity Control mode). Set its value to 3. | -                                   |
| RXPDO[0x60FF] | velocity given                                                              | Command<br>unit/s                   |
| RXPDO[0x6072] | maximum torque                                                              | 0.1%                                |
| RXPDO[0x607F] | maximum internal velocity                                                   | Command<br>unit/s                   |
| RXPDO[0x6080] | maximum motor speed                                                         | r/min                               |
| RXPDO[0x6083] | internal acceleration                                                       | instruction<br>units/s <sup>2</sup> |
| RXPDO[0x6084] | internal deceleration                                                       | instruction                         |

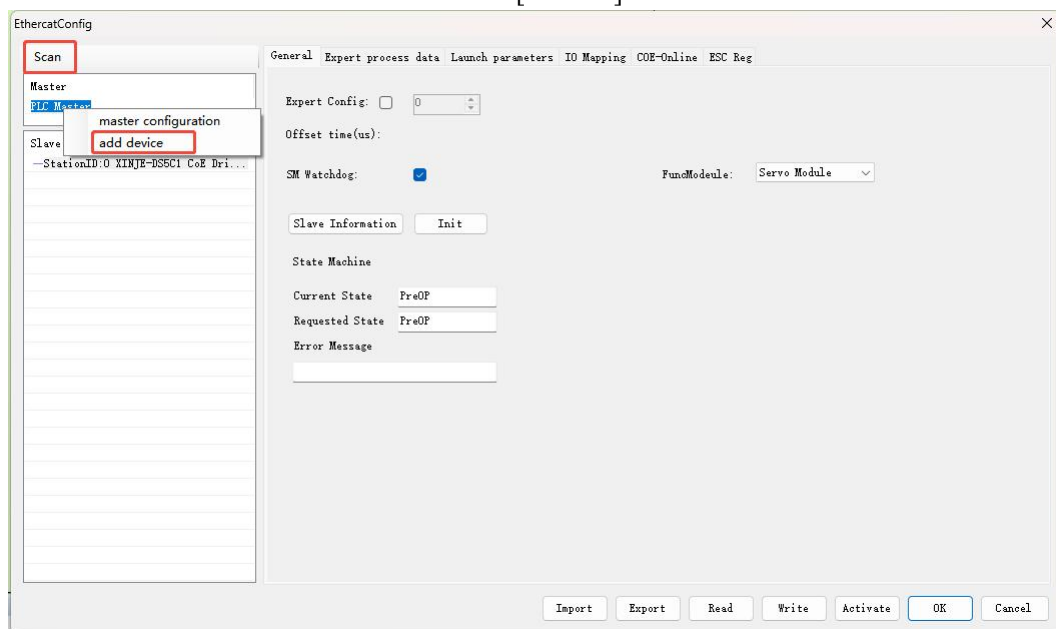


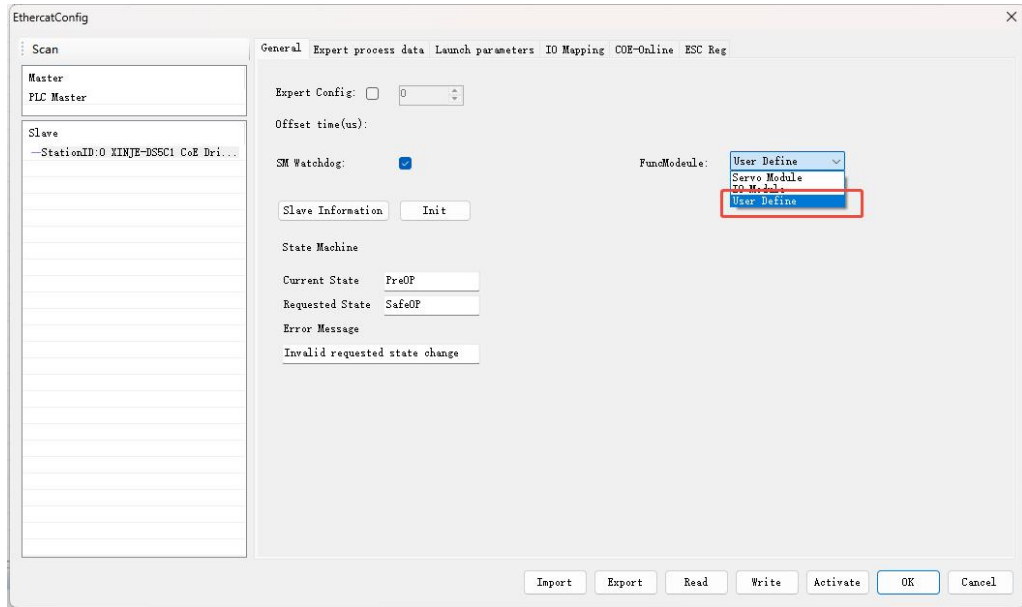
|               |                             |                                     |
|---------------|-----------------------------|-------------------------------------|
|               |                             | units/s <sup>2</sup>                |
| RXPDO[0x60C5] | maximal acceleration        | instruction<br>units/s <sup>2</sup> |
| RXPDO[0x60C6] | maximum deceleration        | instruction<br>units/s <sup>2</sup> |
| RXPDO[0x606D] | Speed reaches the threshold | Command<br>unit/s                   |
| RXPDO[0x606E] | Speed limit exceeded        | ms                                  |
| RXPDO[0x606F] | Speed threshold             | Command<br>unit/s                   |
| RXPDO[0x6070] | Speed threshold time        | ms                                  |

pv control mode associated objects (command,monitoring type)

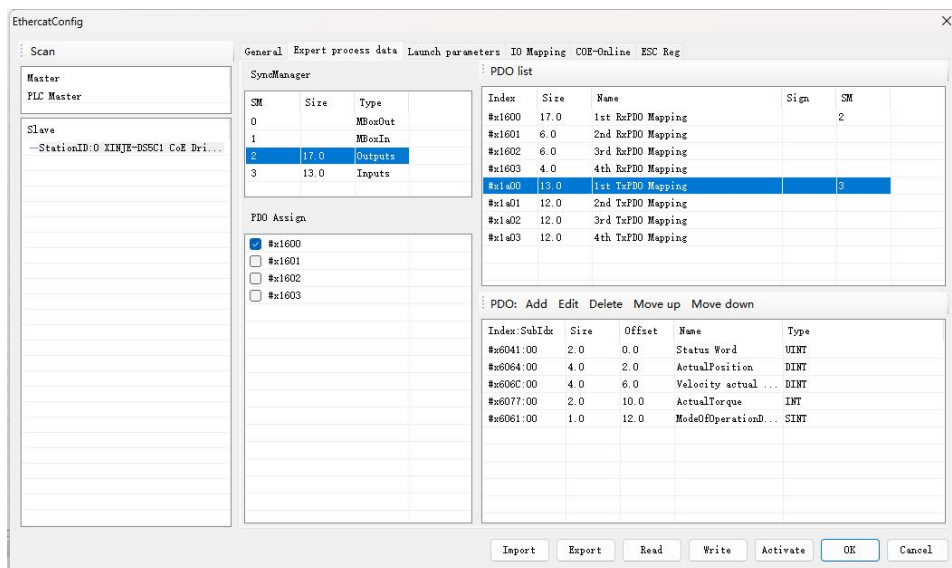
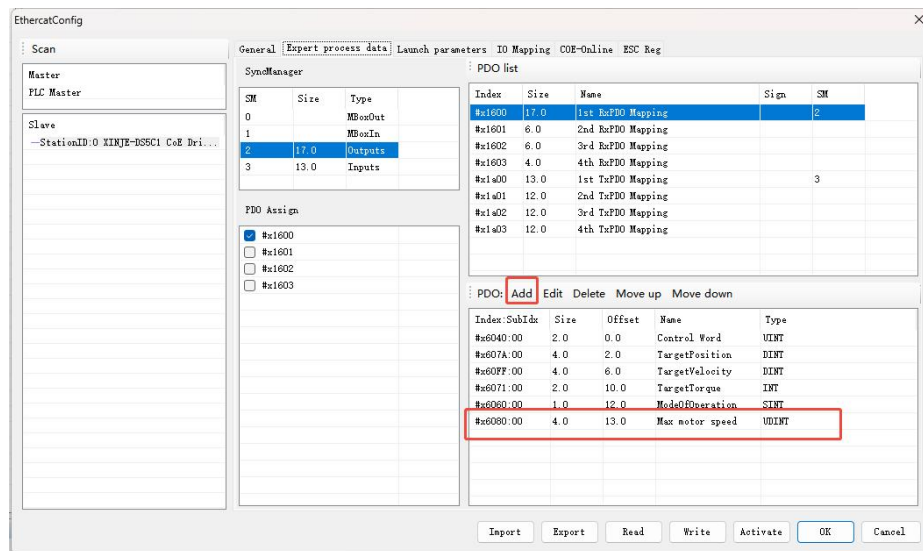
| register      | explain                                   | unit              |
|---------------|-------------------------------------------|-------------------|
| TXPDO[0x6041] | status word                               | -                 |
| TXPDO[0x6064] | Position feedback (actual motor position) | instruction unit  |
| TXPDO[0x606C] | rate feedback                             | Command<br>unit/s |
| TXPDO[0x6077] | actual torque                             | 0.1%              |

- ① On the EtherCAT interface, select the slave device from the [Scan] or [Add Device] menu, then choose User Defined as the function block in the [General] interface.

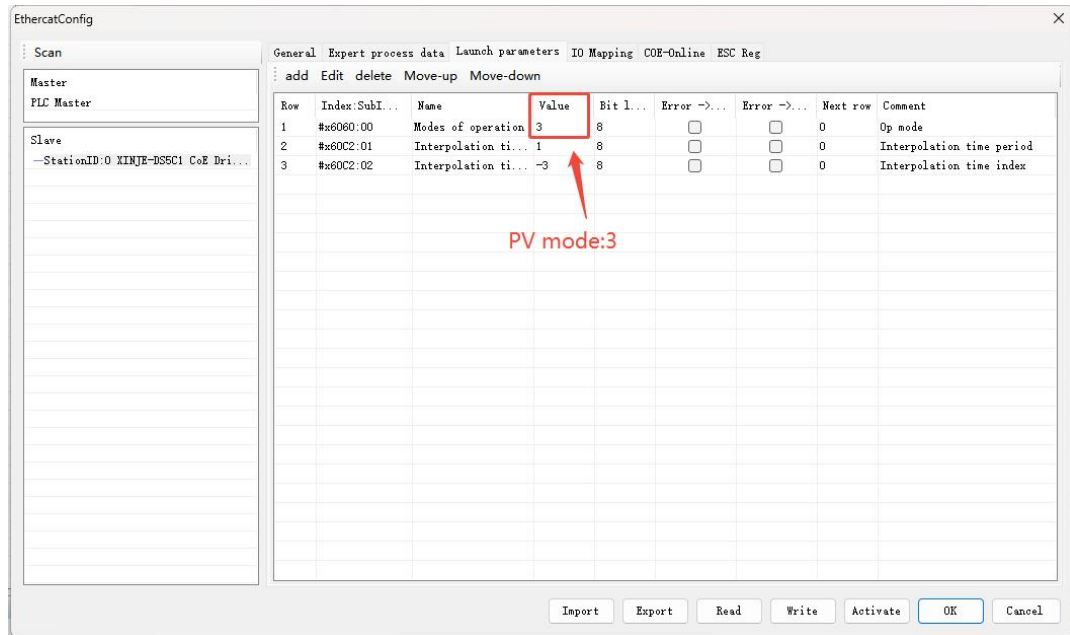




② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00 to add PDO parameters linked to the mode (each parameter cannot exceed 32 bytes).

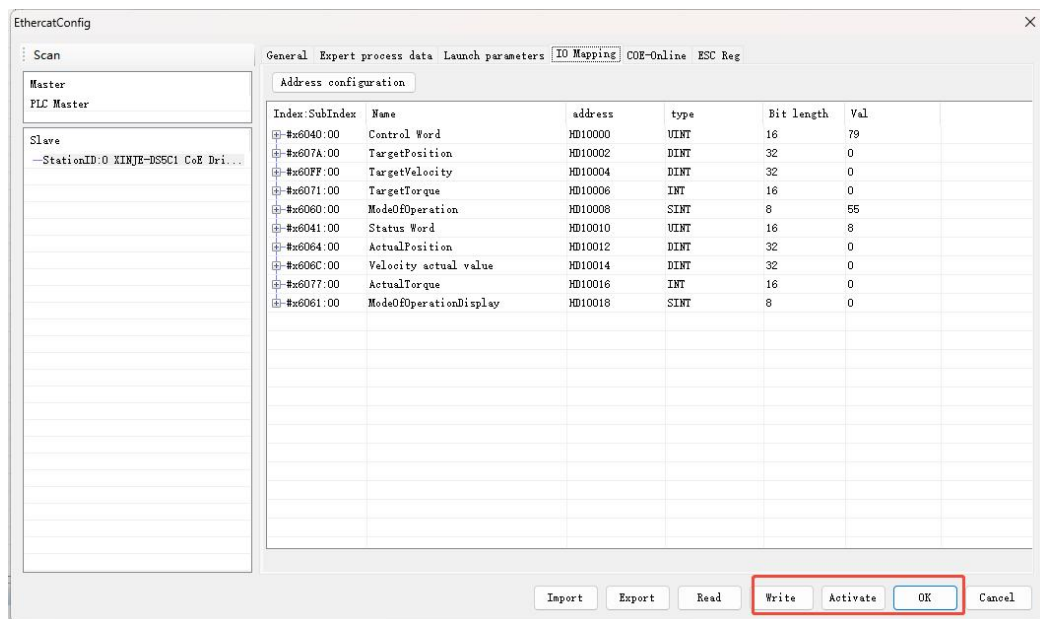


- ③ Verify that the 6060h value in [Start Parameters] is set to 3.



- ④[IO mapping]The starting address can be customized.

- ⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



- ⑥ Upon activation, the station state machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

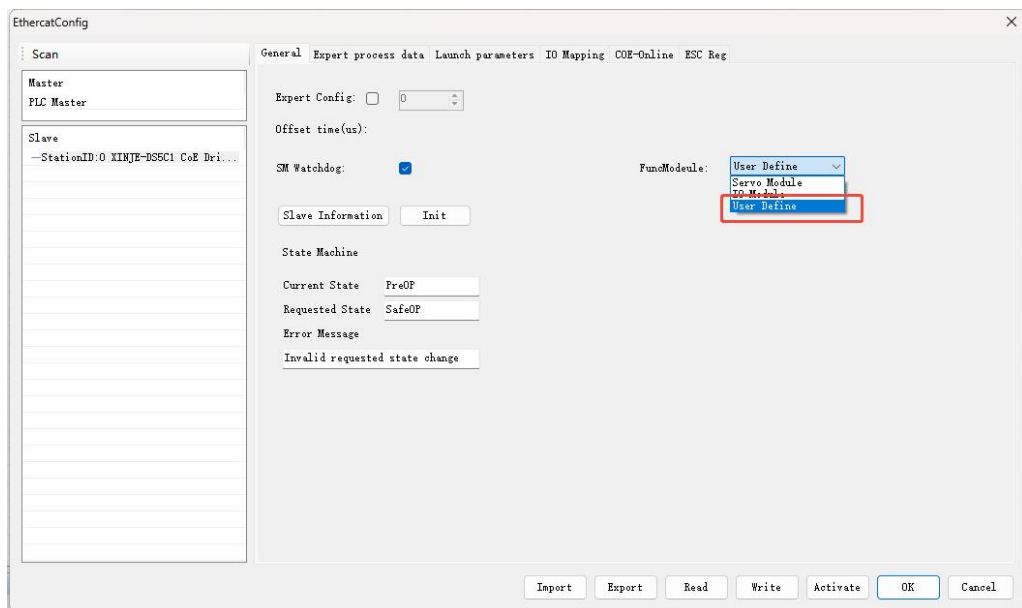
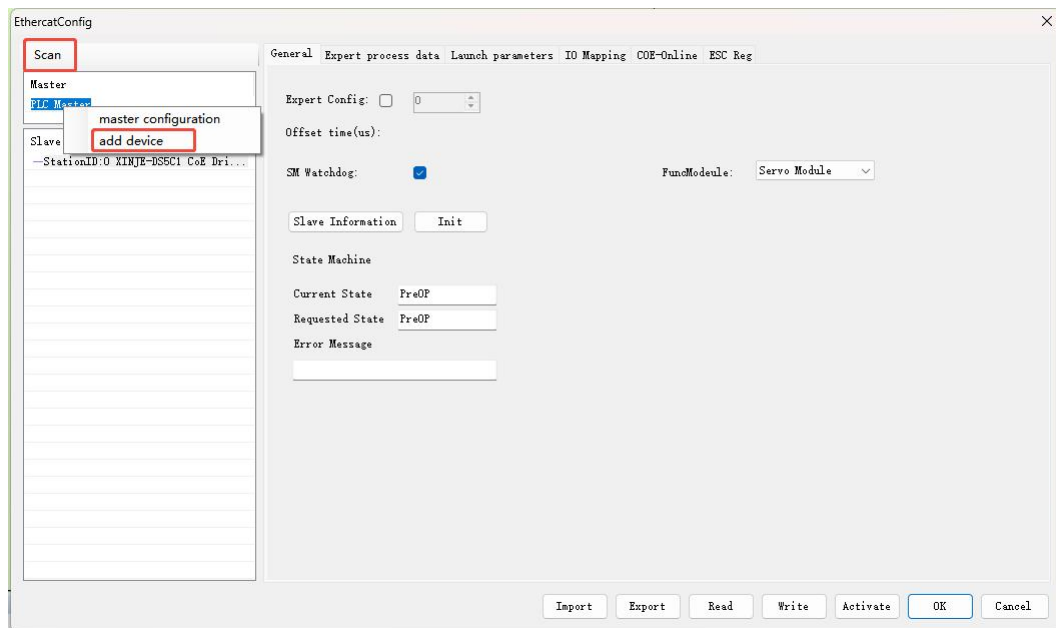
|  |  |
|--|--|
|  |  |
|--|--|

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|--|--|

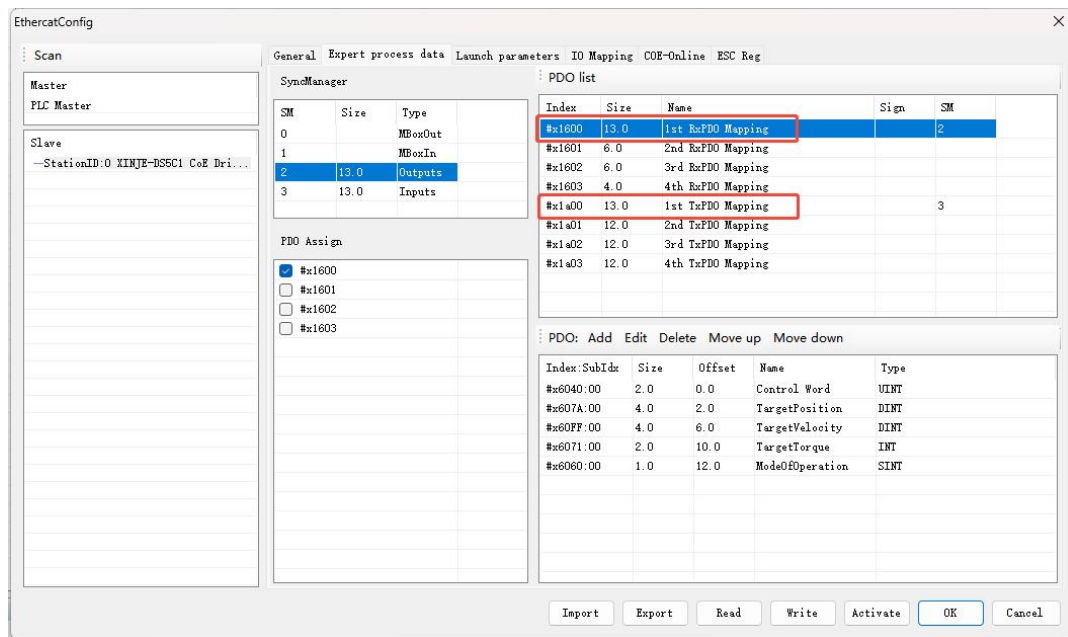
[illegible]

|               |               |      |
|---------------|---------------|------|
| TXPDO[0x6077] | actual torque | 0.1% |
|---------------|---------------|------|

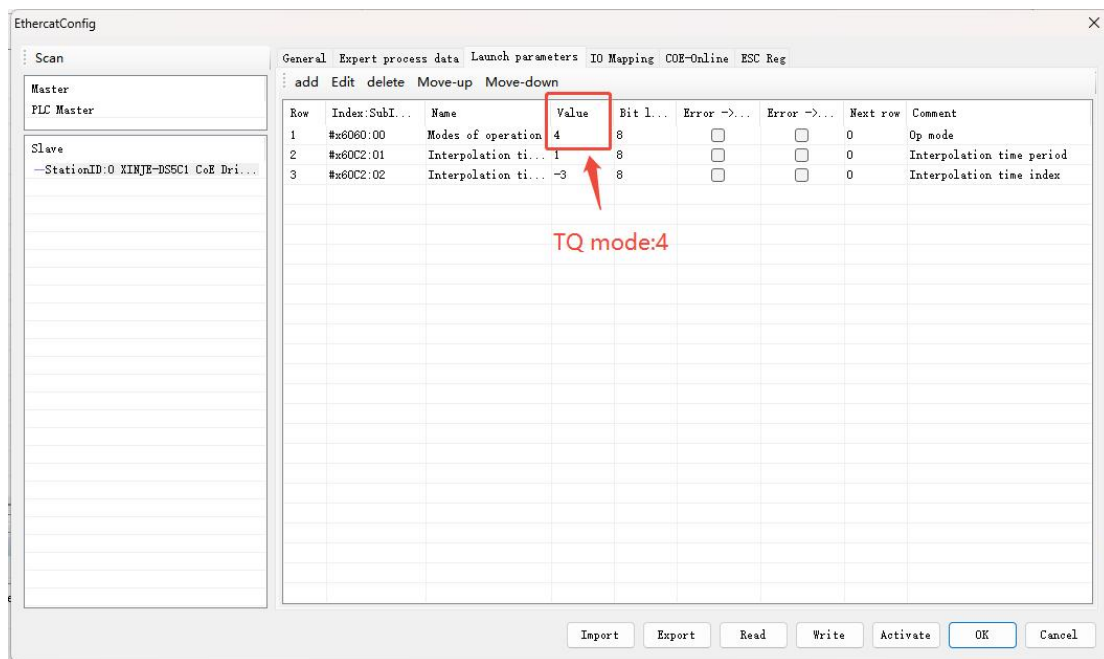
① On the EtherCAT interface, select the slave device from the [Scan] or [Add Device] menu, then choose User Defined as the function block in the [General] interface.



② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00 to add PDO parameters linked to the mode (each parameter cannot exceed 32 bytes).

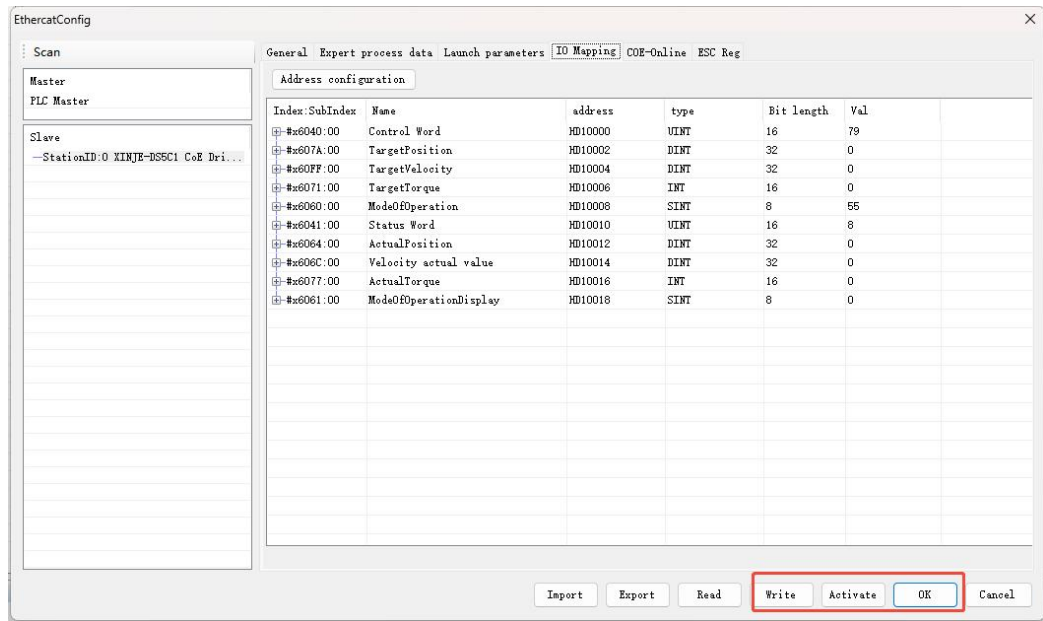


- ③ Verify that the 6060h value in [Start Parameters] is set to 4.



- ④ [IO mapping] The starting address can be customized.

- ⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1 → 2 → 4 → 8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ Modify control word 6040 (6 → 15) to enable the slave, and set parameters like target torque and torque slope to control the motor.

⑧ In tq mode, I/O mapping addresses can be configured and monitored. For example, the control word of Axis 1 can be modified via HD10000 (mapping to 6040h) to enable or disable the motor, the actual torque of Axis 1 can be monitored through HD10016 (mapping to 6077h), and the torque slope of Axis 1 can be set via HD10038 (mapping to 6087h).

| PLC1-FreeMONitor1                                                   |               |       |                |                                         |  |
|---------------------------------------------------------------------|---------------|-------|----------------|-----------------------------------------|--|
| Moni-Window ▾ Add Edit Delete Delete All Upword Downword Top Bottom |               |       |                |                                         |  |
| Name                                                                | Monitor value | type  | Map-Address... | Comment                                 |  |
| HD10000                                                             | 15            | INT   | SWord          | Station ID:0, #x6040:0, Control Word    |  |
| HD10016                                                             | 41            | INT   | SWord          | Station ID:0, #x6077:0, Actualtorque    |  |
| HD10038                                                             | 50            | UDINT | DWord          | Station ID:0, #x6087:0, Torque slope    |  |
| HD10012                                                             | 38084204      | DINT  | DWord          | Station ID:0, #x6064:0, ActualPosition  |  |
| HD10014                                                             | 132188        | DINT  | DWord          | Station ID:0, #x606C:0, Velocity act... |  |

8) Probe function demonstration (using the Xinjie DS5C1-20P4-PTA servo as an example; the DM6C operation method is identical to the DS5C1)

Probe function associated object

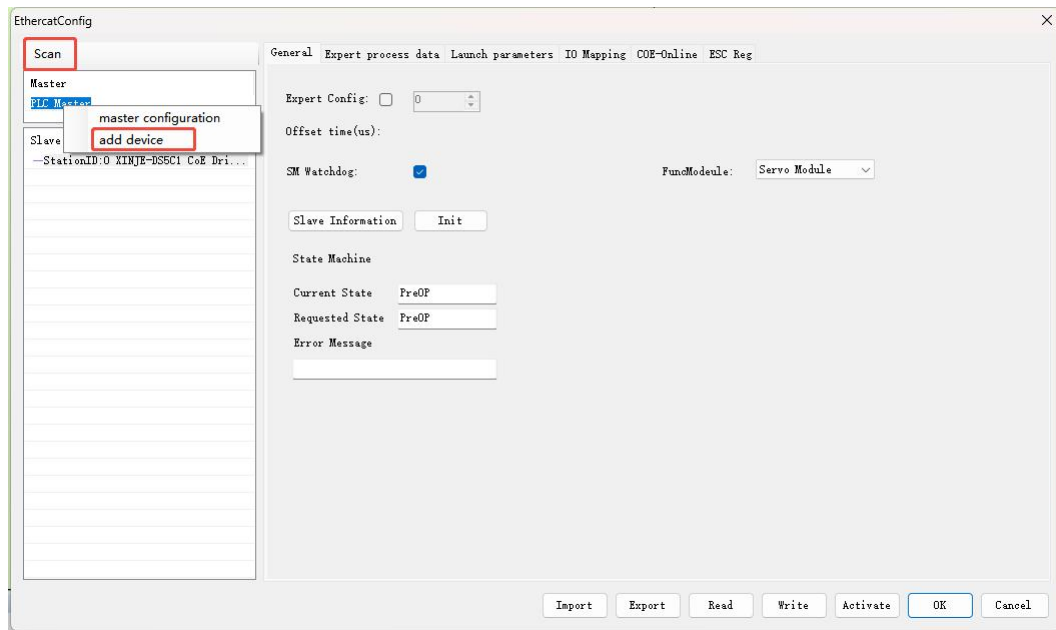
| index of matrix | subindex | name                                                        | unit             |
|-----------------|----------|-------------------------------------------------------------|------------------|
| 60B8h           | 00h      | Probe function settings                                     | -                |
| 60B9h           | 00h      | Indicates the status of the Touch probe function            | -                |
| 60BAh           | 00h      | Indicates the rising edge clamping position of Touch probe1 | instruction unit |

|       |     |                                                                     |                  |
|-------|-----|---------------------------------------------------------------------|------------------|
| 60BBh | 00h | Indicates the clamping position of the falling edge of Touch probe1 | instruction unit |
| 60BCh | 00h | Indicates the rising edge clamping position of Touch probe2         | instruction unit |
| 60BDh | 00h | Indicates the falling edge clamping position of Touch probe2        | instruction unit |

① External wiring and probe terminal allocation: P5-62 and P5-63 are designated for probe functions.

Probe 1 is exclusively assigned to SI1, while Probe 2 is exclusively assigned to SI2. When SI1 is allocated, P5-62 is programmed with 1; when SI2 is allocated, P5-63 is programmed with 2.

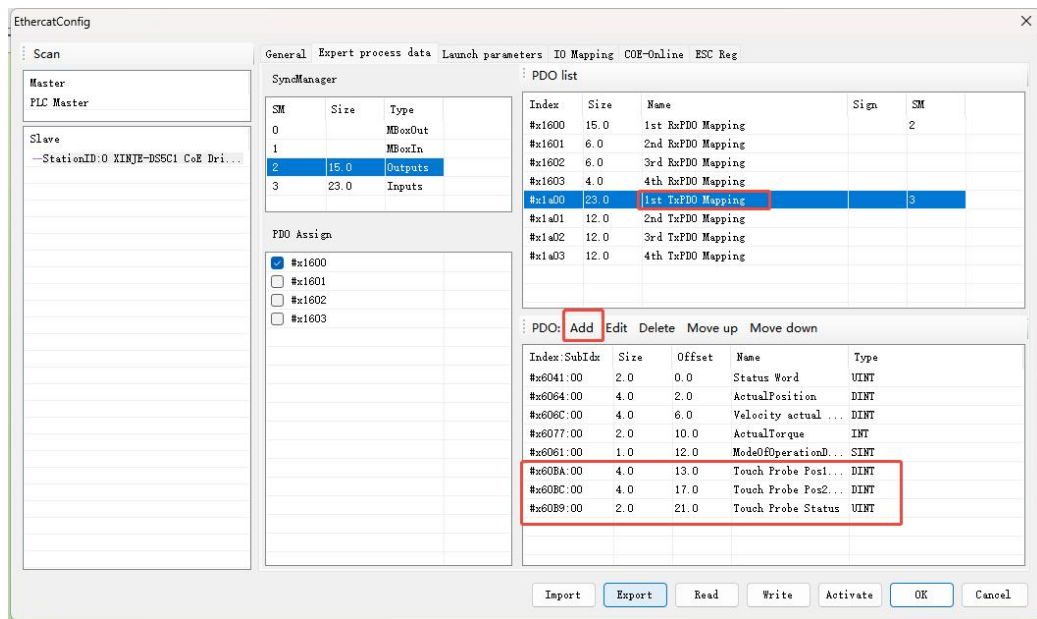
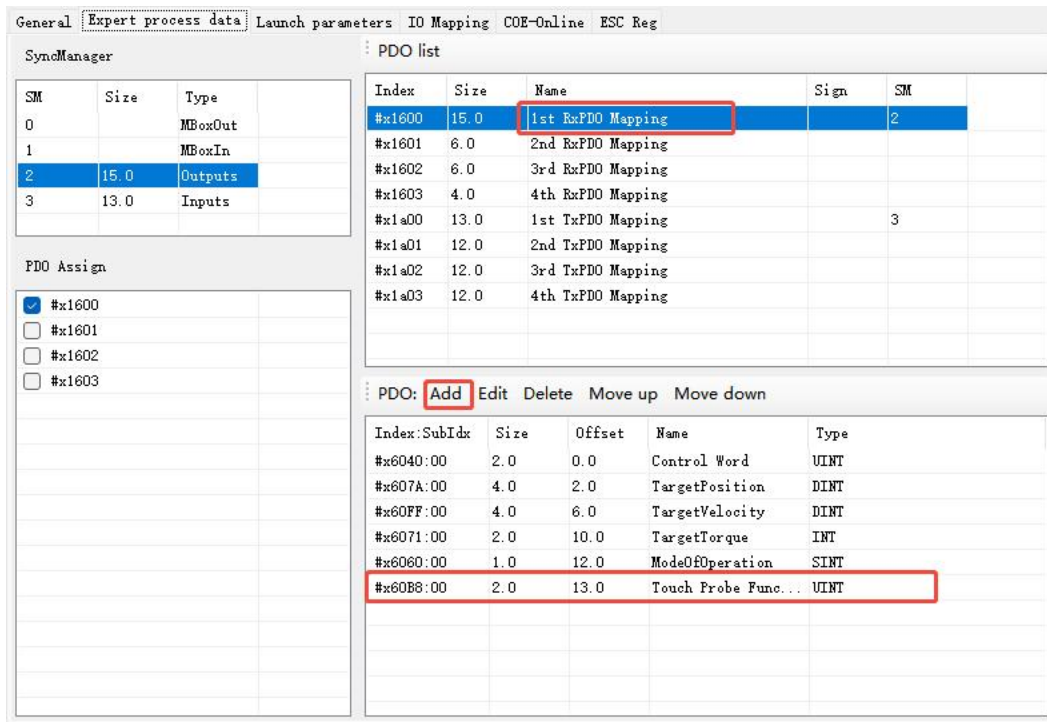
② On the Ethercat interface, select [Scan] or [Add Device] for slave devices, and use the default configuration on the [General] interface.



③ When a level signal on driver SI1 or SI2 undergoes a transition, the probe function is activated, and the probe value is locked in the corresponding COE object address 0X60BA~0X60BD. To retrieve the probe value, the corresponding probe value object (0X60BA-0X60BD) must be added to TxPDO for data acquisition.

In the [Expert Process Data] → [PDO Allocation] section, select 1600 and 1A00. For 1600, add 60B8h; for 1A00, add 60BAh and 60BCh (this example uses the rising edges of two probes. For falling edges, add 60BBh and 60BDh).





④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

- The parameters will take effect after successful activation.

### Address configuration

- ⑦ After enabling the slave station, the probe function can be activated by modifying the HD10024 (mapping 60B8h).

- ⑧ After enabling the probe function, the following parameters can be monitored: the rising edge bit value of Probe 1 via HD10022 (60BAh mapping), the rising edge bit value of Probe 2 via HD10024 (60BCh mapping), the current probe status via HD10026 (60B9h mapping), the motor's actual position via HD10012 (6064h), and the actual speed via HD10014 (606Ch mapping).

| PLC1-FreeMonitor1                                                   |               |       |                |                           |  |
|---------------------------------------------------------------------|---------------|-------|----------------|---------------------------|--|
| Moni-Window ▾ Add Edit Delete Delete All Upword Downword Top Bottom |               |       |                |                           |  |
| Name                                                                | Monitor value | type  | Map-Address... | Comment                   |  |
| M0                                                                  | ON            | BIT   | Bit            | enabled                   |  |
| M1                                                                  | ON            | BIT   | Bit            | Enable state              |  |
| D10                                                                 | 0             | INT   | SWord          | control mode              |  |
| M300                                                                | OFF           | BIT   | Bit            | Absolute operation ins... |  |
| D300                                                                | 1000000000    | LREAL | QWord          | Target absolute position  |  |
| D304                                                                | 10000         | LREAL | QWord          | target velocity           |  |
| D308                                                                | 5000          | LREAL | QWord          | accelerated speed         |  |
| D312                                                                | 5000          | LREAL | QWord          | retarded velocity         |  |
| D316                                                                | 100           | LREAL | QWord          | Accelerate                |  |
| M302                                                                | OFF           | BIT   | Bit            | Absolute positioning c... |  |
| M200                                                                | ON            | BIT   | Bit            | Probe function            |  |
| M310                                                                | ON            | BIT   | Bit            | Probe Sign                |  |
| Y12                                                                 | OFF           | BIT   | Bit            | Probe SII signal status   |  |
| SM11                                                                | ON            | BIT   | Bit            | 10ms RTC pulse: 5ms 0...  |  |
| M310                                                                | ON            | BIT   | Bit            | Probe Sign                |  |
| HD354                                                               | 99140         | LREAL | QWord          | Probe latch position      |  |
| HD358                                                               | 9965          | LREAL | QWord          | Probe latch-up speed      |  |
| HD400                                                               | 99140         | LREAL | QWord          | Position storage register |  |
| HD10012                                                             | 466533        | DINT  | DWord          | Station ID:0,#6064:0      |  |

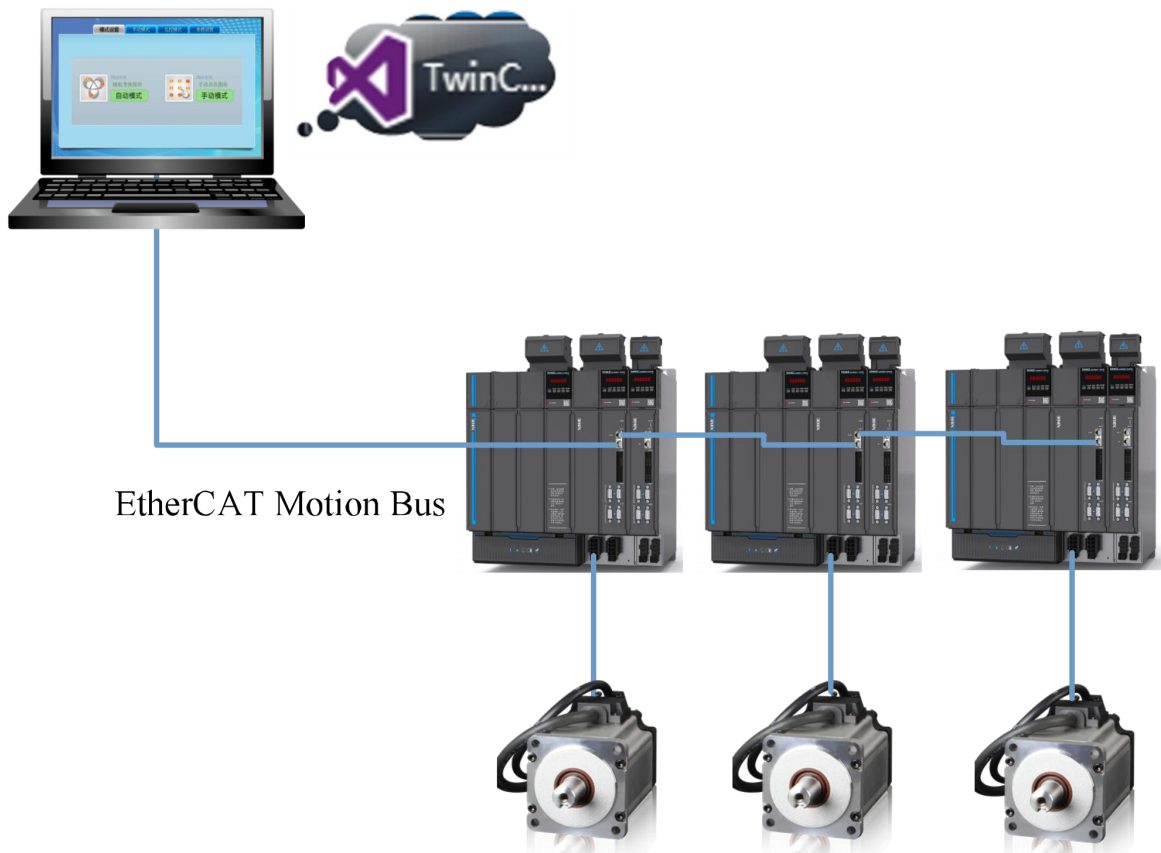
## 11.2 Communication between Beckhoff TWINCAT and XJINJI DM6C Servo EtherCAT

This example demonstrates how to implement EtherCAT motion control by using Beckhoff TWINCAT control software as the master station and XINJE servo as the slave station.

### 11.2.1 System Configuration

| name                    | Model/Specification   | quantity  | remarks                                                                     |
|-------------------------|-----------------------|-----------|-----------------------------------------------------------------------------|
| motion control software | TWINCAT XAE (VS 2013) | 1         | The application version used in this example:<br>TC31-FULL-Setup.3.14022.27 |
| Servo of XJ             | DM6C-45P5-R           | 1         |                                                                             |
| parvicostellae          | JC-CA-3               | a surname | Connects the computer to the servo                                          |

### 11.2.2 System Topology



The two communication ports of the DM6C series servo drive follow the principle of "bottom in, top out". That is, the master station must connect to the port below the CN1 port of the first servo, and then the port above the first servo connects to the port below the second servo, and so on.

### 11.2.3 Debugging Steps

#### Add XML file

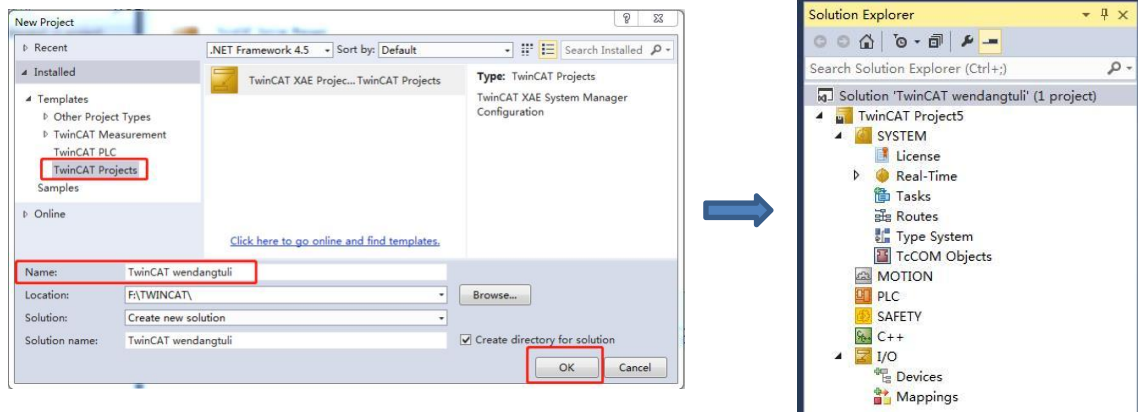
Before starting the software, copy the DM6C servo device description XML file to the Twincat installation directory, which is the default path C:\TwinCAT\3.1\Config\Io\EtherCAT.

#### 2) New project

Double-click to open TwinCAT XAE (VS 2013) and create a new project:

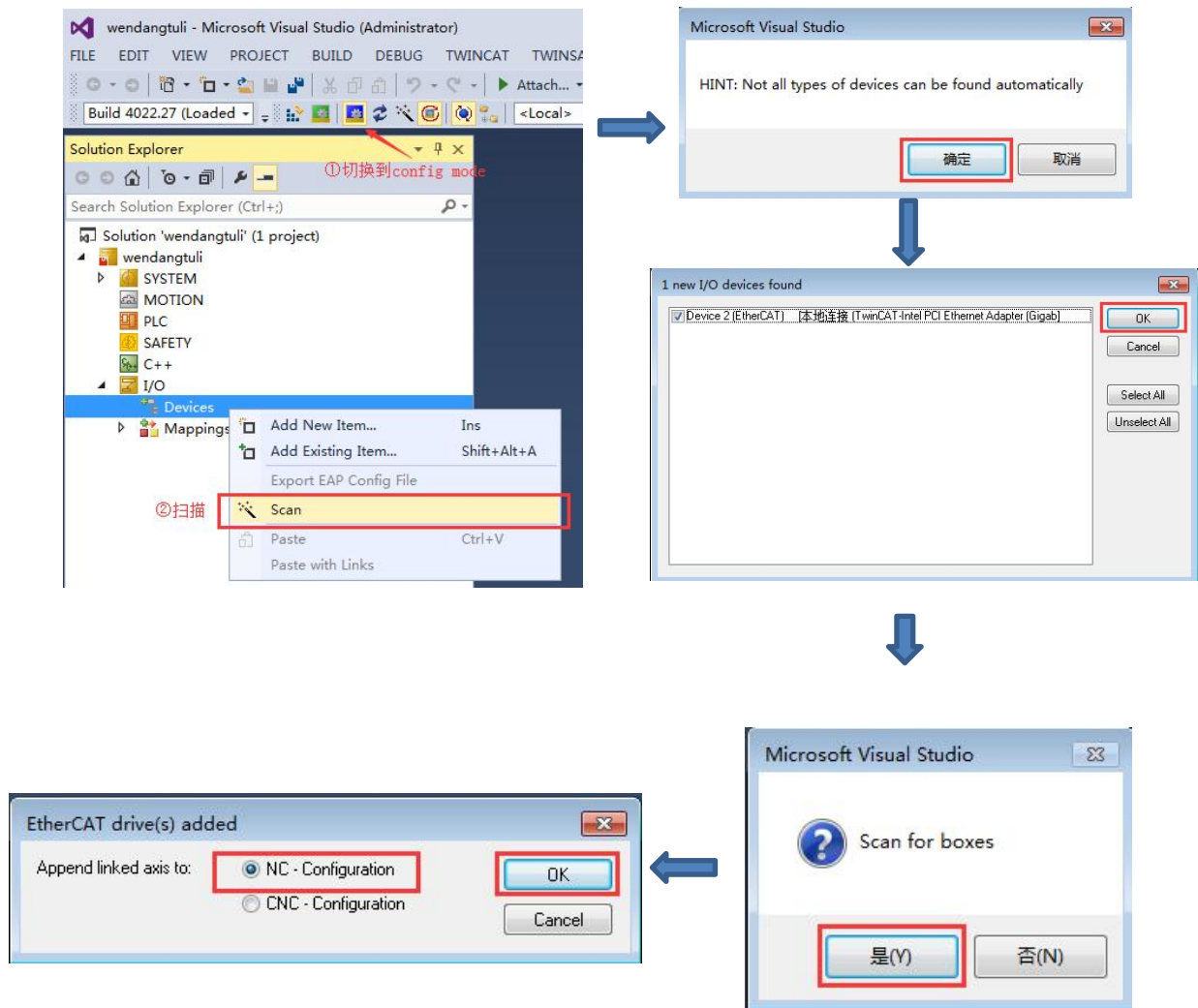
(1) Execute FILE—NEW—Project;

(2) Select the TwinCAT Project, enter the project name and save path, then click OK. The Property Explorer will appear in the Engineering panel.



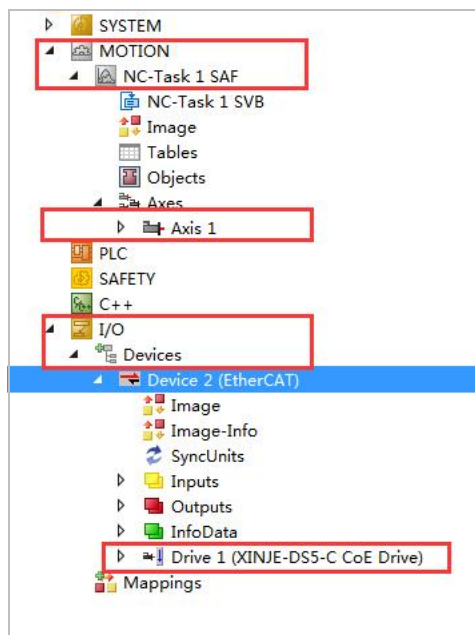
#### 3) Hardware scan

If the controller isn't in config mode, click the icon to switch it to config mode, then right-click Device and select Scan to scan the Ethercat slave.



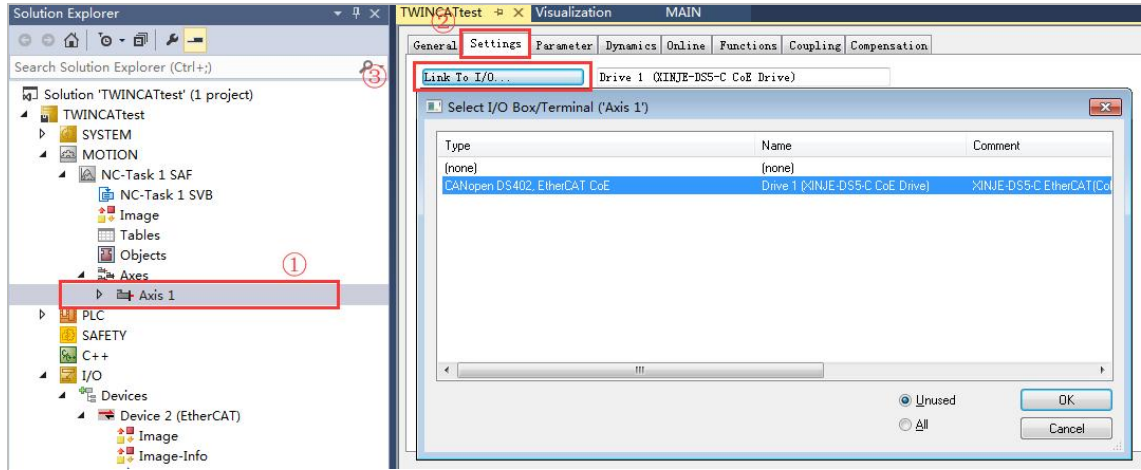
Scan to the end and automatically add to NC mode.

After the scan is complete, you can see an NC axis (Axis1) in Motion, corresponding to the motor connected to the servo, and the scanned driver DM6C in Device.



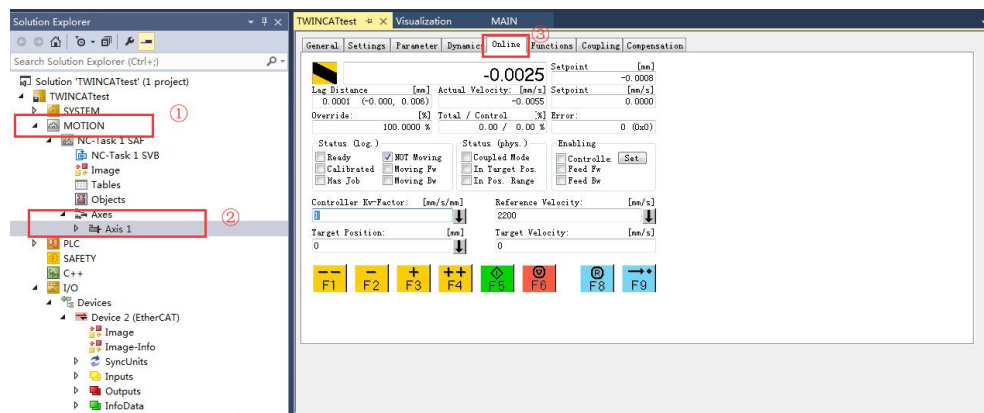
## 4) Link NC axis and physical axis

You can select the physical axis linked to the NC axis through Axis1-Settings-Link. This link is automatically added during hardware scanning, or you can manually add the axis by right-clicking the Axis and selecting Append axis to manually link the NC axis to the physical axis. The window displays the corresponding relationship between the NC axis and the physical axis.



## 5) Debugging through the NC-Online interface

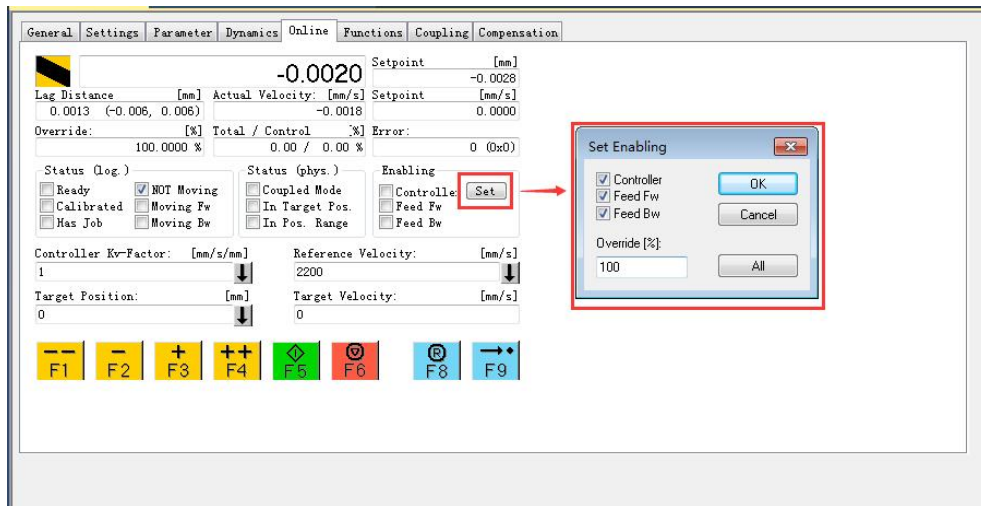
(1) Click the icon to activate configuration, switch TwinCAT to run mode, then sequentially select MOTION-Axis1-Online to debug the servo axis.



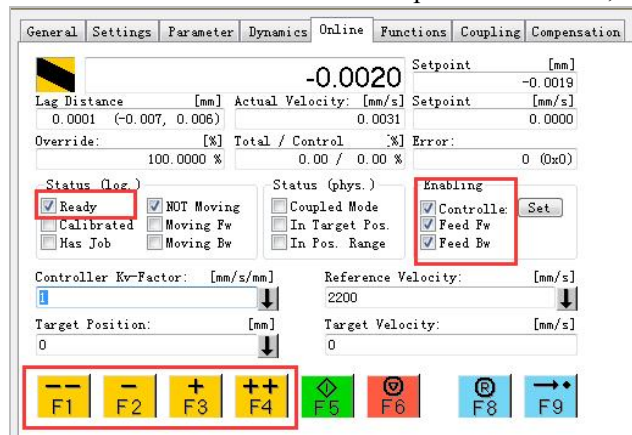
If the current position of the axis is not visible in the Online tab, verify that the motor model has been correctly added and the configuration activated.

(2) Click Set, manually select Controller, Feed Fw, and Feed Bw, then configure the Override (speed ratio). After clicking OK, or simply select ALL to enable all axes, the system will automatically set the speed ratio to 100%.

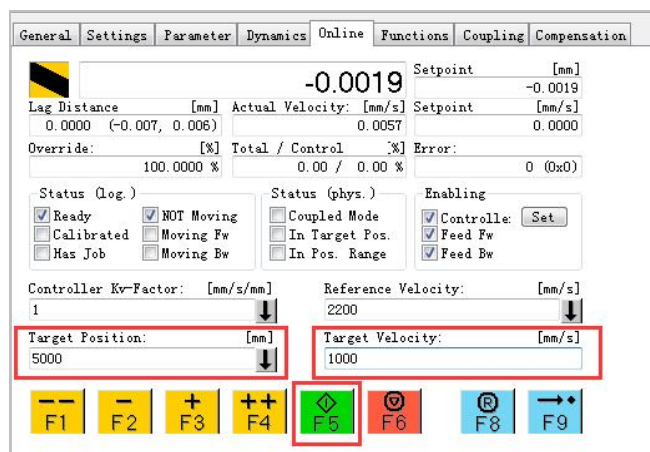




(3) If the Ready status is checked, the motor is enabled. You can then use F1 to F4 to perform point movements on the axis. The point speed is set in the Manual Velocity tab under Parameter, with default speeds of 100mm/s and 600mm/s for slow and fast point movements, respectively.

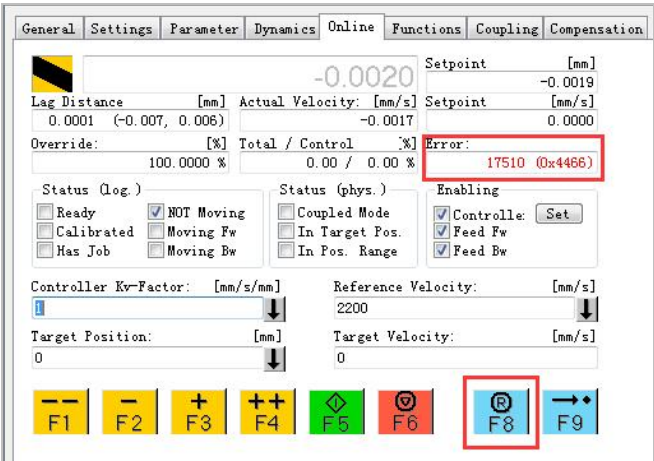


(4) After setting the Target Position and Target Velocity, press F5 to activate position control. The motor will move to the target position as programmed. This is an absolute position control system, and you can use F6 to pause during the process.



(5) When NC error occurs, the Error message displays error codes. To reset the error, press F8; otherwise, the axis will stop moving. F9 is the origin reset button. Pressing F9 resets the axis position to 99999... and moves slowly. However, the origin signal requires external hardware input, which cannot be captured in the Online window. Therefore, F9 is generally not used for origin reset; instead, it is implemented through programming in the program.



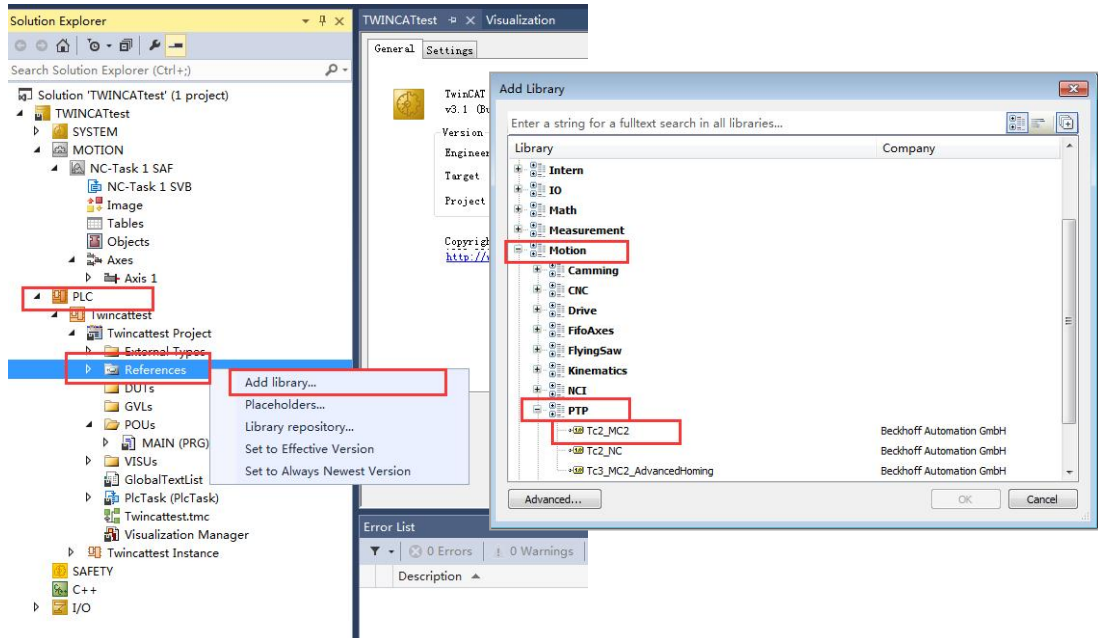


For more single-axis debugging features, refer to the TC3 Training Manual V1.1.0.

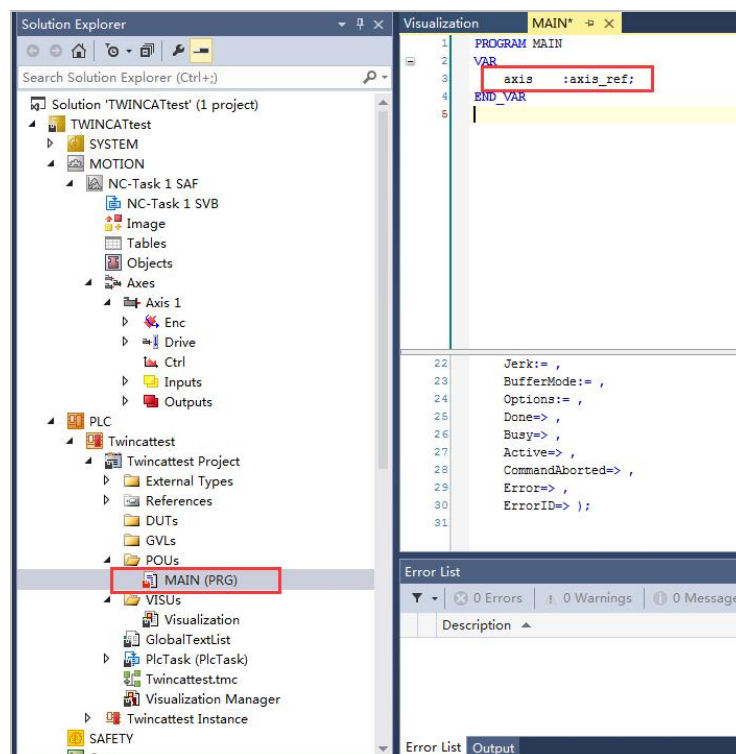
## 6) Control the DM6C servo motor via PLC Control programming

Add motion control library files and axis type variables

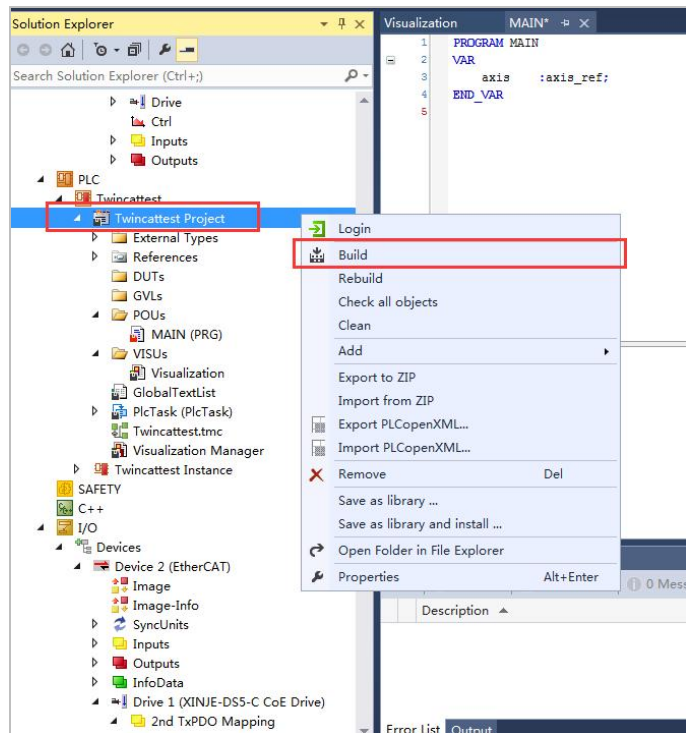
Create a new project in PLC, expand it, locate References at the bottom, right-click and select Add Library. In the dialog box that appears, locate Motion--PTP--TC2-MC2 and add it. This completes the library file addition for the PLC.



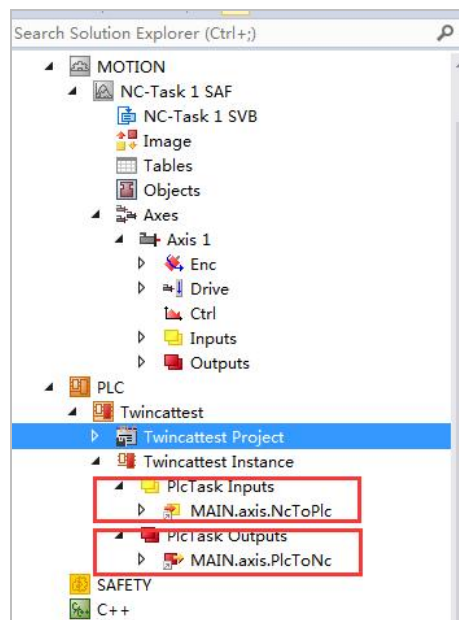
In the main program of POU, a variable of Axis\_ref type is created. Axis\_ref is a structure designed for data exchange between NC and PLC, and it contains other structures internally. This variable is referred to as the axis variable.



After writing the program, compile it to check for errors. In this example, the project is named Twincattest. Find the Twincattest Project, right-click it, select Build, and click.

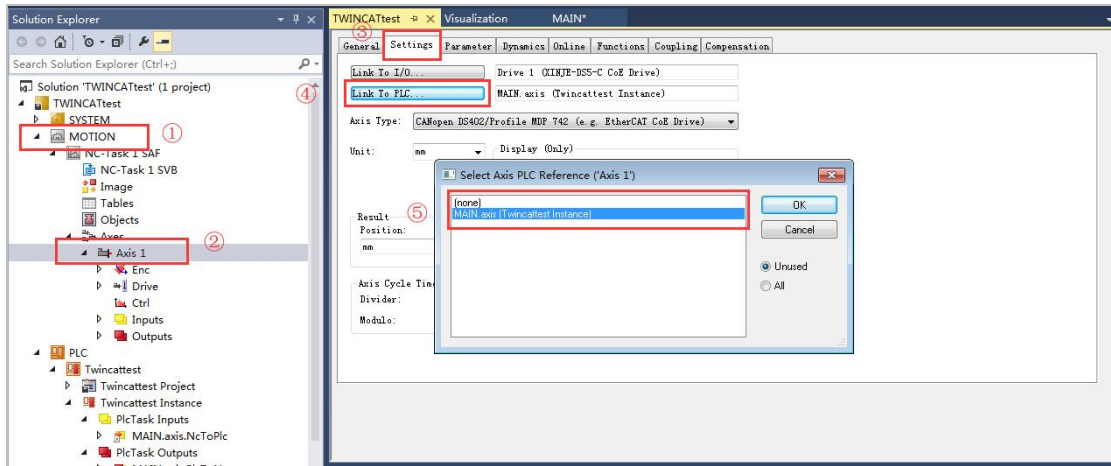


After successful compilation, the corresponding variables will appear in the Instance directory of the project. Once Build completes, you can bind two variables under PlcTask Inputs and PlcTask Outputs in the Twincattest instance.



## (2) Variable Linking between NC and PLC

In Motion, expand the Axes menu, locate the newly created NC axis Axis1, and double-click it. In the right-side interface, navigate to the Settings tab and select 'Link to PLC' to connect Axis1 to the corresponding PLC. This connection enables data exchange between the NC and PLC.

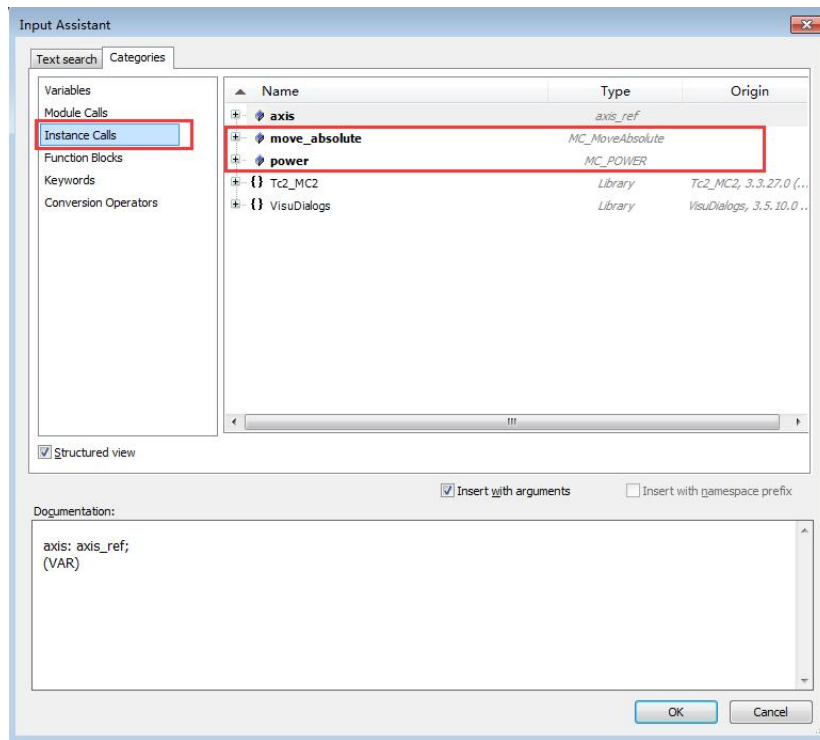


## (3) Call the function block to control the axis movement

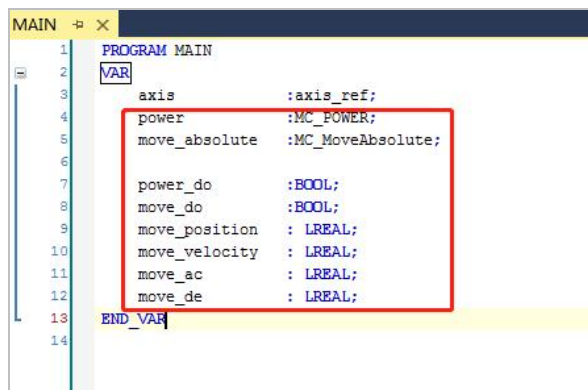
In the POU-MAIN (PRG) interface, declare two function blocks: MC\_POWER and MC\_MoveAbsolute. MC\_POWER controls axis enablement, while MC\_MoveAbsolute manages absolute position movement.

```
PROGRAM MAIN
VAR
    axis          :axis_ref;
    power         :MC_POWER;
    move_absolute :MC_MoveAbsolute;
```

Press F2 in the program editor window, then select power and move\_absolute from the Categories—Instance Calls section to invoke the defined function blocks in the program.



Complete the parameter settings in the function block: Enable indicates the enable bit, with Enable\_Positive permitting forward rotation and Enable\_Negative allowing reverse rotation. The variables include: Override (speed ratio), Axis (corresponding axis), Position (target location), Velocity (positioning speed), Acceleration (acceleration), and Deceleration (deceleration). Two boolean variables, power\_do and move\_do, are declared as trigger bits for the enable and absolute position motion functions. A Lreal-type variable is defined to store absolute position data, velocity, and acceleration/deceleration values.



```

move absolute(
  Axis:= axis ,
  Execute:= move_do ,
  Position:= move_position,
  Velocity:= move_velocity,
  Acceleration:= move_ac,
  Deceleration:= move_de,
  Jerk:= ,
  BufferMode:= ,
  Options:= ,
  Done=> ,
  Busy=> ,
  Active=> ,

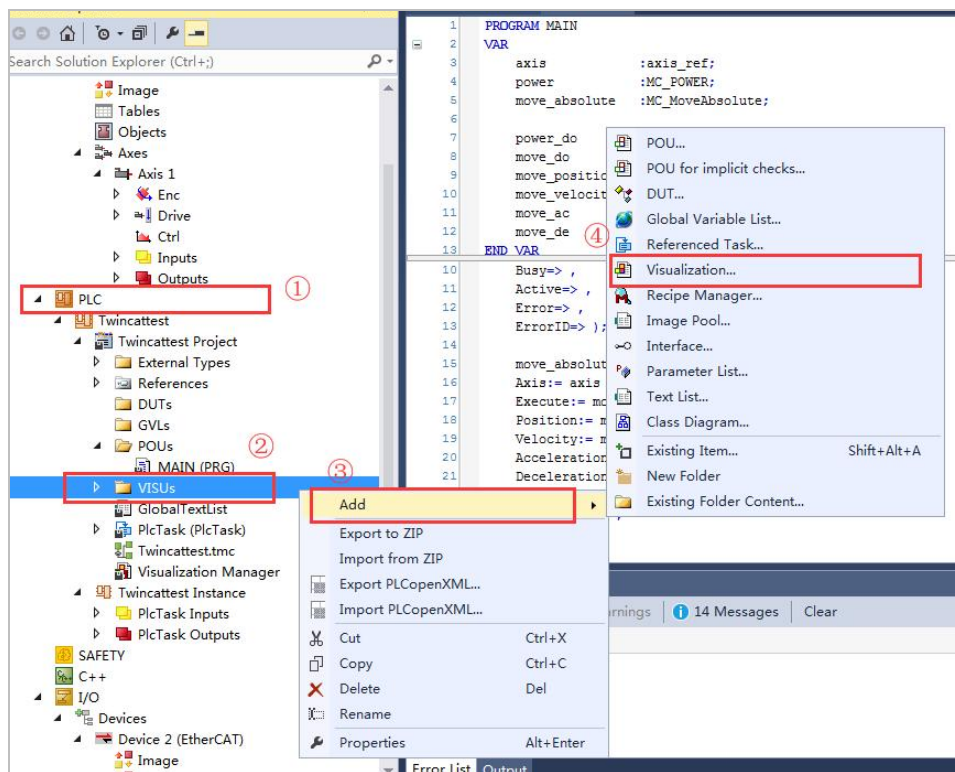
```

```

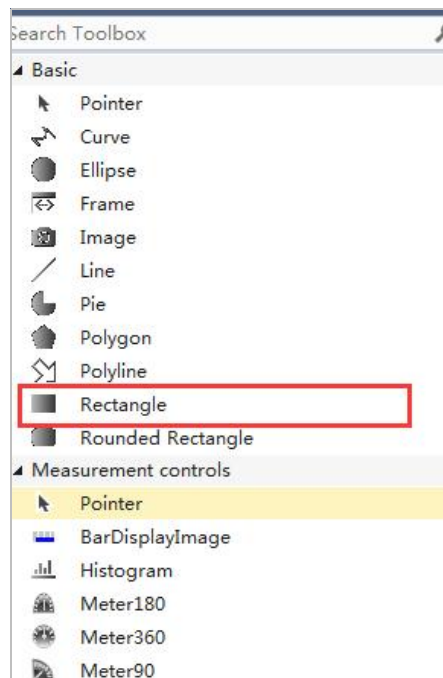
power(
  Axis:= axis,
  Enable:= power_do,
  Enable_Positive:=TRUE ,
  Enable_Negative:=TRUE ,
  Override:= ,
  BufferMode:= ,
  Options:= ,
  Status=> ,
  Busy=> ,
  Active=> ,
  Error=> ,
  ErrorID=> );

```

Locate the VISU component beneath the PLC, right-click it, select Add from the context menu, then choose Add Visualization from the new menu to create a visualization interface.

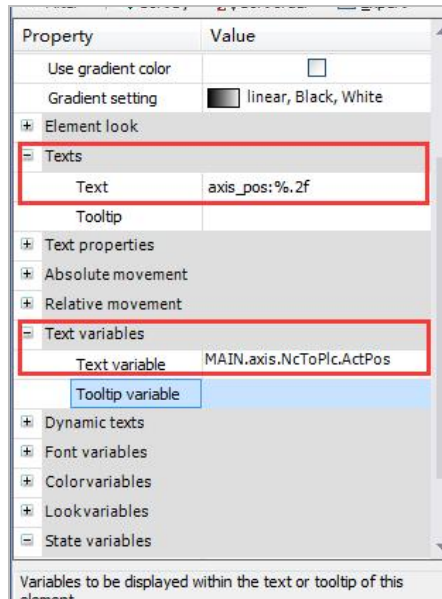


In the toolbar of the Visu interface, select the rectangle box and drag out a control. Double-click the rectangle box control to set it.

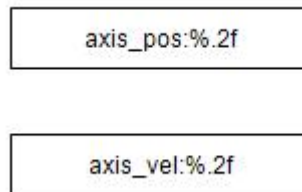


Double-click the control, and under the Properties tab on the right, make the following settings: Texts — Text input `axis_pos:%2f,%2f` represents the floating-point data type to display the values of associated variables (i.e., the variables pointed to by Text variables — Text variable) with only two

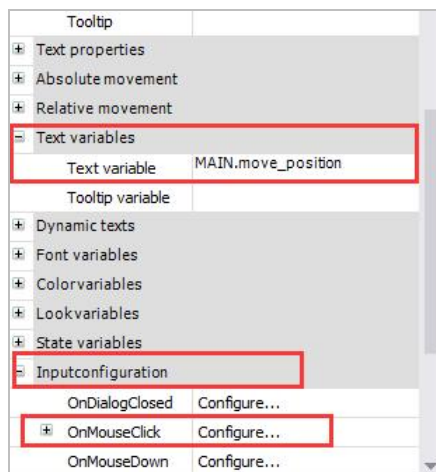
decimal places retained. Text variables — Text variable to input MAIN.axis.NcToPlc.ActPos, indicating the actual position of the control on the axis variable.



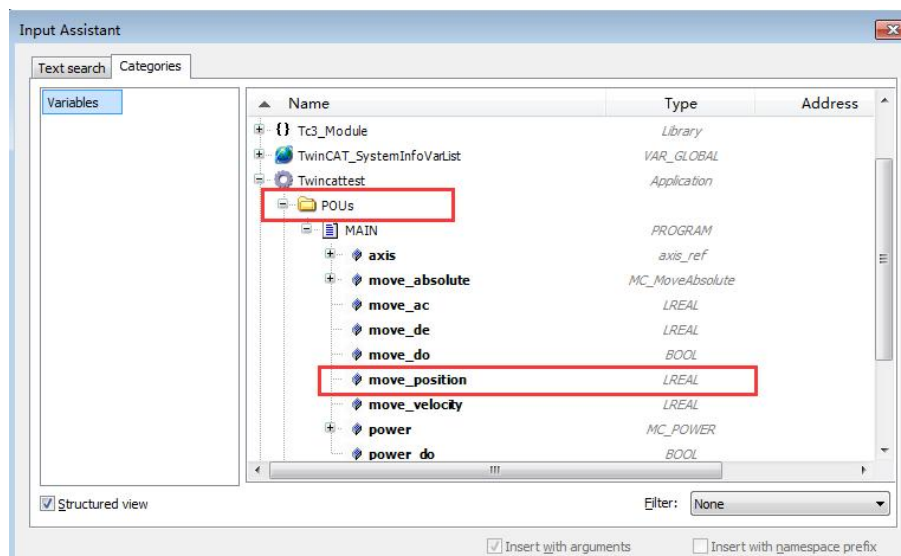
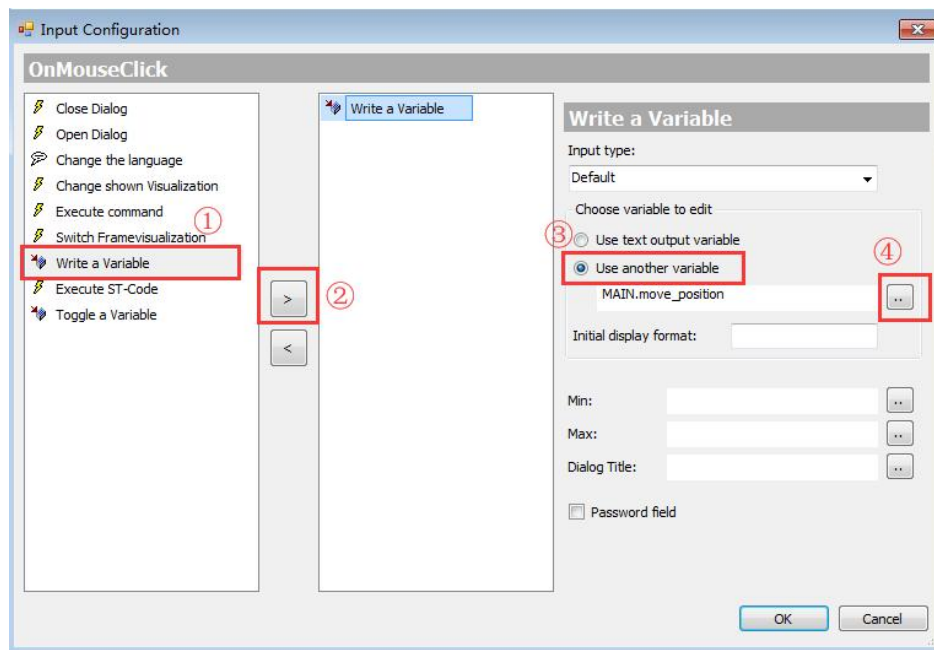
Create another control to indicate the current speed of the shaft, Text variable input MAIN.axis.NcToPlc.ActVelo.



Add a rectangle control to input the target position value of absolute position movement. The specific operation is as follows: Create a rectangle control, input the MAIN.move\_position (a real type variable added in the program) into the Text variable, click Inputconfiguration — OnMouseClicked, select Write a Variable in the pop-up interface, click > to add the function, and choose Use another variable to point to the variable MAIN.move\_position on the right.





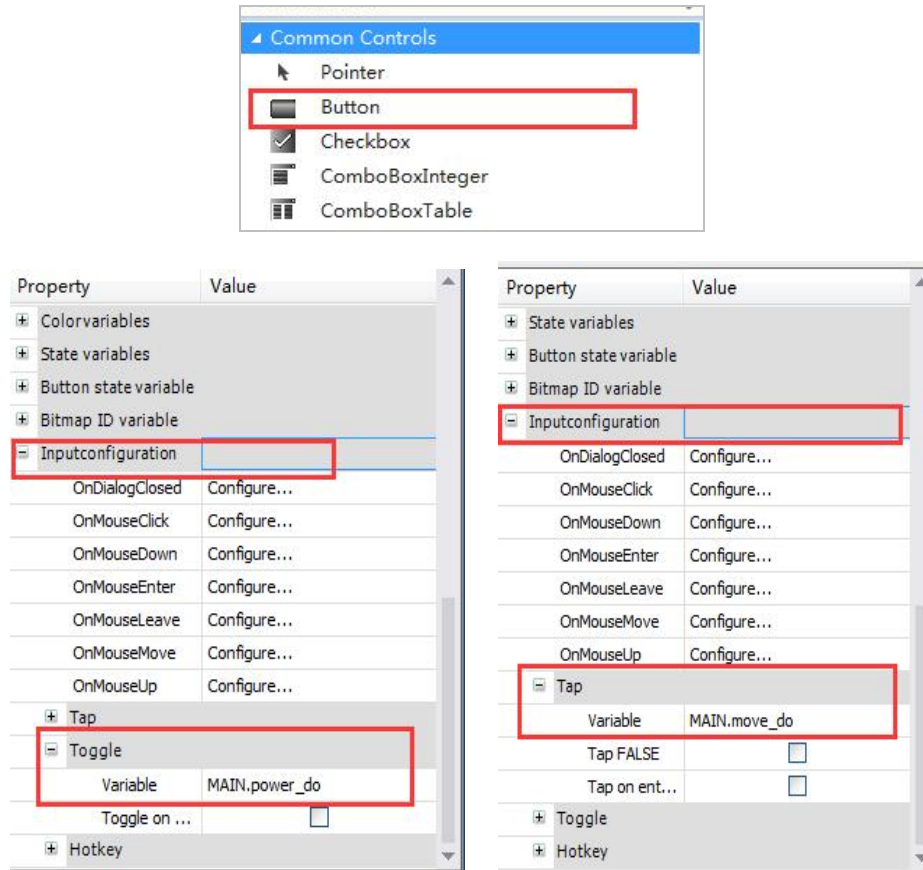


The same method is used to create the control of velocity, acceleration and deceleration of absolute position motion.

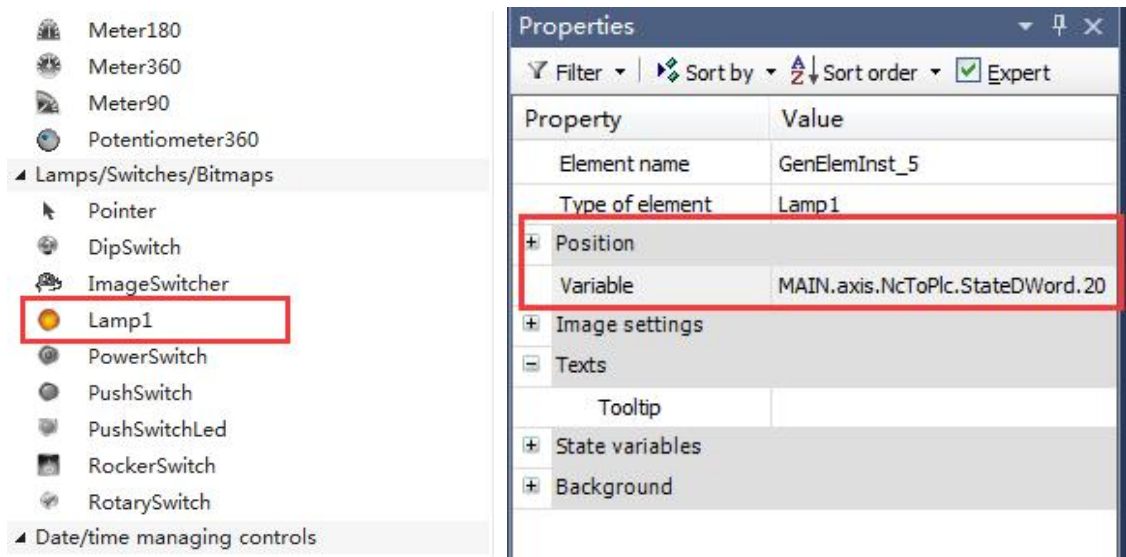
|                                   |                                   |                                            |
|-----------------------------------|-----------------------------------|--------------------------------------------|
| move_position                     | move_ac                           |                                            |
| <input type="text" value="%.2f"/> | <input type="text" value="%.2f"/> | <input type="text" value="axis_pos:%.2f"/> |
| move_velocity                     | move_de                           |                                            |
| <input type="text" value="%.2f"/> | <input type="text" value="%.2f"/> | <input type="text" value="axis_vel:%.2f"/> |



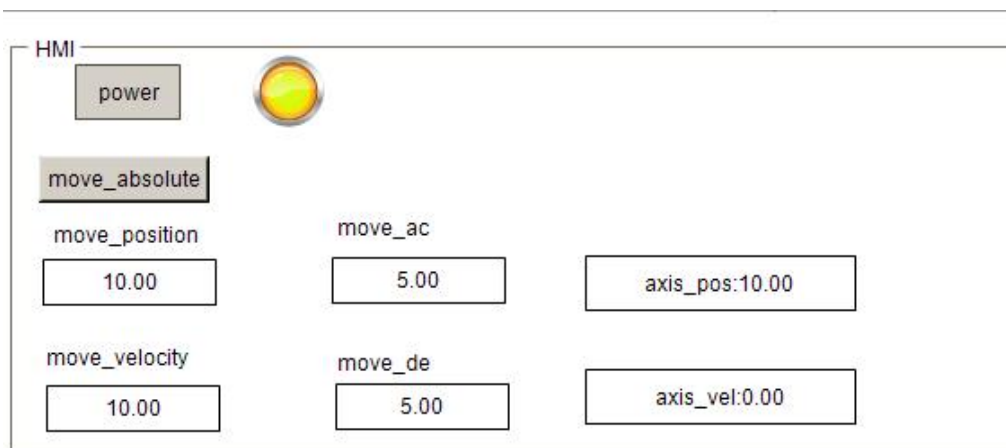
Create two button controls to manage enabling and axis movement. For the enabling control, input MAIN.power\_do in the Inputconfiguration — Toggle (toggle button) — Variable section. One click sets it to 1, another click sets it to 0. For the axis movement trigger control, input MAIN.move\_do in the Inputconfiguration — Tap (instant button) — Variable section. It sets to 1 only when clicked and to 0 when released.



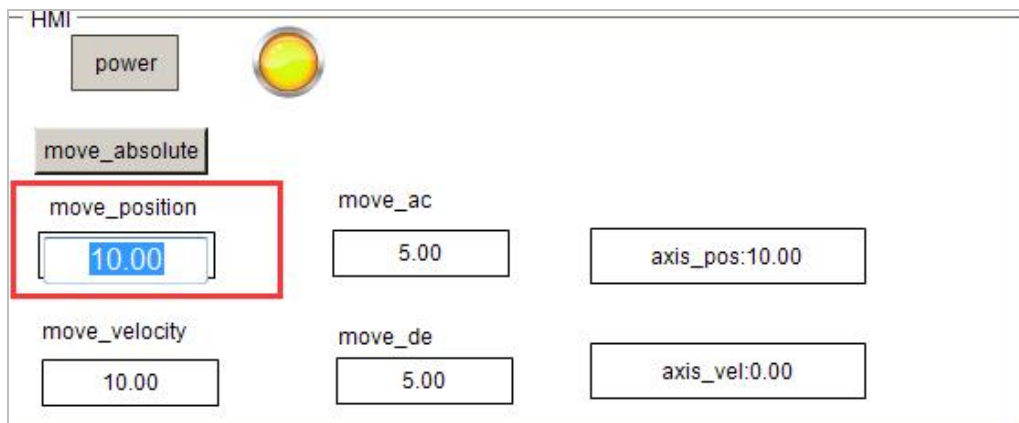
Create an indicator light control to show whether the Power function block is enabled successfully. First, drag an LED icon from the Toolbox on the right, and then bind Position--Variable to MAIN.axis.NcToPlc.StateDWord.20 variable, where StateDWord.20 indicates the enable status of the axis variable.



After writing the program, activate it by  clicking Login to run. Then, click  the Run button to view the values of specified variables in the visual interface.



Click input controls like move\_position to modify variable values in real time.



## 11.3 CODESYS and Xinjie DM6C Servo EtherCAT Communication

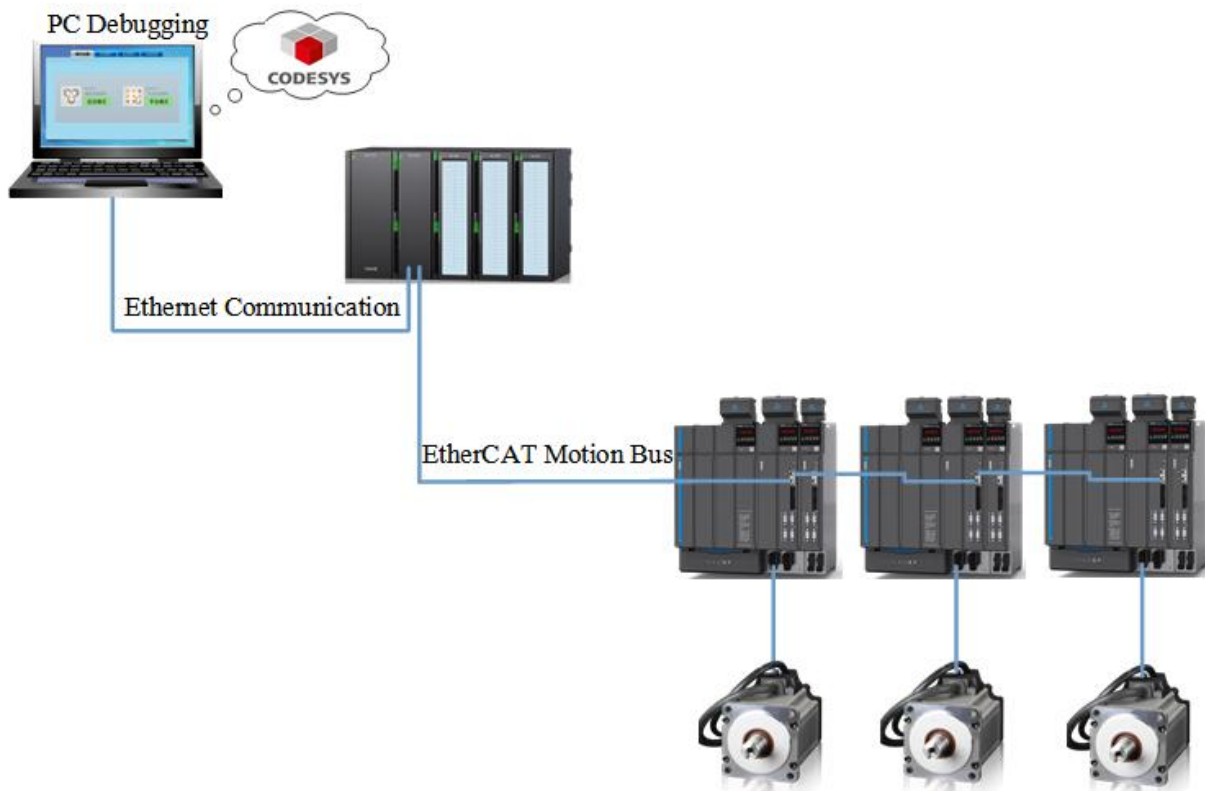
### Example

This case demonstrates how EtherCAT motion control is implemented using CODESYS motion control software as the master station (with the XG3 series PLC serving as a hardware platform) and the DM6C series servo as the slave station.

#### 11.3.1 System Configuration

| name                      | Model/Specification | quantity  | remarks                             |
|---------------------------|---------------------|-----------|-------------------------------------|
| motion control software   | CODESYS             | 1         | Software version: V3.5 SP13 Patch 1 |
| hardware control platform | XS3 series PLC      | 1         |                                     |
| Servo of XJ               | DM6C-45P5-R         | 3         |                                     |
| parvicostellae            | JC-CA-3             | a surname | Connects the computer to the servo  |

#### 11.3.2 System Topology



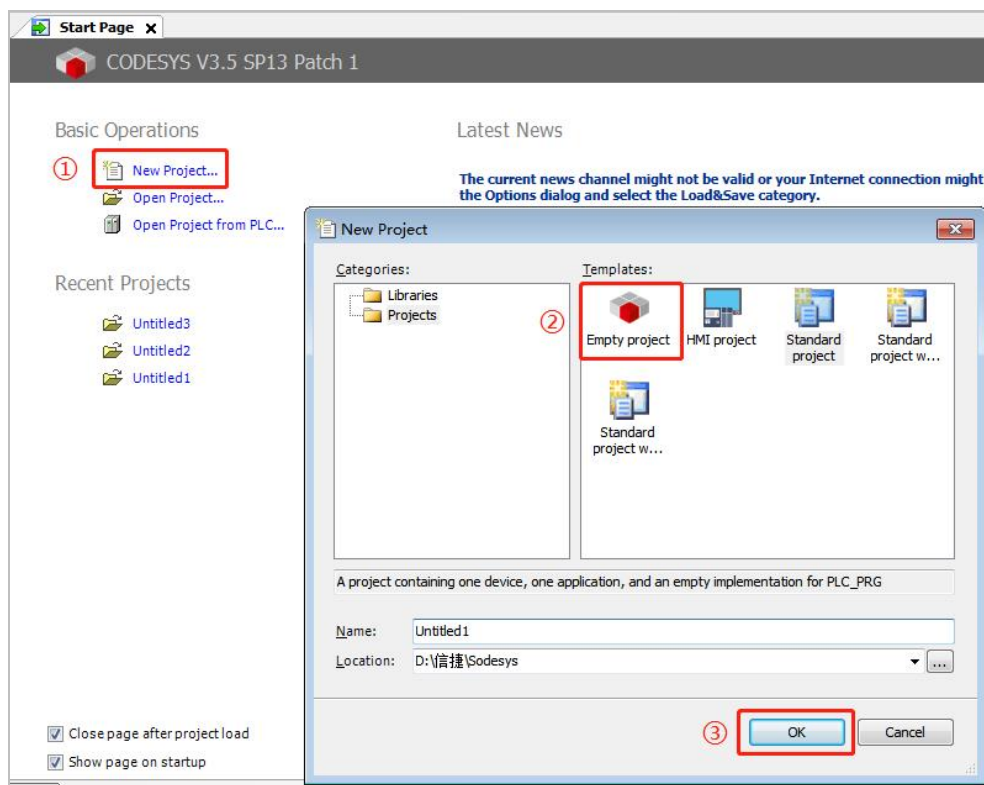
This is a control system developed by CODESYS based on traditional hard PLC. In this solution, the PLC development system typically runs on a standard PC, while the traditional hard PLC serves merely as a hardware platform. The real-time kernel of the software PLC is installed within the hard PLC, and the system programs developed by the development system are downloaded into the hard PLC. The control system diagram is shown in the figure above.

The XS series PLC features dual network ports: the upper Ethernet/IP port connects to the CODESYS host computer, while the lower EtherCAT port interfaces with the XINJE DM6C series servo for EtherCAT communication. The DM6C series servo drives require the 'lower-in, upper-out' principle for their communication ports.

### 11.3.3 Debugging Steps

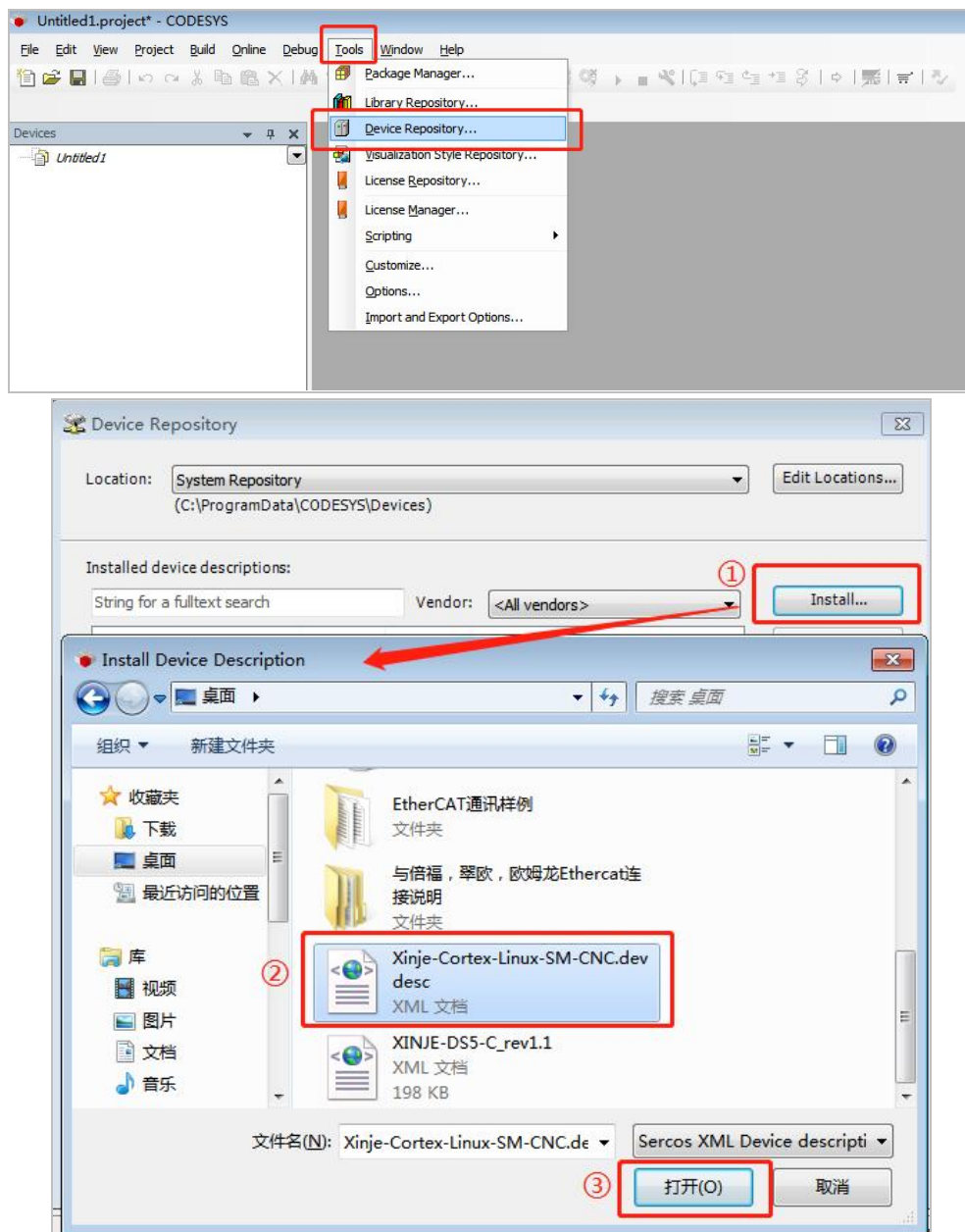
#### 1) New construction projects

Double -click to launch Codesys. Select the New Project command to create a blank project. Enter the project name and save path, then click OK.

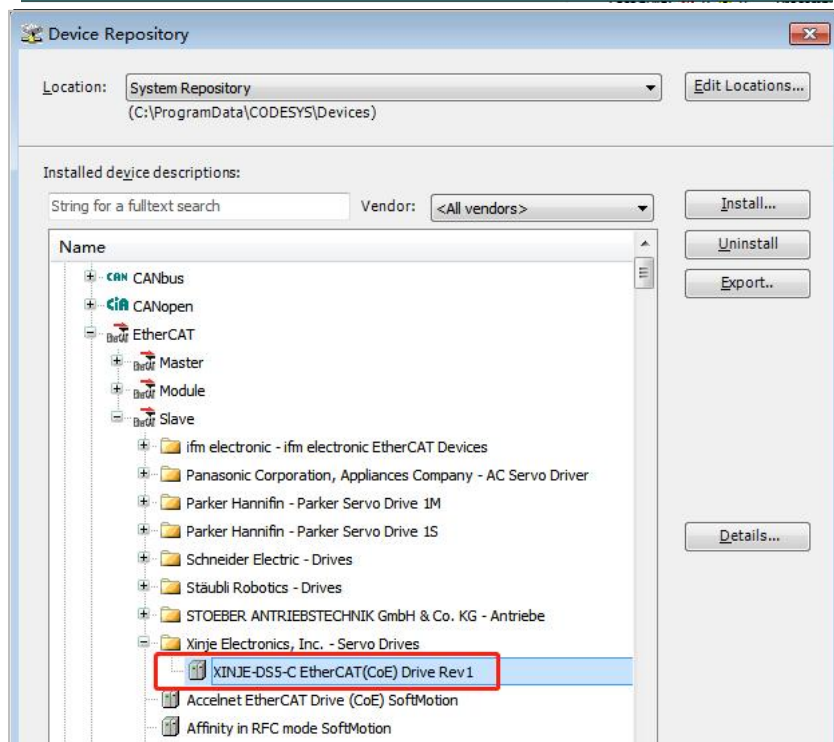
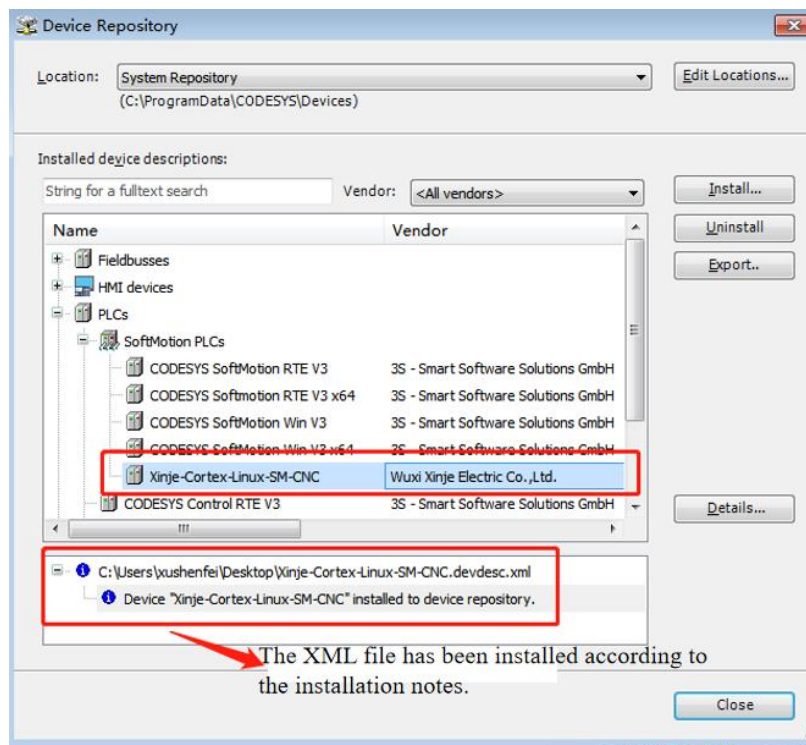


#### 2) Add XML file

Open the Tools Device Repository and add the XML files for both the master and slave devices. First, add the master device's XML file. Click Tools--Device Repository, then click Install in the dialog box. Locate the XML file by selecting its path, and click Open after selection.



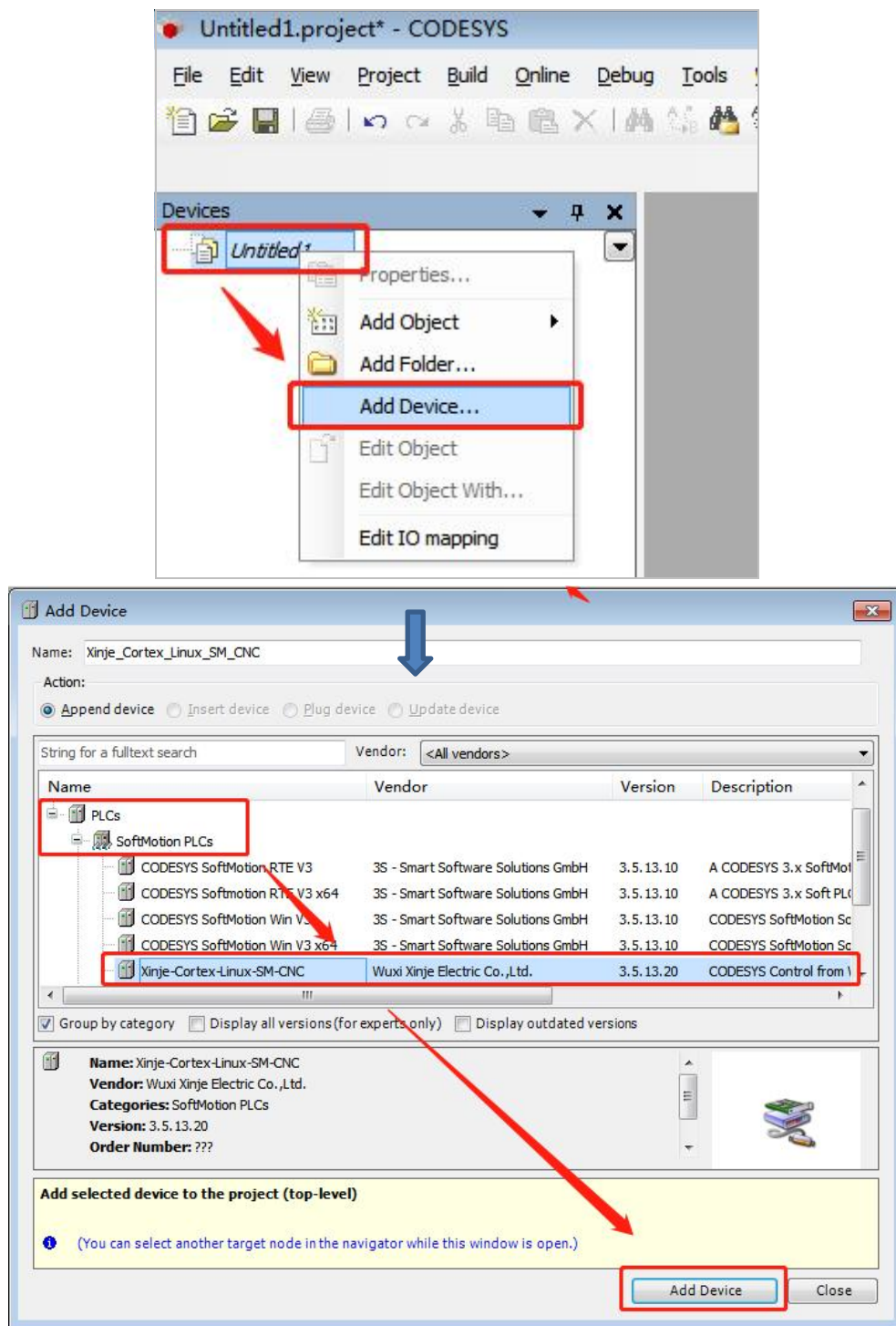
The installation is complete upon opening, as shown in the figure below. Similarly, install the slave XML file (XINJE-DS5-C\_rev1.1) using the same method.



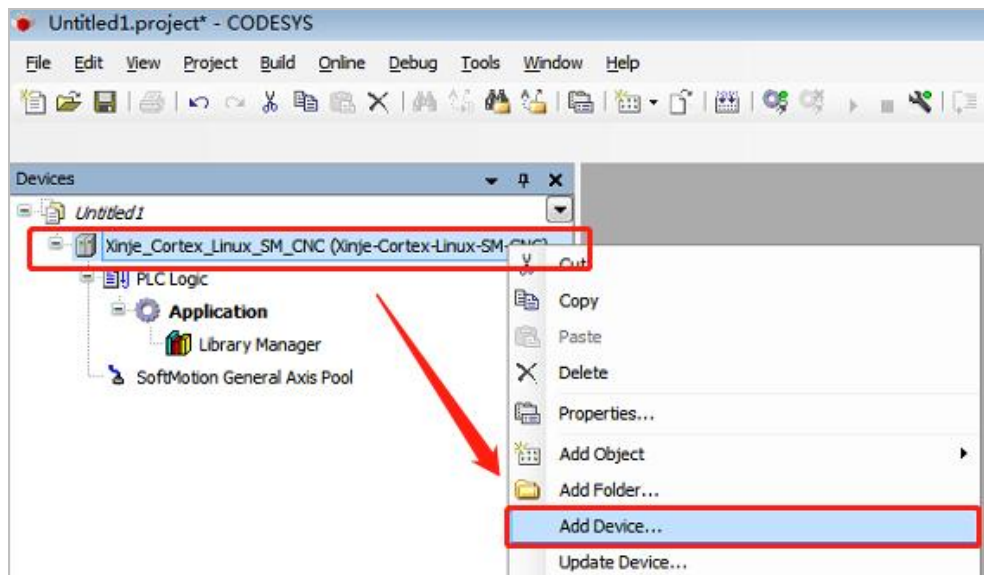
### 3) Add primary site equipment

Right-click the Untitled file, select Add Device, then choose PLCs--SoftMotion PLCs--Xinje --Cortex-Linux-SM-CNC in the dialog box, and finally add the PLC.

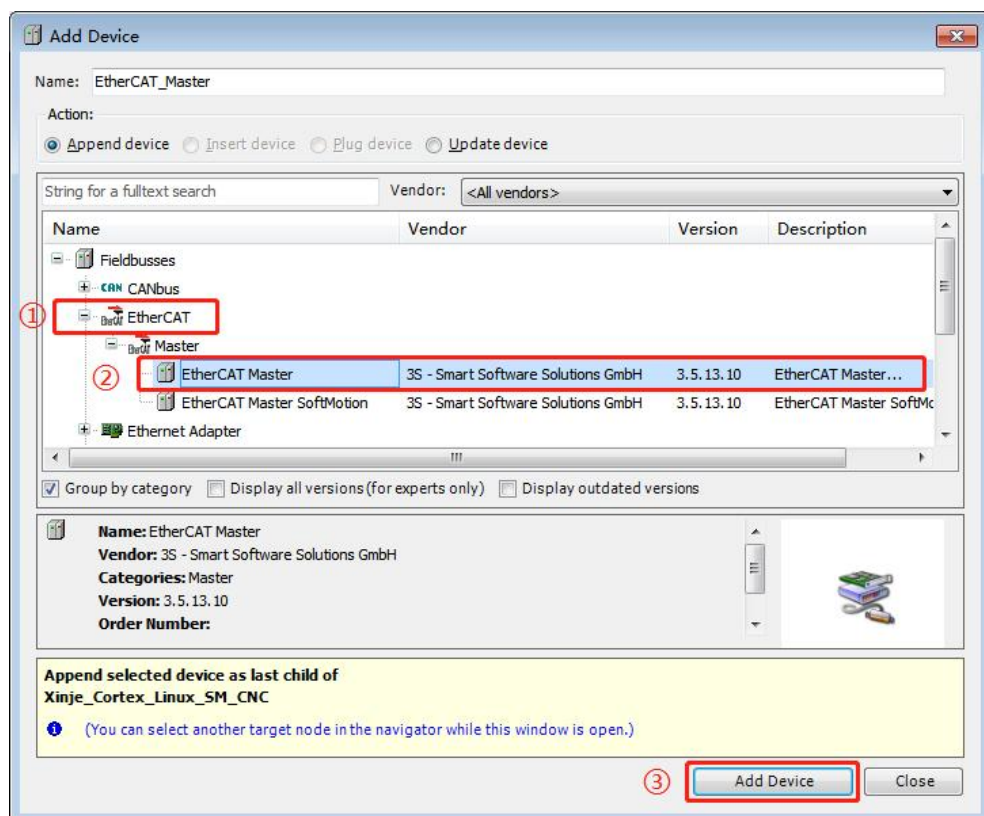




After installing the PLC, the Device Manager will appear on the right side of the interface. Select Xinje -Cortex-Linux-SM-CNC, right-click it, and click Add Device to add the device.

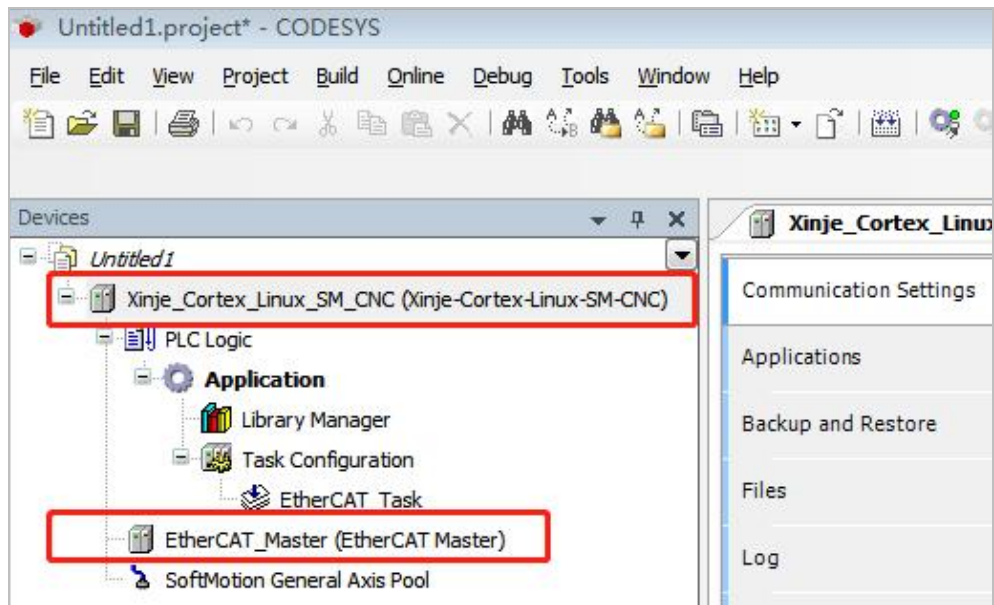


In the Add Device dialog box, select EtherCAT—Master—EtherCAT Master, then click Add Device to complete the process.



Device setup is complete, as shown below:



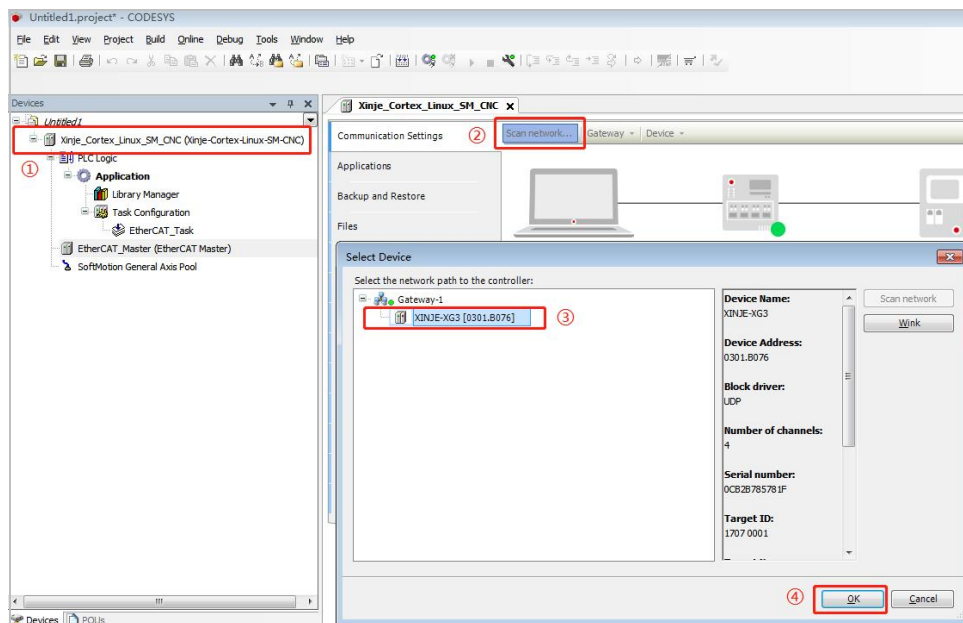


#### 4) Gateway communication settings

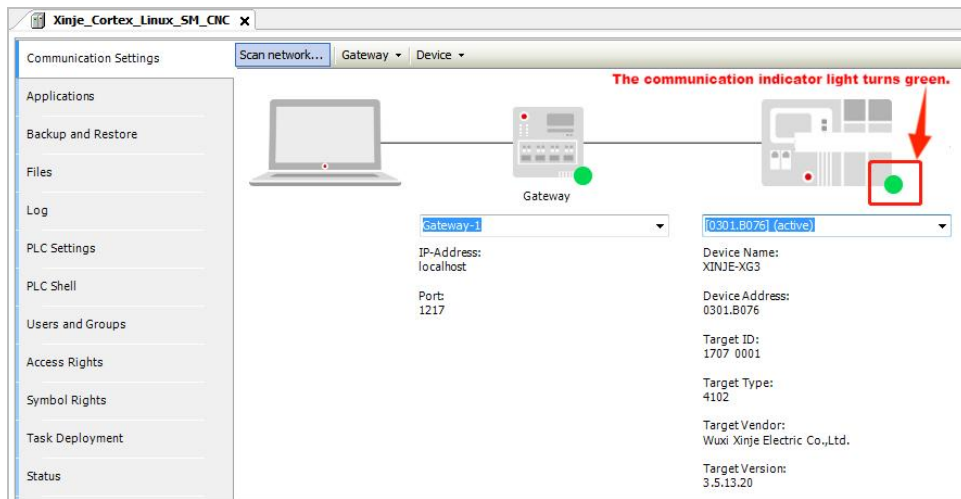
Double-click Xinje \_Cortex\_Linux\_SM\_CNC, then select 'Scan Network' in the Communication Settings tab to search for PLCs on the same network segment. Once found, click OK. The PLC shown below has the device name XINJE-XG3.



To establish an Ethernet connection, the PC's IP address must be within the same subnet as the PLC's. Therefore, verify the PC's IP address configuration before proceeding.

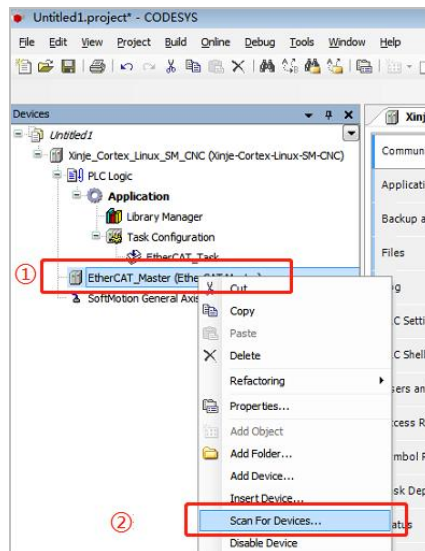


After successful communication, the result is shown below:

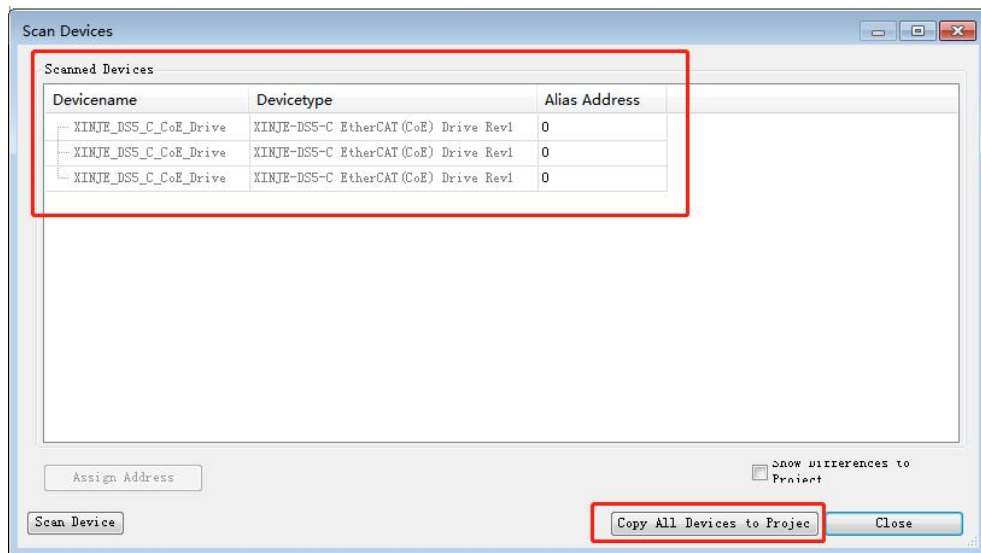


### 5) Scan the slave device

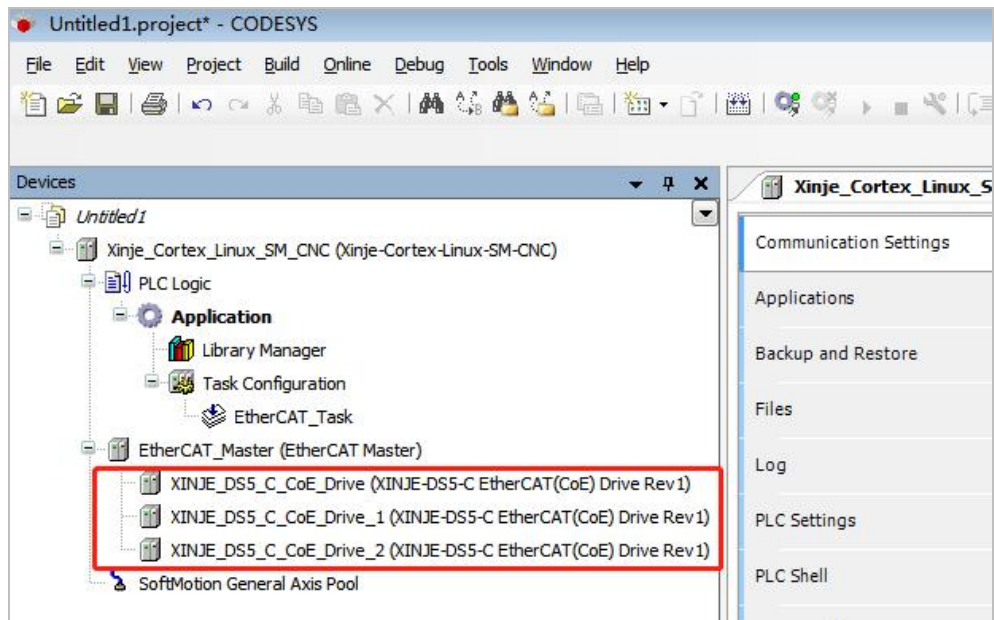
In the Device tab, right-click EtherCAT\_Master and select Scan For Devices to scan EtherCAT slave devices.



In this example, three DM6C-series servos are connected. The scan results are shown below. Click 'Copy All to Project' to add all scanned slaves to the project.

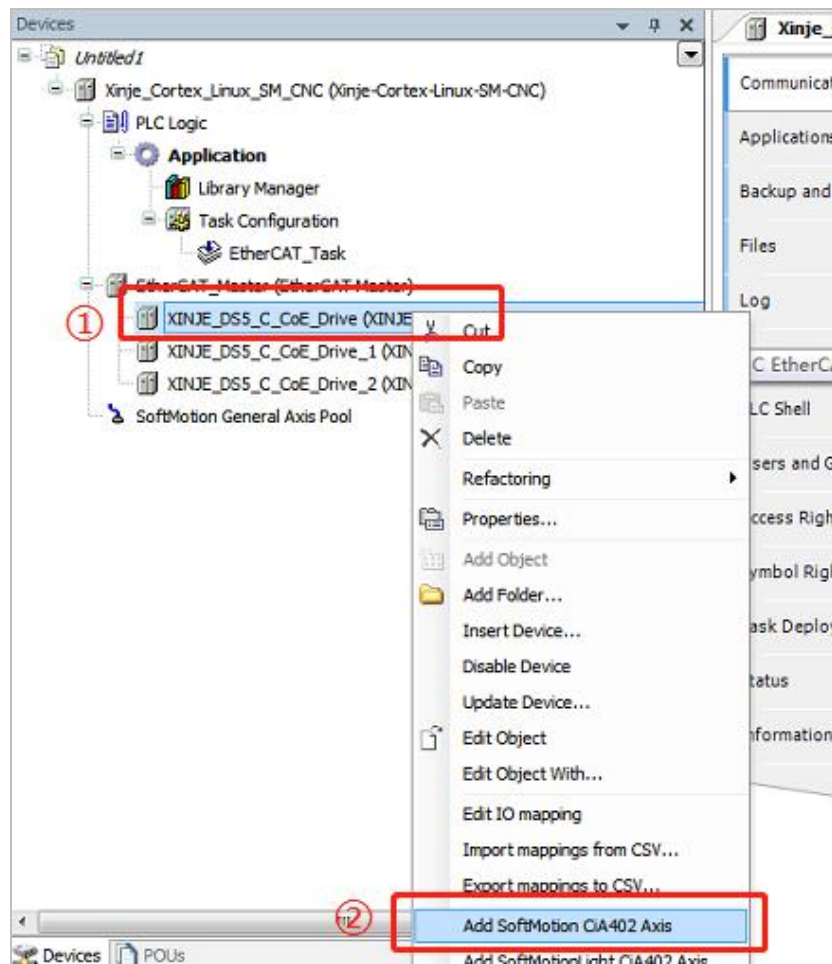


After the station device is successfully added, the 'Devices' column will appear as shown in the figure below.

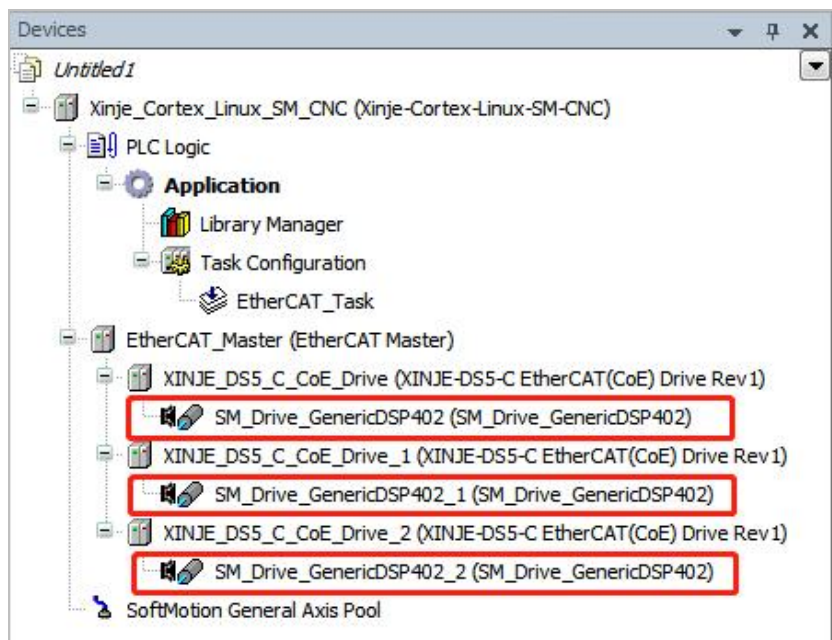


#### 6) Add motion control axis

Right-click the XINJE\_DS5\_C\_CoE\_Drive device and select Add SoftMotion CiA 402 Axis.

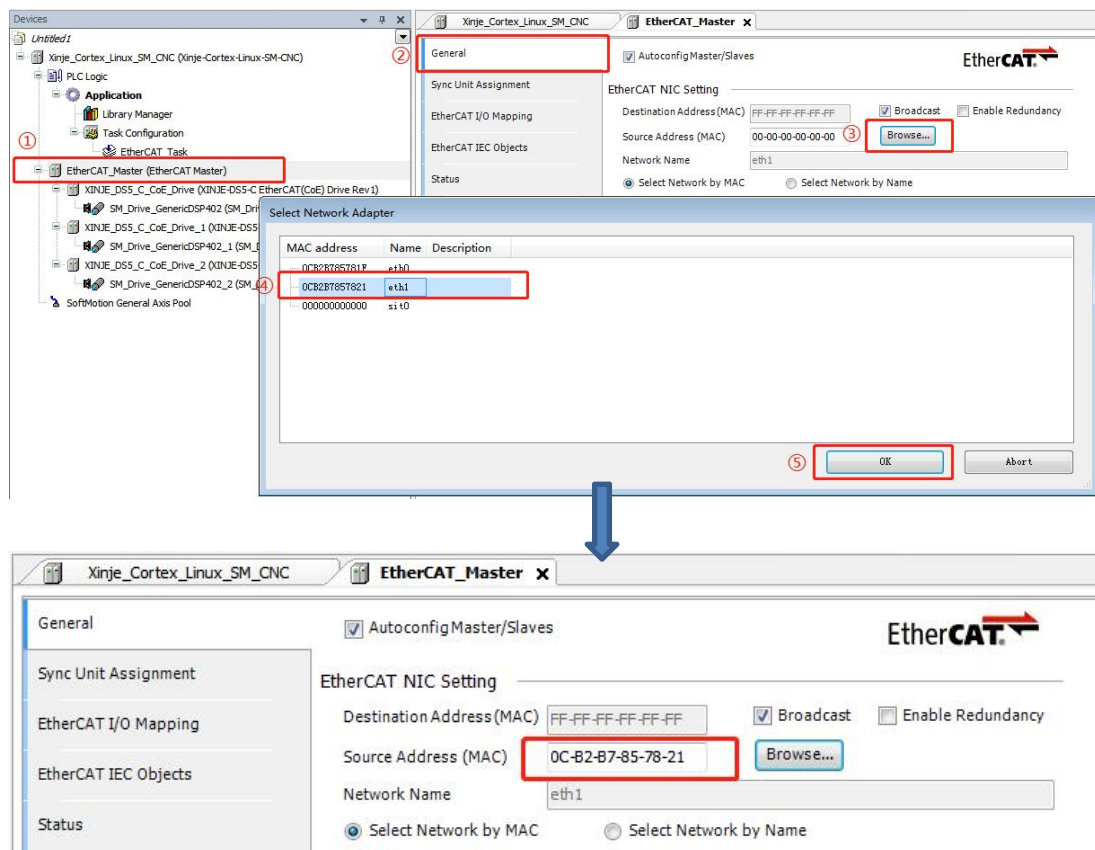


Similarly, add an axis to each slave station. After completion, the result is shown in the figure below.



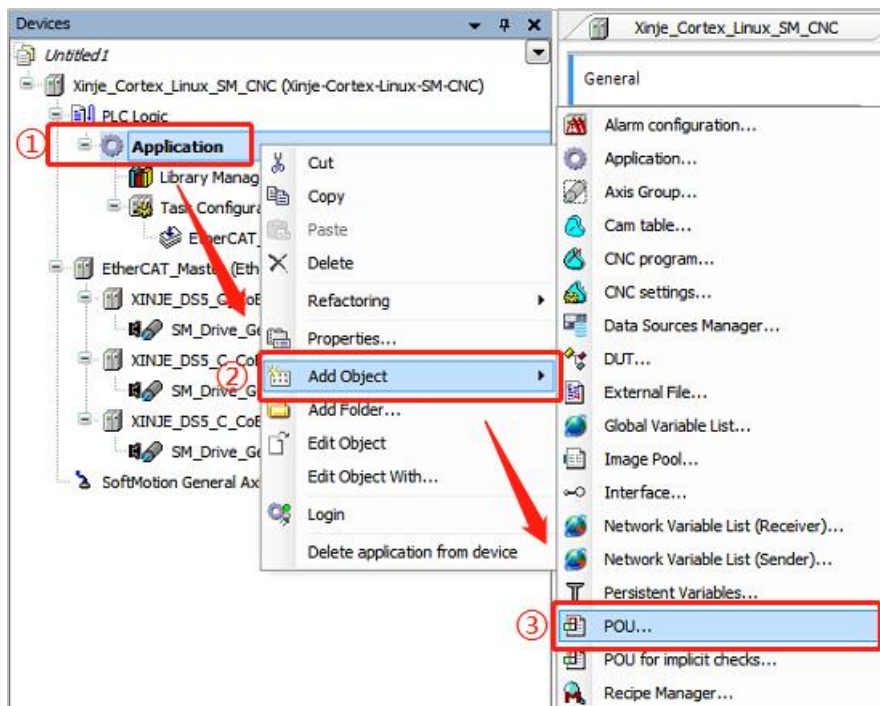
#### 7) Source address selection for the master station equipment

Double-click "EtherCAT\_Master", then select Browse... in the General tab. Choose the target MAC address and click OK to finalize the source address selection.

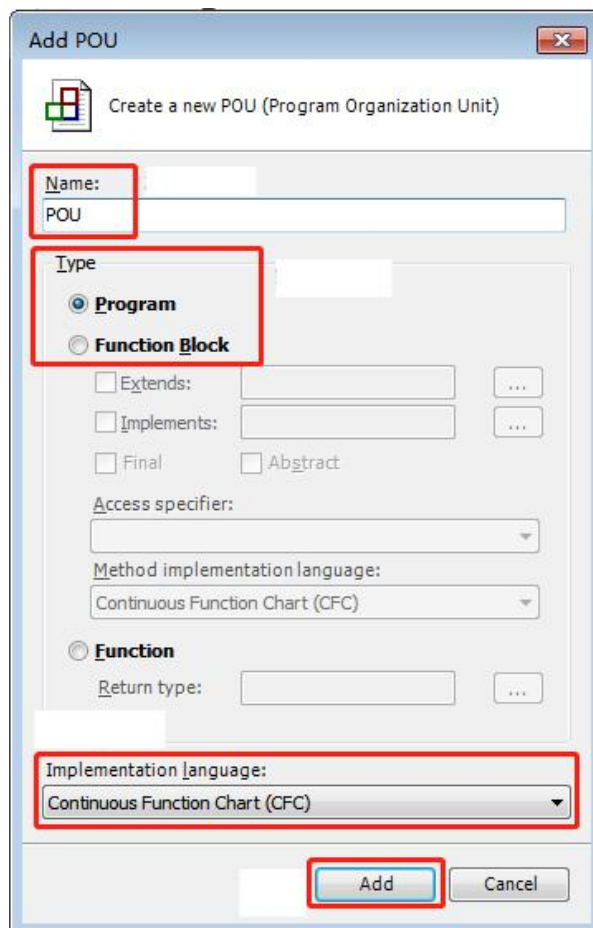


## 8) Write a program

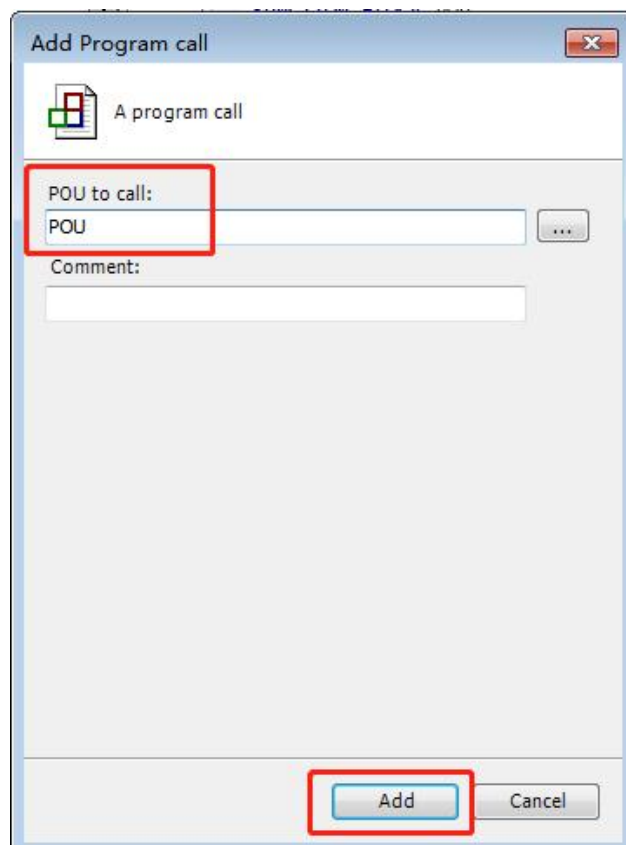
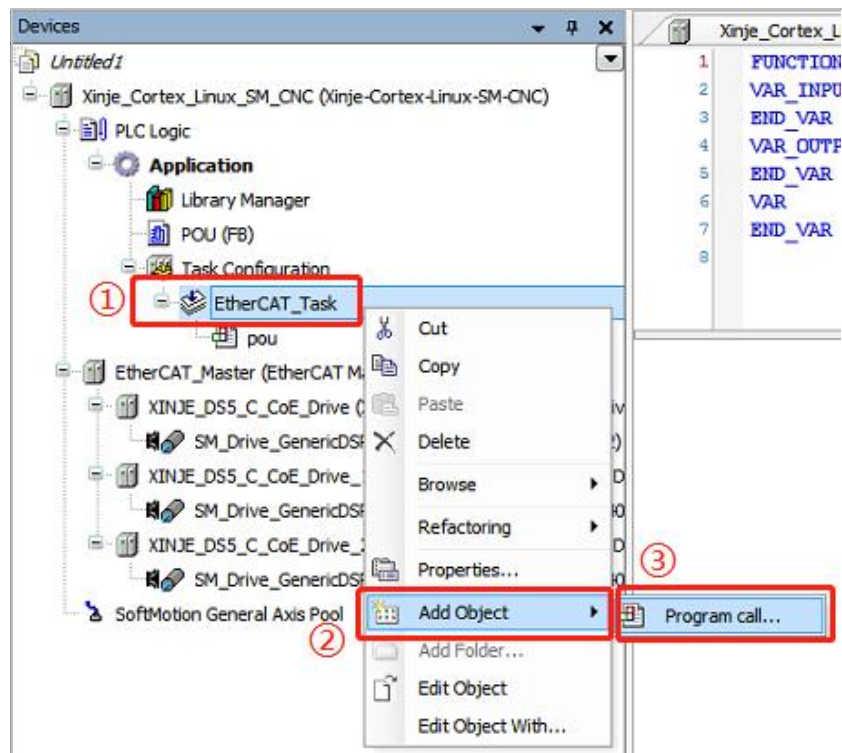
Add POU. Right-click Application in the Devices column, then select Add Object--POU... Select a name for the POU and choose the programming method, then click Add. In this example, select Continuous Function Diagram (CFC) for programming.





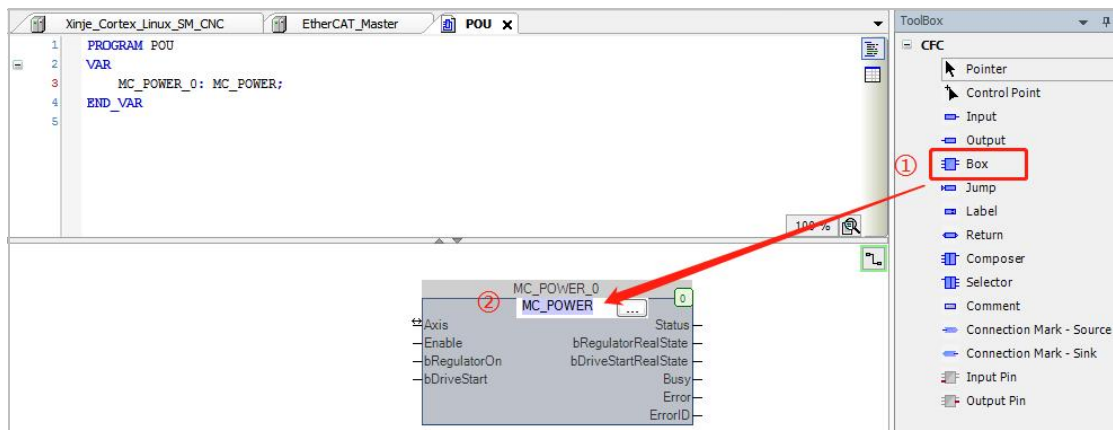


Double-click the added POU to program it in the POU interface. Note: The POU must be added to the task, as the subsequent compilation command only compiles programs included in the task. If the created POU is not added to the task, the compilation command will not perform syntax checking on the POU. Right-click EtherCAT(Task), select Add object--Program call, enter 'POU' in the Add Program call dialog box, and click Add to complete the addition.

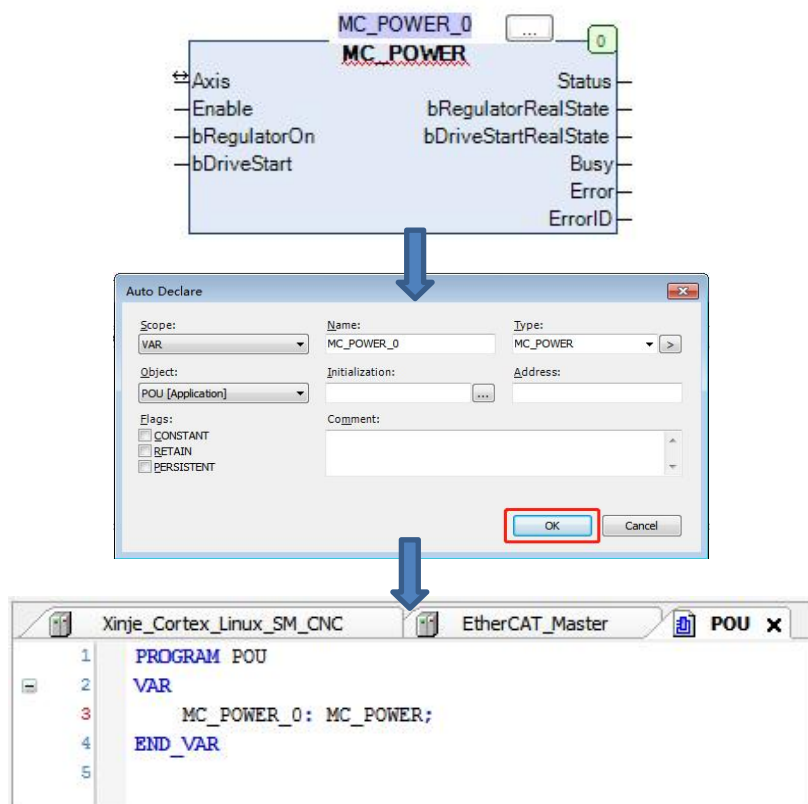


### Call function block

In the POU interface, call the MC\_POWER function block to enable the axis. Select the Box in the toolbar, drag it into the programming interface, and enter MC\_POWER.

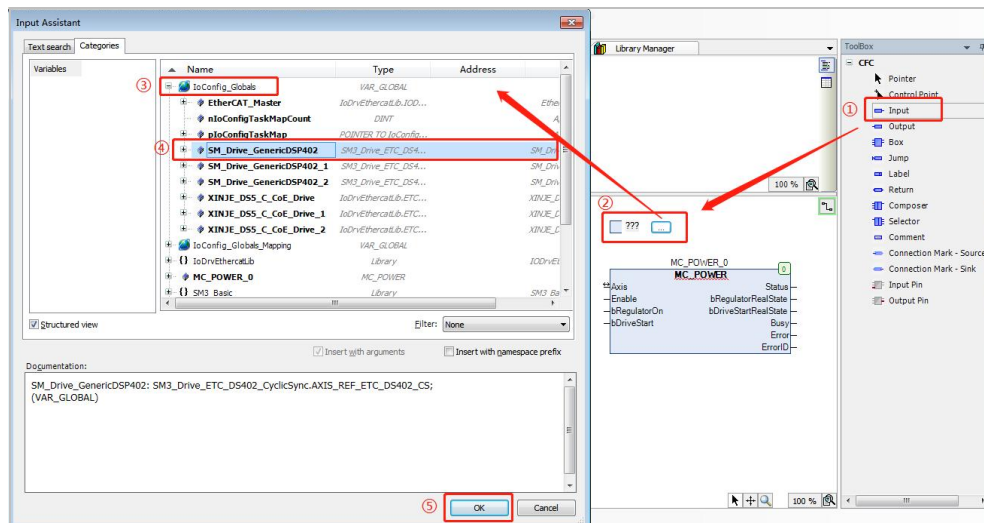


Link this function block to the first slave axis variable. As shown in the diagram, enter MC\_POWER\_0, and the programming interface will automatically generate the required variables.

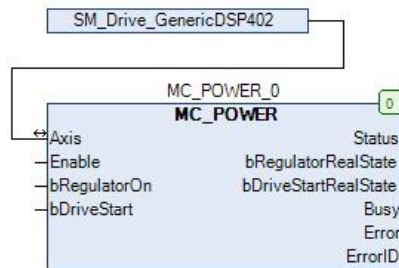


Add "Input" and link this function block to the first slave axis. Select Input from the toolbar, drag it into the programming interface, double-click the control, and click to open the Input Assistant dialog. In the dialog, select IoConfig\_Globals--SM\_Drive\_GenericDSP402, then click OK.

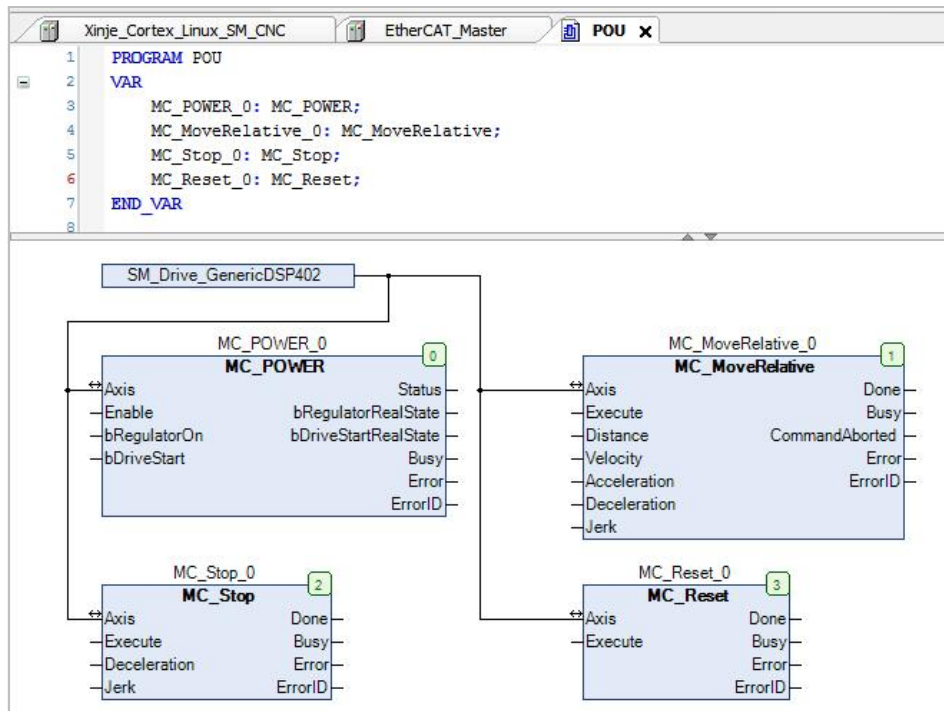




Connect the added input function block to the enabled function block with a wire.



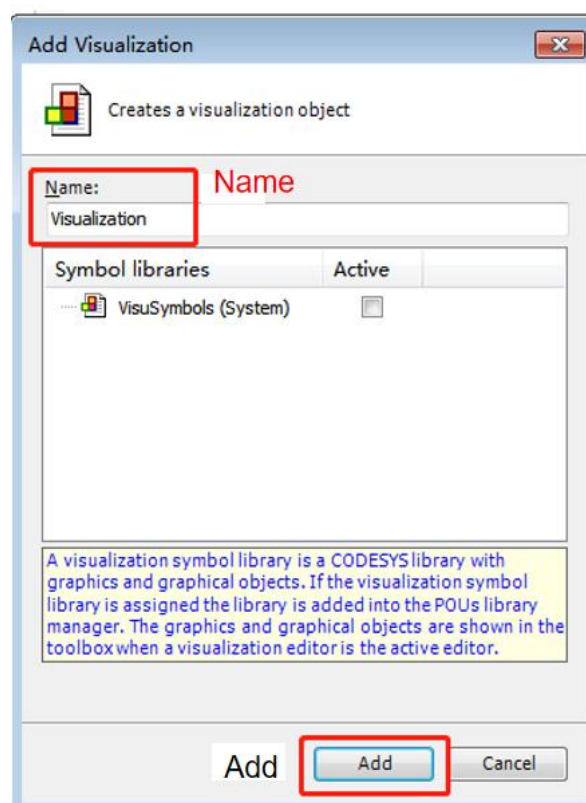
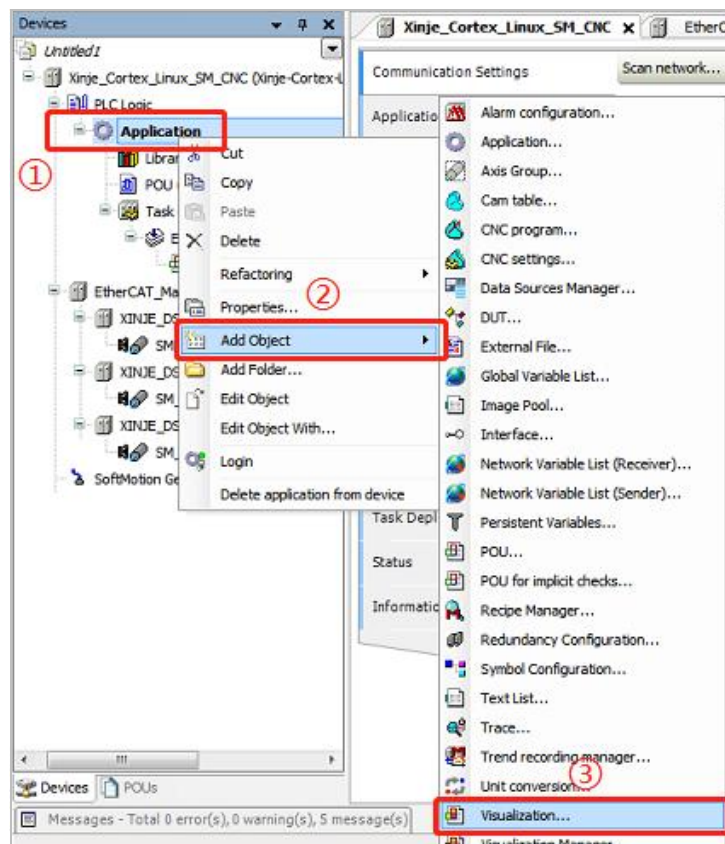
Similarly, add the relative movement function block MC\_MoveRelative, stop function block MC\_Stop, and reset function block MC\_Reset. The program is shown in the figure below.



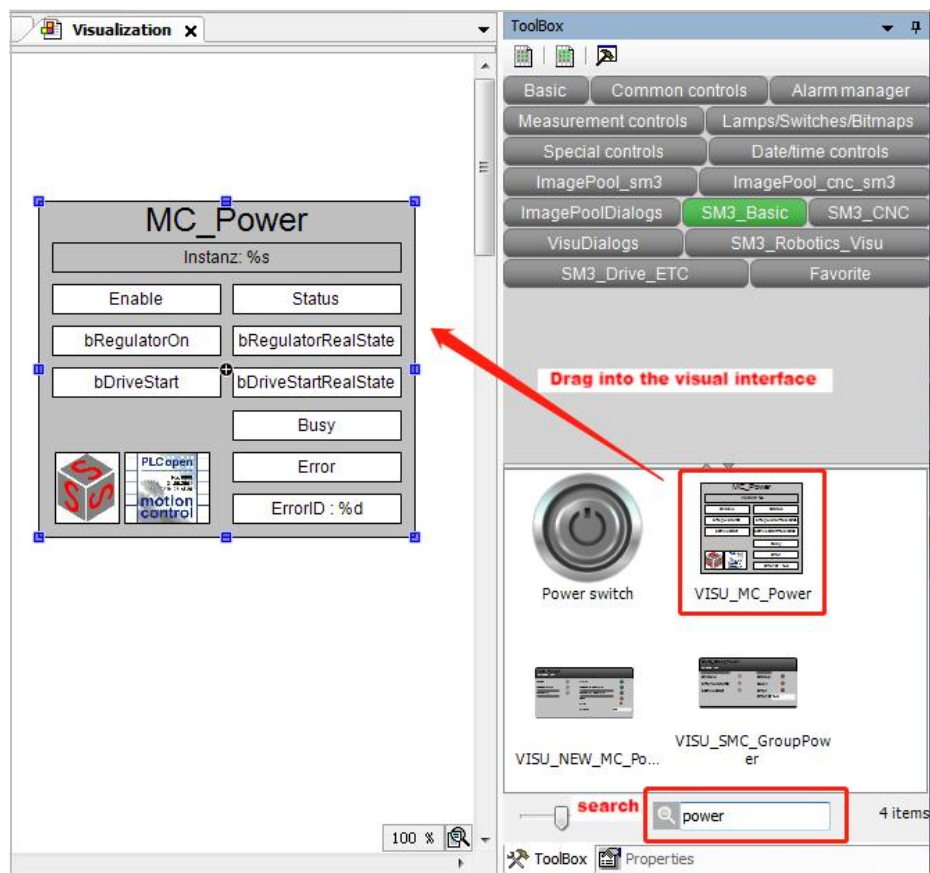
9) Create a view

Add a view. Right-click Application in the Devices column, then select Add Object—Visualization...

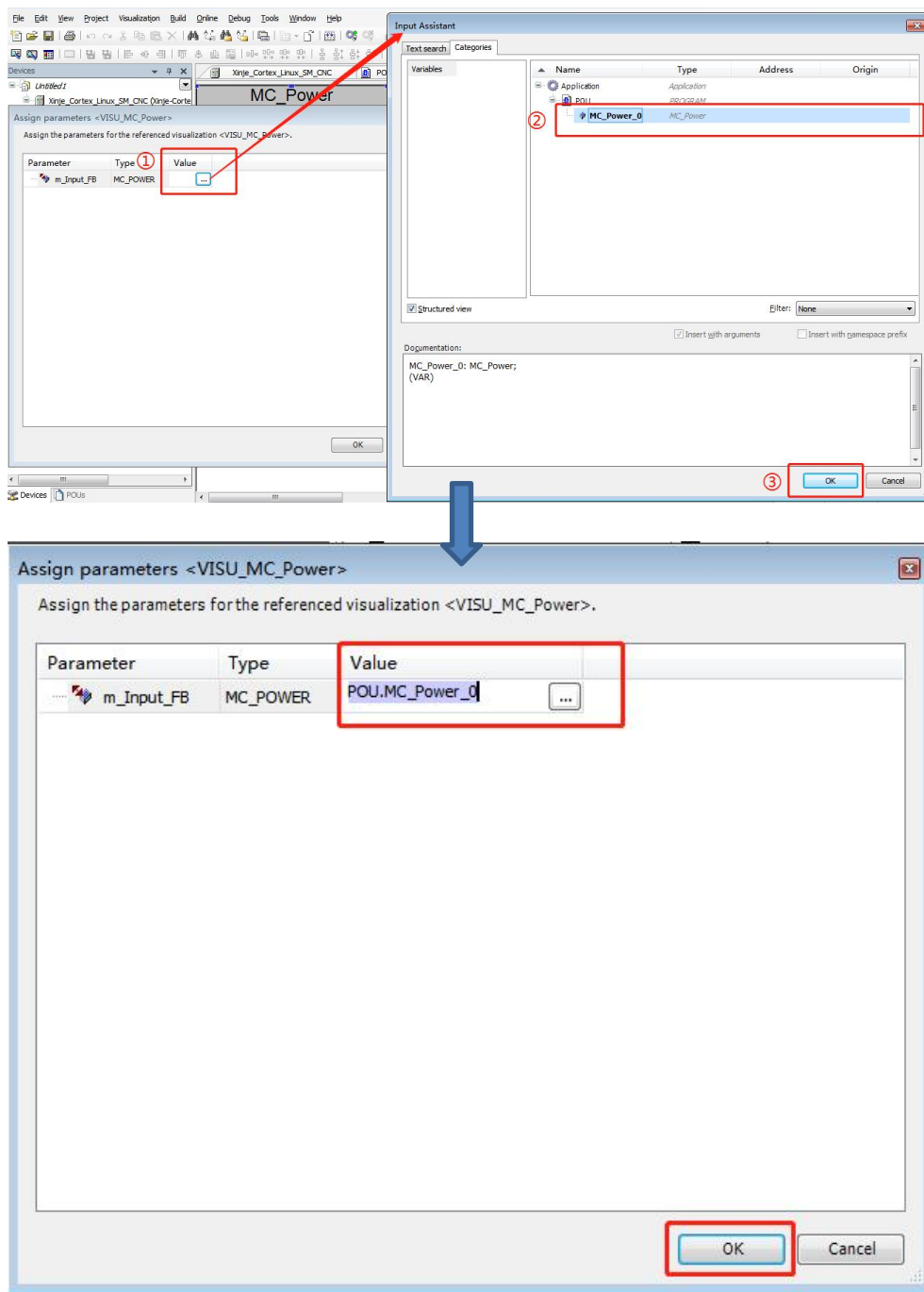
Name the view and select a programming method, then click Add.



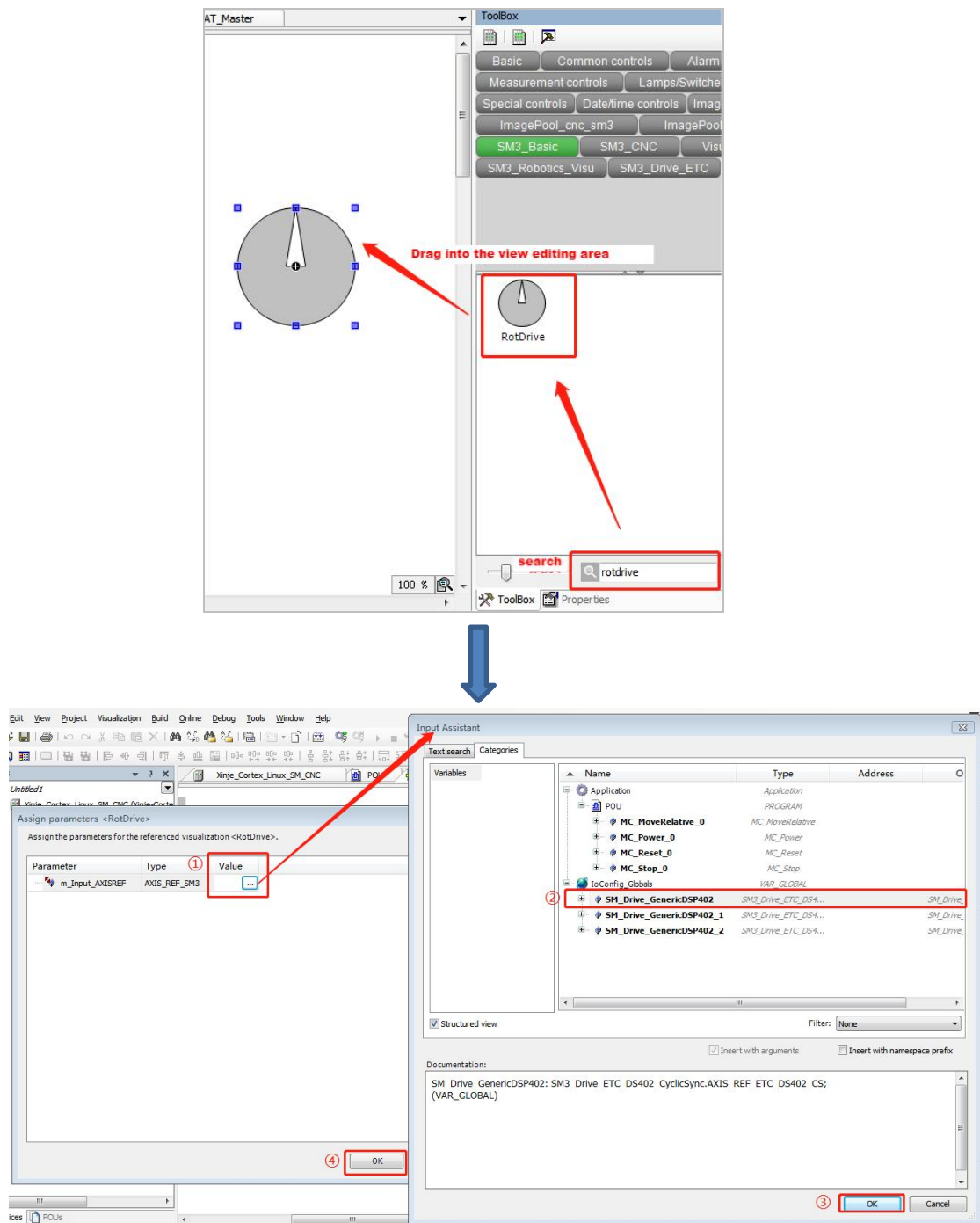
Double-click Visualization in the Devices section to add the desired view to the view interface. For example, search for power in the toolbar to drag the view control for enabling functions into the view.



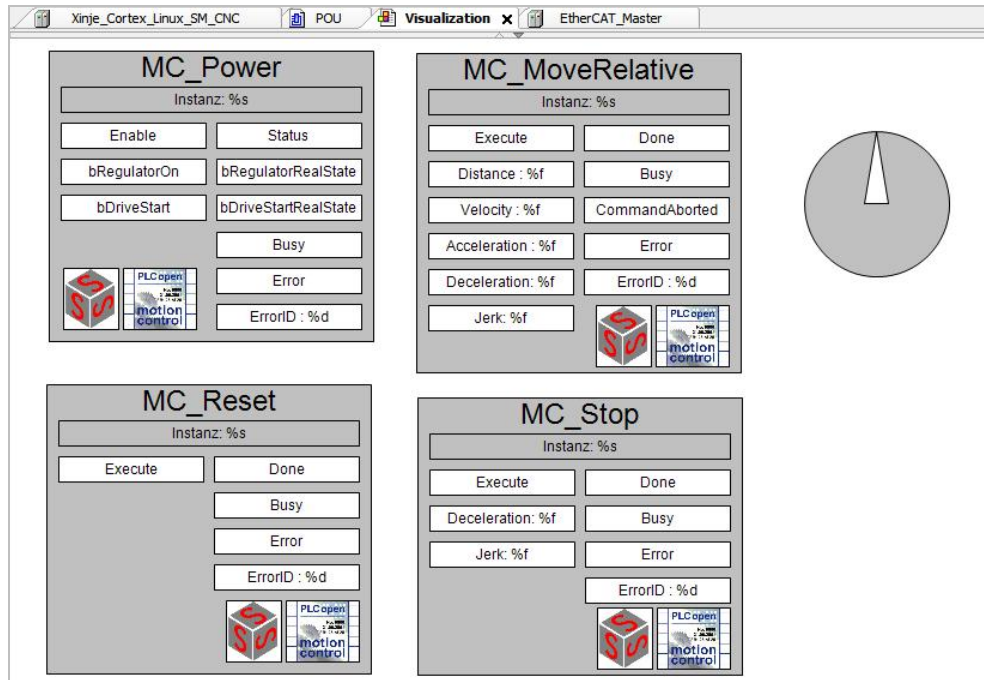
When dragging a control into the view editing area, a dialog box titled "Assign parameters <VISU\_MC\_Power>" will automatically appear. Link the view  control to the declared variable in this dialog. Double-click the "Value" field, select the declared variable in the new dialog, and click OK. The linked variable name will then appear in the "Value" field. Click OK again to complete the variable link. Repeat the same steps for other view controls.



Add a view simulating the motor's rotation and link it to the motor shaft. Add and link it as above.



The completed view is shown below:



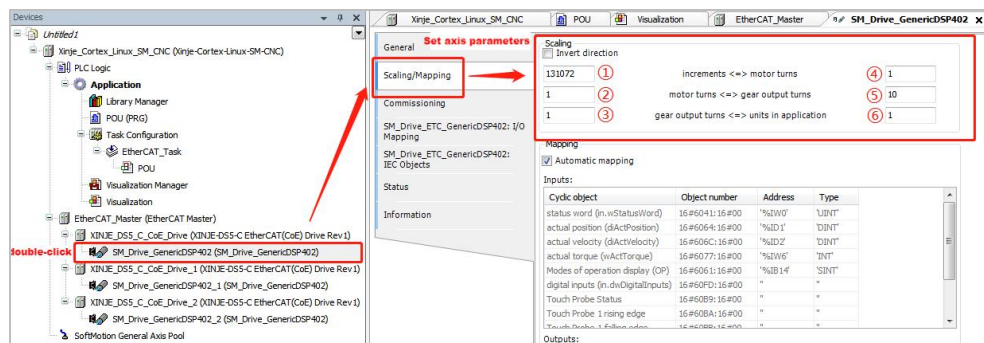
#### 10) Online control

Axis parameter settings. Double-click Axis 1 to configure axis parameters in the Scaling/Mapping tab.

- ① To set encoder precision, enter 131072 for this example, as a 17-bit encoder is connected.

The relationship between setting and output:  $\text{Coefficient} = (\textcircled{4} * \textcircled{5} * \textcircled{6}) / (\textcircled{2} * \textcircled{3})$

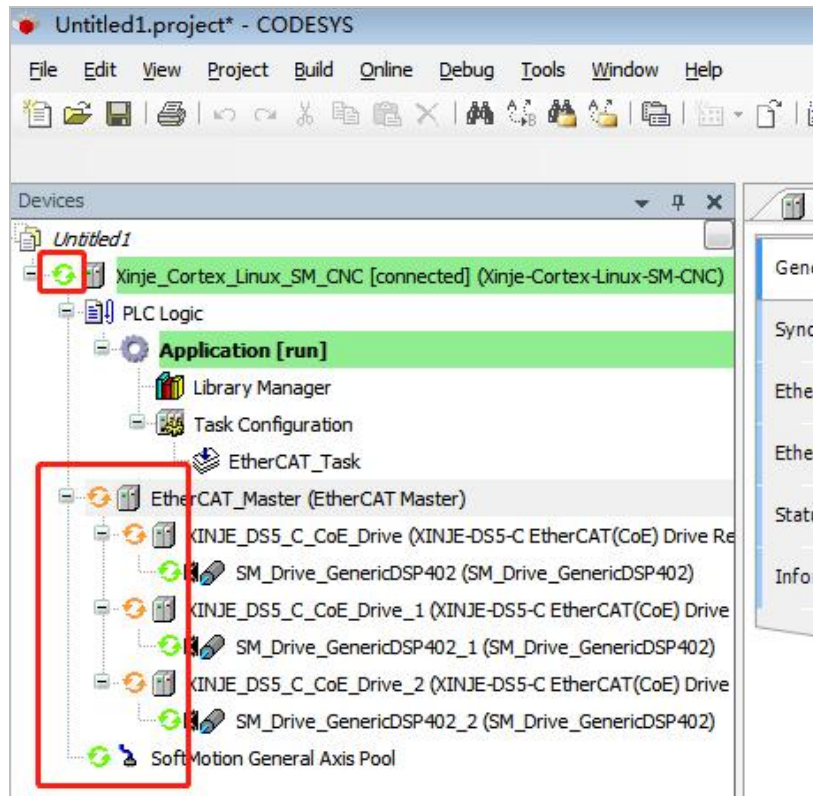
Example: When the input-output relationship coefficient is 10 and the Distance setting in the MC\_MoveRelative function block is 100, the calculation  $100/10 \times 131072$  yields 131070, meaning the motor will complete 10 full rotations over 131072 pulses. Setting the Velocity to 10 results in  $10/10 \times 131072 = 131072$ , operating at 131072 pulses per second. For Acceleration (1000), the calculation  $1000/10 \times 131072 = 13107200$  indicates an acceleration of 13107200 m/s<sup>2</sup>, with deceleration settings following the same logic.



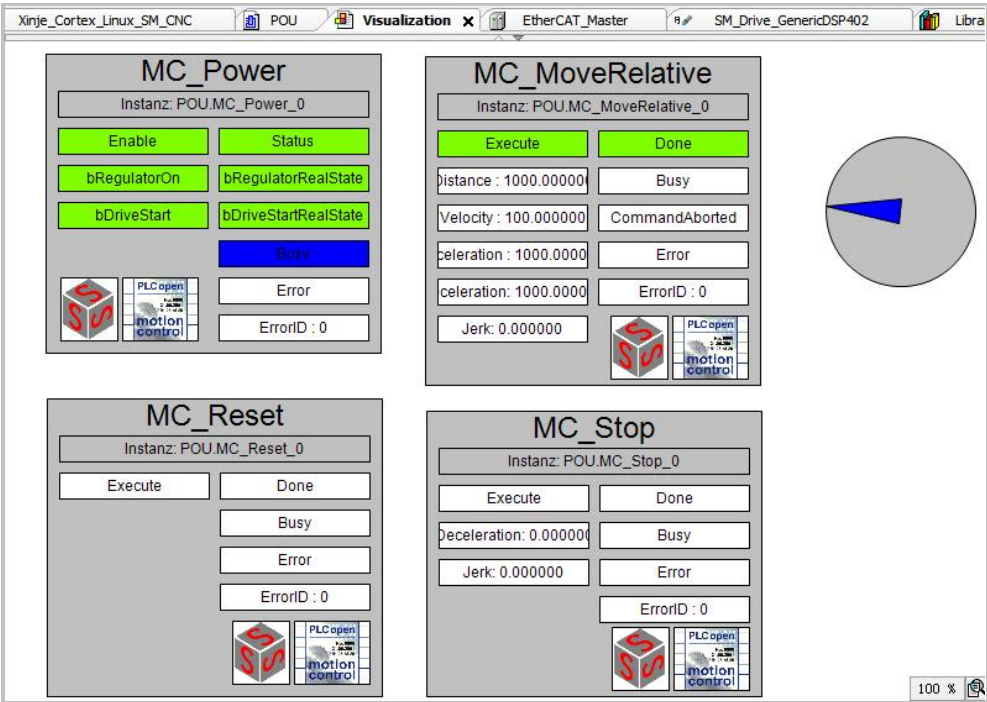
After completing parameter configuration, compile the program for syntax check. Once the program passes the check without errors, you can log in and run it. Logging in establishes a connection



between the application and the target device, enabling  online  operation  . To ensure proper login, the device's communication settings must be correctly configured, and the application must be free of compilation errors. Follow the sequence of compiling, logging in, and running. The normal operational state is illustrated in the figure below.



In this view, you can configure parameters such as the motor's travel distance and speed. To activate the motor, sequentially select bDriveStart, bRegulatorOn, and Enable from the MC\_Power function block. Finally, click Execute in the MC\_MoveRelative function block to initiate the relative position movement.





## 11.4 OMRON and XJIN DM6C Servo EtherCAT Communication

### Example

This example demonstrates how OMRON PLC serves as the EtherCAT master station while XINJE servo acts as the slave station to implement EtherCAT motion control.

#### 11.4.1 System Configuration

| name           | Model/Specification     | quantity  | remarks                                                    |
|----------------|-------------------------|-----------|------------------------------------------------------------|
| upper monitor  | Sysmac Studio           | 1         | Omron upper-level computer software                        |
| controller     | OMRON NJ501-1500 series | 1         |                                                            |
| Servo of XJ    | DM6C-45P5-R             | 1         |                                                            |
| parvicostellae | JC-CA-3                 | a surname | For connecting computers to PLCs and PLCs to servo systems |

#### 11.4.2 System Topology

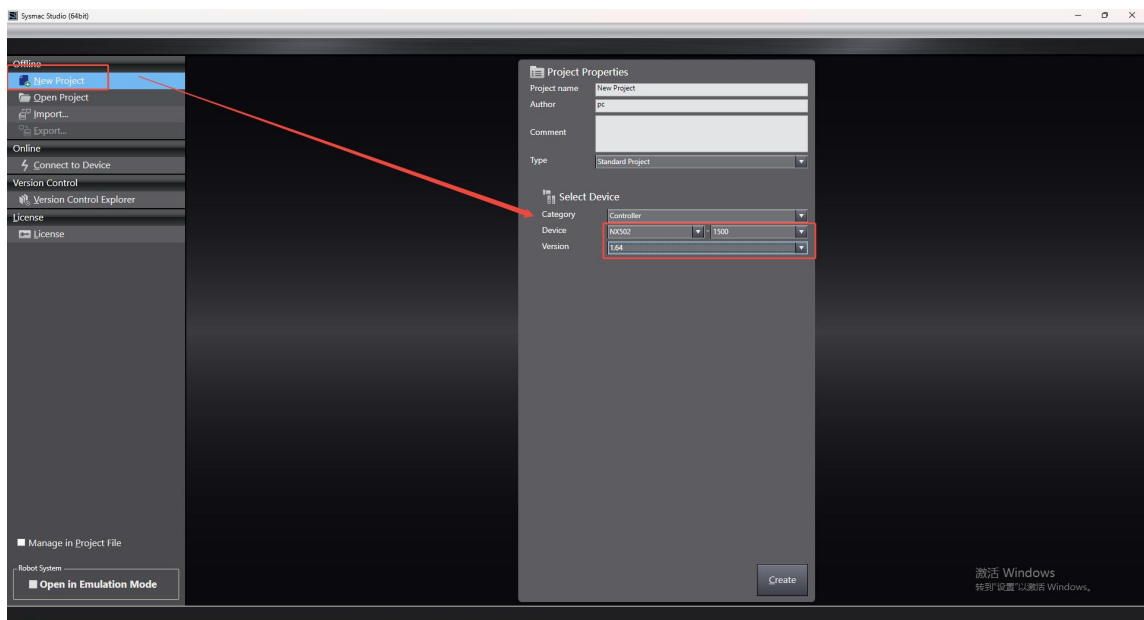
The NJ501 CPU module features two network ports: the red port (Ethernet/IP) connects to OMRON's Sysmac Studio host computer for PLC monitoring and data writing, while the yellow port (EtherCAT) interfaces with XINJE DM6C series servos to enable EtherCAT communication.

Each network port has three indicator lights: RUN, ERROR, and ACT. When the network cable is correctly connected, RUN should light up, and ACT remains normally lit. ACT will flash when communication is established and data is exchanged. ERROR will not light up unless there is an exception.

### 11.4.3 Debugging Steps

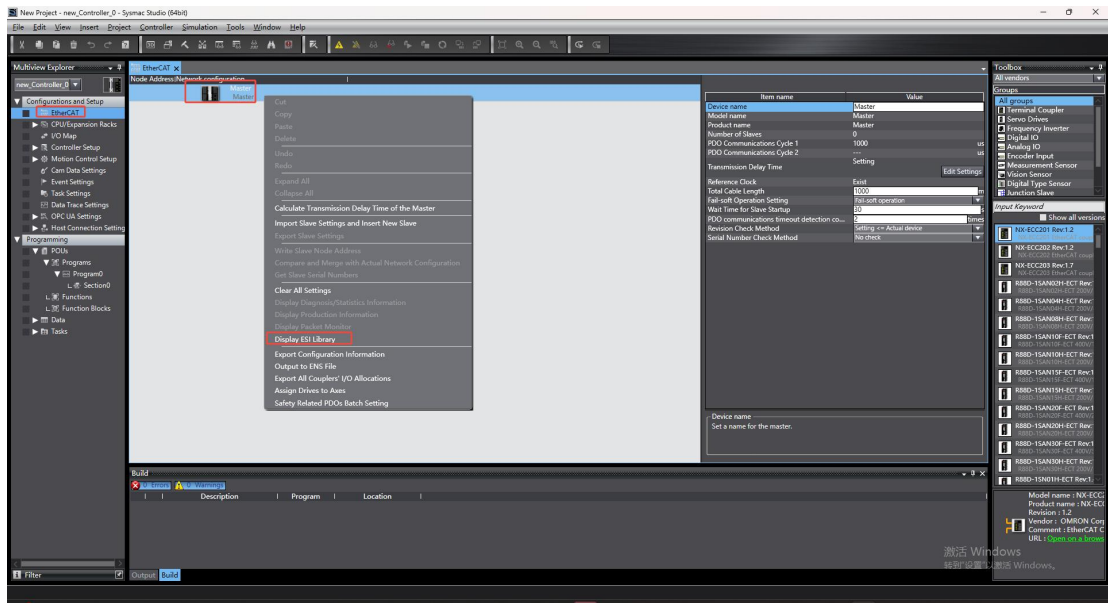
#### 1) New construction projects

Open the OMRON host software Sysmac Studio. For first-time users, select 'New Project' and choose the model: NJ501-1500, version 1.02 in the project properties interface. Click 'Create' to generate the programming interface.

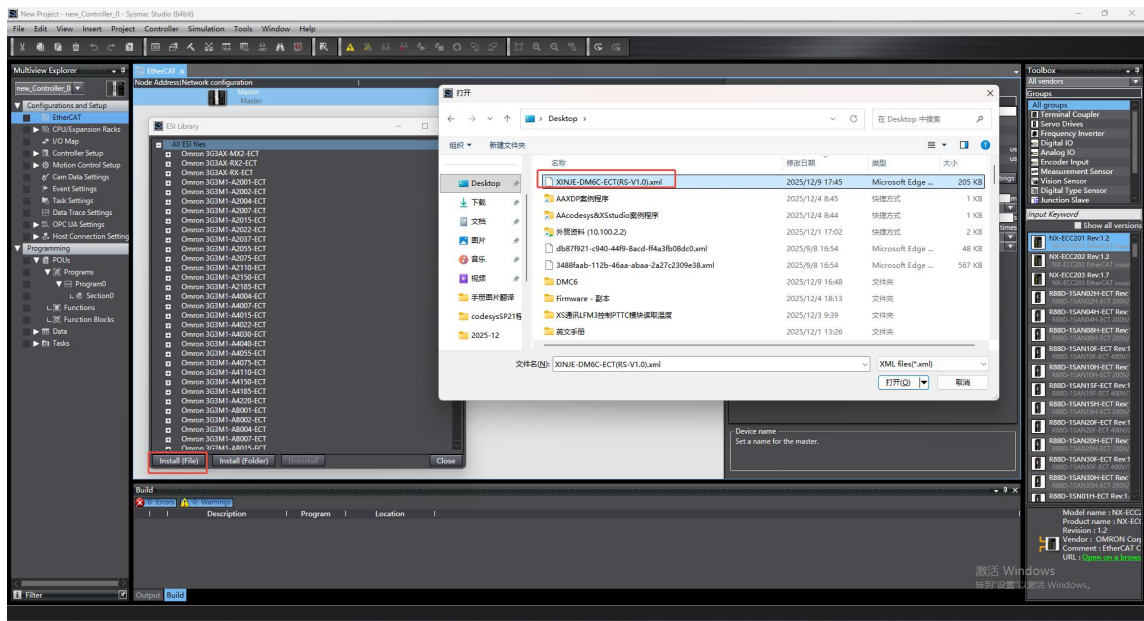


#### 2) Add XML file

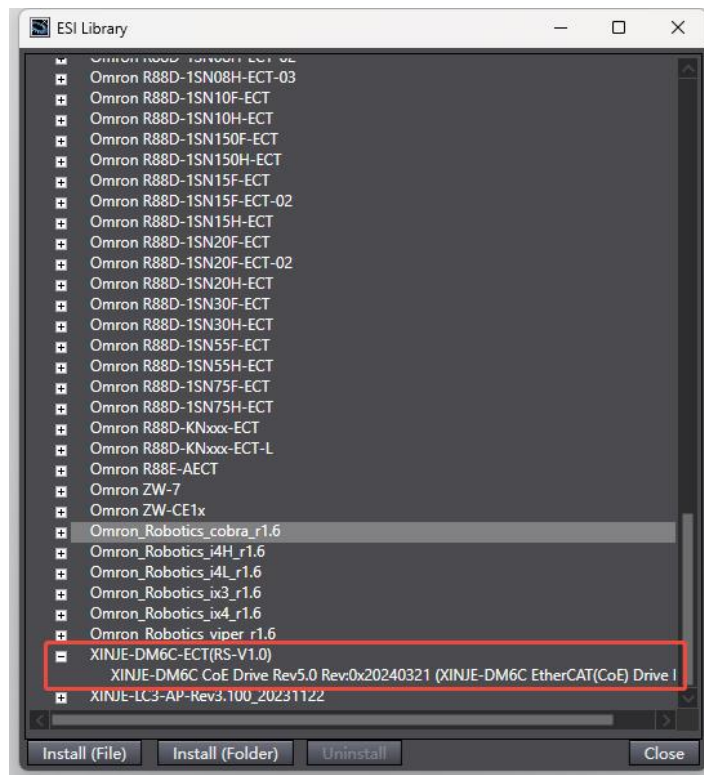
Double-click "EtherCAT" on the main interface to open the EtherCAT configuration interface. For first-time users, add an XML file to the library. Right-click the "Main Device" and select "Show ESI Library".



Next, add the DM6C XML file to the ESI library that appears. Select 'This folder' to display the file storage path, then place the 'XINJE-DM6C-rev1.1' XML file in the specified folder.

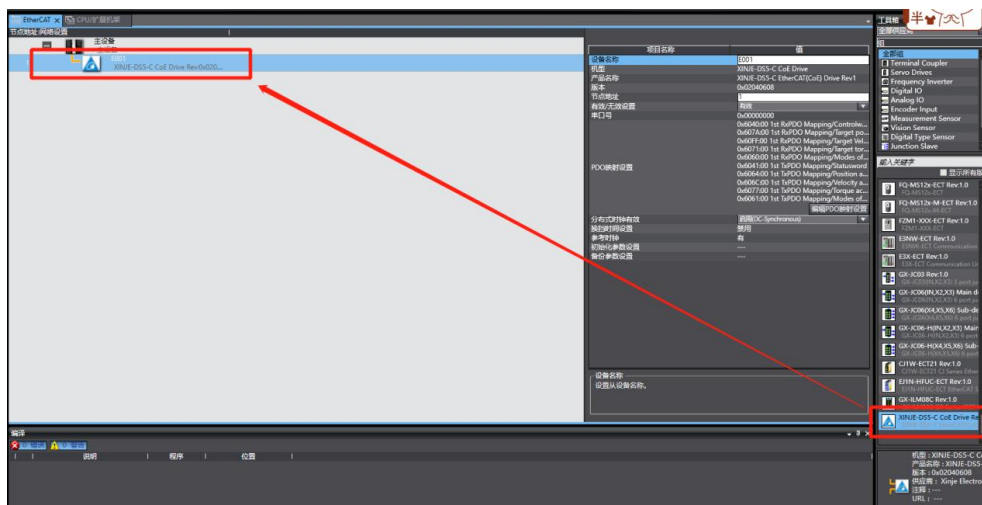


Finally, close Sysmac Studio and restart the software. When you revisit the ESI library, you'll find the XINJE-DM6C slave description file already included.



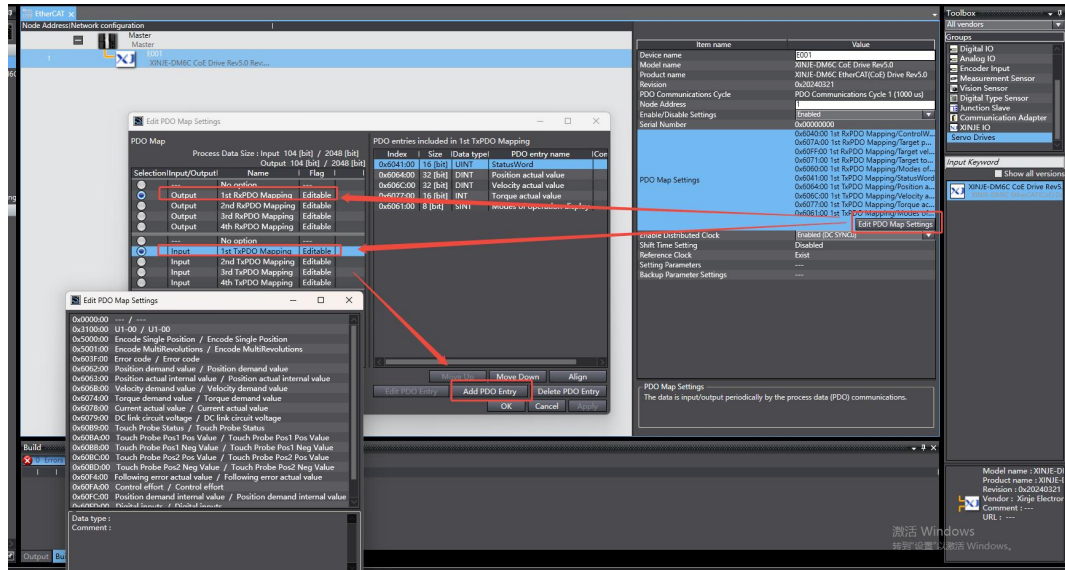
### 3) Add device

On the right side of the interface, locate "XINJE-DS5C CoE Drive Rev" and double-click to add it to the main device node.

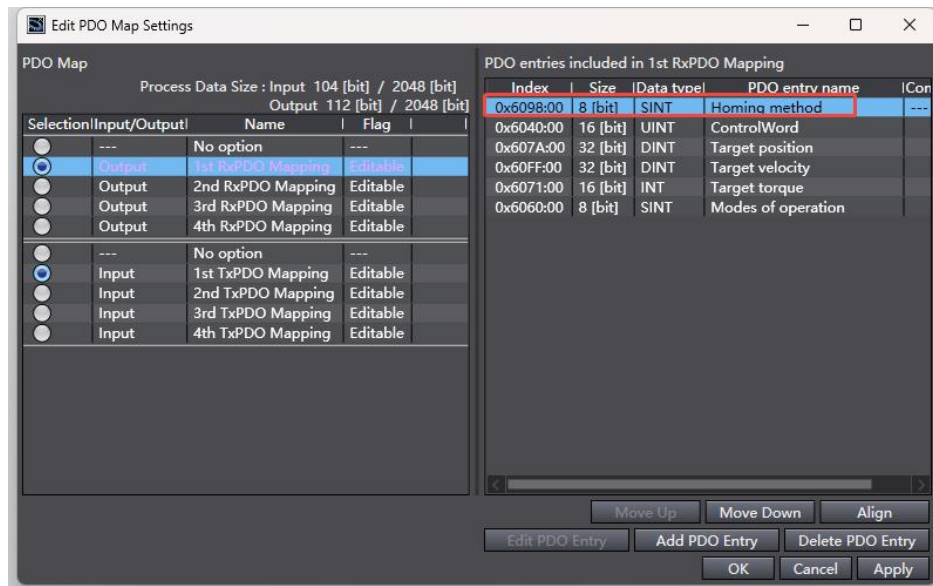


After adding a node, the cursor will highlight its PDO configuration. Select 'Edit PDO Mapping Settings' to view the current output PDO Mapping on the left and PDO entries on the right, where you can add or remove PDOs as needed. To add a PDO, select 'Add PDO Entry' to display available PDO

objects. After selecting one, click 'OK' and then 'Apply' to complete the addition.

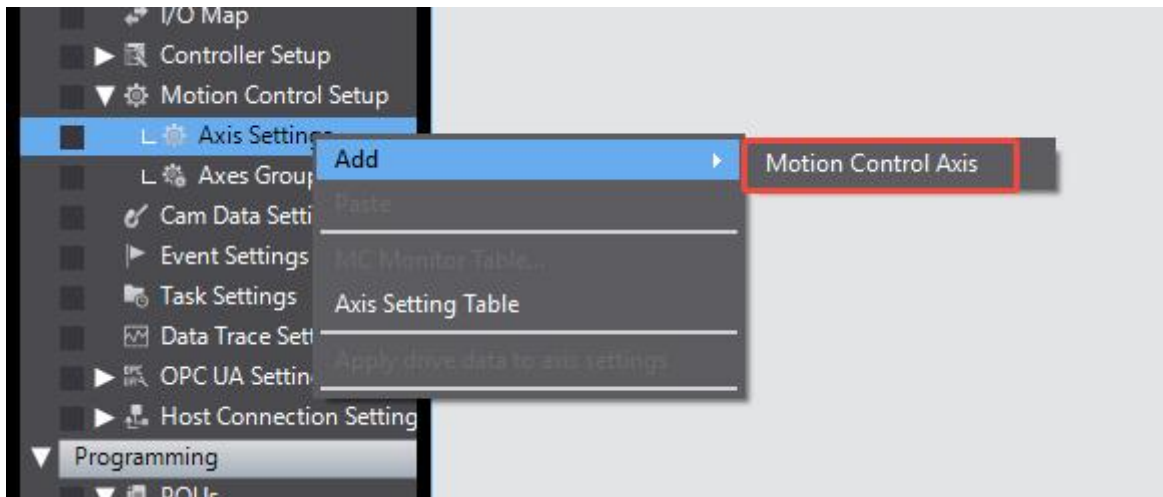


After adding, it will look like this:

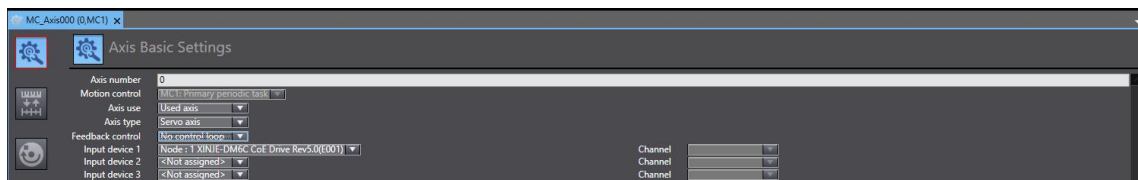


#### 4) Setting of motion control axis

Double-click "Motion Control Settings", right-click "Axis Settings", and select "Add — Motion Control Axis".

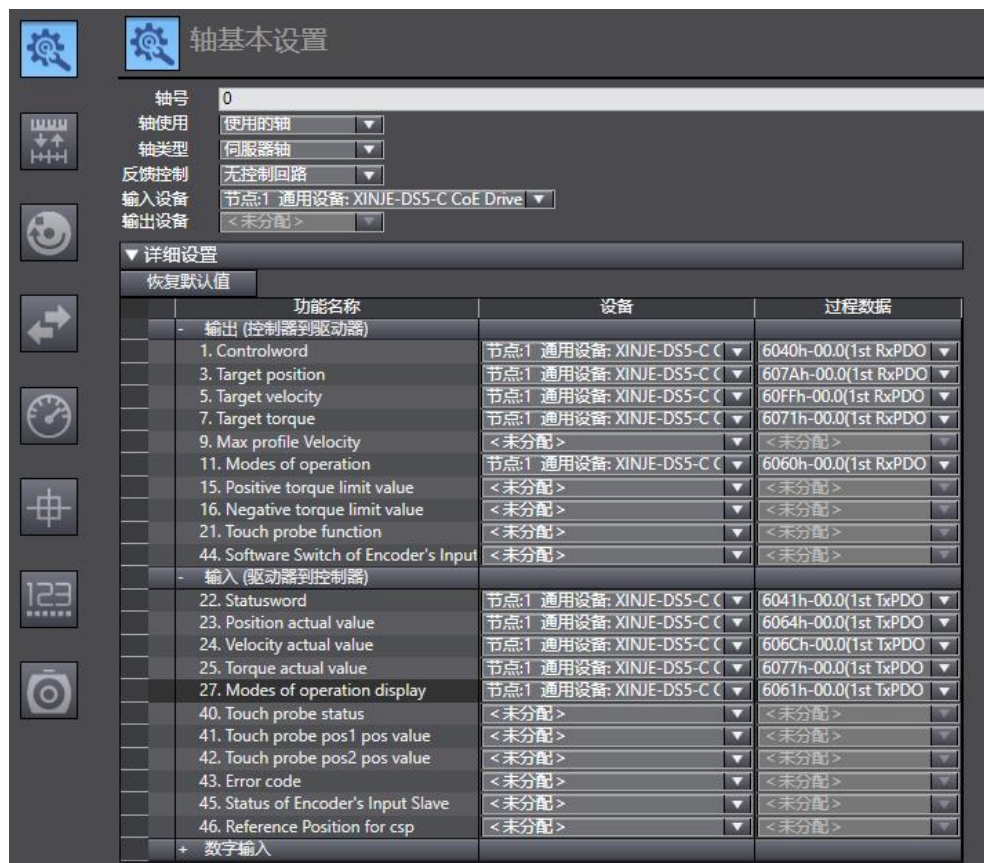
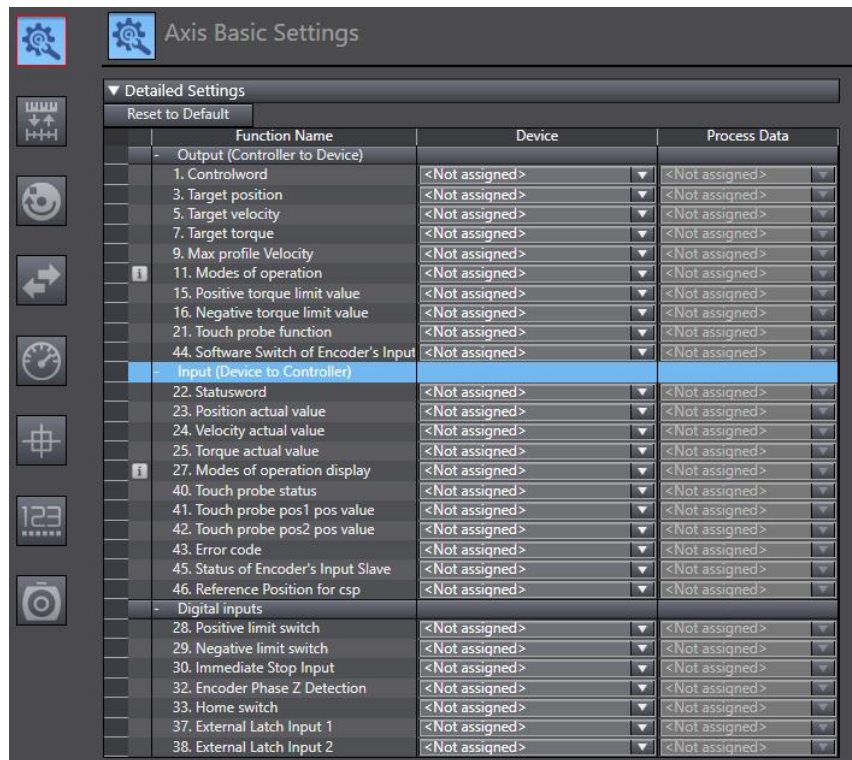


Double-click "MC\_Axis000" to open the axis configuration interface. The interface is divided into multiple sub-interfaces. In the "Basic Axis Settings" interface, select "Axis Type-Servo Axis" and choose "Input Device: Node 1: DS5C".

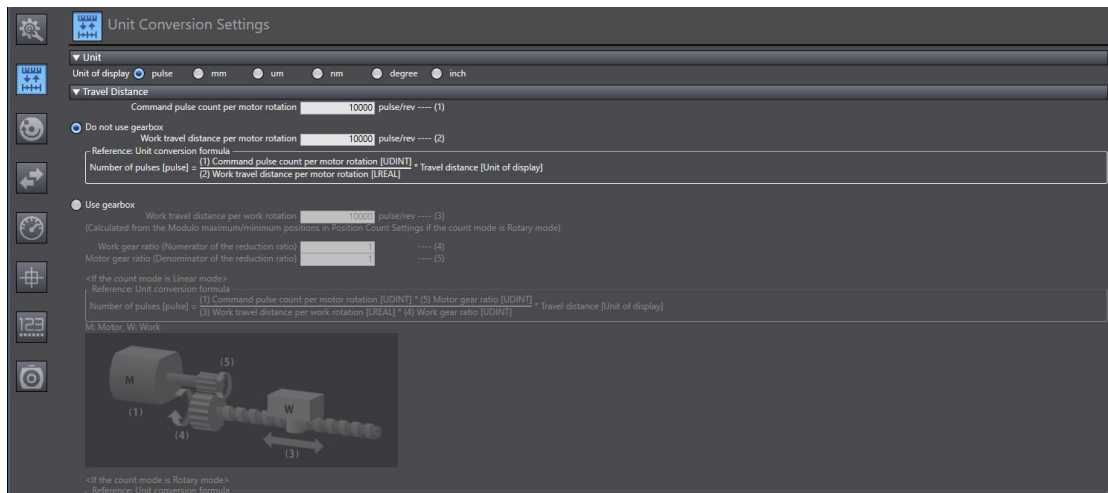


Click Detailed Settings to expand the configuration module. The function names must match the PDO mapping entries on the device. Add them manually here. Omissions or errors will affect the parameter's subsequent use.



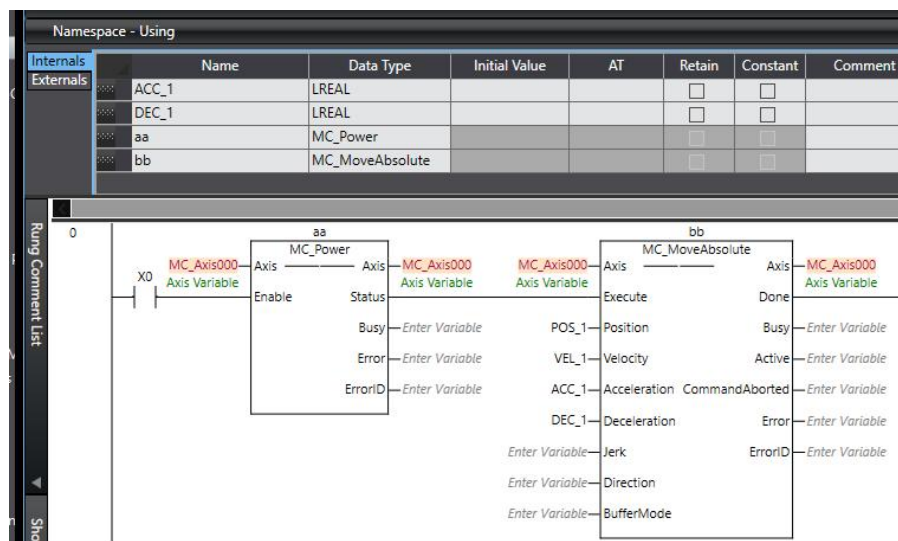


In the "Unit Conversion Settings", the "Number of command pulses per motor revolution" field should specify the motor encoder's bit count. For example, if using a 17-bit encoder, change it to 131072. The "Working stroke per motor revolution" refers to the motor's equivalent travel per rotation. Here, modify it to 131072 with a default gear ratio of 1:1.

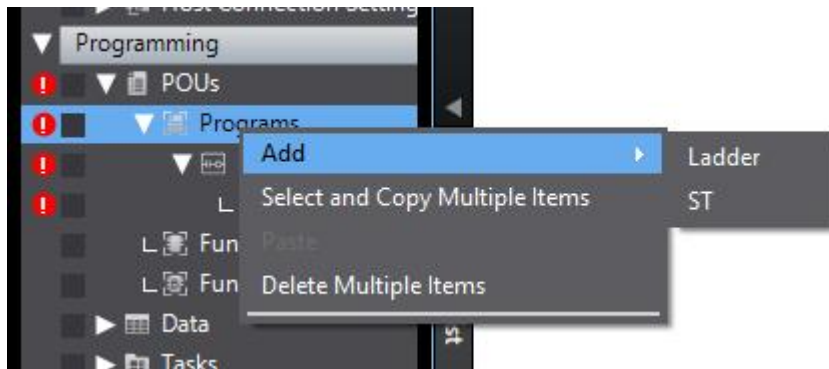


## 5) Write a program for "round trip motion"

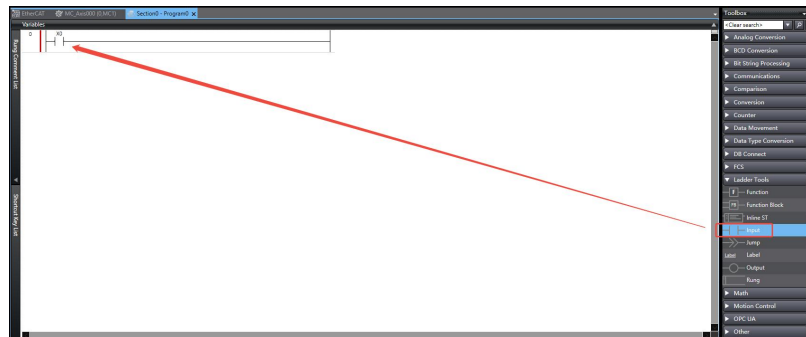
Programming Interface Guide: Select 'Programming — POU — Program — Program0 — Section0' in sequence. Double-click 'Section0' to open the programming interface. By default, Program0 is set to ladder diagram programming. To switch to ST programming, right-click 'Program — Add — ST'. The 'Toolbox' section allows you to add various ladder diagram elements.



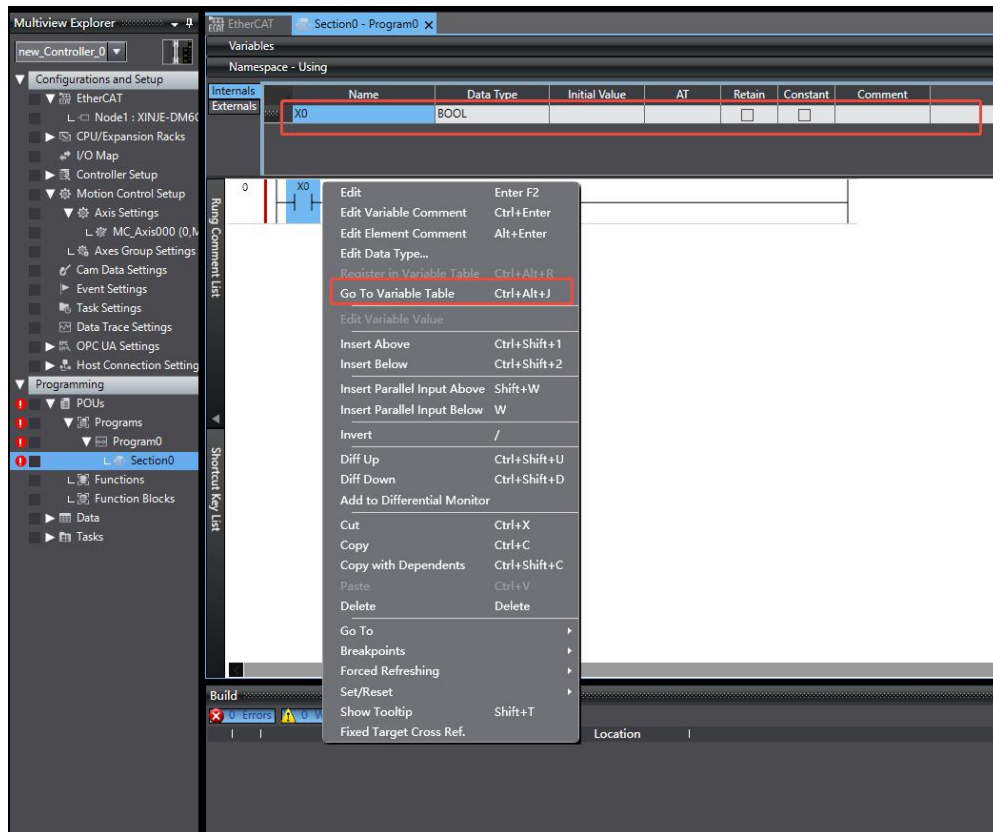




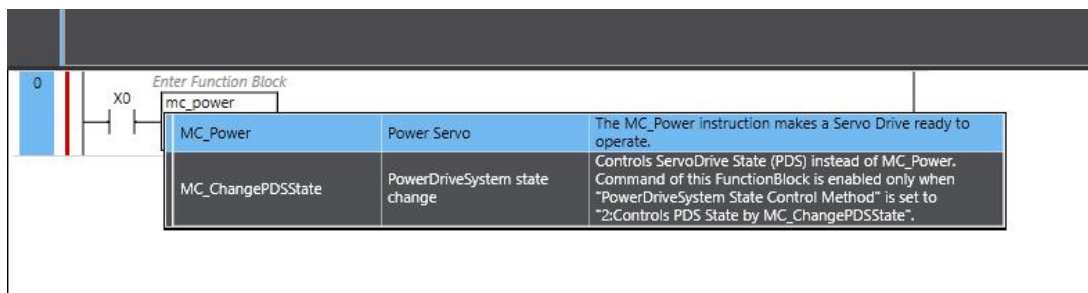
Select a "junction" and drag it directly into a ladder diagram node.



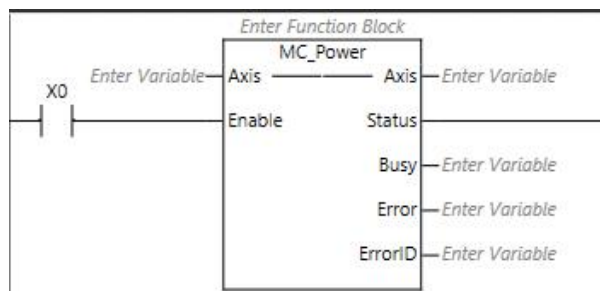
Click "Enter Variable" to enter a variable name. A new variable will be created if you enter a new name, or you can select an existing variable. New variables are listed in the variable table. Right-click variable X0 and select "Go to Variable Table" to expand it. The variable table allows you to create variables of various data types for use or view all defined variables.



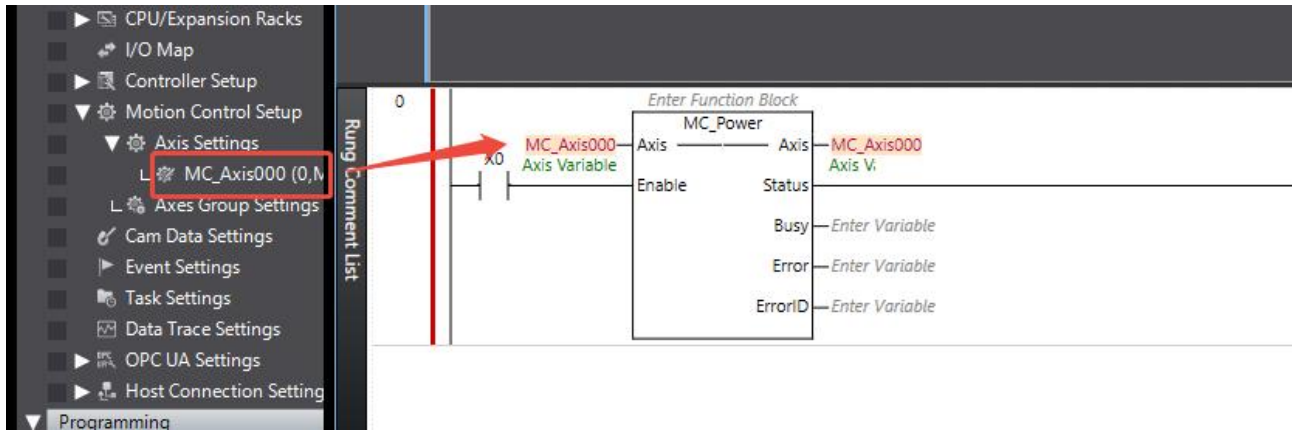
Add a "Function Block" in the same way in the ladder diagram.



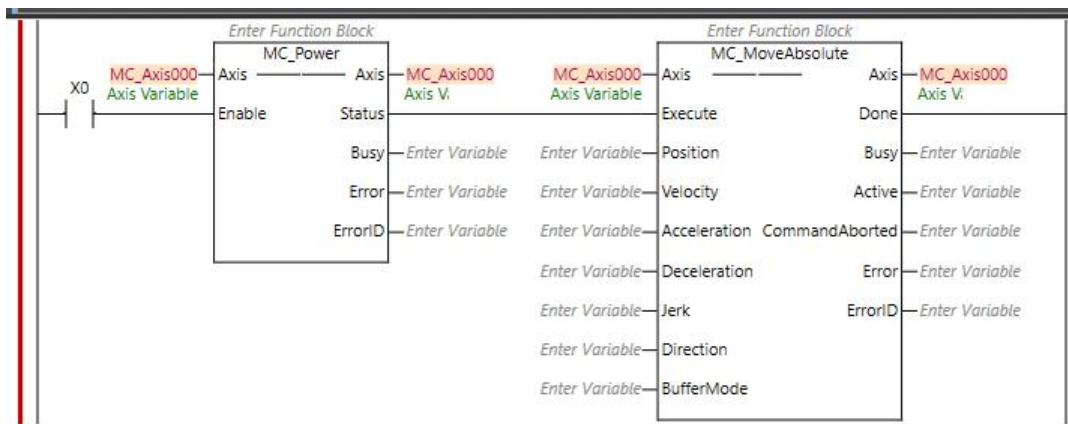
Enter a function block name to call its parameters. For example, enter "MC\_Power" to declare this function block as MC\_Power.



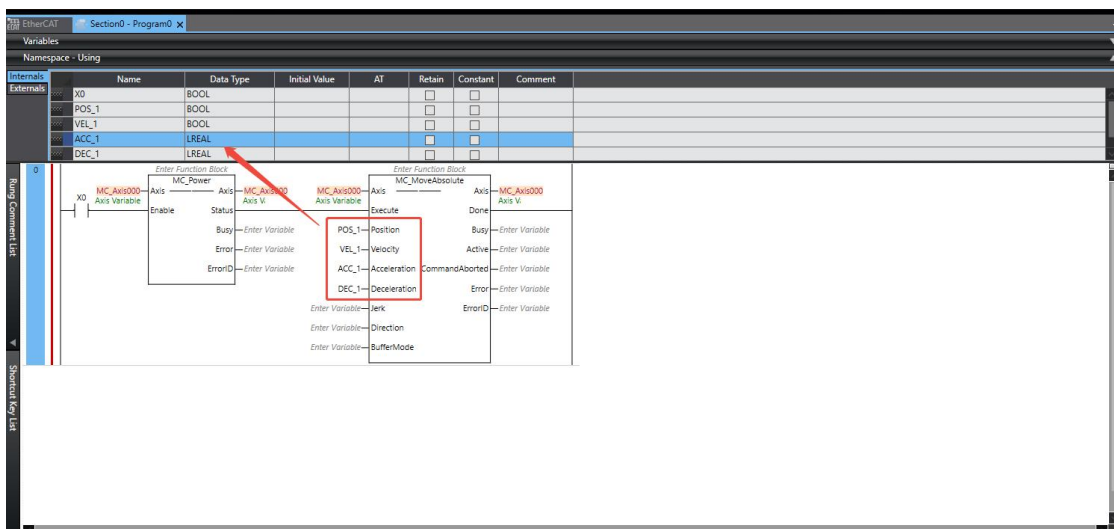
The Axis function block connects to the variable. Inputting MC\_Axis000 indicates the axis 'MC\_Axis000' is applied to the function block.



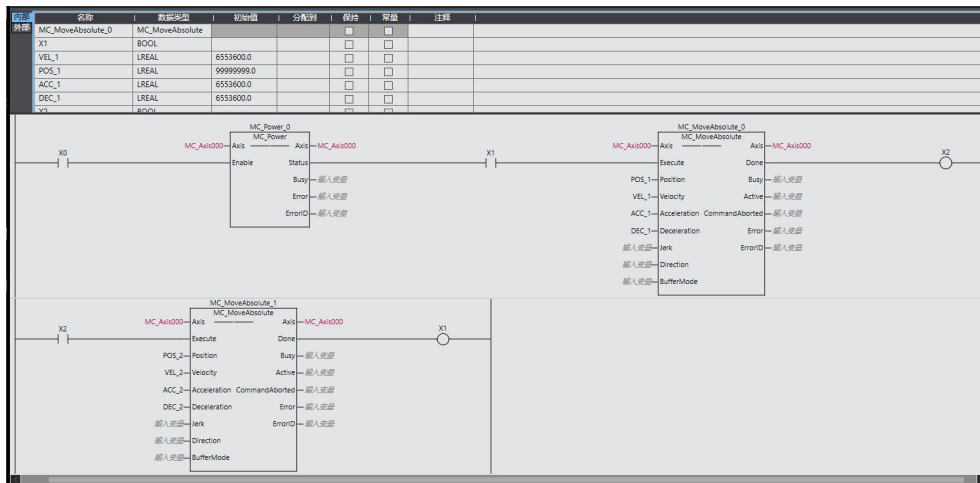
Add the function block "MC\_MoveAbsolute" in the same manner, and define the variables "Pos\_1", "Vel\_1", "Acc\_1", and "Dec\_1" for the pins "Position", "Velocity", "Acceleration", and "Deceleration".



The defined variables can be assigned initial values in the variable table, which take effect during PLC operation.

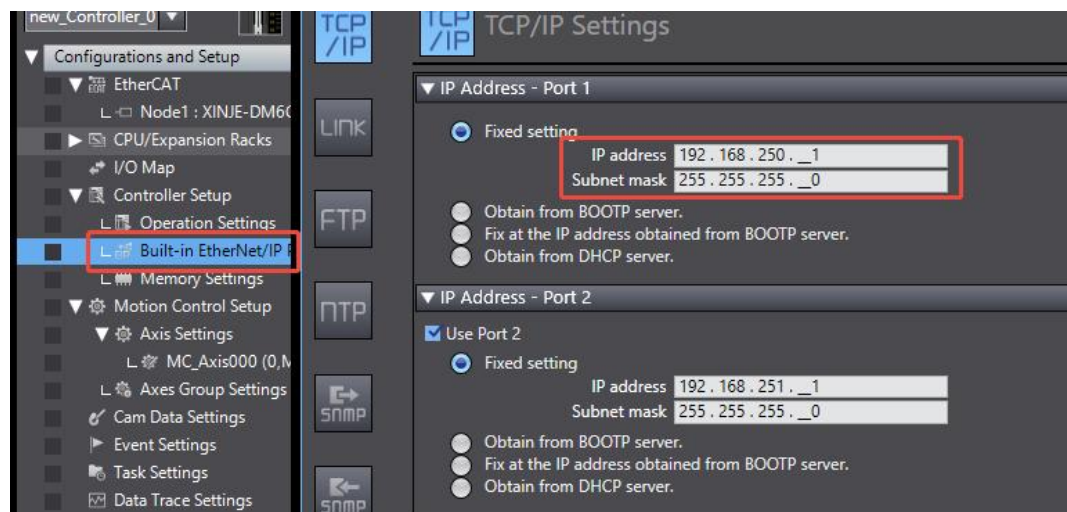


The same way to write the complete return motion ladder program.



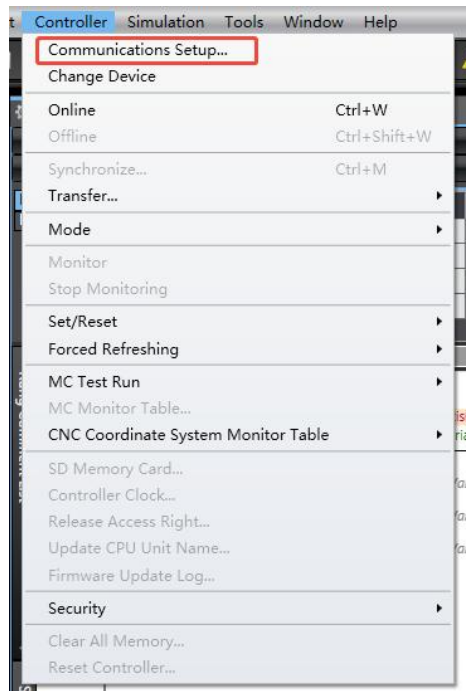
### 6) Gateway communication settings

First, check the PLC's IP address: In the multi-view browser, select "Controller Settings-Built-in Ethernet/IP Port Settings" to access the "TCP/IP Settings" interface on the right. The configuration interface displays the fixed IP address assigned to the current project. For a new program, the default IP address is 192.168.250.1.

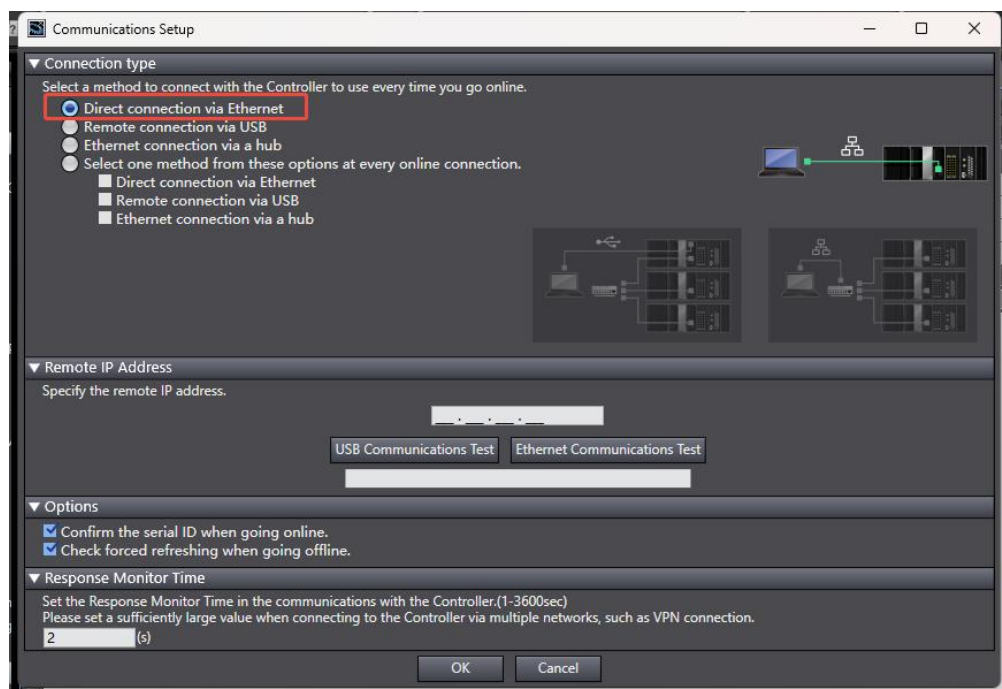


Comm

unication configuration path: "Controller — Communication Settings".

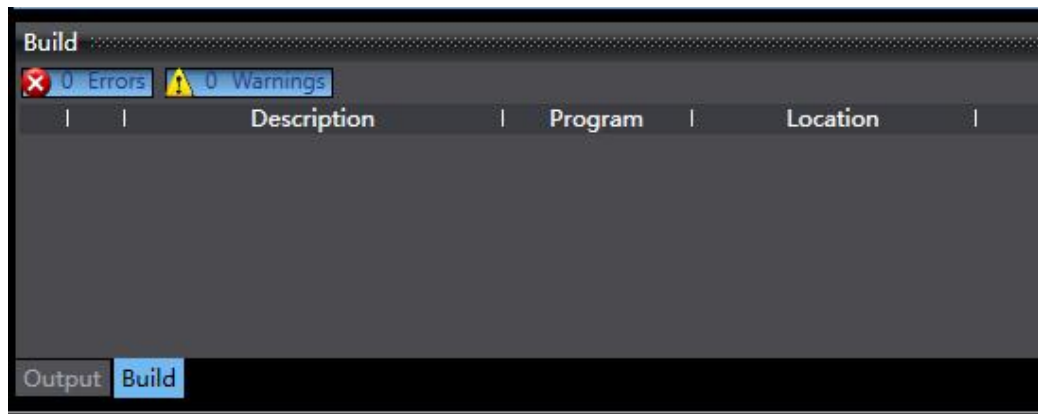
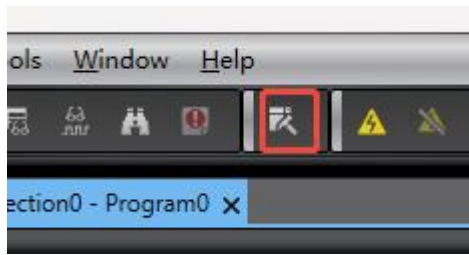


To establish an Ethernet connection, ensure the PC's IP address is either auto-allocated or within the PLC's IP address range. Before proceeding, verify that the PC's IP configuration meets the specified requirements.

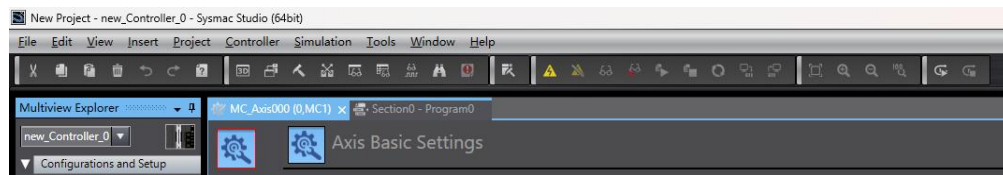


## 7) Compile and prepare for connection

Find the "Compile Controller" in the toolbar to compile the project. If errors occur, check the cause.

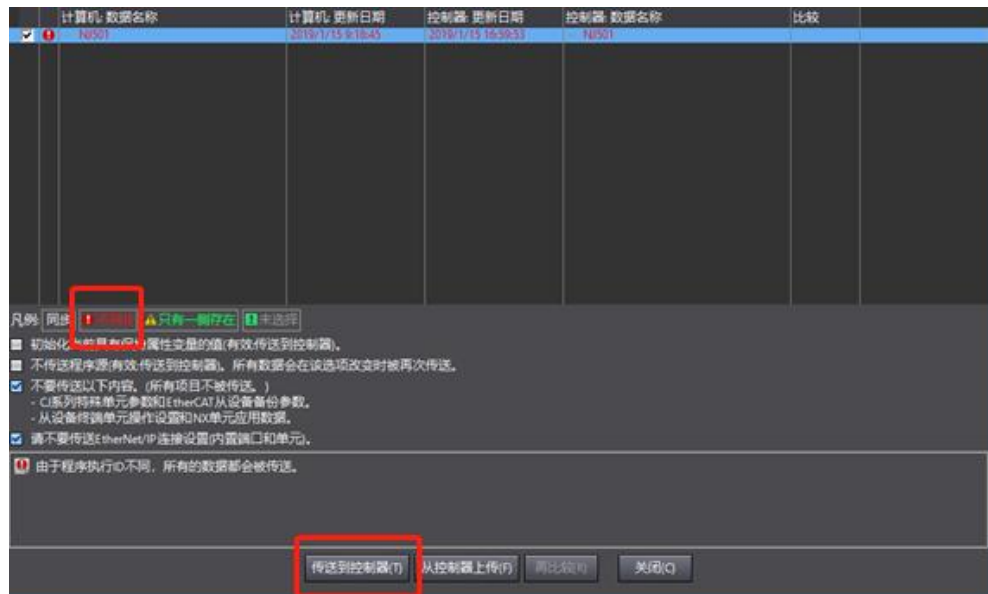


After compilation, find and click "Online" in the toolbar. If the pop-up "Connection to controller failed" appears, check the communication configuration. Once online, the host computer switches to online status.



Select Synchronize in the toolbar. A comparison window will compare the local project with the project in the controller. If the local project and the project in the controller are different, it will display Unsynchronized. Click Transfer to Controller to download the local project and overwrite the original project in the controller.

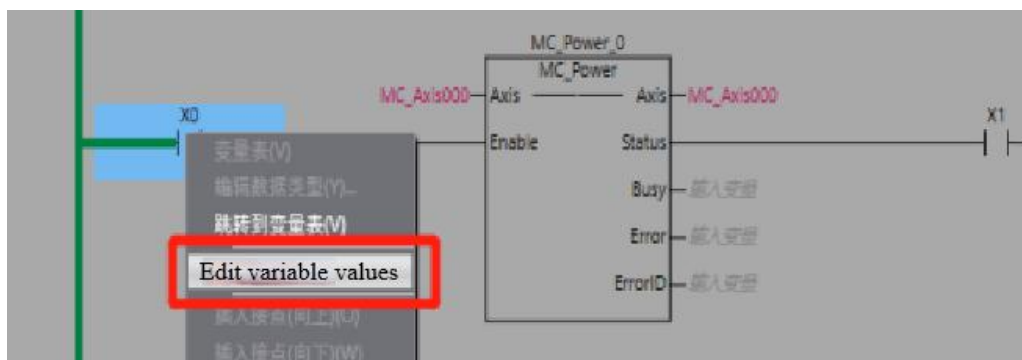




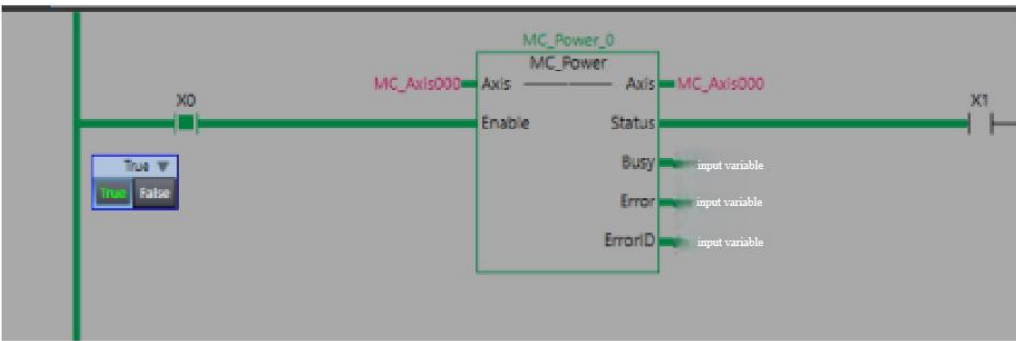
After synchronization, click "Compare Again" to check the synchronization status of entries between the local project and the controller project. Subsequent modifications will highlight entries differing from the controller project during synchronization.

#### 8) Online control

Right-click the variable "X0" in the "Section0" interface, select "Edit Variable Value", and switch the Boolean to "True". The function block "MC\_Power" will activate, enabling the servo. Repeat the same operation to set the variable "X1" to "True", enabling the program's reciprocating motion.







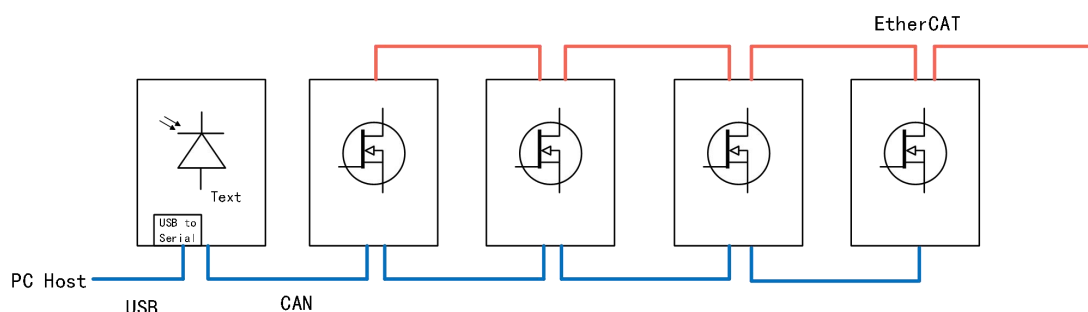
PDO object data can be monitored for real-time changes through "IO mapping".



| Section0 - Program0 |                                      | IO mapping |     |           |           |          |  |
|---------------------|--------------------------------------|------------|-----|-----------|-----------|----------|--|
| Position            | Port                                 | Explain    | R/W | Data type | Value     | Variable |  |
|                     | ▼ EtherCAT network configuration     |            |     |           |           |          |  |
| 节点1                 | ▼ XINJE-DS5-C CoE Drive              |            |     |           |           |          |  |
|                     | 1st RxPDO Mapping_Controlword_604    |            | W   | UINT      | 15        |          |  |
|                     | 1st RxPDO Mapping_Target position_6  |            | W   | DINT      | 121480610 |          |  |
|                     | 1st RxPDO Mapping_Target Velocity_6  |            | W   | DINT      | 6553599   |          |  |
|                     | 1st RxPDO Mapping_Target torque_60   |            | W   | INT       | 124       |          |  |
|                     | 1st RxPDO Mapping_Modes of operat    |            | W   | SINT      | 8         |          |  |
|                     | 1st TxPDO Mapping_Statusword_6041    |            | R   | UINT      | 4663      |          |  |
|                     | 1st TxPDO Mapping_Position actual va |            | R   | DINT      | 121302071 |          |  |
|                     | 1st TxPDO Mapping_Velocity actual va |            | R   | DINT      | 6556499   |          |  |
|                     | 1st TxPDO Mapping_Torque actual val  |            | R   | INT       | 124       |          |  |
|                     | 1st TxPDO Mapping_Modes of operati   |            | R   | SINT      | 8         |          |  |
|                     | ▼ CPU/Extension Rack                 |            |     |           |           |          |  |
| CPU rack            | CPU Rack 0                           |            |     |           |           |          |  |



## 12. Case of DM6C whole machine connection



CAN network diagram

The DM6C multi-functional servo is a dual-power supply model. During operation, first connect to the CAN communication network, then power the 24V and STO ports. Wait until the rectifier and inverter modules display "P-OFF" before applying 380V power. For power-off operations, first disconnect the 380V high-voltage power, then the 24V power. The rectifier and inverter modules require CAN communication to function properly.

Note that the rectifier module's CAN communication network port must connect to the downstream port, which has a built-in terminal resistor. For the inverter module, the network port should be oriented with the top inlet and bottom outlet when viewed from above.

To support the dual-power configuration, the inverter module must activate overcurrent and short-circuit protection upon detecting the rectifier module's enable completion. These protections are deactivated when the rectifier module's enable is turned off and the bus voltage drops below 400V, preventing false alarms caused by current sampling in the inverter module during power-off conditions.

- rectifier module

The upper panel displays a '....' initialization effect lasting approximately 6 seconds, with one dot blinking per second. During this state, the rectifier module performs initialization and waits for the inverter module to fully start.

The panel then displays the 'CAN' status, indicating that CAN communication is attempting to establish a connection. If it remains stuck in this state, it means the CAN communication cable is disconnected. At this point, U4-13 equals 0.

The panel then displays "CAN--", indicating active CAN communication. At this point, U4-13 equals 1.

When the alarm is not active, the panel will display 'P-OFF' indicating successful CAN communication connection, but the 380V AC power remains disconnected. At this point, U4-13 equals 3.

Note: Alarm codes have the highest priority. When an alarm occurs, the panel displays the alarm code first.

- inverter module

The rear panel displays a '-----' effect after power-on. The inverter module's initialization panel shows the same display as the DS5C2.

---

After initialization, the panel displays a 'CAN' waiting status, indicating the inverter module is awaiting CAN communication. If it remains stuck in this state, it suggests the CAN communication cable is disconnected. At this point, P7-14 equals 0.

The panel then displays "CAN--", indicating active CAN communication. At this point, P7-14 equals 1.

When the alarm is not active, the panel will display 'P-OFF', indicating that CAN communication has been successfully established but the rectifier module remains disabled. At this point, P7-14 equals 3.

Note: Alarm codes have the highest priority and are displayed first on the panel when an alarm occurs.

# Appendix

## Appendix 1. List of driver parameters

### Appendix 1.1 Functional parameters of the inverter module P group in the driver

Modification and effective time: "o" indicates modification during servo OFF, effective immediately.

√ indicates changes can be made at any time and take effect immediately.

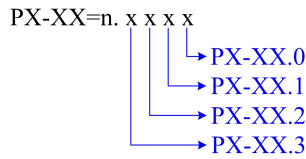
● indicates that the changes require a power cycle to take effect.

The "△" indicates that the setting can be changed at any time and takes effect when the motor is not rotating.

"▲" means it can be modified at any time and requires a power cycle to take effect.

For hexadecimal parameters, add the prefix "n." before the value to indicate that the current value is a hexadecimal number.

Parameter composition:



#### (1) Parameter P0 group

| P0-XX | functional description                                                                                                                                                                                                                                                                                                                                                                                                                   | unit | factory value | setting scope | come into force opportunity | suit pattern |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|---------------|-----------------------------|--------------|
| P0-00 | Drive type<br>0: General Type<br>1: EtherCAT type                                                                                                                                                                                                                                                                                                                                                                                        | -    | 1             | 0 ~ 1         | ○                           | own          |
| P0-01 | P0-00=0: General type<br>1: Internal torque mode<br>3: Internal speed mode<br>5: Internal Position Pattern<br>P0-00=1: EtherCAT type<br>1: Profile Position Control Mode (PP)<br>3: Profile Velocity Control Mode (PV)<br>4: Torque Control Mode (TQ)<br>6: Origin Regression Mode (HM)<br>8: Cycle Synchronization Position Control Mode (CSP)<br>9: Cycle Synchronization Speed Control Mode (CSV)<br>10: Cycle Synchronization Torque | -    | 0             | 1 ~ 10        | ○                           | own          |

| P0-XX          | functional description                                                                                                                                                                            | unit      | factory value         | setting scope | come into force opportunity | suit pattern |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------------|---------------|-----------------------------|--------------|
|                | Control Mode (CST)                                                                                                                                                                                |           |                       |               |                             |              |
| P0-02          | Control Mode 2 (as described above)<br>When the C-SEL signal is active, the servo system will operate in the mode selected by P0-02.                                                              | -         | 0                     | 1 ~ 10        | ○                           | own          |
| P0-03          | Enable mode:<br>0: Disable<br>1: IO /SON input signal<br>2: Software enable (Panel/Modbus)<br>Panel F1-05 writes 1; Modbus writes 1 to register 0x2105. Writing 0 cancels enable<br>3: Bus enable | -         | 3                     | 0~3           | ○                           | own          |
| P0-04          | rigidity class                                                                                                                                                                                    | -         | 13                    | 0~41          | △                           | own          |
| P0-05          | Rotation direction selection                                                                                                                                                                      | -         | 0                     | 0~1           | ●                           | own          |
| P0-07          | first inertia ratio                                                                                                                                                                               | 1%        | 200                   | 0~50000       | √                           | own          |
| P0-09.0        | Input pulse instruction in positive direction<br>0: Positive pulse count<br>1: Counting reverse pulses                                                                                            | -         | 0                     | 0~1           | ●                           | 6、7          |
| P0-09.2        | Input pulse instruction filter time                                                                                                                                                               | -         | F                     | 0~F           | ●                           | 6、7          |
| P0-09.3        | Input pulse instruction filtering pre-assignment                                                                                                                                                  | -         | 0                     | 0~7           | ●                           | 6、7          |
| P-10.0<br>xxx□ | 0: CW/CCW<br>1: AB<br>2: P+D                                                                                                                                                                      | -         | 2                     | 0~2           | ○                           | 6、7          |
| P0-11          | Set the number of pulses per cycle in the lower bit $\times 1$                                                                                                                                    | -         | 0                     | 0~9999        | ○                           | 5、6          |
| P0-12          | Set the number of pulses per cycle to 10,000                                                                                                                                                      | -         | 0                     | 0~65535       | ○                           | 5、6          |
| P0-13          | electronic gear molecule                                                                                                                                                                          | -         | 1                     | 1~65535       | √                           | 5、6          |
| P0-14          | electronic gear denominator                                                                                                                                                                       | -         | 1                     | 1~65535       | ○                           | 5、6          |
| P0-15          | Pulse frequency corresponding to the rated speed of the speed mode                                                                                                                                | 100Hz     | 1000                  | 0~10000       | ○                           | 7            |
| P0-16          | Speed command pulse filtering time                                                                                                                                                                | 0.01ms    | 100                   | 0~10000       | ○                           | 7            |
| P0-23          | pulse deviation limit                                                                                                                                                                             | 0.01 turn | 2000                  | 0~65535       | √                           | 5、6          |
| P0-24          | 0: Cumulative discharge time<br>1: Average Power Mode 1<br>2: Average Power Mode 2                                                                                                                | -         | 0                     | 0~1           | ○                           | own          |
| P0-25          | Power value of the discharge resistor                                                                                                                                                             | W         | drive power dependent | 0~65535       | ○                           | own          |
| P0-26          | Resistance value of the discharge resistor                                                                                                                                                        | Ω         |                       | 1~500         | ○                           | own          |
| P0-27          | Servo governor enables shutdown mode<br>0: Free stop, maintain free running state after stopping<br>2: Slow down and stop. After stopping, keep running freely.                                   | -         | 0                     | 0~5           | ○                           | own          |
| P0-28          | Servo overtravel stop mode                                                                                                                                                                        | -         | 0                     | 0~3           | ○                           | own          |

| P0-XX                   | functional description                                                                                                                                                                                                                                                                                                                                                                                     | unit | factory value | setting scope | come into force opportunity | suit pattern |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|---------------|-----------------------------|--------------|
|                         | (P0-28.0)<br>0: Slow down and stop 1<br>1: Inertial stop<br>2: Slow down and stop 2<br>3: Alarm stopped<br>Overtravel alarm shield switch<br>(P0-28.1)<br>0: Do not block overtime alerts<br>1: Disable overtravel alarm                                                                                                                                                                                   |      |               |               |                             |              |
|                         | EC bus over-run stop mode<br>(P0-28.0)<br>0: Direct alarm, use servo deceleration and stop mode<br>1: Alarm after deceleration and shutdown in 605Ah mode<br>2: Do not use over-range                                                                                                                                                                                                                      | -    | 0             | 0~3           | ○                           | 1 3 4 8 9 10 |
| P0-29                   | servo alarm stop mode<br>0: Inertial operation stopped<br>2: Slow down and stop                                                                                                                                                                                                                                                                                                                            | -    | 0             | 0、2           | ○                           | own          |
| P0-30                   | Stop timeout time                                                                                                                                                                                                                                                                                                                                                                                          | 1ms  | 20000         | 0~65535       | ○                           | own          |
| P0-31                   | stop time                                                                                                                                                                                                                                                                                                                                                                                                  | 1ms  | 25            | 0~5000        | ○                           | own          |
| P0-33                   | motor code setting                                                                                                                                                                                                                                                                                                                                                                                         | -    |               | 0~65535       | ●                           | own          |
| P0-53                   | Automatic reading of motor parameters; alarm shielding switch<br>0: Do not block alarms<br>1: Block the alarm for unreadable valid motor parameters                                                                                                                                                                                                                                                        | -    | 0             | 0/1           | ●                           | own          |
| P0-55                   | open loop rotational speed                                                                                                                                                                                                                                                                                                                                                                                 | -    | 0             | -6000~6000    | ○                           | own          |
| P0-56                   | Number of encoder communication attempts                                                                                                                                                                                                                                                                                                                                                                   | -    | 10            | 1~65535       | ○                           | own          |
| P0-68.0~P0-68.1<br>xx□□ | Number of consecutive errors in the alarm sequence when updating encoded data                                                                                                                                                                                                                                                                                                                              |      | 0x05          | 0x01~0xFF     | ●                           | own          |
| P0-68.2~P0-68.3<br>□□xx | E-241 alarm filtering frequency                                                                                                                                                                                                                                                                                                                                                                            | -    | 0             | 0~0xFF        | ●                           | own          |
| P0-69                   | <b>Fan switch (P0-69.0)</b><br>0: Turn on the fan when temperature exceeds 45°C, and turn it off when it drops below 42 °C (with a hysteresis of 3°C)<br>1: Turn on the fan when enabled, and turn it off when disabled<br><b>The Alarm Shield Switch of the Large Motor Thermocouple Wire Break (P0-69.1)</b><br>0: Do not block the thermocouple break alarm<br>1: Disable thermocouple wire break alarm | -    | 1             | 0/1           | √                           | own          |

| P0-XX         | functional description                                                                                                                                                                        | unit      | factory value | setting scope | come into force opportunity      | suit pattern |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|---------------|----------------------------------|--------------|
| P0-70         | pulse instruction deviation limit                                                                                                                                                             | 0.01 turn | 200           | 0~65535       | √                                | 8            |
| P0-74         | Stall alarm time                                                                                                                                                                              | 1ms       | 0             | 0-65535       | √                                | own          |
| P0-75         | Stall alarm speed                                                                                                                                                                             | 1rpm      | 50            | 5~9999        | √                                | own          |
| P0-79         | Absolute encoder battery low voltage alarm switch<br>0: Used as an absolute encoder<br>1: Used as an incremental encoder<br>2: Use as an absolute encoder, ignoring multi-turn overflow alarm | -         | 1             | 0~2           | ●                                | own          |
| P0-80         | Protection method for the thermal power of the motor<br>0: Current protection<br>1: average thermal power protection<br>2: Simulation of thermal power protection                             | -         | 2             | 0~2           | ●                                | own          |
| P0-92 ~ P0-93 | 32-bit electronic gear ratio molecule<br>P0-11 ~ P0-14 is valid when 0.<br>P0-92*1 + P0-93 *10000                                                                                             | -         | 1             | 1~9999        | ○ ( pattern 5)<br>√ ( pattern 6) | 5、6          |
| P0-94 ~ P0-95 | 32-bit electronic gear ratio<br>P0-11 ~ P0-14 is valid when 0.<br>P0-94*1 + P0-95 *10000                                                                                                      | -         | 1             | 1~9999        | ○ ( pattern 5)<br>√ ( pattern 6) | 5、6          |

## (2) Parameter P1 group

| P1-XX | functional description                  | unit   | factory value | setting scope | come into force opportunity | suit pattern |
|-------|-----------------------------------------|--------|---------------|---------------|-----------------------------|--------------|
| P1-00 | first speed loop gain                   | 0.1Hz  | 300           | 10~20000      | √                           | own          |
| P1-01 | first speed loop integral time constant | 0.01ms | 2653          | 15~51200      | √                           | own          |
| P1-02 | first position loop gain                | 0.1/s  | 480           | 10~20000      | √                           | own          |
| P1-10 | velocity feedforward gain               | 1%     | 0             | 0~300         | √                           | 5 6 7        |
| P1-11 | Speed feedforward filtering time        | 0.01ms | 50            | 0~10000       | √                           | 5 6 7        |
| P1-14 | Gain Switching Mode Settings            | -      | 0             | 0~0x00A2      | √                           | own          |
| P1-15 | gain switching delay                    | ms     | 5             | 0~1000        | √                           | own          |
| P1-16 | gain switching level threshold          | -      | 50            | 0~20000       | √                           | own          |
| P1-17 | gain switching hysteresis               | -      | 30            | 0~20000       | √                           | own          |
| P1-18 | position loop gain switching            | ms     | 3             | 0~1000        | √                           | own          |

| P1-XX | functional description                                                                          | unit  | factory value | setting scope | come into force opportunity | suit pattern |
|-------|-------------------------------------------------------------------------------------------------|-------|---------------|---------------|-----------------------------|--------------|
|       | time                                                                                            |       |               |               |                             |              |
| P1-22 | Selection of speed command filter<br>0: First-order low-pass filter<br>1: Moving Average Filter | -     | 0             | 0~1           | ○                           | 3 4 7        |
| P1-23 | Speed command filter time parameter                                                             | 0.1ms | 0             | 0~65535       | ○                           | 3 4 7        |
| P1-24 | Position command acceleration/deceleration filter time                                          | 0.1ms | 0             | 0~65535       | △                           | 5 6          |
| P1-25 | position command smoothing filter time parameter                                                | 0.1ms | 0             | 0~65535       | △                           | 5 6          |
| P1-74 | Encoder zero-bit offset detection cycle                                                         | -     | 1000          | 0~65535       | √                           | own          |
| P1-75 | Encoder zero-bit offset detection threshold                                                     | -     | 10            | 0~255         | √                           | own          |

## (3) Parameter P2 group

| P2-XX   | name                                                                                                | unit  | factory value   | setting scope | come into force opportunity | suit pattern |
|---------|-----------------------------------------------------------------------------------------------------|-------|-----------------|---------------|-----------------------------|--------------|
| P2-00.0 | perturbation observer switch<br>0: Close<br>1: Open                                                 | -     | 0               | 0~1           | ○                           | own          |
| P2-01.0 | adaptive mode switch<br>0: Close<br>1: Open                                                         | -     | 0               | 0~1           | ●                           | own          |
| P2-01.1 | adaptive grade<br>0: High response<br>1: Low noise                                                  | -     | By device model | 0~1           | ●                           | own          |
| P2-02.0 | self-tuning mode<br>Soft<br>2: Quick location<br>3: Quick positioning and overshoot control         | -     | 3               | 1~3           | √                           | own          |
| P2-02.2 | Load type (valid only during self-tuning)<br>1: Synchronous Belt<br>2: Screw<br>3: Rigid Connection | -     | 2               | 1~3           | √                           | own          |
| P2-03.3 | adaptive load type<br>0: Small inertia mode<br>1: Large Inertia Mode                                | -     | 0               | 0~1           | ●                           | own          |
| P2-05   | Adaptive mode speed loop gain (standard)                                                            | 0.1Hz | 400             | 1~65535       | ○                           | own          |
| P2-07   | inertial ratio of adaptive mode (standard)                                                          | %     | 0               | 0~10000       | ○                           | own          |
| P2-08   | Gain of adaptive mode velocity observer (standard)                                                  | Hz    | 60              | 10~1000       | ○                           | own          |
| P2-12   | Maximum Inertia Ratio (Standard) for Adaptive Mode                                                  | -     | 30              | 1~10000       | ○                           | own          |

| P2-XX   | name                                                                                                                                                                      | unit   | factory value | setting scope | come into force opportunity | suit pattern |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|---------------|-----------------------------|--------------|
| P2-15   | Inertia Identification and Self-adjusting Maximum Stroke of Internal Command                                                                                              | 0.01r  | 100           | 1~3000        | √                           | own          |
| P2-17   | Inertia Identification and Self-adjusting Maximum Speed of Internal Command                                                                                               | -      | 0             | 0~65535       | √                           | own          |
| P2-18   | Initial inertia ratio for inertia identification                                                                                                                          | %      | 500           | 1~20000       | √                           | own          |
| P2-19   | adaptive mode bandwidth                                                                                                                                                   | %      | 50            | 1~100         | ○                           | own          |
| P2-35   | Torque command filter time constant 1                                                                                                                                     | 0.01ms | 66            | 0~65535       | √                           | own          |
| P2-36   | Torque command filter time constant 2                                                                                                                                     | 0.01ms | 100           | 0~65535       | √                           | own          |
| P2-41   | disturbance torque compensation coefficient (Non-adaptive mode is active)                                                                                                 | %      | 85            | 0~100         | √                           | own          |
| P2-47.0 | model loop switch<br>0: Close<br>1: Open                                                                                                                                  | -      | 0             | 0~f           | √                           | own          |
| P2-49   | model loop gain                                                                                                                                                           | 0.1Hz  | 480           | 10~20000      | √                           | 3 4 5 6 7    |
| P2-60.0 | active vibration suppression switch<br>0: Close<br>1: Open                                                                                                                | -      | 0             | 0~1           | √                           | 3 4 5 6 7    |
| P2-60.1 | active self-adjusting switch<br>0: Do not configure active vibration suppression during self-tuning<br>1: Configuration of active vibration suppression after self-tuning | -      | 1             | 0~1           | √                           | 3 4 5 6 7    |
| P2-61   | active vibration damping frequency                                                                                                                                        | 0.1Hz  | 1000          | 10~20000      | √                           | own          |
| P2-62   | active vibration damping gain                                                                                                                                             | %      | 100           | 1~1000        | √                           | own          |
| P2-63   | active vibration damping                                                                                                                                                  | %      | 100           | 0~300         | √                           | own          |
| P2-64   | Active vibration suppression frequency 1                                                                                                                                  | -      | 0             | -5000~5000    | √                           | own          |
| P2-65   | Active vibration suppression frequency 2                                                                                                                                  | -      | 0             | -5000~5000    | √                           | own          |
| P2-69.0 | Shackling filter 1 switch                                                                                                                                                 | -      | 0             | 0~1           | √                           | own          |
| P2-69.1 | Shackling filter 2 switch                                                                                                                                                 | -      | 0             | 0~1           | √                           | own          |
| P2-69.3 | Shackling filter 3 switch                                                                                                                                                 | -      | 0             | 0~1           | √                           | own          |
| P2-70.0 | Shackling filter 4 switch                                                                                                                                                 | -      | 0             | 0~1           | √                           | own          |
| P2-70.1 | Shackling filter 5 switch                                                                                                                                                 | -      | 0             | 0~1           | √                           | own          |
| P2-71   | first notch frequency                                                                                                                                                     | Hz     | 8000          | 50~8000       | √                           | own          |
| P2-72   | first notch attenuation                                                                                                                                                   | 0.1dB  | 71            | 50~1600       | √                           | own          |
| P2-73   | first notch bandwidth                                                                                                                                                     | Hz     | 0             | 0~1000        | √                           | own          |
| P2-74   | second notch frequency                                                                                                                                                    | Hz     | 8000          | 50~8000       | √                           | own          |
| P2-75   | second notch attenuation                                                                                                                                                  | 0.1dB  | 71            | 50~1600       | √                           | own          |
| P2-76   | second notch bandwidth                                                                                                                                                    | Hz     | 0             | 0~1000        | √                           | own          |



| P2-XX | name                       | unit  | factory value | setting scope | come into force opportunity | suit pattern |
|-------|----------------------------|-------|---------------|---------------|-----------------------------|--------------|
| P2-77 | third notch frequency      | Hz    | 8000          | 50~8000       | √                           | own          |
| P2-78 | third stoppage attenuation | 0.1dB | 71            | 50~1600       | √                           | own          |
| P2-79 | third notch bandwidth      | Hz    | 0             | 0~1000        | √                           | own          |
| P2-80 | fourth notch frequency     | Hz    | 8000          | 50~8000       | √                           | own          |
| P2-81 | fourth notch attenuation   | 0.1dB | 71            | 50~1600       | √                           | own          |
| P2-82 | fourth notch bandwidth     | Hz    | 0             | 0~1000        | √                           | own          |
| P2-83 | fifth notch frequency      | Hz    | 8000          | 50~8000       | √                           | own          |
| P2-84 | fifth notch attenuation    | 0.1dB | 71            | 50~1600       | √                           | own          |
| P2-85 | fifth notch bandwidth      | Hz    | 0             | 0~1000        | √                           | own          |

## (4) Speed control parameter group P3

| P3-XX | name                                                    | unit | factory value   | setting scope             | come into force opportunity | suit pattern |
|-------|---------------------------------------------------------|------|-----------------|---------------------------|-----------------------------|--------------|
| P3-05 | Default speed 1                                         | rpm  | 0               | -9999~9999                | √                           | 3            |
| P3-06 | Preset Speed 2                                          | rpm  | 0               | -9999~9999                | √                           | 3            |
| P3-07 | Preset Speed 3                                          | rpm  | 0               | -9999~9999                | √                           | 3            |
| P3-09 | acceleration time                                       | ms   | 200             | 0~65535                   | ○                           | 3 4 7        |
| P3-10 | deceleration time                                       | ms   | 200             | 0~65535                   | ○                           | 3 4 7        |
| P3-12 | zero speed clamping mode                                | -    | 0               | 0~3                       | ○                           | 3 4 7        |
| P3-13 | zero speed clamp speed                                  | rpm  | 10              | 0~300                     | ○                           | 3 4 7        |
| P3-14 | positive maximum speed limit                            | rpm  | 4000            | 0~10000                   | ○                           | own          |
| P3-15 | reverse maximum speed limit                             | rpm  | 4000            | 0~10000                   | ○                           | own          |
| P3-16 | Internal Forward Speed Limitation in Torque Control     | rpm  | 2000            | 5~10000                   | √                           | 1 2          |
| P3-17 | Internal Reverse Speed Limitation in Torque Control     | rpm  | 2000            | 5~10000                   | √                           | 1 2          |
| P3-18 | point velocity                                          | rpm  | 100             | 0~1000                    | ○                           | own          |
| P3-19 | positive warning speed                                  | rpm  | 3000            | 0~10000                   | ○                           | own          |
| P3-20 | reverse warning speed                                   | rpm  | 3000            | 0~10000                   | ○                           | own          |
| P3-21 | positive alarm speed                                    | rpm  | 4000            | 0~10000                   | ○                           | own          |
| P3-22 | Reverse alarm speed                                     | rpm  | 4000            | 0~10000                   | ○                           | own          |
| P3-28 | internal forward torque limit                           | %    | By device model | 0~Motor overload multiple | √                           | own          |
| P3-29 | internal reverse torque limit                           | %    | By device model | 0~Motor overload multiple | √                           | own          |
| P3-30 | external forward torque limit                           | %    | By device model | 0~Motor overload multiple | √                           | own          |
| P3-31 | external reverse torque limit                           | %    | By device model | 0~Motor overload multiple | √                           | own          |
| P3-32 | brake torque                                            | 1%   | 100             | 0~1000                    | √                           | own          |
| P3-33 | preset torque                                           | %    | 0               | -1000~1000                | √                           | 1            |
| P3-38 | Anti-reverse rotation and forward rotation torque limit | %    | By device model | 0~Motor overload multiple | √                           | own          |
| P3-39 | Anti-reverse rotation torque limit                      | %    | By device       | 0~Motor                   | √                           | own          |

| P3-XX | name                                  | unit   | factory value | setting scope     | come into force opportunity | suit pattern |
|-------|---------------------------------------|--------|---------------|-------------------|-----------------------------|--------------|
|       |                                       |        | model         | overload multiple |                             |              |
| P3-45 | friction compensation speed threshold | 0.1rpm | 20            | 0~200             | √                           | 1 2          |

## (5) Internal position parameter group P4

| P4-XX   | name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | unit       | factory value | Set range | come into force opportunity | suit pattern |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------|-----------|-----------------------------|--------------|
| P4-00.0 | Z Number of positive signs<br>The number of Z signals after exiting the limit switch (Note: Stop when the n+1th Z signal arrives)                                                                                                                                                                                                                                                                                                                                                                                                                                                 | individual | 2             | 0~f       | ○                           | 5 6          |
| P4-00.1 | Enable or disable the origin search function<br>0: Not enabled<br>Enable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | -          | 0             | 0~1       | ○                           | 5 6          |
| P4-00.2 | return to zero overtravel prohibition<br>0: Not prohibited<br>1: Prohibited                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -          | 0             | 0~1       | ○                           | 5 6          |
| P4-01   | velocity of collision with proximity switch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | rpm        | 600           | 0~65535   | ○                           | 5 6          |
| P4-02   | Speed of approaching the proximity switch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | rpm        | 100           | 0~65535   | ○                           | 5 6          |
| P4-03.0 | Set the positioning mode for the given internal location pattern<br>0: Relative Positioning<br>1: Absolute Positioning                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -          | 0             | 0~1       | ○                           | 5            |
| P4-03.1 | Set the step mode for the given internal location pattern<br>0: Switch steps when signal ON, can loop<br>1: Step by step on the rising edge of the signal<br>2: Start with the rising edge of the signal, execute all sequentially, no loop<br>3: Communication setting section number<br>4: /CHSTP bilateral trigger<br>5: Select section numbers for terminals/PREFA (P5-57), /PREFB (P5-58), and /PREFC (P5-59), with options 1 to 3.<br>6: Select section numbers for terminals/PREFA (P5-57), /PREFB (P5-58), /PREFC (P5-59), and /PREFD (P5-60), with options from 1 to 16. | -          | 0             | 0~6       | ○                           | 5            |
| P4-03.2 | Internal location given pattern set to wait mode<br>0: Waiting for location to complete<br>1: Do not wait for positioning to                                                                                                                                                                                                                                                                                                                                                                                                                                                      | -          | 0             | 0~1       | ○                           | 5            |

| P4-XX                             | name                                                                              | unit   | factory value | Set range            | come into force opportunity | suit pattern |
|-----------------------------------|-----------------------------------------------------------------------------------|--------|---------------|----------------------|-----------------------------|--------------|
|                                   | complete                                                                          |        |               |                      |                             |              |
| P4-04                             | Number of valid fields                                                            | -      | 0             | 0~35                 | ○                           | 5            |
| P4-10 ~ P4-11                     | first pulse                                                                       | 1pul   | 0             | -327689999~327679999 | √                           | 5            |
| P4-12                             | First paragraph speed                                                             | 0.1rpm | 0             | 0~65535              | √                           | 5            |
| P4-13                             | First acceleration time                                                           | 1ms    | 0             | 0~65535              | √                           | 5            |
| P4-14                             | First deceleration time                                                           | 1ms    | 0             | 0~65535              | √                           | 5            |
| P4-16                             | adjust the time                                                                   | 1ms    | 0             | 0~65535              | √                           | 5            |
| P4-10+ (n-1) *7 ~ P4-16+ (n-1) *7 | Pulse parameters for paragraphs 1 to 35 (n indicates the position segment number) | -      | -             | -                    | √                           | 5            |

Note: 1) Set pulse count = (high bit pulse count) × 10000 + (low bit pulse count);

2) The system consists of 35 sections in total. Parameters for sections 1-12 can be configured via the control panel, while those for sections 13-35 require parameter writing through RS232 and RS485 communication interfaces.

#### (6) Signal parameter settings for Group P5

| P5-XX | name                                                                   | unit                          | factory value | Set range  | come into force opportunity | Applicable mode |
|-------|------------------------------------------------------------------------|-------------------------------|---------------|------------|-----------------------------|-----------------|
| P5-00 | Complete Width/COIN                                                    | instruction unit              | 144           | 1~65535    | √                           | 5 6             |
| P5-01 | Complete detection mode                                                | -                             | 0             | 0~3        | √                           | 5 6             |
| P5-02 | Location completion time                                               | ms                            | 0             | 0~65535    | √                           | 5 6             |
| P5-03 | Rotation detection speed                                               | rpm                           | 50            | 0~10000    | √                           | own             |
| P5-04 | same speed detection speed                                             | rpm                           | 50            | 0~10000    | √                           | own             |
| P5-05 | detection speed                                                        | rpm                           | 1000          | 0~10000    | √                           | own             |
| P5-06 | Positioning close to the output width                                  | instruction unit              | 655           | 1~65535    | √                           | 5 6             |
| P5-07 | Servo-off delay time                                                   | ms                            | 500           | -500~9999  | ○                           | own             |
| P5-08 | brake command output speed                                             | rpm                           | 30            | 20~10000   | ○                           | own             |
| P5-09 | brake command waiting time                                             | ms                            | 500           | 0~65535    | ○                           | own             |
| P5-10 | Custom output 1 trigger condition                                      | -                             | 0             | 0~ffff     | √                           | own             |
| P5-11 | Value to compare with the trigger condition for Custom Output 1        | Related to trigger conditions | 0             | -9999~9999 | √                           | own             |
| P5-12 | Select Custom Output 1                                                 | -                             | 0             | 0~3        | √                           | own             |
| P5-13 | Set custom output 1 hysteresis                                         | Related to trigger conditions | 0             | 0~65535    | √                           | own             |
| P5-14 | Custom Output 2 Trigger Condition                                      | -                             | 0             | 0~ffff     | √                           | own             |
| P5-15 | Set the value to compare with the trigger condition of custom output 2 | Related to trigger conditions | 0             | -9999~9999 | √                           | own             |
| P5-16 | Select Custom Output 2                                                 | -                             | 0             | 0~3        | √                           | own             |
| P5-17 | Set custom output 2 hysteresis                                         | Related to                    | 0             | 0~65535    | √                           | own             |

| P5-XX     | name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | unit               | factory value | Set range | come into force opportunity | Applicable mode |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-----------|-----------------------------|-----------------|
|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | trigger conditions |               |           |                             |                 |
| P5-18     | IO filter time multiplier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                  | 1             | 0~10000   | √                           | own             |
| P5-19     | Z phase output hold time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ms                 | 2             | 1~65535   | √                           | own             |
| P5-20.0~1 | /S-ON: Servo signal<br>00: Set the signal to always "invalid"<br>01: Input positive signal from SI1 terminal<br>02: Input positive signal from SI2 terminal<br>03: Input positive signal from SI3 terminal<br>04: Input positive signal from SI4 terminal<br>10: Set the signal to always "active"<br>11: Input the reverse signal from terminal SI1<br>12: Input the reverse signal from the SI2 terminal<br>13: Input the reverse signal from the SI3 terminal<br>14: Input the reverse signal from the SI4 terminal | -                  | 00            | 0~ff      | √                           | own             |
| P5-20.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-21.0~1 | P/CON ratio action instruction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -                  | 00            | 0~ff      | √                           | own             |
| P5-21.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-22.0~1 | <b>In non-EtherCAT mode:</b><br>/P-OT: Forward drive is prohibited<br><b>EtherCAT mode:</b><br>Control mode 6 (return-to-zero mode), POT disabled                                                                                                                                                                                                                                                                                                                                                                      | -                  | 01            | 0~ff      | √                           | own             |
| P5-22.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-23.0~1 | <b>In non-EtherCAT mode:</b><br>-N/OT: Reverse drive is prohibited<br><b>EtherCAT mode:</b><br>Control Mode 6 (Reset Mode), NOT prohibition signal                                                                                                                                                                                                                                                                                                                                                                     | -                  | 02            | 0~ff      | √                           | own             |
| P5-23.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-24.0~1 | /ALM-RST: Alert Clear                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                  | 0             | 0~ff      | √                           | own             |
| P5-24.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-25.0~1 | P-CL: Positive side external torque limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                  | 00            | 0~ff      | √                           | own             |
| P5-25.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-26.0~1 | -N/CL: Reverse-side external torque limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                  | 00            | 0~ff      | √                           | own             |
| P5-26.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ms                 | 0             | 0~f       | √                           | own             |
| P5-27.0~1 | <b>In non-EtherCAT mode:</b><br>/SPD-D: Internal speed direction selection in<br><b>EtherCAT mode:</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | -                  | 03            | 0~ff      | √                           | 1 2 3 4 7       |

| P5-XX     | name                                                                                                                                                                                                                                                                                                                                                                              | unit | factory value | Set range | come into force opportunity | Applicable mode |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|-----------|-----------------------------|-----------------|
|           | Control Mode 6 (Reset Mode), Home Origin Signal                                                                                                                                                                                                                                                                                                                                   |      |               |           |                             |                 |
| P5-27.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 1 2 3 4 7       |
| P5-28.0~1 | In non-EtherCAT mode:<br>Speed mode:<br>/SPD-A: Internal speed selection<br>New original mode:<br>/SPD-A: Trigger the original action<br>Back to original mode:<br>/SPD-A: Find the origin in forward direction                                                                                                                                                                   | -    | 00            | 0~ff      | √                           | 3 5             |
| P5-28.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 3 5             |
| P5-29.0~1 | In non-EtherCAT mode:<br>Speed mode:<br>/SPD-B: Internal speed selection<br>Back to original mode:<br>/SPD-B: Reverse direction to find the origin                                                                                                                                                                                                                                | -    | 00            | 0~ff      | √                           | 3 5             |
| P5-29.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 3 5             |
| P5-30.0~1 | C-SEL: Control mode selection                                                                                                                                                                                                                                                                                                                                                     | -    | 00            | 0~ff      | √                           | own             |
| P5-30.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | own             |
| P5-31.0~1 | /ZCLAMP: Zero clamp                                                                                                                                                                                                                                                                                                                                                               | -    | 00            | 0~ff      | √                           | 3               |
| P5-31.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 3               |
| P5-32.0~1 | INHIBIT: Inhibit instruction pulse                                                                                                                                                                                                                                                                                                                                                | -    | 00            | 0~ff      | √                           | 5 6 7           |
| P5-32.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 5 6 7           |
| P5-33.0~1 | G/SEL: gain switching                                                                                                                                                                                                                                                                                                                                                             | -    | 00            | 0~ff      | √                           | own             |
| P5-33.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | own             |
| P5-34.0~1 | /CLR: Pulse offset clear                                                                                                                                                                                                                                                                                                                                                          | -    | 00            | 0~ff      | √                           | 5 6             |
| P5-34.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 5 6             |
| P5-35.0~1 | /CHGSTP: internal position pattern step signal                                                                                                                                                                                                                                                                                                                                    | -    | 00            | 0~ff      | √                           | 5               |
| P5-35.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | 5               |
| P5-36.0~1 | I-SEL: Inertial Switching                                                                                                                                                                                                                                                                                                                                                         | -    | 00            | 0~ff      | √                           | own             |
| P5-36.2   | SI terminal filter time                                                                                                                                                                                                                                                                                                                                                           | ms   | 0             | 0~f       | √                           | own             |
| P5-37     | /COIN_HD: Positioning completed<br>00: No output to terminal<br>01: Positive signal output from SO1 terminal<br>02: Positive signal output from SO2 terminal<br>03: Positive signal output from SO3 terminal<br>11: Output the reverse signal from the SO1 terminal<br>12: Output the reverse signal from the SO2 terminal<br>13: Output the reverse signal from the SO3 terminal | -    | 0000          | 0~ffff    | √                           | 5 6             |

| P5-XX     | name                                                                                                                                                               | unit | factory value | Set range | come into force opportunity | Applicable mode  |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|-----------|-----------------------------|------------------|
| P5-38     | /COIN: End of positioning                                                                                                                                          | -    | 0001          | 0~ffff    | √                           | 5 6              |
| P5-39     | V-CMP: same speed detection                                                                                                                                        | -    | 0000          | 0~ffff    | √                           | 3 4 7            |
| P5-40     | /TGON: Rotation Detection                                                                                                                                          | -    | 0000          | 0~ffff    | √                           | own              |
| P5-41     | /S-RDY: Ready                                                                                                                                                      | -    | 0000          | 0~ffff    | √                           | own              |
| P5-42     | torque limit                                                                                                                                                       | -    | 0000          | 0~ffff    | √                           | own              |
| P5-43     | VLT: Velocity Limit Detection                                                                                                                                      | -    | 0000          | 0~ffff    | √                           | 1 2              |
| P5-44     | /BK: Brake interlock                                                                                                                                               | -    | 0000          | 0~ffff    | ○                           | own              |
| P5-45     | /WARN: warn                                                                                                                                                        | -    | 0000          | 0~ffff    | √                           | own              |
| P5-46     | /NEAR: be close to                                                                                                                                                 | -    | 0000          | 0~ffff    | √                           | 5 6              |
| P5-47     | /ALM: report to the police                                                                                                                                         | -    | 0002          | 0~ffff    | √                           | own              |
| P5-48     | /Z: Encoder Z positive signal output                                                                                                                               | -    | 0000          | 0~ffff    | √                           | own              |
| P5-50     | /MRUN: Internal Position Pattern Movement Start Signal                                                                                                             | -    | 0000          | 0~ffff    | √                           | 5                |
| P5-51     | V-RDY: Velocity reached                                                                                                                                            | -    | 0000          | 0~ffff    | √                           | 3 4 7            |
| P5-52     | /USER1: Custom Output 1                                                                                                                                            | -    | 0000          | 0~ffff    | √                           | own              |
| P5-53     | /USER2: Custom Output 2                                                                                                                                            | -    | 0000          | 0~ffff    | √                           | own              |
| P5-55     | Interrupt the fixed-length output signal                                                                                                                           | -    | 0000          | 0~ffff    | √                           | own              |
| P5-56     | /FCLOSE: Full closed switch                                                                                                                                        | -    | 0000          | 0~ffff    | √                           | 5 6 8            |
| P5-57     | /PREFA: Internal Position Selection Signal A                                                                                                                       | -    | 0             | 0~ffff    | √                           | 5                |
| P5-58     | /PREFB: Internal Position Selection Signal B                                                                                                                       | -    | 0             | 0~ffff    | √                           | 5                |
| P5-59     | /PREFC: Internal Position Selection Signal C                                                                                                                       | -    | 0             | 0~ffff    | √                           | 5                |
| P5-60     | /PREFD: Internal position selection signal D                                                                                                                       | -    | 0             | 0~ffff    | √                           | 5                |
| P5-61.0~1 | /TRAJ-START: Trigger signal for the start of the exercise                                                                                                          | -    | 00            | 0~ff      | √                           | 5                |
| P5-62     | Probe Function 1                                                                                                                                                   | —    | 0             | 0005      | ○                           | EtherCAT pattern |
| P5-63     | Probe Function 2                                                                                                                                                   | —    | 0             | 0006      | ○                           | EtherCAT pattern |
| P5-70     | /SRDY: Output condition selection<br>0: The terminal is activated after the driver initialization is complete<br>1: This terminal will conduct only after enabling | -    | 0             | 0~1       | √                           | own              |
| P5-71     | Function Selection of Pulse Velocity Mode Direction Terminal                                                                                                       | -    | 0             | 0~1       | √                           | 7                |

## (7) Signal parameter settings for P6 group (some parameters retained)

| P6-XX | name | unit | factory value | Set range | Trigger time | Applicable mode |
|-------|------|------|---------------|-----------|--------------|-----------------|
|-------|------|------|---------------|-----------|--------------|-----------------|

|       |                                                         |       |     |         |   |               |
|-------|---------------------------------------------------------|-------|-----|---------|---|---------------|
| P6-05 | Adaptive Mode Speed Loop Gain (Large Inertia)           | 0.1Hz | 200 | 1~65535 | ○ | 1 2 3 4 5 6 7 |
| P6-07 | inertia ratio of adaptive mode (large inertia)          | %     | 50  | 0~10000 | ○ | 1 2 3 4 5 6 7 |
| P6-08 | Gain of adaptive mode velocity observer (large inertia) | Hz    | 40  | 10~1000 | ○ | 1 2 3 4 5 6 7 |
| P6-12 | Maximum Inertia Ratio (MIR) of Adaptive Mode            | -     | 50  | 1~10000 | ○ | 1 2 3 4 5 6 7 |

## (8) Communication parameter settings for Group P7

| parameter | functional description                                                                                                                                                                                                                                                                                            | unit      | leave the factory Windows default | short-cut process scope | come into force opportunity | Applicable mode |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------------------------|-------------------------|-----------------------------|-----------------|
| P7-00     | RS485 station number                                                                                                                                                                                                                                                                                              | -         | 0                                 | 0~100                   | ○                           | own             |
| P7-01.0~1 | RS485 baud rate<br>00: 300<br>01: 600<br>02: 1200<br>03: 2400<br>04: 4800<br>05: 9600<br>06: 19200<br>07: 38400<br>08: 57600<br>09:<br>115200<br>0A:<br>192000<br>0B:<br>256000<br>0C: 288000<br>0D: 384000<br>0E: 512000<br>0F: 576000<br>10: 768000<br>11: 1M<br>12: 2M<br>13: 3M<br>14: 4M<br>15: 5M<br>16: 6M | Baud rate | 06                                | 0~16                    | ○                           | own             |

| parameter | functional description                                                                                     | unit      |
|-----------|------------------------------------------------------------------------------------------------------------|-----------|
| P7-01.2   | RS485 stop bit<br>0:2 bits<br>2:1 position                                                                 | stop bit  |
| P7-01.3   | RS485 parity bit<br>0-No validation<br>1-odd parity<br>2 parity                                            | check bit |
| P7-02     | RS485 communication protocol<br>1-Modbus RTU protocol<br>2-Xnet bus protocol<br>3-Read the Xnet bus torque | -         |
| P7-03     | Xnet synchronous sampling time                                                                             | 1ms       |
| P7-04     | Xnet slave data                                                                                            | -         |
| P7-05     | Number of Xnet slaves                                                                                      | -         |
| P7-06     | Number of retry attempts for communication timeout                                                         | Next      |
| P7-07     | bus instruction refresh period                                                                             | 1us       |
| P7-08     | Position deviation compensation threshold                                                                  | -         |

| parameter | functional description                                | unit |
|-----------|-------------------------------------------------------|------|
| P7-09     | Number of times for positional deviation compensation | -    |

| P7-XX     | name                                                                                                                                                                                                                                                                                                     | unit      | factory value | Set range | Trigger time |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|-----------|--------------|
| P7-10     | RS232 station number (the factory default value will be updated once after power-on based on the inverter module's location)                                                                                                                                                                             | -         | 1             | 0~100     | ○            |
| P7-11.0~1 | RS232 baud rate<br>00: 300<br>01: 600<br>02: 1200<br>03: 2400<br>04: 4800<br>05: 9600<br>06: 19200<br>07: 38400<br>08: 57600<br>09: 115200<br>0A: 192000<br>0B: 256000<br>0C: 288000<br>0D: 384000<br>0E: 512000<br>0F: 576000<br>10: 768000<br>11: 1M<br>12: 2M<br>13: 3M<br>14: 4M<br>15: 5M<br>16: 6M | Baud rate | 09            | 0~16      | ○            |
| P7-11.2   | RS232 stop bit<br>0: 2 bits<br>2: 1 position                                                                                                                                                                                                                                                             | stop bit  | 2             | 0~2       | ○            |
| P7-11.3   | RS232 parity bit<br>0: No validation<br>1: Odd parity<br>2: Parity check                                                                                                                                                                                                                                 | check bit | 2             | 0~2       | ○            |

## (9) Parameter P8 group

| P8-XX | name            | unit | factory value | Set range | Trigger time | Applicable mode |
|-------|-----------------|------|---------------|-----------|--------------|-----------------|
| P8-25 | Panel selection | -    | 0             | 0~2       | ▲            | own             |

## (10) Full closed-loop parameter P9 group

| P9-XX | name | Windows default | Parameter range | Trigger time | remarks |
|-------|------|-----------------|-----------------|--------------|---------|
|-------|------|-----------------|-----------------|--------------|---------|



| P9-XX   | name                                                                     | Windows default | Parameter range | Trigger time | remarks                                                                                                                                                                                                                                         |
|---------|--------------------------------------------------------------------------|-----------------|-----------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P9-00.0 | Full closed-loop control mode switch                                     | 0               | 0~3             | √            | 0: Turn off full closed-loop control;<br>1: Enable full closed-loop control;<br>2: Select the SI terminal method to enable/disable the full closed-loop system;<br>3: Select the ECAT bus method to enable/disable the full closed-loop system; |
| P9-00.1 | grating scale counting direction                                         | 0               | 0, 1            | ●            | 0: Use the grating scale directly<br>1: Use after reversing the grating scale count value                                                                                                                                                       |
| P9-00.2 | grating scale type                                                       | 0               | 0~2             | ●            | 0: AB phase counter<br>1: Incremental serial communication (not supported)<br>2: Absolute serial communication (not supported)                                                                                                                  |
| P9-01.0 | Selection of speed feedback in full closed-loop control                  | 0               | 0, 1            | ●            | 0: Use motor encoder speed;<br>1: Use the grating speed.                                                                                                                                                                                        |
| P9-01.1 | Z Sign source                                                            | 0               | 0, 1            | ●            | 0: Motor encoder Z phase<br>1: Z-axis grating scale (not supported in new return original mode)                                                                                                                                                 |
| P9-01.2 | servo pulse output                                                       | 0               | 0, 1            | ●            | 0: Motor encoder ABZ output<br>1: Raster scale ABZ output                                                                                                                                                                                       |
| P9-02   | Alarm threshold for excessive deviation between motor and load positions | 100             | 0~65535         | ○            | The resolution of the grating scale is taken as the standard                                                                                                                                                                                    |
| P9-03   | Motor-load position deviation clearance setting                          | 0               | 0~65535         | ○            | 0: Motor-load position difference not cleared<br>n: The motor clears the load-position deviation after rotating n full turns.                                                                                                                   |
| P9-04   | Motor-load speed deviation alarm threshold                               | 100             | 0~65535         | ○            | Alarm off when RPM is 0                                                                                                                                                                                                                         |
| P9-05   | The number of feedback pulses per revolution of                          | 0               | 0~9999          | ●            | When the set value is 0, set the encoder resolution to the fractional numerator (P9-06*10000+ P9-05).                                                                                                                                           |

| P9-XX | name                                                                        | Windows default | Parameter range | Trigger time | remarks                                                                                                |
|-------|-----------------------------------------------------------------------------|-----------------|-----------------|--------------|--------------------------------------------------------------------------------------------------------|
|       | the motor encoder is low.                                                   |                 |                 |              |                                                                                                        |
| P9-06 | The motor encoder provides a high number of feedback pulses per revolution. | 0               | 0~9999          | ●            | $P9-06 \times 10000 + P9-05$                                                                           |
| P9-07 | The number of feedback pulses per turn of the grating scale is low.         | 0               | 0~9999          | ●            | When the set value is 0, $P9-08 \times 10000 + P9-07$ sets 10000 as the frequency divider denominator. |
| P9-08 | High number of feedback pulses per turn of the grating scale                | 1               | 0~9999          | ●            | $P9-08 \times 10000 + P9-07$                                                                           |
| P9-09 | Full closed-loop integration time constant                                  | 500             | 0~65535         | ○            | 0.01ms                                                                                                 |

## Appendix 1.2 Functional parameters of the F-group inverter module of the drive

| Function code | explain                                 |
|---------------|-----------------------------------------|
| F0-00         | Clear alarm                             |
| F0-01         | Restore factory settings                |
| F0-02         | Clear positional deviation              |
| F1-00         | crawl                                   |
| F1-01         | pilot run                               |
| F1-02         | current sampling zeroing                |
| F1-05         | Enable panel                            |
| F1-06         | Absolute encoder clearance circle count |

## Appendix 1.3 Inverter module U group monitoring parameters of the driver

U0-XX:

| monitoring number | content                          |                         | unit          |
|-------------------|----------------------------------|-------------------------|---------------|
| U0-00             | Current speed of the servo motor |                         | Rpm           |
| U0-01             | Input speed command              |                         | Rpm           |
| U0-02             | torque command                   |                         | % specified   |
| U0-03             | mechanical angle                 |                         | 1°            |
| U0-04             | electric degree                  |                         | 1°            |
| U0-05             | busbar voltage                   |                         | V             |
| U0-06             | IPM temperature                  |                         | 0.1°C         |
| U0-07             | torque feedback                  |                         | % specified   |
| U0-08             | pulse deviation value            | (-9999 ~ 9999) *1       | command pulse |
| U0-09             |                                  | (-32768 ~ 32767) *10000 |               |
| U0-10             | encoder feedback value           | 0000 ~ 9999             | encoder pulse |
| U0-11             |                                  | (0000 ~ 65535) *10000   |               |
| U0-12             | Input command pulse count        | (-9999 ~ 9999) *1       | command pulse |
| U0-13             |                                  | (-32768 ~ 32767) *10000 |               |
| U0-14             | position feedback                | (-9999 ~ 9999) *1       | command pulse |
| U0-15             |                                  | (-32768 ~ 32767) *10000 |               |
| U0-18             | torque current                   |                         | 0.01A         |
| U0-19             | V-REF value for analog input     |                         | 0.001V        |
| U0-20             | T-REF value for analog input     |                         | 0.001V        |
| U0-21             | Input signal state 1             |                         |               |
| U0-22             | Input Signal State 2             |                         |               |
| U0-23             | Output Signal State 1            |                         |               |
| U0-24             | Output Signal State 2            |                         |               |
| U0-25             | input pulse frequency            | (0000 ~ 9999) *1        | Hz            |
| U0-26             |                                  | (0000 ~ 9999) *10000    |               |

| monitoring number | content                                                          | unit               |
|-------------------|------------------------------------------------------------------|--------------------|
| U0-41             | instantaneous output power                                       | 1W                 |
| U0-42             | average output power                                             | 1W                 |
| U0-43             | instantaneous thermal power                                      | 1W                 |
| U0-44             | mean thermal power                                               | 1W                 |
| U0-49             | position feedforward                                             | 1 instruction unit |
| U0-50             | velocity feedforward                                             | rpm                |
| U0-51             | torque feedforward                                               | % specified        |
| U0-52             | Instantaneous bus capacitive power                               | 1W                 |
| U0-53             | Average bus capacitor power                                      | 1W                 |
| U0-55             | instantaneous regenerative braking discharge power               | 1W                 |
| U0-56             | average regenerative braking discharge power                     | 1W                 |
| U0-57             | The absolute encoder's current position feedback is 32 bits low  | Encoder position   |
| U0-58             |                                                                  |                    |
| U0-59             | The absolute encoder's current position feedback is 32 bits high | Encoder position   |
| U0-60             |                                                                  |                    |
| U0-89             | position instruction end flag                                    |                    |
| U0-91             | Number of turns in a multi-turn absolute value motor             |                    |
| U0-98             | Temperature of high-power motors                                 | 0.1°C              |

## U1-XX:

| monitoring number | content                                                                                                           | unit          |
|-------------------|-------------------------------------------------------------------------------------------------------------------|---------------|
| U1-00             | Current alarm code                                                                                                |               |
| U1-01             | Current warning code                                                                                              |               |
| U1-02             | U-phase current at the time of alarm                                                                              | 0.01A         |
| U1-03             | V-phase current at the time of alarm                                                                              | 0.01A         |
| U1-04             | bus voltage at the time of alarm                                                                                  | V             |
| U1-05             | IGBT temperature at the time of alarm                                                                             | 0.1°C         |
| U1-06             | torque current at the time of alarm                                                                               | 0.01A         |
| U1-07             | excitation current at the time of alarm                                                                           | A             |
| U1-08             | Location deviation at the time of the alarm                                                                       | command pulse |
| U1-09             | Speed value at the time of alarm                                                                                  | rpm           |
| U1-10             | The time in seconds when the alarm was triggered (16-bit lower 16-bit). The count starts from the first power-on. | s             |
| U1-11             | The time in seconds when the alarm was triggered (16-bit high). The count starts from the first power-on.         | s             |
| U1-12             | The number of runtime errors is calculated after this power-on                                                    |               |
| U1-13             | The number of operation warnings is calculated after this power-on.                                               |               |
| U1-14             | Total historical alarm count                                                                                      |               |
| U1-15             | Total historical warnings                                                                                         |               |
| U1-16             | The second alarm code recently                                                                                    |               |
| U1-17             | The third alarm code recently                                                                                     |               |
| U1-18             | The 4th alarm code recently                                                                                       |               |
| U1-19             | The 5th alarm code recently                                                                                       |               |
| U1-20             | The 6th alarm code recently                                                                                       |               |

| monitoring number | content                           | unit |
|-------------------|-----------------------------------|------|
| U1-21             | The 7th alarm code recently       |      |
| U1-22             | The 8th alarm code recently       |      |
| U1-23             | The 9th alarm code recently       |      |
| U1-24             | The 10th alarm code recently      |      |
| U1-25             | The 11th alarm code recently      |      |
| U1-26             | The 12th alarm code recently      |      |
| U1-27             | The 13th alarm code recently      |      |
| U1-28             | The 14th alarm code recently      |      |
| U1-29             | The 15th alarm code recently      |      |
| U1-30             | The 16th alarm code recently      |      |
| U1-31             | The 17th alarm code recently      |      |
| U1-32~U1-47       | Recent warning codes 2 through 17 |      |

U2-XX:

| monitoring number | content                                                                                                   | unit                 |
|-------------------|-----------------------------------------------------------------------------------------------------------|----------------------|
| U2-00             | Power-up count                                                                                            | -                    |
| U2-01             | series                                                                                                    | -                    |
| U2-02             | Model (16-bit)                                                                                            | -                    |
| U2-03             | Model (16-bit)                                                                                            | -                    |
| U2-04             | Production date: Year                                                                                     | -                    |
| U2-05             | Production date: Month                                                                                    | -                    |
| U2-06             | Production date:                                                                                          | -                    |
| U2-07             | firmware version                                                                                          | -                    |
| U2-08             | Hardware version                                                                                          | -                    |
| U2-09             | Total runtime (from the first power-on)                                                                   | hour                 |
| U2-10             | Total runtime (from the first power-on)                                                                   | minute               |
| U2-11             | Total runtime (from the first power-on)                                                                   | second               |
| U2-12             | Run time (from the last power-on)                                                                         | hour                 |
| U2-13             | Run time (from the last power-on)                                                                         | minute               |
| U2-14             | Run time (from the last power-on)                                                                         | second               |
| U2-15             | Average output power (the average power during the enabling process from the first enable)                | 1W                   |
| U2-16             | Average heating power (the average power during the enabling process from the first enabling)             | 1W                   |
| U2-17             | Average bus capacitor filter power (the average power during the power-on period from the first power-on) | 1W                   |
| U2-18             | Total number of turns of the motor                                                                        | (0000 ~ 9999) *1     |
| U2-19             |                                                                                                           | (0000 ~ 9999) *10000 |
| U2-20             | Device serial number: 16 bits lower                                                                       |                      |
| U2-21             | Device serial number: 16-digit                                                                            |                      |
| U2-22             | Firmware generation date: Year                                                                            |                      |
| U2-23             | Firmware generation date: Month/Day                                                                       |                      |
| U2-24             | Firmware generation time: hours/minutes                                                                   |                      |

U3-XX:

| monitoring number | content | unit |
|-------------------|---------|------|
|-------------------|---------|------|

|       |                                                                                                          |   |
|-------|----------------------------------------------------------------------------------------------------------|---|
| U3-00 | Motor code for automatic reading (including thermal power parameters)                                    | - |
| U3-01 | Motor version                                                                                            | - |
| U3-02 | Encoder version                                                                                          | - |
| U3-68 | Cumulative number of communication timeouts for rectification and inversion processes                    | - |
| U3-70 | Automatically reads the motor code from the encoder in motor parameters (only related to the motor code) | - |

U4-XX:

| monitoring number | content                                                                         | unit                            |
|-------------------|---------------------------------------------------------------------------------|---------------------------------|
| U4-10             | Resonant Frequency Detected by Fast FFT                                         | Hz                              |
| U4-11             | Raw data from the grating scale                                                 | 1. Grating scale feedback pulse |
| U4-12             | Raw data from the grating scale                                                 | 1. Grating scale feedback pulse |
| U4-13             | The original Z-phase number of the grating scale                                | -                               |
| U4-16             | accumulated value of continuous overload operation for thermal power protection | -                               |
| U4-17             | accumulated instantaneous overload operation value of thermal power protection  | -                               |

## Appendix 1.4 Rectifier module P group function parameters of the driver

Modification and effective time: "○" indicates modification during servo OFF, effective immediately.

√ indicates changes can be made at any time and take effect immediately.

● indicates that the changes require a power cycle to take effect.

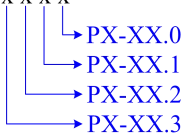
The "△" indicates that the setting can be changed at any time and takes effect when the motor is not rotating.

"▲" means it can be modified at any time and requires a power cycle to take effect.

For hexadecimal parameters, add the prefix "n." before the value to indicate that the current value is a hexadecimal number.

Parameter composition:

PX-XX=n. x x x x



→ PX-XX.0  
→ PX-XX.1  
→ PX-XX.2  
→ PX-XX.3

| parameter | functional description                                                                                                 | unit  | factory value | setting scope | come into force opportunity | suit scope           |
|-----------|------------------------------------------------------------------------------------------------------------------------|-------|---------------|---------------|-----------------------------|----------------------|
| P0-01     | Busbar under-voltage warning threshold<br>After rectifier startup, measure the bus voltage                             | V     | 350           | 0~1000        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-02     | Busbar overvoltage warning threshold                                                                                   | V     | 700           | 0~1000        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-03     | Busbar under-voltage alarm threshold<br>After rectifier startup, measure the bus voltage                               | V     | 300           | 0~1000        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-04     | The busbar voltage exceeds the P0-04 set value and remains above it for the duration of P0-05, triggering alarm E-030. | V     | 780           | 0~1000        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-05     | Bus voltage filtering time constant                                                                                    | 0.1ms | 20            | 0~1000        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-06     | Busbar overvoltage immediate alarm threshold                                                                           | V     | 780           | 0~1000        | √                           | 1 2 3 4 5 6 7 8 9 10 |

| parameter | functional description                                                                                                                                     | unit | factory value | setting scope | come into force opportunity | suit scope           |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|---------------|-----------------------------|----------------------|
|           | If the bus voltage exceeds the set value, an alarm is triggered immediately.                                                                               |      |               |               |                             |                      |
| P0-07     | Fan switch<br>0: Mode 1: Fan on when temperature exceeds 45°C, off when below 42°C (hysteresis 3°C)<br>1: Mode 2: The fan runs continuously after enabling | -    | 1             | 0、1           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-08.0   | Enter the phase loss protection switch<br>0: Not protected<br>1: Protection                                                                                | -    | 1             | 0、1           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-08.1   | Overvoltage protection switch<br>0: Not protected<br>1: Protection                                                                                         | -    | 1             | 0、1           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-08.2   | Enter the three-phase unbalanced protection switch.<br>0: Not protected<br>1: Protection                                                                   | -    | 1             | 0、1           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-09     | Communication Abnormal Protection of Rectifier and Inverter Module<br>0: Not protected<br>1: Protection                                                    | -    | 1             | 0、1           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-10     | Rectification and Inversion Communication Timeout Time                                                                                                     | 10ms | 500           | 100~2000      | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-14     | 0: Disable<br>1: Auto-enable, parallel inverter auto soft start<br>2: Software enables soft start without parallel inverters, with F1-05=1 activation      | -    | 1             | 0~2           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-16     | The signal source for the station is lost.<br>0: AC signal<br>1: Bus voltage threshold                                                                     | -    | 0             | 0、1           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P0-17     | Voltage threshold for power failure from the station                                                                                                       | V    | 250           | 0~500         | ○                           | 1 2 3 4 5 6 7 8 9 10 |



| parameter      | functional description                                                                                                                                                                                                                                                                                           | unit  | factory value | setting scope | come into force opportunity | suit scope           |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------|---------------|-----------------------------|----------------------|
| P5-18          | IO filter time multiplier<br>The filtering time of the SI terminal is the same as that of the data terminal.                                                                                                                                                                                                     | -     | 1             | 0~10000       | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P7-00          | RS485 station number                                                                                                                                                                                                                                                                                             | -     | 1             | 0~100         | ○                           | 1 2 3 4 5 6 7 8 9 10 |
| P7-01.0<br>~ 1 | RS485 baud rate<br><br>00: 300<br><br>01: 600<br><br>02: 1200<br><br>03: 2400<br><br>04: 4800<br><br>05: 9600<br><br>06: 19200<br><br>07: 38400<br><br>08: 57600<br><br>09: 115200<br><br>0A: 192000<br><br>0B: 256000<br><br>0C: 288000<br><br>0D: 384000<br><br>0E: 512000<br><br>0F: 576000<br><br>10: 768000 | bit/s | 06            | 0~16          | ○                           | 1 2 3 4 5 6 7 8 9 10 |

| parameter | functional description                                                         | unit      | factory value | setting scope | come into force opportunity | suit scope           |
|-----------|--------------------------------------------------------------------------------|-----------|---------------|---------------|-----------------------------|----------------------|
|           | 11: 1M<br>12: 2M<br>13: 3M<br>14: 4M<br>15: 5M<br>16: 6M                       |           |               |               |                             |                      |
| P7-01.2   | RS485 stop bit<br>0:2 bits<br>2:1 position                                     | bit       | 2             | 0~2           | ○                           | 1 2 3 4 5 6 7 8 9 10 |
| P7-01.3   | RS485 parity bit<br>0: No validation<br>1: Odd parity<br>2: Parity check       | -         | 2             | 0~2           | ○                           | 1 2 3 4 5 6 7 8 9 10 |
| P7-02     | RS485 communication protocol<br>1: Modbus RTU protocol<br>2: Xnet bus protocol | -         | 1             | 1~255         | ○                           | 1 2 3 4 5 6 7 8 9 10 |
| P7-03     | Xnet synchronous sampling time                                                 | 1ms       | 9             | 1~500         | ○                           | 10                   |
| P7-04     | Xnet slave data                                                                | -         | 15            | 1~500         | ○                           | 10                   |
| P7-05     | Number of Xnet slaves                                                          | -         | 10            | 1~256         | ○                           | 10                   |
| P7-06     | Number of retry attempts for communication timeout                             | Next time | 10            | 1~500         | ○                           | 10                   |
| P7-07     | bus instruction refresh period                                                 | 1us       | 3000          | 1~65535       | ○                           | 10                   |
| P7-08     | Position deviation compensation threshold                                      | -         | 0             | 0             | √                           | 10                   |
| P7-09     | Number of times for positional deviation compensation                          | -         | 0             | 0             | √                           | 10                   |
| P7-10     | RS232 station number                                                           | -         | 1             | 0~100         | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P7-11.0   | RS232 baud rate                                                                | bit/s     | 06            | 0~16          | √                           | 1 2 3 4 5 6 7 8 9 10 |

| parameter | functional description                                                                                                                                                                                                                                            | unit | factory value | setting scope | come into force opportunity | suit scope |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|---------------|-----------------------------|------------|
| ~ 1       | 00: 300<br>01: 600<br>02: 1200<br>03: 2400<br>04: 4800<br>05: 9600<br>06: 19200<br>07: 38400<br>08: 57600<br>09: 115200<br>0A: 192000<br>0B: 256000<br>0C: 288000<br>0D: 384000<br>0E: 512000<br>0F: 576000<br>10: 768000<br>11: 1M<br>12: 2M<br>13: 3M<br>14: 4M |      |               |               |                             |            |

| parameter | functional description                                                   | unit | factory value | setting scope | com e into force opportunity | suit scope           |
|-----------|--------------------------------------------------------------------------|------|---------------|---------------|------------------------------|----------------------|
|           | 15: 5M<br>16: 6M                                                         |      |               |               |                              |                      |
| P7-11.2   | RS232 stop bit<br>0:2 bits<br>2:1 position                               | bit  | 2             | 0、2           | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P7-11.3   | RS232 parity bit<br>0: No validation<br>1: Odd parity<br>2: Parity check | -    | 2             | 0~2           | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-00     | Sampling Channel 1                                                       | -    | 0203          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-01     | Sampling Channel 2                                                       | -    | 0205          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-02     | Sampling Channel 3                                                       | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-03     | Sampling Channel 4                                                       | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-04     | Sampling Channel 5                                                       | -    | 0301          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-05     | Sampling Channel 6                                                       | -    | 0302          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-06     | Sampling Channel 7                                                       | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-07     | Sampling Channel 8                                                       | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-08     | Sampling Channel 9                                                       | -    | 1634          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-09     | Sampling channel 10                                                      | -    | 4452          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-10     | Sampling Channel 11                                                      | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-11     | Sampling channel 12                                                      | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-12     | Sampling channel 13                                                      | -    | 0502          | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |
| P8-13     | Sampling channel 14                                                      | -    | 0             | 0~ffff        | √                            | 1 2 3 4 5 6 7 8 9 10 |

| parameter | functional description                                                                                                                                                                                       | unit | factory value | setting scope | come into force opportunity | suit scope           |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|---------------|-----------------------------|----------------------|
| P8-14     | Sampling channel 15                                                                                                                                                                                          | -    | 0             | 0~ffff        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-15     | Sampling channel 16                                                                                                                                                                                          | -    | 0             | 0~ffff        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-16     | sampling configuration<br>1: Manual sampling<br>2: Auto Sampling<br>3: Trigger Sampling<br>4: Enable sampling<br>5: Signal Sampling<br>6: Incorrect sampling<br>7: Positional sampling<br>8: Enable sampling | -    | 1             | 0~8           | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-17     | sampling interval                                                                                                                                                                                            | -    | 36            | 1~65535       | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-18     | dwell time                                                                                                                                                                                                   | -    | 1024          | 0~65535       | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-19     | trigger channel                                                                                                                                                                                              | -    | 0             | 0~ffff        | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-20     | Trigger threshold is 16 bits lower                                                                                                                                                                           | -    | 0             | 0~65535       | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-21     | Trigger threshold is 16 bits higher                                                                                                                                                                          | -    | 0             | 0~65535       | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-22     | trigger slope                                                                                                                                                                                                | -    | 0             | 0~65535       | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-23     | Sampling ratio                                                                                                                                                                                               | %    | 100           | 0~100         | √                           | 1 2 3 4 5 6 7 8 9 10 |
| P8-25     | Display content settings directly on the panel when powered on<br>0: Power-up display bb<br>1: The power supply shows the speed feedback of U0-00<br>2: Power-on display shows U0-07 torque feedback         | -    | 0             | 0~2           | ▲                           | 1 2 3 4 5 6 7 8 9 10 |

### Appendix 1.5 Function parameters of the U group of the driver rectifier module

| U0-XX | functional description | unit |
|-------|------------------------|------|
| U0-00 | busbar voltage         | V    |

| U0-XX | functional description                                                                                                         | unit |
|-------|--------------------------------------------------------------------------------------------------------------------------------|------|
| U0-01 | rectifier temperature                                                                                                          | °C   |
| U0-02 | Enter the RMS value of the RS voltage                                                                                          | V    |
| U0-03 | Enter the RMS value of the ST voltage                                                                                          | V    |
| U0-04 | Enter the RMS value of the TR voltage                                                                                          | V    |
| U0-05 | Enter the RS phase                                                                                                             | °    |
| U0-06 | Enter ST phase                                                                                                                 | °    |
| U0-07 | Enter TR phase                                                                                                                 | °    |
| U0-08 | Enter the three-phase imbalance degree.                                                                                        | %    |
| U0-09 | Enter the harmonic content of the RS voltage.                                                                                  | %    |
| U0-10 | Enter the ST voltage harmonic content percentage                                                                               | %    |
| U0-11 | Enter the harmonic content of the TR voltage.                                                                                  | %    |
| U0-12 | Mean value of the RS voltage sampling channels                                                                                 | -    |
| U0-13 | Mean value of ST voltage sampling channels                                                                                     | -    |
| U0-14 | Mean value of TR voltage sampling channels                                                                                     | -    |
| U1-00 | Current alarm code                                                                                                             | -    |
| U1-01 | Current warning code                                                                                                           | -    |
| U1-02 | SR voltage at alarm                                                                                                            | V    |
| U1-03 | ST voltage at the time of alarm                                                                                                | V    |
| U1-04 | SR voltage at alarm                                                                                                            | V    |
| U1-05 | SR Phase at Alarm Occurrence                                                                                                   | °    |
| U1-06 | ST Phase at Alarm Occurrence                                                                                                   | °    |
| U1-07 | TR Phase at Alarm Occurrence                                                                                                   | °    |
| U1-08 | bus voltage at the time of alarm                                                                                               | V    |
| U1-09 | Rectifier temperature at the time of alarm                                                                                     | °C   |
| U1-10 | The time in seconds when the alarm was triggered (16-bit lower 16-bit). This is the cumulative count since the first power-on. | s    |
| U1-11 | The time in seconds when the alarm was triggered (16-bit high). This is the cumulative count since the first power-on.         | s    |
| U1-12 | The number of runtime errors is calculated after this power-on                                                                 | -    |
| U1-13 | The number of operation warnings is calculated after this power-on.                                                            | -    |
| U1-14 | Total historical alarm count                                                                                                   | -    |
| U1-15 | Total historical warnings                                                                                                      | -    |
| U1-16 | The first alarm code recently                                                                                                  | -    |
| U1-17 | The second alarm code recently                                                                                                 | -    |
| U1-18 | The third alarm code recently                                                                                                  | -    |

| U0-XX | functional description                  | unit             |
|-------|-----------------------------------------|------------------|
| U1-19 | The 4th alarm code recently             | -                |
| U1-20 | The 5th alarm code recently             | -                |
| U1-21 | The 6th alarm code recently             | -                |
| U1-22 | The 7th alarm code recently             | -                |
| U1-23 | The 8th alarm code recently             | -                |
| U1-24 | The 9th alarm code recently             | -                |
| U1-25 | The 10th alarm code recently            | -                |
| U1-26 | The 11th alarm code recently            | -                |
| U1-27 | The 12th alarm code recently            | -                |
| U1-28 | The 13th alarm code recently            | -                |
| U1-29 | The 14th alarm code recently            | -                |
| U1-30 | The 15th alarm code recently            | -                |
| U1-31 | The 16th alarm code recently            | -                |
| U1-32 | First recent warning code               | -                |
| U1-33 | Second recent warning code              | -                |
| U1-34 | The third warning code recently         | -                |
| U1-35 | The 4th warning code recently           | -                |
| U1-36 | The 5th warning code recently           | -                |
| U1-37 | The 6th warning code recently           | -                |
| U1-38 | The 7th warning code recently           | -                |
| U1-39 | The 8th warning code recently           | -                |
| U1-40 | The 9th warning code recently           | -                |
| U1-41 | The 10th recent warning code            | -                |
| U1-42 | The 11th recent warning code            | -                |
| U1-43 | The 12th recent warning code            | -                |
| U1-44 | The 13th recent warning code            | -                |
| U1-45 | The 14th recent warning code            | -                |
| U1-46 | The 15th warning code                   | -                |
| U1-47 | The 16th warning code                   | -                |
| U2-00 | Power-up count                          | -                |
| U2-01 | series                                  | -                |
| U2-02 | Model (16-bit)                          | -                |
| U2-03 | Model (16-bit)                          | -                |
| U2-04 | Production date: Year                   | -                |
| U2-05 | Production date: Month                  | -                |
| U2-06 | Production date:                        | -                |
| U2-07 | firmware version                        | -                |
| U2-08 | Hardware version                        | -                |
| U2-09 | Total runtime (from the first power-on) | hour<br>hour     |
| U2-10 | Total runtime (from the first power-on) | minute<br>minute |

| U0-XX | functional description                                            | unit             |
|-------|-------------------------------------------------------------------|------------------|
| U2-11 | Total runtime (from the first power-on)                           | second<br>second |
| U2-12 | Run time (from the last power-on)                                 | hour<br>hour     |
| U2-13 | Run time (from the last power-on)                                 | minute<br>minute |
| U2-14 | Run time (from the last power-on)                                 | second<br>second |
| U2-15 | average output power                                              | -                |
| U2-16 | mean thermal power                                                | -                |
| U2-17 | average capacitive power                                          | -                |
| U2-18 | The motor's total operating position is at the lower level (x1).  | -                |
| U2-19 | The motor's total operating position is at the high level x10000. | -                |
| U2-20 | Low bit of the drive serial number                                | -                |
| U2-21 | High bit of the drive serial number                               | -                |
| U2-22 | Firmware production date: Year                                    | -                |
| U2-23 | Firmware production date: Month Day                               | -                |
| U2-24 | Firmware production date: hour and minute                         | -                |
| U2-25 | ModelLow                                                          | -                |
| U2-26 | ModelHigh                                                         | -                |
| U2-27 | Monitoring register                                               | -                |
| U2-28 | ModelIndex                                                        | -                |
| U2-29 | Panel version                                                     | -                |
| U2-30 | FPGA firmware version number                                      | -                |
| U4-00 | SI1 input edge change calculation value                           | -                |
| U4-01 | SI2 input edge change calculation value                           | -                |
| U4-02 | SI3 input edge change calculation value                           | -                |
| U4-03 | SI4 input edge change calculation value                           | -                |
| U4-04 | SI5 input edge change calculation value                           | -                |
| U4-05 | SI6 input edge change calculation value                           | -                |
| U4-06 | SI7 input edge change calculation value                           | -                |
| U4-07 | SI8 input edge change calculation value                           | -                |
| U4-08 | SI9 input edge change calculation value                           | -                |
| U4-09 | SI10 input edge change calculation value                          | -                |
| U4-10 | Resonant Frequency Detected by Fast FFT                           | Hz               |
| U4-12 | Number of CAN slave devices                                       | -                |
| U4-13 | CAN slave status                                                  | -                |

### Appendix 1.6 Rectifier module F group function parameters of the driver

| F0-XX | functional description | unit |
|-------|------------------------|------|
| F0-00 | Clear alarm            | -    |



|       |                          |   |
|-------|--------------------------|---|
| F0-01 | Restore factory settings | - |
|-------|--------------------------|---|

## Appendix 2. List of object dictionaries

object dictionary area allocation

All objects are configured in the object dictionary of each group through a 16-bit index address represented by a 4-digit hexadecimal.

The object dictionaries for CoE (CANopen over EtherCAT) specified in CiA402 and the DM6C series are defined as follows:

| CiA402 object dictionary |                            | Object Dictionary of DM6C Series |                        |
|--------------------------|----------------------------|----------------------------------|------------------------|
| index of matrix          | content                    | index of matrix                  | content                |
| 0000h ~ 0FFFh            | Data Type Area             | 0000h ~ 0FFFh                    | Data Type Area         |
| 1000h ~ 1FFFh            | COE communication area     | 1000h ~ 1FFFh                    | COE communication area |
| 2000h ~ 5FFFh            | Manufacturer Custom Region | 2000h ~ 2FFFh                    | servo parameter area   |
|                          |                            | 3000h ~ 3FFFh                    | continue to have       |
|                          |                            | 4000h ~ 4FFFh                    | continue to have       |
|                          |                            | 5000h ~ 5FFFh                    | continue to have       |
| 6000h ~ 9FFFh            | Profile region             | 6000h ~ 6FFFh                    | Drive Profile Area     |
|                          |                            | 7000h ~ 9FFFh                    | continue to have       |
| A000h ~ FFFFh            | continue to have           | A000h ~ FFFFh                    | continue to have       |

### Appendix 2.1 COE Communication Range (0x1000-0x1FFF)

| index of matrix | subindex | name                         | unit | data area   | data type | sign | PDO |
|-----------------|----------|------------------------------|------|-------------|-----------|------|-----|
| 1000h           | 00h      | device type                  | -    | 0~429496795 | U32       | RO   | NO  |
| 1001h           | 00h      | error register type of alarm | -    | 0~65535     | U16       | RO   | NO  |
| 1008h           | 00h      | Device name                  | -    | -           | -         | RO   | NO  |
| 1009h           | 00h      | Hardware version             | -    | -           | -         | RO   | NO  |
| 100Ah           | 00h      | Software version             | -    | -           | -         | RO   | NO  |
| 1018h           | 00h      | Identity factory information | -    | -           | -         | RO   | -   |
|                 | 01h      | vendor ID Supplier ID        | -    | 0~255       | U8        | RO   | NO  |
|                 | 02h      | product code                 | -    | 0~429496795 | U32       | RO   | NO  |
|                 | 03h      | Revision Version Number      | -    | 0~429496795 | U32       | RO   | NO  |
|                 | 04h      | Serial number                | -    | 0~429496795 | U32       | RO   | NO  |
| 1600h           | 00h      | 1st RxPDO mapping            | -    | 0~24        | U8        | RW   | NO  |

| index of matrix | subindex | name                                                                   | unit | data area    | data type | sign | PDO |
|-----------------|----------|------------------------------------------------------------------------|------|--------------|-----------|------|-----|
|                 |          | Enter the number of mapping objects supported by RxPDO1                |      |              |           |      |     |
|                 | 01h      | First mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                                  | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                                    | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                       | -    | 0~4294967295 | U32       | RW   | NO  |
| 1601h           | 00h      | 2nd RxPDO mapping<br>The number of mapping objects supported by RxPDO2 | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                                  | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                                    | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                       | -    | 0~4294967295 | U32       | RW   | NO  |
| 1602h           | 00h      | 3rd RxPDO mapping<br>The number of mapping objects supported by RxPDO3 | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                                  | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                                    | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                       | -    | 0~4294967295 | U32       | RW   | NO  |
| 1603h           | 00h      | 4th RxPDO mapping<br>The number of mapping objects supported by RxPDO4 | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                                  | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                                    | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                       | -    | 0~4294967295 | U32       | RW   | NO  |
| 1A00h           | 00h      | 1st TxPDO mapping<br>Number of objects supported by TxPDO1             | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                                  | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                                    | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                       | -    | 0~4294967295 | U32       | RW   | NO  |
| 1A01h           | 00h      | 2nd TxPDO mapping<br>Number of mapped objects supported by TxPDO2      | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                                  | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                                   | -    | 0~4294967295 | U32       | RW   | NO  |

| index of matrix | subindex | name                                                              | unit | data area    | data type | sign | PDO |
|-----------------|----------|-------------------------------------------------------------------|------|--------------|-----------|------|-----|
|                 | ...      | ...                                                               | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                  | -    | 0~4294967295 | U32       | RW   | NO  |
| 1A02h           | 00h      | 3rd TxPDO mapping<br>Number of mapped objects supported by TxPDO3 | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                              | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                             | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                              | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                               | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                  | -    | 0~4294967295 | U32       | RW   | NO  |
| 1A03h           | 00h      | 4th TxPDO mapping<br>Number of mapped objects supported by TxPDO3 | -    | 0~24         | U8        | RW   | NO  |
|                 | 01h      | First mapping object                                              | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 02h      | Second mapping object                                             | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Third mapping object                                              | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | ...      | ...                                                               | -    | 0~4294967295 | U32       | RW   | NO  |
|                 | 18h      | The twenty-fourth mapping object                                  | -    | 0~4294967295 | U32       | RW   | NO  |
| 1C00h           | 00h      | Sync mangager communication type<br>Communication type            | -    | 0~255        | U8        | RO   | NO  |
|                 | 01h      | Sub index of matrix 001                                           | -    | 0~4          | U8        | RO   | NO  |
|                 | 02h      | Sub index of matrix 002                                           | -    | 0~4          | U8        | RO   | NO  |
|                 | 03h      | Sub index of matrix 003                                           | -    | 0~4          | U8        | RO   | NO  |
|                 | 04h      | Sub index of matrix 004                                           | -    | 0~4          | U8        | RO   | NO  |
| 1C12h           | 00h      | RxPDO assigns the RxPDO allocation.                               | -    | 0~4          | U8        | RW   | NO  |
|                 | 01h      | Subindex 1                                                        | -    | 1600h~1603h  | U16       | RW   | NO  |
|                 | 02h      | Subindex 2                                                        | -    | 1600h~1603h  | U16       | RW   | NO  |
|                 | 03h      | Subindex 3                                                        | -    | 1600h~1603h  | U16       | RW   | NO  |
|                 | 04h      | Subindex 4                                                        | -    | 1600h~1603h  | U16       | RW   | NO  |
| 1C13h           | 00h      | TxPDO assigns the TxPDO allocation.                               | -    | 0~4          | U8        | RW   | NO  |
|                 | 01h      | Subindex 1                                                        | -    | 1A00h~1A03h  | U16       | RW   | NO  |
|                 | 02h      | Subindex 2                                                        | -    | 1A00h~1A03h  | U16       | RW   | NO  |
|                 | 03h      | Subindex 3                                                        | -    | 1A00h~1A03h  | U16       | RW   | NO  |
|                 | 04h      | Subindex 4                                                        | -    | 1A00h~1A03h  | U16       | RW   | NO  |
| 1C32h           | 00h      | Sync manager 2 synchronization<br>Sync Management Channel 2       | -    | 0~20h        | U8        | RO   | NO  |
|                 | 01h      | Number of sub-objects                                             | -    | 0~65535      | U16       | RW   | NO  |
|                 | 02h      | Sync mode                                                         | ns   | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Cycle time                                                        | ns   | 0~4294967295 | U32       | RW   | NO  |
|                 | 04h      | Shift time                                                        | -    | 0~65535      | U16       | RO   | NO  |
|                 | 05h      | Sync modes supported<br>Set supported sync types                  | ns   | 0~4294967295 | U32       | RO   | NO  |

| index of matrix | subindex | name                                                                                                                                                      | unit | data area    | data type | sign | PDO |
|-----------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------|-----------|------|-----|
|                 | 06h      | Minimum cycle time<br>Minimum communication cycle                                                                                                         | ns   | 0~4294967295 | U32       | RO   | NO  |
|                 | 08h      | Calc and copy time<br>From SM2 event and SYNC0 event to<br>ESC read completion time                                                                       | ns   | 0~65535      | U16       | RO   | NO  |
|                 | 09h      | Command (not supported)                                                                                                                                   | ns   | 0~4294967295 | U32       | RO   | NO  |
|                 | 0Ah      | Delay time (not supported)                                                                                                                                | -    | 0~4294967295 | U32       | RO   | NO  |
|                 | 0Bh      | Sync0 cycle time<br>The value in register 09A0h of the<br>ESC is set to DC SYNC0<br>(1C32h-01h=02h). For other DC<br>SYNC0 values, the value is set to 0. | -    | 0~65535      | U16       | RO   | NO  |
|                 | 0Ch      | Cycle time is too short (not<br>supported)                                                                                                                | -    | 0~65535      | U16       | RO   | NO  |
|                 | 0Dh      | SM event missed (not supported)                                                                                                                           | -    | 0~65535      | U16       | RO   | NO  |
|                 | 0Eh      | Shift time is too short (not supported)                                                                                                                   | -    | 0~65535      | U16       | RW   | NO  |
|                 | 20h      | RxPDO toggle failed (not supported)                                                                                                                       | -    | 0~1          | BOOL      | RO   | NO  |
|                 |          |                                                                                                                                                           |      |              |           |      |     |
| 1C33h           | 00h      | Sync manager 3 synchronization<br>Sync Management Channel 3                                                                                               | -    | 0~20h        | U8        | RO   | NO  |
|                 | 01h      | Number of sub-objects                                                                                                                                     | -    | 0~65535      | U16       | RW   | NO  |
|                 | 02h      | Sync mode                                                                                                                                                 | ns   | 0~4294967295 | U32       | RW   | NO  |
|                 | 03h      | Cycle time                                                                                                                                                | ns   | 0~4294967295 | U32       | RW   | NO  |
|                 | 04h      | Shift time                                                                                                                                                | -    | 0~65535      | U16       | RO   | NO  |
|                 | 05h      | Sync modes supported<br>Set supported sync types                                                                                                          | ns   | 0~4294967295 | U32       | RO   | NO  |
|                 | 06h      | Minimum cycle time<br>Minimum communication cycle                                                                                                         | ns   | 0~4294967295 | U32       | RO   | NO  |
|                 | 08h      | Calc and copy time<br>From SM2 event and SYNC0 event to<br>ESC read completion time                                                                       | ns   | 0~65535      | U16       | RO   | NO  |
|                 | 09h      | Command (not supported)                                                                                                                                   | ns   | 0~4294967295 | U32       | RO   | NO  |
|                 | 0Ah      | Delay time (not supported)                                                                                                                                | -    | 0~4294967295 | U32       | RO   | NO  |
|                 | 0Bh      | Sync0 cycle time<br>The value in register 09A0h of the<br>ESC is set to DC SYNC0<br>(1C32h-01h=02h). For other DC<br>SYNC0 values, the value is set to 0. | -    | 0~65535      | U16       | RO   | NO  |
|                 | 0Ch      | Cycle time is too short (not<br>supported)                                                                                                                | -    | 0~65535      | U16       | RO   | NO  |
|                 | 0Dh      | SM event missed (not supported)                                                                                                                           | -    | 0~65535      | U16       | RO   | NO  |
|                 | 0Eh      | Shift time is too short (not supported)                                                                                                                   | -    | 0~65535      | U16       | RW   | NO  |
|                 | 20h      | RxPDO toggle failed (not supported)                                                                                                                       | -    | 0~1          | BOOL      | RO   | NO  |

## Appendix 2.2 Servo parameter range

| index of matrix | subindex | name  |
|-----------------|----------|-------|
| 2000h           | 00h      | P0-00 |
| 2001h           | 00h      | P0-01 |
| 2002h           | 00h      | P0-02 |
| 2003h           | 00h      | P0-03 |
| ...             | ...      | ...   |
| 205Fh           | 00h      | P0-95 |
|                 |          |       |
| 2100h           | 00h      | P1-00 |
| 2101h           | 00h      | P1-01 |
| 2102h           | 00h      | P1-02 |
| 2103h           | 00h      | P1-03 |
| ...             | ...      | ...   |
| 214Ah           | 00h      | P1-74 |
|                 |          |       |
| 2200h           | 00h      | P2-00 |
| 2201h           | 00h      | P2-01 |
| 2202h           | 00h      | P2-02 |
| 2203h           | 00h      | P2-03 |
| ...             | ...      | ...   |
| 2263h           | 00h      | P2-99 |
|                 |          |       |
| 2300h           | 00h      | P3-00 |
| 2301h           | 00h      | P3-01 |
| index of matrix | subindex | name  |
| 2302h           | 00h      | P3-02 |
| 2303h           | 00h      | P3-03 |
| ...             | ...      | ...   |
| 232Eh           | 00h      | P3-46 |

| index of matrix | subindex | name  |
|-----------------|----------|-------|
| 2500h           | 00h      | P5-00 |
| 2501h           | 00h      | P5-01 |
| 2502h           | 00h      | P5-02 |
| 2503h           | 00h      | P5-03 |
| ...             | ...      | ...   |
| 2547h           | 00h      | P5-71 |
|                 |          |       |
| 2700h           | 00h      | P7-00 |
| 2701h           | 00h      | P7-01 |
| 2702h           | 00h      | P7-02 |
| 2703h           | 00h      | P7-03 |
| ...             | ...      | ...   |
| 2715h           | 00h      | P7-21 |
|                 |          |       |
| 2800h           | 00h      | P8-00 |
| 2801h           | 00h      | P8-01 |
| 2802h           | 00h      | P8-02 |
| 2803h           | 00h      | P8-03 |
| ...             | ...      | ...   |
| 281Ah           | 00h      | P8-26 |

## Appendix 2.3 Profile region (0x6000~0x6FFF)

| index of matrix | son index of matrix | name                                                   | unit | data area | data type | sign | PDO   |
|-----------------|---------------------|--------------------------------------------------------|------|-----------|-----------|------|-------|
| 6007h           | 00h                 | Abort connection option code                           | -    | 0~3       | I16       | RW   | NO    |
| 603Fh           | 00h                 | Error Code                                             | -    | 0~65535   | U16       | RO   | TxPDO |
| 6040h           | 00h                 | Control word                                           | -    | 0~65535   | U16       | RW   | RxPDO |
| 6041h           | 00h                 | Status word                                            | -    | 0~65535   | U16       | RO   | TxPDO |
| 605Ah           | 00h                 | Quickstop option code<br>Quick shutdown mode selection | -    | 0~7       | I16       | RW   | NO    |

| index<br>of<br>matrix | son<br>index<br>of<br>matrix | name                                                                         | unit                | data area              | data<br>type | sign | PDO   |
|-----------------------|------------------------------|------------------------------------------------------------------------------|---------------------|------------------------|--------------|------|-------|
| 605Bh                 | 00h                          | Shutdown option code<br>Shut-down option code                                | -                   | 0~1                    | I16          | RW   | NO    |
| 605Ch                 | 00h                          | Disable the operation<br>option code to pause the<br>shutdown mode selection | -                   | 0~1                    | I16          | RW   | NO    |
| 605Dh                 | 00h                          | Halt option code<br>Pause option code                                        | -                   | 1~3                    | I16          | RW   | NO    |
| 605Eh                 | 00h                          | Fault reaction option code<br>failure mode and effect<br>code                | -                   | 0~2                    | I16          | RW   | NO    |
| 6060h                 | 00h                          | Modes of operation<br>mode control word                                      | -                   | -128~127               | I8           | RW   | RxPDO |
| 6061h                 | 00h                          | Modes of operation<br>display<br>Mode control word<br>display                | -                   | -128~127               | I8           | RO   | TxPDO |
| 6062h                 | 00h                          | Position demand value<br>[PUU] Position<br>instruction                       | instruct<br>unit    | -2147483648~2147483647 | I32          | RO   | TxPDO |
| 6063h                 | 00h                          | Actual internal position<br>feedback                                         | 1 encoder unit      | -2147483648~2147483647 | I32          | RO   | TxPDO |
| 6064h                 | 00h                          | Position actual value<br>position feedback                                   | instruct<br>unit    | -2147483648~2147483647 | I32          | RO   | TxPDO |
| 6065h                 | 00h                          | Following error window<br>Excessive position<br>deviation threshold          | instruct<br>unit    | 0~4294967295           | U32          | RW   | RxPDO |
| 6066h                 | 00h                          | Following error time out<br>Error timeout                                    | 1ms                 | 0~65535                | U16          | RW   | RxPDO |
| 6067h                 | 00h                          | Position windows<br>Location reaches the<br>threshold                        | instruct<br>unit    | 0~4294967295           | U32          | RW   | RxPDO |
| 6068h                 | 00h                          | Position window<br>Time to reach the position<br>threshold                   | 1ms                 | 0~65535                | U16          | RW   | RxPDO |
| 606Bh                 | 00h                          | Velocity demand value<br>velocity instruction                                | instruct<br>unit /s | -2147483648~2147483647 | I32          | RO   | TxPDO |
| 606Ch                 | 00h                          | Actual velocity value;<br>speed feedback                                     | instruct<br>unit /s | -2147483648~2147483647 | I32          | RO   | TxPDO |
| 606Dh                 | 00h                          | Velocity window<br>Speed reaches the<br>threshold                            | instruct<br>unit    | 0~4294967295           | U32          | RW   | RxPDO |
| 606Eh                 | 00h                          | Velocity window time<br>speed to window time                                 | 1ms                 | 0~65535                | U16          | RW   | RxPDO |
| 606Fh                 | 00h                          | Velocity threshold                                                           | instruct<br>unit    | 0~4294967295           | U32          | RW   | RxPDO |
| 6070h                 | 00h                          | Velocity threshold time<br>Speed threshold time                              | 1ms                 | 0~65535                | U16          | RW   | RxPDO |
| 6071h                 | 00h                          | target torque                                                                | 0.10%               | -32768~32767           | I16          | RW   | RxPDO |
| 6072h                 | 00h                          | Maximum torque                                                               | 0.10%               | 0~65535                | U16          | RW   | RxPDO |
| 6073h                 | 00h                          | Maximum current                                                              | 0.10%               | 0~65535                | U16          | RO   | NO    |
| 6074h                 | 00h                          | Torque demand value                                                          | 0.10%               | -32768~32767           | I16          | RO   | TxPDO |

| index of matrix | son index of matrix              | name                                                     | unit                             | data area              | data type | sign | PDO   |
|-----------------|----------------------------------|----------------------------------------------------------|----------------------------------|------------------------|-----------|------|-------|
|                 |                                  | torque command                                           |                                  |                        |           |      |       |
| 6075h           | 00h                              | Motor rated current<br>Rated current of the motor        | 1mA                              | 0~4294967295           | U32       | RO   | TxPDO |
| 6076h           | 00h                              | Motor rated torque<br>motor rated torque                 | Mn·m                             | 0~4294967295           | U32       | RO   | TxPDO |
| 6077h           | 00h                              | Actual torque value  <br>Torque feedback                 | 0.10%                            | -32768~32767           | I16       | RO   | TxPDO |
| 6078h           | 00h                              | Current actual value<br>Current actual value             | 0.10%                            | -32768~32767           | I16       | RO   | TxPDO |
| 6079h           | 00h                              | DC link circuit voltage<br>busbar voltage                | mV                               | 0~4294967295           | U32       | RO   | TxPDO |
| 607Ah           | 00h                              | Target position                                          | instruct unit                    | -2147483648~2147483647 | I32       | RW   | RxPDO |
| 607Bh           | Position range limit             |                                                          |                                  |                        |           |      | -     |
|                 | 00h                              | Number of entries<br>Number of subindexes                | -                                | 2                      | U8        | RO   | NO    |
|                 | 01h                              | Min position range limit<br>Minimum position range limit | instruct unit                    | -2147483648~2147483647 | I32       | RW   | RxPDO |
|                 | 02h                              | Max position range limit<br>Maximum location range limit | instruct unit                    | -2147483648~2147483647 | I32       | RW   | RxPDO |
| 607Ch           |                                  | Home Offset Origin<br>Offset                             | instruct unit                    | -2147483648~2147483647 | I32       | RW   | RxPDO |
| 607Dh           | Software absolute position limit |                                                          |                                  |                        |           |      | -     |
|                 | 00h                              | Number of entries<br>Number of subindexes                | -                                | 2                      | U8        | RO   | NO    |
|                 | 01h                              | Min position limit<br>Minimum position limit             | instruct unit                    | -2147483648~2147483647 | I32       | RW   | RxPDO |
|                 | 02h                              | Max position limit<br>Maximum location limit             | instruct unit                    | -2147483648~2147483647 | I32       | RW   | RxPDO |
| 607Eh           | 00h                              | Polarity instruction<br>polarity                         | -                                | 0~255                  | U8        | RW   | NO    |
| 607Fh           | 00h                              | Max Profile velocity<br>maximum outline velocity         | instruct unit /s                 | 0~4294967295           | U32       | RW   | RxPDO |
| 6080h           | 00h                              | Max motor speed<br>maximum motor speed                   | r/min                            | 0~4294967295           | U32       | RW   | RxPDO |
| 6081h           | 00h                              | Profile velocity<br>Contour speed                        | instruct unit /s                 | 0~4294967295           | U32       | RW   | RxPDO |
| 6082h           | 00h                              | End velocity                                             | Command unit/s                   | 0~4294967295           | U32       | RW   | RxPDO |
| 6083h           | 00h                              | Profile acceleration<br>contour acceleration             | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | RW   | RxPDO |
| 6084h           | 00h                              | Profile deceleration<br>contour deceleration             | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | RW   | RxPDO |
| 6085h           | 00h                              | Quick stop deceleration<br>rapid deceleration            | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | RW   | RxPDO |
| 6086h           | 00h                              | Motion profile type<br>Location trajectory               | -                                | -32768~32767           | I16       | RW   | RxPDO |



| index of matrix | son index of matrix | name                                                       | unit                                               | data area    | data type | sign | PDO   |
|-----------------|---------------------|------------------------------------------------------------|----------------------------------------------------|--------------|-----------|------|-------|
|                 |                     | planning type                                              |                                                    |              |           |      |       |
| 6087h           | 00h                 | Torque slope                                               | 0.1%/S                                             | 0~4294967295 | U32       | RW   | RxPDO |
| 6088h           | 00h                 | Torque profile type<br>Torque planning type                | -                                                  | 0-65535      | I16       | RW   | RxPDO |
| 608Fh           | -                   | Position encoder resolution<br>Position encoder resolution | -                                                  | -            | -         | -    | -     |
|                 | 00h                 | Number of entries subindex                                 | -                                                  | 2            | U8        | RO   | NO    |
|                 | 01h                 | Sub index of matrix 001                                    | pulse                                              | 1~4294967295 | U32       | RO   | NO    |
|                 | 02h                 | Sub index of matrix 002                                    | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | RO   | NO    |
| 6091h           | -                   | gear ratio setting                                         | -                                                  | -            | -         | -    | -     |
|                 | 00h                 | Indicates the 6091h sub-index number                       | -                                                  | 2            | U8        | RO   | NO    |
|                 | 01h                 | motor rotation number                                      | r ( any power-generating or power-driven machine ) | 1~4294967295 | U32       | RW   | NO    |
|                 | 02h                 | rotation number                                            | r ( axle )                                         | 1~4294967295 | U32       | RW   | NO    |
| 6092h           | -                   | Feed constant settings                                     | -                                                  | -            | -         | -    | -     |
|                 | 00h                 | Indicates the 6092h sub-index number                       | -                                                  | 2            | U8        | RO   | NO    |
|                 | 01h                 | Set the Feed value                                         | instruct unit                                      | 1~4294967295 | U32       | RW   | NO    |
|                 | 02h                 | rotation number                                            | r ( axle )                                         | 1~4294967295 | U32       | RW   | NO    |
| 6093h           | 00h                 | Position factor                                            | No supported                                       |              |           |      |       |
| 6098h           | 00h                 | homing method                                              | -                                                  | -128~127     | I8        | RW   | RxPDO |
| 6099h           | homing speed        |                                                            |                                                    |              |           |      | -     |
|                 | 00h                 | Number of entries                                          | -                                                  | 2            | U8        | RO   | NO    |
|                 | 01h                 | Sub index of matrix 001                                    | Command unit/s                                     | 0~4294967295 | U32       | RW   | RxPDO |
|                 | 02h                 | Sub index of matrix 002                                    | Command unit/s                                     | 0~4294967295 | U32       | RW   | RxPDO |
| 609Ah           | 00h                 | Homing acceleration return to zero acceleration            | -                                                  | 0~4294967295 | U32       | RW   | RxPDO |
| 60A3h           | -                   | Profile jerk use                                           | Not supported                                      |              |           |      |       |
|                 | 00h                 | Profile jerk                                               |                                                    |              |           |      |       |
| 60A4h           | 01h                 | Sub index of matrix 001                                    |                                                    |              |           |      |       |
|                 | 02h                 | Sub index of matrix 002                                    |                                                    |              |           |      |       |
| 60B0h           | 00h                 | Position offset                                            | Not supported                                      |              |           |      |       |
| 60B1h           | 00h                 | Velocity offset                                            |                                                    |              |           |      |       |
| 60B2h           | 00h                 | Torque offset                                              |                                                    |              |           |      |       |
| 60B8h           | 00h                 | Touch probe function probe function                        | -                                                  | 0~65535      | U16       | RW   | RxPDO |

| index of matrix | son index of matrix     | name                                                                           | unit                             | data area              | data type | sign | PDO   |
|-----------------|-------------------------|--------------------------------------------------------------------------------|----------------------------------|------------------------|-----------|------|-------|
| 60B9h           | 00h                     | Touch probe status probe state                                                 | -                                | 0~65535                | U16       | RO   | TxPDO |
| 60BAh           | 00h                     | Touch probe pos1 pos value<br>Probe 1 rising edge position value               | instruct unit                    | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60BBh           | 00h                     | Touch probe pos1 neg value<br>Probe 1 rising edge position value               | instruct unit                    | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60BCh           | 00h                     | Touch probe pos2 pos value<br>Probe 2 rising edge position value               | instruct unit                    | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60BDh           | 00h                     | Touch probe pos2 neg value<br>Probe 2 rising edge position value               | instruct unit                    | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60C0h           |                         | Interpolation sub mode select                                                  | No supported                     |                        |           |      |       |
| 60C1h           | -                       | Interpolation data record                                                      |                                  |                        |           |      |       |
|                 | 00h                     | Number of entries                                                              |                                  |                        |           |      |       |
|                 | 01h                     | Sub index of matrix 001                                                        |                                  |                        |           |      |       |
|                 | 02h                     | Sub index of matrix 002                                                        |                                  |                        |           |      |       |
| 60C2h           | -                       | Interpolation time period                                                      | -                                | -                      | -         | -    | -     |
|                 | 00h                     | Number of entries                                                              | -                                | 2                      | U8        | RO   | TxPDO |
|                 | 01h                     | Sub index of matrix 001                                                        | -                                | 0~4294967295           | U32       | RW   | TxPDO |
|                 | 02h                     | Sub index of matrix 002                                                        | -                                | 0~4294967295           | U32       | RW   | TxPDO |
| 60C5h           | -                       | Max acceleration<br>maximal acceleration                                       | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | RW   | RxPDO |
| 60C6h           | -                       | Max deceleration<br>maximum deceleration                                       | instruction units/s <sup>2</sup> | 0~4294967295           | U32       | RW   | RxPDO |
| 60E0h           | 00h                     | Positive torque limited<br>positive torque limit                               | No supported                     |                        |           |      |       |
| 60E1h           | 00h                     | Negative torque limited<br>reverse torque limit                                | No supported                     |                        |           |      |       |
| 60E3h           | Supported Homing method |                                                                                |                                  |                        |           |      | TxPDO |
|                 | 00h                     | Number of entries<br>Number of subindexes                                      | -                                | 1~254                  | U8        | RO   | TxPDO |
|                 | 01h                     | 1st supported Homing method<br>Original method 1 supported                     | -                                | 0~32767                | U16       | RO   | TxPDO |
|                 | ..                      | ..                                                                             | ..                               | ..                     | ..        | ..   | ..    |
|                 | 20h                     | 32nd supported Homing method<br>The restore method supports 32 restore methods | -                                | 0~32767                | U16       | RO   | TxPDO |
| 60F2h           | 00h                     | Positioning option code                                                        | -                                | 0~32767                | U16       | RW   | RxPDO |

| index of matrix | son index of matrix | name                                                                | unit           | data area              | data type | sign | PDO   |
|-----------------|---------------------|---------------------------------------------------------------------|----------------|------------------------|-----------|------|-------|
|                 |                     | Location options code                                               |                |                        |           |      |       |
| 60F4h           | 00h                 | Position deviation of the actual value of the error                 | instruct unit  | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60FAh           | 00h                 | After the error, the actual value of the internal instruction speed | Command unit/s | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60FCh           | 00h                 | Position demand value position instruction                          | pulse          | -2147483648~2147483647 | I32       | RO   | TxPDO |
| 60FDh           | 00h                 | Digital inputs                                                      | Digital inputs |                        |           |      |       |
| 60FEh           | -                   | Digital outputs                                                     | No supported   |                        |           |      |       |
|                 | 00h                 | Number of entries                                                   |                |                        |           |      |       |
|                 | 01h                 | Physical outputs                                                    |                |                        |           |      |       |
|                 | 02h                 | Bit mask                                                            |                |                        |           |      |       |
| 60FFh           | 00h                 | Target velocity                                                     | Command unit/s | 0~4294967295           | U32       | RW   | RxPDO |
| 6502h           | 00h                 | Supported drive modes<br>Supported drive mode                       | -              | 0~4294967295           | U32       | RO   | TxPDO |



- The object dictionaries 607Bh (Position Range Limited) and 607Dh (Softward Position Limited) have default values: Min range limited: -2147483648; Max range limited: 2147483647.

This parameter modification does not work.

- 6086h (Motion Profile Type)

Parameter 0: Step type 1: Slope type

This parameter applies only to HM mode. It is the slope type used directly in the trajectory planning of PP and PV modes.

In CSP and CSV modes, this parameter is unnecessary, as trajectory planning is handled by the master station.

- 6088h (Torque profile type)

Parameter 0: Step type 1: Slope type

## Appendix 3. Glossary

| the abbreviated form of a name | full name                                                                                             | description                                                                                                                            |
|--------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| EtherCAT                       | Ethernet for Control Automation Technology                                                            | The Communication Function of Ethernet for Automation Control Technology                                                               |
| COE                            | CANopen Over EtherCAT                                                                                 | CAN Application Protocol Based on EtherCAT                                                                                             |
| FMMU                           | Fieldbus Memory Management Unit                                                                       | fieldbus memory management unit                                                                                                        |
| SM                             | Sync Manager                                                                                          | Sync Manager                                                                                                                           |
| pp                             | Profile position                                                                                      | Internal Location Control Mode                                                                                                         |
| pV                             | Profile velocity                                                                                      | Internal speed control mode                                                                                                            |
| tq                             | Torque profile                                                                                        | internal torque control mode                                                                                                           |
| csp                            | Cyclic synchronous position mode                                                                      | cyclic position control mode                                                                                                           |
| hm                             | Homing mode                                                                                           | origin reset position control mode                                                                                                     |
| csv                            | Cyclic synchronous velocity mode                                                                      | cyclic speed control mode                                                                                                              |
| cst                            | Cyclic synchronous torque mode                                                                        | cyclic torque control mode                                                                                                             |
| DC                             | Distributed Clock                                                                                     | distributed clock                                                                                                                      |
| SDO                            | Service Data Object                                                                                   | A service data object for transmitting non-periodic communication data                                                                 |
| PDO                            | Process Data Object                                                                                   | Process data object for transmitting periodic communication data                                                                       |
| TxPDO                          | -                                                                                                     | PDO from slave to master                                                                                                               |
| RxPDO                          | -                                                                                                     | PDO from master to slave                                                                                                               |
| ESM                            | EtherCAT State Machine                                                                                | EtherCAT state machine                                                                                                                 |
| ESC                            | EtherCAT Slave Controller                                                                             | station controller                                                                                                                     |
| PHY                            | Physical layer device that converts data from the Ethernet controller to electric or optical signals. | A physical layer device that converts data from Ethernet controllers into electrical or optical signals.                               |
| PDI                            | Process Data Interface or Physical Device Interface                                                   | process data interface                                                                                                                 |
| EEPROM                         | Electrically Erasable Programmable Read Only Memory                                                   | A programmable read-only memory for non-volatile storage of ESC configuration and device descriptions. Connected to the ESI interface. |
| ESI                            | EtherCAT Slave Information, stored in ESI EEPROM (formerly known as SII)                              | EtherCAT data is stored in the ESI EEPROM (formerly known as SII).                                                                     |

# Manual update log

Information about the revision of the data is recorded together with the data number in the lower right corner of the cover of the data.

| order number | Document ID           | chapters and sections | Update content                                                                                                                                                                                                                                                                                                 |
|--------------|-----------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | SM6 01 20250407 1.0   | -                     | The first edition of the manual was published.                                                                                                                                                                                                                                                                 |
| 2            | SM6 01 20250416 1.0.1 | -                     | Change the content of section 1.1.4.                                                                                                                                                                                                                                                                           |
| 3            | SM6 01 20250612 1.1   | -                     | 1、New models (45/55/75kW) with detailed specifications, performance parameters, electrical standards, and dimensional diagrams.<br>2、Update servo motor model, parts description, and shaft radial load specifications.<br>3. The instructions for optimizing motor installation and environmental conditions. |



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