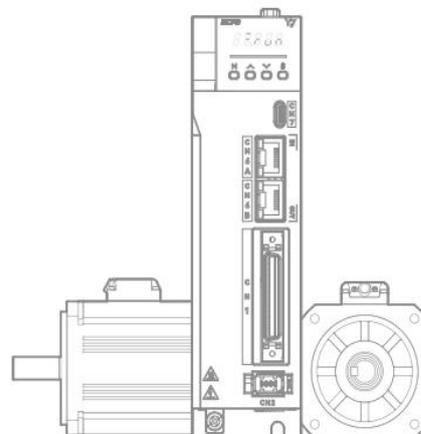

KCFA

Y7 Smart *High-end Servo System*

EtherCAT bus type

User Manual



February, 2023 V1.0
Manula No.:ATC/MY7SEH2310



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Preface

Thank you for using Y7S series servo drive. This operation manual provides information about Y7 Smart Series High Performance Servo System (Hereinafter referred to as Y7S for short) - EtherCAT Servo Drive and related Motor products. Please follow this manual to ensure the correct use method. If you carry out the wrong use method and handling method, it will not only fail to give full play to the performance of the product, but also lead to accidents and shorten the service life of the product.

We hope that you will properly use this product based on carefully reading this instruction manual.

About the instruction manual

① Although every effort has been made to perfect the manual, please feel free to ask us if you have any doubts about the contents.

② The following items should be specified in the instruction manual of the product

- Danger, it is a high-voltage electric machine.
- Danger, voltage remains inside the terminals and machinery after power cut off.
- Local high temperature
- Dismantling is strictly prohibited.

③ This product is subject to specification changes and function additions at any time due to performance upgrades and other reasons. No other notice will be given.

④ If you plan to obtain safety specifications for the equipment equipped with this product, please consult with us in advance.

⑤ To extend the service life of the motor and driver, please use them under the correct conditions of use. Please follow the instruction manual for details.

(6) The operating instructions are as up-to-date as possible, so the contents may change from time to time. If you need a new version of the instruction manual, please contact us for a copy.

(7) Reproduction of part or all of the contents of this User's Manual without the consent of the Company is prohibited.

Confirmation matters when opening the box

- Whether the physical product matches the ordered one.
- Whether there was damage during delivery.
- If you find a problem, please contact your dealer.

Read the content before use

Thank you for using Y7S series EtherCAT servo driver. This manual provides information about Y7S series EtherCAT type servo drive, please make sure to refer to this manual when installing, using and maintaining Y7S series products. Incorrect use and handling methods will not only fail to give full play to the performance of the product and lead to a shortened product life, but will also cause accidents.

Please keep the manual so that you can refer to it when needed.

Terminology

For the terminology used in this manual, please refer to the following descriptions.

| Terminology | Description |
|--------------------|--|
| Servo motor | X2 series, X6 series servo motors |
| Servo Drive | Y7S Series EtherCAT Servo Drive |
| Servo system | A complete system consisting of a servo drive, a host controller and external equipment |
| Servo ON | Motor energized |
| Servo OFF | Motor not energized |
| Base blocking (BB) | Non-energized state formed by cutting off the base current of the power transistor of the current amplifier |
| Servo locking | The state in which the motor is stopped by a zero position command in the position loop |
| Main circuit cable | Cables connected to the main circuit terminals (main circuit power cables, control power cables, servo motor circuit cables, etc.) |

Readers

This manual is intended for reading by.



- whom Possesses knowledge of electrical engineering.
- whom is in charge of transporting and storing Y7S series EtherCAT servo drives or related products.
- whom is responsible for installation, connection, commissioning, and maintenance of Y7S series EtherCAT servo drives or related products.

Products Range of the Manual

| This manual mainly provides information on the following products |
|---|
| Y7S Series EtherCAT Servo Drive |
| |

Confirmation when opening the box

| Projects | Content |
|--|---------|
| Whether the physical product matches the ordered one | |
| Whether the accessories are complete | |
| Whether there is any damage during the delivery. | |

Manual Revision Notes

| Versions | Revised content |
|----------|-----------------|
| V1.0 | First Edition |

Other notes

- The content of this manual will be modified with the hardware and software changes to the product and a series of related information such as product specifications, relevant updates will be released on the official website of HCFA: www.hcfa.cn without notice.
- The content of this manual is edited based on product information and customer requirements. If there is any doubt on the contents of the manual, welcome to call us or send an email to 400@hcfa.cn and follow the version number marked on the cover to help clarify.
- Reproduction, duplication, etc. of part or all of this manual is strictly prohibited.

Trademarks

- **EtherCAT®** is owned by Beckoff Automation GmbH, Germany; **MECHATROLINK®** owned by the MECHATROLINK Association is an open field network.
- Other products described in this manual, product names and trademarks or registered trademarks of products are the property of respective companies and are not our products.

Safety Precautions

When installation, wiring, operation, maintenance and inspection, always read this information and heed the precautions that are provided.

- For ignoring the contents of the manual and using the product incorrectly, the degree of harm and damage that may occur is distinguished by the following safety signs.

Security markings and their meanings are as follows:



Indicates danger of death or serious injury may occur if precautions not heeded.



Indicates an accident that may result in injury or property damage if precautions not heeded



Indicates the "Prohibited Items" that are prohibited from being implemented.



Indicates the "mandatory" content that must be implemented.

| Danger | | |
|--------------------------------------|--|---|
| About Installation and Wiring | | |
| | Do not connect the motor directly to a commercial power source. | There is a risk of fire and malfunction. |
| | Do not place combustible materials around the motor or drive. | There is a risk of a fire accident. |
| | The drive must be protected by an outer case. When setting up the protective outer case, the distance between the outer case wall, other machines and the drive must be maintained as specified in the operating instructions. | There is a risk of electric shock, fire and malfunction. |
| | It should be installed in a place where there is less dust and where it will not come into contact with water, oil, etc. | There is a risk of electric shock, fire, malfunction and breakage. |
| | Motors and drives are mounted on non-combustible materials such as metal. | There is a risk of a fire accident. |
| | Be sure to have a professional electrician perform the wiring operation. | There is a risk of electric shock. |
| | The FG terminal of the motor and driver must be grounded. | There is a risk of electric shock. |
| | The upper circuit breaker must be disconnected in advance for proper wiring. | There is a risk of electric shock, injury, malfunction, and breakage. |
| | The cable should ensure that the connection is good and the energized parts must be insulated with insulating materials to effectively achieve insulation. | There is a risk of electric shock, fire and malfunction. |
| About Operation | | |
| | Do not touch the inside of the drive. | There is a risk of burning and electric shock |
| | Do not allow the cable to be damaged, subjected to excessive external force, heavy pressure, or pinched. | There is a risk of electric shock and malfunction. |

| | | |
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| | Do not touch the rotating part of the motor while it is running. | There is a risk of injury accidents. |
| | Do not use the cable by immersing it in oil or water. | There is a risk of electric shock, injury and fire accidents. |
| | Do not do wiring and operation with wet hands | There is a risk of electric shock, injury and fire accidents. |
| | Do not touch the keyway with your bare hands when using a motor with a keyway on the shaft end, | There is a risk of injury accidents. |
| | The temperature of the motor, driver, and heat sink will rise, so do not touch them. | There is a risk of burning or component damage accidents. |
| | Do not use external power to drive the motor. | There is a risk of a fire accident. |

About other precautions on use

| | | |
|--|--|---|
| | Be sure to confirm safety after an earthquake. | There is a risk of electric shock, injury and fire accidents. |
| | To prevent fire and personal accidents in the event of an earthquake, it should be practically set up and installed. | There is a risk of injury, electric shock, fire, malfunction, and breakage. |
| | Be sure to set up an emergency stop circuit on the outside to ensure that you can stop the operation and cut off the power in time in case of emergency. | There is a risk of injury, electric shock, fire, malfunction, and breakage. |

About maintenance and spot checks

| | | |
|--|---|--|
| | The drive has dangerous high voltage parts. When performing wiring and point inspection, the power must be disconnected and discharged (5 minutes or more). What ' s more, it is absolutely not allowed to be disassembled. | There is a risk of electric shock accidents. |
|--|---|--|

Caution

About installation and wiring

| | | |
|--|---|--|
| | The motor and drive are to be combined in the specified match. | There is a risk of fire and malfunction. |
| | Do not touch the connector terminals directly. | There is a risk of electric shock and malfunction. |
| | Pay attention to the vent not to be blocked, or get foreign objects into. | There is a risk of electric shock and fire. |

| | | |
|---|--|--|
| | The test run must be performed with the motor fixed and separated from the rest of the mechanical system. It must be installed on the mechanical system after confirmation. | There is a risk of injury accidents. |
| | Observe the specified installation method and installation direction. | There is a risk of injury and malfunction. |
| | Please install properly according to the weight of the equipment itself and the rated output of the product. | There is a risk of injury and malfunction. |
| About operation and running | | |
|  | Do not stand on the product, or place heavy objects on the product. | There is a risk of electric shock, injury, malfunction and breakage. |
| | Extreme gain adjustments and changes are prohibited | There is a risk of malfunction and breakage. |
| | Do not use in areas exposed to direct sunlight. | There is a risk of a malfunction. |
| | Do not subject the motor and the motor shaft to strong shocks. | There is a risk of a malfunction. |
| | The purpose of the motor's built-in brake is to hold and it is prohibited to be used in the usual braking situations. | There is a risk of injury and malfunction. |
|  | When power is restored after a power outage, there is a possibility of sudden start-up, so please do not approach the machine. Be sure to set the machine properly to ensure personal safety | There is a risk of injury accidents. |
| | Do not use faulty or broken motors and drives. | There is a risk of electric shock, fire, and injury. |
| | Please check if the power supply specification is normal. | There is a risk of failure. |
| | The holding brake is not a stopping device to ensure the safety of the machine. Please install a stopping device on the machine side to ensure safety. | There is a risk of injury accidents. |
| | When an alarm is raised, troubleshooting the causes and ensure safety, then release the alarm and restart. | There is a risk of injury accidents. |
| | Relays for brakes and emergency stop circuit breakers need to be connected in series. | There is a risk of injury and malfunction. |
| About handling and storage | | |
|  | It cannot be stored in places where rain and water drops are splashed, or where there are toxic gases and liquids. | There is a risk of a malfunction. |
| | Do not grip the cable or motor shaft when handling. | There is a risk of injury and malfunction. |
|  | Take care of falling or overturning when handling and installation. | There is a risk of injury and malfunction. |
| | If long-term storage is required, please contact us with the information listed in this manual. | The cause of the malfunction. |

| | | |
|--|---|-------------------------------------|
| | Please store the products in a place that conforms to the storage environment specified in this manual. | There is a risk of a malfunction. |
| About other precautions on use | | |
|  | When disposing of the battery, please insulate the battery with tape, etc. and dispose of it according to the regulations of the relevant department. | |
| | Please dispose of it as industrial waste when it is disposed of. | |
| About maintenance and spot checks | | |
|  | Do not disassemble for repair work other than by our company. | There is a risk of a malfunction. |
| | The main circuit power switch should not be turned on and off frequently. | There is a risk of a malfunction. |
| | If the drive fails, disconnect the control power and main circuit power. | There is a risk of a fire accident. |
| | Be sure to cut off the main power when not in use for a long time. | There is a risk of injury accidents |
| About maintenance and spot checks | | |
| <p>〈Warranty Period〉</p> <p>- The product is guaranteed for 18 months from the month of manufacture of our company. However, for motors with brakes, it is a prerequisite that the number of acceleration and deceleration of the shaft does not exceed the service life.</p> | | |
| <p>〈Guarantee content〉</p> <p>- Under normal use in accordance with this manual, repair is free of charge in the event of a failure during the warranty period. However, if the following failure occurs, repair will be charged even if the product is in warranty period,</p> <ul style="list-style-type: none"> I Wrong way of use, and inappropriate repair and modification. II Dropping, and damage not due to quality issue. III Use the product out of the product specifications. IV Fire, earthquake, falling lightning, wind and flood, salt damage, voltage anomalies and other disasters. V Water, oil, metal pieces, other foreign objects intrusion. <p>- The scope of the warranty is the body of the delivered goods, and any damage caused by the failure of the delivered goods is judged to be out the scope of compensation.</p> | | |

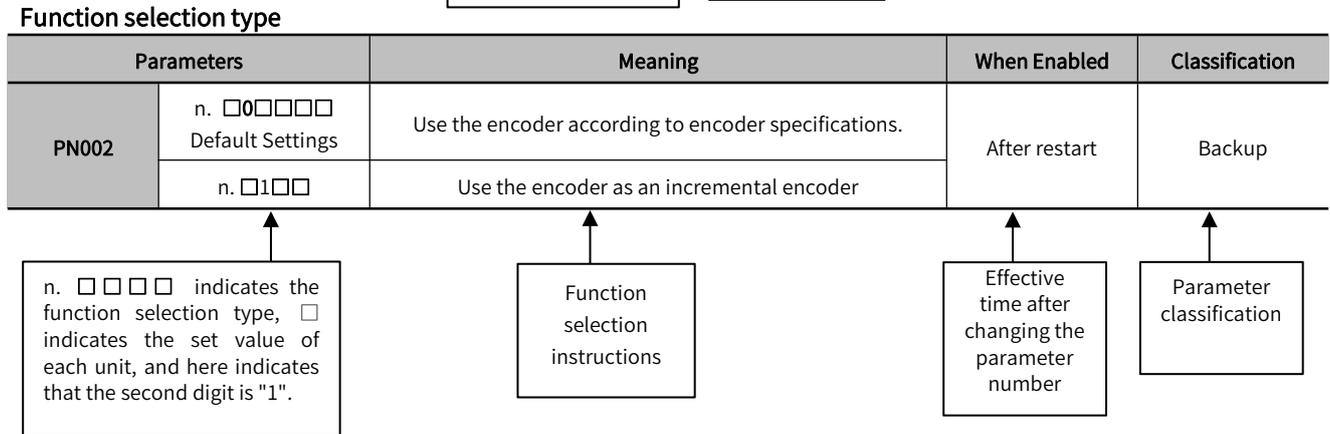
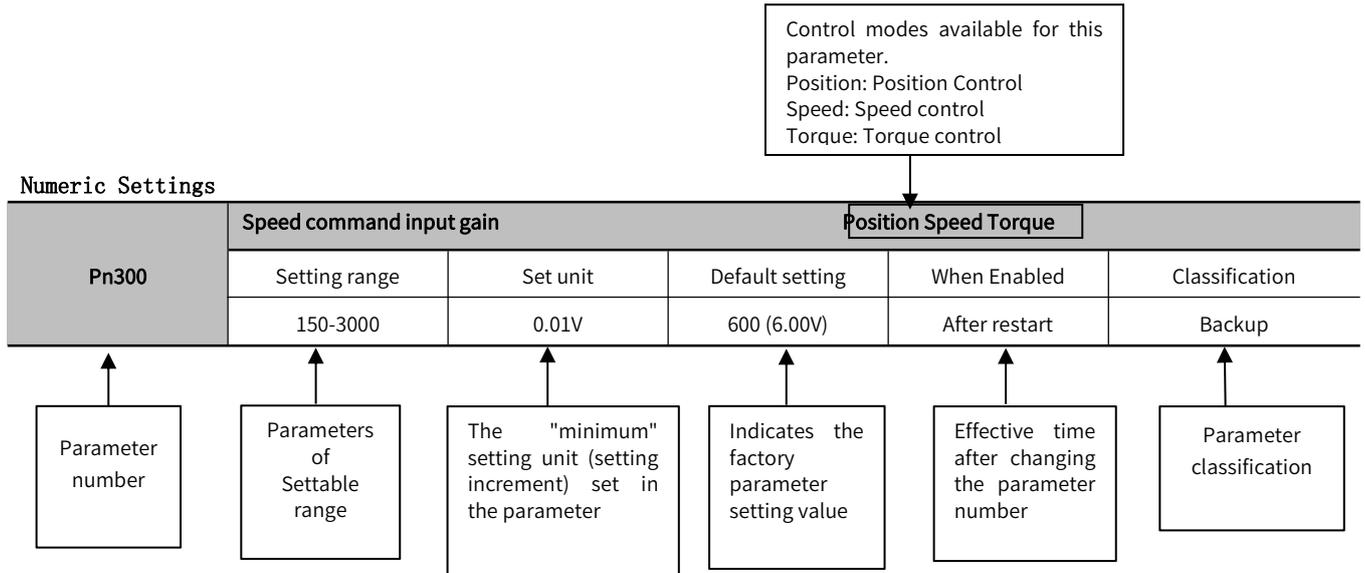
Notation Used in the Manual

Notation for Reverse Signals

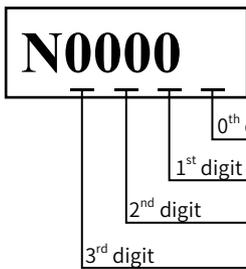
The names of reverse signals (i.e., ones that are valid when low) are written with a forward slash (/) before the signal abbreviation. For example, BK is written as /BK.

Notation for Parameters

The notation depends on whether the parameter requires a numeric setting (parameter for numeric setting) or requires the selection of a function (parameter for selecting functions).



Writing example (Pn002.0 writing example)



| Digit Notation | | Numeric Value Notation | |
|----------------|--|------------------------|--|
| Notation | Meaning | Notation | Meaning |
| Pn002.0 | Indicates the 0th digit of the parameter | Pn002.0=X | Indicates that the 0th digit of the parameter is "x" |
| Pn002.1 | Indicates the 1st digit of the parameter | Pn002.1=X | Indicates that the 1st digit of the parameter is "x" |
| Pn002.2 | Indicates the 2nd digit of the parameter | Pn002.2=X | Indicates that the 2nd digit of the parameter is "x" |
| Pn002.3 | Indicates the 3rd digit of the parameter | Pn002.3=X | Indicates that the 3rd digit of the parameter is "x" |



Chapter 1 Y7S Overview



| | | |
|-----------|---|----|
| Chapter 1 | Y7S Overview | 1 |
| 1.1 | Y7 Smart Series Features | 2 |
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1.1 Y7 Smart Series Features

HCFA Y7 Smart series high performance servo system (Y7S for short) adopts a new control algorithm platform to meet the diverse control needs of customers in different industries with superior drive performance, richer bus and expansion functions. At the same time, it has 7 core features such as higher dynamic response, positioning accuracy and reliability, as well as faster speed, ease of use and adjustment-free function, which can fully help customers upgrade their industries and enhance the value and efficiency of machine tools. Let us work with you to redefine the performance of your machine.

For specific applications of pulse products, please refer to "Y7 Smart Series Advanced Servo System Pulse Type Manual" and for applications of EtherCAT products, please refer to "Y7 Smart Series Advanced Servo System EtherCAT Bus Technology Manual".

1.2 Y7S Nameplate Information

Y7S series Servo Drive version information can be viewed through the label on the side of the product.

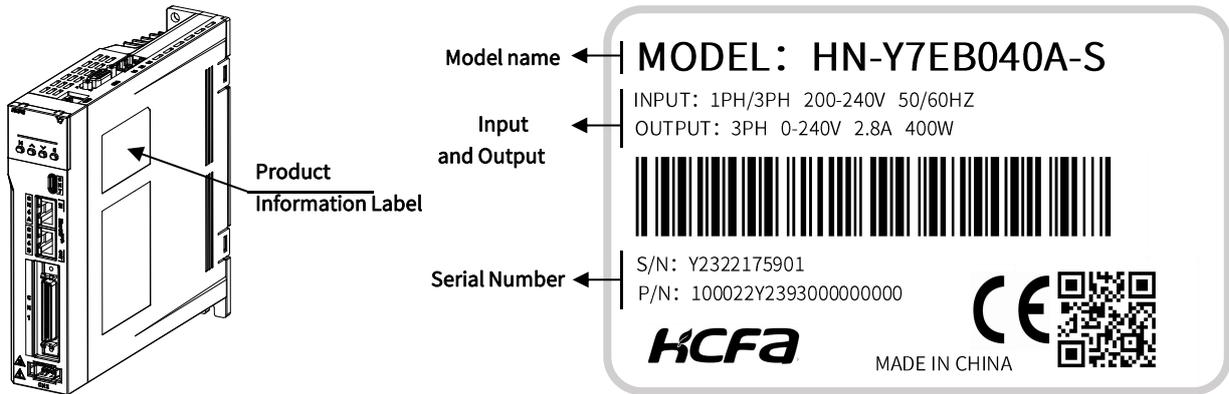


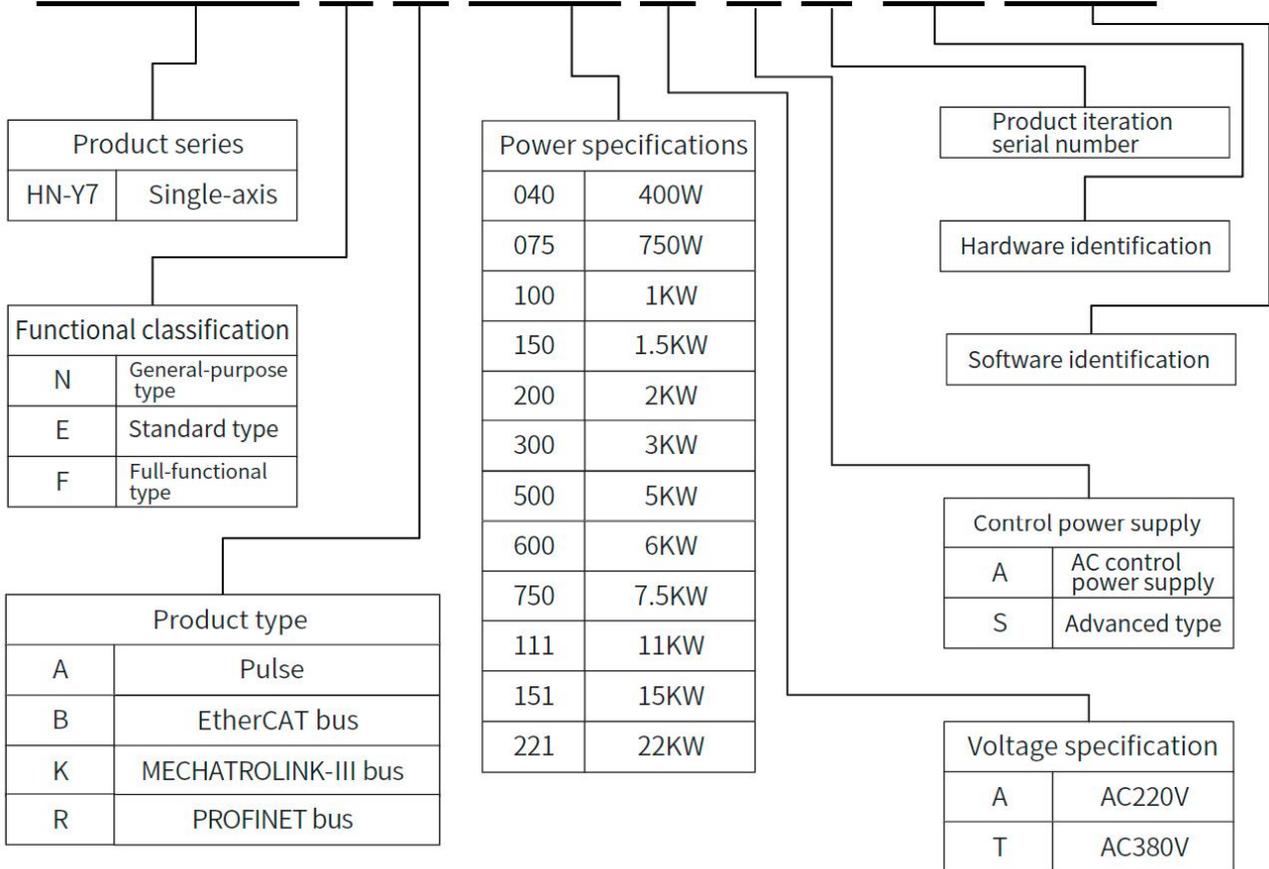
Figure 1-1 Y7S nameplate information diagram

Table 1-1 Label

| Projects | Function Description |
|------------------------|---|
| Model Name | Display the model name of this product |
| Input and output power | Shows the input and output power of the product INPUT: Current phase Rated input voltage Current frequency OUTPUT: Current phase Output voltage range Maximum output current Maximum output power |
| Serial number | Display the serial number of this product S/N: Internal serial number P/N: Internal serial number |

1.3 Y7S Drive Naming Rules

HN-Y7 E A 100 T-S 1-00 000



| Product series | |
|----------------|-------------|
| HN-Y7 | Single-axis |

| Functional classification | |
|---------------------------|----------------------|
| N | General-purpose type |
| E | Standard type |
| F | Full-functional type |

| Product type | |
|--------------|----------------------|
| A | Pulse |
| B | EtherCAT bus |
| K | MECHATROLINK-III bus |
| R | PROFINET bus |

| Power specifications | |
|----------------------|-------|
| 040 | 400W |
| 075 | 750W |
| 100 | 1KW |
| 150 | 1.5KW |
| 200 | 2KW |
| 300 | 3KW |
| 500 | 5KW |
| 600 | 6KW |
| 750 | 7.5KW |
| 111 | 11KW |
| 151 | 15KW |
| 221 | 22KW |

| | |
|---------------------------------|--|
| Product iteration serial number | |
|---------------------------------|--|

| | |
|-------------------------|--|
| Hardware identification | |
|-------------------------|--|

| | |
|-------------------------|--|
| Software identification | |
|-------------------------|--|

| Control power supply | |
|----------------------|-------------------------|
| A | AC control power supply |
| S | Advanced type |

| Voltage specification | |
|-----------------------|--------|
| A | AC220V |
| T | AC380V |

1.1 Y7S AC220V Servo Drive Part Name Diagram

1.1.1 AC220V 400W Servo Drive Part Name Diagram

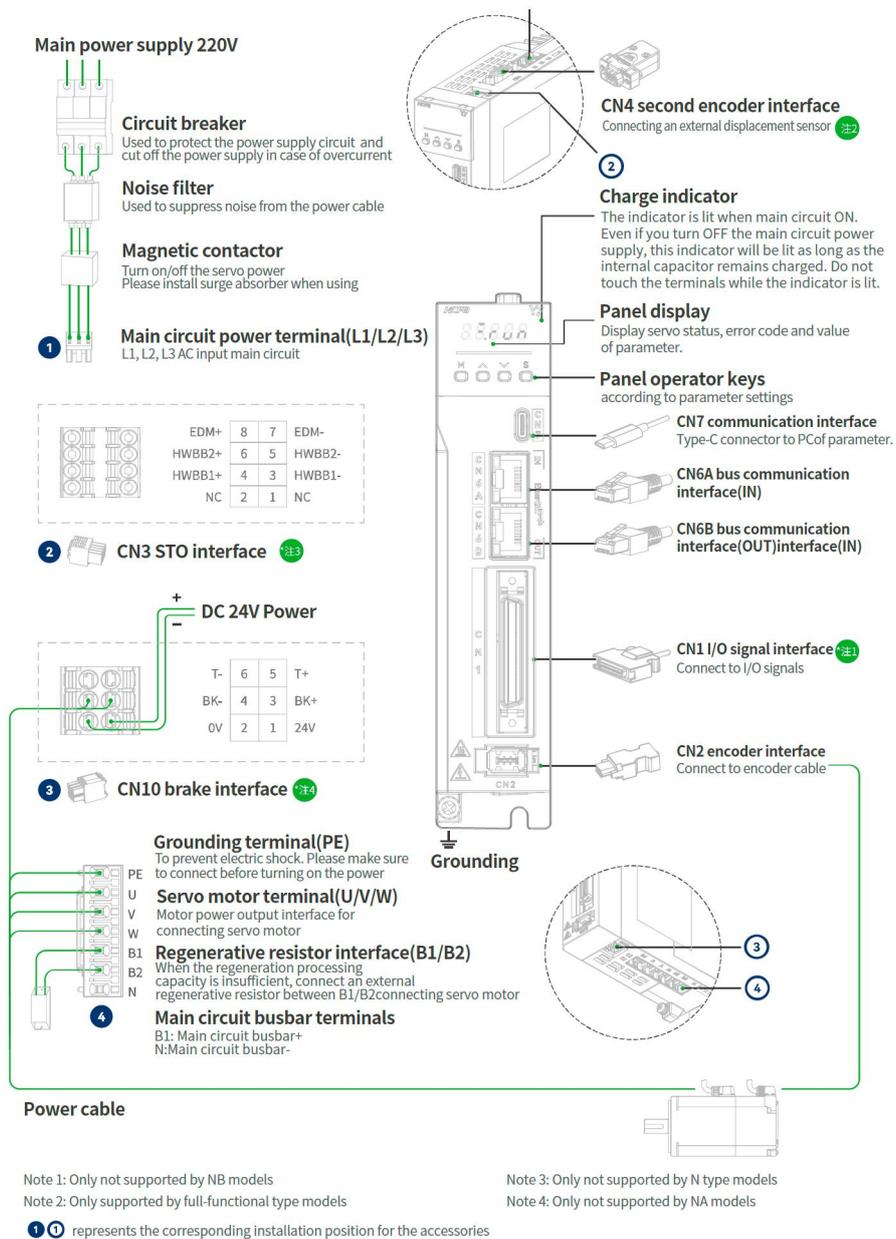
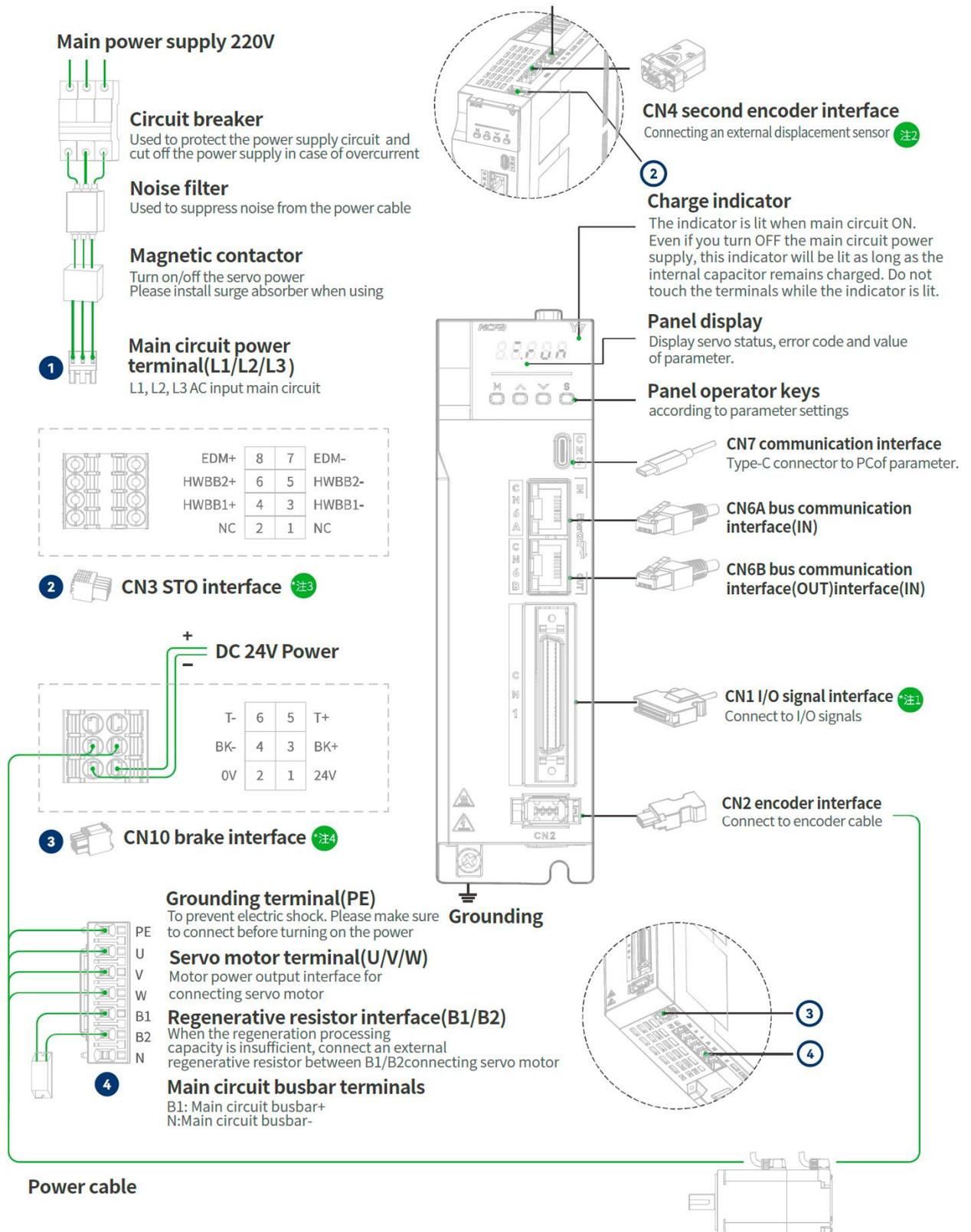


Figure 1-2 AC220V 400W Servo Unit Part Name Diagram

1.1.2 AC220V 750W/1kW/1.5kW/2kW Servo Drive Part Name Diagram



Note 1: Only not supported by NB models

Note 2: Only supported by full-functional type models

Note 3: Only not supported by N type models

Note 4: Only not supported by NA models

① ② represents the corresponding installation position for the accessories

Figure 1-3 750W/1kW/1.5kW/2kW Servo Drive Part Name Diagram

1.2 1.5Y7S AC380V Servo Drive Part Name Diagram

1.2.1 AC380V 3kW and below Servo Drive Part Name Diagram

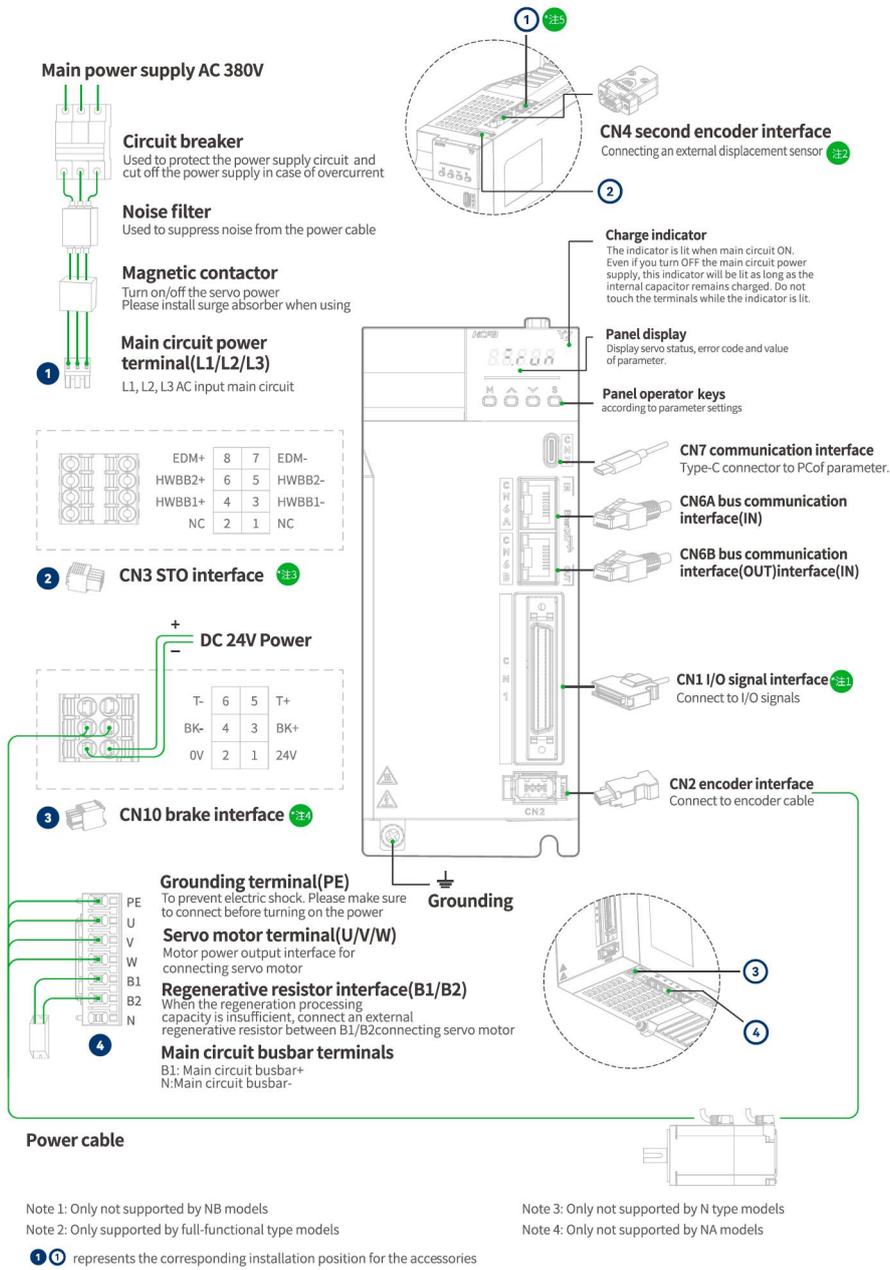


Figure 1-5 Y7S AC380V 3kW Servo Unit Part Name Diagram

1.2.2 AC380V 5kW Servo Unit Part Name Diagram

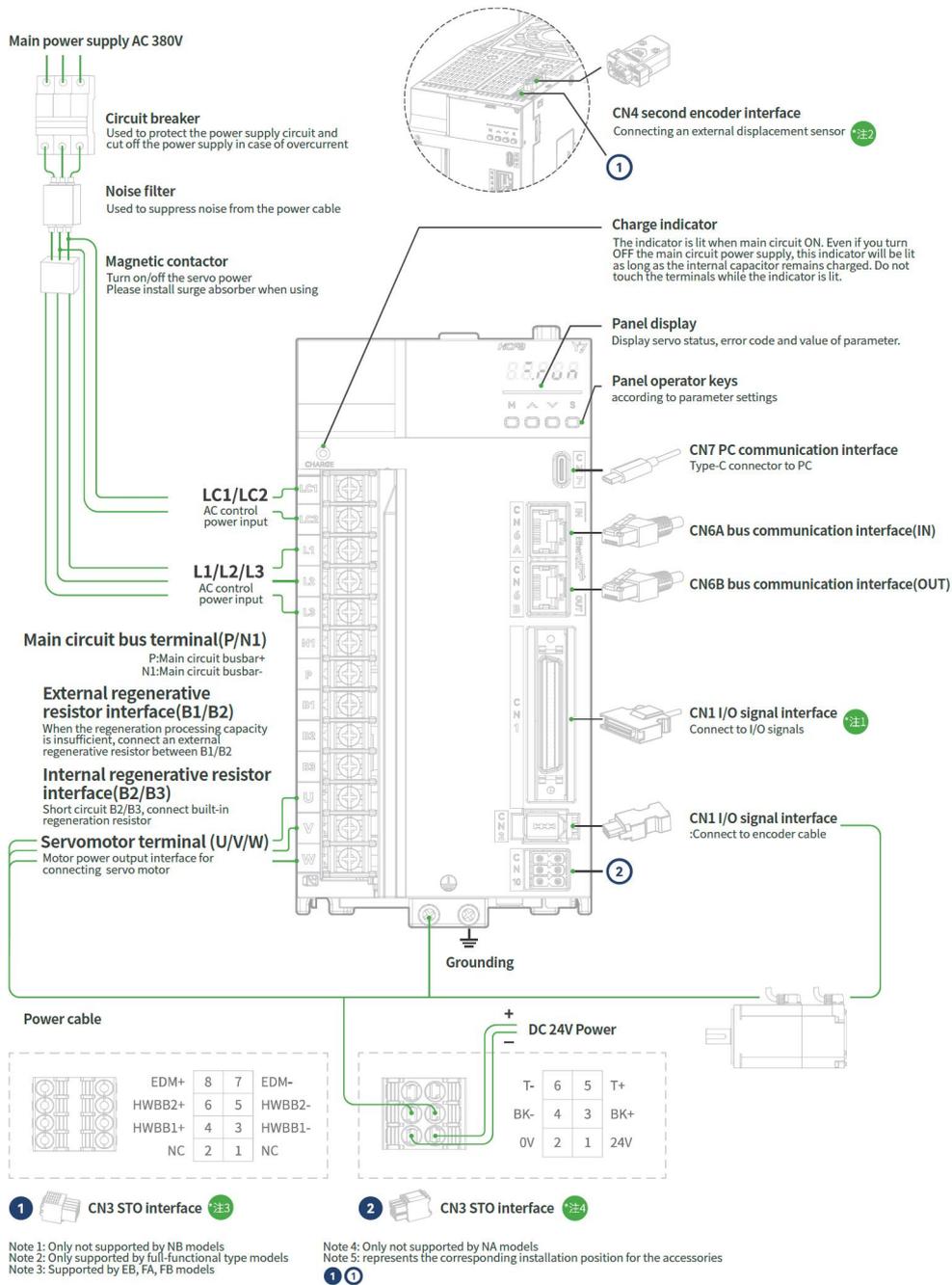
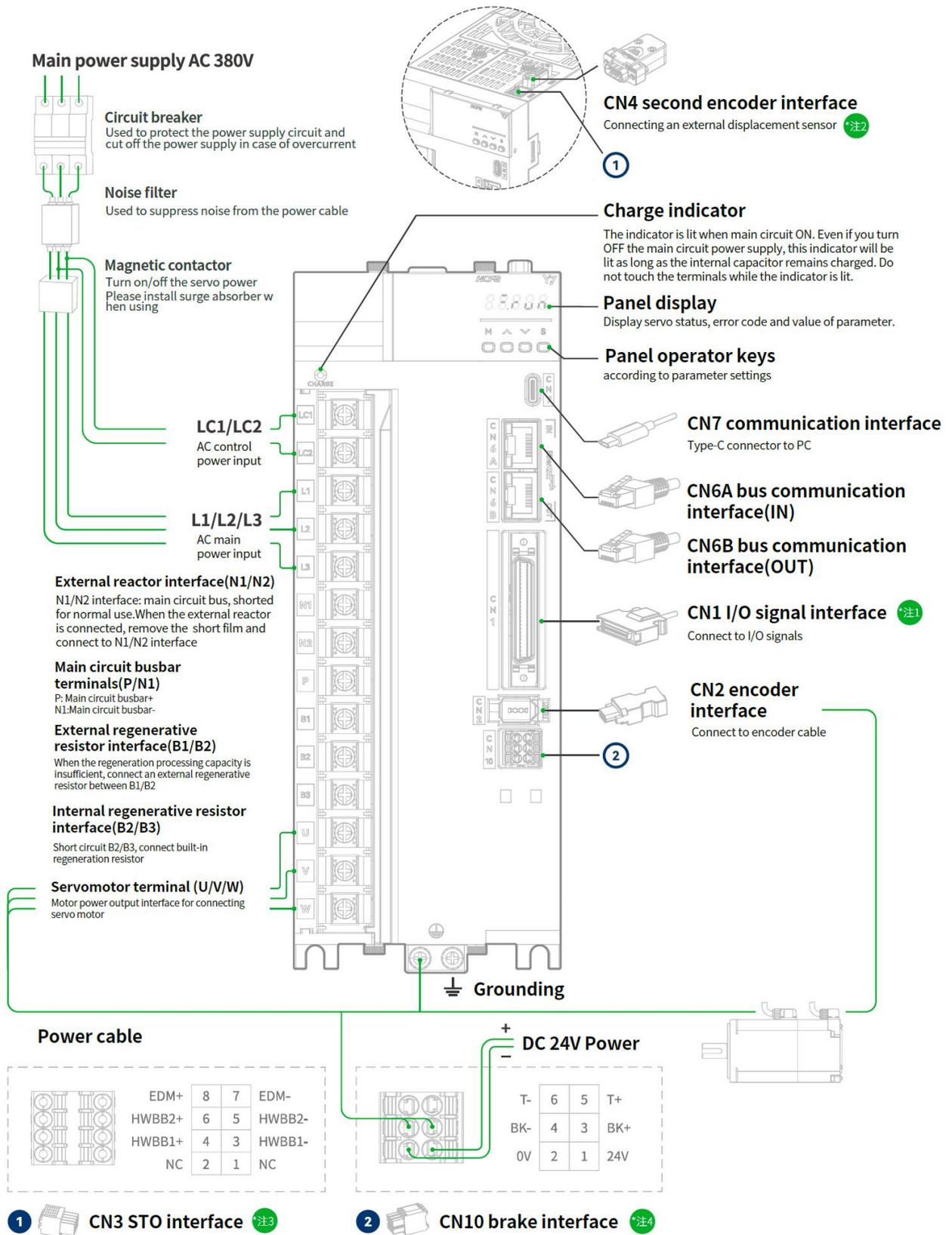


Figure 1-6 Y7S AC380V 5kW Servo Unit Part Name Diagram

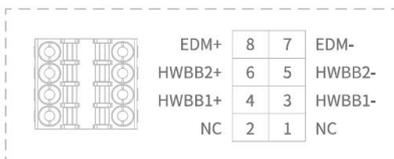
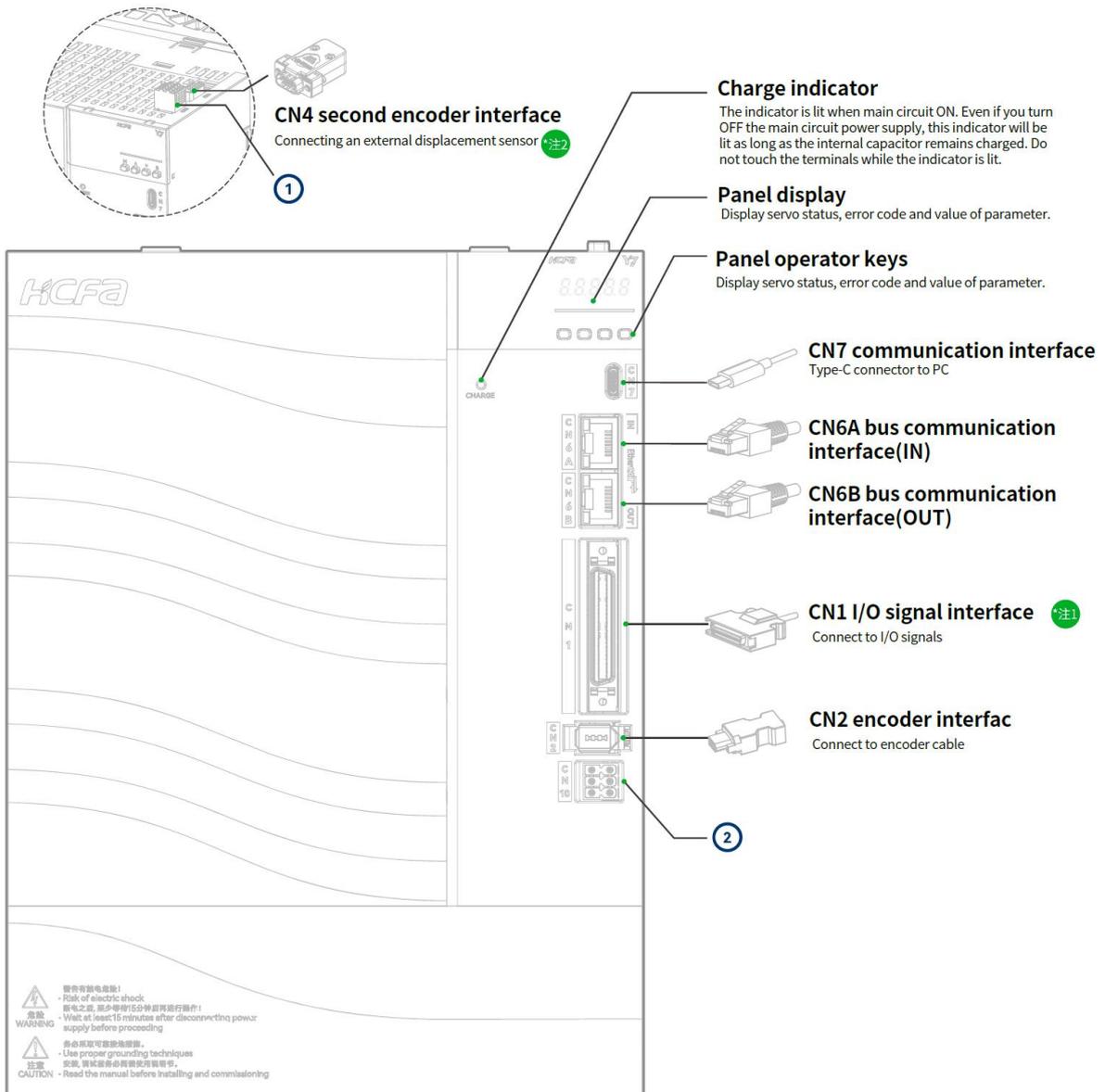
1.2.3 AC380V 6kW/7.5kW Servo Unit Part Name Diagram



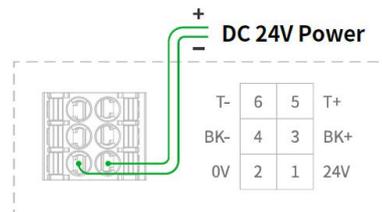
Note 1: Only not supported by NB models
 Note 2: Only supported by full-functional type models
 Note 3: Supported by EB, FA, FB models
 Note 4: Only not supported by NA models
 Note 5: represents the corresponding installation position for the accessories

Figure 1-7 AC380V 6kW/7.5kW servo unit introduction diagram of each part

1.2.4 AC380V 11kW/15kW/22kW Servo Unit Part Name Diagram



1 CN3 STO interface 注3



2 CN10 brake interface 注4

Note 1: Only not supported by NB models
 Note 2: Only supported by full-functional type models
 Note 3: Supported by EB, FA, FB models
 Note 4: Only not supported by NA models
 Note 5: represents the corresponding installation position for the accessories

Figure 1-8 AC380V 11kW/15kW/22kW Servo Drive Part Name Diagram

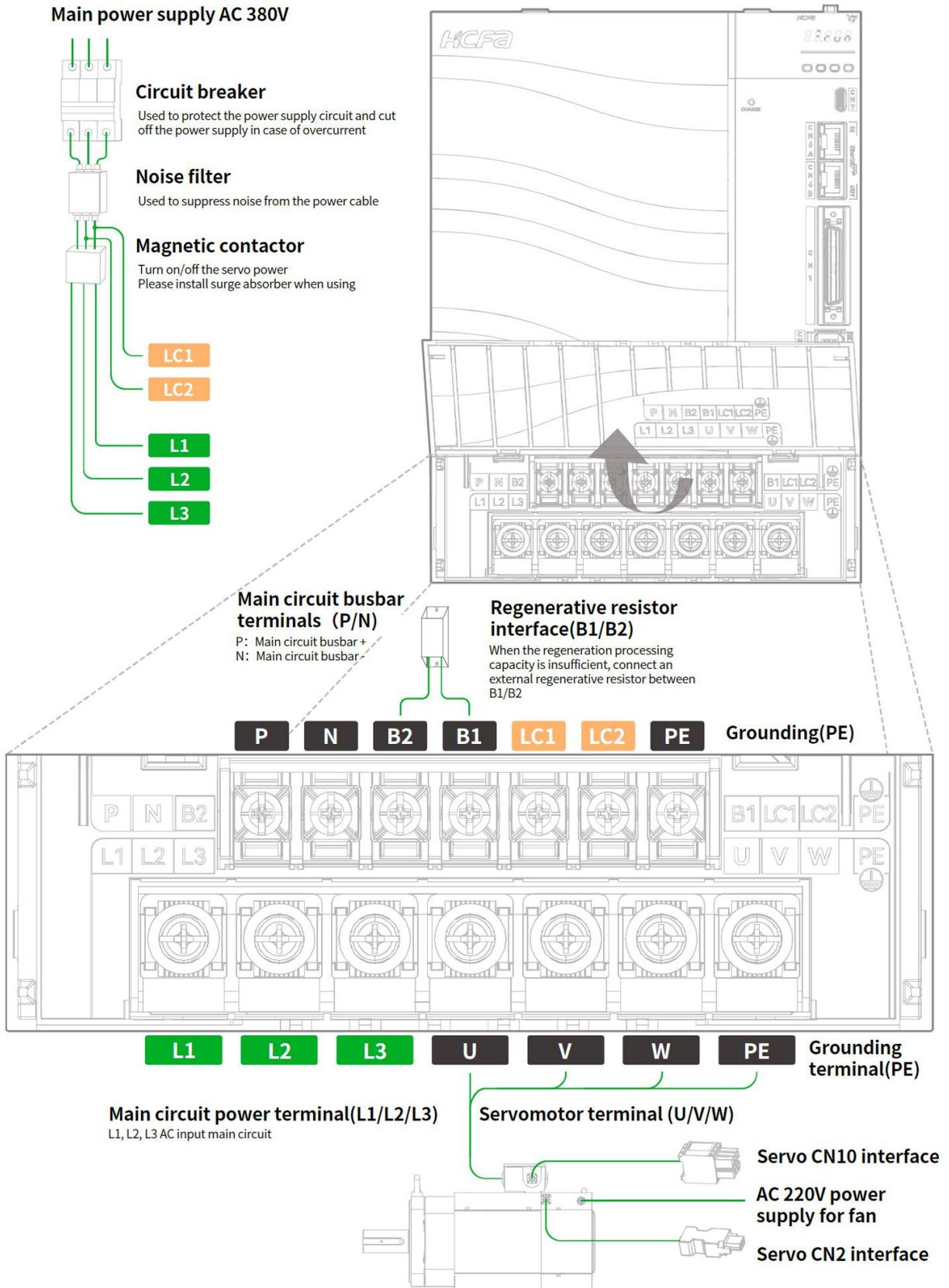


Figure 1-9 AC380V 11kW/15kW/22kW Servo Drive Part Name Diagram

1.3 Y7S Model Specifications

1.3.1 AC220V Servo Unit Specifications

| Specifications | | | | |
|----------------|----------------------------|---------------------------|---------------|---------------|
| Power (W) | Power Supply | Control power | Pulse type | EtherCAT type |
| 400 | AC single-phase 220V | Common main circuit power | HN-Y7□A040A-S | HN-Y7□B040A-S |
| 750 | AC single-phase 220V | Common main circuit power | HN-Y7□A075A-S | HN-Y7□B075A-S |
| 1000 | AC single/three-phase 220V | Common main circuit power | HN-Y7□A100A-S | HN-Y7□B100A-S |
| 1500 | AC three-phase 220V | Common main circuit power | HN-Y7□A150A-S | HN-Y7□B150A-S |
| 2000 | AC three-phase 220V | Common main circuit power | HN-Y7□A200A-S | HN-Y7□B200A-S |

1.3.2 380V Servo Unit Specifications

| Specifications | | | | |
|----------------|---------------------|---------------------------|----------------|----------------|
| Power(W) | Power Supply | Control power | Pulse type | EtherCAT type |
| 1000 | AC three-phase 380V | Common main circuit power | HN-Y7□A100T-S | HN-Y7□B100T-S |
| 1500 | AC three-phase 380V | Common main circuit power | HN-Y7□A150T-S | HN-Y7□B150T-S |
| 2000 | AC three-phase 380V | Common main circuit power | HN-Y7□A200T-S | HN-Y7□B200T-S |
| 3000 | AC three-phase 380V | Common main circuit power | HN-Y7□A300T-S | HN-Y7□B300T-S |
| 5000 | AC three-phase 380V | AC single-phase 380V | HN-Y7□A500T-S | HN-Y7□B500T-S |
| 6000 | AC three-phase 380V | AC single-phase 380V | HN-Y7□A600T-S | HN-Y7□B600T-S |
| 7500 | AC three-phase 380V | AC single-phase 380V | HN-Y7□A750T-S | HN-Y7□B750T-S |
| 11000 | AC three-phase 380V | AC single-phase 380V | HN-Y7□A111T-S | HN-Y7□B111T-S |
| 15000 | AC three-phase 380V | AC single-phase 380V | HN -Y7□A151T-S | HN -Y7□B151T-S |
| 22000 | AC three-phase 380V | AC single-phase 380V | HN -Y7□A221T-S | HN -Y7□B221T-S |

Specification:

| Function | Pulse full function F type | Pulse standard E type | Pulse general N type | EC bus full function F type | EC bus standard E type | EC bus general N type |
|------------------------|----------------------------------|-----------------------|----------------------|-----------------------------------|------------------------|-----------------------|
| STO function | Supported | Not supported | Not supported | Support | Support | Not supported |
| Fully closed loop | Supported | Not supported | Not supported | Supported | Not supported | Not supported |
| Built-in holding brake | Supported | Supported | Not supported | Supported | Support | Support |
| Analog input | 2 way | 2 way | Not supported | 2 way | Not supported | Not supported |
| Analog output | Supported | Supported | Not supported | Supported | Supported | Not supported |
| First encoder | HCFA protocol BISS-C protocol | HCFA protocol | HCFA protocol | HCFA protocol BISS-C protocol | HCFA protocol | HCFA protocol |
| I/O | 5-way DO 7-way DI | 5-way DO 7-way DI | 5-way DO 7-way DI | 3-way DO 2-way HDO 5-way DI | 3-way DO 5-way DI | Not supported |

| | | | | | | |
|----------------------|-----------|-----------|---------------|---------------|---------------|---------------|
| Dynamic Braking | Supported | Supported | Not supported | Supported | Supported | Not supported |
| Pulse divider output | Supported | Supported | Supported | Supported | Not supported | Not supported |
| RS485 | Supported | Supported | Not supported | Not supported | Not supported | Not supported |
| Bluetooth | Supported | Supported | Not supported | Supported | Supported | Not supported |

1.4 Y7S Servo Unit Ratings and Specifications

The servo unit ratings and specifications are shown below.

1.4.1 AC220V Basic Specifications

| Items | | | Specification | | | | |
|---|---|----------------------|------------------------------|------|-----|-----------------------------|------|
| Model HN-Y7□□***A-S** **** | | | 040 | 075 | 100 | 150 | 200 |
| Maximum applicable motor capacity (kW) | | | 0.4 | 0.75 | 1.0 | 1.5 | 2.0 |
| Continuous Output Current (Arms) | | | 2.8 | 5.5 | 7.6 | 11.6 | 15.6 |
| Instantaneous maximum output current (Arms) | | | 9.3 | 16.9 | 17 | 28 | 39 |
| Main Circuit | Supply Voltage (Vrms) | | Single-phase AC220V, 50/60Hz | | | Three-phase AC220V, 50/60Hz | |
| | Current (Arms) | | 2.5 | 4.1 | 5.7 | 7.3 | 10 |
| Control power | | | Common main circuit power | | | | |
| Regenerative resistors | Built-in resistors | Resistance value (Ω) | - | 50 | 50 | 50 | 20 |
| | | Capacity(W) | - | 80 | 80 | 100 | 100 |
| | External minimum allowable resistance value (Ω) | | 40 | 40 | 35 | 20 | 20 |
| Overvoltage level | | | III | | | | |

1.4.2 AC380V Basic Specifications

| Items | | | Specification | | | | | | | | | |
|---|---|----------------------|-----------------------------------|-----|-----|-----------------------------------|------|------|------|------|------|------|
| Model HN-Y7□□***T-S** **** | | | 100 | 150 | 200 | 300 | 500 | 600 | 750 | 111 | 151 | 221 |
| Maximum applicable motor capacity (kW) | | | 1 | 1.5 | 2.0 | 3.0 | 5.0 | 6.0 | 7.5 | 11 | 15 | 22 |
| Continuous Output Current (Arms) | | | 4.7 | 5.4 | 8.4 | 11.9 | 16.5 | 20.8 | 25.7 | 28.1 | 37.2 | 52 |
| Instantaneous maximum output current (Arms) | | | 16.9 | 17 | 24 | 31 | 44 | 52 | 65 | 70 | 88 | 105 |
| Main Circuit | Supply Voltage (Vrms) | | Three-phase AC330 ~ 440V, 50/60Hz | | | | | | | | | |
| | Current (Arms) | | 2.9 | 4.3 | 5.8 | 8.6 | 14.5 | 17.4 | 21.7 | 23.4 | 29.6 | 43.4 |
| Control power | | | Common main circuit power | | | Three-phase AC330 ~ 440V, 50/60Hz | | | | | | |
| Regenerative resistors | Built-in resistors | Resistance value (Ω) | 50 | 50 | 50 | 40 | 25 | 20 | 20 | - | - | - |
| | | Capacity(W) | 80 | 80 | 100 | 100 | 100 | 100 | 100 | - | - | - |
| | External minimum allowable resistance value (Ω) | | 40 | 40 | 40 | 35 | 25 | 20 | 20 | 15 | 10 | 10 |

Overvoltage level

III

1.4.3 Environmental Specifications

| Items | Specification |
|------------------------------|--|
| Ambient temperature | 0~+55°C (10% reduction for every 5 degrees of ambient temperature above 45 degrees) |
| Storage temperature | -20~65°C (maximum temperature guarantee: 80°C 72 hours without condensation) |
| Ambient humidity for use | 20%~85%RH or less (no condensation) |
| Ambient humidity for storage | 20%~85%RH or less (no condensation) |
| Vibration resistance | 5.88m/s ² (0.6G) or less, 10-60Hz (avoid using at resonance point connection) |
| Impact resistance | Acceleration 100m/s ² or less (XYZ) |
| Protection level | IP20 |
| Cleanliness | - No corrosive gas, combustible gas - No water, oil, chemical splash |
| Altitude | 1000m below (1000m ~ 2000m, can be used after reducing the rated value) |
| Pollution level | 2 |
| Overvoltage category | III |
| Fault short circuit current | 5kA |
| Other | No electrostatic interference, strong electric field, strong magnetic field, radiation, etc. |

1.4.4 Technical Specifications

| Items | Specification | | |
|----------------------|--|---|---|
| Control Mode | Position control, speed control, torque control, internal speed control Internal speed control-velocity control, internal speed control-position control, and Internal speed control - Torque control Position Control - Speed Control, Position Control - Torque Control, Torque Control - Speed Control Speed control - Speed control with zero fixing function Position control - Position control with command pulse disable function Fully closed-loop control (supported by full-functional models only) | | |
| Position Control | Pulse input | Maximum pulse frequency | Open collector pulse input: frequency not exceeding 200KHz, pulse width not less than 2.5us Differential common pulse input: frequency not exceeding 500KHz, pulse width not less than 1us Differential high-speed pulse input: frequency not exceeding 4MHz, pulse width not less than 125ns |
| | | Input pulse logic method | Pulse + direction, A-phase + B-phase, CW + CCW |
| | | Electronic gear ratio setting | B/A times |
| | Command Filters | Acceleration and deceleration filters, moving average filters | |
| | Pulse output | Crossover Ratio | < 16384 |
| Output pulse pattern | | Differential output: A/B/ Z; Collector output: Z signal | |
| Speed Control | Control method | External analog input | |

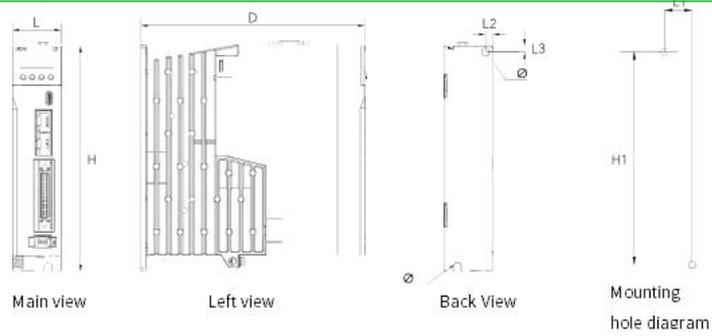
| | | | |
|------------------------|--|--------------|---|
| | Analog input voltage range | | DC±10V (default 6V corresponding to the rated speed can be modified through parameters) |
| | Torque limiting function | | Parameter setting, parameter setting+I/O control, analog input |
| Internal speed control | Control method | | I/O control |
| | Movement speed selection | | Support three different speed switching, set by parameters |
| Torque control | Control method | | External analog input |
| | Analog input voltage range | | DC±10V (default 3V corresponding to the rated speed can be modified through parameters) |
| | Speed limit function | | Parameter setting, parameter setting+I/O control, analog input |
| General Functions | Control signals | Input/output | 7IN/5OUT |
| | Analog signals | Input/output | 2IN (for speed control, torque control)/2OUT (for motor speed, torque monitoring) |
| | STO security features | | Full-featured model support |
| | Second encoder interface | | Full-featured model support |
| | Inertia self-assumption | | Provided |
| | Parameter free adjustment | | Provided |
| | One-touch adjustment function | | Provided |
| | Friction compensation | | Provided |
| | Vibration suppression frequency band 1 | | Provided |
| | Vibration suppression frequency band 2 | | Provided |
| | Adaptive trap filter | | Provided |
| | Encoder output frequency division | | Provided |
| | Dynamic Braking | | Built-in (general-purpose type without this function) |
| | Regenerative function | | Built-in braking resistor, external higher power braking resistor can be connected |
| | Protection function | | Over voltage, low voltage, phase loss, over current, over temperature alarm, high temperature warning, over load, abnormal encoder, over speed, excessive position deviation, abnormal parameters, etc. |
| | Communication function | USB | |
| Industrial Networks | | RS485 | |

1.5 Y7S Servo Unit External Dimensions

1.5.1 Y7S Servo Unit Configuration

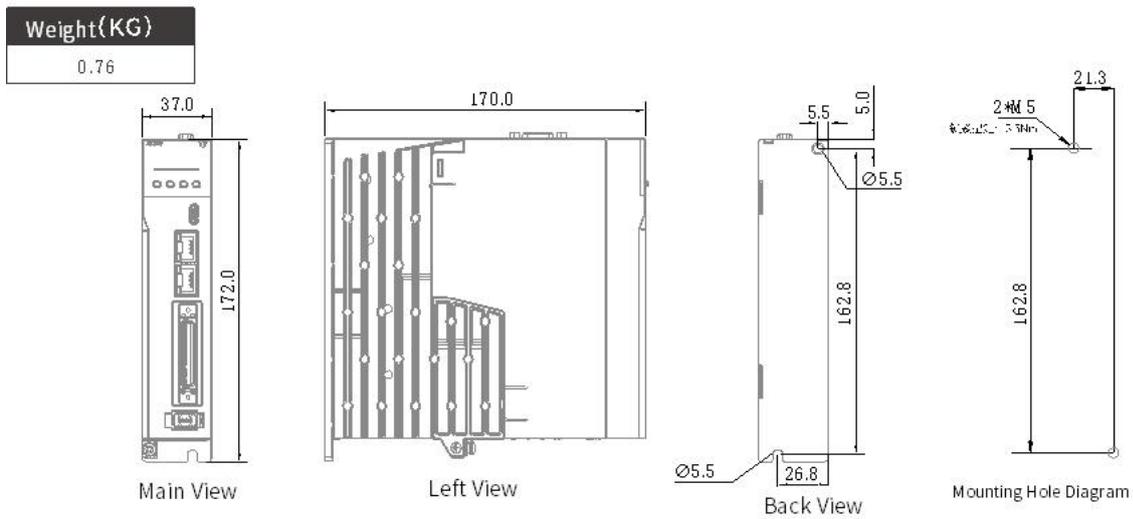
| Servo Drive (AC220V) | SIZE A | | SIZE B | | SIZE D |
|----------------------|--------------------------------|--------------------------------|---------------|--------------------------------|---|
| | | HN-Y7□□040A-S | | HN-Y7□□075A-S HN-Y7□□100A-S | |
| Servo Drive (AC380V) | SIZE C | SIZE D | SIZE E | SIZE F | SIZE G |
| | HN-Y7□□100T-S HN-Y7□□150T-S | HN-Y7□□200T-S HN-Y7□□300T-S | HN-Y7□□500T-S | HN-Y7□□600T-S HN-Y7□□750T-S | HN-Y7□□111T-S HN-Y7□□151T-S HN-Y7□□221T-S |

1.5.2 Y7S Series Drive Mounting Dimensions

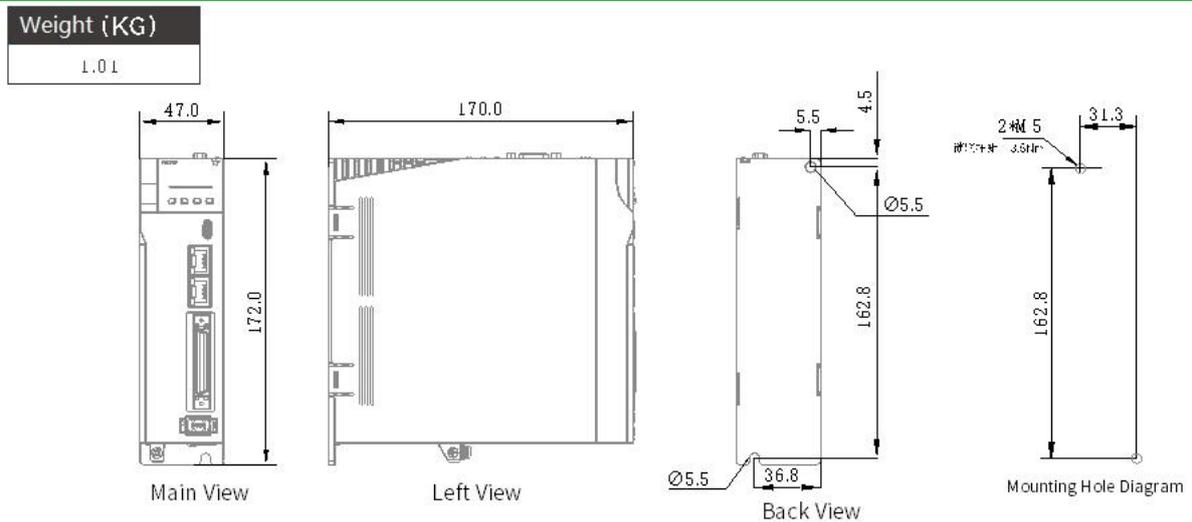


| Structure | SIZE A | SIZE B | SIZE C | SIZE D (AC220V) | SIZE D (AC380V) | SIZE E | SIZE F | SIZE G |
|--------------------|--------|--------|--------|--------------------|--------------------|--------|--------|--|
| L(mm) | 37.0 | 47.0 | 55.0 | 70.0 | | 90.0 | 90.0 | 194.0 |
| H(mm) | 172.0 | 172.0 | 175.0 | 175.0 | | 182.8 | 243.3 | 260.0 |
| D(mm) | 170.0 | 170.0 | 180.0 | 180.0 | | 192.5 | 205.2 | 205.0 |
| L1(mm) | 21.3 | 31.3 | 39.7 | 54.7 | | 76.0 | 76.0 | Please refer to "High Power Driver Installation Instructions". |
| L2(mm) | 5.5 | 5.5 | 5.5 | 5.5 | | 7.0 | 7.0 | |
| L3(mm) | 5.0 | 4.5 | 5.0 | 5.0 | | 6.0 | 6.0 | |
| H1(mm) | 162.8 | 162.8 | 163.0 | 163.0 | | 168.0 | 227.5 | |
| Aperture(φ) | 5.5 | 5.5 | 5.5 | 5.5 | | 6.0 | 6.0 | |
| Screw holes | 2-M5 | 2-M5 | 2-M5 | 2-M5 | | 3-M5 | 4-M5 | |
| Locking torque(Nm) | 3.5N-M | 3.5N-M | 3.5N-M | 3.5N-M | | 3.5N-M | 3.5N-M | |
| Weight(kg) | 0.76 | 1.01 | 1.21 | 1.45 | 1.5 | 2.2 | 3.6 | 8.77 |

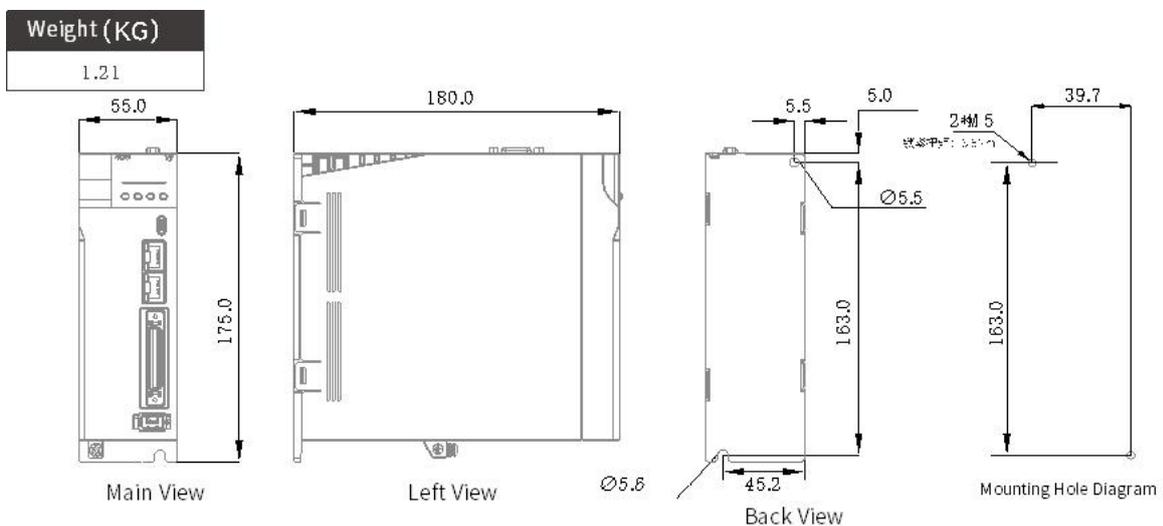
1.5.3 SIZE A Servo Unit External Dimension Drawing



1.5.4 SIZE B Servo Unit External Dimension Drawing

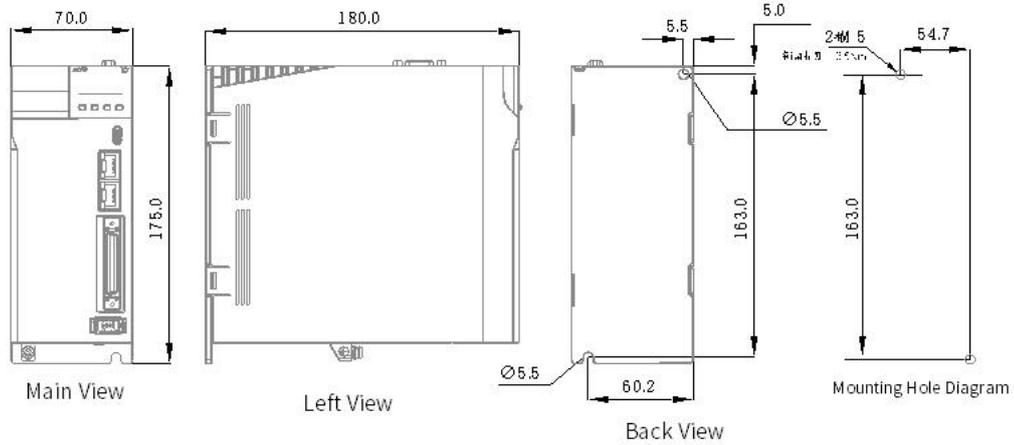


1.5.5 SIZE C Servo Unit External Dimension Drawing



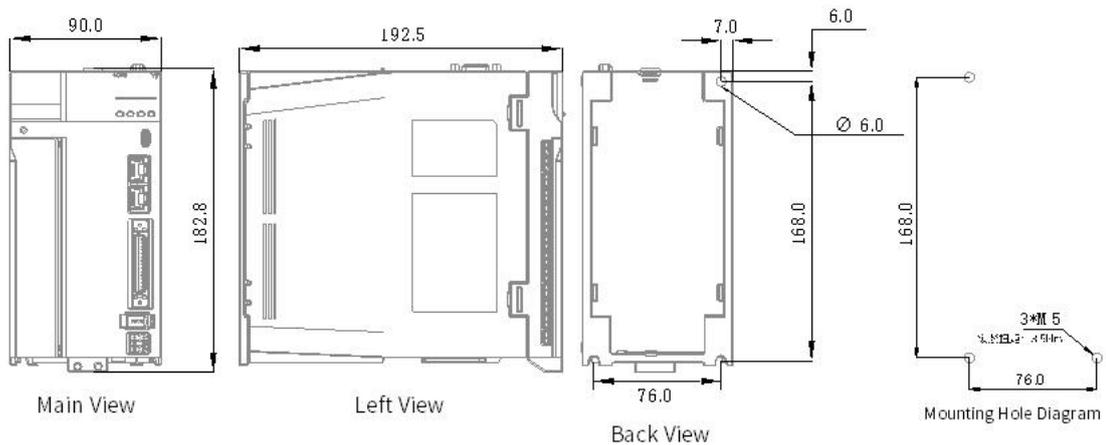
1.5.6 SIZE D Servo Unit External Dimension Drawing

| Weight(KG) | |
|------------|-----|
| 1.45 | 1.5 |



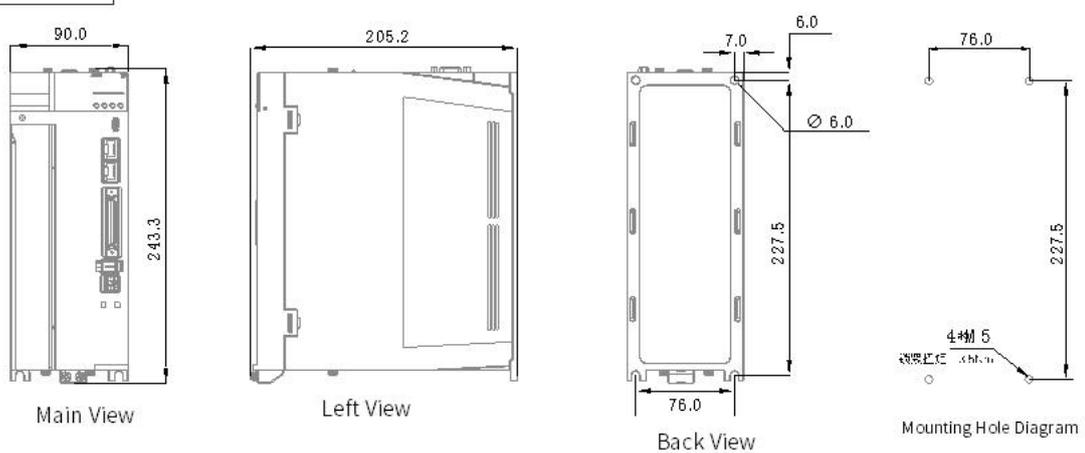
1.5.7 SIZE E Servo Unit External Dimension Drawing

| Weight(KG) | |
|------------|--|
| 2.2 | |



1.5.8 SIZE F Servo Unit External Dimension Drawing

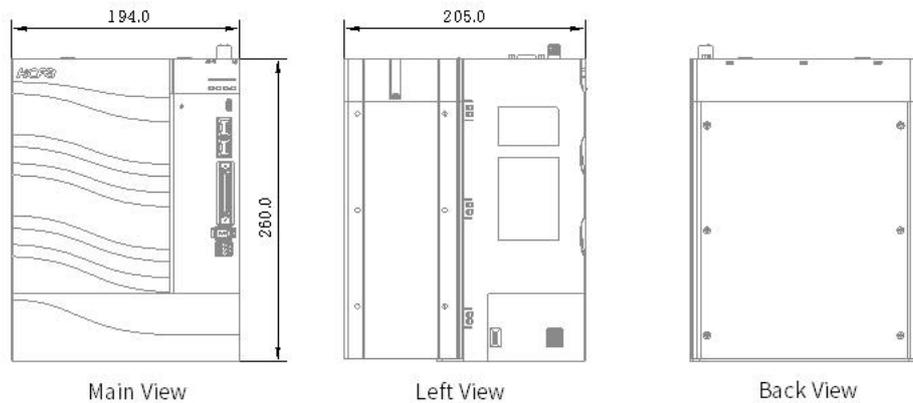
| Weight(KG) | |
|------------|--|
| 3.6 | |



1.5.9 SIZE G Servo Unit External Dimension Drawing

| |
|------------|
| Weight(KG) |
|------------|

| |
|------|
| 8.77 |
|------|



1.6 Servo Unit Installation

1.6.1 Installation Instructions in Control Panel

Cautions

- When installing the servo unit, do not seal its suction and vent holes or place it upside down, otherwise it will cause malfunction.
- In order to get a relatively low air resistance for the cooling fan to effectively dissipate heat, please follow the recommended installation interval distance when installing one or more drives
- Please avoid the top and bottom rows, because the heat generated by the lower row of the drive rises during operation and tends to cause unnecessary temperature increase in the upper row of the drive.

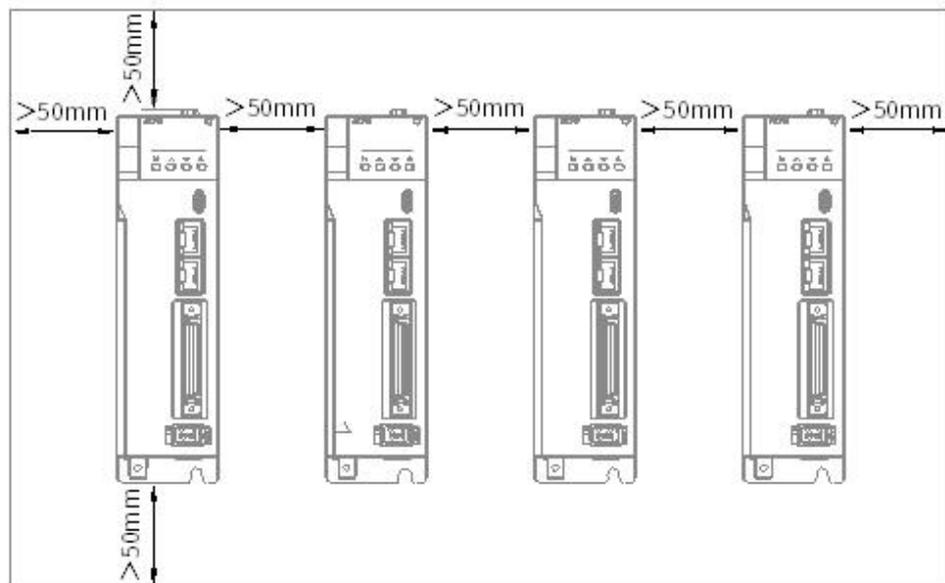


Figure 1-10 Y7S Servo Unit Installation Diagram

1.6.2 Structural Installation Instructions

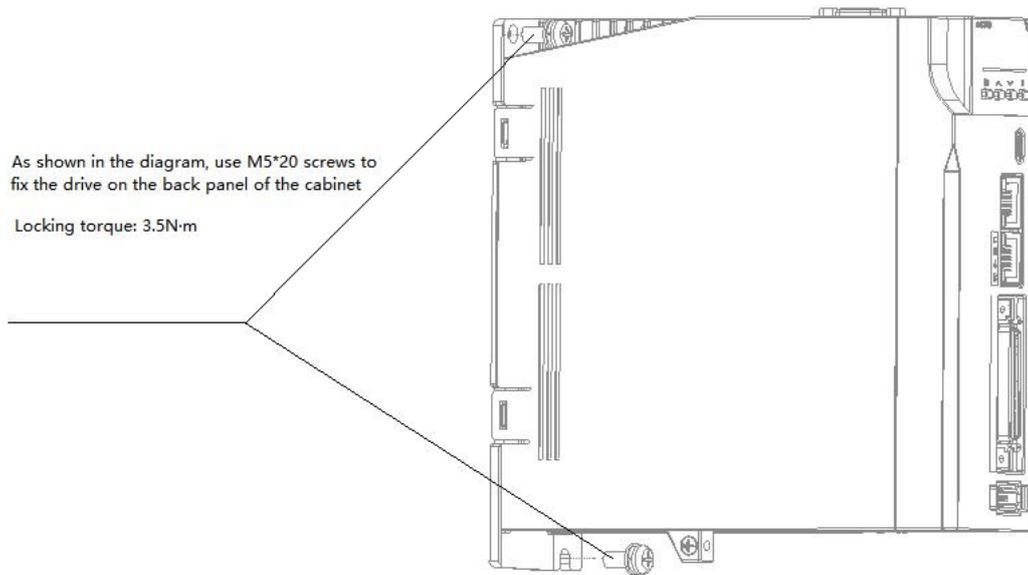
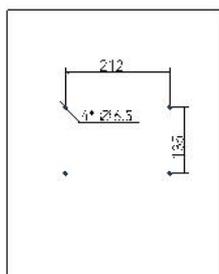


Figure 1-11 Y7S Servo Unit Installation Diagram

1.6.3 High Power Drive Installation Instructions

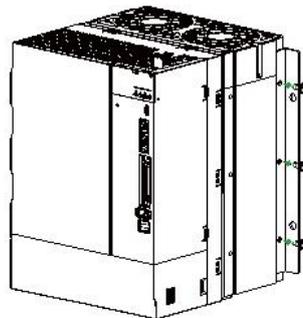
Users can choose to use base-mounted or rack-mounted installation according to the needs of the equipment.

Base-mounted



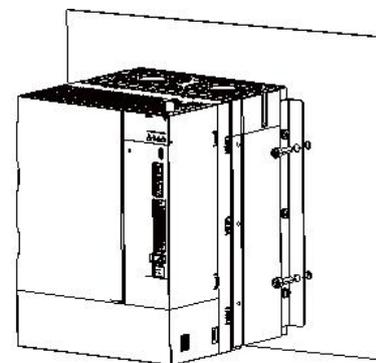
Step1

Make four $\Phi 6.5$ holes in the back panel of the electrical cabinet, the specific dimensions are shown in the figure



Step2

Take out the mounting bracket and six M5*12 screws from the package, fix the mounting bracket on both sides of the drive with screws, as shown in the figure

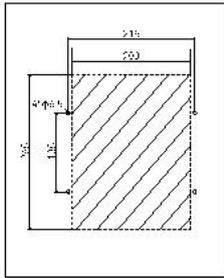


Step3

Use M6 socket head cap screws to fix the drive to the back panel of the cabinet and ensure that it is secure with recommended locking torque of 3N·m

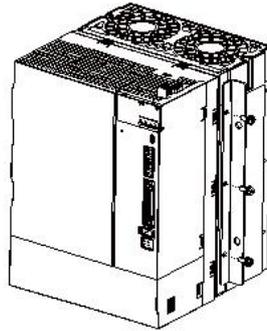
Figure 1-11 Y7S Servo Unit Installation Diagram

Rack-mounted:



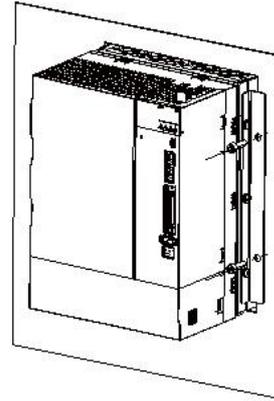
Step 1

Make four $\phi 6.5$ holes in the back panel of the electrical cabinet and remove the shaded area with the specific dimensions shown in the figure



Step 2

Take out the mounting bracket and six M5*12 screws from the package, fix the mounting bracket on both sides of the drive with screws, as shown in the figure



Step 3

Push drive into the hole, and use M6 socket head cap screws to fix the drive to the back panel of the cabinet and ensure it is secure with recommended locking torque of 3N·m

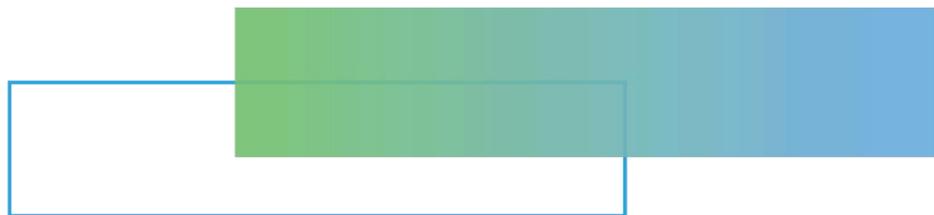
1.7 Maintenance and Inspection

The following explains the maintenance and inspection of the servo unit.

Inspection of servo motor

The servo unit does not require daily inspection, but the following items need to be inspected at least once a year or more.

| Inspection items | Inspection interval | Inspection essentials | Handling in case of failure |
|----------------------|--------------------------|--|--|
| Check the appearance | At least 1 time per year | No garbage, dust, oil stains, etc. | Please wipe with cloth or clean with air gun |
| Loose screws | | Terminal blocks, connector mounting screws, etc. must not be loose | Please tighten further |



Chapter 2 Wiring and Connection

| | | |
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2.1 Precautions

2.1.1 Symbols

Table 2-1 Precaution Symbols

| Name | Function |
|--|--|
|  Danger | Indicates hazards that may cause death or serious injury |
|  Caution | Indicates precautions that may cause injury or property damage |
|  | Indicates the mandatory content that must be implemented |

2.1.2 General Wiring Precautions

 **Please use a circuit breaker or fuse for wiring to protect the main circuit.**

- The servo unit is directly connected to the industrial frequency power supply without using a transformer for insulation. In order to prevent accidents of mixed contact between the servo system and the outside, be sure to use a circuit breaker or fuse for wiring.
- Please install an earth leakage circuit breaker. The servo unit does not have a built-in ground short-circuit protection circuit. In order to build a safer system, install an earth leakage circuit breaker for both overload and short circuit protection, or combine it with a circuit breaker for wiring and install an earth leakage circuit breaker for ground short circuit protection.

Points

- Please avoid turning ON/OFF power frequently
- Frequently turn ON/OFF power will cause elements in servo drive to deteriorate, so do not use it for applications that require to turn ON/OFF power frequently.
 - After you have started actual operation(normal operation), allow at least one hour between turning the power supply ON and OFF.

To ensure safe, stable application of the servo system, please observe the following precautions when wiring.

Use the cables specified by HCFA. Design and arrange the system so that each cable is as short as possible.

- Use twisted-pair wires or multi-core twisted-pair shielded wires for I/O signal cables and encoder cables.
- The wiring length of the input and output signal cables is up to 3m, and the length of the main circuit cable of the servo motor and the encoder cable is up to 10m each.

Observe the following precautions when wiring the ground cable.

- Use a ground cable as thick as possible (2.0 mm² or more).
- Please ground 220V servo unit to a resistance of 100Ω or less, and ground 380V servo unit with a resistance of 10Ω or less.
- Be sure to ground at one point only
- Ground the servo motor directly if the servo motor is insulated from the machine.

The signal cable conductors are as thin as 0.2 mm² or 0.3 mm². Do not subject them to excessive bending stress or tension

Wiring points:

- ※ The control circuit power supply and the main circuit power supply should be wired from the same AC220V main power supply.
- ※ When the user I/O cable is longer than 50cm, please use twisted pair with shielded wire.
- ※ Encoder cable length is 20m or less.

- Note: 1. There is high voltage in the circuit in the solid line. Be careful when wiring and handling.
2. The dotted part of the wiring diagram indicates a non-hazardous voltage circuit.

This section also explains the general precautions when wiring and the precautions in special use environments.

Table 2-2 Precautions for Special Use Environment

| Item | Description |
|---|--|
| External machine configuration | In order to comply with European EC standards, after selecting a machine with applicable specifications, please set it according to the system diagram. |
| Environment | The driver is installed in an environment of pollution degree 2 or pollution degree 1 specified in IEC60664-1. |
| Power supply 1 : AC200 ~ 240V (main circuit and control circuit power supply) | This product is used in an overvoltage category II power supply environment in accordance with IEC60664-1. |
| Power supply 2: DC24V • I/O power • Release the power supply of the motor brake | the DC24V external power supply must meet the following conditions: Use SELV power supply (※), the capacity is below 150W (this is the condition when corresponding to European CE); Safe low voltage/non-hazardous voltage, hazardous voltage require reinforced insulation (Attention). |
| Wiring | Motor power cables, AC220V input cables, FG cables, and main circuit power distribution cables composed of multiple axes: Please use AWG18 / 600V withstand voltage wires below 750W , and use AWG14 / 600V withstand voltage wires above 1kW . |
| Leakage circuit breakers | To protect the power line, the circuit is cut off when an overcurrent flows. Between the power supply and the noise filter, be sure to use an IEC standard and UL-approved circuit breaker. To comply with EMC standards, please use a standard circuit brake with leakage detection function. |
| Noise filter | Prevent noise interference from power lines (Use standard noise filtering for EMC compliance). |
| Electromagnetic contactor | Switch (ON/OFF) the main power supply (please use it with a surge protector connected). |
| surge absorber | To comply with EMC regulations, please use standard surge absorbers. |
| Signal Line Noise Filter / Ferrite Core | To comply with EMC standards, please use standard noise filters. |
| Regenerative resistor | If the smoothing capacitor inside the power unit cannot sufficiently absorb and process regenerative power, it is necessary to install a regenerative resistor outside. For reference, check the setting panel for regenerative discharge status, and use a regenerative resistor when regenerative voltage warning occurs. Regenerative resistor reference specification: Please refer to external braking resistor selection. Use the built-in thermostat, and set the overheat protection circuit. |
| Grounding | Our products have protection settings because they are suitable for Class 1 equipment. The grounding of our products requires protective ground terminal, and is carried out through a protective box and an electrical box that have implemented EMC countermeasures. The protective ground terminal is indicated by the standard FG mark . |

- Note: ※ SELV: safety extra low voltage.

2.2 Connector Type Terminal Definition Diagram

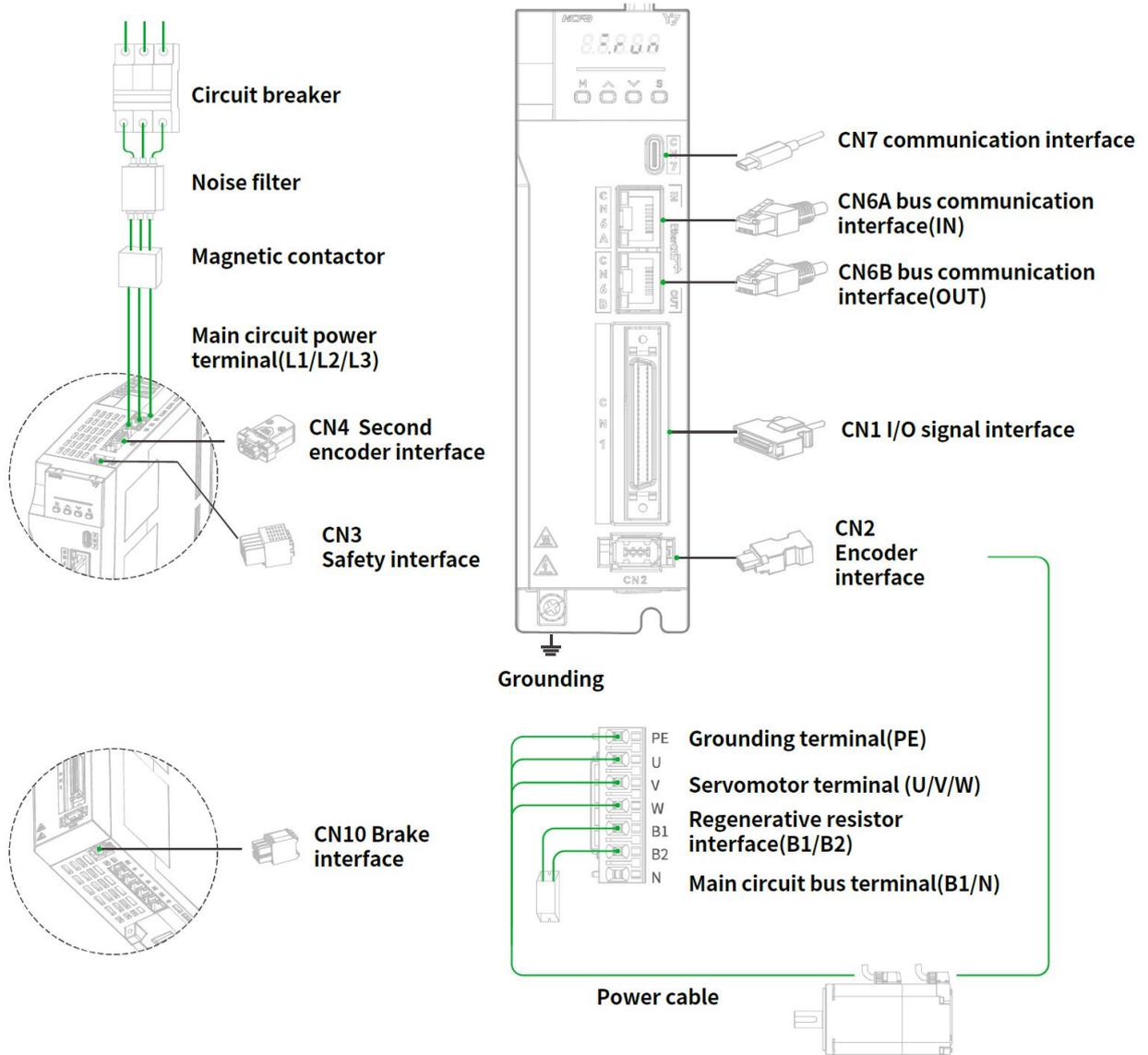


Figure 2-1 Connector Type Terminal Drive Wiring Diagram

Table 2-3 Terminal Symbols and Terminal Names for Connector Type

| Terminal name | Terminal symbols | Signal name/ pin number | content | | | |
|---------------------------------|---|---|--|---------------|---------------------|--------------|
| Regenerative resistor | B1/B2 | B1 | External regenerative resistor interface , main circuit bus+ | | | |
| | | B2 | External regenerative resistor interface | | | |
| Main circuit bus | N | N | Main circuit bus- | | | |
| AC main circuit power input | L1/L2/L3 | L1 | 220V model: three-phase 200-240V (50/60Hz) | | | |
| | | L2 | 380V model: three-phase 380~440V (50/60Hz) | | | |
| | | L3 | Note: Please confirm the drive power specification when wiring | | | |
| Motor power output | U/V/W | u | Motor power U phase output | | | |
| | | V | Motor power V-phase output | | | |
| | | W | Motor power W phase output | | | |
| Encoder | CN2 | 1 | Encoder power supply 5V output | | | |
| | | 2 | Signal Ground | | | |
| | | 3 | — | | | |
| | | 4 | — | | | |
| | | 5 | Encoder signal: serial data + | | | |
| | | 6 | Encoder signal: serial data- | | | |
| | | Case | The shield wire is connected to the connector shell | | | |
| Communication | CN6A/CN6B | - | RS485 | | | |
| User I/O | CN1 | Refer to 2.6 Input and output signal (CN1) wiring details | | | | |
| Second encoder | CN4 | 1 | + 5V output, current output ≤ 300 mA | | | |
| | | 2 | 0 V output | | | |
| | | 3 | Hall U + | | | |
| | | 4 | Hall U - | | | |
| | | 5 | Hall V + | | | |
| | | 6 | Incremental encoder A - | B ISS-C CLK- | Sine Encoder Sin - | Serial DATA- |
| | | 7 | Incremental encoder B- | B ISS-C DATA- | Sine Encoder Cos - | - |
| | | 8 | Incremental encoder Z - | | | |
| | | 9 | Hall W + | | | |
| | | 10 | Hall V - | | | |
| | | 11 | Incremental encoder A + | B ISS-C CLK+ | Sine encoder Sin + | Serial DATA+ |
| | | 12 | Incremental encoder B+ | B ISS-C DATA+ | Sine encoder C os + | - |
| | | 13 | Incremental encoder Z + | | | |
| | | 14 | Hall W - | | | |
| | | 15 | temperature sensor signal | | | |
| Brake and temperature detection | CN10 | 1 | Brake + 24V power supply | | | |
| | | 2 | Brake 0 V | | | |
| | | 3 | B K+ | | | |
| | | 4 | BK- | | | |
| | | 5 | N TC+ | | | |
| | | 6 | N TC- | | | |
| Ground terminal |  | Connect to the ground terminal of the power supply and the servo motor for grounding. | | | | |

➤ Note: Do not short-circuit B1/B2, the servo unit may be damaged.

2.3 Fence Type Terminal Definition Diagram

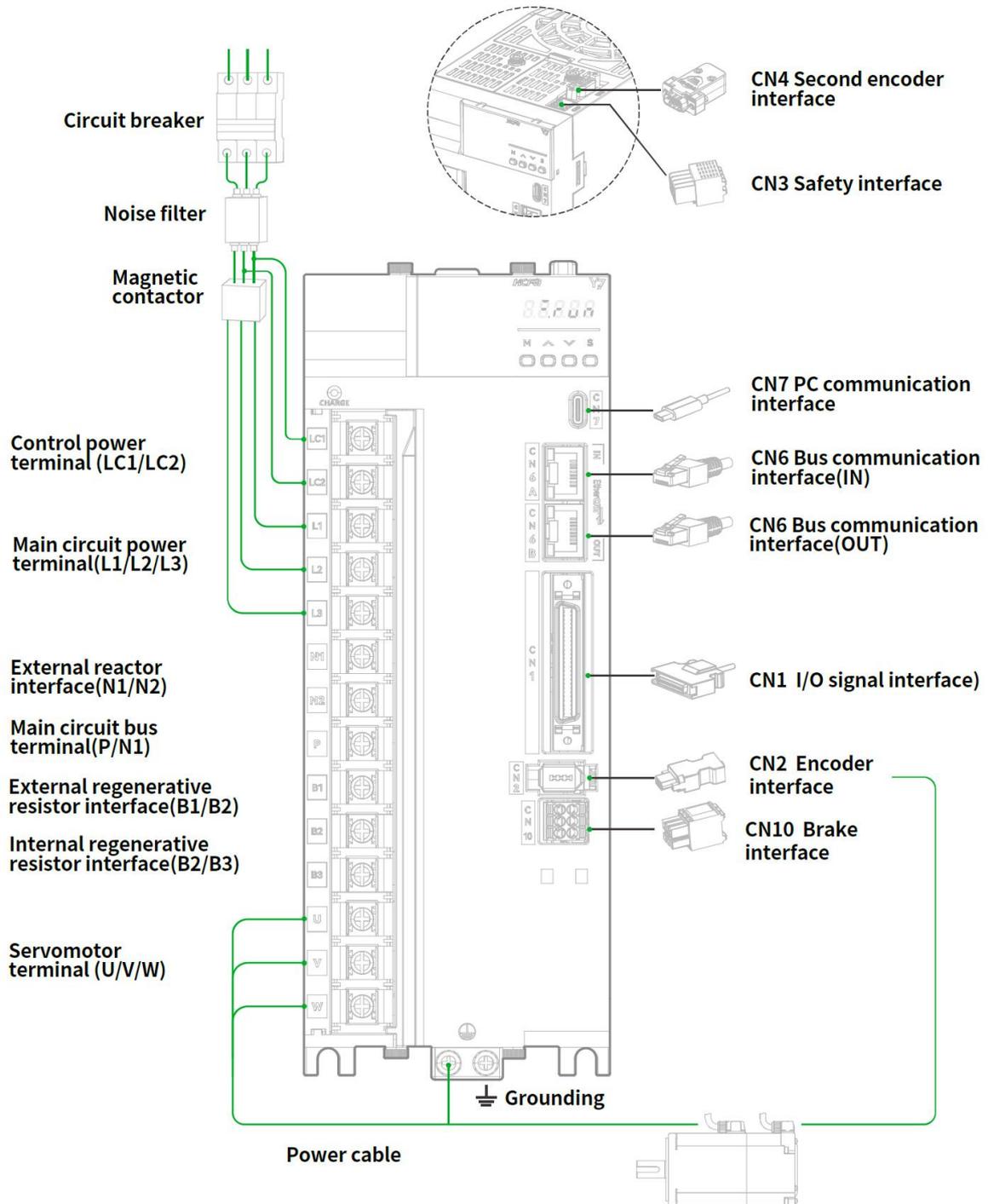


Figure 2-2 Fence Type Terminal Drive Wiring Diagram

Table 2-4 Terminal Symbols and Terminal Names for Fence Type

| Name | Terminal Symbols | Signal name /pin number | Content | | | |
|-----------------------------|------------------|---|--|--------------|--------------------|--------------|
| Regenerative resistor | B1/B2/B3 | B1 | External regenerative resistor interface , main circuit bus+ | | | |
| | | B2 | External regenerative resistor interface | | | |
| | | B 3 | Built-in regenerative resistor interface | | | |
| Main circuit bus | N1/N2/P | N 1 | Main circuit bus- | | | |
| | | N 2 | Main circuit bus - (only available for models with a power of 7.5Kw) | | | |
| | | P | Main circuit bus+ | | | |
| AC control power input | LC1/ LC2 | LC1 | 380V model: 380~440V (50/60Hz) Note: Please confirm the drive power specification when wiring | | | |
| | | LC2 | | | | |
| AC main circuit power input | L1/L2/L3 | L1 | 380V model: three-phase 380~440V (50/60Hz) Note: Please confirm the drive power specification when wiring | | | |
| | | L2 | | | | |
| | | L 3 | | | | |
| Motor power output | U/V/W | u | Motor power U phase output | | | |
| | | V | Motor power V-phase output | | | |
| | | W | Motor power W phase output | | | |
| Encoder | CN2 | VCC | Encoder power supply 5V output | | | |
| | | GND | Signal ground | | | |
| | | — | — | | | |
| | | — | — | | | |
| | | D + | Encoder signal: serial data + | | | |
| | | D- _ | Encoder signal: serial data- | | | |
| Communication | CN6A/CN6B | - | RS485 | | | |
| | | | | | | |
| User I/O | CN1 | Refer to 2.6 Input and output signal (CN1) wiring details | | | | |
| Second encoder | CN4 | 1 | + 5V output, current output \leq 300 mA | | | |
| | | 2 | 0 V output | | | |
| | | 3 | Hall U + | | | |
| | | 4 | Hall U - | | | |
| | | 5 | Hall V + | | | |
| | | 6 | Incremental encoder A- | BISS-C CLK- | Sine encoder Sin - | Serial DATA- |
| | | 7 | Incremental encoder B- | BISS-C DATA- | Sine encoder Cos- | - |
| | | 8 | Incremental encoder Z - | | | |
| | | 9 | Hall W + | | | |
| | | 10 | Hall V - | | | |
| | | 11 | Incremental encoder A + | BISS-C CLK+ | Sine encoder Sin + | Serial DATA+ |
| | | 12 | Incremental encoder B+ | BISS-C DATA+ | Sine encoder Cos + | - |
| | | 13 | Incremental encoder Z + | | | |

| | | | |
|---------------------------------|---|---|---------------------------|
| | | 14 | Hall W - |
| | | 15 | Temperature sensor signal |
| Brake And temperature detection | C N10 | 1 | Brake + 24V power supply |
| | | 2 | Brake 0 V |
| | | 3 | B K+ |
| | | 4 | BK- |
| | | 5 | N TC+ |
| | | 6 | N TC- |
| Ground terminal |  | Connect to the ground terminal of the power supply and the servo motor for grounding. | |

2.4 Main Circuit Wiring

When turning on the power, please consider the following points

Please ensure the following design when the power is turned on: After outputting the signal of "servo alarm", turn OFF the main circuit power supply.

- When the control power supply is turned on, the ALM signal is output (relay: OFF) for up to 5.0 seconds. Please take it into consideration when designing the power-on sequence, and turn off the main circuit power connected to the servo unit through the relay.

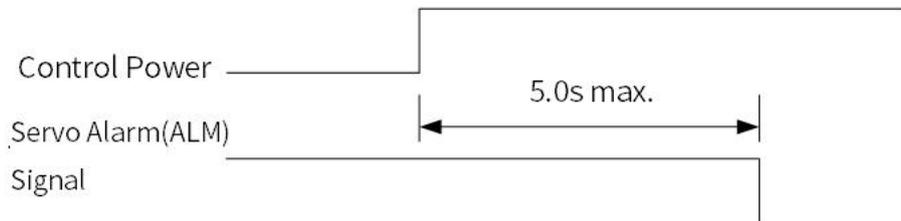


Figure 2-3 Servo Alarm Signal Timing Chart

- Make sure that the power supply specifications are suitable for the input power supply.



Points

- Turn ON the control power supply before the main circuit power supply or turn ON the control power supply and the main circuit power supply at the same time. Turn OFF the main circuit power supply first, and then turn OFF the control power supply.

2.4.1 Example of Main Circuit Wiring for Standard AC220V Power Input

Model name: HN-Y7□□040A-S、HN-Y7□□075A-S、HN-Y7□□100A-S、HN-Y7□□150A-S、HN-Y7□□200A-S

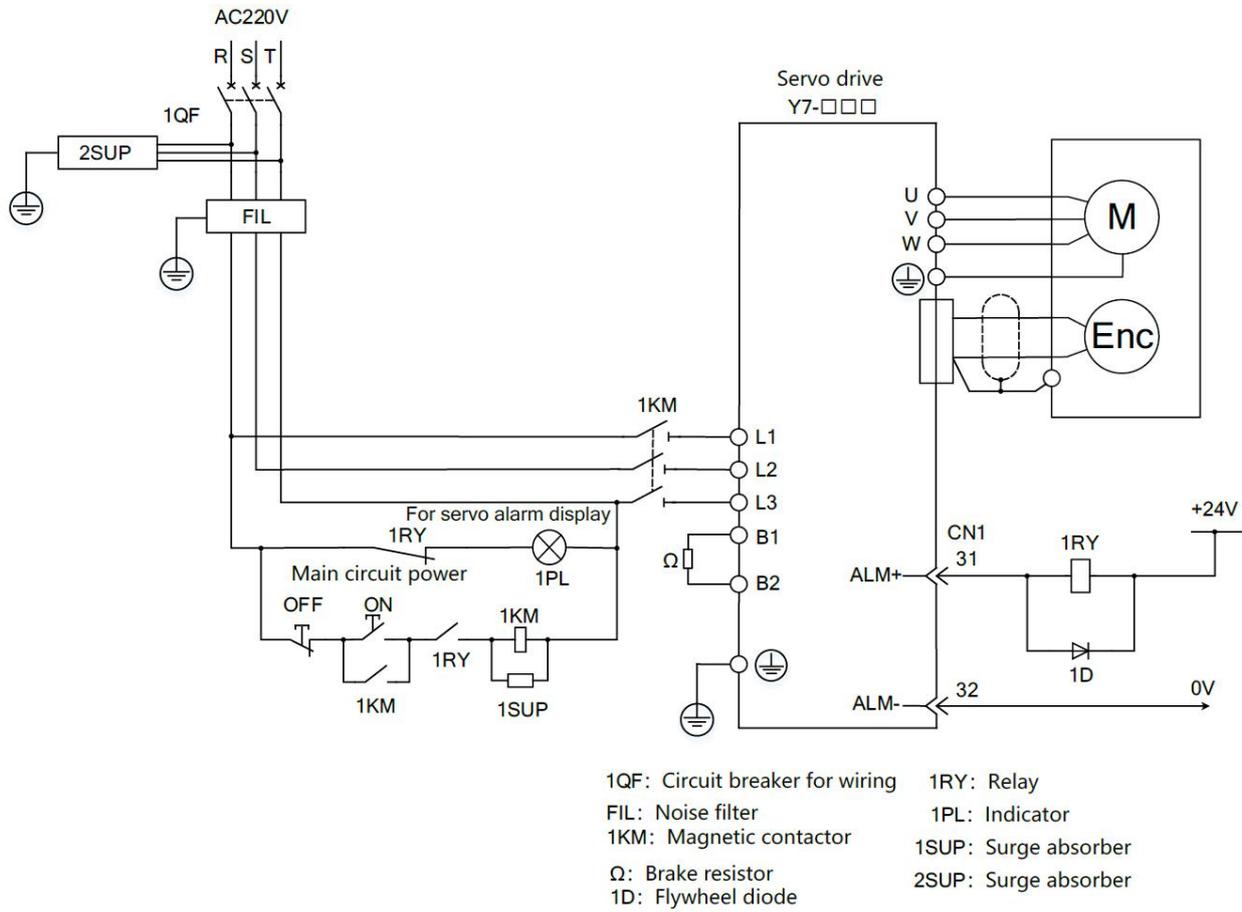
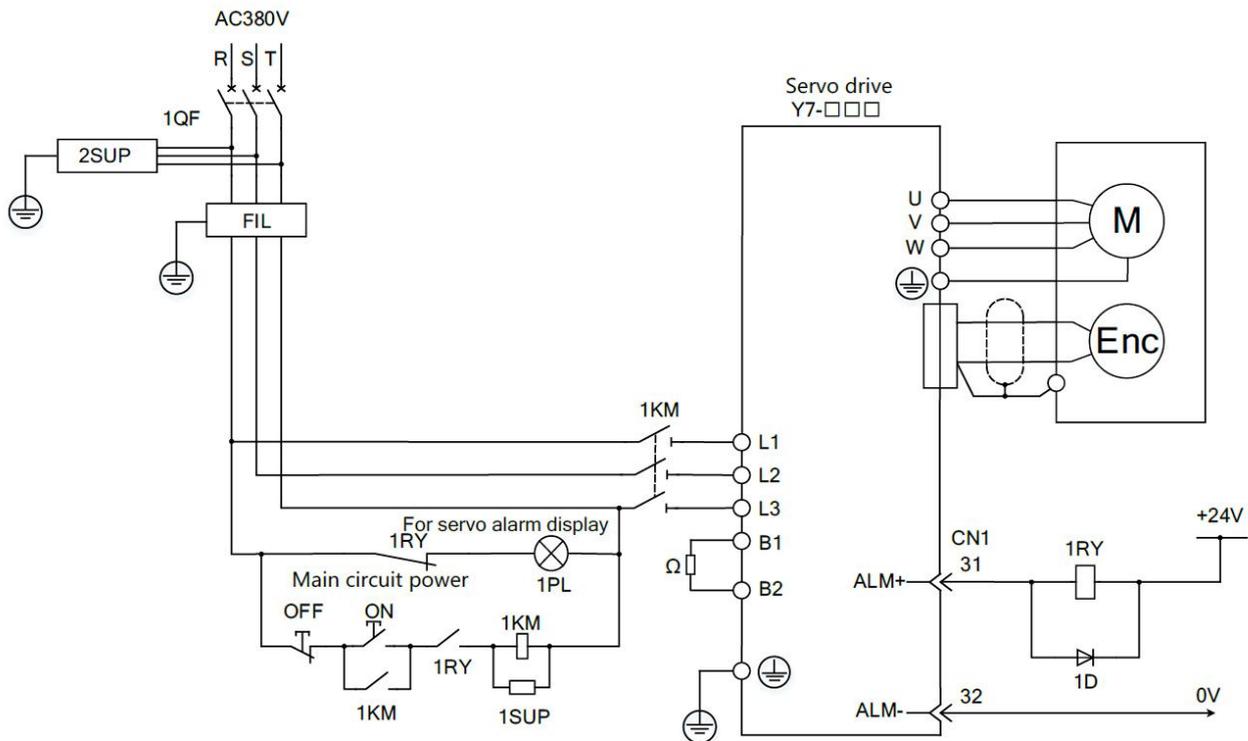


Figure 2-4 Three-phase 220V Wiring

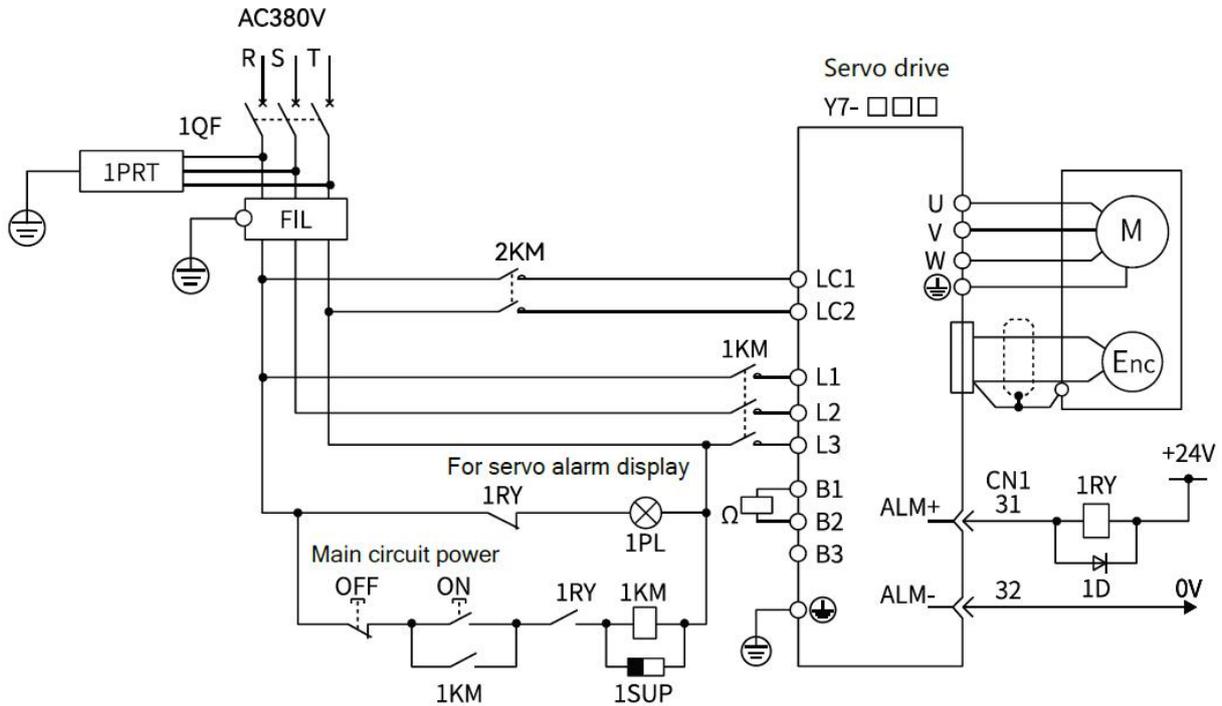
2.4.2 Example of Main Circuit Wiring for Standard AC380V Power Input

Model Name: HN-Y7□□100T-S、HN-Y7□□150T-S、HN-Y7□□200T-S、HN-Y7□□300T-S



- | | |
|---------------------------------|----------------------|
| 1QF: Circuit breaker for wiring | 1RY: Relay |
| FIL: Noise filter | 1PL: Indicator |
| 1KM: Magnetic contactor | 1SUP: Surge absorber |
| Ω: Brake resistor | 2SUP: Surge absorber |
| 1D: Flywheel diode | |

Model name: HN-Y7□□500T-S、HN-Y7□□600T-S、HN-Y7□□750T-S、HN-Y7□□111T-S、HN-Y7□□151T-S、HN-Y7□□221T-S



- 1QF: Circuit breaker for wiring
- FIL: Noise filter
- 1KM: Magnetic contactor
- Ω : Brake resistor
(Connect to B1/B2 when using an external resistor)
(Short circuit B2/B3 when using internal brake resistor)
- 1RY: Relay
- 1PL: Indicator
- 1PRT: Surge absorber
(Absorbing lightning surges)
- 1D: Flywheel diode
- 1SUP: Surge absorber

Figure 2-5 Three-phase 380V Wiring

2.4.3 Servo Drive of Single-phase 220V Power Input

The Y7S series 220V power supply input type servo unit has a three-phase power input specification, and there are also models that can be used under a single-phase 220V power supply. When using the main circuit power supply of the above servo unit under the single-phase 220V power supply, please change it to Pn00B.2=1 (support single-phase power input).

1) Parameter setting for single-phase power input

Table 2-5 Parameter Setting for Single-phase Power Input

| Parameter | Meaning | When Enabled | Classification |
|-----------|------------------------------|---------------|----------------|
| Pn00B | n. □0□□ [Default setting] | After restart | Setup |
| | n. □1□□ | | |

Please observe the following precautions when using.



- When using a servo unit that supports single-phase 220V power input, if you directly input single-phase power without changing the parameter setting to Pn00B.2=1 (supporting single-phase power input), a power phase loss alarm (A.F10) will be detected.
- Single-phase power input is not supported, except for servo units that are suitable for single-phase 220V power input. Otherwise power phase loss alarm (A.F10) will be detected.
- When using single-phase 220V power input, the torque/speed characteristics of the servo motor sometimes cannot meet the characteristics of three-phase power input

2) Main circuit power input

When the power supply is single-phase 220V, please connect it to the L1 and L2 terminals. The power specifications other than the main circuit power input are the same as three-phase power input.

Table 2-6 Main Circuit Power Input Terminal

| Terminal | Name | Function, rating |
|----------|-----------------------------------|----------------------------------|
| L1、L2 | Main circuit power input terminal | Single-phase 200V~240V (50/60Hz) |
| L3 | — | N/A |

➤ Note: Do not connect to L3 terminal.

(3) Wiring example for single-phase 220V power input

Model name: HN-Y7□□040A-S、HN-Y7□□075A-S

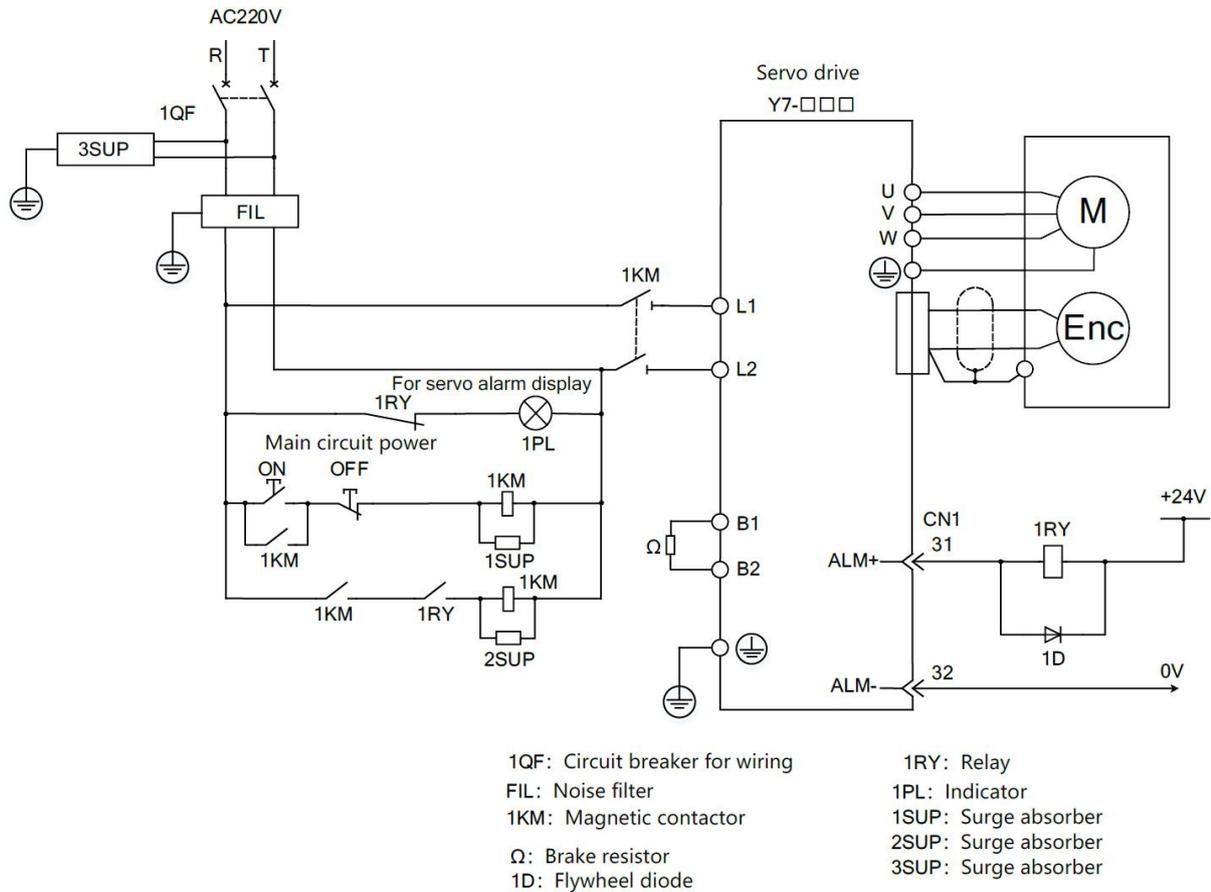


Figure 2-6 Signal-phase 220V Wiring

2.4.4 Servo Unit of DC Power Input

1) Parameter setting for DC power input

Before using the servo unit with DC power input, be sure to change the parameter to Pn001.2 =1 (support DC power input)

Table 2-7 DC Power Supply Settings

| Parameter | Meaning | When Enabled | Classification |
|-----------|---------|---------------|----------------|
| Pn001 | n. □0□□ | After restart | Setup |
| | n. □1□□ | | |

Please observe the following precautions when using.

Danger

- Both 220V and 380V servo unit support AC/DC power input. Please ensure to set Pn001.2=1(Support DC power input) before inputting the power supply.
- Otherwise it will cause the elements in servo unit to burn out and result in fire or device damage.
- Even after you turn OFF the power supply, a high residual voltage may still remain in the servo unit. To prevent electric shock, do not touch the power supply terminals after you turn OFF the power. Make sure to discharge after the power is cut off.
- Please install a fuse on the power wiring when DC power is input
- The servo motor returns regenerative energy to the power supply. If you use a servo unit with a DC power supply input, regenerative energy is not processed. Process the regenerative energy at the power supply.
- If you use a DC power supply input, externally connect an inrush current limiting circuit. Otherwise will cause damage to the servo unit.

2) Main circuit and control power input

① Three-phase 220V Y7S series

Model name: HN-Y7□□040A-S、HN-Y7□□075A-S、HN-Y7□□100A-S、HN-Y7□□150A-S、HN-Y7□□200A-S

Table 2-8 DC220V Power Input Terminals

| Terminal | Name | Specification |
|----------|-------------------------------------|---------------|
| B1 | Main circuit positive side terminal | DC280~360V |

② Three-phase 380V Y7S series

Model name: HN-Y7□□100T-S、HN-Y7□□150T-S、HN-Y7□□200T-S、HN-Y7□□300T-S

Table 2-9 DC380V Power Input Terminals

| Terminal | Name | Specification |
|----------|-------------------------------------|---------------|
| B1 | Main circuit positive side terminal | DC480~620V |
| N | Main circuit negative side terminal | 0V |

③ Three-phase 380V Y7S series

Model: HN-Y7□□500T-S、HN-Y7□□600T-S、HN-Y7□□750T-S、HN-Y7□□111T-S、HN-Y7□□151T-S、HN-Y7□□221T-S

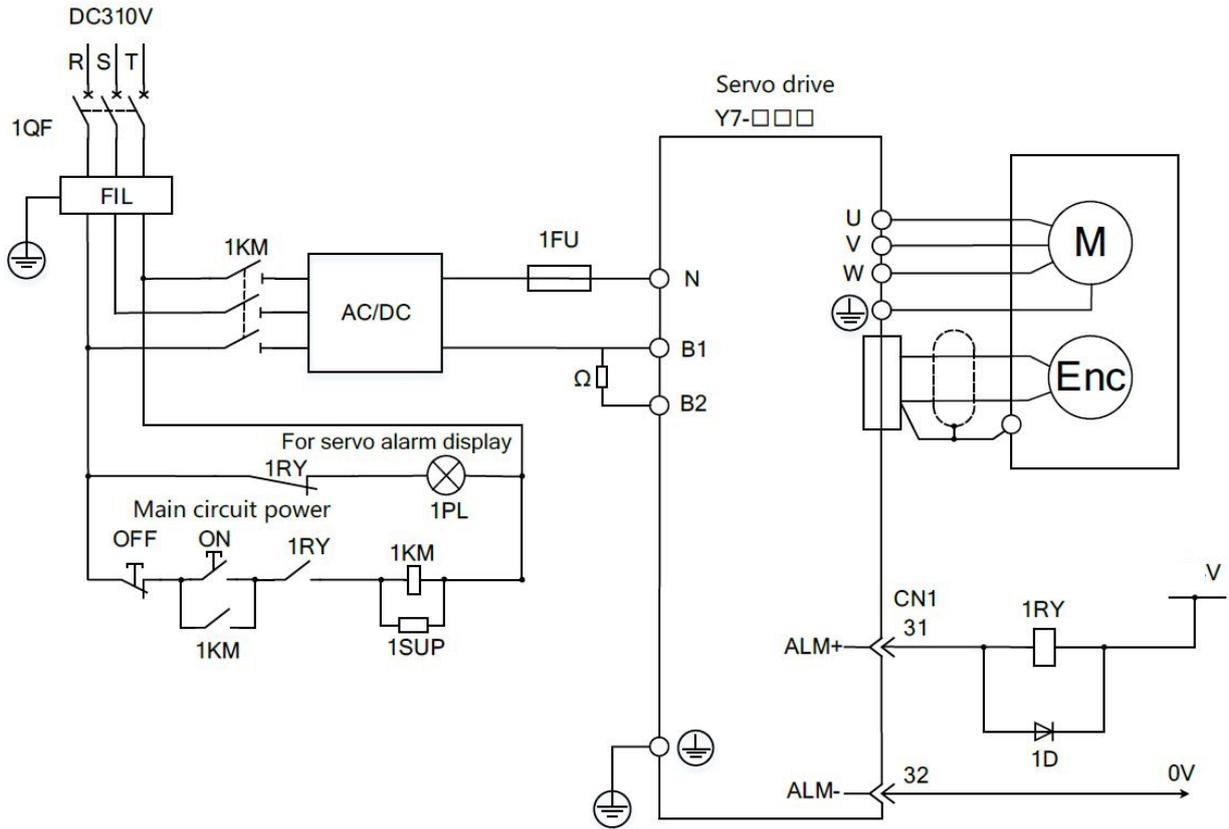
Table 2-10 DC380V Power Input Terminals

| Terminal | Name | Specification |
|---|-------------------------------------|---------------|
| P | Main circuit positive side terminal | DC480~620V |
| N1 (N2 is a model with a power of 7.5 kw) | Main circuit negative side terminal | 0V |
| LC1 , LC2 | Control power terminal | DC480~620V |

3) Wiring example for DC power input

① Wiring for HN-Y7□□□□A-S DC310V power input type servo unit

Model name: HN-Y7□□040A-S、HN-Y7□□075A-S、HN-Y7□□100A-S、HN-Y7□□150A-S、HN-Y7□□200A-S



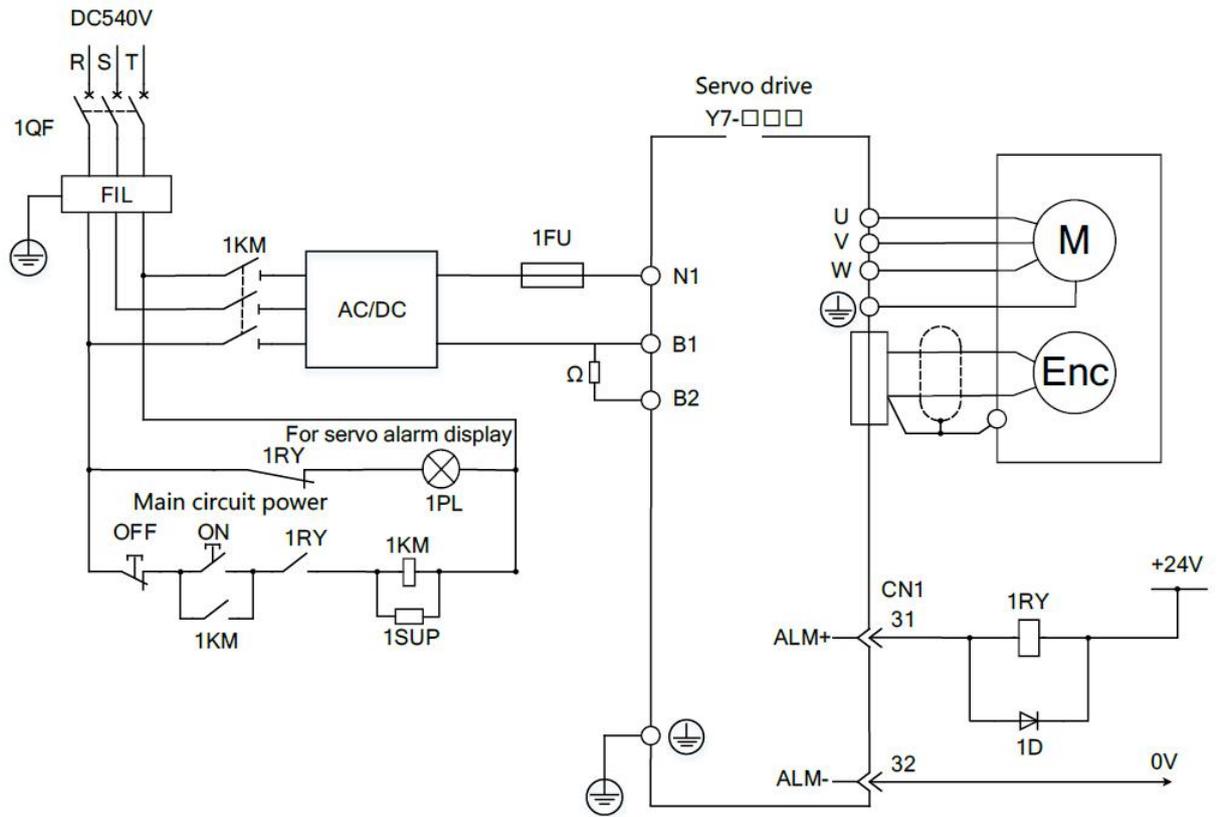
- | | | |
|---------------------------------|----------------------|--------------------|
| 1QF: Circuit breaker for wiring | 1RY: Relay | 1FU: Fuse |
| FIL: Noise filter | 1PL: Indicator | Ω: Brake resistor |
| 1KM: Magnetic contactor | 1SUP: Surge absorber | 1D: Flywheel diode |

Figure 2-7 DC310V Input HN-Y7□□□□A-S Wiring

> Note: The terminals are different according to the model of the servo unit. Please refer to the table in "(2) Main circuit, control power input".

② Wiring 1 of HN-Y7□□□□T-S DC540V power input type servo unit

Model: HN-Y7□□100T-S、HN-Y7□□150T-S、HN-Y7□□200T-S、HN-Y7□□300T-S

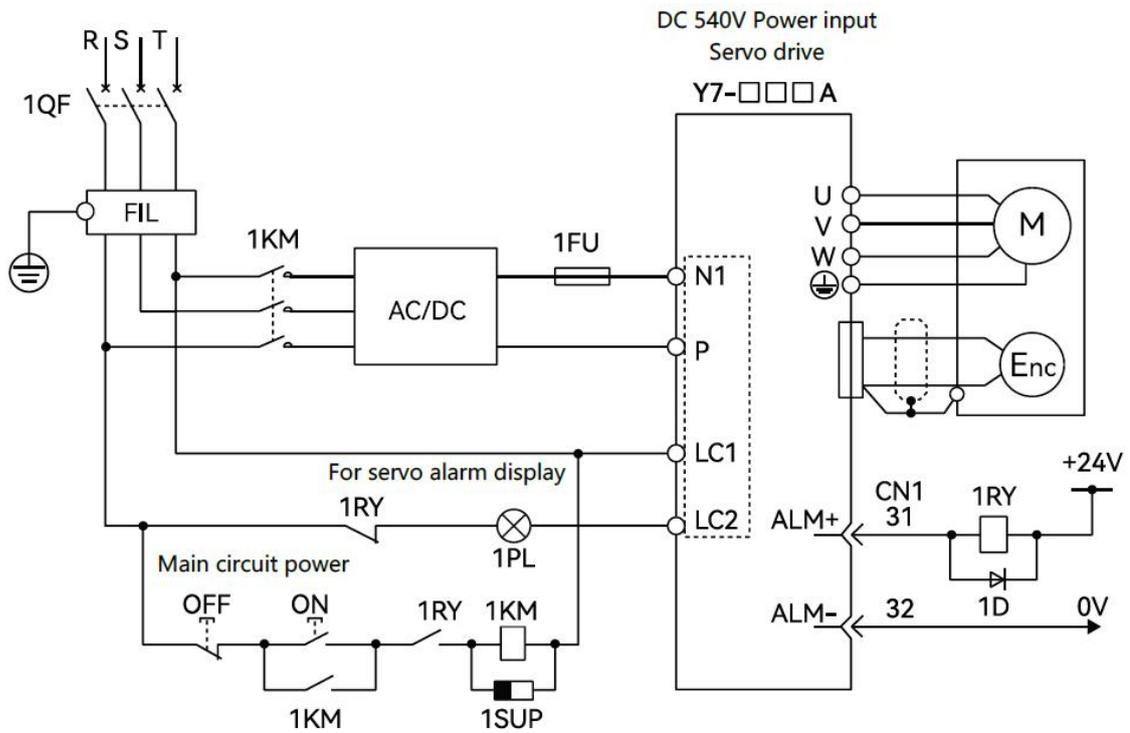


- | | | |
|---------------------------------|----------------------|--------------------|
| 1QF: Circuit breaker for wiring | 1RY: Relay | 1FU: Fuse |
| FIL: Noise filter | 1PL: Indicator | Ω: Brake resistor |
| 1KM: Magnetic contactor | 1SUP: Surge absorber | 1D: Flywheel diode |

Figure 2-8-1 DC540V Input HN-Y7□□□□T-S Three-phase Wiring 1

③ Wiring 2 of HN-Y7□□□□T-S DC540V power input type servo unit

Model name: HN-Y7□□500T-S, HN-Y7□□600T-S, HN-Y7□□750T-S, HN-Y7□□111T-S, HN-Y7□□151T-S, HN-Y7□□221T-S



- 1QF: Circuit breaker for wiring
- FIL: Noise filter
- 1KM: Magnetic contactor
- 1RY: Relay
- 1PL: Indicator
- 1PRT: Surge absorber (Absorbing lightning surges)
- 1D: Flywheel diode
- 1SUP: Surge absorber (Absorbing switching surges)

Figure 2-9 DC540V Input HN-Y7□□□□T-S Three-phase Wiring Diagram

2.4.5 Line Breaker and Fuse Capacity

Table 2-11 Circuit Breaker and Fuse Capacity Table for

| Main circuit power supply | Maximum applicable motor capacity [kW] | Servo unit model Y7- | Power supply capacity for single servo unit kVA | Current capacity | | Impulse current | |
|---------------------------|--|----------------------|---|-------------------|----------------------|-------------------|----------------------|
| | | | | Main circuit Arms | Control loop Arms | Main circuit A0-p | Control loop A0-p |
| Single-phase 220V | 0.4 | 040 | 1.2 | 5.0 | Same as main circuit | 33.0 | Same as main circuit |
| | 0.75 | 075 | 1.9 | 9.0 | | | |
| Three-phase 220V | 1.0 | 100 | 2.3 | 6.0 | | | |
| | 1.5 | 150 | 3.2 | 7.3 | | | |
| | 2 | 200 | 4 | 9.7 | | | |
| Three phase 380V | 1.0 | 100 | 2.3 | 2.9 | | 15 | |
| | 1.5 | 150 | 3.5 | 4.3 | 24 | | |
| | 2.0 | 200 | 4.5 | 5.8 | 34 | | |
| | 3.0 | 300 | 7.1 | 8.6 | 44 | | |

| | | | | | |
|-----|-----|------|------|-----|----|
| 5.0 | 500 | 11.7 | 14.5 | 1.4 | 57 |
| 6.0 | 600 | 12.4 | 17.4 | 1.5 | 34 |
| 7.5 | 750 | 14.4 | 21.7 | | |
| 11 | 111 | 21.9 | 23.4 | 1.7 | 68 |
| 15 | 151 | 30.6 | 29.6 | | |
| 22 | 221 | 45.5 | 43.4 | | |

Note: 1. In order to meet the low voltage standard, please be sure to connect a fuse on the input side for protection when a fault is caused by a short circuit. Please select the fuse or circuit breaker for the input side to meet the UL standard products. In addition, the current capacity and inrush current in the above table are net values. Please select a fuse and a circuit breaker for wiring that satisfy the following conditions for breaking characteristics.

2. Main circuit and control circuit: When the current value is 3 times the value in the above table, the circuit shall not be disconnected within 5s.

Table 2-12 Restrictions to Comply with UL Standard

| Servo Drive Y7--□□□A Y7--□□□A | Usage restrictions |
|-------------------------------------|---|
| 150A, 200A , 300A | Rated current value of circuit breaker for wiring: 40A or less . |
| 600T 750T | The rated current value of circuit breaker for wiring: 6 0A or less. The rated current value of fast-acting fuse and time-delay fuse: below 6 0A . The rated current value of the time-delay fuse: below 3 5A . |
| 111T 151T | The rated current value of circuit breaker for wiring: 80A or less. The rated current value of fast-acting fuse and time-delay fuse: below 125A . The rated current value of the time-delay fuse: 75A or less. |

2.5 Wiring of regenerative resistor

When the processing capacity of regenerative energy is insufficient, connect an external regenerative resistor according to the following method, and set the regenerative resistor capacity (Pn600) for details.

Note: Please connect the regenerative resistor unit correctly. Do not short-circuit B1/B2. Doing so may result in damage to the regenerative resistor or the servo unit and cause fire.

Generally, directly connect regenerative resistor between B1/B2 terminals. In the power range of servo unit above 200 A/ 100T, an external regenerative resistor can be connected to the B1/B2 terminal of the servo unit only when the terminal B2/B3 of the servo unit is open circuited (the wiring is removed). After connecting, please set the regenerative resistor capacity.

When connecting with servo units such as H N-Y7□□□□□A-S, the unit with the model HN -Y7□□□040A-S does not have a built-in regenerative resistor. If the processing capacity of regenerative energy is insufficient, an external regenerative resistor must be connected.

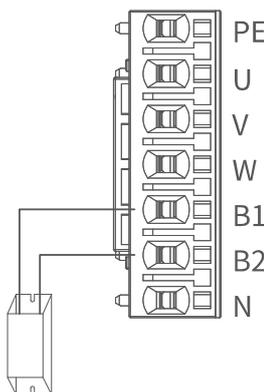


Figure 2-9 Model Below 3kw Regenerative Resistor Wiring

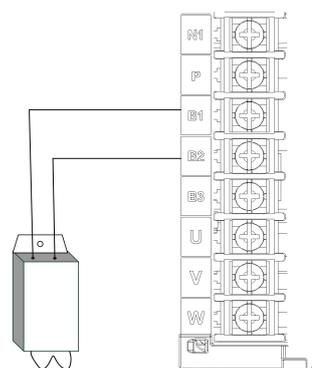


Figure 2-10 Model Above 5kw Regenerative Resistor Wiring (With B3)

2.5.1 AC 220 V Regenerative Resistor

Table 2-13 AC220V Regenerative Resistor Specifications

| Item | | | Specification | | | | |
|----------------------------|--|----------------------|---------------|-----|-----|-----|-----|
| Model HN-Y7EB***A-S** **** | | | 040 | 075 | 100 | 150 | 200 |
| Regenerative resistor | Built-in resistor | Resistance value (Ω) | — | 50 | 50 | 50 | 20 |
| | | Capacity(W) | — | 40 | 80 | 100 | 100 |
| | External minimum allowable resistance value(Ω) | | 40 | 40 | 35 | 20 | 20 |

2.5.2 AC380V regenerative resistor basic specifications

Table 2-14 AC380V Regenerative Resistor Specifications

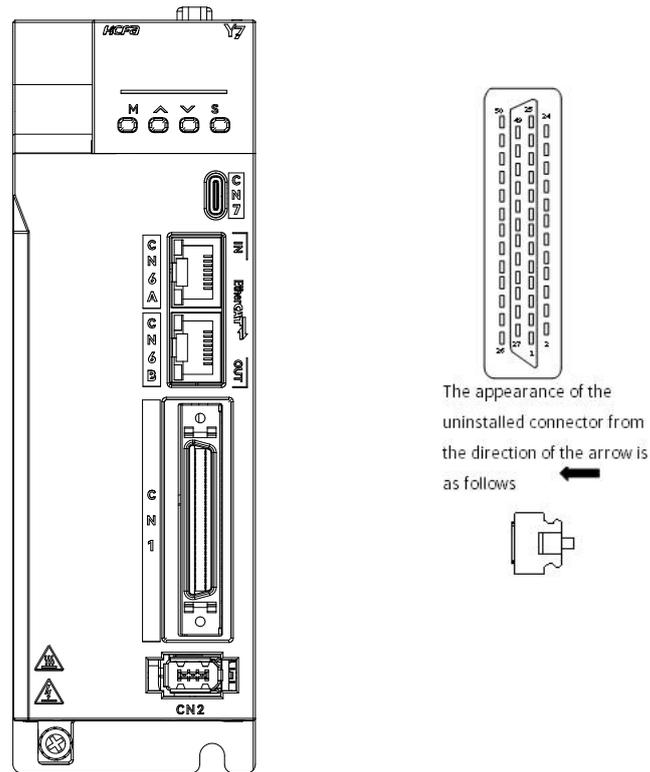
| Item | | | Specification | | | | | | | | | |
|----------------------------|--|----------------------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Model HN-Y7EB***T-S** **** | | | 100 | 150 | 200 | 300 | 500 | 600 | 750 | 111 | 151 | 221 |
| Regenerative resistor | Built-in resistor | Resistance value (Ω) | 50 | 50 | 50 | 40 | 25 | 20 | 20 | — | — | — |
| | | Capacity(W) | 80 | 80 | 100 | 100 | 100 | 100 | 100 | — | — | — |
| | External minimum allowable resistance value(Ω) | | 40 | 40 | 40 | 35 | 25 | 20 | 20 | 15 | 10 | 10 |



Points

- If using an external regenerative resistor at a normal rated load factor, the temperature of the resistor reaches 200°C to 300°C, please be sure to derate before using it. For the load characteristics of the resistor, please consult the manufacturer
- To ensure safety, recommend to use external regenerative resistor with temperature-controlled switch.

2.6 Input and output signals (CN1)



The appearance of the uninstalled connector from the direction of the arrow is as follows



Figure 2-11 CN1 External View

2.6.1 Pin Arrangement of I/O Signal (CN1) Connector

| | | | | | | | | |
|----|------|--|----|-------|---|----|----------|---------------------------------------|
| 2 | SG | GND | 1 | SG | GND | 26 | OUT3- | Assignable output signal |
| 4 | SEN | SEN signal input- | 3 | PL1 | 12V Internal Power Supply for Open Collector Reference Output | 27 | OUT4+ | High speed output |
| 6 | SG | GND | 5 | V-REF | Analog Speed Reference Input | 29 | OUT1+ | Assignable output signal |
| 8 | Null | Null | 7 | Null | Null | 31 | OUT2+ | Assignable output signal |
| 10 | SG | GND | 9 | T-REF | Analog Torque Reference Input | 33 | PA0 | Encoder Divided Pulse Output, Phase A |
| 12 | Null | Null | 11 | Null | Null | 35 | PB0 | Encoder Divided Pulse Output, Phase B |
| 14 | CLR | Position Deviation Clear input Input | 13 | PL2 | 12V Internal Power Supply for Open Collector Reference Output | 37 | OUT5+ | High speed output |
| 16 | Null | Null | 15 | Null | Null | 39 | DAC0 | Analog Output 1 |
| 18 | PL3 | 12V Internal Power Supply for OpenCollector Reference Output | 17 | Null | Null | 41 | SI1 | Probe 1 |
| 20 | /PC0 | Divided Pulse Output, Phase C phase | 19 | PC0+ | Encoder Divided Pulse Output, Phase C | 43 | SI3 | Disabled Reverse Side Drive Input |
| 22 | Null | Null | 21 | Null | Null | 45 | Null | Null |
| 24 | Null | Null | 23 | Null | Null | 47 | DI (COM) | External 24V Power Input |
| | | | 25 | OUT3+ | Assignable output signal | 49 | OCZ | Z Signal Collector Output |
| | | | | | | 50 | TH | External temperature detection |

Figure 2-12 Pin Arrangement of I/O Signal (CN1) Connector

➤ Note: 1. Only Full-function F type supports high speed output, analog input and pulse divided output;

2. No CN1 for general purpose N type.

2.6.2 Name and Function of Input Signal (CN1)

Table 2-15 Input Signal (CN1) Name and Function List

| Control Method | Signal | Pin No. | Function | |
|--------------------|--------|---|------------------------------|---|
| Any Control Method | Home | 40 | Homing signal drive input | |
| | EXT1 | 41 | Probe 1 | |
| | P-OT | 42 | Prohibition of forward drive | When the mechanical movement exceeds the movable range, the drive of the servo motor is stopped (overtravel prevention function). |
| | N-OT | 43 | Prohibition of reverse drive | |
| | EXT2 | 44 | Probe 2 | |
| DI(COM) | 47 | (Note)Available when the control power supply is used for the input signal. Operable voltage range: +11V ~ +25V (+24V power supply is not provided by HCFA) . | | |

➤ Note: 1.Pin numbers in parentheses () indicate signal grounds (SG)

2. The input signal distribution of P-OT, N-OT and probe is changeable, please refer to 2.6.3 "Input Signal Distribution" for details.

2.6.3 Allocation of Input Signal



Points

- If you change the default polarity settings for the /S-ON (Servo ON), P-OT (Forward Drive Prohibit), or N-OT (Reverse Drive Prohibit) signal, the main circuit power supply will not be turned OFF and the overtravel function will not operate if there are signal line disconnections or other problems. If you must change the polarity of one of these signals, verify operation and make sure that no safety problems will exist.
- If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all of the allocated signals will operate accordingly. This may result in unexpected operation.

After changing the distribution of the input signal, please be sure to set Pn50A.0 = 1 when using it, so that the servo is in a state where the distribution can be changed.

The state of the input signal can be confirmed through the input signal monitoring (Un005)

Table 2-16 Input Signal Allocation

| Signal name | Active level | Input signal | CN1 Pin number | | | | | No connection required (Process inside the servo drive) | |
|---|--------------|--------------|----------------|----|----|----|----|---|-----------------|
| | | | 40 | 41 | 42 | 43 | 44 | Always active | Always inactive |
| Parameter Assignment /HomeSwitch Setting of Pn50D.1 | L | HomeSwitch | 0 | 1 | 2 | 3 | 4 | 8 | — |
| | H | /HomeSwitch | 9 | A | B | C | D | | |
| Forward Drive Prohibit Setting of Pn50A.3 | L | P-OT | 0 | 1 | 2 | 3 | 4 | 7 | 8 |
| | H | /P-OT | 9 | A | B | C | D | | |
| Reverse Drive Prohibit Setting of Pn50B.0 | L | N-OT | 0 | 1 | 2 | 3 | 4 | 7 | 8 |
| | H | /N-OT | 9 | A | B | C | D | | |
| External probe 1 signal Setting of Pn511.1 | L | EXT1 | 0 | 1 | 2 | 3 | 4 | 7 | 8 |
| | H | /EXT1 | 9 | A | B | C | D | | |
| External probe 2 signal | L | EXT2 | 0 | 1 | 2 | 3 | 4 | 7 | 8 |

| | | | | | | | |
|--------------------|---|-------|---|---|---|---|----------|
| Setting of Pn511.2 | H | /EXT2 | 9 | A | B | C | D |
|--------------------|---|-------|---|---|---|---|----------|

*□ in table indicates default setting

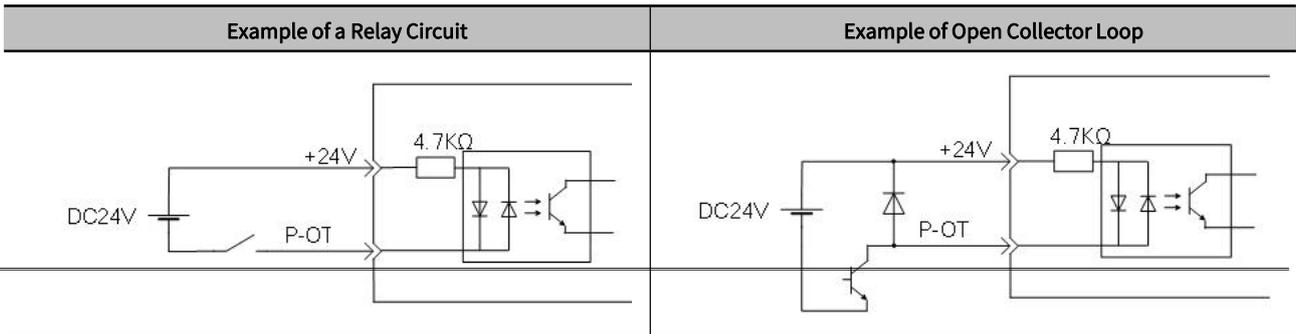
➤ Note: If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all of the allocated signals will operate accordingly. This may result in unexpected operation.

2.6.4 Input Circuit

The following describes terminals 40 to 47 of the CN1 port

1) Relay/Collector Input Circuit

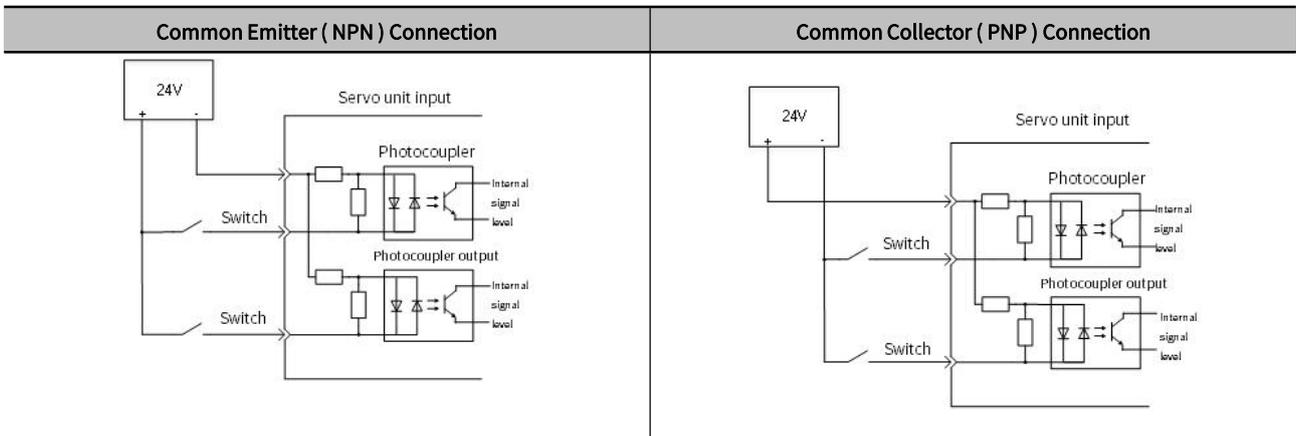
The connection is made via a relay or an open-collector transistor circuit. When using a relay connection, please choose a relay for small current; if you do not use a relay for small current, it will cause poor contact



➤ Note: The external power supply (DC24V) must be a capacity of 50mA or more

2) Photocoupler Input Circuit

The input circuit of the servo unit uses a bidirectional photocoupler. Please choose NPN connection or PNP connection according to the specifications of the machine.



| Input Signal Polarity | | | | Input Signal Polarity | | | |
|-----------------------|--------------|-------------|--------|-----------------------|--------------|-------------|--------|
| Signal | Active level | Power value | Switch | Signal | Active level | Power value | Switch |
| ON | L level | 0V | OFF | ON | H level | 24V | OFF |
| OFF | H level | 24V | ON | OFF | L level | 0V | ON |

➤ Note: Please note that the ON/OFF polarity is different between NPN circuit connection and PNP circuit connection.

2.6.5 Name and Function of Output Signal (CN1)

Table 2-17 Names and Functions of Output Signals (CN1)

| Control Method | Signal | Pin number | Function |
|----------------|--------|------------|----------|
|----------------|--------|------------|----------|

| | | | | |
|--------------------|--|----------------------------|--|--|
| Any control method | OUT3+, OUT3- OUT1+, OUT1- OUT2+, OUT2- | 25、 26 29、 30 31、 32 | Allocable output signal | |
| | PA0 /PA0 | 33 34 | Phase A Signal | Output the encoder divided pulse output signals with a 0° phase differential |
| | PB0 /PB0 | 35 36 | Phase B Signal | |
| | PC0 /PC0 | 19 20 | Phase C Signal | Outputs the origin signal once every encoder rotation.. |
| | OUT4+, OUT4- OUT5+, OUT5- | 27、 28 37、 38 | High speed output | |
| | FG | Shell | Ground is already performed if IO signal is connected to the shell with shield of cables | |

➤ Noted: Pin number in () is used for signal grounding(SG)

2.6.6 Output Signals Allocations



Points

- The signals that are not detected are considered to be OFF. For example, the /COIN (Positioning Completion) signal is considered to be OFF during speed control.
- Reversing the polarity of the /BK (Brake) signal, i.e., changing it to positive logic, will prevent the holding brake from operating if its signal line is disconnected. If you must change the polarity of this signal, verify operation and make sure that no safety problems will exist.
- If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

The allocation of the output signals is shown in the table below:

Table 2-18 Output Signal Allocation

*□ in table indicates default setting

| CN1 pin number | | 25/ (26) | | 27/ (28) | | 29/ (30) | | 37/ (38) | |
|---|------|--------------------------------|-------------|--------------------|------------|--------------------|------------|--------------------|------------|
| Parameter Allocation | | Signal output polarity setting | | | | | | | |
| | | Setting of pn512.0 | | Setting of pn512.1 | | Setting of pn512.2 | | Setting of Pn512.3 | |
| | | 0 | 1 (Reverse) | 0 | 1(Reverse) | 0 | 1(Reverse) | 0 | 1(Reverse) |
| Output signal selection 1 Setting of Pn50E | 0000 | Disabled | | | | | | | |
| | 0001 | L | H | | | | | | |
| | 0020 | | | L | H | | | | |
| | 0300 | | | | | L | H | | |
| | 4000 | | | | | | | L | H |
| Output signal selection 2 Setting of Pn50F | 0000 | Disabled | | | | | | | |
| | 0001 | L | H | | | | | | |
| | 0020 | | | L | H | | | | |
| | 0300 | | | | | L | H | | |
| | 4000 | | | | | | | L | H |
| Output signal selection 3 Setting of Pn510 | 0000 | Disabled | | | | | | | |
| | 0001 | L | H | | | | | | |
| | 0020 | | | L | H | | | | |
| | 0300 | | | | | L | H | | |
| | 4000 | | | | | | | L | H |

| | | | | | | | | | |
|---|------|----------|---|---|---|---|---|---|---|
| Output signal selection 4 Setting of Pn513 | 0000 | Disabled | | | | | | | |
| | 0001 | L | H | | | | | | |
| | 0020 | | | L | H | | | | |
| | 0300 | | | | | L | H | | |
| | 4000 | | | | | | | L | H |

If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

Reversing the polarity of the /BK (Brake) signal, i.e., changing it to positive logic, will prevent the holding brake from operating if its signal line is disconnected. If you must change the polarity of this signal, verify operation and make sure that no safety problems will exist.

➤ Note: Output signals above are only for example. Please self-allocate as appropriate

2.6.7 Output Circuit

The signal output circuits of the servo unit are the following two types.

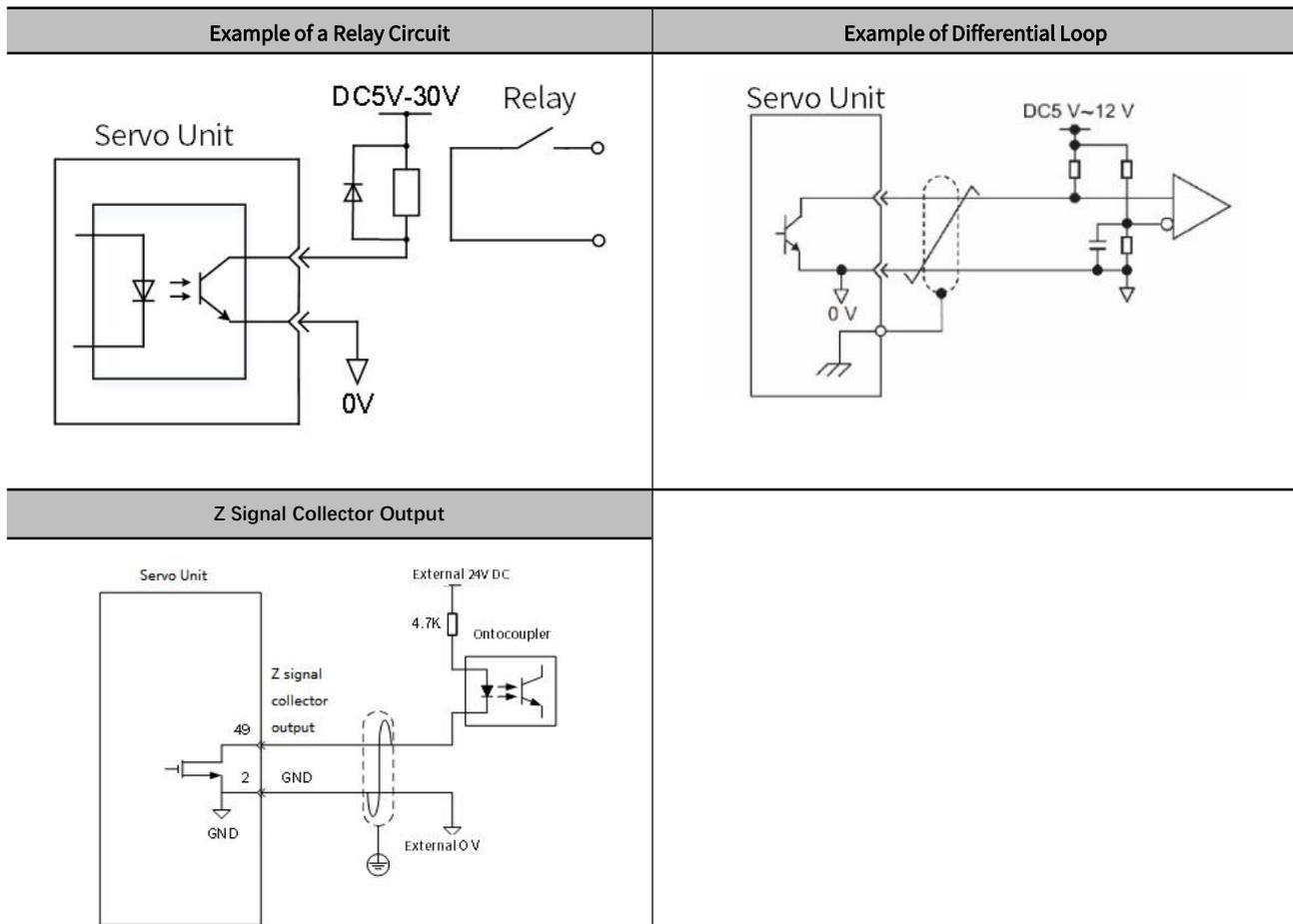


Points

- Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury.

1) Photocoupler output circuit

Photocoupler output circuits are used for the ALM (Servo Alarm) and other sequence output signals. Connect a photocoupler output circuit to a relay or line-receiver circuit.



- Note: The specifications of the photocoupler output circuit are as follows:
- · Maximum allowable voltage: DC30V
- · Current range: DC5mA ~ DC50mA

2.6.8 PG Output

The following describes the terminals 33-34 (A-phase signal), 35-36 (B-phase signal) and 19-20 (C-phase signal) of the CN1 port.

Converts the serial data of the encoder into 2-phase (A-phase, B-phase) pulse output signals (PAO, /PAO, PBO, /PBO) and origin pulse signals (PCO, /PCO) and outputs them through the line driver output circuit. On the host device side, use a differential receiver loop for reception.

2.6.9 Brake Signal

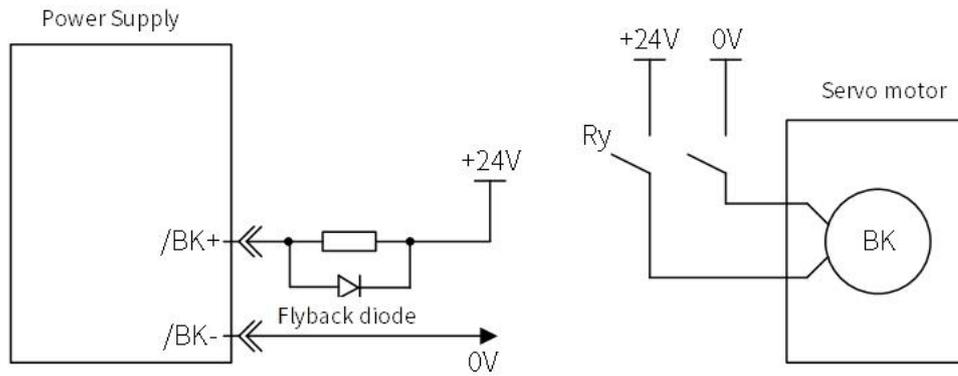


Figure 2-13 Brake Signal Connection

- Note: 1. The /BK (Brake) signal cannot be used with the default settings. You must allocate the output signal. Please use "brake signal (/BK) distribution" to set.
- 2. If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is Common, the I/O signals may malfunction.

2.7 Encoder Signal (CN2)

The following describes the name, function and connection example of encoder signal(CN2).

2.7.1 Name and Function of Encoder Signal (CN2)

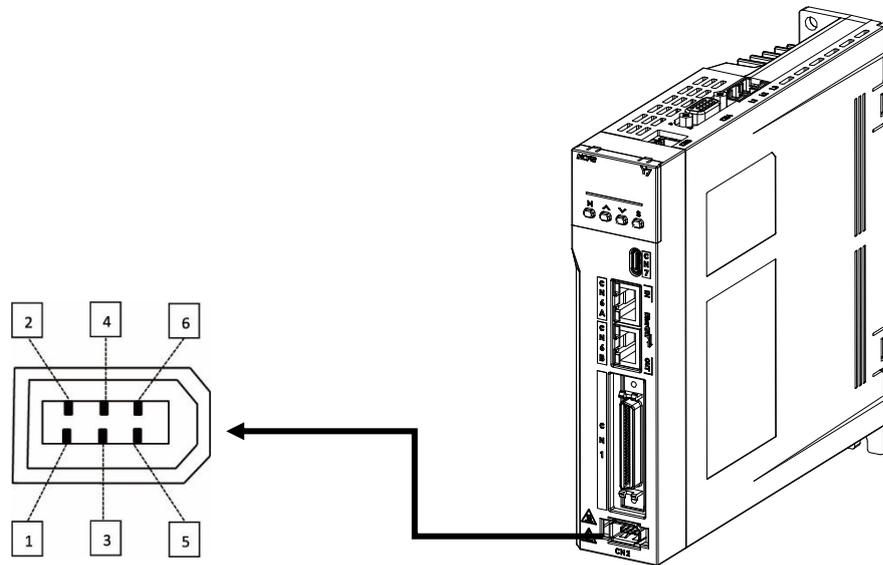


Figure 2-14 Pin Arrangement of Encoder Connector

Table 2-19 Name and Function Table of Encoder Signal (CN2)

| Signal name | Pin number | Function |
|-------------|------------|-------------------|
| PG 5V | 1 | Encoder Power +5V |
| PG 0V | 2 | Encoder Power 0V |
| — | 3 | — |
| — | 4 | — |
| PS | 5 | Serial Data (+) |
| /PS | 6 | Serial Data (-) |
| Shield | Shell | — |

2.7.2 Wiring the Servo Drive to Encoder

The wiring example of the encoder, servo drive and host device is shown below

1) Incremental encoder

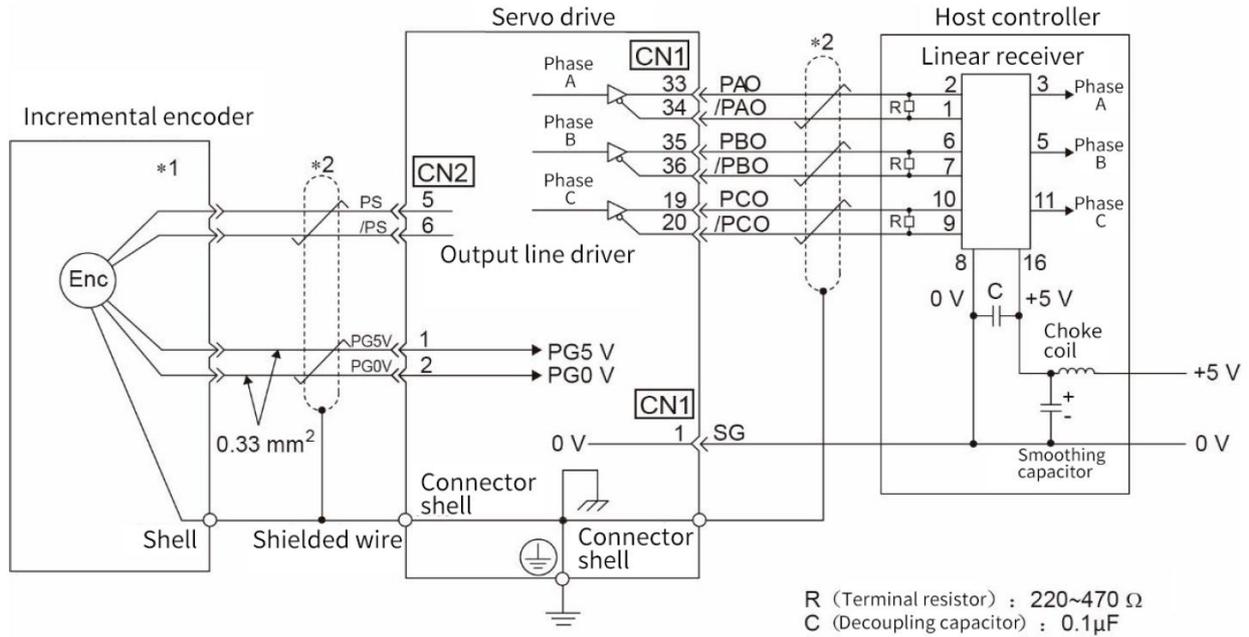
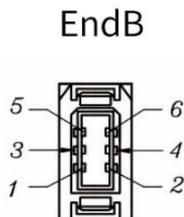
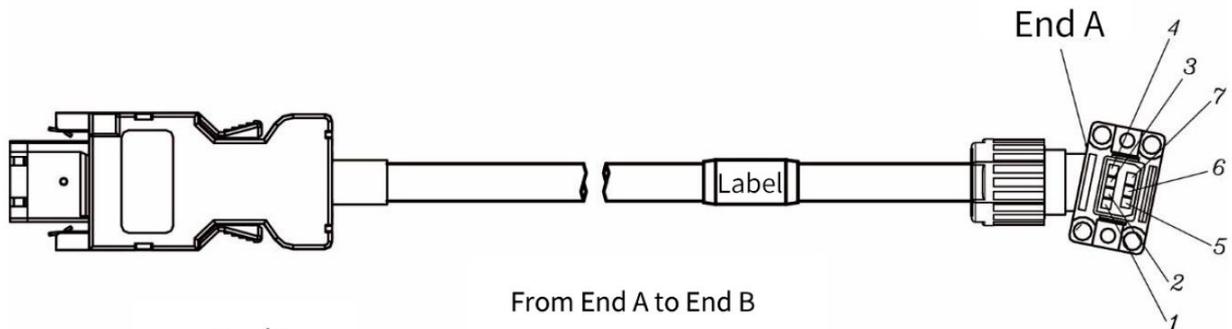


Figure 2-15 Incremental Encoder, Servo Drive and Host Device Connection Diagram

- Note: *1. The connector wiring pin number of the incremental encoder varies depending on the servo motor used.
- *2. Indicates shielded twisted-pair wire.

Incremental Encoder Cable — SVCAB-ENC075CA-***L-05:



From End A to End B

| End A | Type | Color | End B | Signal name |
|-------|-------|----------------------|------------|-------------|
| 1 | AWG26 | Orange(red dotted) | 1 | VCC |
| 2 | | Orange(black dotted) | 2 | GND |
| 3 | | — | 3 | — |
| 4 | | White(black dotted) | 6 | -D0 |
| 5 | | — | 4 | — |
| 6 | | Black | Iron shell | SHIELD |
| 7 | | White(red dotted) | 5 | +D0 |

2) Absolute encoder

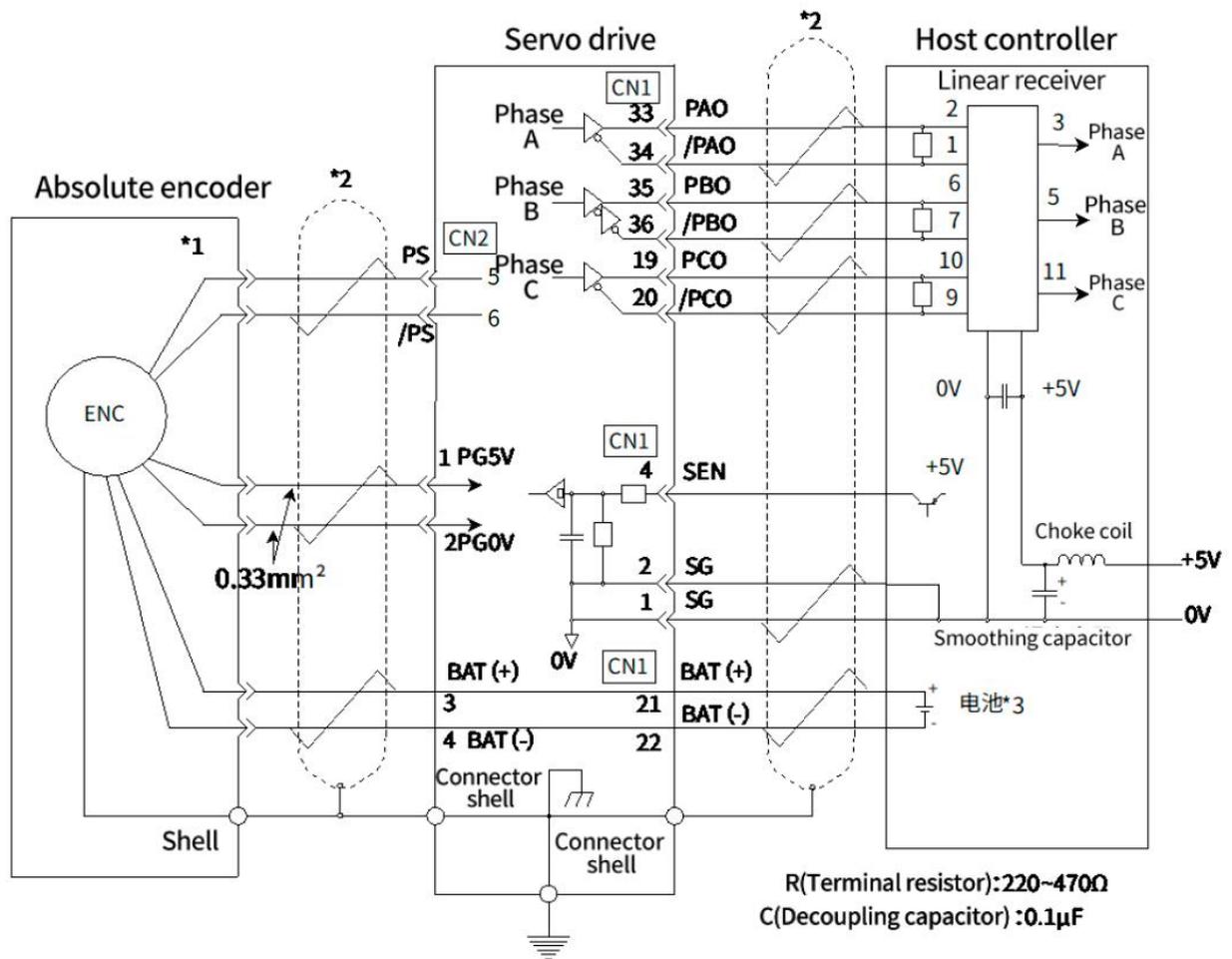
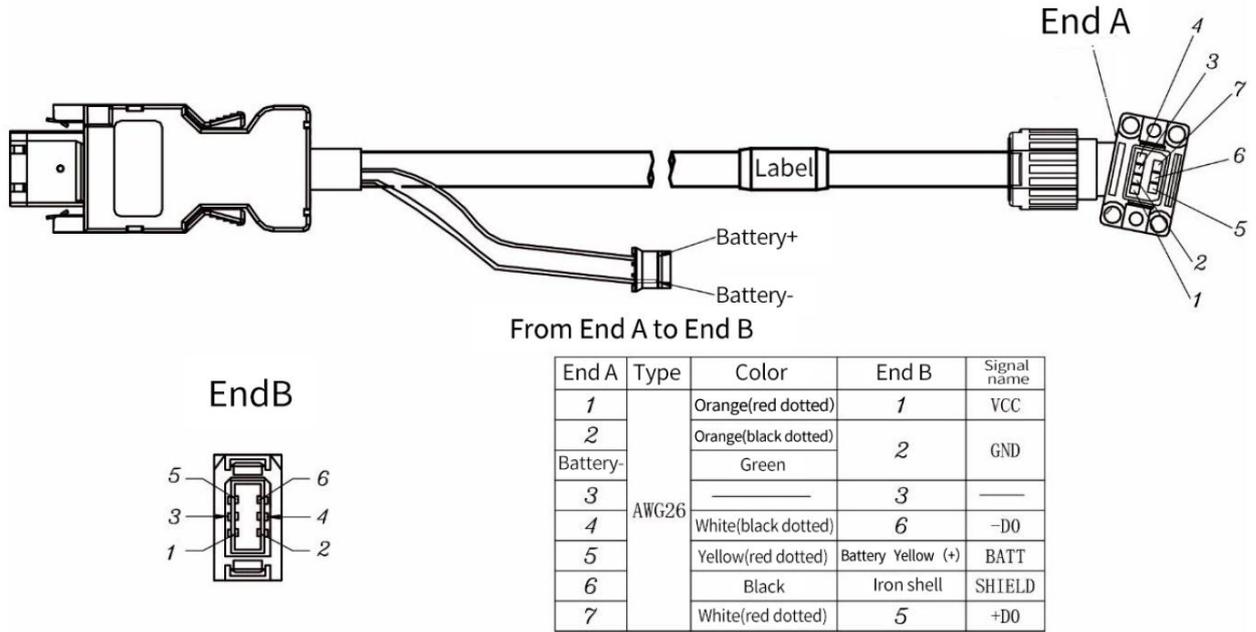


Figure 2-16 Absolute Encoder, Servo Drive and Host Controller Connection Diagram

- Note: *1. The connector wiring pin number of the absolute encoder varies depending on the servo motor used.
- *2. Indicates shielded twisted-pair wire.
- *3. When using an absolute encoder, install a battery on either side of the encoder cable with a battery unit or on the host side to supply power.

Absolute Encoder Cable — SVCAB-ENC075CA-ABS-***L-05



2.8 Safety Function Signals STO(CN3)

The following describes the name, function and connection example of the safety function signal (CN3)

2.8.1 Names and Functions of the Safety Function Signal (CN3)

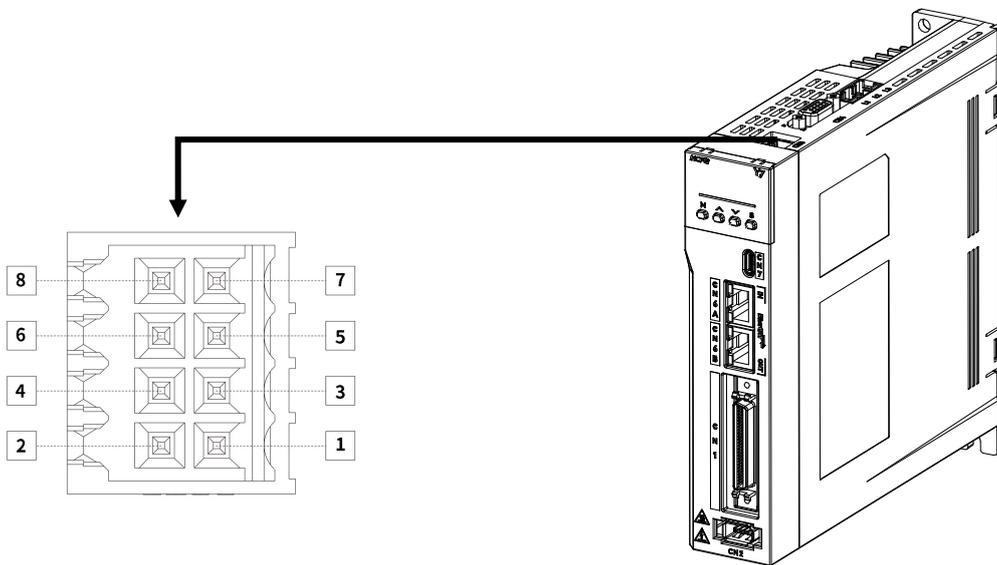


Figure 2-17 Pin Arrangement of Safety Function Signals (CN3)

Table 2-20 Name and function list of safety function use signal (CN3)

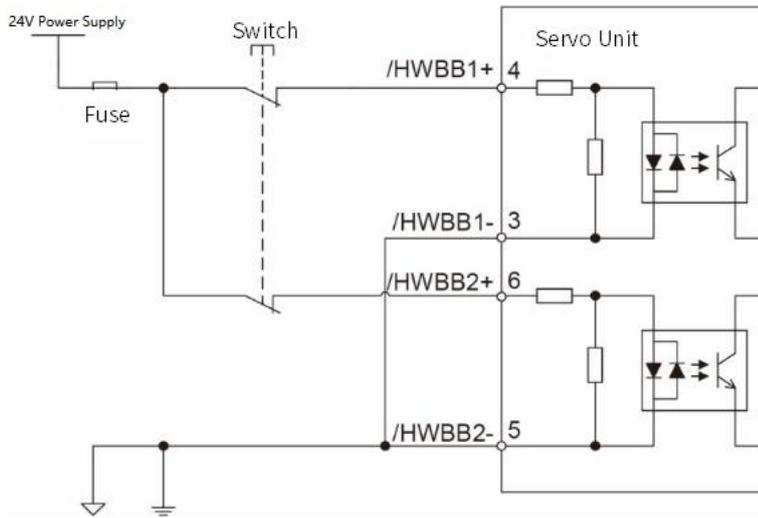
| Signal name | Pin | Function |
|-------------|-----|--|
| — | 1 | Do not make any connections |
| — | 2 | |
| /HWBB1- | 3 | For a hard wire base block input. The base block (motor power turned OFF) is in effect when the signal is OFF. |
| /HWBB1+ | 4 | |

| | | |
|---------|---|---|
| /HWBB2- | 5 | |
| /HWBB2+ | 6 | |
| EDM1- | 7 | Turns ON when the hardware base blocking function is normally active for monitoring loop status output |
| EDM1+ | 8 | Turns OFF when the hardware base blocking function is normally active for monitoring loop status output |

2.8.2 Safety Input Circuit

Use a 0-V common to connect the safety function signals. You must connect redundant input signals.

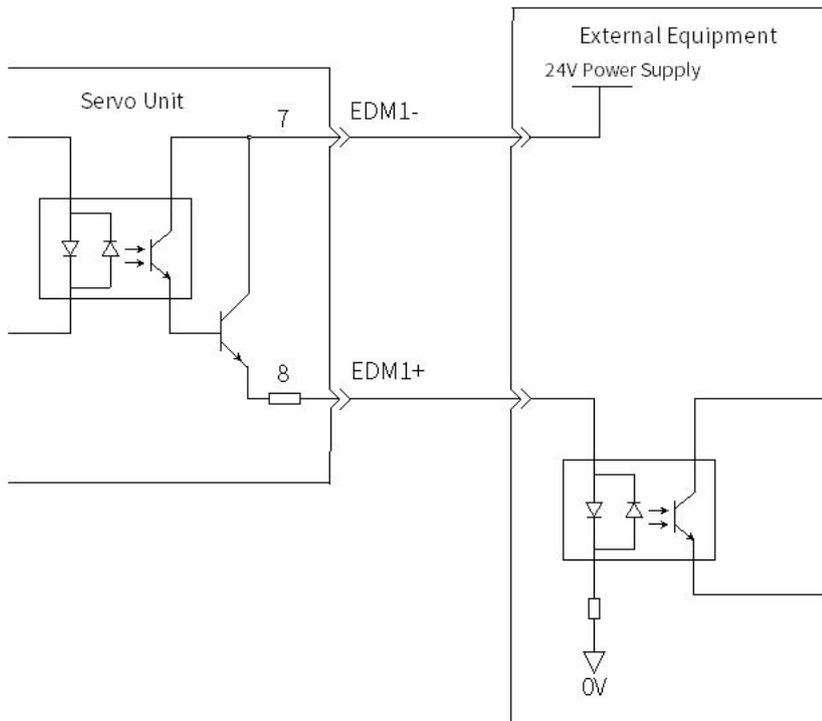
Input Signal Connection Example



2.8.3 Safety Output Circuit

The following describes safety output signal, the external device monitoring (EDM1). A connection example of the output signal (EDM1 signal) is shown below.

Example of Output Signal Connection



2.8.4 Output Signal (EDM1 Signal) Specifications

Table 2-21 Output Signal Specifications

| Type | Signal | Pin number | Status | Meaning |
|--------|--------|----------------|--------|--|
| Output | EDM1 | CN3-8 CN3-7 | ON | Both the /HWBB1 and /HWBB2 signals are operating normally. |
| | | | OFF | The /HWBB1 signal, the /HWBB2 signal, or both are not operating. |

Table 2-22 Electrical Characteristics Table of Output Signal (EDM1 signal)

| Item | Characteristic | Remarks |
|---------------------------|----------------|---|
| Maximum Allowable Voltage | DC30V | — |
| Maximum Allowable Current | DC 20mA | — |
| Maximum ON Voltage Drop | 1.0V | Voltage between EDM1+ and EDM1- when current is 50 mA. |
| Maximum Delay Time | 20ms | Time from a change in /HWBB1 or /HWBB2 until a change in EDM1 |

2.8.5 Example of Wiring for Safety Terminals

If you need to use the safety terminal (CN3), please connect as shown below:

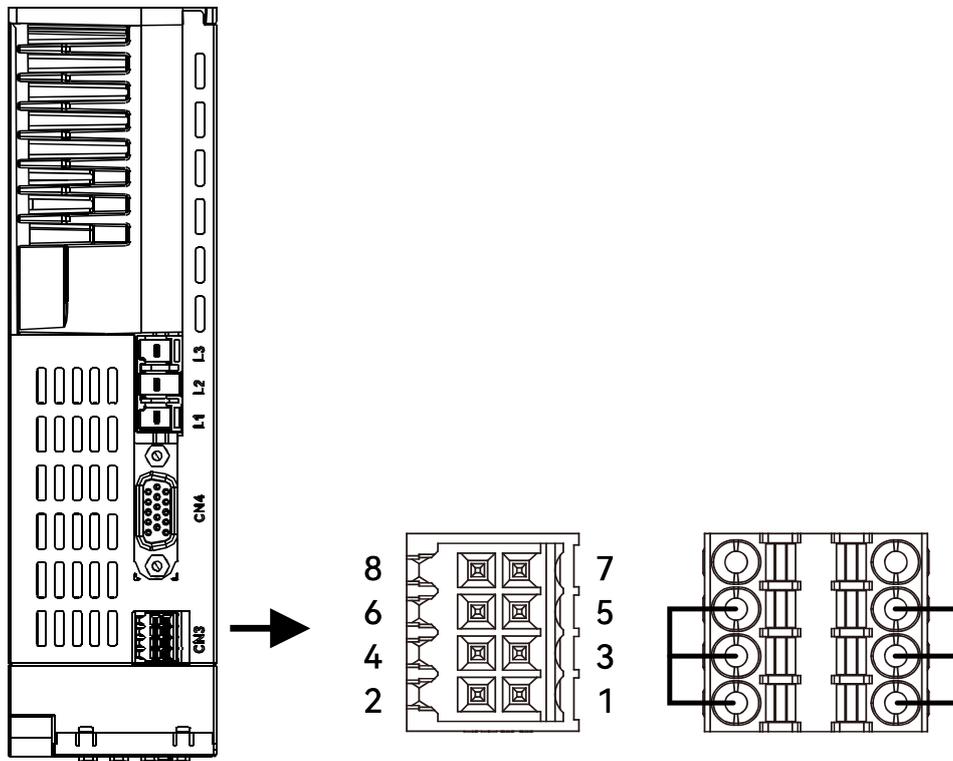


Figure 2-18 Safety Terminal Wiring

2.9 The Second Encoder Interface (CN4)

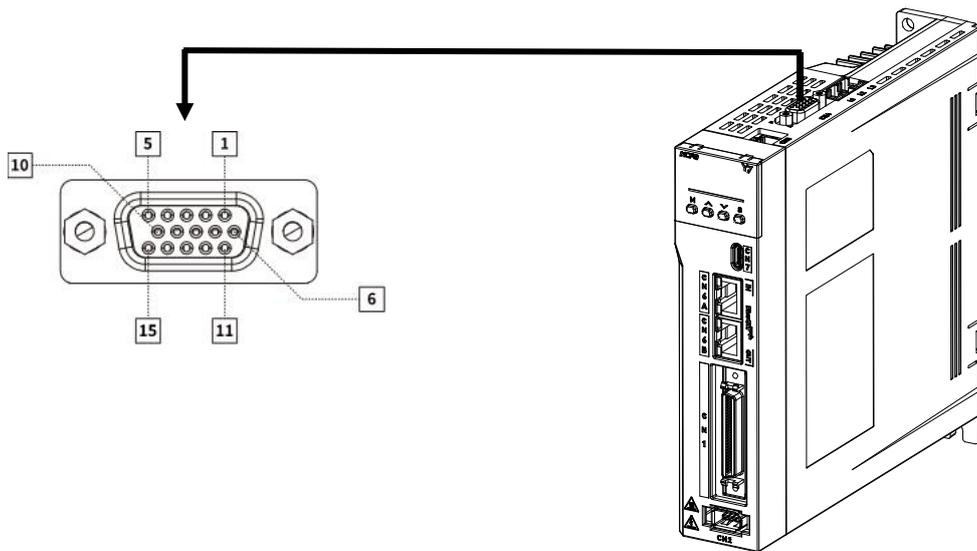


Figure 2-19 CN4 Pin Arrangement

Table 2-23 Names and Functions of the Second Encoder Interface

| Pin | Incremental ABZ Encoder with Differential Hall Sensors | SinCos Encoder with Differential Hall Sensors and Z Signal | BISS Encoder | Tamagawa Encoder |
|-------|--|--|------------------------------------|------------------------------------|
| 1 | +5V output Current output≤300mA | +5V output Current output≤300mA | +5V output Current output≤300mA | +5V output Current output≤300mA |
| 2 | 0V output | 0V output | 0V output | 0V output |
| 3 | Hall U+ | Hall U+ | — | — |
| 4 | Hall U- | Hall U- | — | — |
| 5 | Hall V+ | Hall V+ | — | — |
| 6 | Incremental encoder A - | Sine encoder Sin - | BISS-C CLK - | Serial DATA - |
| 7 | Incremental encoder B- | Sinusoidal encoder Cos - | BISS-C DATA - | — |
| 8 | Incremental encoder Z - | Incremental encoder Z - | — | — |
| 9 | Hall W + | Hall W + | — | — |
| 10 | Hall V - | Hall V - | — | — |
| 11 | Incremental encoder A + | Sine encoder Sin + | BIS -C CLK+ | Serial DATA+ |
| 12 | Incremental encoder B + | Sine encoder Cos + | BISS-C DATA+ | — |
| 13 | Incremental encoder Z + | Incremental encoder Z + | — | — |
| 14 | Hall W - | Hall W - | — | — |
| 15 | Temperature sensor signal | Temperature sensor signal | Temperature sensor signal | Temperature sensor signal |
| Shell | Shield | Shield | Shield | Shield |

2.10 Communication Connector (CN6)

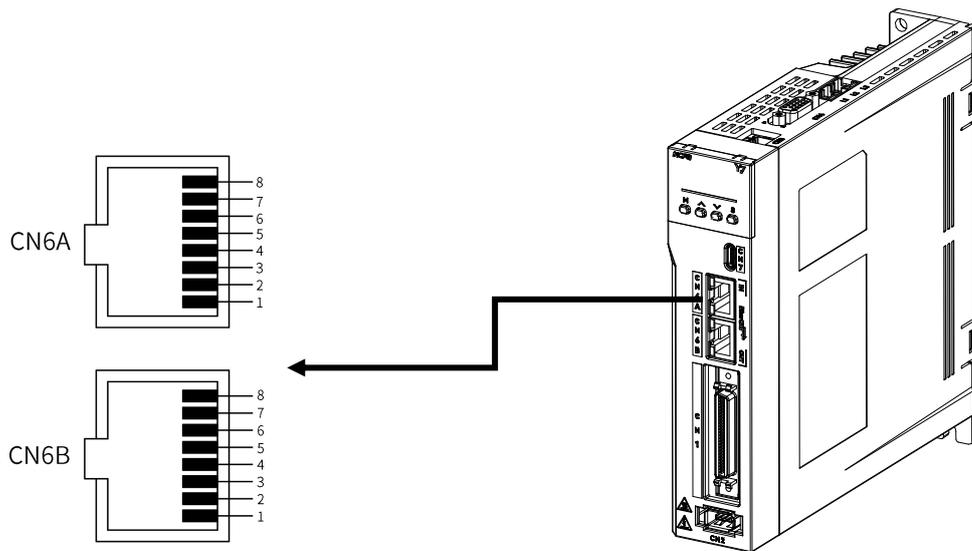


Figure 2-20 CN6 RJ45 Interface Pin Arrangement

Table 2-25 Name and Function of EtherCAT Communication

| Connector | Signal | Pin | Meaning |
|---------------|--------|---------|-------------|
| CN6A (In) | TD+ | 1 | Send data + |
| | TD- | 2 | Send data - |
| | RD+ | 3 | Send data + |
| | - | 4 and 5 | - |
| | RD- | 6 | Send data - |
| | - | 7 and 8 | - |
| CN6B (Out) | TD+ | 1 | Send data + |
| | TD- | 2 | Send data - |
| | RD+ | 3 | Send data + |
| | - | 4 and 5 | - |
| | RD- | 6 | Send data - |
| | - | 7 and 8 | - |

2.11 Brake Input Connection(CN10)

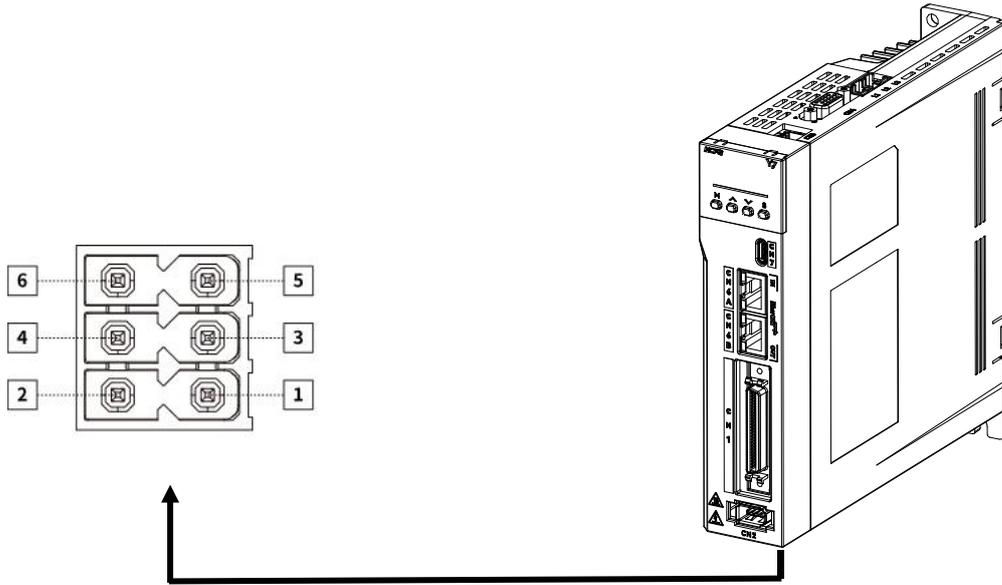


Figure 2-21 CN10 Brake Input Interface Pin Arrangement

Table 2-26 Name and Function of Brake Interfaces

| Signal name | Pin | Function |
|-------------|-----|-----------------------------|
| 24V | 1 | Brake external power supply |
| 0V | 2 | |
| BK+ | 3 | Brake BK+ |
| BK- | 4 | Brake BK- |
| NTC+ | 5 | Temperature control+ |
| NTC- | 6 | Temperature control- |

2.1.1.1 Brake wiring

The brake is a mechanism that prevents the servo motor shaft from moving when the servo drive is not running, and keeps the motor locked in position, so that the moving parts of the machine will not move due to its own weight or external force.

The connection of the brake input signal has no polarity, please install a separate power supply for the 24-VDC power supply from other power supplies. The standard wiring example of the brake signal BK and the brake power supply is as follows:

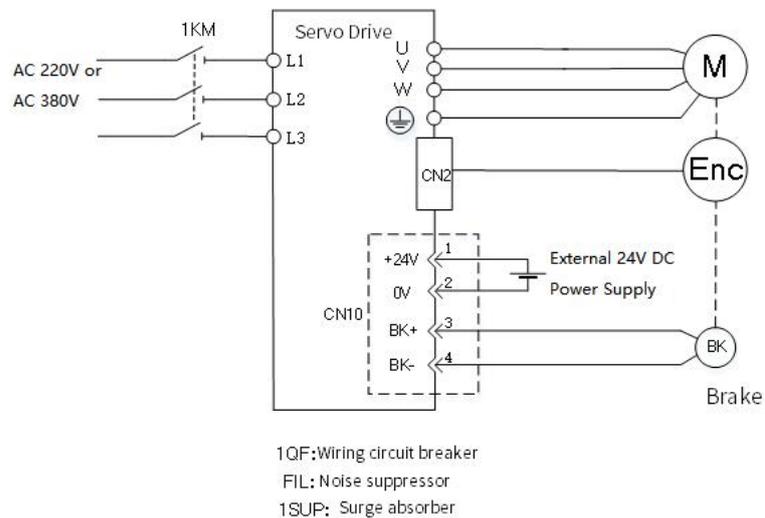


Figure 2-22 Brake CN10 Connection

- Note: It is forbidden for the brake to share the power supply with other electrical appliances to prevent the voltage or current from decreasing due to the work of other electrical appliances, which will eventually cause the brake to malfunction.

2.12 Noise and Harmonic countermeasures

The following describes countermeasures against noise and harmonics

2.12.1 Countermeasures against Noise

- Note: 1. As the servo unit is designed as an industrial device, no measures provided to prevent radio interference.
- 2. The Servo unit uses high-speed switching elements in the main circuit. Therefore, external devices may be affected by switching noise. If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.

This servo unit uses microprocessor. Therefore, there may be noise interference from its externals.

In order to prevent mutual noise interference between the servo unit and its external equipment, take the following countermeasures against noise interference as required.

- Install the input reference device and noise filter as close to the servo unit as possible
- Always install a surge absorber for relays, solenoids, and magnetic contactor coils.
- Do not place the main circuit cables and I/O signal cables/encoder cables in the same duct or bundle them together. Also, separate the cables from each other by at least 30 cm.
- Do not share the power supply with an electric welder or electrical discharge machine. If the servo unit is placed near a high-frequency generator, install Noise Filters on the input side on the main circuit power supply cable and control power supply cable even if the same power supply is not Common with the high-frequency generator. For the connection method of the noise filter, refer to "(1) Noise filter".
- Please implement suitable grounding measures, refer to "(2) Grounding".

1) Noise filter

Connect the noise filter to an appropriate place to avoid adverse effects of noise on the servo unit.

The following is an example of wiring for countermeasures against noise.

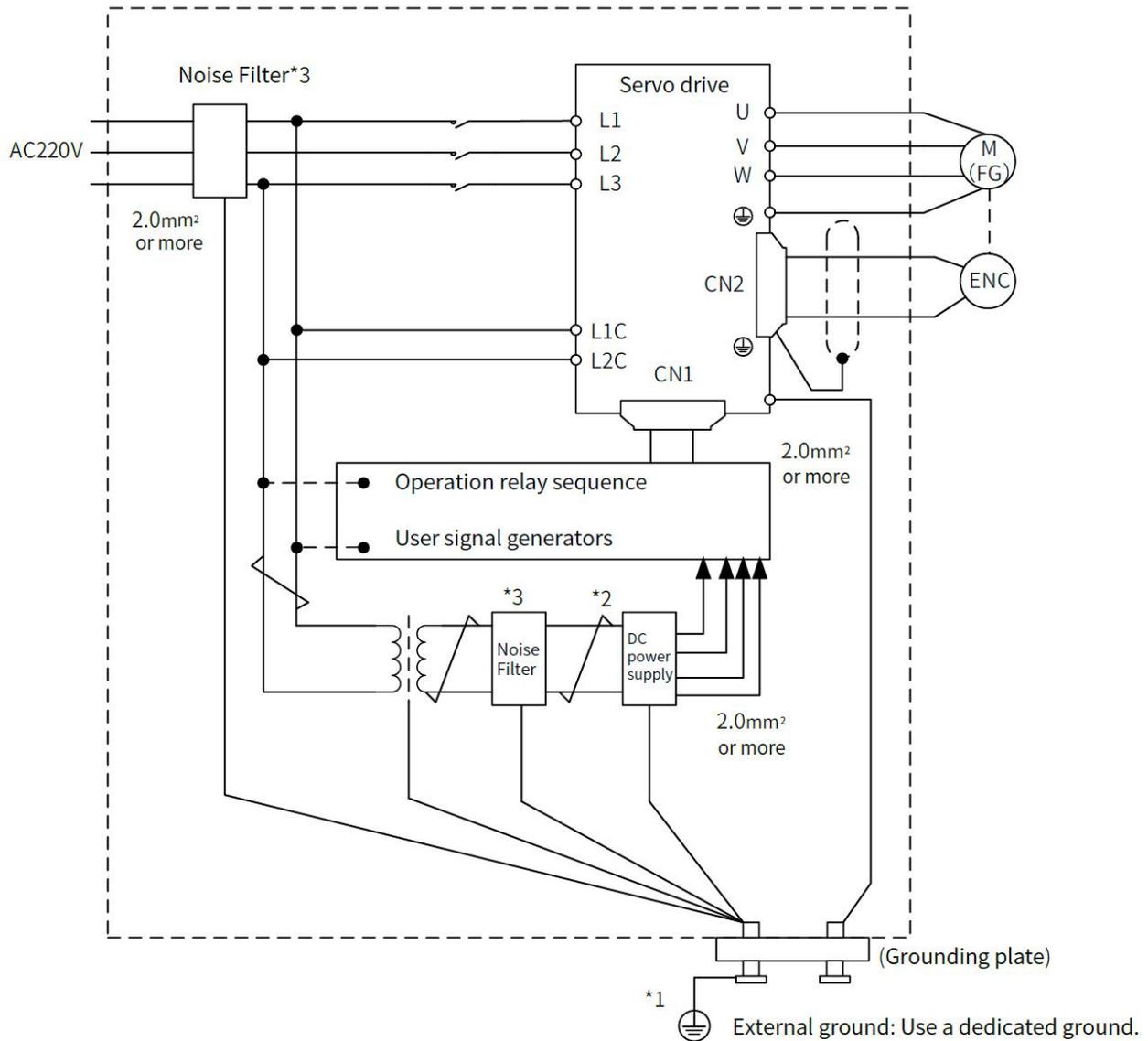


Figure 2-23 Wiring Example of Noise Countermeasure

- Note: * 1. For the ground wire, use a wire with a thickness of at least 2.0 mm² (preferably, flat braided copper wire).
- * 2. Please use twisted-pair wires for wiring
- * 3. Regarding the use of noise filters, please observe the precautions in 2.13.1 "Noise and its countermeasures"

2) Grounding

In order to prevent malfunction due to the influence of noise, the proper grounding method is as below.

Motor Frame Ground

If you ground the servo motor through the machine, switching noise current can flow from the main circuit of the servo unit through the stray capacitance of the servo motor. To prevent this, always connect the FG terminal of the servo motor main circuit cable connected to the servo motor to the ground terminal on the servo unit. Also be sure

to ground the ground terminal on servo unit.

Noise on I/O Signal Cables

Implement one-point grounding on the 0V line (SG) of the I/O signal cable . When the main circuit cable of the servo motor is covered with a metal sleeve, be sure to ground at one point for the metal sleeve and the junction box.

2.12.2 Noise Filter Wiring and Connection Precautions

1) Noise Filter for Brake Power Supply

Use a noise filter for the brake power input for a servo motor of 400W or less with brake.

2) Precautions for Noise Filter Installation and Wiring

Please observe the following precautions when installing and wiring the noise filter.

➤ Note: Depending on the model, some noise filters have a large leakage current. In addition, due to the different grounding conditions, the leakage current will also change greatly. Please consider the grounding conditions and the leakage current of the filter, etc., and choose to use leakage detectors and leakage circuit breakers. For details, please consult the filter manufacturer.

Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.

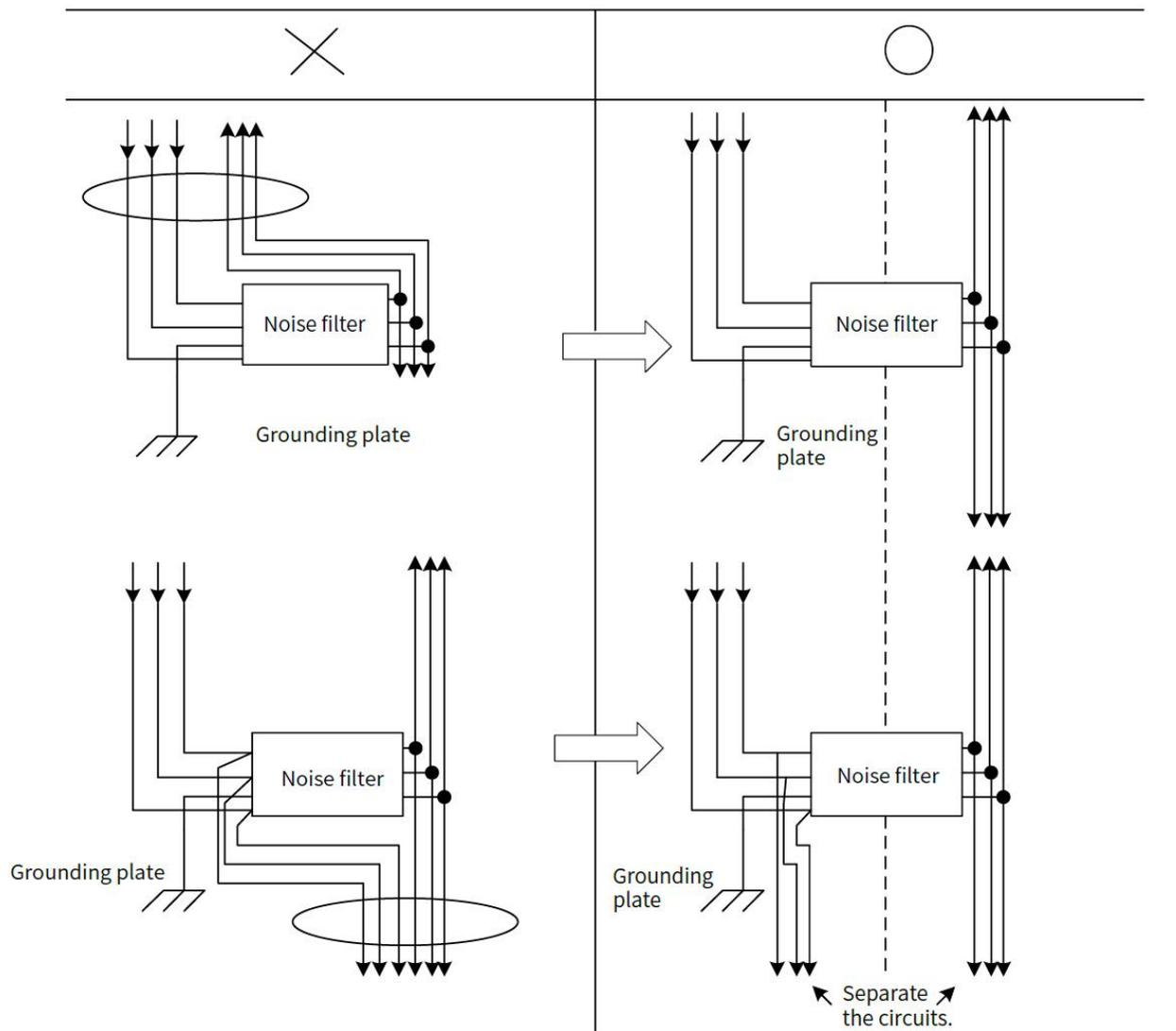


Figure 2-24 Noise Filter Wiring

Separate the noise filter ground wire from the output lines. Do not place the noise filter ground wire, output lines, and other signal lines in the same duct or bundle them together.

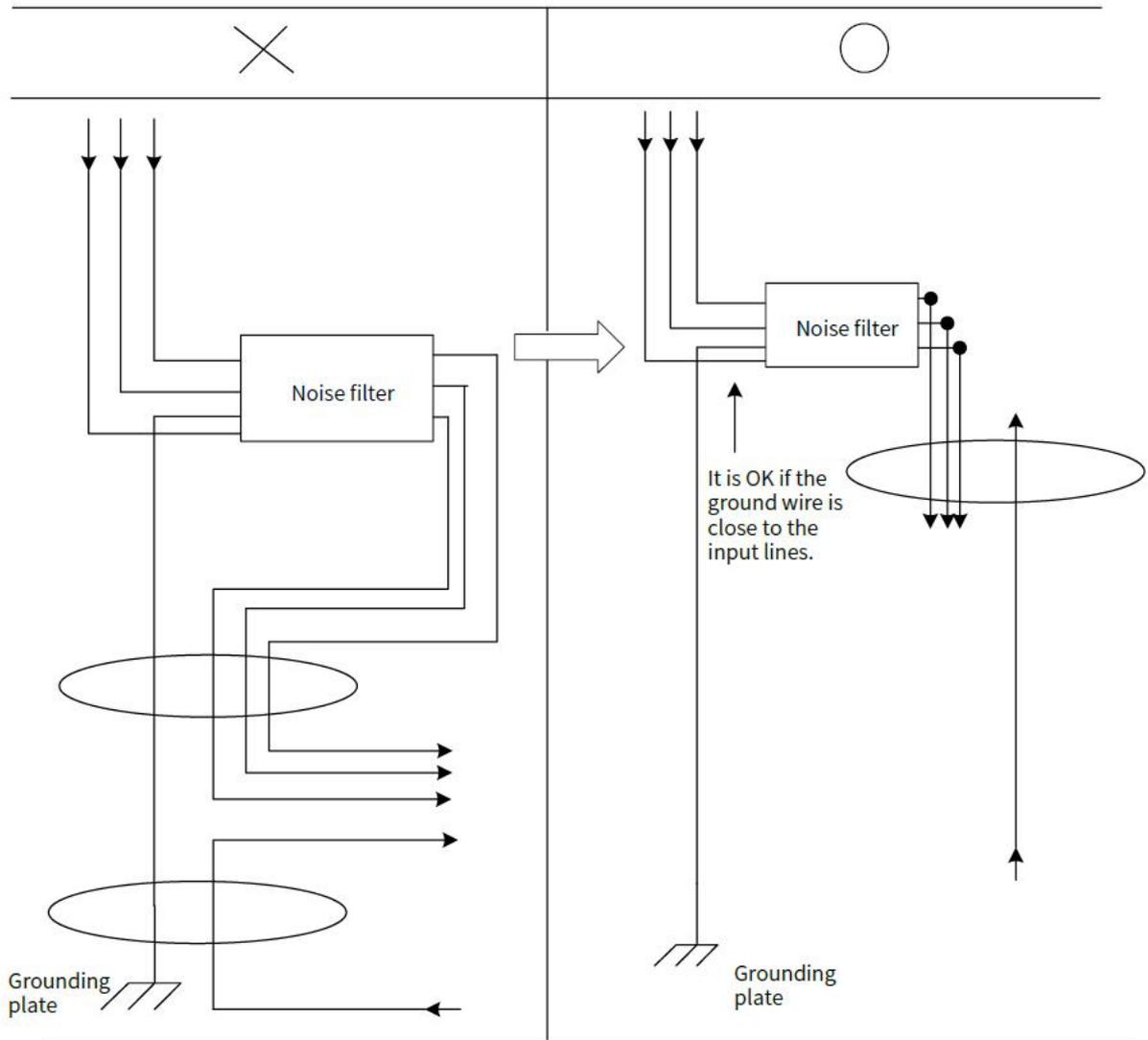


Figure 2-25 Noise Filter Grounding

Connect the ground wire of the noise filter to the grounding plate separately. Do not connect other ground wires

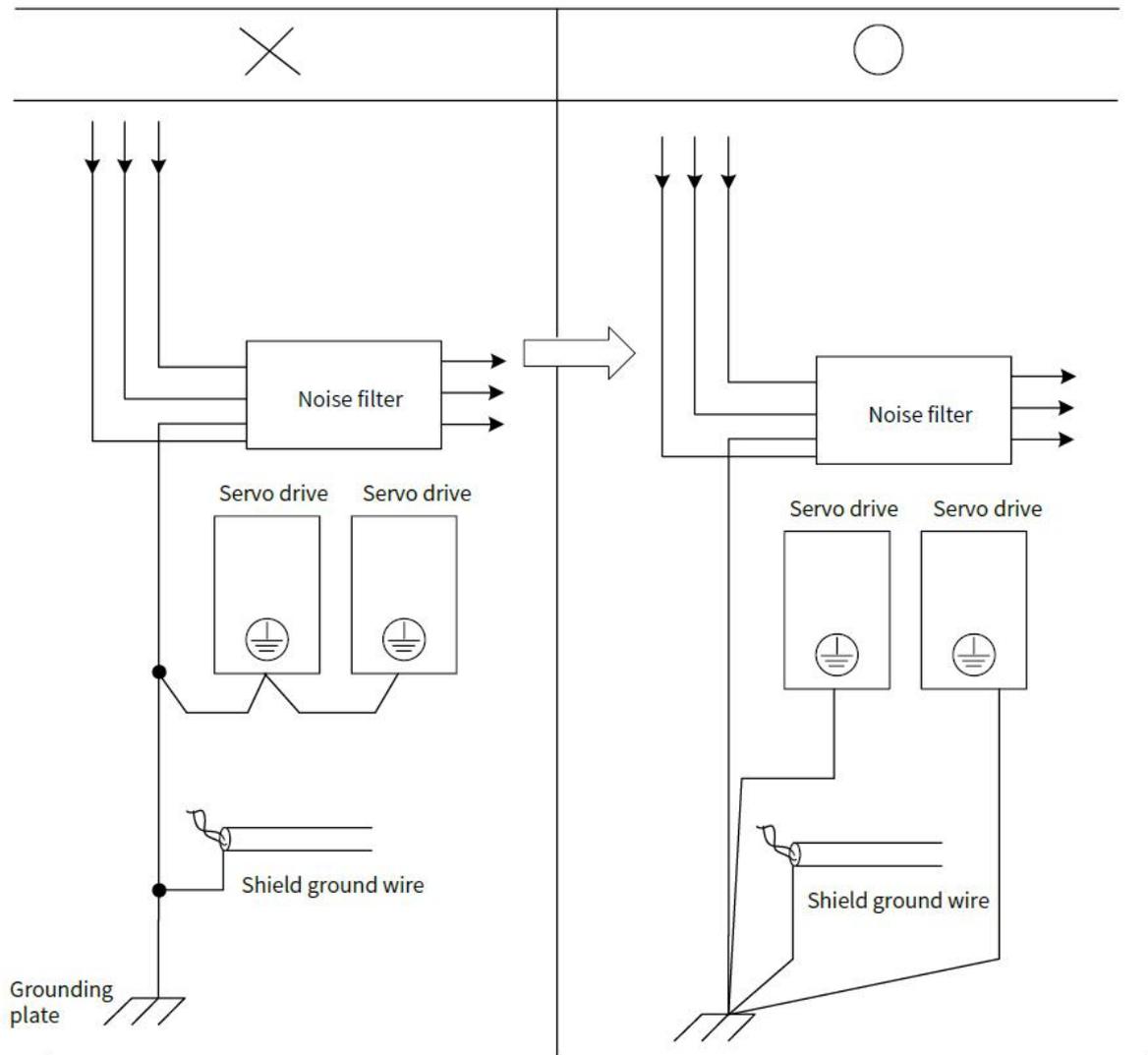


Figure 2-26 Noise Filter Grounding

If a noise filter is located inside a control panel, first connect the Noise Filter ground wire and the ground wires from other devices inside the control panel to the grounding plate for the control panel, then ground the plate.

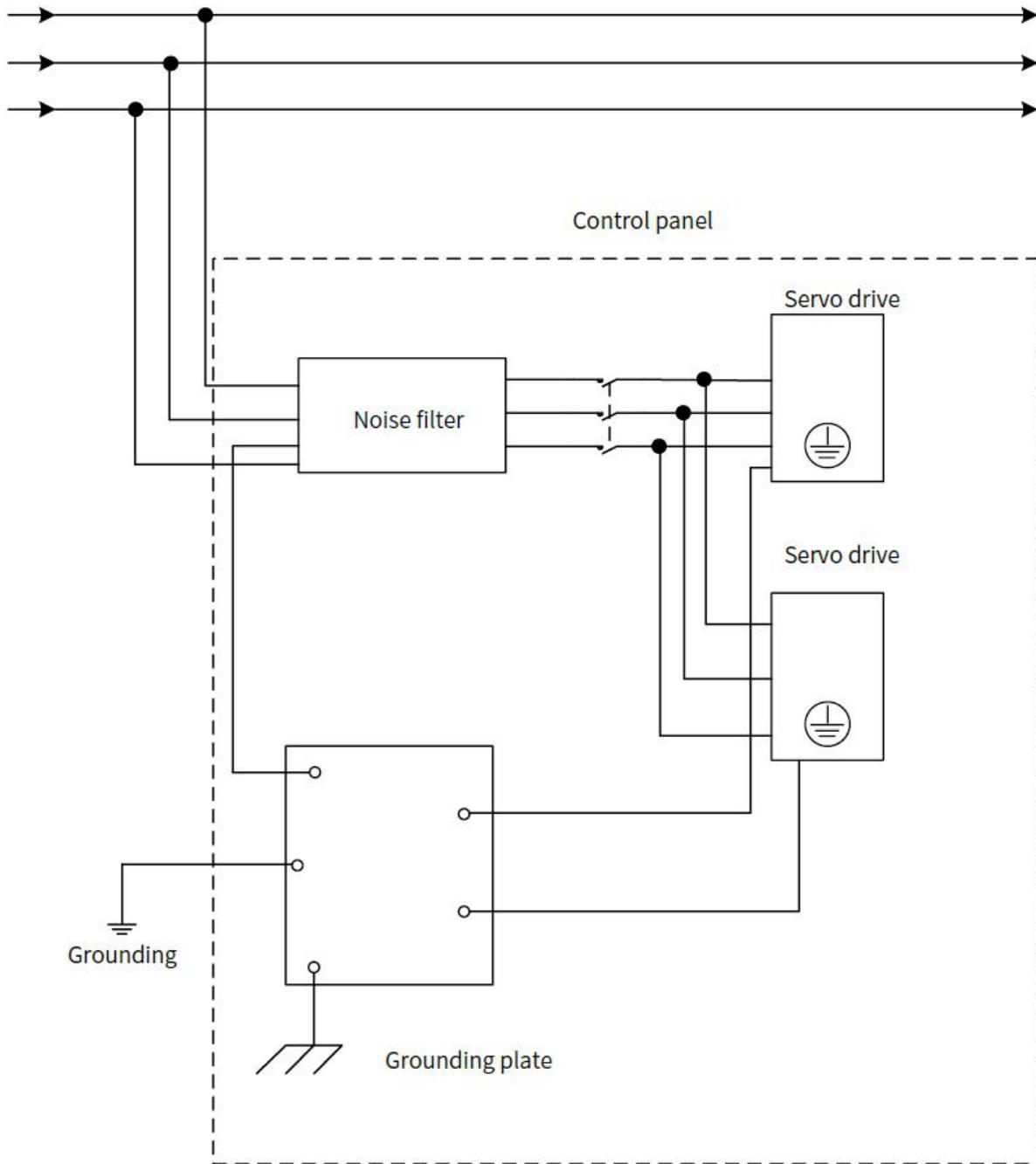
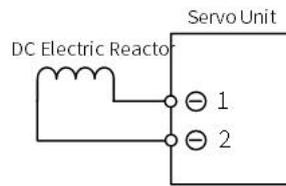


Figure 2-27 Noise Filter and Control Panel Grounding

2.12.3 Connection of Reactor for Harmonic Suppression

When it is necessary to take countermeasures against high-order harmonics, a reactor for suppressing high-order harmonics can be connected to the servo unit.

AC220V/380V Power Input Type Servo Drive



- Note: * 1. Connection terminals 1 and 2 for a DC Reactor are connected when the servo unit is shipped. Remove the lead wire and connect a DC Reactor.
- * 2. The reactor is optional (need to be equipped separately).



Chapter 3 EtherCAT Communication Introduction



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3.1 EtherCAT Communication Protocol Introduction

EtherCAT is a high-speed real-time Ethernet technology developed by Beckhoff in Germany. Its features include low hardware cost, simple and convenient application, simple network topology, and uses standard Ethernet physics. It can be used for high-speed IO interconnection and data interaction in industrial sites. Its basic communication mode is master-slave communication, single master and multi-slave communication. The master station can be realized by the ordinary network card of the computer or a dedicated master station PLC, and the slave station is generally composed of ET1100 provided by Beckhoff or an authorized third-party integrated slave station ASIC.

Basic features:

- High speed:

Precise synchronization is achieved by distributed clocks

- Fast data refresh:

30 μ s processing 1000 digital I/Os

100 μ s processing 100 servo axes

- High efficiency, maximizing the use of Ethernet bandwidth for user data transmission
- Good synchronization performance, each node slave device can achieve a synchronization accuracy of less than 1 μ s

3.2 Definition of Communication Network Interface

Definition of Communication Network Interface is shown as table 3-1:

Table 3-1 EtherCAT Communication Network Interface Definition

| Pin | Definition |
|-----|------------|
| 1 | TD+ |
| 2 | TD- |
| 3 | RD+ |
| 4 | N/A |
| 5 | N/A |
| 6 | RD- |
| 7 | N/A |
| 8 | N/A |

3.3 Parallel Networking of Multiple Servos

EtherCAT servo drive:

When multiple EtherCAT servo drives are networked, the network cables must be inserted in strict accordance with the order of the top-in and bottom-out network ports (note that no terminal resistors are added). As for whether to set the servo station number, it is determined by the host controller.

The EtherCAT servo drive supports a fixed communication rate of 100M bit/s, and the maximum communication length between 2 stations is 100 meters.

- Note: 1. The bus servo drive network cable should be separated from other cables when routing in the electric cabinet, especially the strong current line, and should be kept away from interference sources (such as transformers, frequency converters, cabinet fans, etc.) as much as possible.
 2. The network cable of the bus servo driver should be twisted-pair network cable to improve the resistance to high-frequency magnetic field noise interference and reduce the external radiation of the cable.
 3. Bus servo drive grounding is separated from other grounding as much as possible, separate grounding treatment.

3.4 EtherCAT Communication Basics

3.4.1 Control Modes Supported by EtherCAT

The Y7S drive EtherCAT is based on the CANOpen application layer profile CiA402 servo and motion control profile. Support the following modes of CiA 402, which is shown as Table 3-2:

Table 3-2 CiA402 mode supported by EtherCAT servo drives

| CiA402 control mode | Supported or not |
|----------------------------------|------------------|
| Cyclic synchronous position(CSP) | Supported |
| Cyclic synchronous velocity(CSV) | Supported |
| Cyclic synchronous torque (CST) | Supported |
| Profile position mode(PP) | Supported |
| Profile velocity mode(PV) | Supported |
| Profile torque mode(PT) | Supported |
| Home mode(HM) | Supported |

3.4.2 EtherCAT Frame Structure

The frame structure of EtherCAT consists of EtherCAT frame header + more than one EtherCAT sub-message + frame check sequence (FCS), as shown in the figure below:

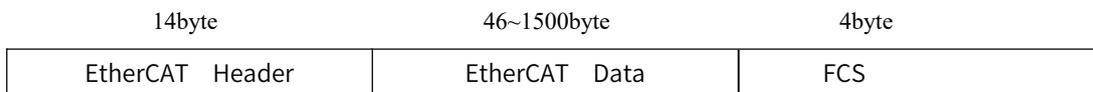


Figure 3-1 EtherCAT Frame Structure

3.4.3 EtherCAT State Machine

The EtherCAT slave device requires the above four basic states to facilitate data interaction between the master and the slave to manage the state machine of the slave application. It is shown as Figure 3-3:

Init(I): Initialization state

Pre-Operational (P): Pre-operational state

Safe-Operational(S): Safe operational state

Operational (O): Operational state

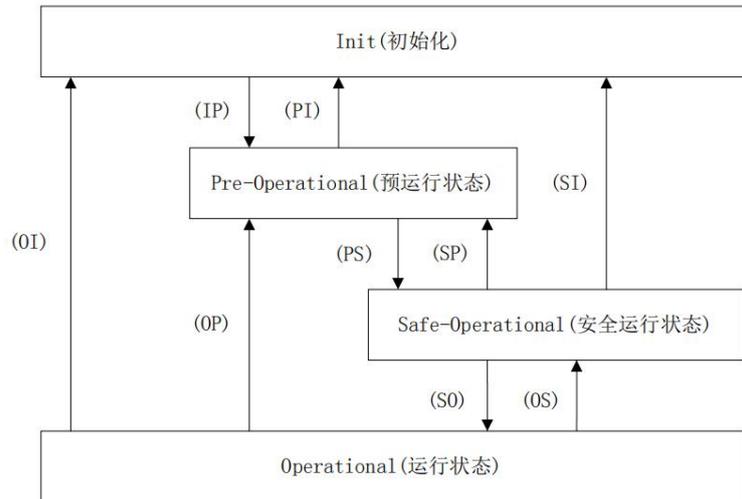


Figure 3-2 EtherCAT State Machine

The initialization of the slave station to the operational state follows the rule of switching from the pre-operational state, then the safe operational state, and then to the operational state. The operational state can be directly switched back to other various state.

EtherCAT status transition operations are shown in Table 3-3:

Table 3-3 EtherCAT State Transition

| State Transition | Operation |
|-----------------------|---|
| Init | There is no communication in the application layer, and the slave station can only read and write ESC chip registers. |
| Init To Pre-OP(IP) | The master configures the slave site address register. If mailbox communication is supported, configure mailbox-related registers. If distributed clock is supported, configure DC-related registers. The master writes to the status control register to request the Pre-OP status. |
| Pre-OP | Application layer mailbox communication |
| Pre-OP To Safe-OP(PS) | The master uses the mailbox to initialize the process data map. The master configures the SM channel used by the process data. The master configures the FMMU. The master writes to the status control register to request the Safe-OP status. |
| Safe-OP | The application layer supports email communication. There is process data communication, but it only allows to read in data, and cannot generate output signal. |
| Safe-OP To Op(SO) | Master sends output data. The master writes to the status control register, requesting Op states. |
| Op | All input and output is enabled |

A brief introduction is shown in table 3-4:

Table 3-4 EtherCAT States Profile

| States | Communication operation | | | Description |
|-------------------|-------------------------|-------|-------|--|
| | SDO | TxPDO | RxPDO | |
| Initialization(I) | NO | NO | NO | Communication initialization; There is no communication in the application layer, the master station can only read and write the ESC register |

| | | | | |
|----------------------|-----|-----|-----|--|
| IP | NO | NO | NO | Communication initialization; There is no communication in the application layer, the master station can only read and write the ESC register |
| Pre-Operational(P) | YES | NO | NO | Application layer mailbox data communication (SDO) |
| PS | YES | NO | NO | The master station uses SDO to initialize the process data mapping; The master station configures the SM channel used for process data communication; The master station configures FMMU; Request " Safe-Operational" staes |
| Safe-Operational (S) | YES | NO | YES | SDO and TxPDO can be used, distributed clock mode can be used |
| SO | YES | NO | YES | Master sends output data to request "Operational" states |
| Operational(O) | YES | YES | YES | Normal operating state; All inputs and outputs are enabled; Email communication is still available |

3.4.4 Process Data PDO

Periodic process data is used for periodic control data interaction between the master station and the slave station. The servo drive uses the SM2 (0x1C12) channel to map RxPDO data, and uses the SM3 (0x1C13) channel to map TxPDO data.

The servo drive supports five groups of PDO mappings, and each group of PDOs supports up to 24 mapping objects, among which TxPDO1 and RxPDO1 support remapping, and the remaining 4 groups of PDOs are fixed mappings. It is shown as Table 3-5.

Table 3-5 EtherCAT Default PDO Mapping Configuration

| TxPDO | Mapping object | TxPDO Configuration |
|----------------------------|-----------------------------|---------------------|
| 1600h (RxPDO1) (9Byte) | Control word(6040h) | 60400010 |
| | Control mode(6060h) | 60600008 |
| | Target position(607Ah) | 607A0020 |
| | Touch probe function(60B8h) | 60B80010 |
| 1601h (RxPDO2) (19Byte) | Control word(6040h) | 60400010 |
| | Control mode (6060h) | 60600008 |
| | Target torque(6071h) | 60710010 |
| | Target position(607Ah) | 607A0020 |
| | Max motor speed(6080h) | 60800020 |
| | Touch probe function(60B8h) | 60B80010 |
| | Target velocity(60FFh) | 60FF0020 |
| 1602h (RxPDO3) (15Byte) | Control word(6040h) | 60400010 |
| | Control mode(6060h) | 60600008 |
| | Max. torque(6072h) | 60720010 |
| | Target position(607Ah) | 607A0020 |
| | Touch probe function(60B8h) | 60B80010 |
| | Target velocity(60FFh) | 60FF0020 |
| 1603h (RxPDO4) (21Byte) | Control word(6040h) | 60400010 |
| | Control mode(6060h) | 60600008 |
| | Target torque(6071h) | 60710010 |
| | Max. torque(6072h) | 60720010 |

| | Target position(607Ah) | 607A0020 |
|----------------------------|--|---------------------|
| | Motor max. speed(6080h) | 60800020 |
| | Touch probe function(60B8h) | 60B80010 |
| | Target velocity(60FFh) | 60FF0020 |
| 1604h (RxPDO5) (12Byte) | Control word(6040h) | 60400010 |
| | Target position(607Ah) | 607A0020 |
| | Target velocity(60FFh) | 60FF0020 |
| | Target torque(6071h) | 60710010 |
| | Control mode(6060h) | 60600008 |
| | Touch probe function(60B8h) | 60B80010 |
| | Positive torque limit (60E0h) | 60E00010 |
| | Negative torque limit (60E1h) | 60E10010 |
| | Max. speed (607Fh) | 607F0020 |
| RxPDO | Mapping object | RxPDO configuration |
| 1A00h (TxPDO2) (23Byte) | Error code(603Fh) | 603F0010 |
| | Status word(6041h) | 60410010 |
| | Position feedback(6064h) | 60640020 |
| | Control mode display(6061h) | 60610008 |
| | Touch probe status(60B9h) | 60B90010 |
| | Touch probe 1 rising edge position feedback(60BAh) | 60BA0020 |
| | Position offset value(60F4h) | 60F40020 |
| | DI status(60FDh) | 60FD0020 |
| 1A01h (TxPDO2) (29Byte) | Error code(603Fh) | 603F0010 |
| | Status word(6041h) | 60410010 |
| | Control mode display(6061h) | 60610008 |
| | Position feedback(6064h) | 60640020 |
| | Velocity value feedback (606Ch) | 606C0020 |
| | Torque value feedback (6077h) | 60770010 |
| | Touch probe status(60B9h) | 60B90010 |
| | Touch probe 1 rising edge position feedback (60BAh) | 60BA0020 |
| | Touch probe 1 falling edge position feedback (60BBh) | 60BB0020 |
| DI status (60FDh) | 60FD0020 | |
| 1A02h (TxPDO3) (25Byte) | Error code (603Fh) | 603F0010 |
| | Status word(6041h) | 60410010 |
| | Control mode display(6061h) | 60610008 |
| | Position feedback(6064h) | 60640020 |
| | Velocity value feedback (606Ch) | 606C0020 |
| | Torque value feedback (6077h) | 60770010 |
| | Touch probe status(60B9h) | 60B90010 |
| | Touch probe 1 rising edge position feedback (60BAh) | 60BA0020 |
| | DI input status (60FDh) | 60FD0020 |
| 1A03h (TxPDO4) (25Byte) | Error code(603Fh) | 603F0010 |
| | Status word(6041h) | 60410010 |
| | Control mode display (6061h) | 60610008 |
| | Position feedback(6064h) | 60640020 |
| | Velocity value feedback (606Ch) | 606C0020 |

| | | |
|----------------------------|---|----------|
| | Torque value feedback(6077h) | 60770010 |
| | Touch probe status (60B9h) | 60B90010 |
| | Touch probe 1 rising egde position feedback (60BAh) | 60BA0020 |
| | DI status(60FDh) | 60FD0020 |
| 1A04h (TxPDO5) (22Byte) | Error code(603Fh) | 603F0010 |
| | Status word(6041h) | 60410010 |
| | Position feedback(6064h) | 60640020 |
| | Torque value feedback(6077h) | 60770010 |
| | Control mode display (6061h) | 60610008 |
| | Position offset reference(60F4h) | 60F40020 |
| | Touch probe status(60B9h) | 60B90010 |
| | Touch probe 1 rising egde position feedback (60BAh) | 60BA0020 |
| | Touch probe 2 rising egde position feedback (60BCh) | 60BC0020 |
| | Velocity value feedback(606Ch) | 606C0020 |
| | DI Status(60FDh) | 60FD0020 |

1) Synchronously manage PDO configuration

In Y7S, only one RxPDF and TxPDO configuration is supported. As shown in Table 3-6:

Table 3-6 PDO Supported by EtherCAT Servo Drive

| Index | Subindex | Mapping Object |
|--------|----------|---|
| 0x1C12 | 0 | 1600~1604 One of the five RxPDO groups is used as PDO configuration |
| 0x1C13 | 0 | 1A00~1A04 One of the five TxPDO groups is used as PDO configuration |

2) PDO mapping management

The PDO mapping content contains the information that needs to receive or send PDO, including index, sub-index and data length. Its sub-index 0 indicates the number of PDO mapping objects, and sub-indexes 1 to n represent the content represented by the first to n elements of the PDO. Each PDO mapping object can map a data object containing 4 bytes at most, and one PDO can contain up to 4*n data lengths.

The mapping content consists of 2 bytes representing the index of the object, one byte representing the sub-index, and one byte representing the data length, as shown in Table 3-7 below

Table 3-7 Mapping Content Structure

| Bytes | Bytes 3~2 | Bytes 1 | Bytes 0 |
|---------|-----------|----------|-------------|
| Meaning | Index | Subindex | Data length |

The index and sub-indexes determine the positional information of the object in the object dictionary, and the data length indicates how many bits make up the object. The length information generally has byte (8bit), word (16bit), double word (32bit) three types, specific by the actual length of the object which consists of a hexadecimal string.

For example: an object mapping content of 60400010h means that the index of the object is 0x6040, the sub-index is 0x00, the length of 16bit that is a word.

3.4.5 Mailbox Data SDO

SDO parameters are CoE-defined non-periodic data communication, and the master realizes non-periodic data interaction through the read/write mailbox data SM channel. Y7S drives can modify drive parameters through SDO.

3.4.6 Distributed Clock

The Distributed Clock (DC, Distributed Clock, 64bit) allows all EtherCAT settings to have the same system time, thus

controlling the synchronized execution of the tasks of the devices. The slave devices can be used to trigger synchronous updates of the slave data at the same time, based on the synchronization signals generated by the synchronized system clock. the Y7S drive supports the synchronized clock mode, which currently supports the synchronization signals generated by SYNC0 and Free Run.

3.4.7 CiA402 Control Process Introduction

The state machine related to the power control of the servo drive is shown in Figure 3-3 below. The power status of each phase of the PDS state machine is shown in Table 3-8 below.

Table 3-8 PDS State Machine Power Status in Different Phase

| PDS Phase | Control power | Power supply | Drive status |
|-----------|---------------|--------------|--------------|
| Phase 1 | OK | NO | NO |
| Phase 2 | OK | OK | NO |
| Phase 3 | OK | OK | OK |

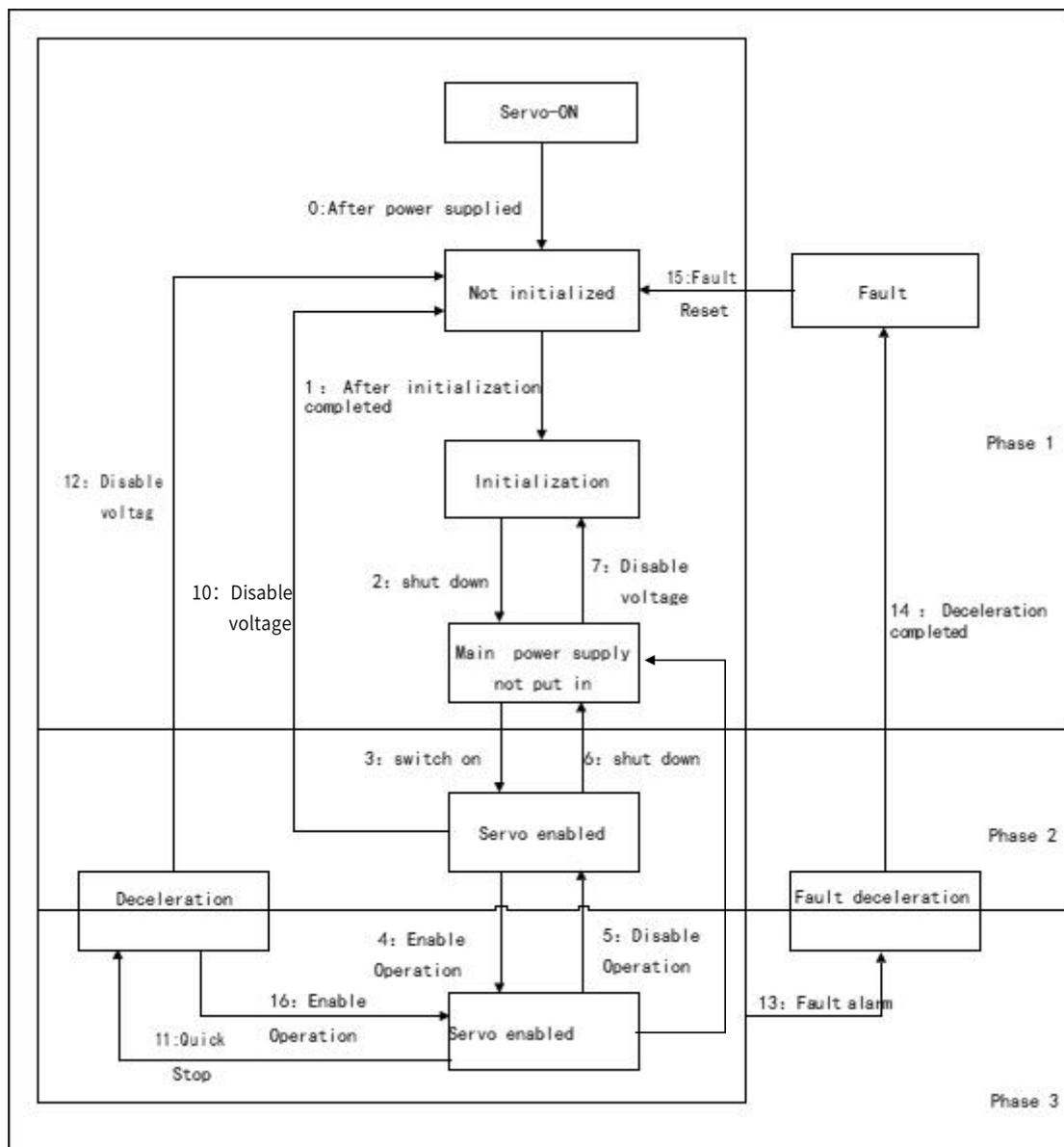
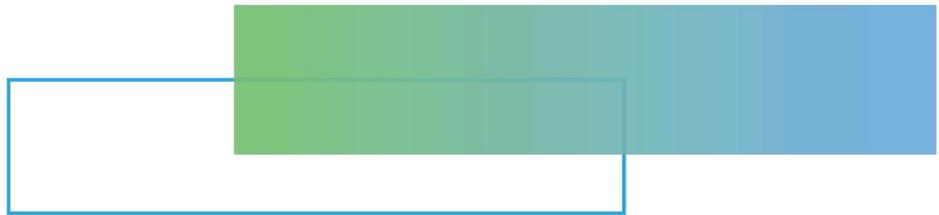


Figure 3-3 CiA402 Control Process State Machine

3.4.8 ESI Documents

The ESI file (.XML file) contains information about the Y7S Servo Drive's EtherCAT slave, and the master generates an

ENI based on the ESI to form an EtherCAT network, so the ESI file (.XML file) provided by our company needs to be saved in a folder specified by the master for normal communication. Therefore, the ESI file (.XML form) provided by our company should be saved in the folder specified by the master in order to communicate properly.



Chapter 4 Trial Operation

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4.1 Inspection and Precautions Before Trial Operation

To ensure safe and correct trial operation, check the following items before you start trial operation.

1) Inspection of the Servo Motor

Check and confirm the following items, and if any problem is found, please handle it properly before trial operation.

- Make sure that the setting and wiring are correct.
- Make sure that there are no loose parts in the servo motor mounting.

➤ Note: If you are using a servo motor with an oil seal, make sure that the oil seal is not damaged. Also make sure that oil has been applied. If you are performing trial operation on a servo motor that has been stored for a long period of time, make sure that all servo motor inspection and maintenance procedures have been completed.

2) The Status of the Servo Drive

To ensure safe and correct trial operation, check the following items before you start trial operation.

- Make sure that the setting and wiring are correct.
- Make sure that the power supply voltage supplied to the servo unit is correct according to specifications

4.2 Trial Operation for Servo Motor

Please refer to Auxiliary function Fn002 in Chapter 8 for trial operation of Servo motor

4.3 Origin Search Positioning (Fn003)

Origin search is a function to determine the origin pulse (phase C) position of the incremental encoder and stop at that position. This function is used when the motor shaft and mechanical need to be positioned.

Origin search can be performed under the following conditions.

- S-ON is not input.
- Parameter Pn50A.1 ≠ 7.

The motor speed at the time of execution is 60min-1.



Points

- Make sure that the load is not coupled when you execute an origin search
- The Forward Drive Prohibit (P-OT) signal and Reverse Drive Prohibit (N-OT) signal are disabled during an origin search.

Please refer to Auxiliary function Fn003 in Chapter 7 for the operation

4.4 Trial Operation from Host Controller for Servo Motor

Please confirm the following items when performing a test run of the servo motor according to the instructions from the host.

- Make sure that the servo motor operation reference from the host controller to the servo unit and the I/O signals are set up properly.
- Make sure that the wiring between the host controller and servo unit and the polarity of the wiring are correct.
- Make sure that the operation setting of servo unit is correct



Caution

- Before you perform trial operation of the servo motor without a load for references from the host controller, make sure that there is no load connected to the servo motor (i.e., that all couplings and belts are removed from the servo motor) to prevent unexpected accidents.

4.4.1 Input Signal Connection and Parameter Settings

Please connect the input signal circuit required for test operation to the input and output signal interface (CN1). The following conditions need to be met for connection.

Modify the corresponding parameters:

Prohibition of forward drive (P-OT), prohibition of reverse drive (N-OT) input signal OFF (forward and reverse drive possible).

Setting method: Input CN1-42, 43 as "ON" signal, or set "Pn50A.3=8, Pn50B.0=8" to disable the function of prohibiting forward rotation and reverse rotation.

If the encoder is an absolute encoder, there is no need to change the parameters, and if it is an incremental encoder, it is necessary to set " Pn002.2 =1".

If it is a single-phase electric input, then necessary to set " Pn00B.2 =1".

4.5 Trial Operation with the servo motor Connected to the Machine

The following describes the test operation after connecting the servo motor to the machine. Make sure that the procedure Trial Operation from the Host Controller for the servo motor without a Load has been completed.



Caution

Operating mistakes that occur after the servo motor is connected to the machine may not only damage the machine, but they may also cause accidents resulting in personal injury



- If you disabled the overtravel function for trial operation of the servo motor without a load, enable the overtravel function (P-OT and N-OT signal) before you preform trial operation with the servo motor connected to the machine in order to provide protection.

Table 4-1 Trial Operation steps

| Step | Operation | Reference |
|------|--|--|
| 1 | Turn on the control power supply and the main circuit power supply, and make settings for safety functions, overtravel, brakes, and other protective functions. • When using a servo motor with a brake, please implement measures to prevent the machine from falling or vibrating due to external force, and confirm that the action of the servo motor and the brake are normal. | "5.4.3 Setting of Overtravel" "5.4.4 Brakes " |
| 2 | With the power OFF, connect the servo motor and the machine with a coupling, etc. | |
| 3 | After confirming that the servo unit is servo OFF, turn on the machine (host controller) power supply. And reconfirm whether the protection function set in step 1 works normally. (Note) In order to prevent abnormalities in the next operation, please make the devices in the state of emergency stop. | "5.4.5 How to stop the motor when the servo is OFF and an alarm occurs " |
| 4 | Confirm again that the parameter setting is consistent with each control mode, and then confirm whether the operation of the servo motor meets the machine operating specifications. | |
| 5 | If necessary, adjust the servo gain to improve the servo motor response characteristics. During the test operation, the servo motor and the machine may not be | "Chapter 7 Tuning" |

| | | |
|--|---|--|
| | suitable. Therefore, let the system run for a sufficient amount of time | |
|--|---|--|

4.6 Trial Operation of Servo Motor with Brake

Please observe the following precautions for the test operation of the servo motor with brake.

- When performing a test operation of a servo motor with a brake, be sure to take measures to prevent the machine from falling naturally or vibrating due to external force in advance
- When performing a trial operation of a servo motor with a brake, first confirm the operation of the servo motor and the brake with the servo motor separated from the machine. If there is no problem, please connect the servo motor to the machine and perform a test operation again.

Please use the brake interlock output (/BK) signal of the servo unit to control the brake action of the servo motor with brake. Please refer to " 5.4.4 Brake " for wiring and related parameter setting.



Chapter 5 Basic Function of Servo

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5.1 Precautions

Table 5-1 Signal Table

| Name | Meaning |
|--|--|
|  Danger | Indicates that may cause death or serious injury |
|  Caution | Indicates that may cause injury or property damage |

5.2 Panel Operation Procedures and Display

The user can confirm the servo status through the panel display of the servo unit.

modify and monitor the Utility function (Fn □□□), parameter setting (Pn □□□) and monitoring function (Un □□□) through the operator keys. Also, when an alarm or warning occurs, the corresponding alarm/warning number is displayed.

5.2.1 Panel Operator Keys

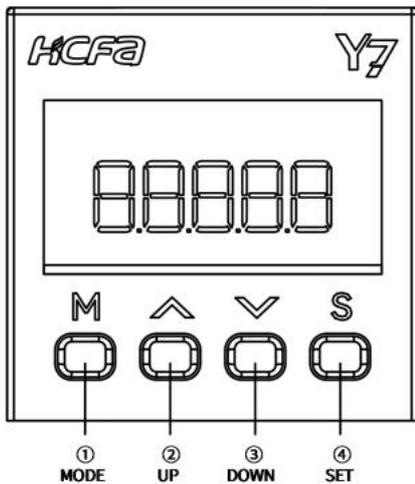


Figure 3-1 Panel Operator

Table 5-2 Panel Operator Keys

| Key number | Key name | Function |
|------------|-------------------------------------|---|
| ① | MODE (Mode and confirmation key) | (1) Switch the basic mode: Utility function, parameter setting, monitoring function. (2) Confirm the set value: After modifying the parameters, press and hold this key for more than 1 second to confirm the set value. The effect is consistent with the SET key. |
| ② | UP | (1) Increase the set value. (2) It is used as the forward rotation start key when JOG is running in the Auxiliary function mode. |
| ③ | DOWN | (1) Decrease the setting value. (2) It is used as the reverse start key when the JOG is running in the Auxiliary function mode. |
| ④ | SET | (1) Long press this key for more than 1 s to display the set value of each parameter. (2) After modifying the parameters, press and hold this key for more than 1 s to confirm the set value. (3) Short press this key to move the digit to the left by one digit (when the digit is flashing). If the data length exceeds the four digits displayed on the panel, press it four times to switch the panel display to the middle four digits, and then press four times to switch to the top two. |

5.2.2 Changing Modes

Table 5-3 Modes Switching Table

| Function | MODE Key | Long press the SET key |
|---------------------|----------|------------------------|
| Initial status | | --- |
| Auxiliary function | | Q 9b3 |
| Parameter setting | | n0000 |
| Monitoring function | | 0000 |

➤ Note: Press the MODE key to switch modes, it will cycle from top to bottom according to the table

5.2.3 Status Display and Judgment

After the power is turned on, the normal state display is shown in Figure 5-2. The first data bit is used for EtherCAT communication status display. The second data bit is used for judging signal status, and the short codes are for motor status.

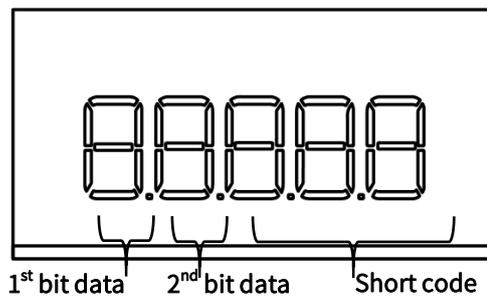


Figure 3-2 Display Status After Power is On

Table 5-4 Data Bit Interpreting table

| Serial number | Display | Control mode | Meaning |
|------------------------|---------|--------------|-----------------------|
| First data bit display | 18888 | — | Initialization status |

| | | | |
|-------------------|--------------|---|--|
| | 28888 | — | Pre-operation status |
| | 48888 | — | Safe running status |
| | 88888 | — | Running status |
| Second data bit b | 88888 | Position control, speed control, torque control | Lit when the speed exceeds the set value of Pn502, and not lit when it is lower than the set value of Pn502 |
| Second data bit g | 88888 | Position control | Lit when there is a pulse input. |
| | | Speed control | Lit when the command speed is higher than the set value of Pn502, and not lit when it is lower than the set value of Pn502. |
| Second data bit d | 88888 | Position control | Lit when a pulse clear signal is being input. Not lit when there is no pulse clear signal. |
| | | Speed control | Lit when the torque command is greater than 10% of the rated torque of the motor, and not lit when it is less than 10% of the rated torque of the motor. |
| Second data bit h | 88888 | Position control, speed control, torque control | Lit when the main power is turned on, and not lit when the main power is not turned on. |

Table 5-5 Code Interpreting Table

| Display | Meaning |
|--------------|--|
| . bb | Base Block Active Indicates the servo is OFF. |
| ≡run | Operation in Progress Indicates the servo is ON. |
| . not | Reverse Drive Prohibited Indicates that the N-OT (Reverse Drive Prohibit) signal is open. |

| | |
|--------------|--|
| . Pot | Forward Drive Prohibited Indicates that the P-OT (Forward Drive Prohibit) signal is open. |
| . 9b8 | Security Function Indicates the safety function is activated and the servo is in the hardware base block status |
| . C90 | Alarm Log Indicates the alarm number |

5.2.4 Operation of Auxiliary Function (Fn□□□)

The Auxiliary function is used for the functional operation of the servo unit, take the Origin Search " Fn003 " operation as an example

- (1) Press (M) key to switch to Utility mode " **FN000** " is displayed.
- (2) Press (▲) or (▼) key to select to " **FN003** ".
- (3) Press (S) After pressing the key for 1 second, Fn003 is displayed (origin search) execution screen " **.. CSR** ", the duration is about 1 second.
- (4) First press the button (M) to enable the servo, and then press and hold (▲) (the motor rotates forward) or (▼) (motor reverse rotation) to search for the origin, the search direction of the servo motor rotation origin changes according to the setting of Pn000.0 . Keep pressing the (▲) (motor forward) or (▼) (motor reverse) key until the servo motor stops, and the panel displays " **~CSR** ", at this time, the motor searches for the origin.
- (5) After the origin search is completed, press the key (M) to disable the motor, and the panel displays " **~CSR** " .
- (6) After pressing the key (S) for 1 second, return to the Utility function menu " **FN003** " (origin search function)

5.2.5 Parameter Setting (Pn□□□)

There are two types of Parameter setting for Pn □□□.

The first type of Parameter for numeric settings: set a specific value.

The second type of Parameters for Selecting Functions: Select the application function.

The setting methods of “numerical setting type” and “function selection type” are introduced respectively below..

➤ Note: When the panel displays incomplete parameters, please modify the parameter "Pn00B.0" to "1: Display all parameters".

In the default setting, only the parameters for setting are displayed, and the parameters for adjustment are not displayed. To display all parameters, please set Pn00B =n. □□□1 (display all parameters).

Table 5-6 Pn00B =n. □□□1 Parameter

| Parameter | Meaning | When Enabled | Classification |
|--|------------------------------|---------------|----------------|
| Pn00B (Function selection application switch B) | n. □□□0 (default setting) | After restart | Setup |
| | n. □□□1 | | |

5.2.6 Numeric Settings

Take the electronic gear ratio (numerator): " Pn78C " changed to 8388608 as an example.

- (1) Press (M) key to switch to parameter setting mode " **PN000** " is displayed.
- (2) Press (S) After selecting the digit to be changed, press the (▲) or (▼) key to select " **Pn78C** ".

(S)

- (3) Press and hold the key S for about 1 second, and the current setting value of "Pn20E" shown on the screen will be displayed " Pn20E ".
- (4) Press the key S to move the flashing digit left and right, and then press the A D key to set the last four digits 8608, and the panel displays " Pn20E ".
- (5) Press the key S to move the flashing number to the leftmost, and press S key again to switch to the first four-digit setting page, and the panel displays " Pn20E ".
- (6) Press the key S to move the flashing digit left and right, and then press A or D key, set the first four digits to 0838, the panel will display " Pn20E ".
- (7) So far Pn 78C is the first four digits + last four digits = 08388608.
- (8) After pressing the S key for about 1 second, the set value is confirmed, and the value on the panel flashes three times quickly.
- (9) Press and hold the key S again for about 1 second to return to parameter setting " Pn78C " (Electronic Gear Ratio Numerator) panel is displayed.

- Note: 1. When the last four digits are selected, the first data bit d is on, and when the middle four digits are selected, the first data bit g is on.
- 2. When the first two digits are selected, the first data bit a lights up. If you want to set more than four digits, the method is the same.

5.2.7 Selecting Functions

Take the function selection basic switch 0: " Pn000 " as an example to select " Pn000.1 " as the control mode to change from speed control to position control.

- (1) Press M key to switch to parameter setting mode " Pn000 " is displayed.
- (2) Press and hold the key S to display the original set value of "Pn000" shown on the screen, and the panel displays " Pn000 ".
- (3) Press S key for once to move the digit to the left by one (flashing) to select Pn 000.1, and the panel displays " Pn000 ".
- (4) Press the A or D key to change the setting value to "N.0010", and the panel display is " Pn000 ".
- (5) Press and hold the key S for about 1 second to confirm the set value, and the panel value flashes three times quickly.
- (6) Press and hold the key S again for about 1 second to return to the Pn 000 menu, and the panel is set to " Pn000 ".
- (7) In order to make the setting effective, please reconnect the power supply of the servo unit.

5.2.8 Operation of Monitor display (Un□□□)

The monitoring display is used to monitor the status of the servo unit, take the "Un000 " motor speed monitoring operation as an example.

- (1) Press M key to switch to Auxiliary mode " Un000 " is displayed.
- (2) Press S After pressing the key for 1 second, the current motor speed will be displayed " Un000 " (display 0 000 means the speed is 0).
- (3) Press and hold the key S for about 1 second, return to " Un000 " menu.

5.3 Automatic Detection of Connected Motor

When the servo unit is connected to a standard rotating motor, it will automatically determine which type of servo motor connected. Therefore, you normally do not need to specify the servo motor type.

5.4 Basic Function Settings

5.4.1 Power Settings

1) AC/DC Power Input Setting

The servo unit supports AC/DC power input, which can be set by parameter Pn001 = n. □X□□.

Table 5-7 Pn001 = n. □X□□ Parameter Setting Table

| Parameter | | Meaning | When Enabled | Classification |
|--|---------------------------------|---|---------------|----------------|
| Pn001 (Function Select Application Switch 1) | n. □0□□ (default setting) | Use an AC power supply input: input AC power from L1, L2, L3 terminals | After restart | Setup |
| | n. □1□□ | Use a DC power supply input.: directly input DC power from B1 to N or input DC power from P, N | | |

- Note: 1. When the set value is Pn001 = n. □X□□, if it is inconsistent with the actual power input specifications, A.330 (main circuit power supply wiring error) will occur
- Please connect the AC power supply to the L1/L2/L3 terminals and LC1/LC2 terminals of the servo unit.
 - Please connect the DC power supply to the B1 (P) terminal and N (N1) terminal of the servo unit, and connect LC1/LC2 to the AC power supply. Otherwise may result in malfunction or fire.
 - Always specify a DC power supply input (Pn001 = n. □1□□) before you input DC power for the main circuit power supply. If you input DC power without specifying a DC power supply input (i.e., without setting Pn001 to n. □1□□), the servo unit's internal elements may burn and may cause fire or damage to the equipment.
 - With a DC power supply input, time is required to discharge electricity after the main power supply is turned OFF. A high residual voltage may remain in the servo unit after the power supply is turned OFF. Be careful not to get an electric shock.
 - When DC power is input, please install a fuse on the power supply line.
 - The servo motor returns regenerative energy to the power supply. If you use a servo unit with a DC power supply input, regenerative energy is not processed. Process the regenerative energy at the power supply.
 - When using three-phase 220V Y7S series-□□□A with DC power input (□□□=040A, 075A, 100A, 150A, 200A), please connect an inrush current limiting circuit to build a standard power on and off sequence control.
 - When using three-phase 380V Y7S series-□□□T with DC power input (□□□=100T, 150T, 200T, 300T, 500T, 600T, 750T, 111T, 151T, 221T), please connect an inrush current limiting circuit to build a standard power on and off sequence control.

2) Single-phase/three-phase AC power input setting

Servo drive units of 750W and below support single-phase AC power input, which can be set by parameter Pn00B = n. □X□□.

Table 5-8 Pn00B = n. □X□□ Parameter Setting Table

| Parameter | | Meaning | When Enabled | Classification |
|---|---------------------------------|---|---------------|----------------|
| Pn00B (Function selection application switch B) | n. □0□□ (default setting) | Use a three-phase power supply input. | After restart | Setup |
| | n. □1□□ | Use a three-phase power supply input as a single-phase power supply input. | | |

- Note: 1. If you use a single-phase power supply input without specifying a single-phase AC power supply (Pn00B = n. □1□□), an A.F10 alarm (Power Supply Line Open Phase) will occur
- When using single-phase 220V power input, do not connect the L3 terminal

5.4.2 Setting Rotation Direction of Servo Motor

The rotation direction of the servo motor can be reversed through Pn000.0 without changing the PLC command. This causes the rotation direction of the servo motor to change, but the polarity of the signals, such as encoder output pulses, output from the servo unit do not change.

Table 5-9 Pn000 Rotation Direction Selection Table

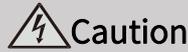
| Parameter | Forward / Reverse Command | Motor Direction and Encoder Divided Pulse Outputs | Applicable Overtravel Signal(OT) |
|-----------|---|---|----------------------------------|
| Pn000 | n.□□□0 Use CCW as the forward direction. (default setting) | <p>Forward command</p> | P-OT |
| | | <p>Reverse command</p> | N-OT |
| | n.□□□1 Use CW as the Forward direction.(Reverse Rotation Mode) | <p>Forward command</p> | P-OT |
| | | <p>Reverse command</p> | N-OT |

➤ Note: The "forward rotation direction" under the default setting is "counterclockwise rotation (CCW)" viewed from the load side of the servo motor.

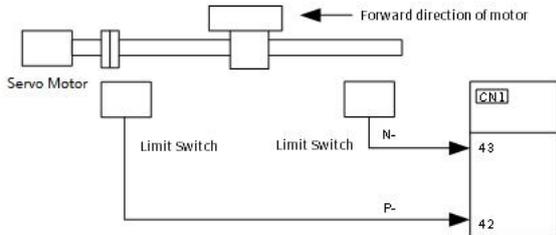
5.4.3 Overtravel Setting

Overtravel is a function of the servo unit that forces the servo motor to stop in response to a signal input from a limit switch that is activated when a moving part of the machine exceeds the safe range of movement.

For rotary applications such as round tables and conveyors, the overtravel function may not be required, and in this case, the input signal wiring for overtravel is also unnecessary.



• Limit Switch Installation



Precautions when external force are applied to servo motor shaft during overtravel:

1. The /BK (Brake) signal will remain ON (i.e., the brake will be released) when overtravel occurs. This may result in the workpiece falling when overtravel occurs. To prevent the workpiece from falling, set Pn001 to n.□□1□ to place the servo motor in a zero-clamped state when it stops.
2. A base block state is entered after stopping for overtravel. This may cause the servo motor to be pushed back by an external force on the load shaft. To prevent the servo motor from being pushed back, set Pn001 to n. □□1□ to place the servo motor in zero-clamped state when it stops)

➤ Note: When the servo motor stops due to overtravel during position control, the position deviation is held. You must input the CLR (Clear) signal to clear the position deviation.

(1) Forward overtravel (P-OT) signal setting

Table 5-10 Pn50A=n.X□□□ Forward Drive Overtravel (P-OT) Setting

| Parameter | Meaning | When Enabled | Classification |
|-------------------------------------|---------|--|----------------------------|
| Pn50A (Input signal selection 1) | n.0□□□ | Enable forward drive when CN1-40 input signal is ON (closed) | After restart Setup |
| | n.1□□□ | Enable forward drive when CN1-41 input signal is ON (closed) | |
| | n.2□□□ | Enable forward drive when CN1-42 input signal is ON (closed) | |
| | n.3□□□ | Enable forward drive when CN1-43 input signal is ON (closed) | |
| | n.4□□□ | Enable forward drive when CN1-44 input signal is ON (closed) | |
| | n.7□□□ | Set the signal to always prohibit forward drive. | |
| | n.8□□□ | Set the signal to always enable forward drive. | |
| | n.9□□□ | Enable forward drive when CN1-40 input signal is OFF (open) | |
| | n.A□□□ | Enable forward drive when CN1-41 input signal is OFF (open) | |

| | | | | |
|--|--------|---|--|--|
| | n.B□□□ | Enable forward drive when CN1-42 input signal is OFF (open) | | |
| | n.C□□□ | Enable forward drive when CN1-43 input signal is OFF (open) | | |
| | n.D□□□ | Enable forward drive when CN1-44 input signal is OFF (open) | | |

2) Reverse drive overtravel (N-OT) signal setting

Table 5-11 Pn50B=n. □□□X Reverse Drive Overtravel (N-OT) Setting Table

| Parameter | | Meaning | When Enabled | Classification |
|-------------------------------------|---------|--|---------------|----------------|
| Pn50B (Input signal selection 2) | n. □□□0 | Enable reverse drive when CN1-40 input signal is ON (closed) | After restart | Setup |
| | n. □□□1 | Enable reverse drive when CN1-41 input signal is ON (closed) | | |
| | n.□□□2 | Enable reverse drive when CN1-42 input signal is ON (closed) | | |
| | n.□□□3 | Enable reverse drive when CN1-43 input signal is ON (closed) | | |
| | n. □□□4 | Enable reverse drive when CN1-44 input signal is ON (closed) | | |
| | n. □□□7 | Set the signal to always prohibit reverse drive. | | |
| | n. □□□8 | Set the signal to always enable reverse drive. | | |
| | n. □□□9 | Enable reverse drive when CN1-40 input signal is ON (closed) | | |
| | n. □□□A | Enable reverse drive when CN1-41 input signal is ON (closed) | | |
| | n. □□□B | Enable reverse drive when CN1-42 input signal is ON (closed) | | |
| | n. □□□C | Enable reverse drive when CN1-43 input signal is ON (closed) | | |
| | n. □□□D | Enable reverse drive when CN1-44 input signal is ON (closed) | | |

3) Motor Stopping Method for Overtravel

When overtravel occurs, you can choose any of the following three methods to stop the servo motor through Pn001:

- I . Dynamic brake (DB) stop: By short-circuiting the electrical circuit, the servo motor is stopped urgently.
- II . Deceleration to stop: Deceleration to stop by emergency stop torque.
- III. Coasting to stop stop: stop naturally due to friction when the motor rotates.

After stopping, there are the following two states:

- I . Coasting to stop status: The state of natural stop due to friction when the motor rotates.
- II . Zero position fixed state: the state of maintaining the zero position in the position loop

Table 5-12 Pn001=n. □□XX Reverse Drive Overtravel (N-OT) Setting Table

| Parameter | | Motor Stop Method | State after motor stops | When Enabled | Classification |
|---|-----------------------------|-------------------|-------------------------|---------------|----------------|
| Pn001 (Function Select Application Switch 1) | n.□□00 (default setting) | Dynamic brake | Coasting to stop | After restart | Setup |
| | n. □□01 | | | | |
| | n. □□02 | Coasting to stop | | | |
| | n. □□1□ | Slow down | Zero fixed | | |
| | n. □□2□ | | Coasting to stop | | |

➤ Note: Deceleration to stop is not possible in torque control. With the setting of Pn001.0, the status of servo motor is Coasting to stop after the servo motor stops performing DB or Coasting to stop.

When the motor stop method is selected as deceleration stop:

Set Pn406 (Emergency Stop Torque) to stop the servo motor by setting emergency stop torque, the default setting is 800%. And it will actually stop according to the maximum torque of the motor.

Table 5-13 Pn406 Deceleration Stop Setting Table

| Pn406 | Emergency Stop Torque | | | When Enabled | Classification |
|-------|-----------------------|--------------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting Range | Setting Unit | Default Setting | Immediately | Setup |
| 0~800 | 1% | 800% | | | |

4) Overtravel Warning function

You can set the system to detect an A.9A0 warning (Overtravel) if overtravel occurs while the servo is ON. This allows the servo unit to notify the host controller with a warning even when the overtravel signal is input only momentarily. It can be set by Pn00D = n.X□□□. Overtravel warnings are also synchronized to error code 603Fh and servo error codes to 213Fh.

Table 5-14 Pn00D=nX□□□ Overtravel Warning Setting Table

| Parameter | Meaning | When Enabled | Classification | |
|---|-----------------------------|-----------------------------------|----------------|-------|
| Pn00D (Function selection application switch D) | n.0□□□ (default setting) | Do not detect overtravel warnings | Immediately | Setup |
| | n.1□□□ | Detect overtravel warnings | | |

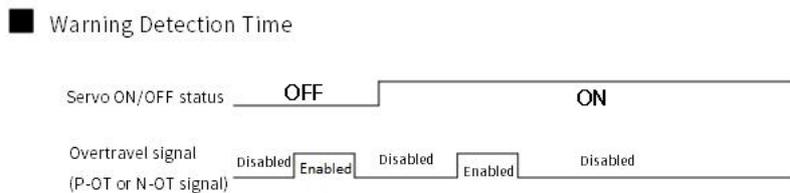


Figure 5-1 Overtravel Detected Timing Chart

Information:

1. Warnings are detected for overtravel in the same direction as the reference.
2. Warnings are not detected for overtravel in the opposite direction from the reference.
3. A warning can be detected in either the forward or reverse direction if there is no command.
4. A warning will not be detected when the servo is OFF even if overtravel status exists.
5. A warning will not be detected when the servo is turned ON even if overtravel status exists.
6. The warning status will be held for one second after the overtravel status no longer exists and it will then be cleared automatically.

➤ Note: The overtravel warning function is only the action of detecting the warning. It will not affect the stop processing of the overtravel and the motion control of the PLC device. But the motor has not reached the PLC command position, so please check the PLC command.

5.4.4 Holding Brake

Since the gravity in the Z-axis direction will cause the mechanism to slide down, the holding brake is more often used in the Z-axis direction. Using the brake can prevent the moving part from falling down, and also prevent the servo motor from continuously exerting a large resistance (if the servo continues to exert force, a large amount of heat will be generated, which will reduce the service life of the motor). The electromagnetic brake will cause unnecessary malfunction, and the brake must be applied after the servo is turned off. The brake is controlled by DO (/BK signal), and the user can use Pn506, Pn507 and Pn508 to set the relevant delay time.

The holding brake is used in the following cases:

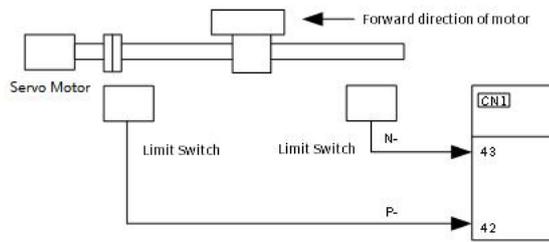


Figure 5-4 Cases for Holding Brake

Electromagnetic brake control timing chart:

Plaease consider the brake release delay and set the parameters in the timing sequence as shown in the figure below

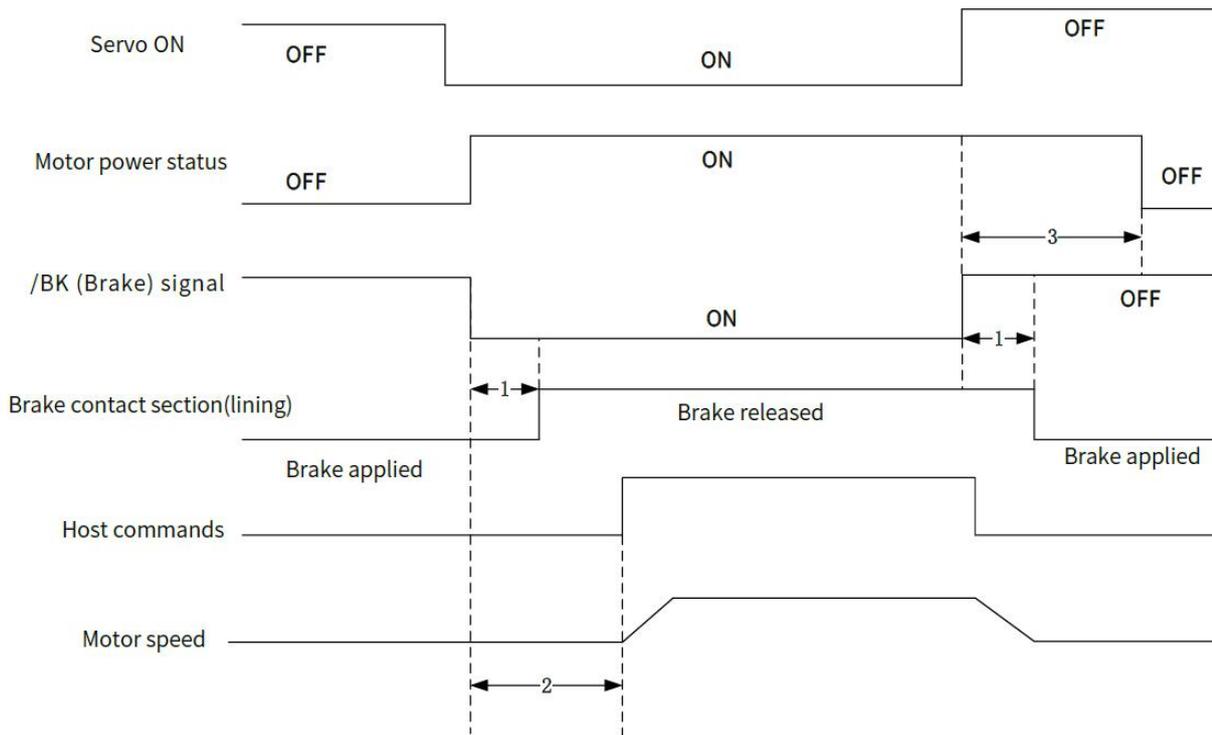


Figure 5-5 Electromagnetic Brake Timing Chart

- Note: 1. Before you output a reference from the host controller to the servo unit, wait for at least 50 ms plus the brake release delay time after you turn ON the /S-ON signal.
- 2. Please set the brake operate and servo OFF time through Pn506, Pn507 and Pn508.
- 3. It can only be used for holding and not for braking. Please use it with the servo OFF.

1) Brake signal

Output signal to control the brake. The /BK (Brake) signal is not allocated by default. To use the brake, change the setting of (3) Braking signal(/BK) alPosition.

The /BK signal is turned OFF (to operate the brake) when the servo is turned OFF or when an alarm is detected.

The servo is ON, /BK will be ON (the brake does not operate)

- Note: The /BK signal will remain ON during overtravel. The brake will not be applied.

The /BK (Brake) signal is not allocated by default. Please set with Pn50F= n.□X□□ to allocate

Table 5-15 Pn50F=n.□X□□ Brake Signal (/BK) Setting Table

| Parameter | Connector Pin No. | | Meaning | When Enabled | Classification |
|-----------|-------------------|------|---------|--------------|----------------|
| | +Pin | -Pin | | | |

| | | | | | | |
|--------------------------------------|------------------------------|--------|--------|--|---------------|-------|
| Pn50F (Output Signal Selection 2) | n. □0□□ (default setting) | — | — | The /BK signal is not used. | After restart | Setup |
| | n. □1□□ | CN1-25 | CN1-26 | The /BK signal is output from CN1-25 and CN1-26. | | |
| | n. □2□□ | CN1-27 | CN1-28 | The /BK signal is output from CN1-27 and CN1-28. | | |
| | n. □3□□ | CN1-29 | CN1-30 | The /BK signal is output from CN1-29 and CN1-30 | | |
| | n. □4□□ | CN1-37 | CN1-38 | The /BK signal is output from CN1-37 and CN1-38 | | |

➤ Note: If you allocate more than one signal to the same output connector pin, a logical OR of the signals is output. Allocate the /BK signal to its own output connector pin, i.e., do not use the same output terminal for another signal.

2) Output timing of brake signal (/BK) (when the motor stops)

When the servo motor stops, the brake (/BK) signal and the servo ON (/S-ON) signal are OFF at the same time. By setting Pn506, the time from the servo ON (/S-ON) signal OFF to the motor entering the non-energized state can be changed.

Table 5-16 Pn506 Brake Singnal (/BK) Setting Table

| Pn506 | Brake command - Servo OFF delay time | | | When Enabled | Classification |
|-------|--------------------------------------|--------------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Setting unit | default setting | | |
| | 0~50 | 10ms | 10 | Immediately | Setup |

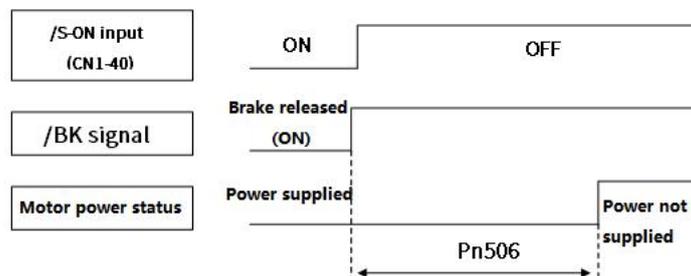


Figure 5-6 Brake Signal (/BK) Output Timing Chart(Servo motor stops)

- Note: 1. When the servo motor is used to control a vertical axis, the machine moving part may move slightly due to gravity or an external force. You can eliminate this slight motion by setting the servo OFF delay time so that power supply to the motor is stopped after the brake is applied.
- 2. When an alarm occurs, the servo motor immediately enters a unpowered state regardless of the setting. Therefore, due to the self-weight or external force of the mechanical moving part, the machine sometimes will move before the brake operates.

(3) Output timing of brake signal (/BK) (when the motor is operating)

If an alarm occurs while the servo motor is operating, the servo motor will start stopping and the /BK signal will be turned OFF. You can adjust the timing of /BK signal output by setting the brake command output speed level Pn507 and the servo OFF-Brake Command Waiting Time (Pn508).

- Note: The stop method when the alarm occurs is the setting of the electronic gear. After the motor is stopped by the zero-speed command, follow the output sequence of " 5.3.6 (2) Brake signal (/BK) (when motor is stopped)"

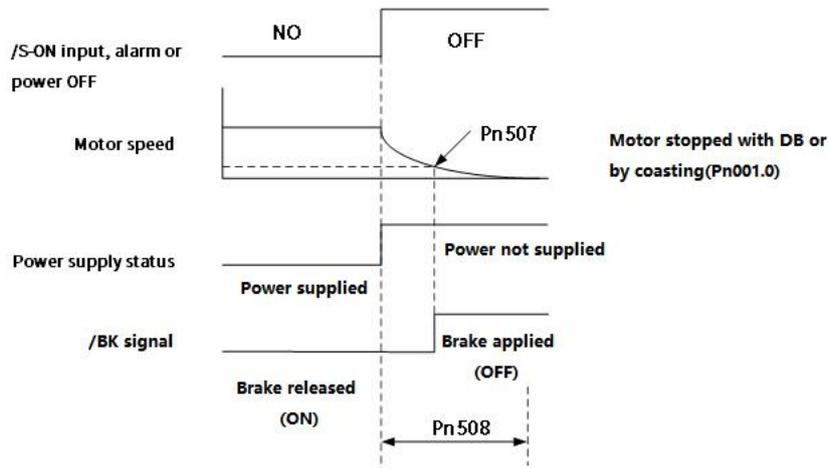


Figure 5-7 Signal Brake (/BK) Output Timing Chart(When motor is operating)

The brake operates when either of the following conditions is satisfied:

1. When the motor speed goes below the level set in Pn507 for a servo motor after the power supply to the motor is stopped
2. When the time set in Pn508 elapses after the power supply to the motor is stopped

Table 5-17 Pn507/ Pn508 Brake Operating Table

| Pn507 | Brake Command Output Speed Level | | | When Enabled | Classification |
|-------|--------------------------------------|--------------------|-----------------|--------------|----------------|
| | Position | Torque | Speed | | |
| | Setting range | Setting unit | Default setting | Immediately | Setup |
| | 0-10000 | 1min ⁻¹ | 100 | | |
| Pn508 | Servo OFF-Brake Command Waiting Time | | | When Enabled | Classification |
| | Position | Torque | Speed | | |
| | Setting range | Setting unit | Default setting | Immediately | Setup |
| | 10-100 | 10ms | 50 | | |

5.4.5 Motor Stopping Methods for Servo OFF and Alarms

Caution

- The dynamic brake is used for emergency stops. The dynamic brake circuit will operate frequently if the power supply is turned ON and OFF or the servo is turned ON and OFF while a reference input is applied to start and stop the servo motor. This may result in deterioration of the internal elements in the servo unit. Use speed input references or position references to start and stop the servo motor.
- If you turn OFF the main circuit power supply or control power supply during operation before you turn OFF the servo, the servo motor stopping method depends on the servo unit model as shown in the following table.
- If the servo motor must be stopped by coasting rather than with the dynamic brake when the main circuit power supply or the control power supply is turned OFF before the servo is turned OFF, combine the sequence signals externally to disconnect the wiring (U, V, W) of the servo motor.
- To minimize the coasting distance of the servo motor to come to a stop when an alarm occurs, zero-speed stopping is the default method for alarms to which it is applicable. However, depending on the application, stopping with the dynamic brake may be more suitable than zero-speed stopping.

1) Stopping Method for Servo OFF

Table 5-18 Pn001 Stopping Setting Table (When servo is OFF)

| Parameter | | Servo Motor Stop Method | Status After the Servo Motor Stops | When Enabled | Classification |
|---|------------------------------|-------------------------|------------------------------------|---------------|----------------|
| Pn001 (Function Select Application Switch 1) | n. □□□0 (default setting) | DB | DB | After restart | Setup |
| | n. □□□1 | | Coasting to stop | | |
| | n. □□□2 | Coasting to stop | Coasting to stop | | |

2) Stopping method for Alarms

According to the stop method when the alarm occurs, there are two types of alarms BM. 1 and BM. 2 which are selected by Pn001.0 and Pn00B.1.

When BM.1 alarm occurs, the servo motor will stop according to the setting of Pn001.0

When BM.2 alarm occurs, the servo motor will stop according to the setting of Pn00B.1.

Please refer to the following tables to check BM.1 alarm or BM.2 alarm

Table 5-19 Parameter Setting Table when BM.1 Alarm Occurs (Same as Servo OFF)

| Parameter | | Servo Motor Stop Method | Status After the Servo Motor Stops | When Enabled | Classification |
|---|------------------------------|-------------------------|------------------------------------|---------------|----------------|
| Pn001 (Function Select Application Switch 1) | n. □□□0 (default setting) | DB | DB | After restart | Setup |
| | n. □□□1 | | Coasting to stop | | |
| | n. □□□2 | Coasting to stop | Coasting to stop | | |

Table 5-20 Parameter setting Table when BM.2 Alarm Occurs

| Parameter | | Servo Motor Stop Method | Status After the Servo Motor Stops | When Enabled | Classification |
|------------------------------|------------------------------|-------------------------|------------------------------------|---------------|----------------|
| Pn00B | Pn001 | | | | |
| n. □□0□ (default setting) | n. □□□0 (default setting) | Zero | DB | After restart | Setup |
| | n. □□□1 | | Coasting to stop | | |
| | n. □□□2 | | | | |
| n. □□1□ | n. □□□0 (default setting) | DB | DB | After restart | Setup |
| | n. □□□1 | | Coasting to stop | | |
| | n. □□□2 | Coasting to stop | | | |

5.4.6 Operation for Momentary Power Interruptions

Even if the main power supply to the servo unit is interrupted momentarily, power supply to the motor (servo ON status) will be maintained for the time set in Pn509 (Momentary Power Interruption Hold Time).

Table 5-21 Pn509 (Momentary Power Interruption Hold time) Setting Table

| Pn509 | Momentary Power Failure Holding Time | | | When Enabled | Classification |
|----------|--------------------------------------|--------------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Setting unit | Default setting | | |
| 20-50000 | 1ms | 20 | | | |

If the momentary power interruption time is equal to or less than the setting of Pn509, power supply to the motor will be continued. If it is longer than the setting, power supply to the motor will be stopped. Power will be supplied to the motor again when the main circuit power supply recovers.

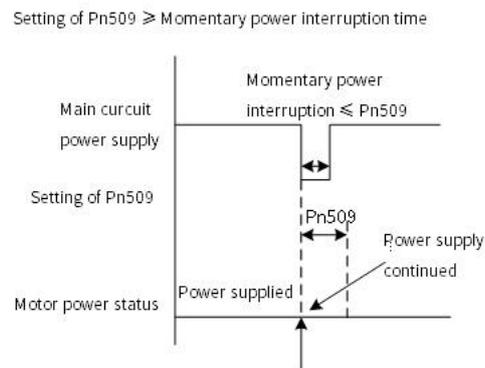


Figure 5-8 Main Circuit Power Supply and Servo Motor Power Status (Pn509 value \geq momentary power interruption time)

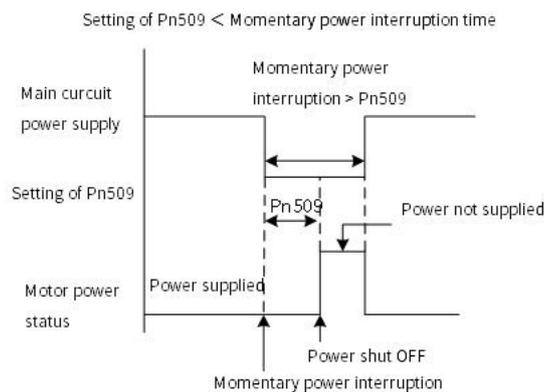


Figure 5-9 Main Circuit Power Supply and Servo Motor Power Status (Pn509 value \leq momentary power interruption time)

Information:

1. If the momentary power interruption time exceeds the setting of Pn509, the /S-RDY (Servo Ready) signal will turn OFF and servo is OFF.
2. If uninterruptible power supplies are used for the control power supply and main circuit power supply, the servo unit can withstand a power interruption that lasts longer than 1,000 ms.
3. The holding time of the servo unit control power supply is approximately 100 ms. If control operations become impossible during a momentary power interruption of the control power supply, the setting of Pn509 will be ignored and the same operation will be performed as for when the power supply is turned OFF normally.

When performing the same operation, the setting of Pn509 will be ignored.

5.4.7 Setting of Motor Overload Detection Value

The motor overload detection value is the value (threshold value) at which an overload warning and an overload alarm are detected when a continuous load exceeding the rated value of the servo motor is applied.

It prevents the servo motor from overheating.

The servo unit is able to change the detection time of A.910 (overload warning) and A.720 (overload (continuous maximum) alarm). However, the detection value of A.710 (overload characteristics and overload (instantaneous maximum) alarm) cannot be changed.

Detection time of overload warning (A.910)

With the default setting for overload warnings, an overload warning is detected in 20% of the time required to detect an overload alarm. You can change the time required to detect an overload warning by changing the setting of the overload warning level (Pn52B). You can increase safety by using overload warning detection as an overload protection function matched to the system

For example, if the overload warning value (Pn52B) is changed from 20% to 50%, an overload warning is detected in half of the time required to detect an overload alarm.

Table 5-22 Pn52B (Overload Warning Level) Setting Table

| Pn52B | Overload Warning Level | | | When Enabled | Classification |
|---------|------------------------|--------------|-----------------|--------------|----------------|
| | Position | Torque | Speed | | |
| | Setting range | Setting unit | Default setting | Immediately | Setup |
| 1 ~ 100 | 1% | 20 | | | |

Detection Timing for Overload Alarms (A.720)

If servo motor heat dissipation is insufficient (e.g., if the heat sink is too small), you can lower the overload alarm detection level to help prevent overheating.

To reduce the overload alarm detection level, change the setting of Pn52C (Base Current Derating at Motor Overload Detection)

Table 5-23 Pn52C (Base Current Derating at Motor Overload Detection) Setting Table

| Pn52C | Base Current Derating at Motor Overload Detection | | | When Enabled | Classification |
|----------|---|--------------|-----------------|---------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Setting unit | Default setting | After restart | Setup |
| 10 ~ 100 | 1% | 100 | | | |

An A.720 alarm (Continuous Overload) can be detected earlier to protect the servo motor from overloading.

5.4.8 Regenerative resistor capacity setting

If an External Regenerative Resistor is connected, you must set Pn600.

If you set Pn600=0 with external regenerative resistor connected, A.320 alarms (Regenerative Overload) will not be detected correctly, and the External Regenerative Resistor may be damaged or personal injury or fire may result.

Table 5-24 Pn600 (Regenerative Resistor Capacity) Setting Table

| Pn600 | Regenerative Resistor Capacity | | | When Enabled | Classification |
|---|--------------------------------|--------------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Setting unit | Default setting | Immediately | Setup |
| 0 - Servo unit's maximum applicable motor capacity | 10W | 0 | | | |

The setting of regenerative resistance capacity depends on the way of external cooling.

1. For self-cooling (natural convection cooling): Set the parameter to a maximum 20% of the capacity (W) of the actually installed regenerative resistor.

2. For forced air cooling: Set the parameter to a maximum 50% of the capacity (W) of the actually installed regenerative resistor.

(Example) For a self-cooling 50-W External Regenerative Resistor, set Pn600 to 1 ($\times 10$ W) (50 W $\times 20\%$ = 10 W).

➤ Note: 1. When an External Regenerative Resistor is used at the normal rated load ratio, the resistor temperature increases to between 200°C and 300°C. Always apply derating. Consult the manufacturer for the resistor's load characteristics.

2. For safety, use an External Regenerative Resistor with a thermoswitch

5.5 Other Input and Output Signals

5.5.1 Input Signal Allocations

After changing the input signal, please set Pn50A = n.□□□1 (Input Signal Allocation Mode).

Table 5-25 Pn50A = n. □□□1 (Input Signal Allocation Mode)

| Parameter | | Meaning | When Enabled | Classification |
|-------------------------------------|------------------------------|---|---------------|----------------|
| Pn50A (Input signal selection 1) | n. □□□0 (default setting) | Use the sequence input signal terminals with the default allocations. | After restart | Setup |
| | n. □□□1 | Change the individual sequence input signal Allocations. | | |

5.5.2 Alarm Output (ALM) Signal

This signal is output when the servo unit detects an error.

Table 5-26 Alarm Signal Output

| Type | Signal | Connector Pin No. | Status | Meaning |
|--------|--------------------|-------------------|-------------|-------------------|
| Output | Alarm output (ALM) | CN1-31、CN1-32 | ON (closed) | Normal status |
| | | | OFF (open) | Servo drive alarm |

5.5.3 Warning Output (/WARN) Signal

Both alarms and warnings are generated by the servo unit. Alarms indicate errors in the servo unit for which operation must be stopped immediately. Warnings indicate situations that may result in alarms but for which stopping operation is not yet necessary.

Table 5-27 Warning Signal Output

| Type | Signal | Connector Pin No. | Status | Meaning |
|--------|------------------------|-------------------|-------------|---------------|
| Output | Warning output (/WARN) | Must be allocated | ON (closed) | Warning |
| | | | OFF (open) | Normal status |

5.5.4 Rotation Detection Output Signal (/TGON)

This signal is output when the shaft of the servo motor rotates faster than the setting of Pn502.

Table 5-28 Rotation Detection Output

| Type | Signal | Connector Pin No. | Status | Meaning |
|--------|--|-------------------|-------------|---|
| Output | Rotation detection output signal (/TGON) | Self-Allocated | ON (closed) | The Servo motor is operating faster than the setting of Pn502 |
| | | | OFF (open) | The Servo motor is operating slower than the setting of Pn502 |

Rotation Detection Output (/TGON) Parameters:

Use the following parameter to set the speed detection level at which to output the /TGON signal.

Table 5-29 Pn502 (Rotation Detection Level) Parameter Setting

| Pn502 | Rotation Detection Level | | | When Enabled | Classification | |
|-------|--------------------------|--------------------|-----------------|--------------|----------------------|--------|
| | | Speed | Position | | | Torque |
| | Setting range | Setting unit | Default setting | | | |
| | 0-10000 | 1min ⁻¹ | 20 | | Immediately Setup | |

5.5.5 Servo Ready Output (/S-RDY) Signal

The /S-RDY (Servo Ready) signal turns ON when the servo unit is ready to accept the /S-ON (Servo ON) input signal.

Table 5-30 Servo Ready Signal Output

| Type | Signal | Connector Pin No. | Status | Meaning |
|--------|-----------------------------|-------------------|-------------|--|
| Output | Servo Ready Output (/S-RDY) | Self-Allocated | ON (closed) | Ready to receive the /S-ON (Servo ON) signal |
| | | | OFF (open) | Not ready to receive the /S-ON (Servo ON) signal |

- Note: 1. When using an absolute value encoder, The /S-RDY (Servo Ready) signal turns ON when the servo unit is ready to accept the SEN (Absolute Data Request) signal.
- 2. The /S-RDY signal is turned ON when the main circuit power is ON, there is no hard wire base block state, and there are no alarms

5.6 Electronic Gear Ratio

The essential of electronic gear ratio is the corresponding travel distance of motor for a load shaft travel distance of 1 reference unit (Unit: encoder unit)

The gear ratio consists of the numerator 6091-01h and the denominator 6091-02h. The gear ratio establishes a proportional relationship between the load shaft travel distance (reference unit) and the travel distance (encoder unit): Motor travel distance = Load shaft travel distance × Gear ratio

The motor is connected to the load parts by means of gearbox and other mechanical transmissions. Therefore, the gear ratio is related to the mechanical reduction ratio, mechanical dimensions, and the resolution of the motor. The calculation method is as follows

Gear ratio = Motor resolution / Load shaft resolution;

Gear ratios are used to establish a specified ratio of load shaft travel distance to motor shaft travel distance

Table 5-31 Electronic Gear Ratio Settings

| Pn78C | Electronic Gear Ratio numerator | | | When Enabled | Classification |
|-------|---------------------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | 1-1073741824 | — | 1 | | |

| Pn78E | Electronic gear ratio denominator | | | When Enabled | Classification |
|-------|-----------------------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | 1-1073741824 | — | 1 | | |

If the gear ratio between servo motor shaft and the load is given as n/m:

$$\text{Electronic gear ratio} \frac{B}{A} = \frac{Pn78C}{Pn78E} = \frac{\text{Encoder resolution}}{\text{Pulses per load shaft revolution}} \times \frac{m}{n}$$

The encoder resolution can be checked by the motor model as follows:

X6 series-□□□□□□□□

Table 5-32 Encoder Resolution Selection Table

| Code | Specification | Encoder resolution |
|------|-----------------------------------|----------------------------|
| A | 17-bit absolute type (multi-turn) | 131072 (2 ¹⁷) |
| D | 23-bit absolute type (multi-turn) | 8388608 (2 ²³) |

- Note: Electronic gear ratio setting range: 0.001 ≤ electronic gear ratio (B/A) ≤ 4000, if it is not within the range, "parameter setting abnormality (A.040) alarm" will occur.

5.7 Profile Position Mode, PP

In the Profile Position Mode, there are absolute positioning and relative positioning for drive controlling the motor. The host controller is able to set target position, start velocity, stop velocity and acceleration(deceleration). Set object 6060H to 1 to enable Profile Position Mode. The following figure 5-10 and 5-11 show the block diagram for the Profile Position Mode.

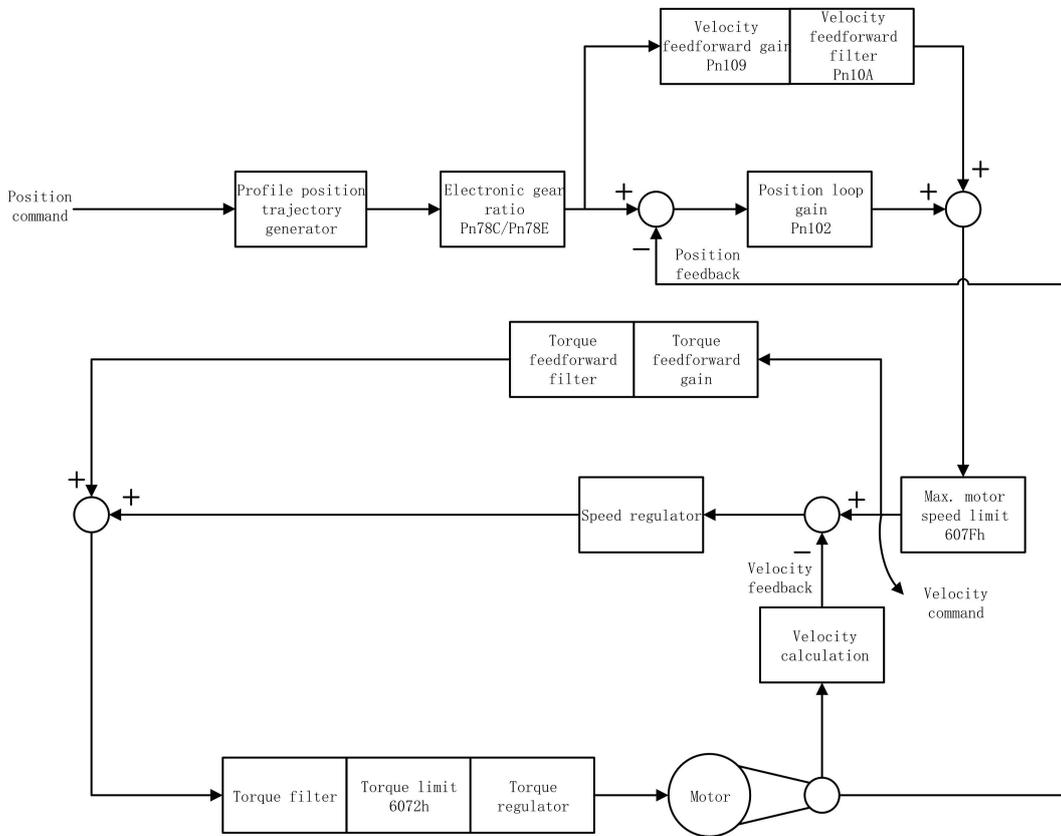


Figure 5-10 Blocking Diagram for Profile Position Mode

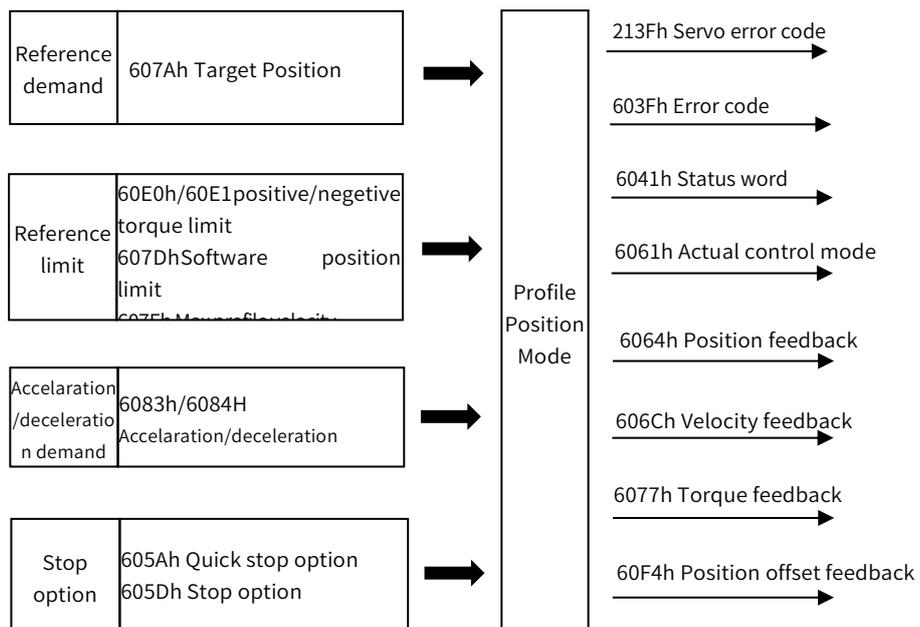


Figure 5-11 Profile Position Mode Input/Output

5.7.1 Control Word in Profile Position Mode(6040010h)

In profile position mode, the meaning of control word(6040h) is as the table 5-33. The item in dark background indicates the dedicated control reference in profile position mode.

Table 5-33 Description of Control Word in Profile Position Mode

| Bit | Name | Description |
|-------|---------------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo, if set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4 | Update position reference | When 0→1, load the next positioning operation(including target position or position increment, start velocity, operation velocity and acceleration(deceleration)) |
| 5 | Update immediately | 0: Starts the next positioning operation after the current positioning operation is completed 1: Stop the current operation and starts the next positioning operation immediately |
| 6 | Position reference type | 0: absolute position reference, 1: relative position reference |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: disabled, 1: enabled. When enabled the operation is halted. |
| 9 | PP mode reserved | - |
| 10 | Reserved | - |
| 11~15 | Customized | - |

5.7.2 Status Word in Profile Position Mode(60410010h)

The meaning of status word(6041h) is as table 5-35 in profile position mode. The item in dark background indicates the dedicated control reference in profile position mode.

Table 5-34 Status Word Description in Profile Position Mode

| Bit | Name | Description |
|-----|--------------------------------|---|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Fault | 0: No fault, 1: Fault |
| 4 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 5 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 6 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | Target reached | 60400010h bit 8 (halt)=0, 0: Target position is not reached 1: Target position is reached; 60400010h bit 8 (halt)=1, 0: Decelerating, 1: Velocity is 0 |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |

| | | |
|----|---|---|
| 12 | Received status of new position reference | 0: Position reference can be updated. 1: Position reference cannot be updated. |
| 13 | Position offset error | 0: Position offset value is in the set range(6065h) 1: Position offset value is out of the set range(6065h) |
| 14 | Customized | - |
| 15 | Homing completed | 0: Disabled, 1: Homing is completed For absolute system, after setting Pn781.3=1, Bit15 value will be saved after homing is completed(retained when power failure) |

5.7.3 Related Parameter of Profile Position Mode

Table 5-35 shows related objects dictionary in profile position mode.

Table 5-35 Object Dictionary List of Profile Torque Mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|---|--------|------------|---------------|
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 6062h | | User position reference | ro | integer32 | 0 |
| 6063h | | Motor position feedback | ro | integer32 | 0 |
| 6064h | | User position feedback | ro | integer32 | 0 |
| 6065h | | User position offset threshold | rw | unsigned32 | 0 |
| 6067h | | Position threshold | rw | unsigned32 | 50 |
| 6068h | | Position reaching time | rw | unsigned16 | 0 |
| 606Bh | | Velocity demand value | ro | integer32 | 0 |
| 606Ch | | Velocity actual value | ro | integer32 | 0 |
| 607Ah | | Target position | rw | integer32 | 0 |
| 607Ch | | Home offset | rw | integer32 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 607Eh | | Reference polarity | rw | unsigned8 | 0 |
| 607Fh | | Max profile velocity | rw | unsigned32 | 2147483647 |
| 6080h | | Max motor velocity | rw | unsigned32 | 10000 |
| 6081h | | Profile velocity | rw | unsigned32 | 0 |
| 6083h | | Profile acceleration | rw | unsigned32 | 10485760 |
| 6084h | | Profile deceleration | rw | unsigned32 | 10485760 |
| 60F4h | | User Position offset | ro | integer32 | 0 |
| 60FCh | | Motor position reference feedback | ro | integer32 | 0 |

5.7.4 Simple Tutorial for Profile Position Mode

1. Parameter setting in servo drive

Table 5-36 Parameter of Servo Drive for Operating Profile Position Mode

| Parameter | Set value | Description |
|-----------|-----------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |

2. The host controller connects to servo drive and set configuration PDO parameters.

3. Run the host controller

Table 5-37 Profile Position Mode Startup and Operation

| Address | Name | Set value(Decimal value) |
|---------------------------|--|---|
| 60600008h | Control mode | 1 |
| 607A0020h | Demand position | Set by user |
| 60810020h | Demand velocity in profile position loop | -2147483648~2147483647 |
| 60400010h Control word | Enable | Any number → 6 → 7 → 15/47/79/111 |
| | Alarm clear | Any number → 128 (Enabled on rising edge) |
| | Demand absolute position(Not update immediately) | 6 → 7 → 15 → 31 |
| | Demand absolute position(Update immediately) | 6 → 7 → 47 → 63 |
| | Demand relative position(Not update immediately) | 6 → 7 → 79 → 95 |
| | Demand relative position(Update immediately) | 6 → 7 → 111 → 127 |
| 60830020h | Profile acceleration | -2147483648~2147483647 |
| 60840020h | Profile deceleration | -2147483648~2147483647 |
| 607F0020h | Max. profile velocity | -2147483648~2147483647 |

5.8 Profile Velocity Mode, PV

In the Profile Velocity Mode, target acceleration and deceleration can be set by host controller. When profile velocity mode is enabled, 6060H is set to 3. It is available for EtherCAT. The following figure 5-12 and 5-13 shows the block diagram for the Profile Velocity Mode.

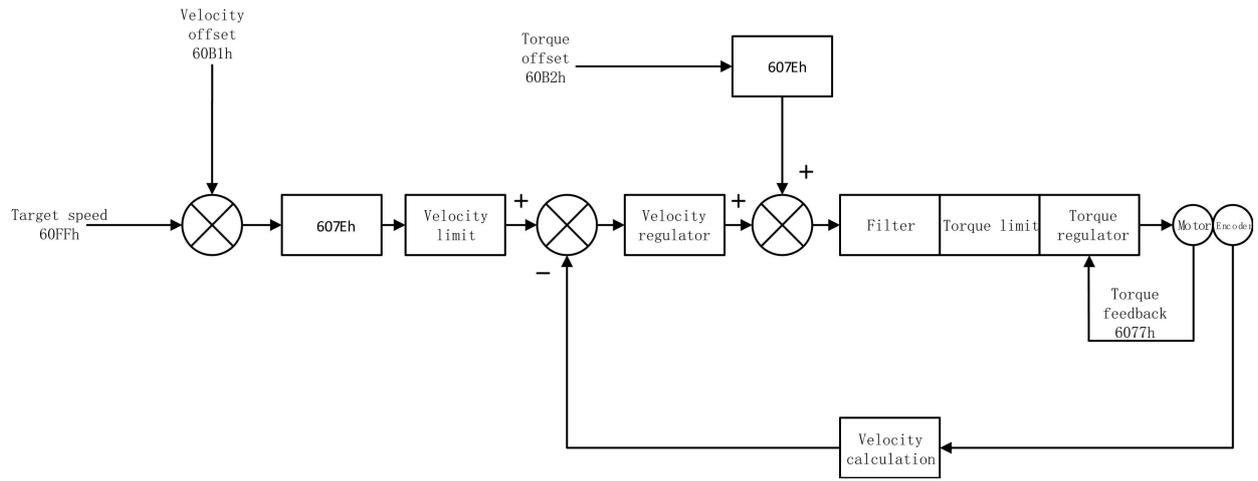


Figure 5-12 Block Diagram for Profile Velocity Mode

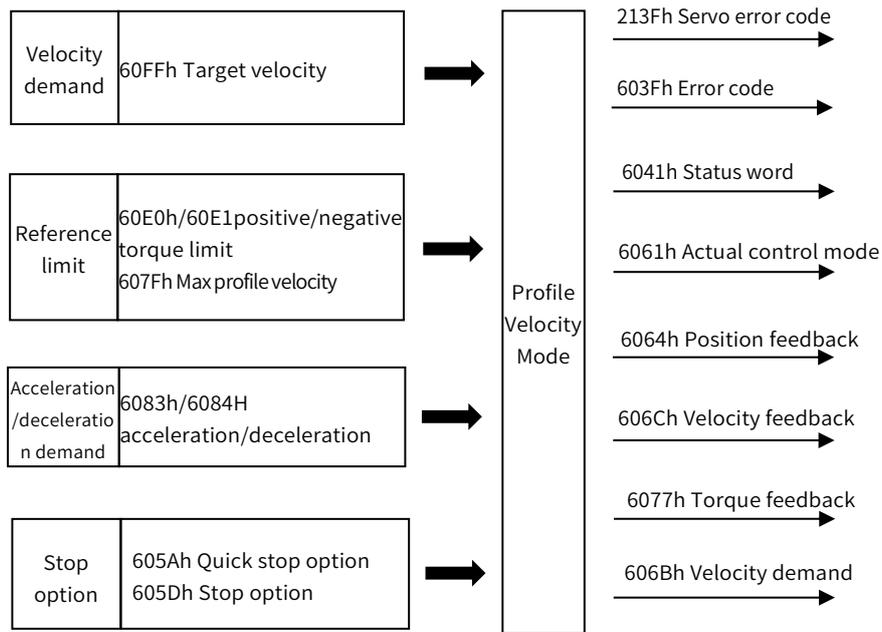


Figure 5-13 Profile Velocity Mode Input/output

5.8.1 Profile Velocity Mode Control Word Setting(60400010h)

In profile velocity mode, the meaning of control word is shown as Table 5-38. The item in dark background indicates the dedicated control reference in profile velocity mode.

Table 5-38 Description of Control Word in Profile Velocity Mode

| Bit | Name | Description |
|-------|----------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo. When set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4~6 | Reserved for PV Mode | - |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: Disabled, 1: Enabled. When disabled reference is executed, when enabled无 then halt. |
| 9 | Reserved for PV Mode | - |
| 10 | Reserved | - |
| 11~15 | Customized | - |

5.8.2 Status Word in Profile Position Mode(60410010h)

In profile velocity mode, the meaning of bit of status word is shown as Table 5-39. The item in dark background indicates the dedicated control reference in profile velocity mode.

Table 5-39 Description of Status Word in Profile Velocity Mode

| Bit | Name | Description |
|-----|--------------------|--|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |

| | | |
|-------|--------------------------------|---|
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Fault | 0: No fault, 1: Fault |
| 4 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 5 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 6 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | Target reached | 60400010h bit 8 (halt)=0, 0: Target velocity is not reached, 1: Target velocity is reached 60400010h bit 8 (halt)=1, 0: Decelerating, 1: Velocity is 0 |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |
| 12 | Zero velocity status | 0: Velocity is not 0, 1: Velocity is 0 |
| 13 | Reserved for PV mode | - |
| 14~15 | Customized | - |

5.8.3 Related Parameter of Profile Velocity Mode

Table 5-40 shows related objects dictionary in profile velocity mode.

Table 5-40 Object Dictionary List of Profile Torque Mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|---|--------|------------|---------------|
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 6063h | | Motor position feedback | ro | integer32 | 0 |
| 6064h | | User position feedback | ro | integer32 | 0 |
| 606Bh | | User velocity reference value | ro | integer32 | 0 |
| 606Ch | | User actual velocity feedback | ro | integer32 | 0 |
| 606Dh | | Velocity threshold | rw | unsigned16 | 10 |
| 606Eh | | Velocity reaching time | rw | unsigned16 | 0 |
| 607Ch | | Home offset | rw | integer32 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 607Eh | | Reference polarity | rw | unsigned8 | 0 |
| 607Fh | | Max profile velocity | rw | unsigned32 | 2147483647 |
| 6080h | | Max motor velocity | rw | integer32 | 10000 |
| 6083h | | Profile acceleration | rw | unsigned32 | 10485760 |
| 6084h | | Profile deceleration | rw | unsigned32 | 10485760 |
| 60FFh | | Target velocity | rw | integer32 | 0 |

5.8.4 Simple Tutorial for Profile Velocity Mode

1. Parameter setting in servo drive

Table 5-41 Parameter of Servo Drive for Operating Profile Velocity Mode

| Parameter | Value | Description |
|-----------|-------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |

- The host controller connects to servo drive and set configuration PDO parameters.
- Run the host controller

Table 5-42 Profile Velocity Mode Startup and Operation

| Address | Name | Value set(Decimal value) |
|---------------------------|---------------------------|---|
| 60600008h | Control mode | 3 |
| 60FF0020h | Demand profile velocity | -2147483648~2147483647 |
| 60400010h Control word | Enbale | Any number→6→7→15 |
| | Alarm clear | Any number→ 128(Enabled on rising edge) |
| | Motor rotation | Demand velocity reference after enabled |
| 60830020h | Profile acceleration | -2147483648~2147483647 |
| 60840020h | Profile deceleration | -2147483648~2147483647 |
| 607F0020h | Max. profile acceleration | -2147483648~2147483647 |

5.9 Profile Torque Mode, PT

In profile torque mode, the host controller is able to set the target torque and torque reference change rate(torque ramp). To enable the profile torque mode, set 6060H to 4. It is available for EtherCAT. The following figure 5-14 and 5-15 shows the block diagram for the Profile Velocity Mode.

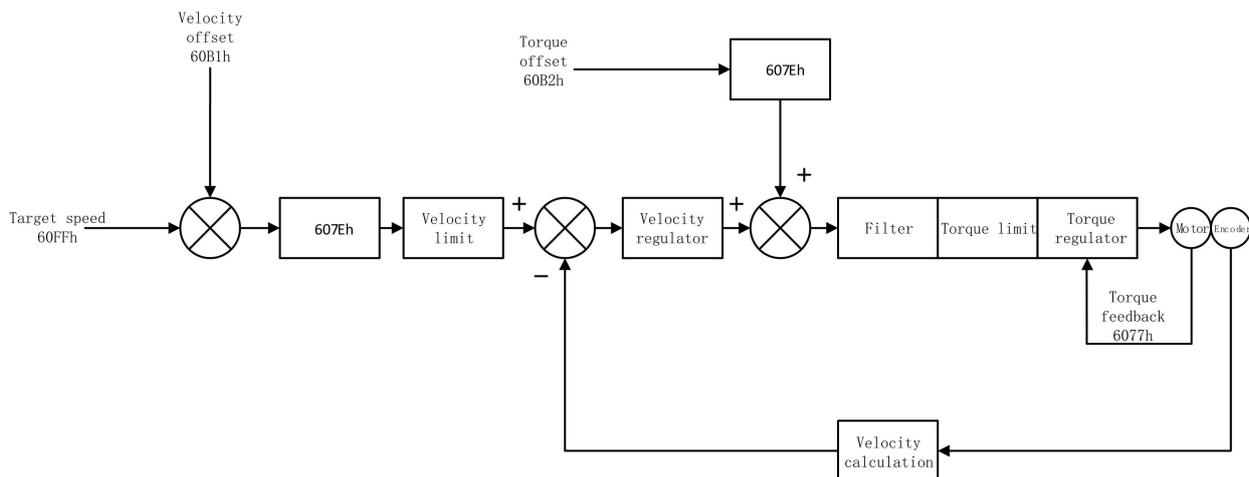


Figure 5-14 Block Diagram for Profile Torque Mode

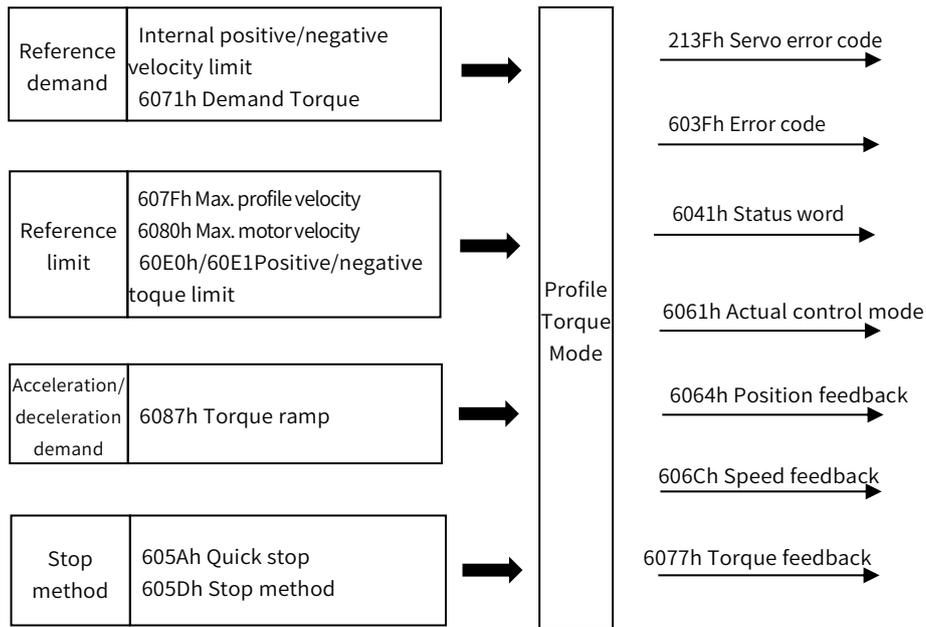


Figure 5-15 Profile Torque Mode Input and Output

5.9.1 Setting of Control Word in Profile Torque Mode(60400010h)

In profile position mode, the meaning of control word(6040h) is as the table 5-43. The item in dark background indicates the dedicated control reference in profile torque mode.

Table 5-43 Description of Control Word in Profile Torque Mode

| Bit | Name | Description |
|-------|----------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo, if set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4~6 | Reserved for PT Mode | - |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: disabled, 1: enabled. When enabled the operation is halted. |
| 9 | Reserved for PT Mode | - |
| 10 | Reserved | - |
| 11~15 | Customized | - |

5.9.2 Status Word in Profile Torque Mode(60410010h)

In profile torque mode, the meaning of control word(6040h) is as the table 5-44. The item in dark background indicates the dedicated control reference in profile torque mode.

Table 5-44 Description of Control Word in Profile Torque Model

| Bit | Name | Description |
|-----|--------------------|--|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |

| | | |
|-------|--------------------------------|--|
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Fault | 0: No fault, 1: Fault |
| 4 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 5 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 6 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | Target Torque reached | 0: Target torque is not reached, 1: Target torque is reached. |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |
| 12、13 | Reserved for PT mode | - |
| 14、15 | Customized | - |

5.9.3 Related Parameter of Profile Torque Mode

Table 5-45 shows related objects dictionary in profile velocity mode.

Table 5-45 Object Dictionary List of Profile Torque Mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|---|--------|------------|---------------|
| 603Fh | | Error code | ro | unsigned16 | 0 |
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 606Ch | | User actual velocity feedback | ro | integer32 | 0 |
| 6071h | | Target torque | rw | integer16 | 0 |
| 6074h | | Demand torque | ro | integer16 | 0 |
| 6077h | | Actual torque feedback | ro | integer16 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 607Fh | | Max. profile velocity | rw | unsigned32 | 2147483647 |
| 6080h | | Max. motor velocity | rw | unsigned32 | 10000 |
| 6087h | | Torque ramp | rw | unsigned32 | 0 |

5.9.4 Simple Tutorial for Profile Torque Mode

1. Parameter setting in servo drive

Table 5-46 Parameter of Servo Drive for Operating Profile Velocity Mode

| Parameter | Set value | Description |
|-----------|-----------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |

| | | |
|---------|---|--|
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |
|---------|---|--|

- The host controller connects to servo drive and set configuration PDO parameters.
- Run the host controller

Table 5-47 Profile Torque Mode Startup and Operation

| Address | Name | Set value(Decimal value) |
|---------------------------|---|---|
| 60600008h | Control mode | 4 |
| 60800020h | Max. speed limit in profile torque mode | Set by user |
| 60710010h | Demand profile torque | Set by user |
| 60400010h Control word | Enable | Any number → 6 → 7 → 15 |
| | Alarm clear | Any number → 128 (Enabled on rising edge) |
| | Motor operates | Demand reference after enabled |
| 60870020h | Torque ramp | Set by user(Torque reference acceleration in profile torque mode) |
| 607F0020h | Max profile velocity | -2147483648~2147483647 |

5.10 Home Mode, HM

According to home switch signal, limit switch signal and encoder Z signal, CiA402 protocol defines 31 methods of homing. To enabled home mode, set object 6060H to 6. It is available in EtherCAT.

Table 5-48 Connector configuration and Corresponding Function of Input Signal

| Input signal description | Function | Connector |
|-------------------------------|-------------|------------|
| Homing signal | Home switch | SI0(PIN40) |
| Positive position limit input | P-OT | SI1(PIN42) |
| Negative position limit input | N-OT | SI2(PIN43) |

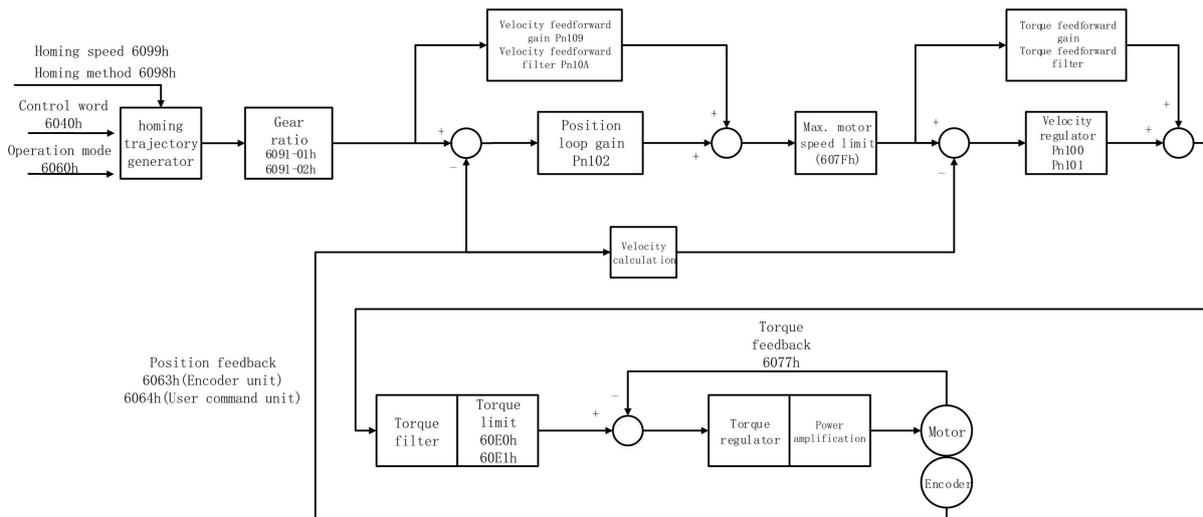


Figure 5-16 Block Diagram for Home Mode

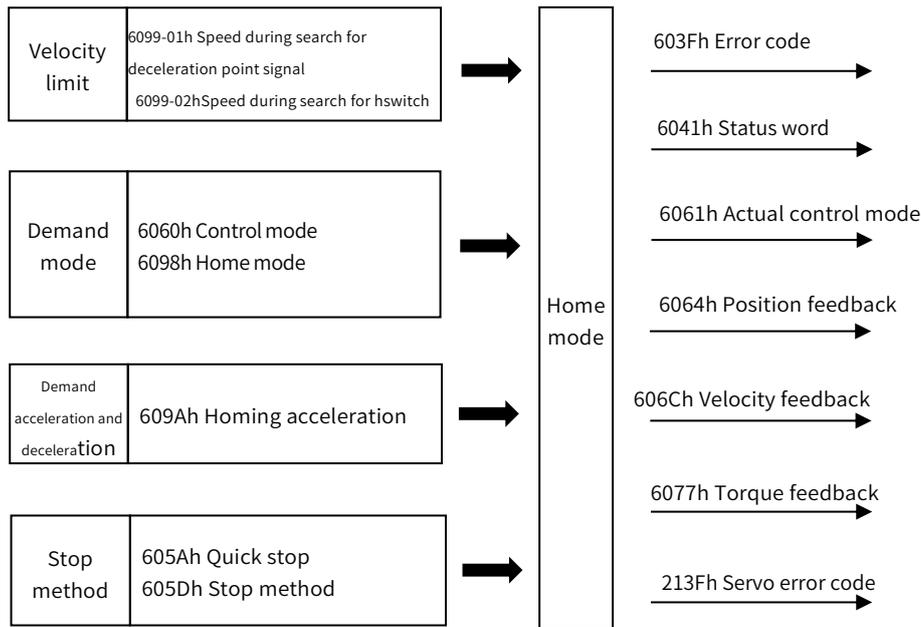


Figure 5-17 Home Mode Input and Output

5.10.1 Control Word in Home Mode (60400010h)

In Home Mode, the meaning of every bit of control word is shown as Table 5-49(6040h). The item in dark background indicates the dedicated control reference in Home mode.

Table 5-49 Description of Control Word in Home Mode

| Bit | Name | Description |
|-------|------------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo, if set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4 | Home enable | 0: Disabled, 1: Enabled. When enabled the homing is started. If switch to disabled then stop the homing process. |
| 5、6 | Reserved for home mode | - |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: disabled, 1: enabled. When enabled the operation is halted. |
| 9 | Reserved for home mode | - |
| 10 | Reserved | - |
| 11~15 | Customized | - |

5.10.2 Status word in Home Mode (60410010h)

In home mode, the meaning of every bit of status word is shown as Table 5-50. The item in dark background indicates the dedicated control reference in profile position mode.

Table 5-50 Description of Status Word in Home Mode

| Bit | Name | Description |
|-----|--------------------|--|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |

| | | |
|----|--------------------------------|--|
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 4 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 5 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 6 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | Target position reached | 60400010h bit 8 (Halt)=0, 0: Position is not reached, 1: Position is reached; 60400010h bit 8 (Halt)=1, 0: Decelerating, 1: Velocity is 0 |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |
| 12 | Homing complete output | 0: Homing is not completed, 1: Homing is completed |
| 13 | Homing error | 0: No error, 1: Homing error |
| 14 | Customized | - |
| 15 | Homing completed | 0: Disabled, 1: Homing has been completed. For absolute system, after setting Pn781.3=1, Bit15 value will be saved after homing is completed(retained when power failure) |

5.10.3 Related Parameter of Home Mode

Table 5-51 shows related objects dictionary in home mode.

Table 5-51 Object Dictionary List of home mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|---|--------|------------|---------------|
| 603Fh | | Error code | ro | unsigned16 | 0 |
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 6062h | | User position reference | ro | integer32 | 0 |
| 6063h | | Motor position feedback | ro | integer32 | 0 |
| 6064h | | User position feedback | ro | integer32 | 0 |
| 6065h | | User position offset threshold | rw | unsigned32 | 0 |
| 6067h | | Position reaching threshold | rw | unsigned32 | 50 |
| 6068h | | Position reaching time | rw | unsigned16 | 0 |
| 606Bh | | User velocity value | ro | integer32 | 0 |
| 606Ch | | Actual velocity feedback | ro | integer32 | 0 |
| 607Ch | | Home offset | rw | integer32 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 6098h | | Home mode | rw | integer8 | 0 |
| 6099h | 01h | Speed during search for deceleration point signal | rw | unsigned32 | 50000 |
| | 02h | Speed during search for switch | rw | unsigned32 | 10000 |

| | | | | | |
|-------|--|---------------------|----|------------|------|
| 609Ah | | Homing acceleration | rw | unsigned32 | 1000 |
|-------|--|---------------------|----|------------|------|

5.10.4 Simple Tutorial for Home Mode

1. Parameter setting in servo drive

Table 5-52 Parameter of Servo Drive for Operating Home Mode

| Parameter | Set value | Description |
|-----------|-----------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |

2. The host controller connects to servo drive and set configuration PDO parameters.
3. Run the host controller

Table 5-53 Home Mode Startup and Operation

| Address | Name | Set value(Decimal value) |
|---------------------------|---|--|
| 60600008h | Control mode | 6 |
| 60980008h | Home mode | 1~35 |
| 60400010h Control mode | Alarm clear | Any number → 128(Enabled on rising edge) |
| | Homing | 6 → 7 → 15 → 31(Always 31 when homing) |
| 60990120h | Speed during search for deceleration point signal | 0~3000rpm |
| 60990220h | Speed during search for switch | 0~3000rpm |
| 609A0020h | Homing acceleration | 0~1000rpm |

5.10.5 Home Mode Introduction

CiA402 internally defines 31 kinds of methods for homing (applicable for EtherCAT), which is shown as Table 5-54

In the following description, HSW represents the signal of the origin position sensor, NL represents the negative limit signal, and PL represents the positive limit signal. ON indicates the enabled status of the signal, and OFF indicates the disabled status of the signal. OFF→ON means the transition edge of the signal from enabled status to disabled status, ON→OFF means the transition edge of the signal from enabled status to disabled status. The following introduces the running tracks and signal status changes of various home modes respectively. The meanings of the icons in the diagrams of various homing modes are shown in Figure 5-18:

Table 5-54 Home Mode Startup and Operation

| Homing method | Description |
|---------------|---|
| 0 | No homing |
| 1 | Homing starts in negative direction. Change to low speed when encounter OFF→ON status of NL and then go back to find nearest Z pulse position as the origin. |
| 2 | Homing starts in positive direction. Change to low speed when encounter OFF→ON status of PL and then go back to find nearest Z pulse position as the origin. |
| 3 | If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter ON→OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin. |
| 4 | If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter OFF→ON status of HSW when running in positive direction and then keep running in positive direction to |

| | |
|----|---|
| | <u>find nearest Z pulse position as the origin.</u> |
| 5 | If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter ON→OFF status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin. |
| 6 | If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter ON→OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin. |
| 7 | If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter ON→OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin. |
| 8 | If HSW is inactive then homing starts in positive direction, otherwise in negative direction Change to low speed when encounter OFF→ON status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin. |
| 9 | Homing always starts in positive direction no matter HSW is inactive or active. Change to low speed when encounter OFF→ON status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin. |
| 10 | Homing always starts in positive direction no matter HSW is inactive or active. Change to low speed when encounter ON→OFF status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin. |
| 11 | If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter ON→OFF status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin. |
| 12 | If HSW is inactive then homing starts in negative direction, otherwise in positive direction Change to low speed when encounter OFF→ON status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin. |
| 13 | Homing always starts in negative direction no matter HSW is inactive or active. Change to low speed when encounter OFF→ON status of HSW when running in positive direction and then keep running in positive direction to find nearest Z pulse position as the origin. |
| 14 | Homing always starts in negative direction no matter HSW is inactive or active. Change to low speed when encounter ON→OFF status of HSW when running in negative direction and then keep running in negative direction to find nearest Z pulse position as the origin. |
| 15 | Reserved |
| 16 | Reserved |
| 17 | Similar to Method 1, but not to find Z pulse position but the position when encountering OFF→ON status of NL as origin in negative direction. |
| 18 | Similar to Method 2, but not to find Z pulse position but the position when encountering OFF→ON status of PL as origin in positive direction. |
| 19 | Similar to Method 3, but not to find Z pulse position but the position when encountering ON→OFF status of HSW as origin in negative direction. |
| 20 | Similar to Method 4, but not to find Z pulse position but the position when encountering OFF→ON status of HSW as origin in positive direction. |
| 21 | Similar to Method 5, but not to find Z pulse position but the position when encountering ON→OFF status of HSW as origin in positive direction. |
| 22 | Similar to Method 6, but not to find Z pulse position but the position when encountering OFF→ON status of HSW as origin in negative direction. |
| 23 | Similar to Method 7, but not to find Z pulse position but the position when encountering ON→OFF status of HSW as origin in negative direction. |
| 24 | Similar to Method 8, but not to find Z pulse position but the position when encountering OFF→ON status of HSW as origin in positive direction. |
| 25 | Similar to Method 9, but not to find Z pulse position but the position when encountering OFF→ON status of HSW as origin in negative direction. |
| 26 | Similar to Method 10, but not to find Z pulse position but the position when encountering ON→OFF status of HSW as origin in positive direction. |
| 27 | Similar to Method 11, but not to find Z pulse position but the position when encountering ON→OFF status of HSW as origin in positive direction. |

| | |
|----|---|
| 28 | Similar to Method 12, but not to find Z pulse position but the position when encountering OFF→ON status of HSW as origin in negative direction. |
| 29 | Similar to Method 13, but not to find Z pulse position but the position when encountering OFF→ON status of HSW as origin in positive direction. |
| 30 | Similar to Method 14, but not to find Z pulse position but the position when encountering ON→OFF status of HSW as origin in negative direction. |
| 31 | Reserved |
| 32 | Reserved |
| 33 | After starting, find the nearest Z pulse position in negative direction |
| 34 | After starting, find the nearest Z pulse position in positive direction |
| 35 | Take current position as origin |

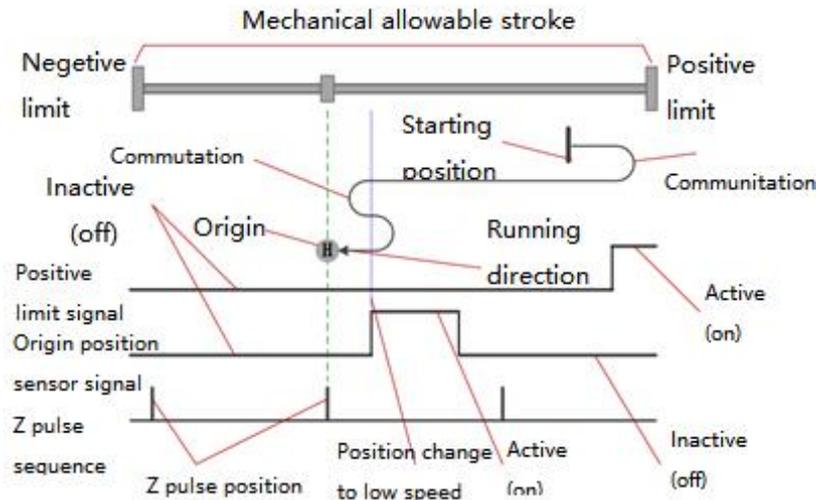


Figure 5-18 Meaning of Icons in Home Mode

In general, it is recommended to apply home mode 3~6, 19~22 to the situation where OFF/ON status of HSW just divided the entire mechanical allowable travel range into two parts. Because in these 8 modes, whenever NL or PL is encountered, operation will stop and alarm and not automatically search for the origin in reverse

It is recommended to apply home mode 7~14, 23~30 to the whole mechanical allowable travel range which is exactly just the range of HSW ON status.

In the case where the travel range is divided into three parts, the range of ON status only occupies only a small part of the whole allowable travel range (ON status is transient)

The above is just suggestion and not mandatory.

1) Mode 1, find negative limit switch and Z pulse, deceleration point: reverse overtravel switch

Starts in negative direction at high speed if deceleration point signal is inactive. Decelerate to stop after encountering OFF→ON status of negative limit switch and running in positive direction at a low speed. After encountering ON→OFF status of negative limit switch, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if deceleration point signal is active. After encountering ON→OFF status of negative limit switch, keep running in positive direction to find the nearest Z pulse position as the origin

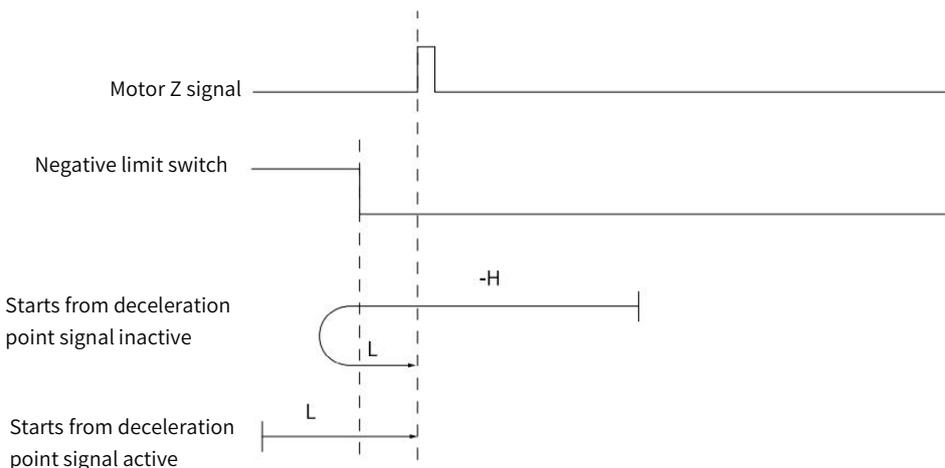


Figure 5-19 Home Mode 1 Trajectory and Signal Status

2) Mode 2, find positive limit switch and Z pulse, deceleration point: positive overtravel switch

Starts in positive direction at high speed if deceleration point signal is inactive. Decelerate to stop after encountering OFF→ON status of positive limit switch and running in negative direction at a low speed. After encountering ON→OFF status of positive limit switch, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if deceleration point signal is active. After encountering ON→OFF status of positive limit switch, keep running in negative direction to find the nearest Z pulse position as the origin

As figure 5-20 shows

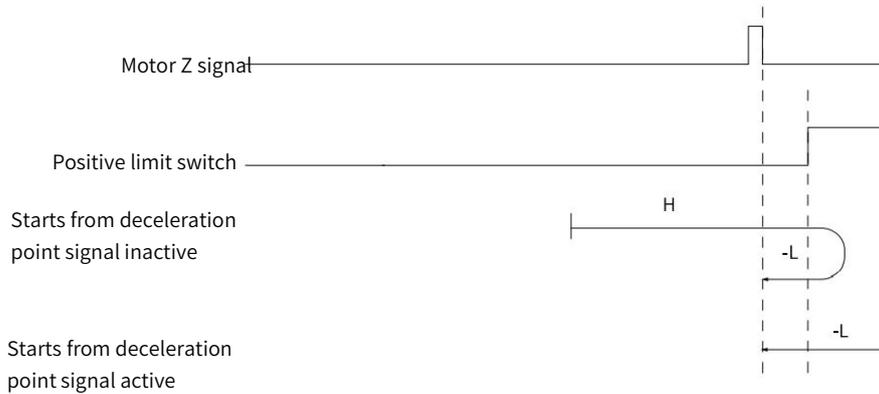


Figure 5-20 Home Mode 2 Trajectory and Signal Status

3) Mode 3, find HW ON→OFF position when running in negative direction and Z pulse, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, keep running in negative direction to find the nearest Z signal position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON→OFF status of positive limit switch, keep running in negative direction to find the nearest Z pulse position as the origin

As Figure 5-21 shows

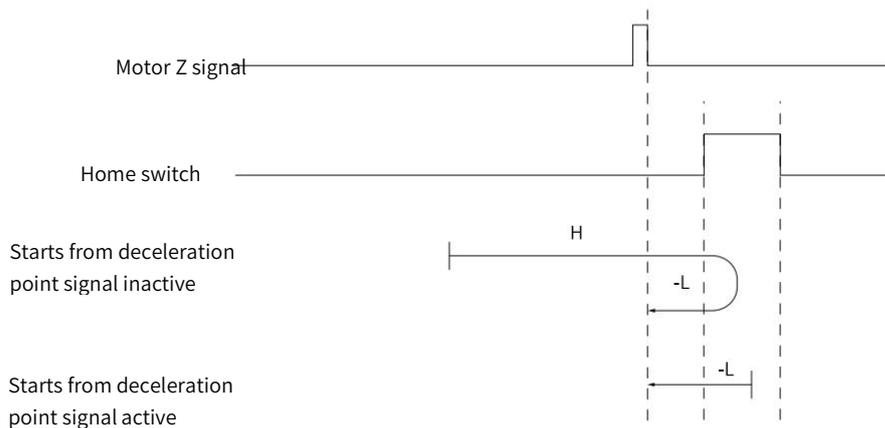


Figure 5-21 Home Mode 3 Trajectory and Signal Status

4) Mode 4, find HW OFF→ON position when running in positive direction and Z pulse, deceleration point: Home switch

Starts in positive direction at a low speed if HW is inactive. After encountering OFF→ON status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is active. Decelerate to stop after encountering ON→OFF status of HW and running in positive direction at a low speed. After encountering OFF→ON status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As Figure 5-22 shows

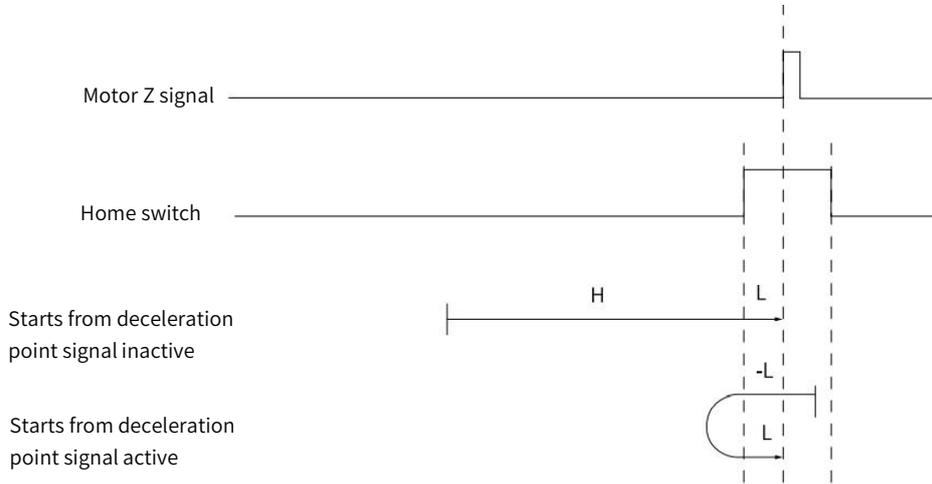


Figure 5-22 Home Mode 4 Trajectory and Signal Status

5) Mode 5, find HW ON→OFF position when running in positive direction and Z pulse, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin

Starts in positive direction at a low speed if HW is active. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

As figure 5-23 shows

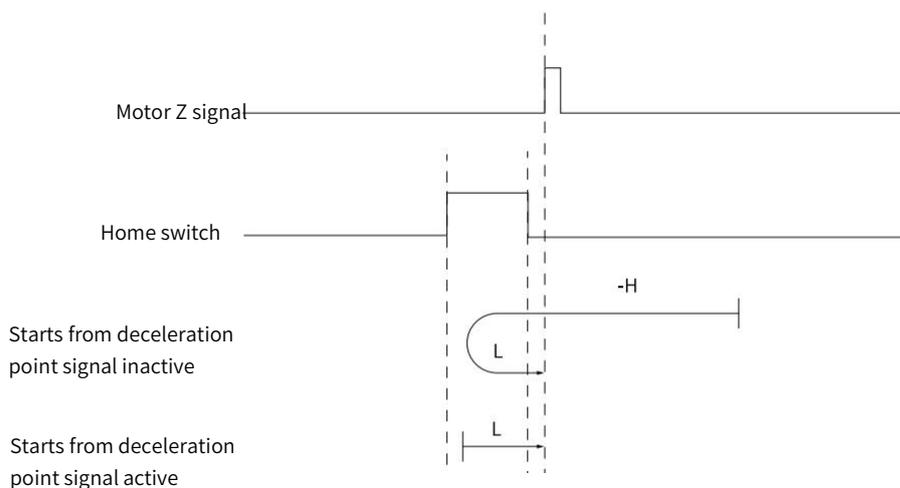


Figure 5-23 Home Mode 5 Trajectory and Signal Status

6) Mode 6, find HW OFF→ON position when running in negative direction and Z pulse, deceleration point: Home switch

Starts in negative direction at a low speed if HW is inactive. After encountering OFF→ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is active. Decelerate to stop after encountering ON→OFF status of HW and running in negative direction at a low speed. After encountering OFF→ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

As figure 5-24 shows.

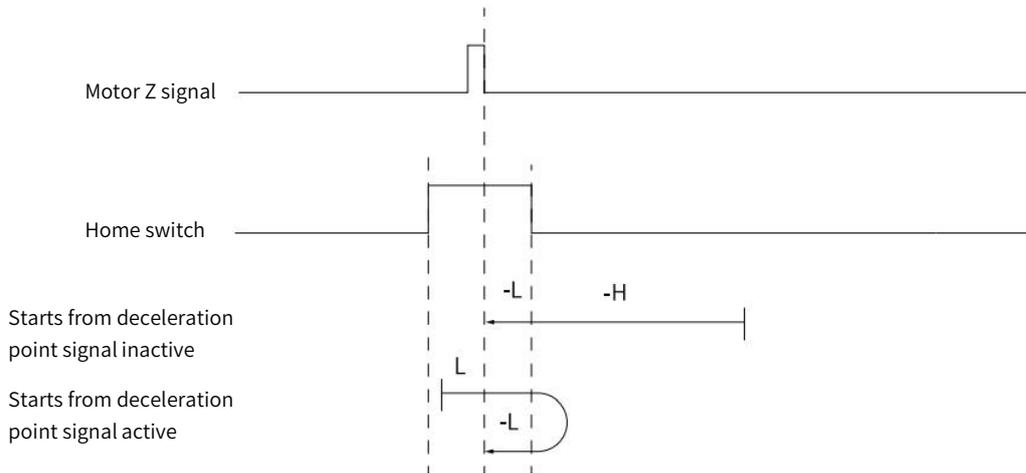


Figure 5-24 Home Mode 6 Trajectory and Signal Status

7) Mode 7, find HW ON→OFF position when running in negative direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON→OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

The figure 5-25 shows.

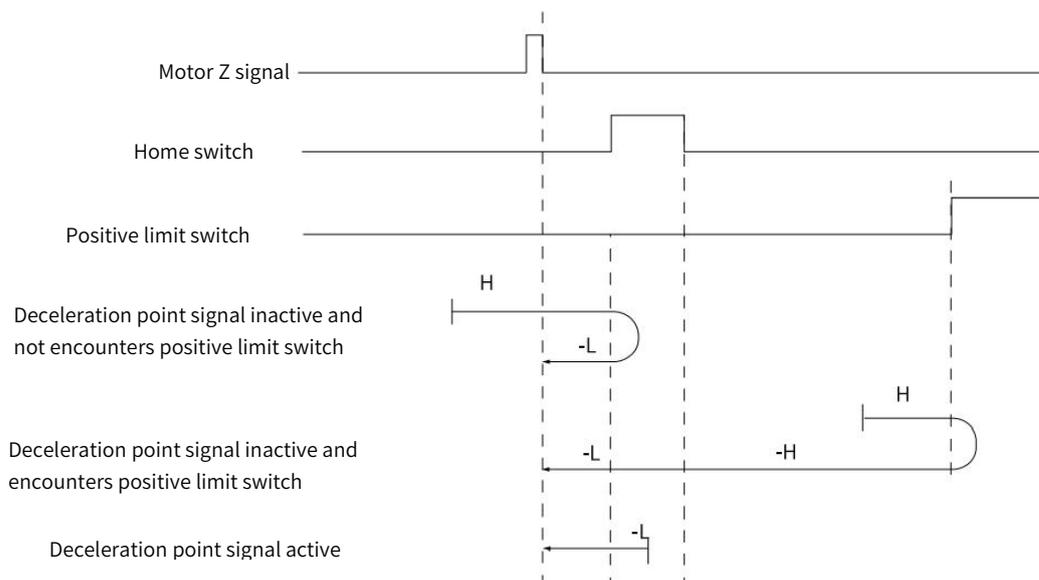


Figure 5-25 Home Mode 7 Trajectory and Signal Status

8) Mode 8, find HW OFF→ON position when running in positive direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, decelerates to stop and running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, decelerates to stop and running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON→OFF status of HW, decelerate to stop and running in positive direction. After encounter OFF→ON status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

The figure 5-26 shows.

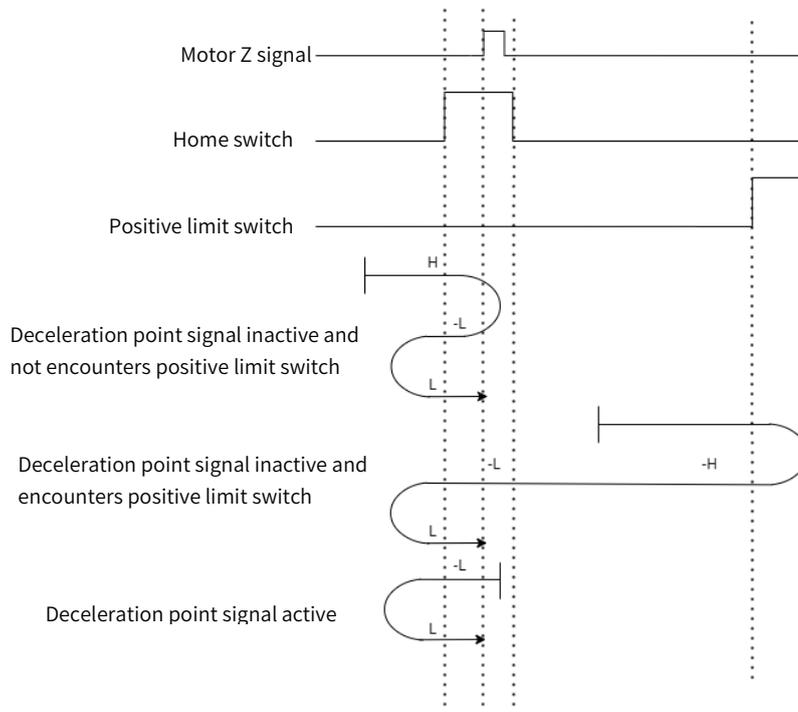


Figure 5-26 Home Mode 8 Trajectory and Signal Status

9) Mode 9, find HW OFF→ON position when running in negative direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, decelerates to stop and running in negative direction. After encountering OFF→ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, decelerates to stop and running in negative direction at a low speed. After encountering OFF→ON of HW, running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON→OFF status of HW, decelerate to stop and running in negative direction. After encounter OFF→ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

The figure 5-27 shows.

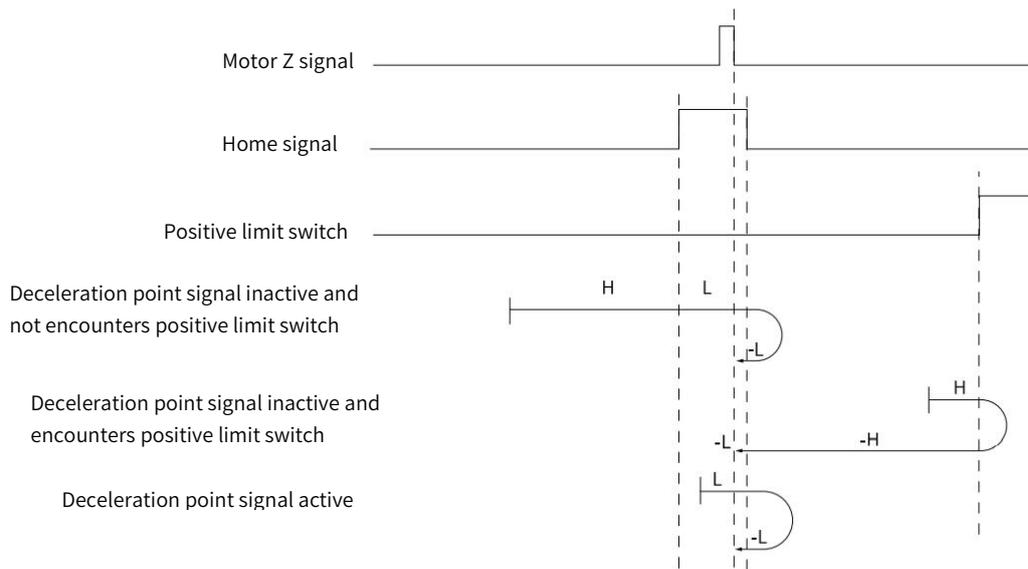


Figure 5-27 Home Mode 9 Trajectory and Signal Status

10) Mode 10, find HW ON→OFF position when running in positive direction and Z pulse, when encountering positive limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

The figure 5-28 shows.

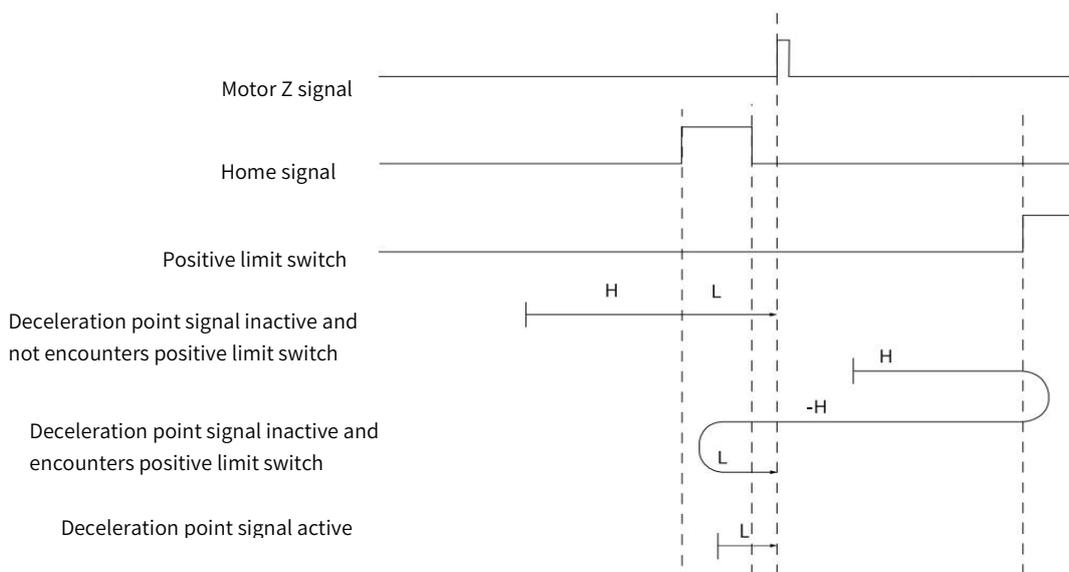


Figure 5-28 Home Mode 10 Trajectory and Signal Status

11) Mode 11, find HW ON→OFF position when running in positive direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON→OFF status of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

The figure 5-29 shows.

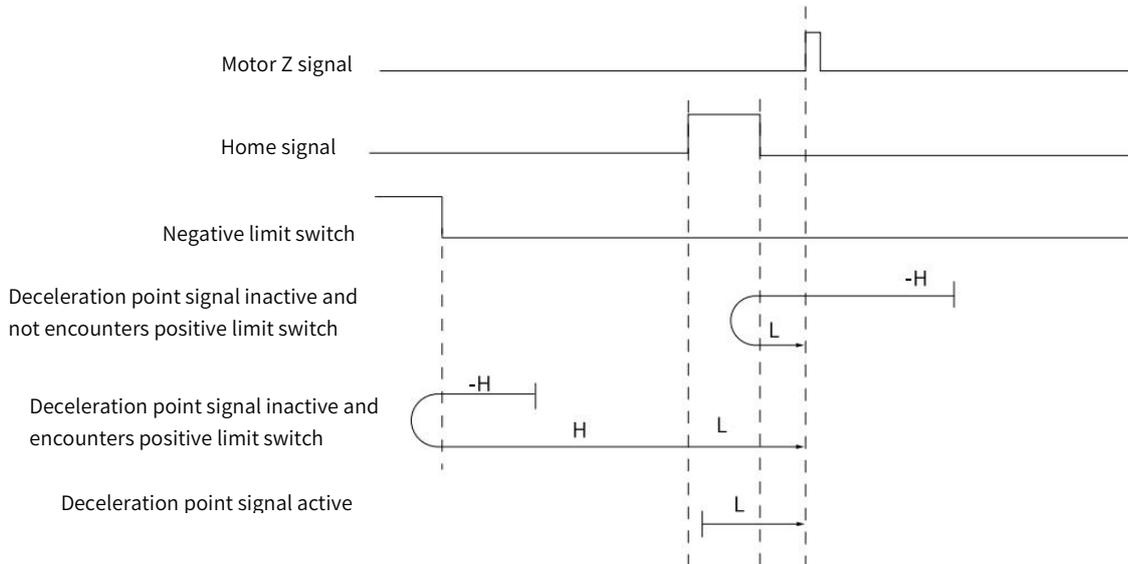


Figure 5-29 Home Mode 11 Trajectory and Signal Status

12) Mode 12, find HW OFF→ON position when running in negative direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, decelerate to stop and running in negative direction. After encountering OFF→ON of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at a low speed. After encountering ON→OFF status of HW, decelerate to stop and running in negative direction at a low speed. After encountering OFF→ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in positive direction at a low speed if HW is active. After encountering ON→OFF status of HW and running in negative direction at a low speed. After encountering OFF→ON of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

The figure 5-30 shows.

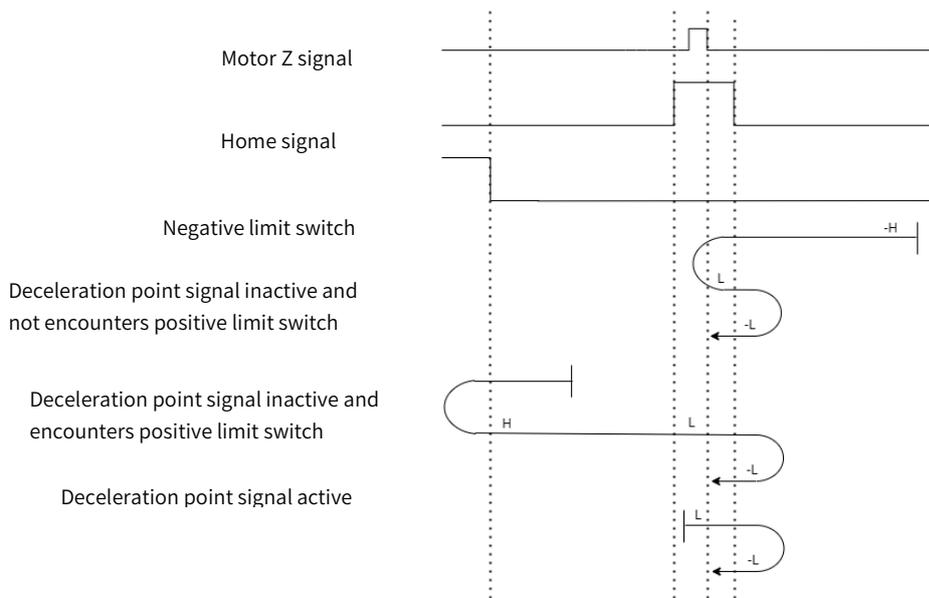


Figure 5-30 Home Mode 12 Trajectory and Signal Status

13) Mode 13, find HW OFF→ON position when running in positive direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, decelerate to stop and running in positive direction. After encountering OFF→ON of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, decelerate and running in negative direction at a low speed. After encountering OFF→ON status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON→OFF status of HW and running in positive direction at a low speed. After encountering OFF→ON of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

The figure 5-31 shows.

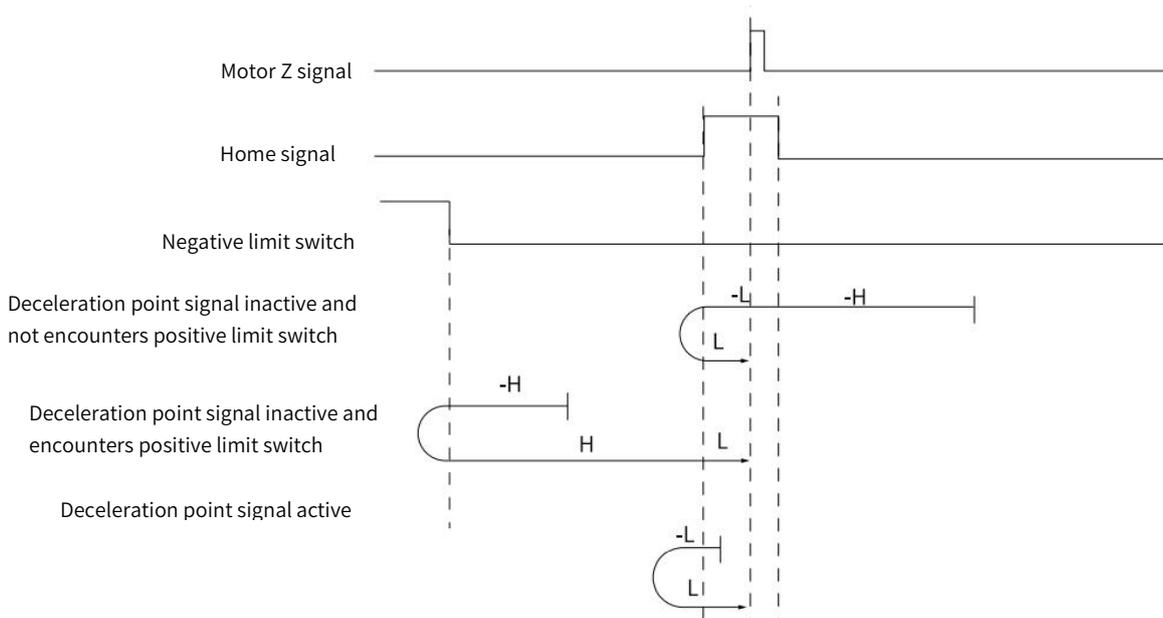


Figure 5-31 Home Mode 13 Trajectory and Signal Status

14) Mode 14, find HW ON→OFF position when running in negative direction and Z pulse, when encountering negative limit switch, running in reverse direction automatically, deceleration point: Home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, decelerate to stop and running in positive direction. After encountering OFF→ON of HW, keep running in positive direction to find the nearest Z pulse position as the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, keep running in negative direction to find the nearest Z pulse position as the origin.

Starts in negative direction at a low speed if HW is active. After encountering ON→OFF status of HW, keep running in negative direction at a low speed.

The figure 5-32 shows.

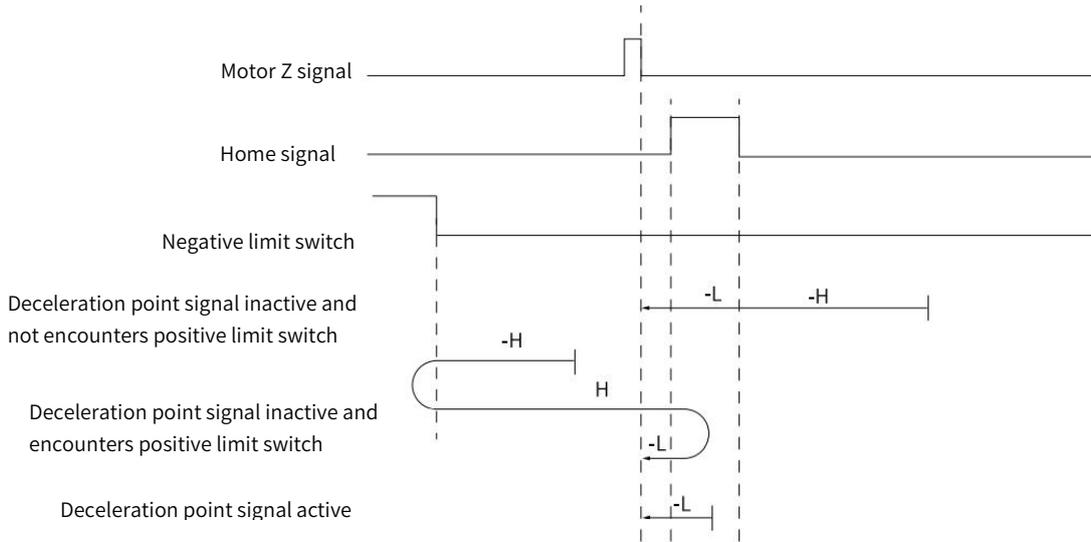


Figure 5-32 Home Mode 14 Trajectory and Signal Status

15) Mode 15, reserved, please do not set.

16) Mode 16, reserved, please do not set.

17) Mode 17, find negative limit switch, deceleration point: reverse overtravel switch

Starts in negative direction at high speed if negative limit switch is inactive. Decelerate to stop after encountering OFF→ON status of negative limit switch and running in positive direction at a low speed. After encountering ON→OFF status of negative limit switch, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if negative limit switch is active. Decelerate to stop after encountering ON→OFF status of negative limit switch and the stop position is the origin.

The figure 5-33 shows and please refer to table 5-52

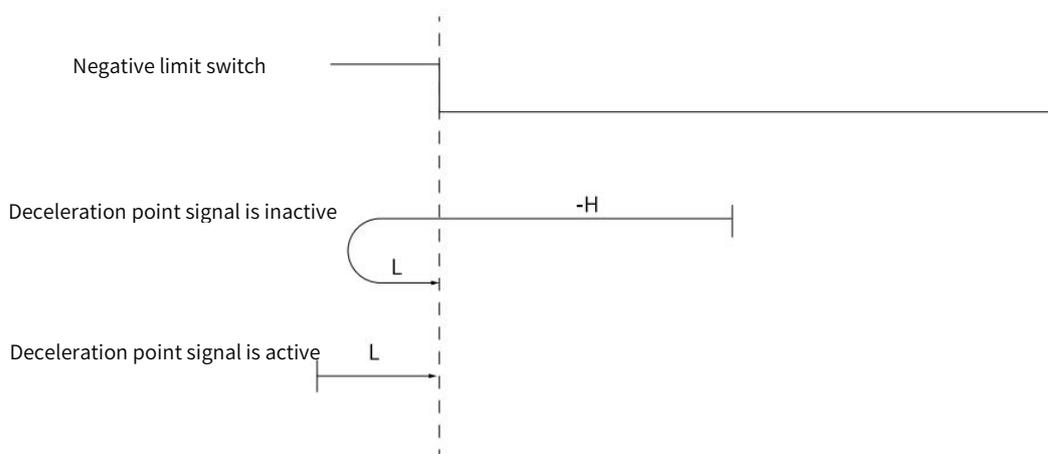


Figure 5-33 Origin Mode 17 Trajectory and Signal Status

18) Mode 18, find positive limit switch, deceleration point: Overtravel switch

Starts in positive direction at high speed if positive limit switch is inactive. Decelerate to stop after encountering OFF→ON status of positive limit switch and running in negative direction at a low speed. After encountering ON→OFF status of negative limit switch, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if positive limit switch is active. Decelerate to stop after encountering ON→OFF status of positive limit switch and the stop position is the origin.

The figure 5-34 shows.

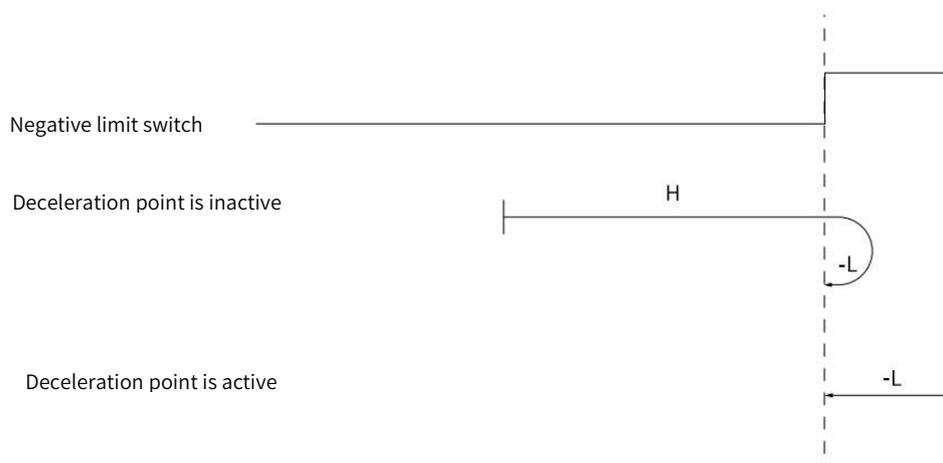


Figure 5-34 Home Mode 18 Trajectory and Signal Status

19) Mode 19, find home switch ON→OFF position when running in negative direction, deceleration point: home switch

Starts in positive direction at high speed if HW is inactive. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at a low speed. After encountering ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is active. Decelerate to stop after encountering ON→OFF status of HW and the stop position is the origin.

The figure 5-35 shows.

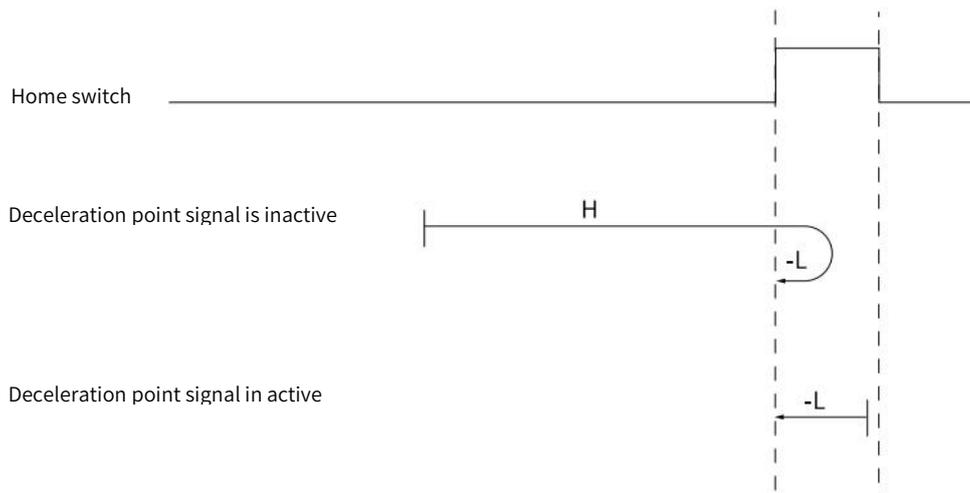


Figure 5-35 Home Mode 19 Trajectory Signal and Status

20) Mode 20, find home switch OFF→ON position when running in positive direction, deceleration point: home switch

Starts in positive direction at low speed if HW is inactive. Decelerate to stop after encountering OFF→ON status of HW and the stop position is the origin.

Starts in negative direction at high speed if HW is active. Decelerate to stop after encountering ON→OFF status of HW and running at a low speed in positive direction. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin.

The figure 5-36 shows.

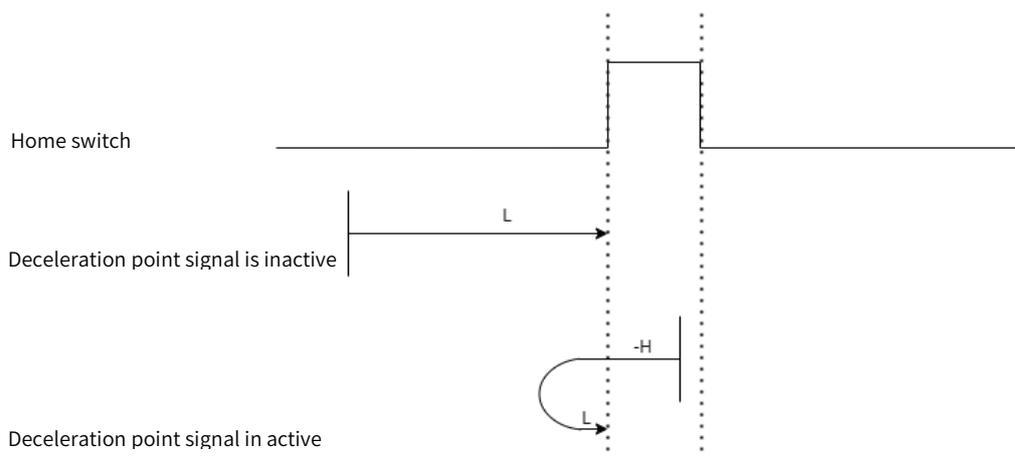


Figure 5-36 Home Mode 20 Trajectory Signal and Status

21) Mode 21, find home switch ON→OFF position when running in positive direction, deceleration point: home switch

Starts in negative direction at high speed if HW is inactive. Decelerate to stop after encountering OFF→ON status of HW and running at low speed in positive direction. After encountering ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop after encountering ON→OFF status of HW and the stop position is the origin.

The figure 5-37 shows.

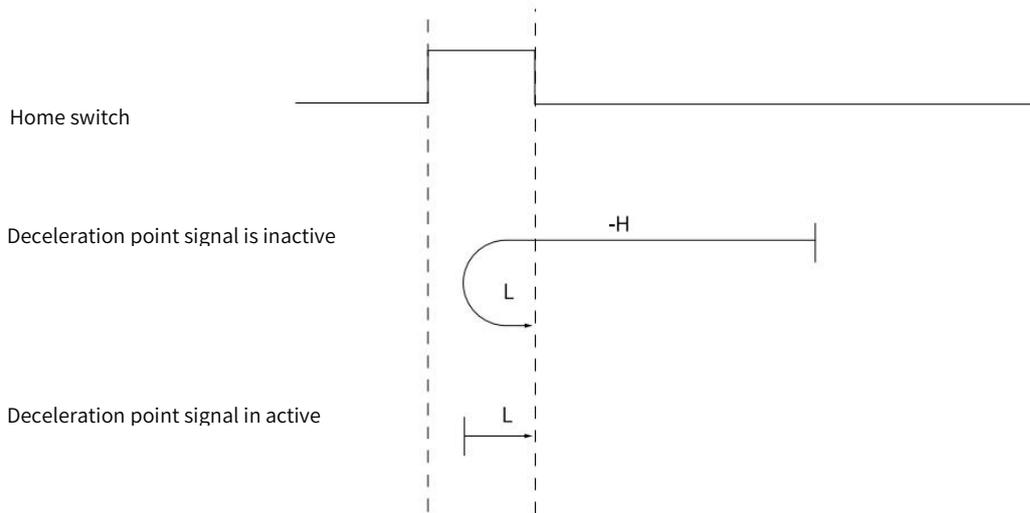


Figure 5-37 Home Mode 21 Trajectory Signal and Status

22) Mode 22, find home switch OFF→ON position when running in negative direction, deceleration point: home switch

Starts in negative direction at low speed if HW is inactive. Decelerate to stop after encountering OFF→ON status of HW and the stop position is the origin.

Starts in positive direction at high speed if HW is active. Decelerate to stop after encountering ON→OFF status of HW and running in negative direction at low speed. After encountering the OFF→ON status of HW, decelerate to stop the stop position is the origin.

The figure 5-38 shows.

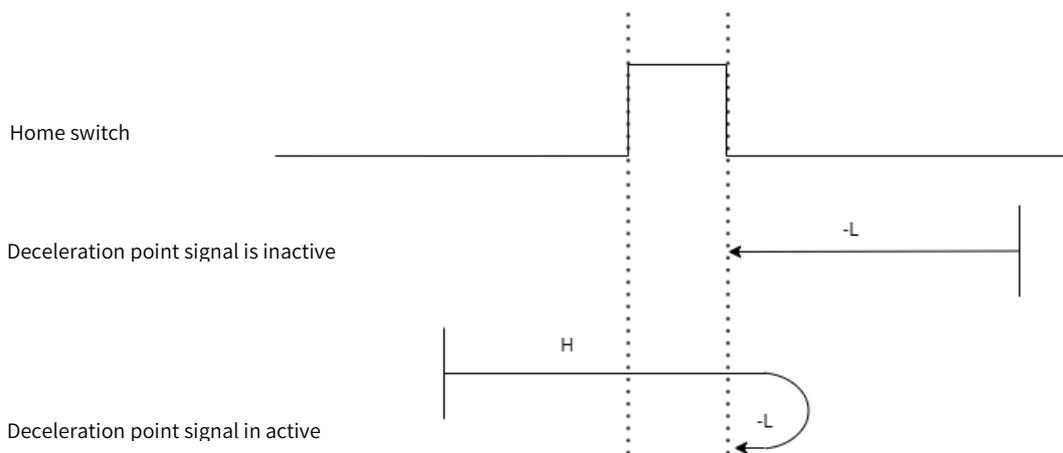


Figure 5-38 Home Mode 22 Trajectory Signal and Status

23) Mode 23, find home switch OFF→ON position when running in negative direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering

ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction if HW is active. Decelerate to stop after encountering ON→OFF status of HW and the stop position is the origin

The figure 5-39 shows.

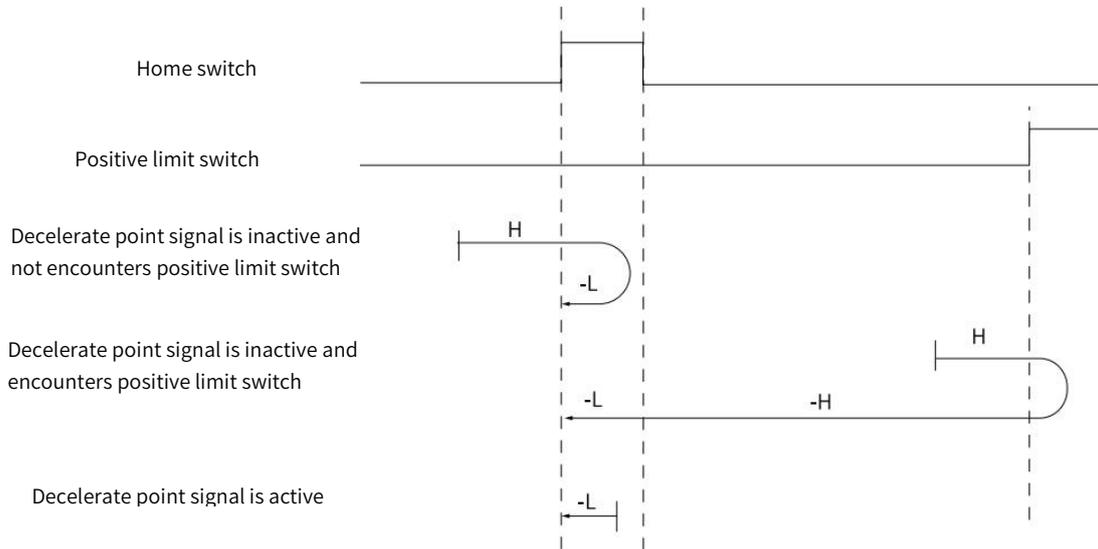


Figure 5-39 Home Mode 23 Trajectory and Signal Status

24) Mode 24, find home switch OFF→ON position when running in positive direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering ON→OFF status of HW, decelerate to stop and running in positive direction at low speed. After encountering the OFF→ON status, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and running in positive direction at low speed. After encountering the OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if HW is active. Decelerate to stop and running in positive direction after encountering ON→OFF status of HW. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin

The figure 5-40 shows.

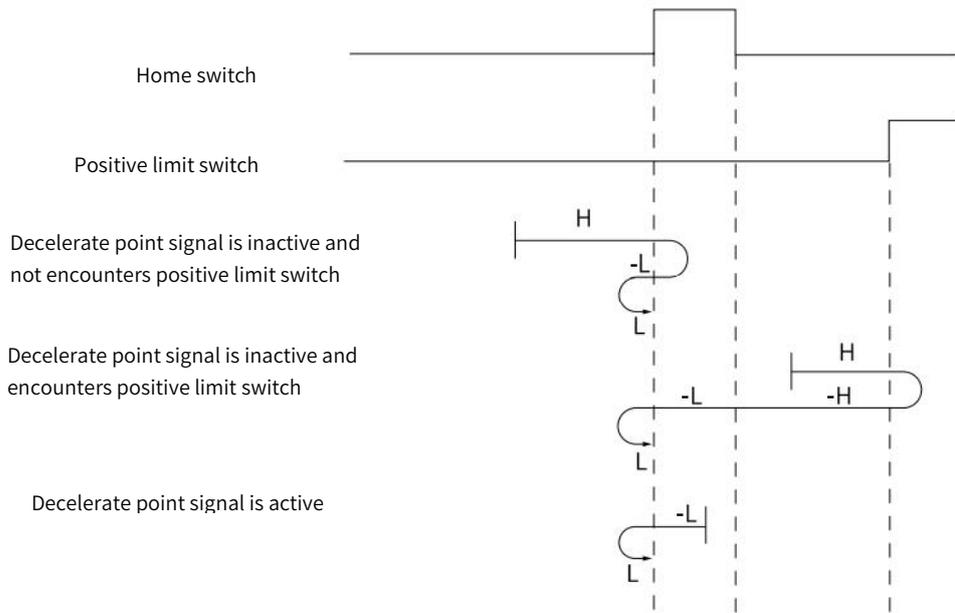


Figure 5-40 Home Mode 24 Trajectory and Signal Status

25) Mode 25, find home switch OFF→ON position when running in negative direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering ON→OFF status of HW, decelerate to stop and running in negative direction at low speed. After encountering the OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and running in negative direction at low speed. After encountering the OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and running in positive direction after encountering ON→OFF status of HW. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin

The figure 5-41 shows.

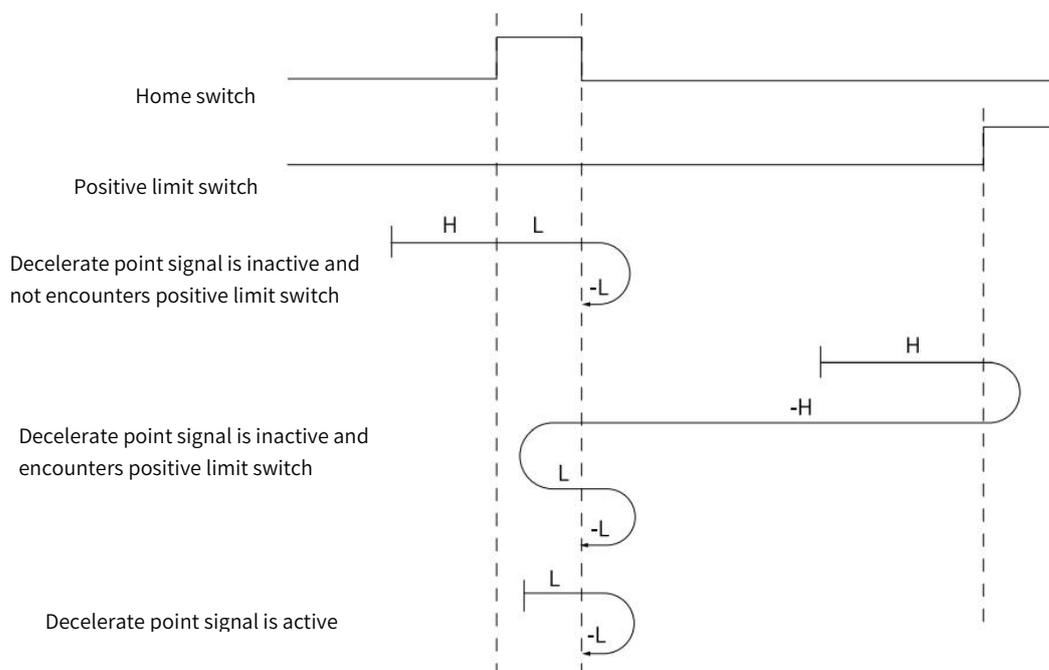


Figure 5-41 Home Mode 25 Trajectory and Signal Status

26) Mode 26, find home switch ON→OFF position when running in positive direction, when encounters positive limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in positive direction at high speed if HW is inactive and not encounters positive limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at high speed if HW is inactive and encounters positive limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and the stop position is the origin after encountering ON→OFF status of HW.

The figure 5-42 shows.

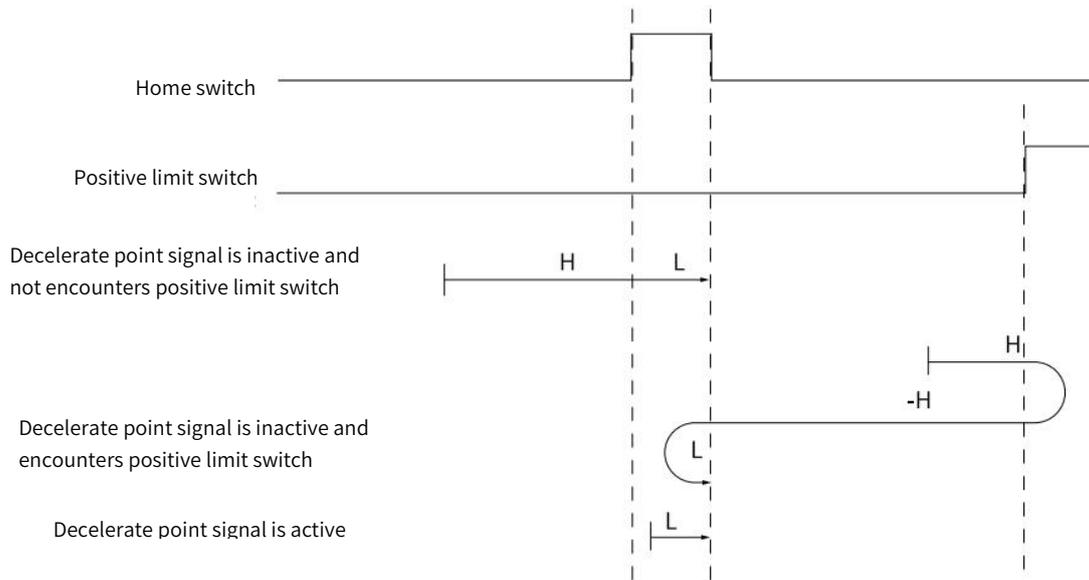


Figure 5-42 Home Mode 26 Trajectory and Signal Status

27) Mode 27, find home switch ON→OFF position when running in positive direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and the stop position is the origin after encountering ON→OFF status of HW.

The figure 5-43 shows.

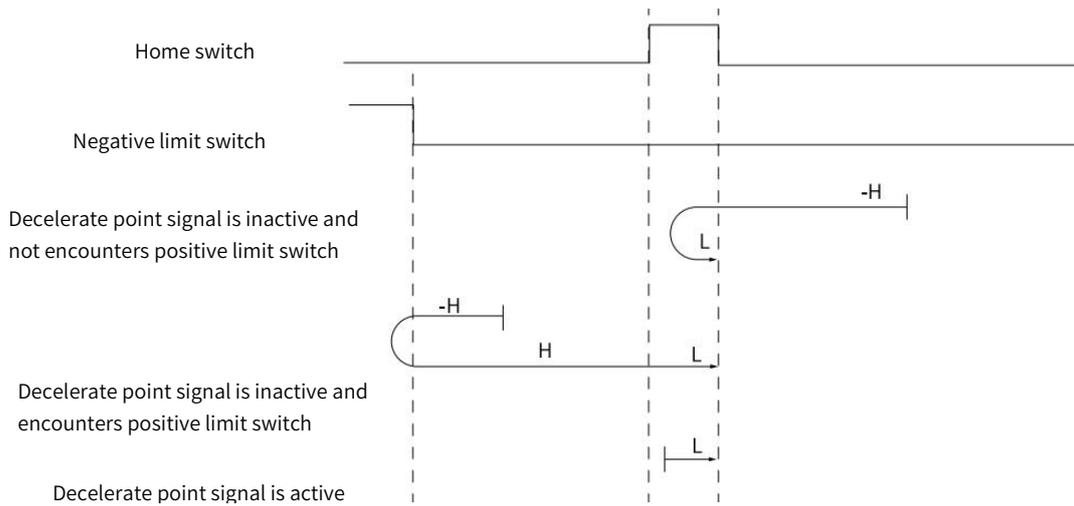


Figure 5-43 Home Mode 27 Trajectory and Signal Status

28) Mode 28, find home switch OFF→ON position when running in negative direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering ON→OFF status of HW, decelerate to stop and running in negative direction at low speed. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in positive direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and running in the negative direction at low speed. After encountering the OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at low speed if HW is active. Decelerate to stop and running in the negative direction at low speed after encountering the ON→OFF status of HW. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin.

The figure 5-44 shows.

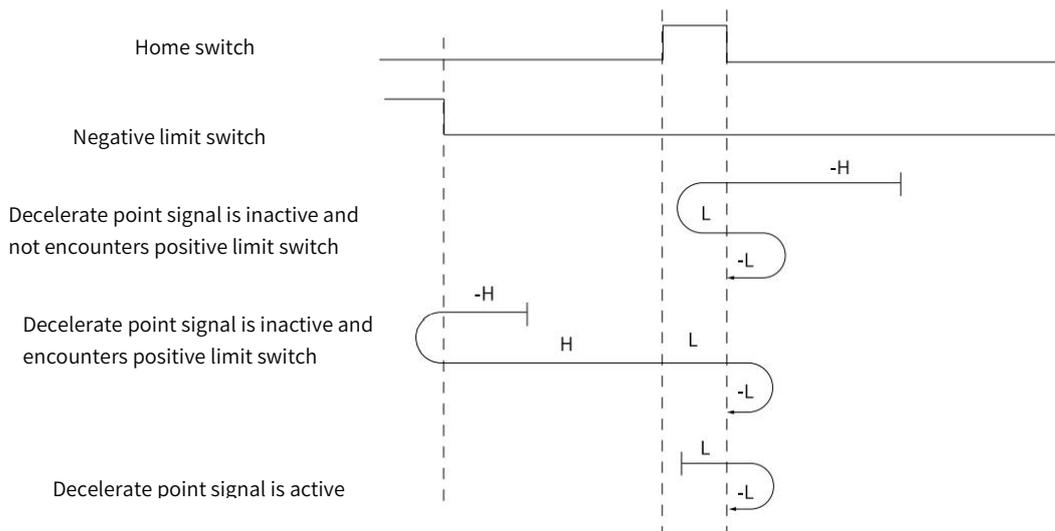


Figure 5-44 Home Mode 28 Trajectory 28 and Signal Status

29) Mode 29, find home switch OFF→ON position when running in positive direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering ON→OFF

status of HW, decelerate to stop and running in positive direction at low speed. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and running in the positive direction at low speed. After encountering the OFF→ON status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if HW is active. Decelerate to stop and running in the positive direction at low speed after encountering the ON→OFF status of HW. After encountering OFF→ON status of HW, decelerate to stop and the stop position is the origin.

The figure 5-45 shows

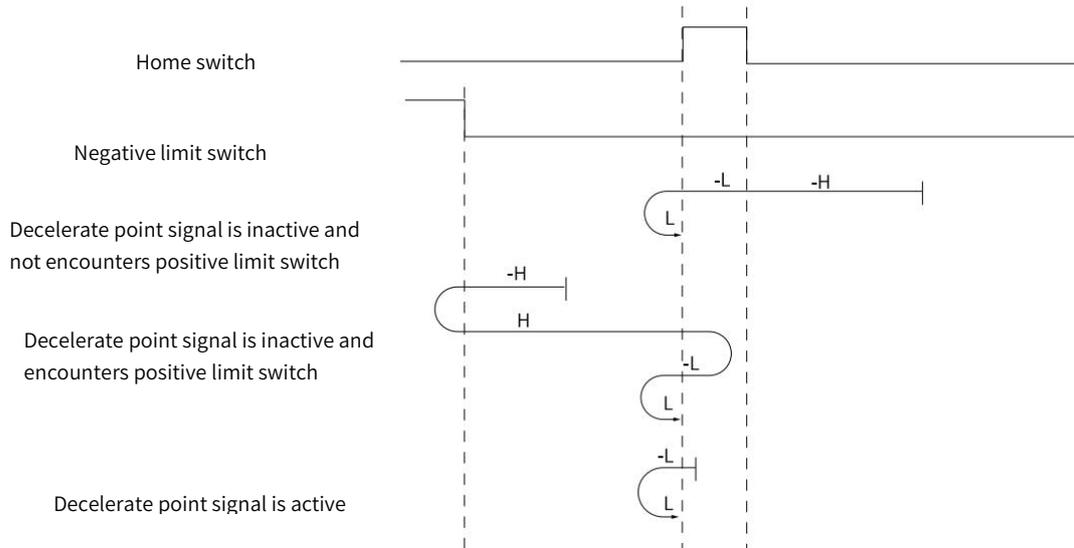


Figure 5-45 Home Mode 29 Trajectory and Signal Status

30) Mode 30, find home switch OFF→ON position when running in negative direction, when encounters negative limit switch, running in reverse direction automatically. deceleration point: home switch

Starts in negative direction at high speed if HW is inactive and not encounters negative limit switch. Decelerate after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in positive direction at high speed if HW is inactive and encounters negative limit switch. Decelerate to stop after encountering OFF→ON status of HW and running in negative direction at low speed. After encountering the ON→OFF status of HW, decelerate to stop and the stop position is the origin.

Starts in negative direction at low speed if HW is active. Decelerate to stop after encountering the ON→OFF status of HW and the stop position is the origin.

The figure 5-46 shows

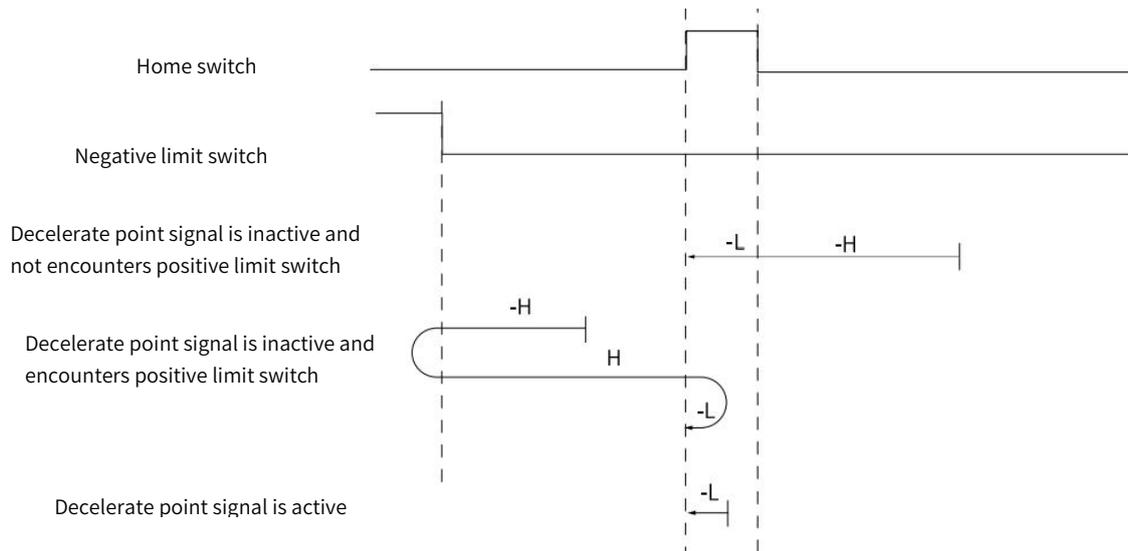


Figure 5-46 Home Mode 30 Trajectory and Signal Status

31) Mode 31, reserved, please do not set.

32) Mode 32, reserved, please do not set.

33) Mode 33, find the nearest Z pulse when running in negative direction.

Starts in negative direction at low speed and find the nearest Z pulse as origin.

The figure 5-47 shows

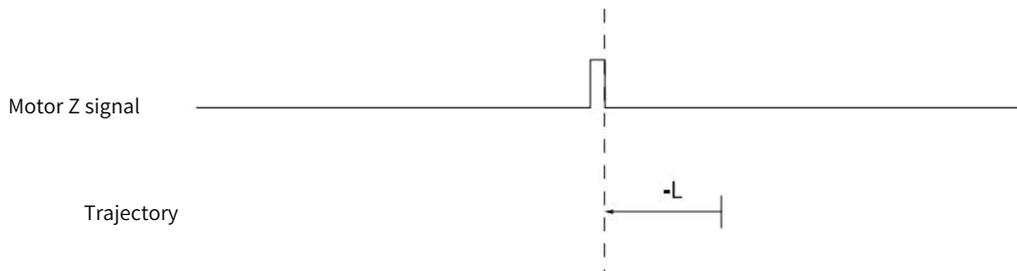


Figure 5-47 Home Mode 33 Trajectory and Signal Status

34) Mode 34, find the nearest Z pulse when running in positive direction

Starts in positive direction at low speed and find the nearest Z pulse as the origin.

The figure 5-48 shows

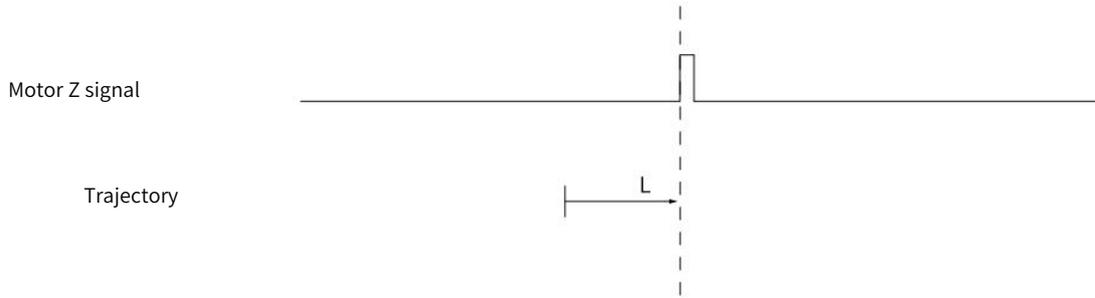


Figure 5-48 Home Mode 34 Trajectory and Signal Status

35) Mode 35, take current position as origin

After triggering homing to zero, take current position as origin.

The figure 5-49 shows.

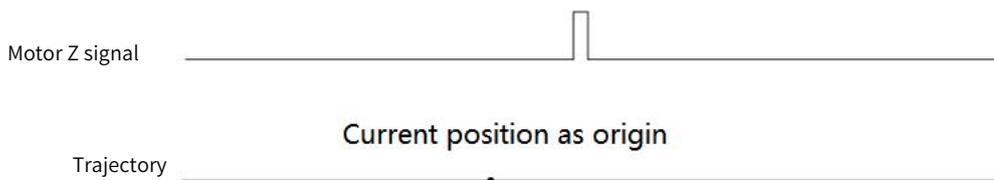


Figure 5-49 Home Mode 35 Trajectory and Signal Status

5.11 Cyclic Synchronous Position Mode, CSP

In Cyclic synchronous position mode, host controller is to plan the start velocity and the stop velocity, the acceleration(deceleration) to reach the target position and absolute value of target position in each synchronous cycle. Servo drive follows the target position. To enable CSP mode, set object 6060H to 8. It is available in EtherCAT. The blocking diagram is shown as figure 5-50 and 5-51

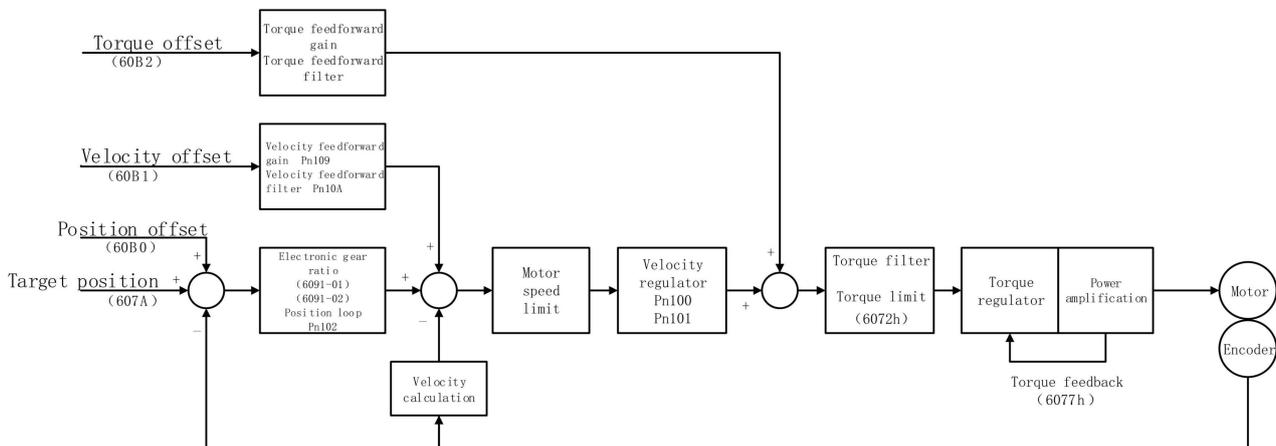


Figure 5-50 Cyclic Synchronous Position Mode Block Diagram

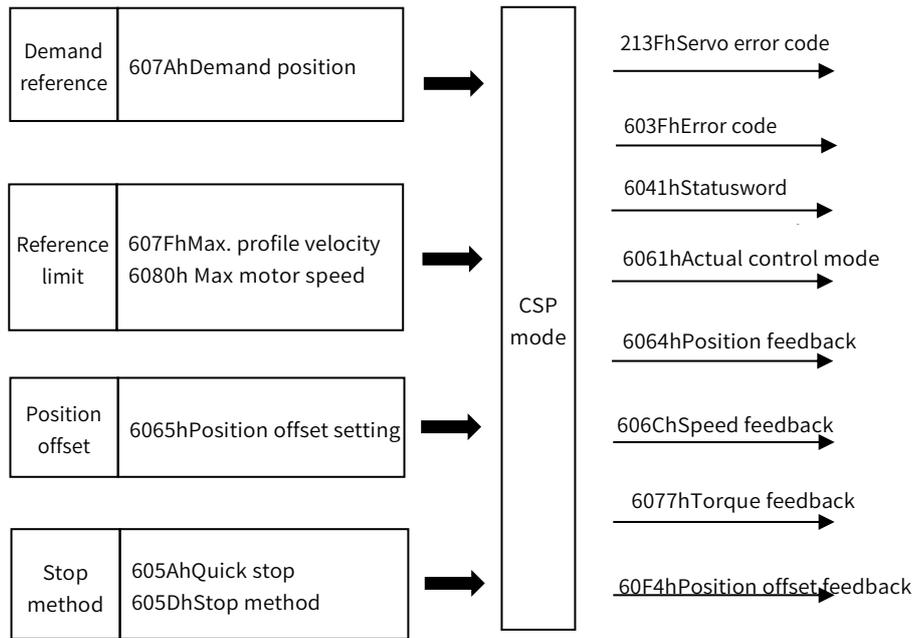


Figure 5-51 Cyclic Synchronous Position Mode Input and Output

5.1.1.1 Control Word in Cyclic Synchronous Position Mode(60400010h)

The meaning of each bit of control word in cyclic synchronous position mode is shown as table 5-55

Table 5-55 Description of Control Word in Cyclic Synchronous Position Mode

| Bit | Name | Description |
|-------|-------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo, if set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4~6 | CSP mode reserved | - |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: disabled, 1: enabled. When enabled the operation is halted. |
| 9 | CSP mode reserved | - |
| 10 | Reserved | |
| 11~15 | Customized | - |

5.1.1.2 Status Word in Cyclic Synchronous Position Mode(60410010h)

The meaning of each bit of status word in cyclic synchronous position mode is shown as table 5-56. The item in dark background indicates the dedicated control reference in cyclic synchronous position mode.

Table 5-56 Description of Status Word in Cyclic Synchronous Position Mode

| Bit | Name | Description |
|-----|--------------------|--|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |

| | | |
|----|-------------------------------------|--|
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Fault | 0: No fault, 1: Fault |
| 4 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 5 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 6 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | Position reached | 60400010h bit 8 (Halt)=0, 0: Position is not reached, 1: Position is reached; 60400010h bit 8 (Halt)=1, 0: Decelerating, 1: Velocity is 0 |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |
| 12 | Whether to follow target position | 0: Target position is not followed, 1: Target position is followed |
| 13 | Alarm for position following offset | 0: No position offset alarm, 1: Position offset alarm |
| 14 | Customized | - |
| 15 | Origin completed | 0: Disabled, 1: Homing has been completed. For absolute system, after setting Pn781.3=1, Bit15 value will be saved after homing is completed(retained when power failure) |

5.11.3 Related Dictionary Objects in Cyclic Synchronous Position Mode

Table 5-57 Related Dictionary Objects in Cyclic Synchronous Position Mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|---|--------|------------|---------------|
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 6062h | | User position reference | ro | integer32 | 0 |
| 6063h | | Motor position feedback | ro | integer32 | 0 |
| 6064h | | User position feedback | ro | integer32 | 0 |
| 6065h | | User position offset | rw | unsigned32 | 0 |
| 6067h | | Position reaching threshold | rw | unsigned32 | 0 |
| 6068h | | Position reaching time | rw | unsigned16 | 0 |
| 606Bh | | User velocity reference | ro | integer32 | 0 |
| 606Ch | | User velocity feedback | ro | integer32 | 0 |
| 607A | | Target position | rw | integer32 | 0 |
| 607Ch | | Home offset | rw | integer32 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 6080h | | Max motor speed | rw | unsigned32 | 10000 |
| 60B0h | | Position offset | rw | integer32 | 0 |
| 60B1h | | Velocity offset | rw | integer32 | 0 |
| 60B2h | | Torque offset | rw | integer32 | 0 |

| | | | | | |
|-------|--|-------------------------|----|-----------|---|
| 60F4h | | User position offset | ro | integer32 | 0 |
| 60FCh | | Motor position feedback | ro | integer32 | 0 |

5.11.4 Simple Tutorial for Cyclic Synchronous Position Mode

1. Set parameter in servo drive

Table 5-58 Servo Drive Parameter for Cyclic Synchronous Position Mode

| Parameter | Set value | Description |
|-----------|-----------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |

2. The host controller connects to servo drive and set the communication parameter(communication of synchronous cycle time, axis parameter, etc.)

3. Run the host controller

Table 5-59 Cyclic Synchronous Position Mode Startup and Operation

| Address | Name | Value set(Decimal value) |
|---------------------------|--------------------------|--|
| 60600008h | Control mode | 8 |
| 60400010h Control word | Enable | Any number → 6 → 7 → 1 or MC_Power |
| | Alarm clear | Any number → 128 (Enable on rising edge) |
| | Axis error reset | Set by host controller or by reference MC_Reset from PLC |
| 607A0020h | Demand position | Set by host controller (including acceleration and deceleration, etc.) |
| | Analog velocity control | Set by host controller, or by reference MC_MoveVelocity from PLC |
| | Demand relative position | Set by host controller, or by reference MC_MoveRelative from PLC |
| | Demand additive position | Set by host controller, or by reference MC_MoveAdditive from PLC |
| | Demand absolute position | Set by host controller, or by reference MC_MoveAbsolute from PLC |
| | Axis decelerate to stop | Set by host controller, or by reference MC_Stop from PLC |
| | Cyclic synchronous time | Set by host controller (DC-SYN-chro) |

5.11.5 Positioning Completion Signal

In position control, it indicates the reference pulse output by the host controller and the current position offset of the servo motor is less than the setting value of Pn522, which is for host controller to confirm the positioning is completed.

Table 5-60 Positioning Completion Signal Input

| Type | Name | Connector | Status | Meaning |
|-------|-------|-----------|-------------|------------------------------|
| Input | /COIN | CN1-25、26 | ON (closed) | Positioning is completed |
| | | | OFF (open) | Positioning is not completed |

Table 5-61 Table 5-48 Positioning Completion Signal Parameter Setting

| Pn522 | Positioning Completed Width | | | When enabled | Classification |
|-------|-----------------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | | | Position | Immediately | Setup |

| | | | | | |
|--|--------------|------------------|----|--|--|
| | 1-1073741824 | 1 reference unit | 50 | | |
|--|--------------|------------------|----|--|--|

- > Note: 1. No effect on final positioning accuracy.
- > 2. If the parameter is set to a value that is too large, the /COIN signal may be output when the position deviation is low during a low-speed operation. Please set this parameter in a reasonable range.

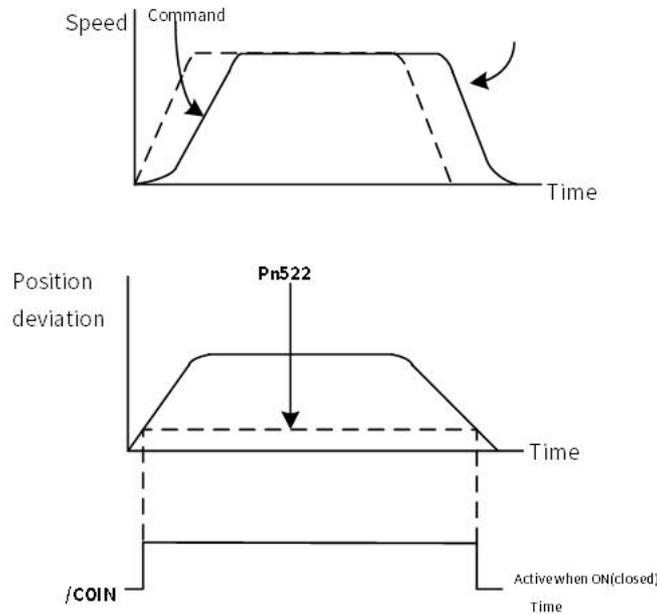


Figure 5-53 /COIN Signal Output Timing Chart

If the position deviation is always low and a narrow positioning completed width is used, change the setting of Pn207.3

Table 5-62 /COIN Output Timing Parameter Setting

| Parameter | Signal | Meaning | When Enabled | Classification |
|---|------------------------------|---|---------------|----------------|
| Pn207 (Position control command form selection switch) | n. 0□□□ (default setting) | Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 | After restart | Setup |
| | n. 1□□□ | Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 and the command after the position command filter is 0. | | |
| | n. 2□□□ | Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 and the command input is 0. | | |

5.11.6 Encoder Divided Pulse Output

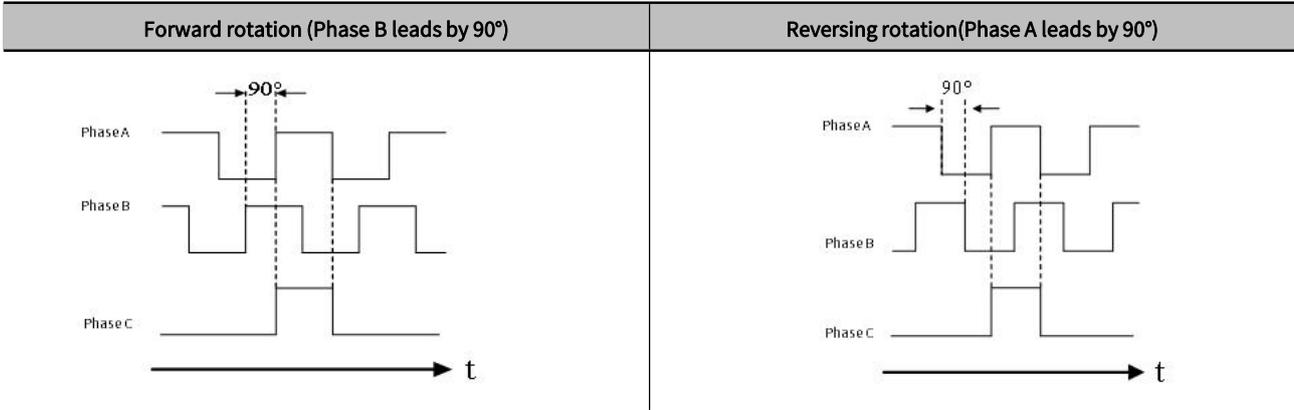
The encoder divided pulse output is a signal that is output from the encoder and processed inside the servo unit. It is then output externally in the form of two phase pulse signals (phases A and B) with a 90° phase differential. At the host controller, it is used as the position feedback.

Table 5-63 Encoder Divided Pulse Output

| Type | Signal | Connector | Meaning | Remarks |
|--------|--------|-----------|---------------------------------------|---|
| Output | PAO | CN1-33 | Encoder Divided Pulse Output, Phase A | The amount of pulses per revolution of the motor set by |
| | /PAO | CN1-34 | | |

| | | | | |
|--|------|--------|--|---------|
| | PBO | CN1-35 | Encoder Divided Pulse Output, Phase C | Pn212 . |
| | /PBO | CN1-36 | | |
| | PCO | CN1-19 | Encoder Divided Pulse Output, Phase C | |
| | /PCO | CN1-20 | | |

1) Output Form



- Note: 1. The pulse width of the origin within one encoder rotation depends on the setting of number of encoder output pulses (Pn212). It is the same as the width of phase A
2. Even for reverse operation (Pn000 = n.□□□1), the output phase form is the same as shown above.
3. If you use the servo unit's Phase-C pulse output for an origin return, rotate the servo motor two or more rotations before you start an origin return. If the servo motor cannot be rotated two or more times, perform an origin return operation at a motor speed of 600 min⁻¹ or lower. If the motor speed is higher than 600 min⁻¹, the Phase-C pulse may not be output correctly.

2) Setting for the Encoder Divided Pulse Output

Table 5-64 Encoder Divided Pulse Output Parameter Setting

| Pn212 | Encoder Divided Pulse | | | When Enabled | Classification |
|-------|-----------------------|--------------|-----------------|---------------|----------------|
| | Position | Speed | Torque | | |
| | Setting range | Setting unit | Default setting | After restart | Setup |
| | 16-16383 | 1P/Rev | 2048 | | |

The number of pulses from the encoder per rotation are processed inside the servo unit, divided by the setting of Pn212, and then output.

Set the number of encoder divided output pulses according to the system specifications of the machine or host controller.

The setting of the number of encoder output pulses is limited by the resolution of the encoder

➤ Note: Encoder divided pulse setting:

1. Pn212 value < encoder resolution, otherwise "divided pulse output setting abnormality (A.041)" will occur.
2. The upper limit of pulse frequency is about 1.6Mpps. An A.511 alarm (Encoder Output Pulse Overspeed) will occur if the upper limit of the motor speed is exceeded

Output example: when Pn212=16

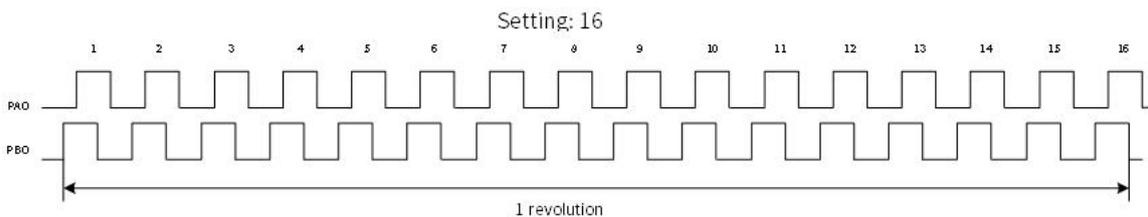


Figure 5-54 Encoder Divided Pulse when Pn212=16

5.12 Cyclic Synchronous Velocity Mode, CSV

In Cyclic Synchronous Velocity Mode, the host controller is to plan the acceleration(deceleration) to reach the target velocity and target velocity in each synchronous cycle. Servo drive follows the target velocity. To enable CSV mode, set object 6060H to 9. It is available in EtherCAT. The blocking diagram is shown as figure 5-55 and figure 5-56

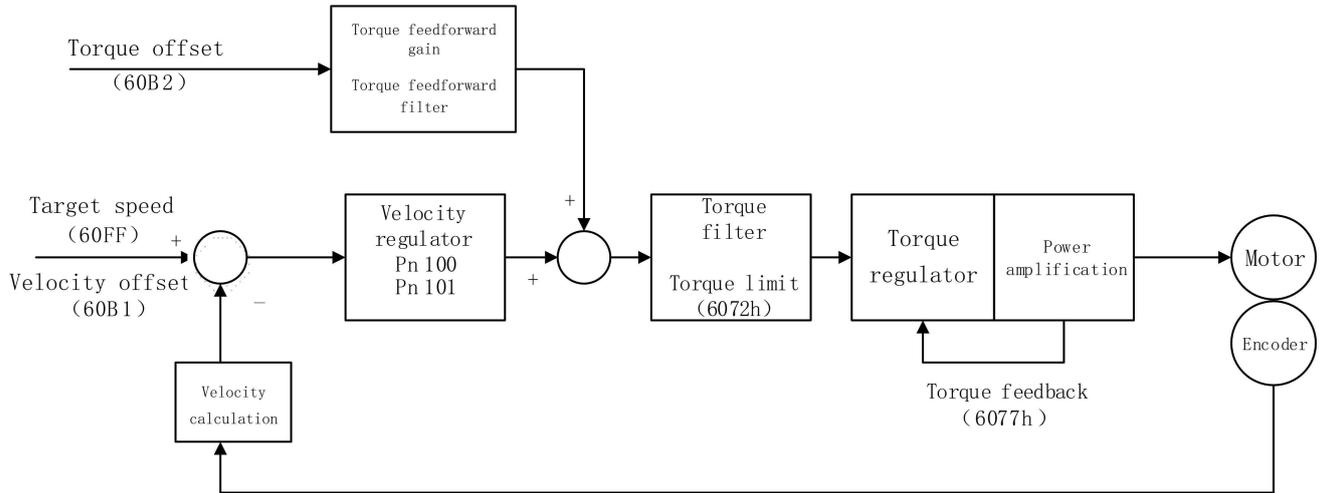


Figure 5-55 Cyclic Synchronous Velocity Mode Input and Output

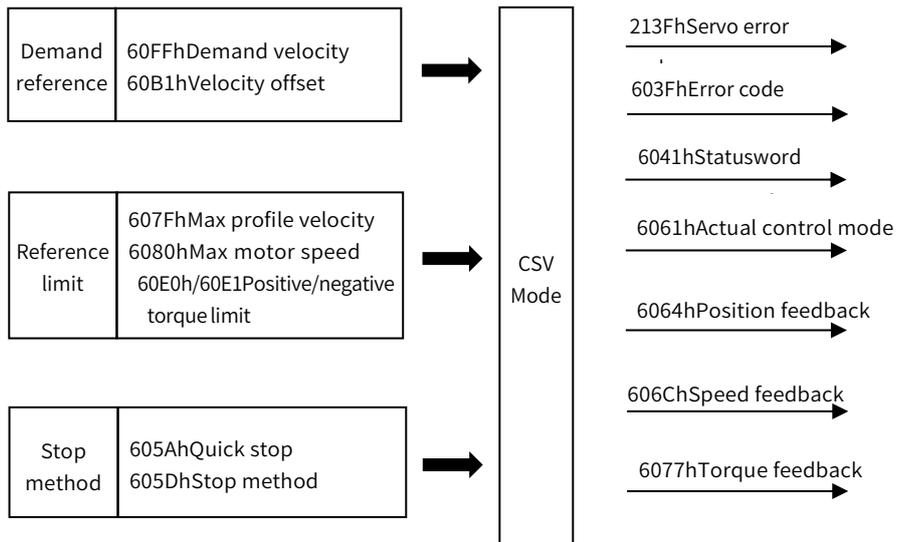


Figure 5-56 Cyclic Synchronous Velocity Mode Input and Output

5.12.1 Control Word in Cyclic Synchronous Velocity Mode(60400010h)

The meaning of each bit of control word(6040h) in cyclic synchronous velocity mode is shown as table 5-65

Table 5-65 Description of cyclic synchronous velocity mode

| Bit | Name | Description |
|-------|-------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo, if set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4~6 | CSV mode reserved | - |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: disabled, 1: enabled. When enabled the operation is halted. |
| 9 | CSV mode reserved | - |
| 10 | Reserved | - |
| 11~15 | Customized | - |

5.12.2 Status Word in Cyclic Synchronous Velocity Mode(60410010h)

The meaning of each bit of status word in cyclic synchronous velocity mode is shown as table 5-66. The item in dark background indicates the dedicated control reference in cyclic synchronous velocity mode.

Table 5-66 Description of Status Word in Cyclic Synchronous Velocity Mode

| Bit | Name | Description |
|-------|-----------------------------------|--|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Fault | 0: No fault, 1: Fault |
| 4 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 5 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 6 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | CSV mode reserved | - |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |
| 12 | Whether to follow target velocity | 0: Target velocity is not followed, 1: Target velocity has been followed. |
| 13 | CSV mode reserved | - |
| 14~15 | Customized | - |

5.12.3 Related Dictionary Objects in Cyclic Synchronous Velocity Mode

Table 5-67 Related Dictionary Objects in Cyclic Synchronous Velocity Mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|------------|--------|------------|---------------|
| 603Fh | | Error code | ro | unsigned16 | 0 |

| | | | | | |
|-------|-----|---|----|------------|-------------|
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 6063h | | Motor position feedback | ro | integer32 | 0 |
| 6064h | | User position feedback | ro | integer32 | 0 |
| 606Bh | | User velocity demand vaule | ro | integer32 | 0 |
| 606Ch | | User actual velocity feedback | ro | integer32 | 0 |
| 606Dh | | Velocity threshold | rw | unsigned16 | 0 |
| 606Eh | | Velocity reaching time | rw | unsigned16 | 0 |
| 607Ch | | Home offeset | rw | integer32 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 607Eh | | Reference polarity | rw | unsigned8 | 0 |
| 6080h | | Max. motor speed | rw | unsigned32 | 10000 |
| 6083h | | Profile acceleration | rw | unsigned32 | 1000 |
| 6084h | | Profile deceleration | rw | unsigned32 | 1000 |
| 60B1h | | Speed offset | rw | unsigned32 | 0 |
| 60B2h | | Torque offset | Rw | unsigned32 | 0 |
| 60FFh | | Target velocity | rw | integer32 | 0 |

5.12.4 Simple Tutorial for Cyclic Synchronous Position Mode

1. Set parameter in servo drive

Table 5-68 Servo Drive Parameter for Cyclic Synchronous Velocity Mode

| Parameter | Set value | Description |
|-----------|-----------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |

2. The host controller connects to servo drive and set the communication parameter(communication of synchronous cycle time, axis parameter, etc.)
3. Run the host controller

Table 5-69 Cyclic Synchronous Velocity Mode Startup and Operation

| Address | Name | Value setting(Decimal value) |
|---------------------------|------------------|---|
| 60600008h | Control mode | 9 |
| 60400010h Control word | Enable | Any number → 6 → 7 → 15 或 MC_Power |
| | Alarm clear | Any number → 128(Enable on rising edge) |
| | Axis error reset | Set by host controller or by reference MC_Reset from PLC |
| 60FF0020h | Demand velocity | Set by host controller or by reference MC_MoveVelocity from PLC |

| | | |
|--|-------------------------|---|
| | Axis decelerate to stop | Set by host controller or by reference MC_Stop from PLC |
| | Cyclic synchronous time | Set by host controller (DC-SYN-chro) |

5.12.5 Velocity Reference Filter

The velocity reference filter is a primary delay filter that is applied to the V-REF (Speed Command Input) signal to smooth the velocity reference

➤ Note: It is normally not necessary to change this parameter. If the setting is too high, the response to the speed reference may be slowed down

Table 5-70 Velocity Reference Filter Time Constant Parameter Setting Table

| Pn307 | Velocity Reference Filter Time Constant | | | When Enabled | Classification | |
|-------|---|--------------|-----------------|--------------|----------------|--------|
| | | Velocity | Position | | | Torque |
| | Setting range | Setting unit | Default setting | | | |
| | 0-65535 | 0.01ms | 0 | | Immediately | Setup |

5.13 Cyclic Synchronous Torque Mode, CST

In Cyclic Synchronous Torque Mode, the host controller is to plan the torque ramp rate to reach the target torque and target torque in each synchronous cycle. Servo drive follows the target torque. To enable CST mode, set object 6060H to 10. It is available in EtherCAT. The blocking diagram is shown as figure 5-57 and figure 5-58

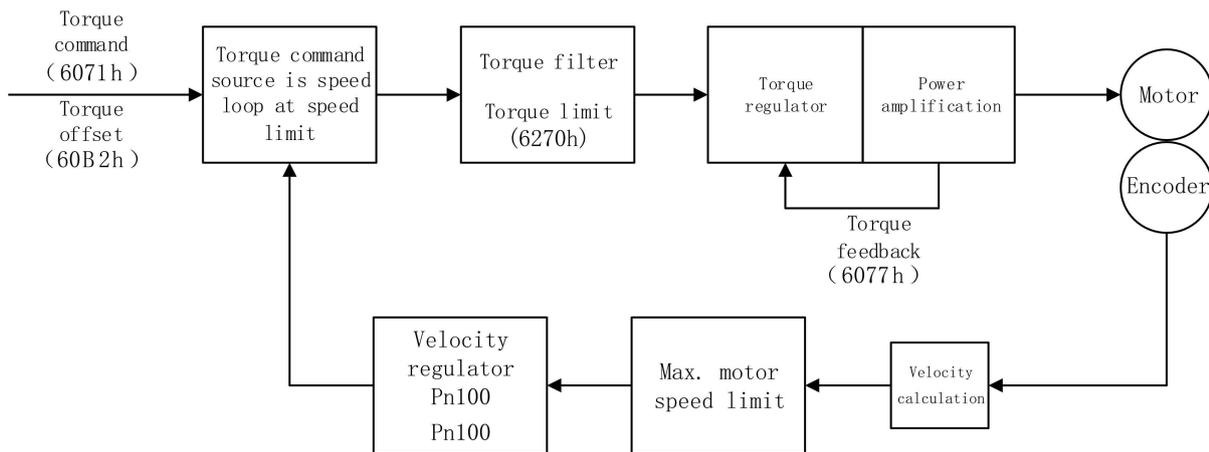


Figure 5-57 Cyclic Synchronous Torque Mode Block Diagram

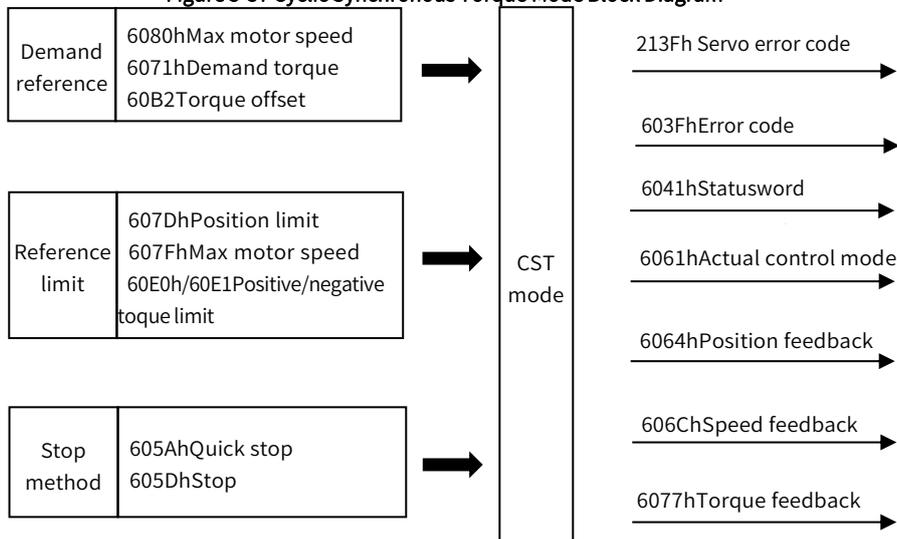


Figure 5-58 Cyclic Synchronous Torque Mode Input and Output

5.13.1 Control Word in Cyclic Synchronous Torque Mode(60400010h)

The meaning of each bit of control word(6040h) in cyclic synchronous torque mode is shown as table 5-71

Table 5-71 Description of Control Word in Cyclic Synchronous Torque Mode

| Bit | Name | Description |
|-------|-------------------|--|
| 0 | Switch on | Must be set to 1 when enable the servo |
| 1 | Enable voltage | Must be set to 1 when enable the servo |
| 2 | Quick stop | Must be set to 1 when enable the servo, if set to 0 then quick stop |
| 3 | Operation enable | Must be set to 1 when enable the servo |
| 4~6 | CST mode reserved | - |
| 7 | Fault reset | When 0→1 executes alarm reset for once. If multiple resets are required, multiple changes from 0→1 are required. When it is set to 1, other control reference is disabled. |
| 8 | Halt | 0: disabled, 1: enabled. When enabled the operation is halted. |
| 9~10 | CST mode reserved | - |
| 10 | Reserved | |
| 11~15 | Customized | - |

5.13.2 Status Word in Cyclic Synchronous Torque Mode(60410010h)

The meaning of each bit of status word in cyclic synchronous torque mode is shown as table 5-72. The item in dark background indicates the dedicated control reference in cyclic synchronous torque mode.

Table 5-72 Description of Status Word in Cyclic Synchronous Torque Mode

| Bit | Name | Description |
|-------|---------------------------------|--|
| 0 | Ready to switch on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 1 | Switched on | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 2 | Operation enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo has been enabled. |
| 3 | Fault | 0: No fault, 1: Fault |
| 4 | Voltage enabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 5 | Quick stop | 0: Quick stop enabled, 1: Quick stop disabled |
| 6 | Switch on disabled | 0: Disabled, 1: Enabled. When enabled it indicates Servo can be enabled. |
| 7 | Warning | 0: No warning, 1: Warning |
| 8 | Customized | - |
| 9 | Remote | 0: Disabled, 1: Enabled. When enabled it indicates control words has been enabled. |
| 10 | Reserved | - |
| 11 | Internal software limit active | 0: Software limit position is not reached. 1: Software limit position is reached |
| 12 | Whether to follow target torque | 0: Target torque is not followed, 1: Target torque has been followed. |
| 13 | CST mode reserved | - |
| 14~15 | Customized | - |

5.13.3 Related Dictionary Objects in Cyclic Synchronous Torque Mode

Table 5-73 Related Dictionary Objects in Cyclic Synchronous Torque Mode

| Index | Subindex | Name | Access | Data type | Default value |
|-------|----------|---|--------|------------|---------------|
| 603Fh | | Error code | ro | unsigned16 | 0 |
| 6040h | | Control word | rw | unsigned16 | 0 |
| 6041h | | Status word | ro | unsigned16 | 0 |
| 6060h | | Control mode | rw | integer8 | 0 |
| 6061h | | Control mode display | ro | integer8 | 0 |
| 606Ch | | User actual velocity feedback | ro | integer32 | 0 |
| 6071h | | Target torque | rw | integer16 | 0 |
| 6074h | | User demand torque | ro | integer16 | 0 |
| 6077h | | Actual torque feedback | ro | integer16 | 0 |
| 607Dh | 01h | Software position limit: min position limit | rw | integer32 | -2147483648 |
| | 02h | Software position limit: max position limit | rw | integer32 | 2147483647 |
| 607Eh | | Reference polarity | rw | unsigned8 | 0 |
| 607Fh | | Max profile velocity | rw | unsigned32 | 2147483647 |
| 6087h | | Torque ramp time | rw | unsigned32 | 0 |

5.13.4 Simple Tutorial for Cyclic Synchronous Position Mode

1. Set parameter in servo drive

Table 5-74 Servo Drive Parameter for Cyclic Synchronous Torque Mode

| Parameter | Set value | Description |
|-----------|-----------|---|
| Pn002.2 | 1 | Take absolute encoder as incremental. No need to change the parameter in absolute system. |
| Pn00B.2 | 1 | Change the power supply to single-phase. If using three-phase power supply, then no need to change the parameter. |
| Pn50A.3 | 8 | Positive position limit, assigned as appropriate for actual use. |
| Pn50B.0 | 8 | Negative position limit, assigned as appropriate for actual use. |

2. The host controller connects to servo drive and set the communication parameter(communication of synchronous cycle time, axis parameter, etc.)
3. Run the host controller

Table 5-75 Cyclic Synchronous Torque Mode Startup and Operation

| Address | Name | Value setting(Decimal value) |
|---------------------------|-------------------------|---|
| 60600008h | Control mode | 10(In hexadecimal is A) |
| 60710010h 607F0020h | Demand torque/velocity | Set by reference MC_TorqueControl from PLC |
| 60400010h Control word | Enable | Any number→ 6 → 7 → 15/MC_Power |
| | Alarm clear | Any number→ 128(Enable on rising edge) |
| | Axis error reset | Set by host controller, or by reference MC_Reset from PLC |
| | Cyclic synchronous time | Set by host controller(DC-SYN-chro) |
| 607F0020h | Max profile velocity | -2147483648~2147483647 |

5.13.5 Torque Reference Filter

A function to smooth the torque reference by applying a primary delay filter to the torque reference input.

Note: It is normally not necessary to change this parameter. If the setting is too high, the response to the speed reference may be slowed down

Table 5-76 Parameters for Torque command filter

| Pn415 | T-REF Filter Time Constant | | | When Enabled | Classification |
|-------|----------------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | 0-65535 | 0.01ms | 0 | | |

5.13.6 Internal Torque Limit

The internal torque limit is a limiting method that limits the maximum output torque.

The setting unit is the motor rated torque percentage.

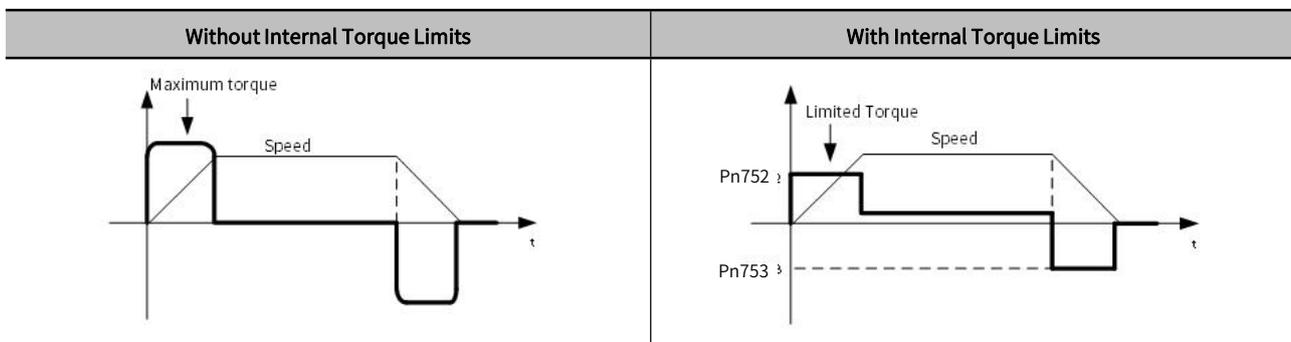
If the value is too low, it will cause insufficient torque during acceleration and deceleration.

Table 5-77 Internal Torque Limit Parameter Setting

| Pn752 | Forward torque limit | | | When Enabled | Classification |
|-------|----------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | 0-8000 | 0.1% | 8000 | | |

| Pn753 | Reverse torque limit | | | When Enabled | Classification |
|-------|----------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | 0-8000 | 0.1% | 8000 | | |

The torque waveform is as follows:





Chapter 6 Application Function



| | | |
|-----------|---|-----|
| Chapter 6 | Application Function | 146 |
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6.1 Absolute Encoder

With a system that uses an absolute encoder, the host controller can monitor the current position.

Therefore, it is not necessary to perform an origin return operation when the power supply to the system is turned ON.

To save the position data of the absolute encoder, a battery unit is required. Install the battery on the encoder cable with the battery unit. When not using an encoder cable with a battery unit, install a battery in the host controller

Prohibition: Do not install batteries on both sides of the host controller and the battery unit (if installed on both sides at the same time, a short circuit will be formed between the batteries, which is very dangerous).

When using an absolute encoder, set Pn002.2=0 (Default setting).

Table 6-1 Absolute Encoder Parameter Setting

| Parameter | Meaning | When Enabled | Classification |
|-----------|------------------------------|---------------|----------------|
| Pn002 | n. □0□□ (Default setting) | After restart | Setup |
| | n. □1□□ | | |

6.1.1 Absolute Data Request (SENS_ON command)

When outputting absolute value data from the servo unit, it is necessary to input the sensor ON (SENS_ON) command. The sensor ON (SENS_ON) command operates at the following timing.

Table 6-2 Absolute Data Input

| Type | Signal | Connector Pin No. | Status | Meaning |
|-------|--------|-------------------|---------------|--|
| Input | SEN | CN1-41 | OFF (L level) | Does not request the absolute data from the servo unit |
| | | | ON (H level) | Requests the absolute data from the servo unit |

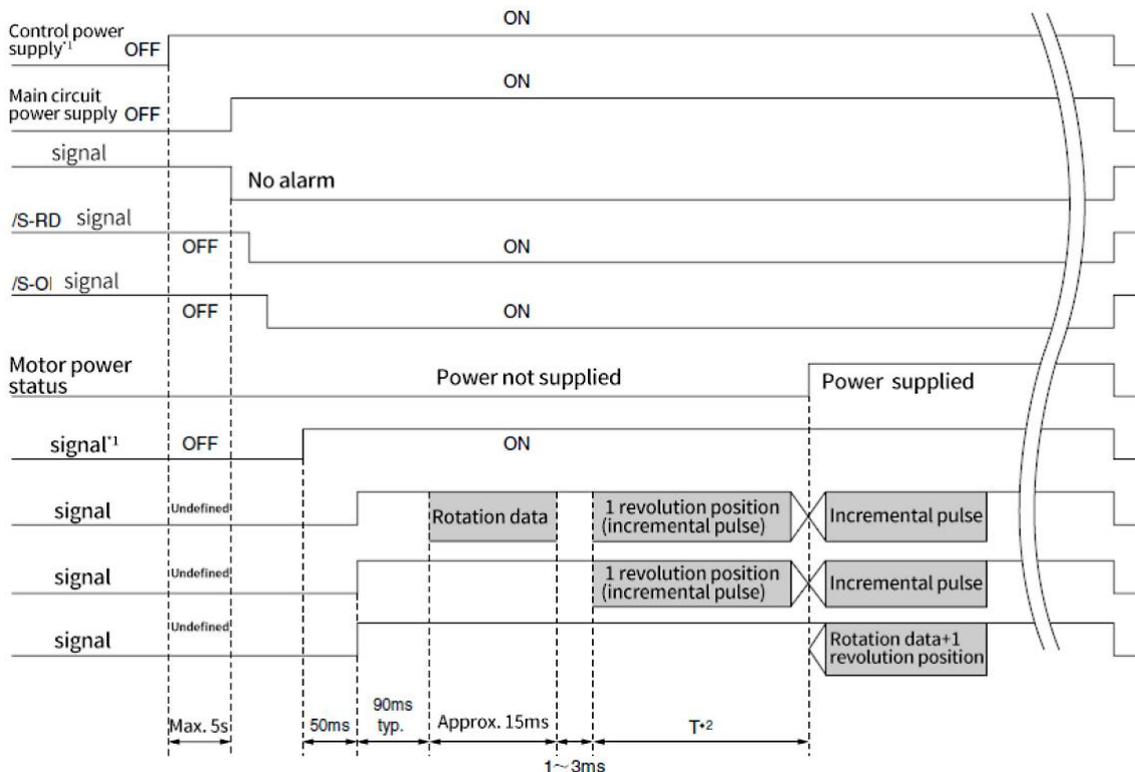


Figure 6-1 Absolute Data Output from Servo Unit Timing Chart

➤ Note: When the control power supply is OFF, please input the sensor OFF (SENS_OFF) command

6.1.2 Battery Replacement

If the battery voltage drops to approximately 2.7 V or less, an A.830 alarm (Encoder Battery Alarm) or an A.930 warning (Absolute Encoder Battery Error) will be displayed. When the above alarm or warning appears, please follow the steps below to replace the battery.

Whether to display an A.830 alarm or a A.930 warning is determined by the setting of Pn008.

Table 6-3 Alarm Display Parameter Setting

| Parameter | Meaning | When enabled | Classification |
|-----------|------------------------------|---------------|----------------|
| Pn008 | n. □□□0 (Default setting) | After restart | Setup |
| | n. □□□1 | | |

- When Pn008.0=0 is set

The ALM signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored for four seconds. No alarm will be displayed even if the battery voltage drops below the specified value after these four seconds.

- When Pn008.0=1 is set

The ALM signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored continuously.

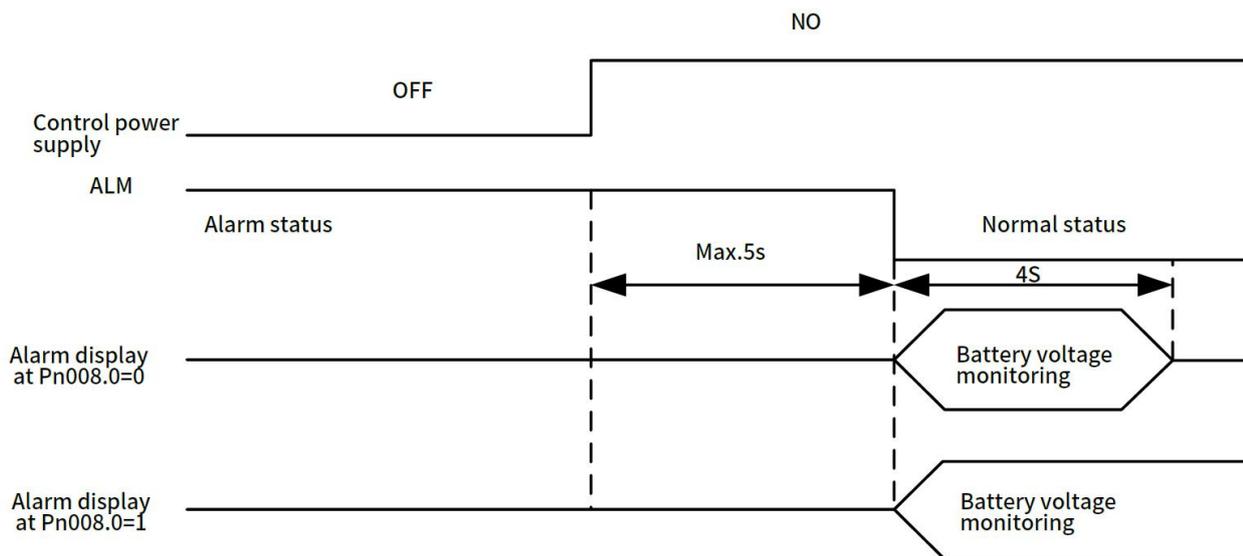
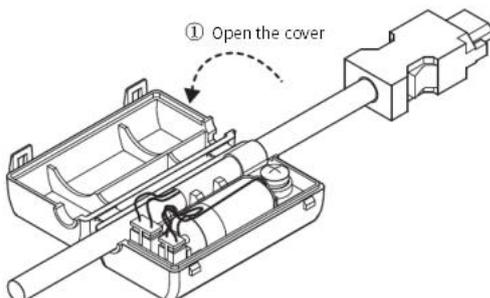


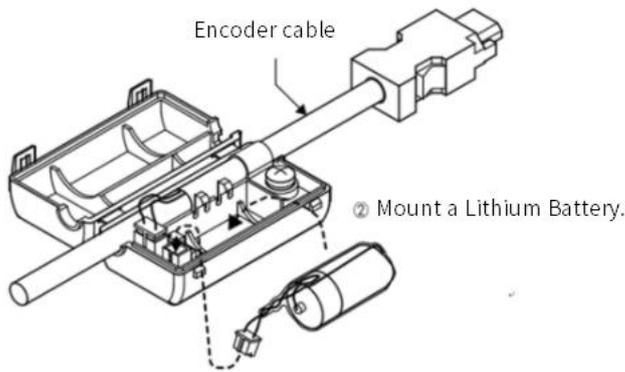
Figure 6-2 Alarm Display Timing Chart

Battery replacement procedure when using an encoder cable with a battery unit

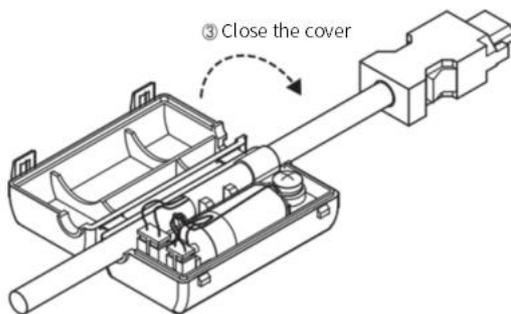
- (1) Only turn on the control power supply of the servo unit.
- (2) Open the cover of the battery unit.



- (3) Remove the old battery and mount a new battery.



(4) Close the cover of battery unit.



(5) Turn OFF the power supply to the servo drive to clear the A.830 alarm(Encoder Battery Alarm)

(6) Turn on the power supply to servo unit again

(7) Make sure that the alarm has been cleared and that the servo unit operates normally.

Note: If you remove the Battery or disconnect the encoder cable while the control power supply to the servo unit is OFF, the absolute encoder data will be lost.

6.1.3 Sequence for Reading and Outputting Position Data from Absolute Encoder

The sequence from reading and outputting position data from absolute encoder to the host controller from the servo unit is described below.

1) Overview of Absolute Data

As shown in the figure below, the serial data and pulses from the absolute encoder output by the servo unit are output from "PAO, PBO, PCO".

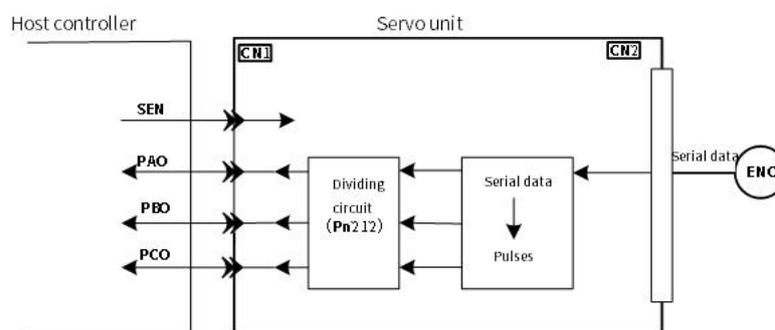


Figure 6-3 Absolute Data Output from Servo Unit Conceptual Diagram

Table 6-4 Signal Output

| Signal | Status | Signal Contents |
|--------|--------------|---|
| PAO | First signal | Rotary serial data Initial incremental pulses |

| | | |
|-----|-------------------------|---|
| | During normal operation | Incremental pulses |
| PBO | First signal | Rotary serial data Initial incremental pulses |
| | During normal operation | Incremental pulses |
| PCO | Always | Origin pulse |

C Phase output specifications:

The pulse amplitude of phase C (origin pulse) changes with encoder divided pulses (Pn212), which is the same as the amplitude of phase A. The output time is one of the following modes.

- Synchronize with A Phase Rising Edge
- Synchronize with A Phase Falling Edge
- Synchronize with B Phase Rising Edge
- Synchronize with B Phase Falling Edge

Note: When the host controller is used to process the outputting and reading of the absolute encoder data, do not reset the count through the PCO signal output.

2) Sequence of Reading and Outputting Position Data form Absolute Encoder

- ① Output sensor ON(SENS_ON) command from the host controller
- ② After 100ms, it enters the status for receiving the rotary serial data, and the reversible counter used for incremental pulse counting is cleared.
- ③ Receive 8-character rotary serial data.
- ④ After reading the last rotary serial data for about 400ms, it enters the normal incremental action status.

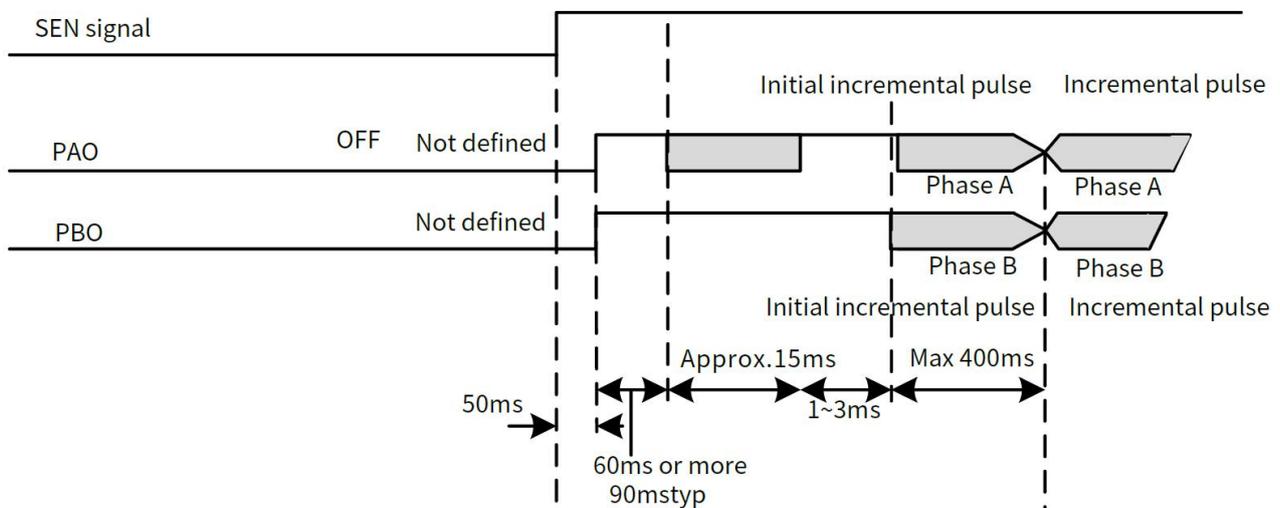


Figure 6-4 Sequence of Reading and Outputting of the Position Data from Absolute Encoder Timing Chart

<Notes>

Regardless of Pn000.0 setting value, when the divided pulse receives the forward rotation command, B-phase lead.

Multiturn data: Indicates the position at which the motor shaft has rotated several times from the reference position (the value of basic setting (initialization)).

Initial incremental pulse: Same as the usual incremental pulse, it sends an absolute initial incremental pulse. That is the pulse from the origin position of the motor shaft to the current motor shaft position, which is output after divided by the divider inside the servo unit output

The pulse output speed varies according to the setting value of the encoder divided pulse(Pn212). It can be calculated by the following formula.

Table 6-5 Initial Incremental Pulse Output Speed Calculation

| Setting Range of Number of Encoder Output Pulses | Initial Incremental Pulse Output Speed Calculation Formula |
|--|--|
| 16-16383 | $\frac{680 \times Pn212}{16383}$ |

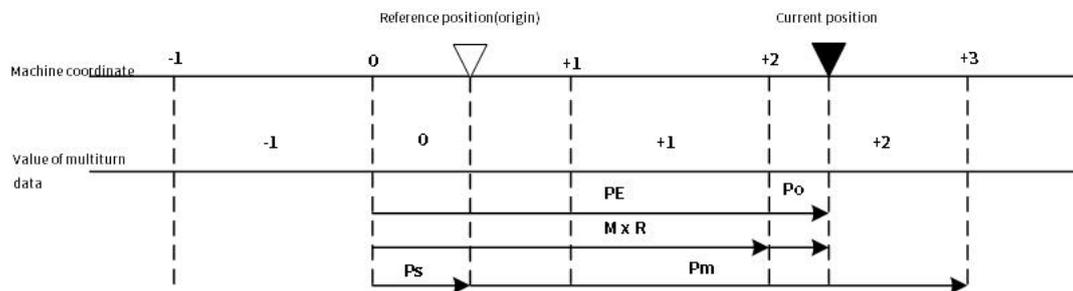


Figure 6-5 Position Data from Absolute Encoder PM Output Method

The current position P_M in the machine coordinate system is calculated as follows:

$$P_E = M \times R + P_O$$

$$P_S = M_S \times R + P_S'$$

$$P_M = P_E - P_S$$

Table 6-6 Formula Symbol Definition

| Symbol | Meaning |
|--------|--|
| P_E | Position data for the current position of the absolute encoder |
| M | Current position of the multiturn data of the absolute encoder |
| P_O | Initial incremental pulse |
| P_S' | The initial incremental pulse number read at the basic setting . |
| P_M | The current value required in the user's system . |
| R | Number of encoder pulses per revolution (Setting of Pn212). |
| P_E | Current value read from encoder . |

➤ Note: In reverse mode (Pn000.0=1), the formula is as follows:

$$P_E = -M \times R + P_O$$

$$P_S = M_S \times R + P_S'$$

$$P_M = P_E - P_S$$

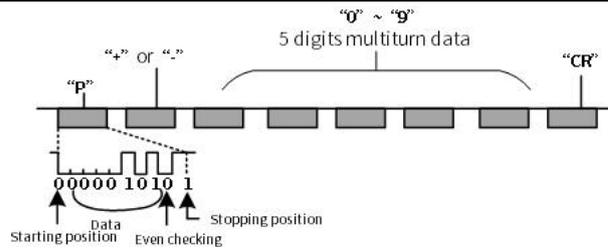
3) Rotational serial data specification and initial incremental pulse rotary serial data specification

Rotation serial data output from PAO.

Table 6-7 Multiturn Data Specification and Initial Incremental Pulse

| Data Transmission Method | Start-stop Synchronization (ASYNC) |
|--------------------------|------------------------------------|
| Baud rate | 9600bps |
| Start bits | 1 bit |
| Stop bits | 1 bit |
| Parity | even |
| Character code | ASCII, 7 bits |

Data format
(8 characters)



1. The zero rotation range is any one of "P+00000 " (CR) or "P-00000" (CR).
2. The range of multiturn is " ± 32768 ". If it exceeds this range, the data will become "-32768" when "+32768" is set, and will become "+32768" when "-32768" is set. When changing the upper limit of the number of rotations, it will be changed within the setting range in "Setting the upper limit of the number of rotations".

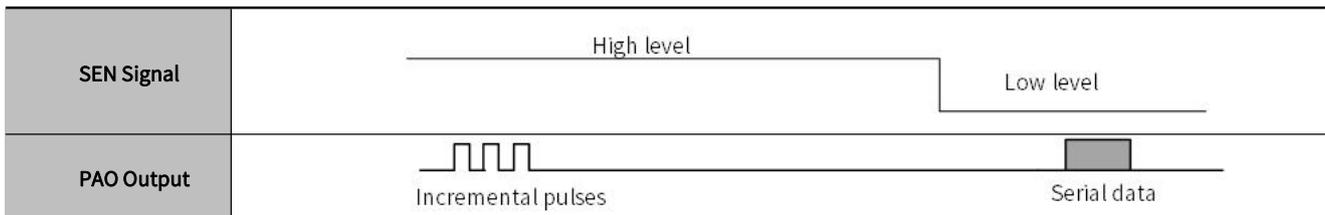
The initial incremental pulse is the same as the usual incremental pulse, and the initial incremental pulse is output after divided by the divider inside the servo unit.

4) Alarm content transmission

When the absolute encoder is used, the alarm content detected by the servo unit can be transmitted to the host device through PA0 output in the form of serial data when the SEN signal changes from H level to L level.

- > Note : The SEN signal is not received during servo ON, and the output example of the alarm content is as follows.

Table 6-8 Alarm Transmission



6.1.4 Initialization of Absolute Encoder(When Alarming)



The multiturn data will be reset to a value between -2 and +2 rotations when the absolute encoder is reset. The reference position of the machine system will change. Adjust the reference position in the host controller to the position that results from resetting the absolute encoder.

If the machine is started without adjusting the position in the host controller, unexpected operation may cause personal injury or damage to the machine.

In the following cases, reset the abosulte encoder.

- When starting the system for the first time.
- When Encoder Backup Alarm (A.810) occurs .
- When Encoder Checksum alarm (A.820) occurs .
- When you want to reset the multiturn data in the absolute encoder.

Perform basic reset through Fn008.

Initial setting steps:

- (1) Press on the panel **(M)** key to select the Utility function Fn000, and the panel displays "**FN000**".
- (2) Press the **(^)** or **(v)** key , the panel displays "**FN008**".
- (3) Press the key **(S)** for about 1 second, the panel displays "**PGCLI**".
- (4) Press the key **(^)** until the bread shows "**PGCL5**". (If you press wrong key operation in the process, the panel will

display "no_oP" flashing for about 1 second, and then returns to the Utility function mode. Then please restart the operation from the beginning.)

- (5) Press **M** key to start resetting the absolute encoder. After the resetting is completed, the panel will display " " flashing for about 1 second.
- (6) Return and the panel displays "PGCL5".
- (7) To make the setting active, please turn on the power again.

6.2 Position comparison output function

6.2.1 Function Description

The position comparison function is to use the instantaneous position data to compare with the value stored in the data group in advance. When the comparison condition is satisfied, it will immediately output a DO signal with an adjustable pulse width for subsequent motion control.

Position comparison function: It can be selected to enable DO terminal output at high/low level. When enabled at high level, it is enabled when the corresponding DO terminal is connected to the common terminal, and it is disabled when it is disconnected from the common terminal; when enabled at low level, it is disabled when the corresponding DO terminal is connected to the common terminal, and enabled when it is disconnected. There are a total of 4 DO outputs on the Y7S.

Table 6-9 Function Description

| Operating Conditions of the Position Comparison Output Function | |
|---|---|
| Control mode | All control modes |
| Other | The elements besides the control parameters are properly set, and the motor is operating normally |

6.2.2 Related Objects

Table 6-10 Description Table of Related Objects

| Parameter | Name | Unit | Description |
|-----------|--|---------|--|
| Pn610 | Position comparison output function | — | 0: OFF (default setting); 1: positive comparison; 2: negative comparison; 3: Two-way comparison; |
| Pn611 | first set position | — | -1073741824—1073741823 |
| Pn613 | second set position | — | -1073741824—1073741823 |
| Pn615 | third set position | — | -1073741824—1073741823 |
| Pn617 | 4th set position | — | -1073741824—1073741823 |
| Pn619 | Effective time of first position output signal | 0.125ms | 0—65535 |
| Pn61A | Effective time of first position output signal | 0.125ms | 0—65535 |
| Pn61B | Effective time of first position output signal | 0.125ms | 0—65535 |
| Pn61C | Effective time of first position output signal | 0.125ms | 0—65535 |
| Pn513 | Bit0: First position output comparison | — | 0: Disabled (The signal is not output) 1: Output the signal from CN1-25! 26 output terminal 2: Output the signal from CN1-27! 28 output terminal 3: Output the signal from CN1-29! 30 output terminal 4: Output the signal from CN1-37! 38 output terminal |

| | | |
|--|---|--|
| Bit1: Second position output comparison | — | 0: Disabled (The signal is not output) 1: Output the signal from CN1-25! 26 output terminal 2: Output the signal from CN1-27! 28 output terminal 3: Output the signal from CN1-29! 30 output terminal 4: Output the signal from CN1-37! 38 output terminal |
| Bit2: The third position output comparison | — | 0: Disabled (The signal is not output) 1: Output the signal from CN1-25! 26 output terminal 2: Output the signal from CN1-27! 28 output terminal 3: Output the signal from CN1-29! 30 output terminal 4: Output the signal from CN1-37! 38 output terminal |
| Bit3: Fourth position output comparison | — | 0: Disabled (The signal is not output) 1: Output the signal from CN1-25! 26 output terminal 2: Output the signal from CN1-27! 28 output terminal 3: Output the signal from CN1-29! 30 output terminal 4: Output the signal from CN1-37! 38 output terminal |

6.2.3 Function Running

1) Function Principle

Position comparison COMPARE is to use the instantaneous position data fed back by the servo to compare with the value stored in the target position array in advance. When the comparison condition is satisfied, it will immediately output a DO pulse signal (Number of DO and the pulse width can be configured) , used for the follow-up motion control. Since the comparison is done inside the FPGA, no software data communication delay, and accurate comparison can also be done for high-speed motion axes.

Position comparison output function: When the value 0 of the position comparison output function Pn610 changes to 1/2/3, the comparison starts. When Pn610 becomes 0, the comparison ends immediately, and the current comparison status is cleared.

Position comparison output width: When the position comparison condition is satisfied, output DO active level signal, the width of the active level signal can be set through Pn 619/Pn 61A/Pn61B/Pn61C. Setting range: $0 - 65535 \times 0.125$ ms.

Target position comparison point: There are 4 target position comparison points in total, and the target position comparison value needs to be set to the Pn611/Pn613/Pn615/Pn617 target parameters in advance.

2) Functional Operation

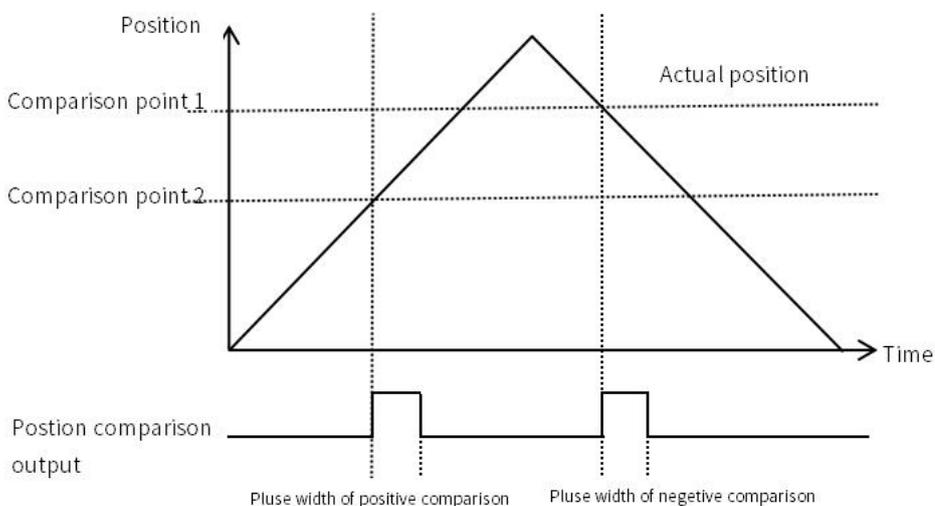


Figure 6-6 Operation Chart

When Pn610 is set to 1-positive comparison output, when the axis passes the target position comparison point and the position relationship changes from low to high, DO outputs position comparison signal.

When Pn610 is set to 2- reverse comparison output, when the axis passes the target position comparison point and the position relationship changes from low to high, DO outputs position comparison signal.

When Pn610 is set as 3- two-way comparison output, the signal output is independent of passing direction of the axis. When the target position comparison point is passed and the position relationship changes, DO outputs a position comparison signal.

6.3 Gravity Compensation

When the Servo motor is used with a vertical axis, gravity compensation prevents the moving part from falling due to the machine's own weight when the brake is released.

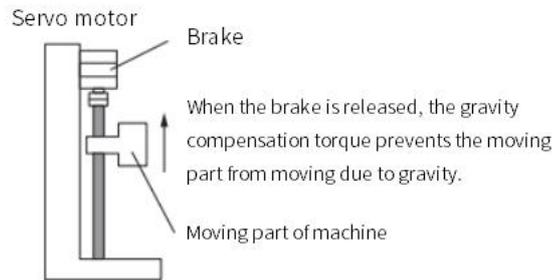


Figure 6-7 Operating Diagram

A timing chart for when the moving part is raised then lowered is provided below.

For details of the brake operating time, please refer to the following chart.

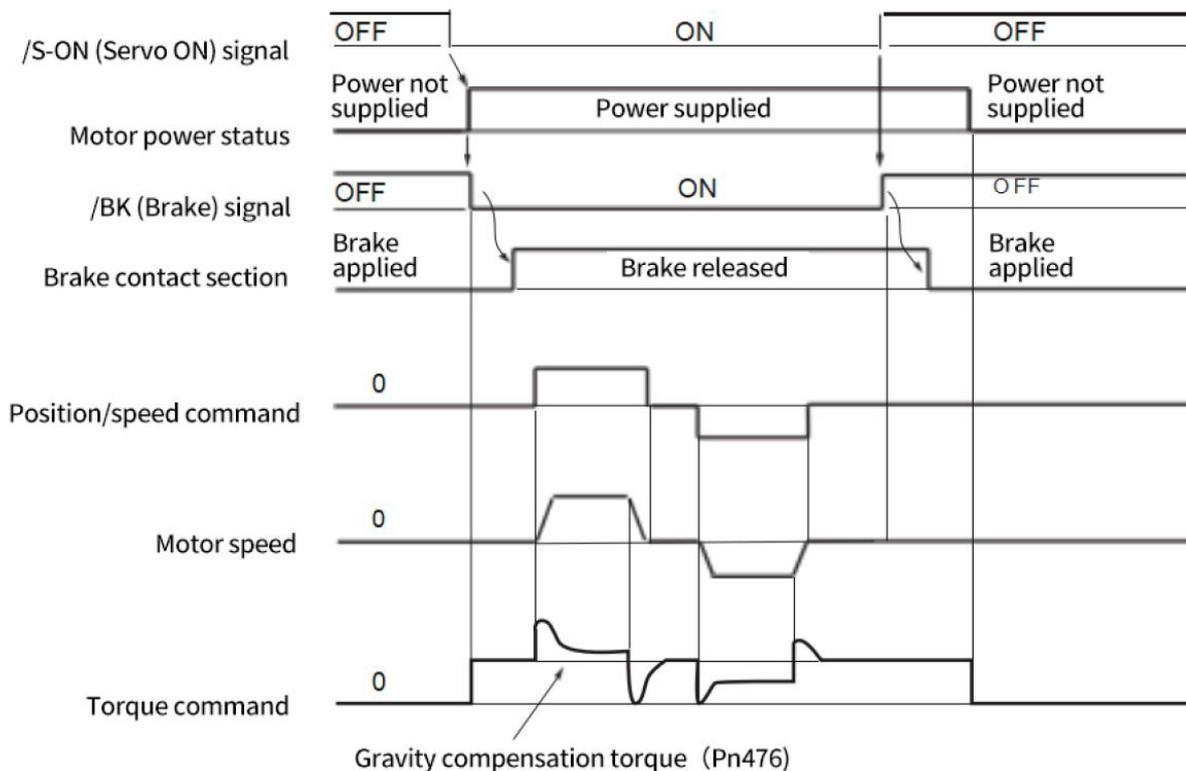


Figure 6-8 Brake Application Timing Chart

6.3.1 Required Parameters Setting

To use the gravity compensation function, the following parameters are required

Table 6-11 Parameter Setting

| Parameter | Description | | | When Enabled |
|------------|-------------------------------|--------------|-----------------|---------------|
| Pn 609.1=0 | Disable gravity compensation. | | | After restart |
| Pn 609.1=2 | Enable gravity compensation. | | | |
| Pn 476 | Setting range | Setting unit | Default setting | When Enabled |
| | -1000 ~ 1000 | 0.1% | 0 | Immediately |

6.3.2 Operating Procedure for Gravity Compensation

The operating procedure of the gravity compensation function are as follows.

1. Set Pn609.1 = 2 (Enable gravity compensation).
2. To enable changes to the settings, turn the power of the servo unit OFF and ON again.
3. Use the Y7 host controller software HCServoWorks.Y7 to find the torque command value when the motor is stopped with the servo ON
4. Set the torque command value found in step 3 in Pn476 (Gravity Compensation Torque).
5. Turn servo ON/servo OFF several times, and fine-tune Pn476, so that the moving part of machine does not fall.

6.4 Forced DO Function

6.4.1 Function Description

There' s two offline DO default options for EtherCAT forced DO state in non-OP state (including offline).

1. Offline holding state: The servo is switched to non-OP state and the DO is forced to maintain the state before disconnection.
2. Initialization state: When the servo is in non-OP state, disable the DO.

When the network is switched to OP, the forced DO is jointly determined by 60FE.01h/60FE.02h.

Select the forced DO function by bit. Select DO bit by bit as EtherCAT forced DO, which supports part of DO is local function, and part of is EtherCAT forced output function. Y7S has 4 forced DO outputs, which can be monitored through the panel Un006, and DO status can also be monitored through the monitoring panel of the host computer.

6.4.2 Related Objects

Table 6-12 Related Objects Parameters

| Parameter No. | Name | Setting range | Setting unit | Default setting | When enabled | Classification | Reference |
|---------------|----------------|---------------|--------------|-----------------|---------------|----------------|-----------|
| Pn517 | ECAT forced DO | 0000 ~ 4444H | — | 0000H | After restart | — | — |

| | | | | | | | | |
|----|--------------------------|--------------------------|--------------------------|--------------------------|---------------|---|--|-----------|
| n. | 3rd | 2nd | 1st | 0 | | | | |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | |
| | | | | | | Forced DO 0 | | Reference |
| | | | | | | 0 | Disabled(Not using the above signal outputs) | |
| | | | | | 1 | The signals are output from the CN1-25 and 26 output terminals. | | |
| | | | | | 2 | The signals are output from the CN1-27 and 28 output terminals. | | |
| | | | | | 3 | The signals are output from the CN1-29 and 30 output terminals. | | |
| | | | | | 4 | The signals are output from the CN1-37 and 38 output terminals. | | |
| | | | | | Forced DO 01 | | Reference | |
| | | | | | 0 | Disabled(Not using the above signal outputs) | | — |
| | | | | | 1 | The signals are output from the CN1-25 and 26 output terminals. | | |
| | | | | | 2 | The signals are output from the CN1-27 and 28 output terminals. | | |
| | | | | | 3 | The signals are output from the CN1-29 and 30 output terminals. | | |
| | | | | | 4 | The signals are output from the CN1-37 and 38 output terminals. | | |
| | | | | | Forced DO0 2 | | Reference | |
| | | | | | Same as above | | — | |
| | | | | | Forced DO03 | | Reference | |
| | | | | | Same as above | | — | |

| Parameter No. | Name | Setting range | Setting unit | Default setting | When enabled | Classification | Reference |
|---------------|-----------------------|---------------|--------------|-----------------------|---------------|----------------|-----------|
| Pn791.0 | ECAT forced DO status | 0 ~ 1 | — | 0 | After restart | — | — |
| | | | 0 | Offline holding state | | | |
| | | | 1 | Initialization state | | | |

6.4.3 Instructions

1. Set the bit of Pn517 to select the corresponding DO.
2. Set bit0 of Pn791 to enable the forced DO output after disconnection.
3. Configure 60FE.01h/60FE.02h as RPDO and operate bit0~bit3(Set bit0 to 1 as DO0 output, Set bit 2 to 1 as DO2 output, set bit3 to 1 as DO3 output) to control DO

6.5 Software Position Limit Function

6.5.1 Function Description

In the traditional way, the limit position can only be given by an external signal, by connecting the external sensor signal to the CN1 interface of the servo drive.

Table 6-13 Comparison of Advantages and Disadvantages of Hardware Limit and Software Limit

| Traditional Hardware limit | | Software limit | |
|----------------------------|---|----------------|--|
| 1 | Can be only limited to linear motion, single-turn rotary motion | 1 | Can be used not only in linear motion but also in rotary mode |
| 2 | Requires external equipment to install mechanical limit switches | 2 | No hardware wiring is required to prevent the poor contact of the line from causing misoperation |
| 3 | Unable to judge mechanical slippage abnormality | 3 | Internal position comparison to prevent movement caused by mechanical slippage abnormal |
| 4 | When power off, unable to judge or alarm after machine moves out of the limit | | |

The software limit function refers to the comparison between the internal position feedback of the drive and the set limit value, and when the limit value is exceeded, a warning will be issued immediately and the shutdown operation will be executed. This function is available in both absolute position mode and incremental position mode.

6.5.2 Related Objects

Table 6-14 Related Objects Parameters

| | Name | Unit | Value range | Default setting | When enabled |
|------------|-----------------------|------|-------------|-----------------|-----------------|
| Pn781.bit0 | Software limit switch | — | 0-1 | 0 | After power off |
| | 0:Disabled; 1:Enabled | | | | |

Table 6-15 Software Limit Description

| Object 607D _h : Software Limit | | | |
|---|-----------------------------------|---------------------------|-----------------|
| Objects description | | Objects entry description | |
| Item | Value | Item | Value |
| Index | 607D _h | Subindex | 00 _h |
| Name | Number of software limit subindex | Access | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | UInt8 | Data range | 0~512 |
| Operation mode | ALL | Default value | 2 |

| Objects description | | Objects entry description | |
|---------------------|------------------------------|---------------------------|------------------------|
| Item | Value | Item | Value |
| Index | 607D _h | Subindex | 01 _h |
| Name | Min. Software position limit | Access | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default value | -2147483648 |

Software limit function:

Bit0 of Pn781 is software limit switch;

0: Disabled;

1: Enabled;

Software limit function is enabled after restart;

Set the min. Value of software absolute position limit. When set to -2147483648, indicates no min software limit in negative direction = (607D-01_h);

| Item | Value | Item | Value |
|-------|------------------------------|----------|-----------------|
| Index | 607D _h | Subindex | 02 _h |
| Name | Max. Software position limit | Access | Rw |

| | | | |
|----------------|--------|------------------|------------------------|
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default value | -2147483648 |

Software limit function:

Bit0 of Pn781 is software limit switch;

0: Disabled;

1: Enabled;

Software limit function is enabled after restart;

Set the max. Value of software absolute position limit. When set to 2147483648, indicates no max software limit in positive direction = (607D-02_n);

6.5.3 Instruction

The software limit function refers to the comparison between the internal position feedback and the set limit value, when the limit value is exceeded, a warning will be issued immediately and shutdown will be executed. In the profile position mode, cyclic synchronous position mode, when the target position setting value is out of the software limit value, bit11 of the status word 06041 becomes TRUE and the drive runs with the limit value as the target position and prompts positive limit (..POT)/negative limit(..NOT) warning, the drive stops according to the set overtravel stop mode. In other modes, when the position feedback 6064 is out of the software limit value, the drive will prompt a limit warning in the corresponding direction, and stops according to the set overtravel mode.

When 2781h=0, software limit function cannot be enabled.

When 2781h=1, software limit function is enabled after restart.

(607D-01h) min. software absolute position limit;

(607D-01h) max. software absolute position limit;

➤ Note: 1. Ensure 607D-01 ≤ 607D-02, if 607D-01 > 607D-02 is set, .9B0 error (max. software position limit less than the min.) will be prompted on drive.

2. Ensure the value of 607C (home offset) is in the range of max. software limit and min. software limit, otherwise .9B1 error(home offset is out of the software limit) will be prompted on drive

6.6 Modulus Function

In absolute system, if Pn781.1=1, modulus mode is enabled. Meanwhile set the max. value of the modulus position of Pn78A, then the count value of 6064 can only be counted from 0 to the set value. It is enabled after restart.

Table 6-16 Modulus Function Description

| | Name | Unit | Value range | Default setting | When Enabled |
|------------|--------------------------------------|------|--------------|-----------------|-----------------|
| Pn781.bit1 | Modulus switch | — | 0-1 | 0 | After power off |
| | 0:Disabled; 1:Enabled | | | | |
| Pn78A | Modules function max. Position limit | — | 0-4294967296 | 0 | After restart |

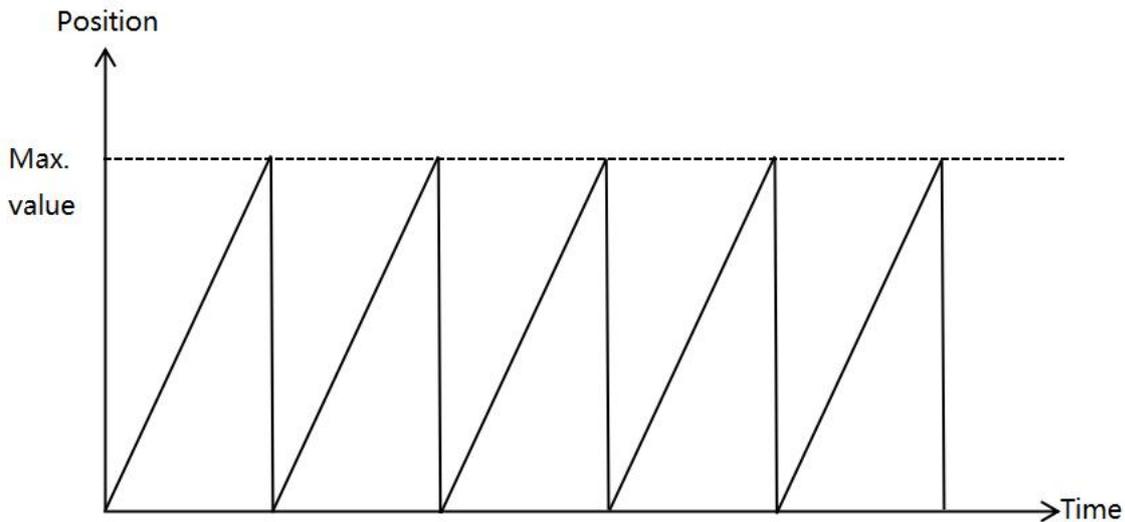


Figure6-9 6064 Waveform Diagram after Modulus Enabled

6.7 Touch Probe Function

Touch Probe Function is for the servo drive records the position information and saves it to the designated register when the servo driver changes according to the externally specified DI signal or the motor Z signal. Y7S servo drive supports 2 touch probes. The falling edge of the Z signal is not currently supported.

The steps to use touch probe function are as follows:

1. Set the touch probe trigger DI signal: Y7S servo drive designates DI1, DI4 as the input DI of probe 1 and probe 2, and the corresponding DI pins of probe 1 and 2 are 41 and 44 respectively;
2. Set the touch probe function(60B8h) code

The meaning of each bit of touch probe function (60B8h) and touch probe status word (60B9h) is shown in Table 6-17:

Table 6-17 Touch Probe Function Code

| Bit | Touch probe function(60B8h) | Touch probe stauts word(60B9h) |
|-----|--|--|
| 0 | Enable touch probe 1 0: Disabled 1: Enabled | Enabled touch probe 1 0: Disabled 1: Enabled |
| 1 | Touch probe 1 trigger mode 0: Trigger for once(60B8h need to set to) 1: Continous triggering | Touch Probe 1 rising edge latch 0: Rising edge latch of touch probe 1 not implemented 1: Rising edge latch of touch probe 1 is implemented |
| 2 | Touch probe 1 trigger signal selection 0: Triggered by DI4 1: Triggered by Z signal | Touch Probe 1 falling edge latch 0: Falling edge latch not implemented 1: Falling edge latch is implemented |
| 3 | Reserved | Reserved |
| 4 | Touch Probe 1 rising edge latch 0: Disabled 1: Enabled | Reserved |
| 5 | Touch Probe 1 falling edge latch 0: Disbaled 1: Enabled | Reserved |
| 6 | Reserved | Touch probe 1 trigger signal selection 0: Triggered by DI 4 1: Triggered by Z signal |

| | | |
|----|---|---|
| 7 | Reserved | Touch Probe 1 Trigger DI Level Selection 0: DI4 is low level 1: DI4 is high level |
| 8 | Enable Touch probe 2 0: Disabled 1: Enabled | Enable Touch probe 2 0: Disabled 1: Enabled |
| 9 | Touch probe 2 trigger mode 0: Trigger for once(60B8h need to set to) 1: Continuous triggering | Touch Probe 2 rising edge latch 0: Rising edge latch of touch probe 2 not implemented 1: Rising edge latch of touch probe 2 is implemented |
| 10 | Touch probe 2 trigger signal selection 0: Triggered by DI5 1: Triggered by Z signal | Touch Probe 2 falling edge latch 0: Falling edge latch of touch probe 2 not implemented 1: Falling edge latch of touch probe 2 is implemented |
| 11 | Reserved | Reserved |
| 12 | Touch Probe 2 rising edge latch 0: Disabled 1: Enabled | Reserved |
| 13 | Touch Probe 2 falling edge latch 0: Disabled 1: Enabled | Reserved |
| 14 | Reserved | Touch probe 2 trigger signal selection 0: Triggered by DI5 1: Triggered by Z signal |
| 15 | Reserved | Touch Probe 2 Trigger DI Level Selection 0: DI5 is low level 1: DI5 is high level |

For example, If you want to use the rising edge and falling edges of touch probe 1 and 2, DI is triggered for once, then set 60B8h=3131h (In decimal is 12593). When DI4, DI5 signal rises, the value of 60BAh and 60BCh is updated, When DI4, DI5 signal falls, the value of 60BBh and 60BDh is updated.

Note: If you want to trigger again, you need to set 60B8h=0, 60B8h=3131h 3. The common object dictionary of the probe function is shown in Table 6-18.

Note: If you want to trigger again, need to set 60B8h=0, 60B8h=3131h.

Touch probe function common object dictionary is shown as Table 6-18

Table 6-18 Related Touch Probe Function

| Object dictionary | Meaning |
|-------------------|--|
| 60B8h | Touch probe function |
| 60B9h | Touch probe status word |
| 60BAh | Touch probe 1 rising edge position feedback |
| 60BBh | Touch probe 1 falling edge position feedback |
| 60BCh | Touch probe 2 rising edge position feedback |
| 60BDh | Touch probe 2 falling edge position feedback |

6.8 Safety Funtion

Safety circuit(STO)

To protect operator from injured by moving parts and lowering the risk of operating the machine, the servo unit is built in with safety function. Especially in the case that the shield must be opened during the maintenance, the safety function is able to prevent the machine from making dangerous movements.

6.8.1 Hard Wire Base Block (HWBB) Function

The hard wire base block function (hereinafter referred to as HWBB function) refers to the safety function of shutting off the motor current through hard wire circuit.

The drive signals to the Power Module that controls the motor current are controlled by the circuits that are independently connected to the two input signal channels to turn OFF the power module and shut OFF the motor current. Please refer to the figure in the following.

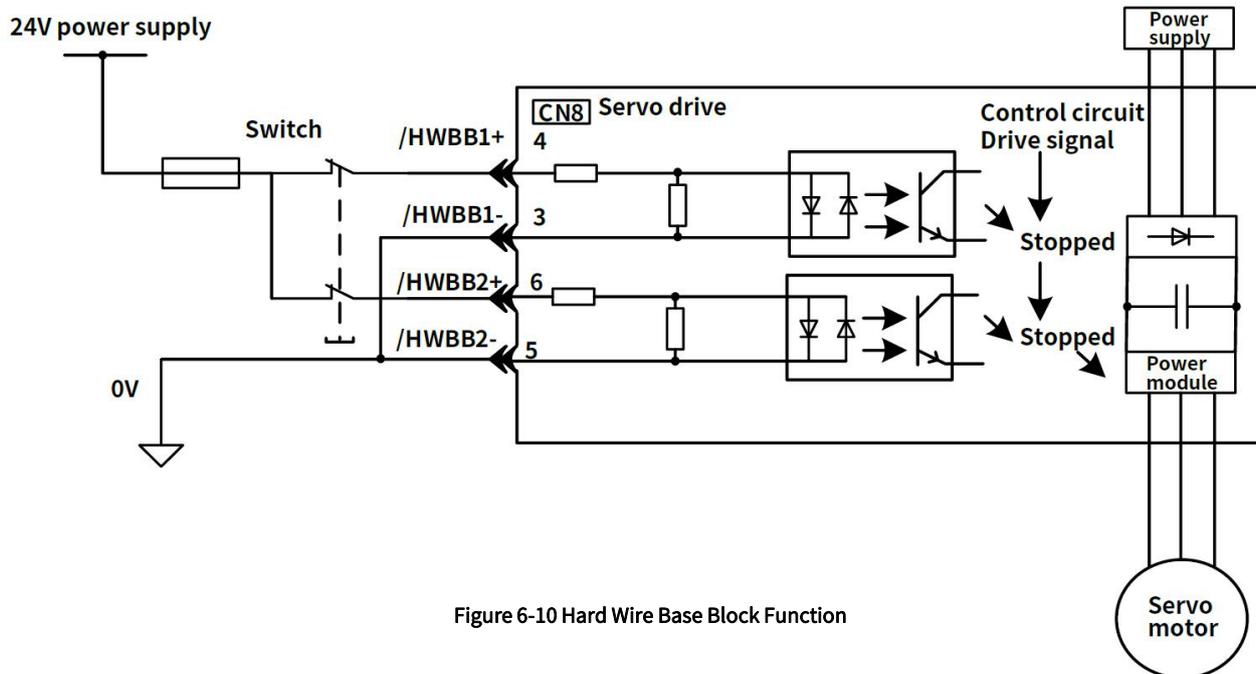


Figure 6-10 Hard Wire Base Block Function

➤ Note: Note: For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

1) Risk Assessment

Using the HWBB function, be sure to perform a risk assessment of the equipment to confirm that the safety level of the standards is satisfied

Even if the HWBB function is effective, the following risks still exist, please be sure to consider the safety of the following factors in the risk assessment.

- The servo motor will move if an external force is applied to it (for example, gravity on a vertical axis). Implement measures to hold the servo motor, such as installing a separate mechanical brake.
- If a failure occurs such as a power module failure, the servo motor may move within an electric angle of 180. Check if there's a risk of danger.

The rotational angle or travel distance depends on the type of servo motor as follows.

Rotary servo motor: 1/6 rotation max (rotational angle calculated at the motor shaft).

Direct drive motor: 1/20 rotation max (rotational angle calculated at the motor shaft).

- The HWBB does not shut OFF the power to the servo unit or electrically isolate it. Implement measures to shut OFF the power supply to the servo unit before you perform maintenance on it.

2) Hard Wire Base Block State (HWBB state)

The status of the servo unit when the hard wire base block function is running is as follows. When the /HWBB1 or /HWBB2 signal is OFF, the HWBB function of the servo unit will operate and the servo unit will enter the hard wire base block state (hereinafter referred to as the HWBB state).

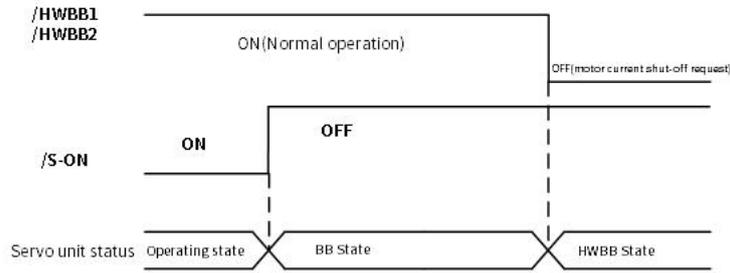


Figure 6-11 Hard Wire Base Block State Timing Chart

3) Resetting the HWBB state

Normally, after the /S-ON signal is turned OFF and power is no longer supplied to the servo motor, the /HWBB1 and /HWBB2 signals will turn OFF and the servo unit will enter the HWBB state. If you turn ON the /HWBB1 and /HWBB2 signals in this state, the servo unit will enter a base block (BB) state and will be ready to acknowledge the /S-ON signal.

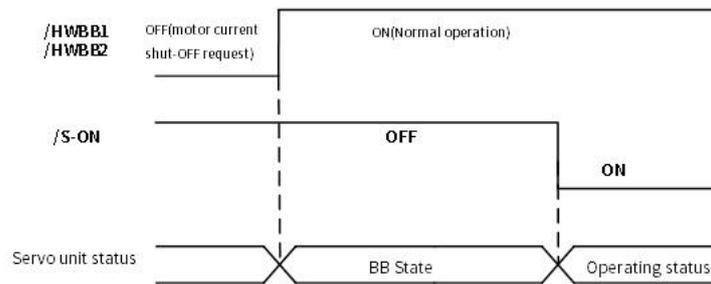


Figure 6-12 Hard Wire Base Block State Timing Chart

If the /HWBB1 and /HWBB2 signals are OFF and the /S-ON signal is input, the HWBB state will be maintained even after the /HWBB1 and /HWBB2 signals are turned ON.

Turn OFF the /S-ON signal to place the servo unit in the BB state and then turn ON the /S-ON signal again.

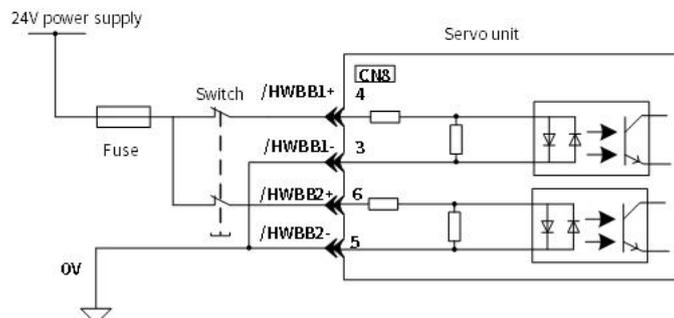


Figure 6-13 Resetting from HWBB State Timing Chart

- Note: 1. If the servo unit is placed in the BB state while the main circuit power supply is OFF, the HWBB state will be maintained until the /S-ON (Servo ON) signal is turned OFF.
- 2. If the /S-ON (Servo ON) signal is set to be always active(Pn50A.1), you cannot reset the HWBB state. Do not set this value if you are using the HWBB.

4) Detecting Errors in HWBB signal

If only the /HWBB1 or /HWBB2 signal is input, a safety function signal input timing error (A.Eb1) alarm will occur. This

makes it possible to detect failures, such as disconnection of an HWBB signal.

➤ Note: The A.Eb1 alarm (Safety Function Signal Input Timing Error) is not a safety-related element. Keep this in mind when you design the system.

5) Connection Example and Specifications of Input Signal (HWBB signal)

The input signal must be connected to the two input signal channels. The connection example and specifications of the input signal (HWBB signal) are as follows:

➤ Note: For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

Input signal (HWBB signal) connection example:

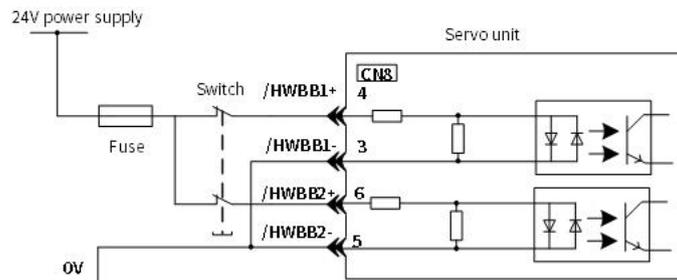


Figure 6-14 HWBB Input Signal Connection Example

Table 6-19 Input Signal (HWBB Signal) Specifications

| Type | Signal | Connector Pin No. | Status | Meaning |
|-------|--------|-------------------|------------|--|
| Input | /HWBB1 | CN3-4 CN3-3 | ON(closed) | HWBB function is not active (normal) |
| | | | OFF(open) | HWBB function is active (requires to shut OFF the motor current) |
| | /HWBB2 | CN3-6 CN3-5 | ON(closed) | HWBB function is not active (normal) |
| | | | OFF(open) | HWBB function is active (requires to shut OFF the motor current) |

Table 6-20 Input Signal (HWBB Signal) Electrical Characteristics

| Item | Characteristic | Remarks |
|-----------------------|----------------|---|
| Internal Resistance | 4.7kΩ | - |
| Working Voltage Range | +11V~+25V | - |
| Maximum Delay Time | 20ms | The interval between /HWBB1 and /HWBB2 OFF and HWBB function starts |

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2), the power supply to the servo motor will be turned OFF within 20 ms

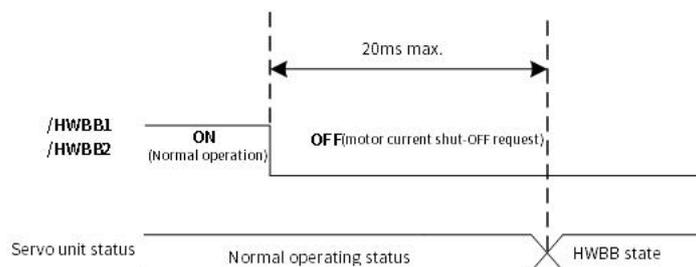


Figure 6-15 Base Block Function Operation Timing Chart

- Note: 1. The OFF status is not recognized if the OFF interval of the /HWBB1 or /HWBB2 signal is 0.5 ms or shorter
- 2. You can check the status of the input signals by using monitor displays. For details, refer to "Safety Input Signal Monitoring".

6) When running through the Utility function

The HWBB function is also available when running through Utility functions.

However, under the following Utility functions, the /HWBB1 and /HWBB2 signals are OFF. Even if the /HWBB1 and /HWBB2 signals are turned ON during the operation of the Utility functions, the operation will not work. Please exit utility function and enter again to restart

- Jogging (Fn002)
- Origin search (Fn003)
- Program jogging (Fn004)
- Advanced auto tuning (Fn201)
- EasyFFT (Fn206)
- Adjustment of motor current detection signal offset (Fn00E)

7) Servo Ready Output (/S-RDY) Signal

The /S-ON (Servo ON) signal will not be acknowledged in the HWBB state, so the servo ready output will turn OFF .

The Servo Ready Output Signal will turn ON if both the /HWBB1 and /HWBB2 signals are ON and the /S-ON signal is turned OFF.

An example is provided below for when the main circuit power supply is ON and the SEN signal turns ON when there is no servo alarm. (An absolute encoder is used in this example.)

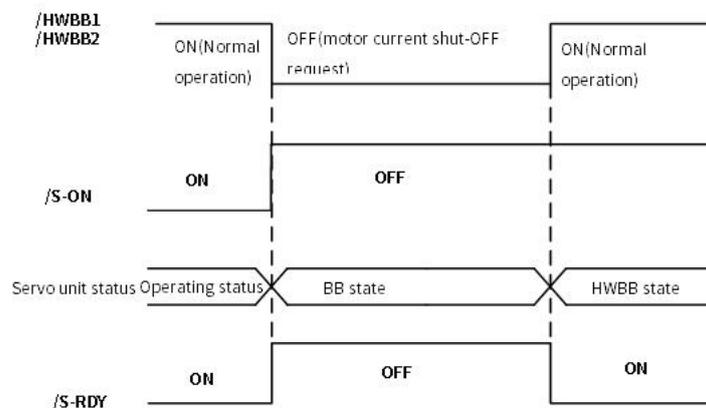


Figure 6-16 Servo Ready Output (/S-RDY) Timing Chart

8) Brake Signal (/BK)

If the HWBB operates when the /HWBB1 or /HWBB2 signal is OFF, the /BK (Brake) signal will turn OFF . At that time, the setting in Pn506 (Brake Reference - Servo OFF Delay Time) will be disabled. Therefore, the servo motor may be moved by external force until the actual brake becomes effective after the /BK signal turns OFF.

- Note: Since the brake signal output is not a safety function, please ensure that no danger will occur even if the brake signal fails in the HWBB state when designing the system. In addition, please note that the brake of the servo motor is for fixing but not stopping the motor.

9) Dynamic Brake

When activate dynamic brake through Selection of Stopping Method at Servo OFF (Pn001.0), the dynamic brake will stop the servo motor after the /HWBB1 or /HWBB2 signal is OFF and the HWBB function is operating.

- Note: 1. The dynamic brake is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the servo motor coasts to a stop in the HWBB state. Normally, we recommend that you use a sequence that returns to the HWBB

state after stopping for a reference.

➤ 2. If the application frequently uses the HWBB, stopping with the dynamic brake may result in the deterioration of elements in the servo unit. To prevent internal elements from deteriorating, use a sequence in which the HWBB state is returned to after the servo motor has come to a stop.

10) Setting of Position Deviation Clearing

A position deviation in the HWBB state is cleared according to the setting of Pn200.2(Clear Operation)

If you specify not clearing the position deviation during position control (Pn200.2=1), the position deviation will accumulate unless the position command from the host controller is canceled in the HWBB state. The following conditions may result.

- An A.d00 alarm (Position Deviation Overflow) may occur
- If you turn ON the servo after changing from HWBB state to BB state, the servo motor may move for the accumulated position deviation.

Therefore, stop the position reference from the host controller while in the HWBB state. If you specify not clearing the position deviation during position control(Pn.200.2=1), input the CLR signal during the HWBB or BB state to clear the position deviation.

11) Servo Alarm Output Signal (ALM)

The servo alarm output signal (ALM) cannot be output in the HWBB state.

6.8.2 External Device Monitoring (EDM1)

External device monitor (EDM1) is a function to monitor the failure in HWBB. Please connect as a feedback signal such as to the safety unit.

Failure Detection Signal for EDM1 Signal:

EDM1 and /HWBB1 and /HWBB2 signals is shown below.

The relationship between the EDM1, /HWBB1, and /HWBB2 signals is shown below. Detection of failures in the EDM1 signal circuit can be achieved by using the status of the /HWBB1, /HWBB2, and EDM1 signals in the following table. A failure can be detected by checking the failure status, e.g., when the power supply is turned ON.

Table 6-21 Four Status of EDM1

| Signal | Logic | | | |
|--------|-------|-----|-----|-----|
| | ON | ON | OFF | OFF |
| /HWBB1 | ON | ON | OFF | OFF |
| /HWBB2 | ON | OFF | ON | OFF |
| EDM1 | OFF | OFF | OFF | ON |

➤ Note: The EDM1 signal is not a safety output. Use it only for monitoring for failures

1) Connection Example and Specifications of Output Signal (EDM1 signal)

The connection example output signal (EDM1 signal) are shown below.

➤ Note: For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

2) Connection example of output signal (EDM1 signal):

The output signal (EDM1 signal) is a common emitter output, and the connection example is as follows:

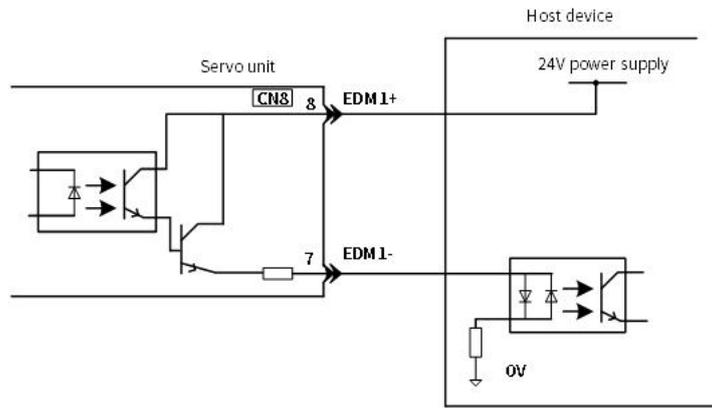


Figure 6-17 Common Emitter Output Signal (EDM1 Signal)

Table 6-22 Output Signal (EDM1 Signal) Specifications

| Type | Signal | Connector Pin No. | Status | Meaning |
|--------|--------|-------------------|------------|---|
| Output | EDM1 | CN3-8 CN3-7 | ON(closed) | /HWBB1 signal and /HWBB2 signal operate normally. |
| | | | OFF(open) | /HWBB1 signal or /HWBB2 signal is not activated, or neither the /HWBB1 signal nor the /HWBB2 signal operates. |

Table 6-23 Output Signal (EDM1 Signal) Electric Characteristics

| Item | Characteristic | Remarks |
|--|----------------|---|
| Maximum Allowable Voltage | DC30V | — |
| Maximum Current | DC50mA | — |
| The Maximum Voltage Drop when the Signal is ON | 1.0V | It is the voltage between EDM1+ ~ EDM1- when the current is 20mA, |
| Maximum Delay Time | 20ms | The time of changing from /HWBB1, /HWBB2 to EDM1 |

6.8.3 Application Examples for Safety Functions

The following provides the examples of using safety functions.

(1) Output Signal (EDM1 Signal) Connection Example and Specifications

In the following example, a safety Unit is used and the HWBB operates when the guard is opened:

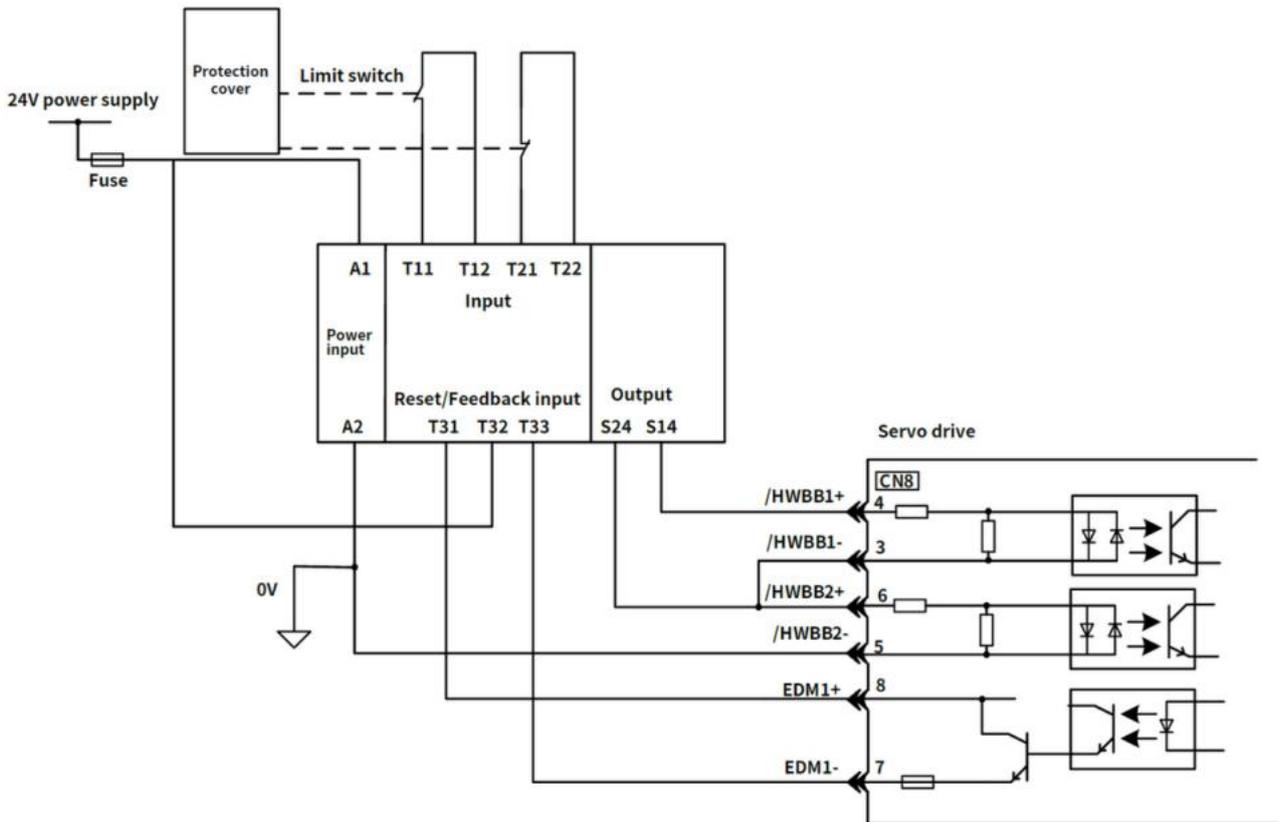


Figure 6-18 Connection Example of HWBB Operating when Safety Unit is used and the Guard is Opened

Under normal circumstances, When the guard is opened, both the /HWBB1 and the /HWBB2 signals turn OFF, and the EDM1 signal turns ON. Because the feedback circuit is ON while the guard is closed, the Safety Unit is reset, the /HWBB1 and the /HWBB2 signals turn ON, and the operation is enabled.

➤ Note: EDM1 signal is used for common emitter output. When wiring, make sure that current flows from EDM1+ to EDM1-

(2) Failure Detection Method

If a failure occurs (e.g., the /HWBB1 or the /HWBB2 signal remains ON), the safety unit is not reset when the guard is closed because the EDM1 signal remains OFF. Therefore, starting is not possible and a failure is detected.

In this case the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the servo unit. Find the cause and correct the problem

(3) Steps to use

- ① Request is received to open the guard
- ② When the motor is running, the stop command is received from the host controller, the servo motor will stop and be OFF.
- ③ The guard is opened
- ④ The /HWBB1 and /HWBB2 turn OFF, the HWBB function operates (Working inside the guard is enabled).
- ⑤ Leave the guard after completing the work.
- ⑥ The guard is closed.
- ⑦ Servo turns ON by the host controller.

6.8.4 Validating Safety Functions

When you commission the system or perform maintenance or servo unit replacement, you must always perform the following validation test on the HWBB function after completing the wiring

- When the /HWBB1 and /HWBB2 signals turn OFF, confirm that the panel operator or digital operator displays Hbb and that the servo motor does not operate.
- Monitor the ON/OFF status of the /HWBB1 and /HWBB2 signals via Un015 .
- If the ON/OFF status of the signals do not coincide with the display, the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the servo unit. Find the cause and correct the problem.
- Confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.

6.8.5 Safety Precautions When Using the Security Function

- To confirm that the HWBB function satisfies the safety requirements of the system, you must conduct a risk assessment of the system. Incorrect use of safety function may cause injury
- The servo motor will move if there is an external force (e.g., gravity on a vertical axis) even when the HWBB function is operating. Use a separate means, such as a mechanical brake, that satisfies the safety requirements. Incorrect use of the safety function may cause injury
- While the HWBB function is operating, the servo motor may move within an electric angle of 180° or less as a result of a servo drive failure. Use the HWBB function for an application only after confirming that movement of the servo motor will not result in a hazardous condition. Incorrect use of the safety function may cause injury
- Dynamic brake • The dynamic brake and the brake signal are not safety-related elements. You must design the system so that servo drive failures will not cause a hazardous condition while the HWBB function is operating. Incorrect use of the safety function may cause injury
- Connect devices that satisfy the safety standards for the signals for safety functions. Incorrect use of the safety function may cause injury.
- When using the HWBB function as an emergency stop function, please use an electrical mechanical part separately to cut off the power to the motor. Incorrect use of the safety function may cause injury.
- The HWBB function does not shut OFF the power to the servo drive or electrically isolate it. Implement measures to shut OFF the power supply to the servo drive before you perform maintenance on it. There is a risk of electric shock.

6.9 Soft Start

The soft start function takes a stepwise speed command input and applies the specified acceleration/deceleration rates to convert it to a trapezoidal speed reference. Acceleration time and deceleration time can be set.

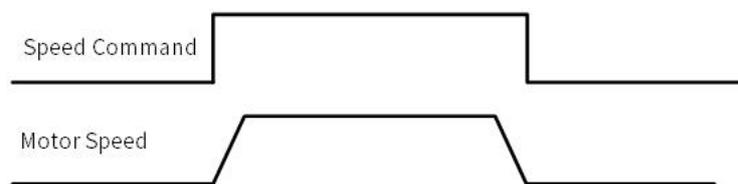


Figure 6-19 Soft Start Speed Command and Servo Motor Rate

Table 6-24 Soft Start Parameter Setting Table

| Pn305 | Soft Start Acceleration Time | | | When Enabled | Classification |
|-------|------------------------------|--------------|-----------------|--------------|----------------|
| | Setting range | Setting unit | Default setting | | |
| | 0-10000 | 1ms | 0 | | |
| Pn306 | Soft Start Deceleration Time | | | When Enabled | Classification |
| | Setting range | Setting unit | Default setting | | |
| | 0-10000 | 1ms | 0 | | |

Pn305: The time required for the servo motor to accelerate from a stopped state to the maximum motor speed.

Pn306: The time required for the servo motor to decelerate from the maximum motor speed to a stopped state.

The actual acceleration and deceleration time is calculated by the following formula.

$$\text{Actual acceleration time} = \frac{\text{Target speed}}{\text{Maximum speed}} \times \text{Soft start(Acceleration speed Pn305)}$$

$$\text{Actual deceleration time} = \frac{\text{Target speed}}{\text{Maximum speed}} \times \text{Soft start(Deceleration speed Pn306)}$$

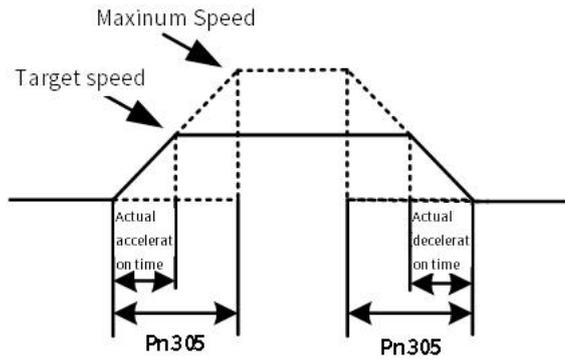


Figure 6-20 Pn305, Pn306 command Acceleration/Deceleration time

6.10 Smooth Function

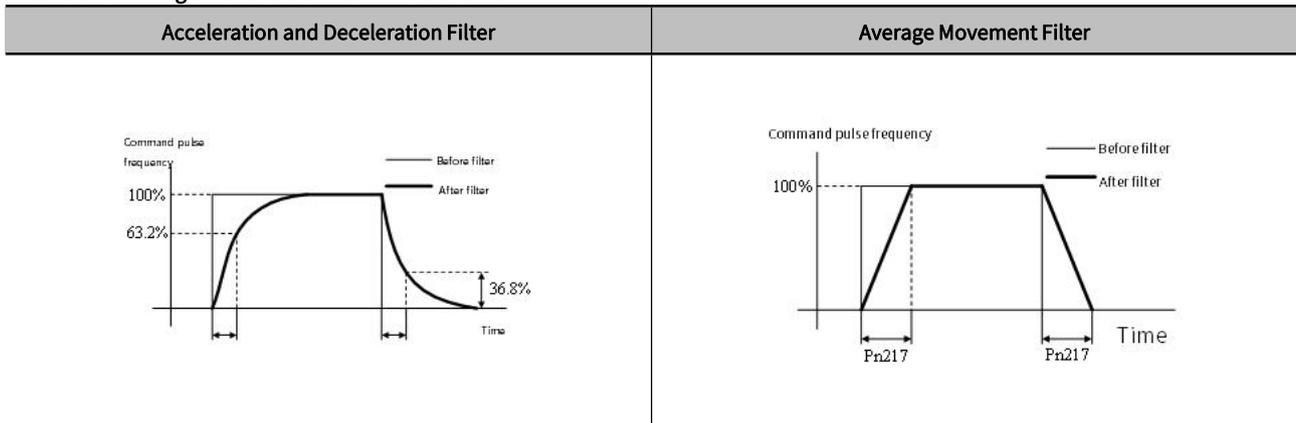
Apply a filter to the pulse input command to make command smoother

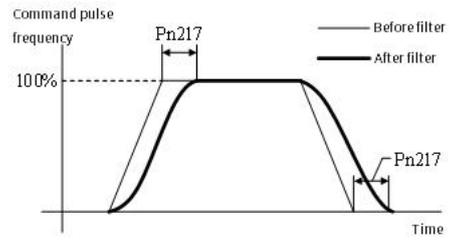
Table 6-25 Pn216, Pn217 Filter Command Table

| Pn216 | Position Reference Acceleration/Deceleration Time Constant | | | When Enabled | Classification |
|-------|--|--------------|-----------------|-----------------------------------|----------------|
| | Position | | | | |
| | Setting range | Setting unit | Default setting | | |
| | 0-65535 | 0.1ms | 0 | Immediately after the motor stops | Setup |
| Pn217 | Position command moving average time | | | When Enabled | Classification |
| | Position | | | | |
| | Setting range | Setting unit | Default setting | | |
| | 0-10000 | 0.1ms | 0 | Immediately after the motor stops | Setup |

Pn216 and Pn217 functions are as follows:

Table 6-26 Timing difference between Pn216 and Pn217







Chapter 7 Tuning

| | | |
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7.1 About Tuning

Tuning is used to optimize the response of the servo system through multiple parameters (speed loop gain, position loop gain, filter, friction compensation, moment of inertia ratio, etc.). Therefore, when setting the servo gain, you have to consider the balance between the setting values of various parameters.

The factory setting of the servo gain is stable. According to the status of the user's machine, the following auxiliary functions can be used to adjust the servo gain to further improve response. Advanced auto-tuning function is the latest gain control algorithm of Y7S series servo drive. After using this function, the above-mentioned parameters will be automatically adjusted. Therefore, it is usually not necessary to adjust separately.

7.1.1 Basic Tuning Method

The table below provides a description of the auxiliary functions related to the adjustment. Please select according to the status and operating conditions of the machine you are using.

Table 7-1 Auxiliary functions

| Auxiliary functions | Overview | Available control mode | Operating tool | |
|--|--|-----------------------------------|----------------|--------------|
| | | | Panel operator | HCServoWorks |
| Tuning-less (Fn200) | The setting of this function is invalid by default. If need to use this function, please set Pn170.0=1. Stable response can be obtained regardless of the type of machinery and load fluctuations. | Speed control Position control | ✓ | ✓ |
| Advanced Auto tuning 1 (Internal command) | When the automatic gain tuning function 1 is on, the servo drive will perform the following automatic adjustments. (recommended to use this function) <ul style="list-style-type: none"> • Moment of inertia ratio • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control • vibration suppression | Speed control Position control | × | ✓ |
| Advanced Auto tuning 2 (Host controller command) | When the automatic gain tuning function 2 is on, the position command is input from the upper device, and the following automatic adjustments are performed. <ul style="list-style-type: none"> • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control • vibration suppression | Position control | × | ✓ |
| One-parameter tuning | Input the position command or speed command from the host device, and perform the following adjustments. <ul style="list-style-type: none"> • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control | Speed control Position control | △ | ✓ |
| Adjust Anti-resonance Control function | To suppress vibration of 100~1000Hz | Speed control Position control | × | ✓ |
| Vibration suppression function | To suppress aftershock generated during positioning | Position control | × | ✓ |

✓: Operable △: Operable, but some functions are limited × : Not operable

7.1.2 Monitoring during Tuning

When adjusting the servo gain, it is necessary to adjust while observing the operating state of the machine and the signal waveform. In order to observe the signal waveform, please connect the measuring instrument such as the memory recording device to the analog quantity monitoring connection port (CN5) of the servo drive.

The following are the settings and parameters related to the monitoring of analog signals.

1) Monitor signals that can be observed

The monitoring signals shown below can be selected through Pn006 and Pn007.

Pn006 is used for analog monitoring 1, and Pn007 is used for analog monitoring 2.

Table 7-2 Monitoring signal parameters

| Parameter | Content | | |
|--|---|---|--|
| | Monitoring signal | Output unit | Remarks |
| n.□□00 [Factory setting of Pn007] | Motor Speed | 1V/1000min ⁻¹ | - |
| n.□□01 | Speed Command | 1V/1000min ⁻¹ | - |
| n.□□02 [Factory setting of Pn006] | Torque Command | 1V/100% rated torque | - |
| n.□□03 | Position Deviation | 0.05V/1 command unit | 0V during speed / torque control . |
| n.□□04 | Position Amplifier Deviation | 0.05V/1 encoder pulse unit | Position deviation after setting the electronic gear ratio. |
| n.□□05 | Position Command Speed | 1V/1000min ⁻¹ | Position command speed output by n times of the input command pulse. |
| Pn006 n.□□06 | Reserved parameters (Do not change) | - | - |
| Pn007 n.□□07 | Motor-Load Position Deviation | 0.01V/1 command unit | - |
| n.□□08 | Positioning Completion | Position completed: 5V Positioning not completed: 0V | Completedd by the output voltage. |
| n.□□09 | Speed Feedforward | 1V/1000min ⁻¹ | - |
| n.□□0A | Torque Feedforward | 1V/100% rated torque | - |
| n.□□0B | Active Gain* 1 | 1st gain : 1V 2nd gain : 2V | Gain types are expressed in terms of output voltage. |
| n.□□0C | Completion of Position Command Distribution | Output completed: 5V Positioning not completed: 0V | Completedd by the output voltage. |
| n. □□0D | External Encoder Speed | 1V/1000min ⁻¹ | Value calculated at the motor shaft |

* 1 For details, please refer to "Switching Gain"

2) Set the analog monitor magnification

Set the Output voltage of analog monitoring 1 and 2 according to the following.

Output voltage of analog monitoring 1 =

$$(-1) \times \{ \text{Analog monitor 1 signal selection}(\text{Pn007} = \text{n.00}\square\square) \times \text{Analog monitor 1 magnification}(\text{Pn552}) + \text{Analog monitor 1 offset voltage}(\text{Pn550}) \}$$

Output voltage of analog monitoring 2 =

$$(-1) \times \{ \text{Analog monitor 2 signal selection}(\text{Pn007} = \text{n.00}\square\square) \times \text{Analog monitor 2 magnification}(\text{Pn553}) + \text{Analog monitor 2 offset voltage}(\text{Pn551}) \}$$

3) Related parameters

Change the Monitor magnification and offset by the following parameters.

Table 7-3 Related parameters

| Pn550 | Analog Monitor 1 Offset Voltage <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/> | | | When enabled | Classification |
|-------|---|-------------|-----------------|--------------|----------------|
| | Setting range | Set unit | Factory setting | Immediately | Setup |
| | -10000 ~ 10000 | 0.1V | 0 | | |
| Pn551 | Analog Monitor 2 Offset Voltage <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/> | | | When enabled | Classification |
| | Setting range | Immediately | Factory setting | Immediately | Setup |
| | -10000 ~ 10000 | 0.1V | 0 | | |
| Pn552 | Analog Monitor 1 Magnification <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/> | | | When enabled | Classification |
| | Setting range | Immediately | factory setting | Immediately | Setup |
| | -10000 ~ 10000 | x0.01 | 100 | | |
| Pn553 | Analog Monitor 2 Magnification <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/> | | | When enabled | Classification |
| | Setting range | Immediately | Factory setting | Immediately | Setup |
| | -10000 ~ 10000 | x0.01 | 100 | | |

<Example>

Analog monitoring output when setting the Motor Speed (n.00)

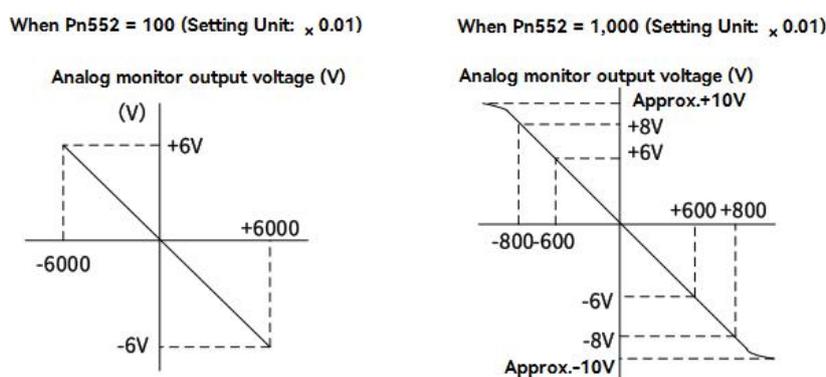


Figure 7-1 Analog detection output

7.1.3 Safety Precautions at Tuning

When making adjustments, be sure to observe the following precautions.

- Do not touch the rotating part of the motor while the servo is ON and the servo motor is running.
- When the servo motor is running, please make sure it can be stopped in an emergency at any time.
- Make adjustments after confirming that the test run is completed normally.
- To ensure safety, install a stop device on the machine side.

When making adjustments, please set the protection functions shown in the following items (1) to (5) under appropriate conditions.

1) Overtravel setting

Please set the overtravel. For details, refer to " Section 5. 3. 5 Overtravel Setting ".

2) Torque limit setting

The torque limit function is a function that calculates the torque required for machine operation and limits the output torque so that it does not exceed the setting range. Shock can be reduced in the event of mechanical failure such as interference or collision. If the torque is lower than the value required for operation, overshoot or vibration may occur.

3) Set the alarm value of excessive position deviation

The excessive position deviation alarm is an effective protection function when the servo drive is used for position control.

When the servo motor action does not match the command, by setting an appropriate alarm value for excessive position deviation, the error can be detected and the servo motor will stop running.

The position deviation refers to the difference between the value of position command and the actual position.

Relationship between the Position loop gain (Pn102) and the Motor speed below.

① Please refer to "Section 5.5.4 Electronic Gear Ratio".

The calculation example when $Pn102 = 400 \frac{Pn78C}{Pn78E} = \frac{1}{1}$

$$Pn520 = \frac{600}{60} \times \frac{1048576}{400/10} \times \frac{1}{1} \times 2 = 2621440 \times 2$$

$$= 5242880 (Pn520 \text{ Factory setting}) \times (1.2 \sim 2)$$

② When confirming the setting value of Pn102, please set the parameter display to "Display all parameters" (Pn00B.0 = 1).

$$\text{Position deviation "Command unit"} = \frac{\text{Motor Speed} [\text{min}^{-1}]}{60} \times \frac{\text{Encoder resolution} * 1}{\frac{Pn102 \left[\frac{0.1}{s} \right]}{10} * 2} \times \frac{Pn78C}{Pn78E}$$

Alarm value for excessive position deviation (Pn 520) [setting unit: 1 command unit]

$$Pn520 > \frac{\text{Max. Motor Speed} [\text{min}^{-1}]}{60} \times \frac{\text{Encoder resolution} * 1}{\frac{Pn102 \left[\frac{0.1}{s} \right]}{10} * 2} \times \frac{Pn78C}{Pn78E} \times (1.2 \sim 2)$$

" × (1.2 ~ 2)" in the double underlined part is the surplus coefficient to avoid frequent occurrence of excessive position deviation alarm (A.d00).

As long as make the setting as above, the excessive position deviation alarm will not occur during normal operation.

When a position deviation occurs because the motor action does not match the command, an abnormal situation will be detected and the motor will stop running.

When the acceleration and deceleration of the position command exceeds the tracking capability of the servo motor, the position deviation cannot satisfy the above relational expression. Please reduce the acceleration and deceleration of the position command to the value that the motor can track, or increase the alarm value of excessive position deviation.

Table 7-4 Parameters for setting the alarm value of excessive position deviation

| Pn520 | Position Deviation Overflow Alarm Level <u>Position</u> | | | When enabled | Classification |
|-------|---|----------------|-----------------|--------------|----------------|
| | Setting range | Unit | Factory setting | | |
| | 1 ~ 1073741823 | 1 command unit | 5242880 0 | | |

Table 7-5 Alarm No.

| Alarm number | Name | Content |
|--------------|-----------------------------|--|
| A.d00 | Position Deviation Overflow | The alarm displayed when the position deviation exceeds the Position Deviation Overflow Alarm Level (Pn520). |

4) Set the vibration detection function

Set an appropriate value for the vibration detection function. For details, refer to "Section 7.15 Initialize Vibration Detection Level (Fn01B)".

5) Set the position deviation excessive alarm value when the servo is ON

If the position deviation is accumulating and turnon the servo, the servo motor will return to the original position in order to make the position deviation "0", which will cause danger. In order to avoid this kind of situation, the alarm

value of excessive position deviation can be set when the servo is ON.

The relevant parameters and alarms are shown below.

Table 7-6 Set the parameters of excessive position deviation when the servo is ON

| Pn526 | Position Deviation Overflow Alarm Level at Servo ON Position | | | When enabled | Classification |
|-------|--|--------------------|-----------------|--------------|----------------|
| | Setting range | Unit | Factory setting | | |
| | 1 ~ 1073741823 | 1 command unit | 5242880 0 | | |
| Pn528 | Position Deviation Overflow Warning Level at Servo ON Position | | | When enabled | Classification |
| | Setting range | Unit | Factory setting | | |
| | 10 ~ 100 | 1% | 100 | | |
| Pn529 | Speed Limit Level at Servo ON Position | | | When enabled | Classification |
| | Setting range | Unit | Factory setting | | |
| | 0 ~ 10000 | 1min ⁻¹ | 10000 | | |

Table 7-7 Alarm No.

| Alarm No. | Alarm name | Content |
|-----------|---|--|
| A.d01 | Position Deviation Overflow Alarm at Servo ON | This is an alarm displayed when trying to turn on the servo while the position deviation is greater than the setting value of Pn526 during servo OFF. |
| A.d02 | Position Deviation Overflow Alarm for Speed Limit at Servo ON | If the servo is ON while the position deviation is accumulating, the speed will be limited by the Speed Limit Level at Servo ON (Pn529) at servo ON. Input the command pulse in this state, and the alarm will be displayed when the setting value of Position Deviation Overflow Alarm Level (Pn520) is exceeded. |

7.2 Tuning-less Function

Tuning-less function is set to "invalid" at the factory setting. If you use the Tuning-less function, please set Pn170.0=1. When resonance sound or vibration occurs, please change the rigidity value (Pn170.2) and load value (Pn170.3) through "Section 7.2.2 Operation Steps of Tuning-less Level Setting (Fn200)".

Note: 1. The Tuning-less function is set to "invalid" at the factory. If you use the Tuning-less function, please set Pn170.0=1. After the servo drive is installed on the machine, there will be a momentary sound when the servo is turned ON for the first time. This is the sound when the automatic notch filter is set, and it is not a malfunction. There will be no sound when the servo is turned ON next time. For details on the automatic notch filter, refer to "(3) About setting the automatic notch filter".

2. The servo motor may vibrate when used beyond the allowable moment of inertia of the load. At this time, please set Mode = 2 through Fn200, or lower the tuning value.

7.2.1 About the Tuning-less Function

The Tuning-less function is to obtain a stable response through automatic adjustment regardless of the type of machine or load fluctuations.

1) Set the Tuning-less function to be valid/invalid

Tuning-less function can be set by the following parameters.

Table 7-8 Parameters of the Tuning-less function

| Parameter | Contents | When enabled | Classification |
|-----------------------------|-------------------------------------|--------------------------------|----------------|
| n.□□□0 (Factory setting) | Disable the Tuning-less function | After restart the power supply | Setup |
| n.□□□1 | Enable the Tuning-less function | | |
| n.□□0□ (Factory setting) | Used as speed control | | |
| n.□□1□ | For speed control, position control | | |

2) Restrictions on usage

The Tuning-less function is valid for position control and speed control, but invalid during torque control.

Meanwhile, when the Tuning-less function is enabled, the control functions shown in the table below are partially restricted.

Table 7-9 Parameters of the Tuning-less function

| Function name | Executable/not executable | Executable Conditions and Remarks |
|---|---------------------------|--|
| Initialize Vibration Detection Level (Fn01B) | ✓ | — |
| Advanced Auto tuning 1 | △ | <ul style="list-style-type: none"> • Can be selected only at estimated moment of inertia. • To be invalid at the Tuning-less function executed, and becomes effective after Tuning-less function ends. |
| Advanced Auto tuning 2 | x | — |
| One-parameter tuning | x | — |
| Anti-Resonance Control Adjustment | x | — |
| Vibration Suppression Function | x | — |
| EasyFFT | ✓ | — |
| Friction Compensation | x | — |
| Gain Switching | x | — |
| Estimated Off-line Moment of Inertia (operated via HCServoWorks) | x | Operate after disable the Tuning-less function (Pn170.0 = 0). |
| Mechanical Analysis (operated via HCServoWorks) | ✓ | Operate after disable the Tuning-less function (Pn170.0 = 0). |

✓: Operable △: Operable, but some functions are limited × : Inoperable

3) About setting the automatic notch filter

Generally, set it to "Automatic adjustment" (by default).

At "automatic adjustment", vibration will be detected automatically when the Tuning-less function is enabled, and the notch filter will be set.

Please set it to "Do not adjust automatically" only when you do not change the notch filter setting.

Table 7-10 Setting automatic notch filter parameters

| Parameter | | Contents | When enabled | Classification |
|-----------|------------------------------|--|--------------|----------------|
| Pn460 | n.□0□□ | Automatic adjustment of the 2nd notch filter without auxiliary functions | Immediately | Setup |
| | n. □1□□ (Factory setting) | Automatic adjustment of the 2nd notch filter by auxiliary function | | |

4) About the Tuning-less value

The Tuning-less values: "Rigidity value" and "Load value". The adjustment value can be selected using the auxiliary function (Fn200) or the parameter setting (Pn170).

Table 7-11 Rigidity values

| Parameter | | Contents | When enabled | Classification |
|-----------|-----------------------------|---------------------------|--------------|----------------|
| Pn170 | n.□0□□ (Factory setting) | Rigidity value 0 (Level0) | Immediately | Setup |
| | n. □1□□ | Rigid value 1 (Level1) | | |
| | n.□2□□ | Rigid value 2 (Level2) | | |
| | n.□3□□ | Rigid value 3 (Level3) | | |
| | n.□4□□ | Rigid value 4 (Level4) | | |

Table 7-12 Load values

| Parameter | Contents | When enabled | Classification | |
|-----------|------------------------------|-----------------------------|----------------|-------|
| Pn170 | n. 0□□□ | Load value- lower (Mode0) | Immediately | Setup |
| | n. 1□□□ (Factory setting) | Load value- medium (Mode1) | | |
| | n. 2□□□ | Load value - higher (Mode2) | | |

7.2.2 Tuning-less Value Setting (Fn200)

The procedure for setting the Tuning-less value is as follows.

The Tuning-less value can be set by the operational panel or HCServoWorks.

1) Confirmation before execution

Please confirm the following settings before performing Tuning-less value. If the setting is not satisfied, " NO_OP " will be displayed during operation.

- Select Tuning-less to be valid (Pn170.0 = 1).
- The Write Prohibition Setting (Fn010) is disabled.

2) Operations steps via the operation panel

- ① Press **M** key to switch to Auxiliary function mode “**FN000**”
 - ② Press **▲** or **▼** key to “**FN200**”
 - ③ After long-pressing **S** for 1 sec., switch to the load value of tuning-less “**d**”
 - ④ Press **M** key to switch to the rigidity setting screen of tuning-less” **L 4** “
 - ⑤ Press **▲** or **▼** key to select the rigidity value. The higher the value, the higher the gain and the higher the response. (Factory setting:4)
- Vibration may occur when the rigidity value is too large. At this time, lower the rigidity value.
 - When a high tone occurs, press **S** to automatically adjust the frequency of the notch filter to the vibration frequency.
- ⑥ Press **M** key, the status display will change to “**done**” and flashes for about 1 sec., then displays “**L0004**” . And the setting will be stored in the servo drive.
 - ⑦ Press **S** for about 1 sec., then return to “**FN200**” .

Note: If overshoot occurs in the waveform, or when the load moment of inertia exceeds the allowable load (not subject to product warranty), press the key to change the load value to "2".

3) Alarm and treatment method

When a resonance sound occurs or a large vibration occurs in position control, an Auto-tuning Alarm (A.521) may appear. In this case, perform the following steps.

- When resonance sound occurs

Decrease the setting value of Mode or Level through Fn200.

- When large vibration occurs during position control

Increase the setting value of Mode or Level through Fn200. It is also possible to increase the setting value of Pn170.3 or decrease the setting value of Pn170.2 through parameter setting.

4) Parameters that make Tuning-less function become invalid

When the Tuning-less function is valid, the parameters Pn100, Pn101, Pn102, Pn103, Pn104, Pn105, Pn106, Pn160, Pn139, and Pn408 in the table below are invalid.

However, when the functions shown in the table below are executed, the above parameters related to gain may become valid.

For example, when Easy FFT is executed when the Tuning-less function is valid, the setting values of parameters Pn100, Pn104, Pn101, Pn105, Pn102, Pn106, Pn103 and the Manual gain switching are valid, and the setting value of Pn408.3, Pn160.0 and Pn139. 0 are invalid.

Table 7-13 Parameters that make Tuning-less function become invalid

| Parameters that make Tuning-less function become invalid | | | Executed functions and valid parameters | | |
|--|---|------------------|---|------------------|---|
| Items | Parameter | Items | Parameter | Items | Parameter |
| Gains | Speed Loop Gain 2nd Speed Loop Gain | Gains | Speed Loop Gain 2nd Speed Loop Gain | Gains | Speed Loop Gain 2nd Speed Loop Gain |
| | Speed Loop Integral Time Constant Second Speed Loop Integral Time Constant | | Speed Loop Integral Time Constant Second Speed Loop Integral Time Constant | | Speed Loop Integral Time Constant Second Speed Loop Integral Time Constant |
| | Position Loop Gain 2nd Position Loop Gain | | Position Loop Gain 2nd Position Loop Gain | | Position Loop Gain 2nd Position Loop Gain |
| | Moment of Inertia Ratio | | Moment of Inertia Ratio | | Moment of Inertia Ratio |
| Advanced Control | Friction Compensation Function Selection | Advanced Control | Friction Compensation Function Selection | Advanced Control | Friction Compensation Function Selection |
| | Anti-Resonance Control Selection | | Anti-Resonance Control Selection | | Anti-Resonance Control Selection |
| Gain switching | Gain Switching Selection | Gain switching | Gain Switching Selection | Gain switching | Gain Switching Selection |

✓: The parameter setting value is valid ✗: The parameter setting value is invalid

7.2.3 Related Parameters

The following 3 items are shown in the table below.

- Parameters associated with this function

The parameters used or referenced when executing this function.

- Is it possible to change the setting value of the parameter when executing this function?

"No": Parameters cannot be changed through HCServoWorks etc. when executing this function.

"Yes": Parameters can be changed through HCServoWorks etc. when executing this function.

- Whether there is automatic setting of parameters after executing this function

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-14 Parameters about Tuning-less function

| Parameter | Name | Possible to change the setting value | Automatic setting |
|-----------|--|--------------------------------------|-------------------|
| Pn170 | Tuning-less Function | No | Yes |
| Pn401 | 1st Stage 1st TorqueCommand Filter Time Constant | No | Yes |
| Pn40C | 2nd Stage Notch Filter Frequency | No | Yes |
| Pn40D | 2nd Stage Notch Filter Q Value | No | Yes |

7.3 Advanced Auto Tuning 1 - By HCServoWorks Internal Position Command

This section explains how to perform adjustments with advanced auto tuning 1.

Note: 1. Advanced auto tuning 1 controls the operation of the mechanism through the internal position command of the HCServoWorks software. Pay attention to the safety distance and mechanical collision when using it.

2. When using advanced auto tuning 1, please ensure that the Tuning-less function Pn170.0=0.

3. Advanced auto-tuning 1 starts to adjust based on the currently set speed loop gain (Pn100). Therefore, if vibration occurs at the start of adjustment, correct adjustment will not be possible.

At this time, please reduce the Speed Loop Gain (Pn100) until the vibration disappears

4. After performing advanced auto-tuning 1, if the advanced auto-tuning of "estimated load moment of inertia" is performed again due to changes in the load state and transmission mechanism of the machine, please change the following parameters number, and set all the set values after the last adjustment to be invalid. If advanced auto-tuning 1 is performed without changing the parameters, it may cause mechanical vibration or damage.

- ① Pn00B.0 = 1 (Display all parameters)
- ② Pn140.0 = 0 (Do not use model tracking control)
- ③ Pn160.0 = 0 (Adjust Anti-resonance Control is not used)
- ④ Pn408 = n.00 □0 (Do not use friction compensation, 1st or 2nd notch)

5. The operation of Advanced Auto tuning 1 can be performed through HCServoWorks. This function cannot be operated through the operation panel.

Table 7-15 Description of tuning mode

| Mode | Content |
|--------|---|
| Mode 1 | Adjust gain, notch filter, A-mode vibration |
| Mode 2 | Adjust the gain, model tracking, notch filtering, Anti-Resonance, and vibration suppression |
| Mode 3 | Adjust gain, notch filter, Anti-Resonance, and vibration suppression |

7.3.1 About Auto Tuning 1

Advanced auto tuning 1 refers to the function that the servo drive automatically adjusts according to the mechanical characteristics when performing automatic operation (forward and reverse reciprocating motion) within the setting range.

Advanced auto tuning can be performed without connecting a host controller.

The operation specifications of automatic operation are as follows.

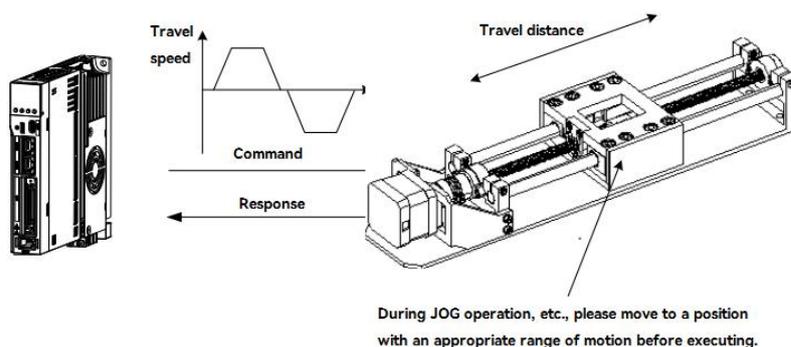


Figure 7-2 Automatic operation specification

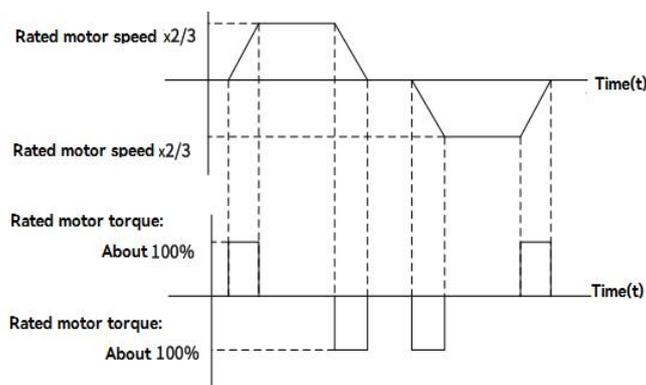


Figure 7-3 Example of automatic operation

- Maximum speed: Motor rated speed $\times (2/3)$.
- Acceleration torque: About 100% of the rated torque of the motor.

Acceleration torque will change according to the setting of Moment of Inertia Ratio (Pn103), mechanical friction, and external disturbance.

- Travelling distance: Can be set arbitrarily. The factory setting is equivalent to 3 revolutions of the servo motor.

Items of advanced Auto tuning 1:

- Moment of inertia ratio.
- Gain adjustment (speed loop gain, position loop gain, etc.).
- Filter adjustment (torque command filter, notch filter).
- Friction compensation.
- Anti-Resonance Control Adjustment.
- Vibration suppression (only when Mode = 2 or 3).

Note: Advanced Auto tuning 1 performs adjustments in automatic operation mode, so vibration or overshooting may occur during operation. In order to ensure safety, please execute the advance auto tuning in the state of emergency stop at any time.

Confirmation items before execution

Before performing advanced auto tuning 1, be sure to confirm the following settings. When the following items are not set, the operation will display "NO_OP":

- The main circuit power supply must be ON
- Servo must be OFF
- Forward-rotation prohibition (P-OT), reverse-rotation prohibition (N-OT) must not be in an overtravel state
- The clear signal must be L level (not cleared)
- Not for torque control
- The gain switching selection is manual gain switching (Pn139.0 = 0).
- The 1st gain is selected.
- No servo motor test function selection is invalid (Pn00C.0 = 0).
- No alarms or warnings occurred.
- Hardwired base block function (HWBB) is invalid
- Auto gain switching must be disabled
- Write Prohibition should be disabled (Fn010)
- Set the Tuning-less function to be invalid (Pn170.0 = 0)

<Supplement>

- When the advanced auto-tuning is performed under speed control, it will automatically switch to position control. And return to speed control after adjustment.

In the following cases, advanced auto tuning 1 cannot be performed normally. Please adjust with advanced auto tuning 2 or One-parameter tuning.

- When a mechanical system can only operate in one direction.
- The range of activity is narrow, and it is below 0.5 circles.

Advanced auto-tuning 2 → refer to "Section 6.4 Advanced Auto-tuning 2".

One-parameter tuning → refer to "Section 6.5 One-parameter Tuning".

Adjustment with advanced auto tuning 1 cannot be performed smoothly in the following cases. Please adjust with advanced auto tuning 2 or One-parameter tuning.

- When an appropriate range of motion cannot be obtained.
- When the moment of inertia fluctuates within the setting range.
- When the dynamic friction of the machine is large.
- When the rigidity of the machine is low and vibration occurs during the positioning operation.
- When using the position integration function.
- During P (proportional) control.

Note: When set to "Estimated Moment of Inertia", "Error" will be displayed during the process of estimated the moment of inertia, or when switching to P control via the /P-CON signal.

- When using the mode switch.

Note: When set to "Estimated moment of inertia", the mode switch function becomes invalid during the process of estimating the moment of inertia, and becomes PI control. Mode switch function becomes valid again after the moment of inertia estimation is completed.

- When Speed feedforward and Torque feedforward are input.
- When the Positioning Completion Width (Pn522) is narrow.

Advanced auto-tuning 2 → Refer to "Section 7.4 Advanced auto-tuning 2".

One-parameter tuning → Refer to "Section 7.5 One-parameter tuning".

Fine-tuning the overshoot without changing the positioning Completion Width (Pn522), use the overshoot detection value (Pn561). Since the factory setting of Pn561 is 100%, it is allowed to adjust up to the same overshoot as the positioning completion width. If changed to 0%, the adjustment can be performed without overshoot within the positioning completion width. However, after changing this value, the positioning time may be extended.

Table 7-16 Overshoot detection value parameters

| Pn561 | Overshoot Detection Value | | | When enabled | Classification |
|-------|---------------------------|------|-----------------|--------------|----------------|
| | Setting range | Unit | Factory setting | | |
| | 0-100 | 1% | 100 | Immediately | Setup |

7.3.2 Precautions for Advanced Auto-tuning 1

The operation of Advanced Auto-tuning 1 can only be performed by HCServoWorks software. This function cannot be operated through the operation panel.

1) The causes and countermeasures when error occurs in advanced auto-tuning 1

Table 7-17 "NO_OP" flashing display

| Reason | Countermeasures |
|--|--|
| Main circuit power OFF | Turn on the main circuit power supply |
| An alarm or warning has occurred | Troubleshooting the cause of an alarm or warning |
| Overtravel occurred | Troubleshooting the cause of overtravel |
| The 2nd gain is selected by gain switching | Disable auto gain switching |

| | |
|--|--|
| HWBB function action | Disable HWBB function |
| When the Tuning-less function is enabled | Turn off the Tuning-less function, and set P n170.0 to 0 |

Table 7-18 When "Error" is blinking

| Error content | Reason | Countermeasures |
|---|--|---|
| Gain adjustment not completed normally | Mechanical vibration occurs, or the positioning completion signal (/COIN) is unstable when the motor stops | <ul style="list-style-type: none"> • Increase the setting value of Pn522. • Change the mode from "Mode = 2" to "Mode = 3". • When mechanical vibration occurs, please use the Anti-Resonance adjustment function and vibration suppression function to suppress the vibration. |
| Error during moment of inertia estimation | Please refer to the following table "When an error occurs in estimated moment of inertia". | |
| Movement distance setting error | The movement distance is below the minimum adjustable movement distance (approximately 0.5 turn) | Increase movement distance. (The recommended number of rotations of the motor shaft is about 3 turns.) |
| Within 10 seconds after the positioning adjustment is completed, the positioning completion signal (/COIN) is not turned ON | The setting of the positioning completion width is too small, or the P control is selected. | <ul style="list-style-type: none"> • Increase the setting value of Pn522. • Turn OFF the /P-CON signal. |
| The Tuning-less function is enabled, but the estimated moment of inertia is not executed | The Tuning-less function is enabled, set to "Estimated moment of inertia (OFF)" | <ul style="list-style-type: none"> • Make Tuning-less function invalid. • Set to "Estimated moment of inertia (ON)". |

2) When an error occurs in Estimated moment of inertia

The following explains the causes and countermeasures of errors that may occur in the "Estimated moment of inertia".

Table 7-19 Errors

| Error display | Reason | Countermeasures |
|---------------|--|---|
| Err1 | The estimation operation of the moment of inertia has started, but the estimation process has not been executed | <ul style="list-style-type: none"> • Increase the setting value of speed gain (Pn100) • Increase Stroke (moving distance) |
| Err2 | The estimated value of the moment of inertia deviates too much, and the deviation has not decreased after 10 retries | Set the calculated value in Pn103 according to the machine specifications, and execute the estimation when the "Estimated moment of inertia OFF" |
| Err3 | Low frequency vibration detected | Double the starting value of the estimated moment of inertia (Pn324) |
| Err4 | Torque limit reached | <ul style="list-style-type: none"> • When using torque limit, increase the limit value • Double the starting value of the estimated moment of inertia (Pn324) |
| Err5 | When /P-CON etc. is input, the speed control becomes P control during estimated moment of inertia. | Change to PI control |

7.4 Advanced Auto-Tuning 2 - Via Host Controller Position Commands

This section explains how to perform adjustments with Advanced Auto Tuning 2. This function is controlled by the operation command (Pulse sequence command) of the upper device.

Note: 1. Advanced auto-tuning 2 is operated by the control mechanism of the upper device's operation command (Pulse sequence command). Pay attention to the safety distance and mechanical collision when using.

2. When using advanced auto-tuning 2, please ensure that the Tuning-less function Pn170.0=0 is turned off.

3. Advanced auto-tuning 2 starts to adjust based on the currently set speed loop gain (Pn100). Therefore, if vibration occurs at the start of adjustment, correct adjustment will not be possible.

At this time, please reduce the Speed Loop Gain (Pn100) until the vibration disappears.

4. After performing advanced auto-tuning 2, if the "Estimated moment of inertia" is performed again due to changes in the load state and transmission mechanism of the machine, please change the following parameters and set all the set values to be invalid. If advanced auto-tuning 2 is performed without changing the parameters, it may cause mechanical vibration or damage.

- ① Pn00B.0 = 1 (Display all parameters)
- ② Pn140.0 = 0 (Do not use model tracking control)
- ③ Pn160.0 = 0 (Do not use Adjust Anti-resonance Control)
- ④ Pn408 = n.00 □□ (Do not use friction compensation, 1st or 2nd notch)

5. The operation of Advanced auto tuning 2 can be performed through HCServoWorks. This function cannot be operated through the operation panel.

7.4.1 About Advanced Auto-tuning 2

Advanced auto-tuning 2 is a method for automatically performing optimal adjustments to the operation command (pulse train command) from the host controller.

Advanced Autotuning 2 can also be used for additional adjustments after Advanced auto-tuning.

In addition, if the correct moment of inertia ratio is set in Pn103, we don't have to perform advanced auto-tuning and only perform the advanced auto-tuning 2.

Advanced Auto Tuning 2 makes adjustments to the following items.

- Gain adjustment (speed loop gain, position loop gain, etc.)
- Filter adjustment (torque command filter, notch filter)
- Friction compensation
- Adjust Anti-Resonance Control

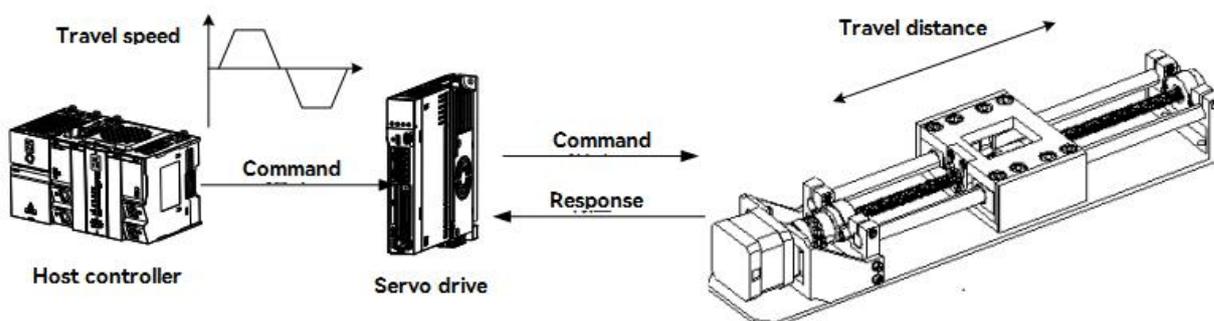


Figure 7-4 Example of automatic operation

Note: Advanced Autotune 2 performs automatic adjustment, so vibration or overshoot may occur during operation. To ensure safety, perform advanced tuning in a state where an emergency stop is possible at any time.

Confirmation items before operation

Before perform advanced auto tuning 2, be sure to confirm the following settings. When the following items are not correct, the "NO_OP" will display:

- The main circuit power supply must be ON
- The servo must be OFF
- Prohibition of forward-rotation (P-OT), prohibition of reverse-rotation (N-OT) must not be in an overtravel state
- The gain switching selection switch is manual gain switching (Pn139.0 = 0).
- The 1st gain is selected.
- No motor test function selection is invalid (Pn00C.0 = 0).
- No alarms or warnings occurred.
- Hardwired base block function (HWBB) does not work
- Auto gain switch must be disabled
- Write Prohibition should be disabled (Fn010)

- Set the Tuning-less function to be invalid (Pn170.0 = 0)
- The servbo motor is in the Position control while the servo ON.

The advanced auto tuning 2 cannot be adjusted smoothly in the following cases. Please adjust by One-parameter tuning.

- When the movement amount indicated by the upper device command is the setting value of the positioning completion width (Pn522) or less.
- When the moving speed commanded by the upper device is the setting value of the rotation detection value (Pn502) or less.
- When the Stop time (the time during which the positioning complete signal (/COIN) is OFF) is 10ms or less.
- When the rigidity of the machine is low and vibration occurs during the positioning operation.
- When using the position integration function.
- During P (proportional) control.
- When using the mode switch.
- When the positioning completion width (Pn522) is narrow.

One-parameter tuning → refer to "Section 7.5 One-parameter Tuning".

Only use the overshoot detection value (Pn561) when fine-tuning the overshoot without changing the positioning completion range (Pn522). Since the factory setting of Pn561 is 100%, it is allowed to adjust up to the same overshoot as the positioning completion width. If changed to 0%, the adjustment can be performed without overshoot within the positioning completion width. However, after changing this value, the positioning time may be extended.

Table 7-21 Related Parameters about Advanced Auto Resonance 1

| Pn561 | Overshoot Detection Value | | | When enabled | Classification |
|-------|---------------------------|------|-----------------|--------------|----------------|
| | Setting range | Unit | Factory setting | | |
| | 0-100 | 1% | 100 | | |

7.4.2 Precautions for Advanced Auto tuning 2

Advanced Auto tuning 2 operations can only be performed through HCServoWorks. This function cannot be operated through the operation panel.

The causes and countermeasures when the error occurs at performing advanced auto tuning 2:

Table 7-22 When "NO_OP" is blinking

| Reason | Countermeasures |
|--|--|
| Main circuit power OFF | Turn on the main circuit power |
| An alarm or warning has occurred | Troubleshooting the cause of an alarm or warning |
| Overtravel occurred | Troubleshooting the cause of overtravel |
| The 2nd gain is selected by gain switching | Disable auto gain switching |
| HWBB function action | Disable HWBB function |

Table 7-23 Parameters about executing Advanced auto-tuning 2

| Parameter | Content | When enabled | Classification |
|-----------|-----------------------------|--------------|----------------|
| Pn160 | n.□□0□ | Immediately | Tuning |
| | n.□□1□ (Factory setting) | | |

Table 7-24 When "Error" is blinking

| Error | Reason | Countermeasures |
|--|-------------------------------------|--------------------------------------|
| Gain adjustment not completed normally | Mechanical vibration occurs, or the | •Increase the setting value of Pn522 |

| | | |
|--|---|---|
| | positioning completion signal (/COIN) is unstable when the servo motor stops | <ul style="list-style-type: none"> • Change mode from "Mode = 2" to "Mode = 3" • When mechanical vibration occurs, please use the Anti-Resonance adjustment function and vibration suppression function to suppress the vibration |
| Positioning completion signal (/COIN) is not turned ON within 10 seconds after the positioning adjustment is completed | The setting of the positioning completion width is too small, or the P control is set | <ul style="list-style-type: none"> • Increase the setting value of Pn522 • Set /P-CON signal to OFF |

7.5 One-parameter Tuning

This section explains how to adjust by One-parameter tuning.

7.5.1 About One-parameter Tuning

One-parameter tuning is a method of manually adjusting a speed command or a position command from a host device while running.

Adjusting one or two values through One-parameter tuning automatically adjusts the setting value of the associated gain.

One-parameter tuning has the following items.

- Gain adjustment (speed loop gain, position loop gain, etc.).
- Filter adjustment (torque command filter, notch filter).
- Friction compensation.
- Adjust Anti-resonance Control.

<Supplement>

If the response characteristics cannot be obtained with advanced auto tuning 1 or advanced auto tuning 2, use One-parameter tuning.

In addition, if you want to further fine-tune servo gain after One-parameter tuning, please refer to "Adjustment Application Function"

Note: Vibration or overshoot may occur during adjustment. To ensure safety, perform advanced tuning in a state where an emergency stop is possible at any time.

Confirmation items before execution:

Before perform One-parameter tuning, be sure to confirm the following settings. When the following items are not set, "NO_OP" will display:

- The test without a motor function must be disabled (Pn00C.0 = 0).
- Write Prohibition should be disabled (Fn010).
- Set the Tuning-less function to be invalid (Pn170.0 = 0).
- When performing tuning by speed control, set the tuning mode to 0 or 1.

7.5.2 Operation Steps for One-parameter Tuning

The operation steps of One-parameter tuning are as follows.

According to the selected adjustment mode, there are two operation procedures for One-parameter tuning.

- When Mode = 0 or 1 - Model tracking control is "invalid", and make adjustments except positioning.
- When Mode = 2 or 3 - Model tracking control is "valid", and make adjustments of positioning.

The operation of One-parameter tuning can be executed through the operation panel or HCServoWorks.

However, the operation panel can only be operated when the tuning mode is set to "Mode = 0", "Mode = 1".

Please operate after setting the Moment of Inertia Ratio (Pn103) correctly by advanced auto tuning.

7.6 Supplements for Auto-tuning

7.6.1 Supplements for Function

Automatic notch filter function:

Normally, please set to "Auto-tuning" (Factory setting: "Auto-tuning").

When set to "Auto-tuning", vibration will be detected automatically when this function is executed, and the notch filter will be adjusted.

Please set to "No auto-tuning" only when you do not change the notch filter setting.

Table 7-25 Parameters for Automatic notch filter

| Parameter | Contents | When enabled | Classification |
|-----------|------------------------------|--------------|----------------|
| Pn460 | n.□□□0 | Immediately | Tuning |
| | n.□□□1 (Factory setting) | | |
| | n. □0□□ | | |
| | n. □1□□ (Factory setting) | | |

Adjust Anti-resonance Control function:

Normally, please set to "Auto-tuning" (Factory setting: "Auto-tuning")

When set to "Auto Tuning", vibration is automatically detected during Advanced auto-tuning, and Adjust Anti-Resonance Control is automatically adjusted.

Table 7-26 Parameters about Adjust Anti-resonance Control

| Parameter | Contents | When enabled | Classification |
|-----------|-----------------------------|--------------|----------------|
| Pn160 | n.□□0□ | Immediately | Tuning |
| | n.□□1□ (Factory setting) | | |

Vibration suppression function:

The vibration suppression function is mainly used to suppress the low-frequency vibration (shaking) of about 1 to 100 Hz caused by the vibration of the machine during positioning.

Normally, please set to "Auto-tuning" (Factory setting: "Auto-tuning").

When set to "Auto-tuning", vibration is automatically detected during advanced auto-tuning, and vibration suppression control is automatically adjusted.

Set to "No auto-tuning" only when you do not change the vibration suppression control setting that was set before executing advanced auto tuning.

Table 6-27 Parameters about Vibration suppression function

| Parameter | Contents | When enabled | Classification |
|-----------|------------------------------|--------------|----------------|
| Pn140 | n.□0□□ | Immediately | Tuning |
| | n. □1□□ (Factory setting) | | |

Friction compensation function:

- Lubricant viscous resistance changes in machine sliding parts
- Frictional resistance change caused by mechanical assembly deviations
- Frictional resistance change due to Aging

The applicable conditions for friction compensation differ depending on the mode. "Mode= 1" follows the setting of "Friction compensation function selection (Pn408.3)". "Mode = 2" or "Mode = 3" has nothing to do with the setting of "Friction compensation function selection (Pn408.3)", and can be adjusted through "Valid friction compensation function".

Table 7-28 Parameters for Friction compensation function

| Friction compensation function selection | | Mode | "Mode= 1" | "Mode= 2" | "Mode= 3" |
|--|-----------------------------|------|--|--|--|
| Pn408 | n.0□□□ (Factory setting) | | Adjust when friction compensation is invalid | Adjust when friction compensation is valid | Adjust when friction compensation is valid |
| | n.1□□□ | | Adjust when friction compensation is valid | | |

Feedforward function:

After adjustment by "Mode= 2" and "Mode = 3" in the factory setting mode, "Feedforward (Pn109)", "Speed feedforward (V-REF) input" and "Torque feedforward (T- REF) input" will become invalid.

According to the system configuration, if you want to use the "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" and Model tracking control from the upper device at the same time, please set Pn140.3 = 1.

Table 7-29 Parameters for Feedforward function

| Parameter | Contents | When enabled | Classification |
|-----------|-----------------------------|--------------|----------------|
| Pn140 | n.0□□□ (Factory setting) | Immediately | Tuning |
| | n.1□□□ | | |

Note: When using the model tracking control under this function, the model tracking control will have the best feedforward inside the servo. Therefore, usually do not use "speed feedforward (V-REF) input" and "torque feedforward (T-REF) input" from the upper device at the same time. However, Model tracking control and "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" can be used at the same time as required. In this case, if the input feed-forward is not correct, it may cause overshoot, please pay attention.

7.6.2 Related Parameters

Related parameters are listed in Table 7-30 below.

- Parameters related to this function

The parameters used or referenced when executing this function.

- Whether to change the setting value of the parameter when executing this function.

"No": When executing this function, parameters cannot be changed through HCServoWorks, etc.

"Yes": Parameters can be changed through HCServoWorks, etc. when executing this function.

- Whether there is automatic setting of parameters after executing this function

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-30 Parameters related to One-parameter tuning

| Parameter | Name | Is it possible to change the setting value | Automatic setting |
|-----------|-----------------------------------|--|-------------------|
| Pn100 | Speed Loop Gain | No | Yes |
| Pn101 | Speed Loop Integral Time Constant | No | Yes |
| Pn102 | Position Loop Gain | No | Yes |
| Pn103 | Moment of Inertia Ratio | No | No |
| Pn121 | Friction Compensation Gain | No | Yes |
| Pn123 | Friction Compensation Coefficient | No | Yes |

| | | | |
|-------|--|-----|-----|
| Pn124 | Friction Compensation Frequency Correction | No | No |
| Pn125 | Friction Compensation Gain Correction | No | Yes |
| Pn401 | 1st Stage 1st Torque Command Filter Time Constant | No | Yes |
| Pn408 | Torque-Related Function Selections | Yes | Yes |
| Pn409 | 1st Stage Notch Filter Frequency | No | Yes |
| Pn40A | 1st Stage Notch Filter Q Value | No | Yes |
| Pn40C | 2nd Stage Notch Filter Frequency | No | Yes |
| Pn40D | 2nd Stage Notch Filter Q Value | No | Yes |
| Pn140 | Model Following Control-Related Selections | Yes | Yes |
| Pn141 | Model Following Control Gain | No | Yes |
| Pn142 | Model Following Control Gain Correction | No | Yes |
| Pn143 | Model Following Control Bias in the Forward Direction | No | Yes |
| Pn144 | Model Following Control Bias in the Reverse Direction | No | Yes |
| Pn145 | Vibration Suppression 1 Frequency A | No | Yes |
| Pn146 | Vibration Suppression 1 Frequency B | No | Yes |
| Pn147 | Model Following Control Speed Feedforward Compensation | No | Yes |
| Pn160 | Anti-Resonance Control-Related Selections | Yes | Yes |
| Pn161 | Anti-Resonance Frequency | No | Yes |
| Pn163 | Anti-Resonance Damping Gain | No | Yes |

7.7 Adjust Anti-resonance Control Function

This section describes the Adjust Anti-resonance Control function.

7.7.1 About Adjust Anti-resonance Control Function

Adjust Anti-Resonance Control function is used to further improve the effect of vibration suppression after the One-parameter tuning.

Adjust Anti-resonance Control function can effectively suppress the continuous vibration of about 100-1000Hz that occurs when the control gain is increased.

This function will be automatically set by Advanced Auto-tuning or Advanced Auto-tuning 2. So use this function only when further fine-tuning is required and when re-adjustment is required due to vibration detection failure.

After executing this function, if want to improve the response, perform One-parameter tuning, etc. Vibration may reoccur after the anti-vibration gain is increased by one-parameter tuning, etc. At this time, please execute this function again to make minor adjustments.

Note: •After executing this function, relevant parameters will be set automatically. Therefore, when this function is executed, the response may change greatly. For the sake of safety, please execute this function in the state of emergency stop at any time.

- Before executing the Adjust Anti-resonance Control function, please correctly set the moment of inertia ratio (Pn103) through advanced auto-tuning, etc. Otherwise, vibration may occur. .
- The vibration frequency range that can be detected by this function is 100Hz to 1,000Hz. Vibration outside the detection range cannot be detected, and "F----" is displayed. In this case, set the notch filter automatically with "Mode = 2" of one-parameter tuning, or use the vibration suppression function.
- Increasing the A-type anti-vibration damping gain (Pn163) can improve the vibration suppression effect, but if the damping gain is too large, the vibration may be increased instead. While checking the vibration suppression effect, gradually increase the damping gain setting value in units of 10% within the range of 0% to 200%. If the vibration suppression effect cannot be obtained even after the damping gain reaches 200%, please stop the setting and reduce the control gain through One-parameter tuning, etc.

Confirmation items before execution:

Before executing Adjust Anti-Resonance Control, be sure to confirm the following settings. When the following items are not set, "NO_OP" will display:

- Select Tuning-less function to be invalid (Pn170.0 = 0) .
- The test without a motor function must be disabled (Pn00C.0 = 0).
- Torque control is not allowed.
- Write Prohibition should be disabled(Fn010) .

7.7.2 Operation Steps of Anti-resonance Control Function

Execute this function when vibration occurs after inputting an action command

Adjust Anti-Resonance Control function can be done through HCServoWorks. This function cannot be operated through the operation panel.

Operation steps of Adjust Anti-resonance Control function are as follows.

- When using the Adjust Anti-Resonance Control function for the first time.
- When the vibration frequency is unknown.
- When the vibration frequency is known.
- When making further fine-tuning after using the Adjust Anti-resonance Control function .

7.7.3 Related Parameters

Related parameters are shown in Table 7-31 below.

- Parameters related to the function.

The parameters used or referenced when executing this function.

- Whether to change the setting value of the parameter when executing this function.

"No": When executing this function, parameters cannot be changed through HCServoWorks, etc.

"Yes": When executing this function, parameters can be changed through HCServoWorks, etc..

- Whether there is automatic setting of parameters after executing this function.

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-31 Parameters for Anti-Resonance control function

| Parameter | Name | Is it possible to change the setting value | Automatic setting |
|-----------|--|--|-------------------|
| Pn160 | Anti-Resonance Control-Related Selections | Yes | Yes |
| Pn161 | Anti-Resonance Frequency | No | Yes |
| Pn162 | Anti-Resonance Gain Correction | Yes | No |
| Pn163 | Anti-Resonance Damping Gain | No | Yes |
| Pn164 | Anti-Resonance Filter Time Constant 1 Correction | Yes | No |
| Pn165 | Anti-Resonance Filter Time Constant 2 Correction | Yes | No |

7.8 Vibration Suppression Function

This section explains the vibration suppression function.

7.8.1 About the Vibration Suppression Function

The vibration suppression function is mainly used to suppress the low-frequency vibration (shaking) of about 1-100 Hz caused by the vibration of the machine during positioning.

This function will be automatically set by Advanced Auto-tuning 1 or Advanced Auto-tuning 2. Only use this function when further fine-tuning and re-adjustment is required due to vibration detection failure.

After executing this function, please perform One-parameter tuning to improve the response.

Note: • After executing this function, related parameters will be set automatically. But the response may change greatly. For safety, please execute this function in a state where an emergency stop is possible at any time.

- Before executing this function, correctly set the Moment of Inertia Ratio (Pn103) by advanced auto tuning, etc. Otherwise, vibration may occur.
- The vibration frequency range that can be detected by using this function is 1~100Hz. Vibration outside the detection range cannot be detected, and "F-----" is displayed.
- Vibration cannot be detected if there is no vibration due to positional deviation, or if the vibration frequency is outside the detection frequency range. In this case, please use a displacement meter or a vibration meter to measure the vibration.
- When the vibration cannot be eliminated with the automatically detected vibration frequency, there may be an error between the actual vibration frequency and the detected frequency, please fine-tune the vibration frequency.

1) Confirmation items before execution

Before executing the vibration suppression function, be sure to confirm the following settings. When the following items are not set, "NO_OP" will display:

- In position control.
- Set the Tuning-less function to be invalid (Pn170.0 = 0) .
- The test without a motor function must be disabled (Pn00C.0 = 0).
- Write Prohibition should be disabled(Fn010) .

2) Items affecting performance

Sufficient vibration suppression effect cannot be obtained by the vibration suppression function for vibrations that continue to occur during a stop. In this case, adjust with the Adjust Anti-resonance Control function or One-parameter tuning.

3) About the detection of vibration frequency

Frequency detection may not be possible if vibration does not appear in the position deviation or the vibration that results from the position deviation is too small. You can adjust the detection sensitivity by changing the setting of the residual vibration detection width (Pn560), which is set as a percentage of the positioning completed width (Pn522). Perform the detection of vibration frequencies again after adjusting the setting of Pn560.

Table 7-32 Parameter settings for Vibration frequency detection

| Pn560 | Residual Vibration Detection Width | | Speed | Position | Torque | When enabled | Classification |
|-------|------------------------------------|------|-----------------|----------|--------|--------------|----------------|
| | Setting range | Unit | Factory setting | | | | |
| | 0-3000 | 0.1% | 400 | | | | |

Note: As a guideline, change the setting 10% at a time. If the setting of this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if the setting is too small. The vibration frequencies that are automatically detected may vary somewhat with each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

7.8.2 Precautions for Vibration Suppression Function

The operation procedure of the vibration suppression function is as follows.

The operation of the vibration suppression function can be performed through HCServoWorks. This function cannot be operated through the operation panel.

Suppliments for the vibration suppression function:

Feedforward function:

In the factory setting mode, "Feedforward (Pn109)", "Speed feedforward input (V-REF) " and "Torque feedforward (T-REF) input" will become invalid.

According to the system configuration, if you want to use the "Speed feedforward input (V-REF)" and "Torque feedforward input(T-REF)" from the upper device and model tracking control at the same time, please set Pn140.3 = 1.

Table 7-33 Parameters for Feedforward Function

| Parameter | Contents | When enabled | Classification |
|-----------|---|--------------|----------------|
| Pn140 | n.0 □□□ (Factory setting) | Immediately | Tuning |
| | n.1 □□□ Using Model tracking control and Speed/torque feedforward simultaneously | | |

Note: When using the Model following control under this function, the best feedforward will be set inside the servo.

Therefore, generally do not use the "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" from the host device at the same time.

However, Model following control and "Speed feedforward (V-REF) input" and "Torque feedforward (T-REF) input" can be used at the same time as required.

At this time, if the input feedforward is incorrect, it may cause overshoot.

7.8.3 Related Parameters

Related parameters are shown in Table 7-34 below.

•Parameters related to this function

The parameters used or referenced when executing this function.

• Is it possible to change the setting value of the parameter when executing this function?

"No": When executing this function, parameters cannot be changed through HCServoWorks, etc.

"Yes": Parameters can be changed through HCServoWorks, etc. when executing this function.

• Whether there is automatic setting of parameters after executing this function

"Yes": After executing this function, the parameter setting value will be automatically set or adjusted.

"No": After executing this function, the parameter setting value will not be automatically set or adjusted.

Table 7-34 Parameters for Vibration Suppression Function

| Parameter | Name | Is it possible to change the setting value | Automatic setting |
|-----------|--|--|-------------------|
| Pn140 | Model Following Control-Related Selections | Yes | Yes |
| Pn141 | Model Following Control Gain | No | Yes |
| Pn142 | Model Following Control Gain Correction | No | No |
| Pn143 | Model Following Control Bias in the Forward Direction | No | No |
| Pn144 | Model Following Control Bias in the Reverse Direction | No | No |
| Pn145 | Vibration Suppression 1 Frequency A | No | Yes |
| Pn146 | Vibration Suppression 1 Frequency B | No | Yes |
| Pn147 | Model Following Control Speed Feedforward Compensation | No | No |
| Pn14A | Vibration Suppression 2 Frequency | No | No |
| Pn14B | Vibration Suppression 2 Correction | No | No |

7.9 Adjustment Application Function

The following describes the functions for further individual adjustments after advanced auto-tuning 1, advanced auto-tuning 2, and One-parameter tuning.

- Gain switching.
- Friction compensation function.

- Current control mode selection.
- Current gain value setting.
- Speed detection method selection.

7.9.1 Gain Switching

The gain switching function includes "Manual gain switching" that uses an external input signal and "Auto gain switching".

By using the gain switching function, the gain can be increased during positioning to shorten the positioning time, and the gain can be decreased to suppress vibration when the servo motor is stopped.

Table 7-35 Parameters for Gain Switching

| Parameter | | Contents | When enabled | Classification |
|-----------|------------------------------|-----------------------|--------------|----------------|
| Pn139 | n. □□□0 (Factory setting) | Manual gain switching | Immediately | Tuning |
| | n.□□□ 2 | Auto gain switching | | |

Note: 1. n. □□□1 is a reserved parameter (Do not set).

2. For gain switching combinations, please refer to "1) Gain switching combinations".
3. For manual gain switching, please refer to "2) Manual gain switching".
4. For the auto gain switching, please refer to "(3) Auto gain switching".

1) Gain switching combinations

Table 7-36 Gain switching combinations

| Gain switching | Speed loop gain | Speed loop integral time constant | Position loop gain | Torque command filter | Model tracking control gain* | Model tracking control gain correction* | Friction compensation gain |
|----------------|-----------------------------|---|--------------------------------|--|---|--|--|
| 1st gain | Speed loop gain (Pn100) | Speed loop integral time constant (Pn101) | Position loop gain (Pn102) | Filter time constant of 1st stage 1st torque command (Pn401) | Model tracking control gain (Pn141) | Model tracking control gain correction (Pn142) | Model friction compensation gain (Pn121) |
| 2nd gain | 2nd speed loop gain (Pn104) | 2nd speed loop integral time constant (Pn105) | 2nd position loop gain (Pn106) | Filter time constant of 1st stage 2nd torque command (Pn412) | 2nd model tracking control gain (Pn148) | 2nd model tracking control gain correction (Pn149) | 2nd model friction compensation gain (Pn122) |

*The gain switching of model tracking control gain and model tracking control gain correction is only applicable to "Manual switching gain".

In addition, the gain is switched only when the following conditions are satisfied at the same time and the gain switching signal is input. When the conditions are not met, even if other parameters in the above table are switched, these parameters will not be switched.

- No command
- The servo motor stops

2) Manual gain switching

" Manual gain switching " switches the 1st gain and the 2nd gain through the external input signal (/G-SEL).

Table 7-37 Parameters for Manual gain switching

| Parameter | Contents | When enabled | Classification |
|-----------|------------------------------|--|-----------------------|
| Pn139 | n. □□□0 (Factory setting) | Manual gain switching by external input signal (/G-SEL) | Immediately Tuning |

Table 7-38 Manual gain switching

| Type | Signal name | Connector pin | Setting | Content |
|-------|-------------|----------------------|---------|---------------------|
| Input | /G-SEL | Need to be allocated | OFF | Switch to 1st gain. |
| | | | ON | Switch to 2nd gain. |

3) Auto gain switching

"Auto gain switching " is only valid at position control. The switching conditions are executed with the following settings.

Table 7-39 Parameters for Auto gain switching

| Parameter | Switch condition | Switching gain | Waiting time | Switching time | |
|-----------|------------------|---------------------------|----------------------|-------------------------|---------------------------|
| Pn139 | n.□□□2 | Condition A satisfied | 1st gain 2nd gain | Waiting time 1 Pn135 | Switching time 1 Pn131 |
| | | Condition A not satisfied | 2nd gain 1st gain | Waiting time 2 Pn136 | Switching time 2 Pn132 |

Select "Switching condition A" for auto gain switching from the following settings.

Table 7-40 "Switching condition A" parameters of auto gain switching

| Parameter | Position control Switching condition A | Other than position control (no switching) | When enabled | Classification | |
|-----------|---|--|-------------------|----------------|--------|
| Pn139 | n.□□0□ (factory setting) | Positioning completion signal (/COIN) ON | Fixed at 1st gain | Immediately | Tuning |
| | n.□□1□ | Positioning completion signal (/COIN) OFF | Fixed at 2nd gain | | |
| | n.□□2□ | Positioning proximity signal (/NEAR) ON | Fixed at 1st gain | | |
| | n.□□3□ | Positioning proximity signal (/NEAR) OFF | Fixed at 2nd gain | | |
| | n.□□4□ | Position command filter output = 0 And the command pulse input is OFF | Fixed at 1st gain | | |
| | n.□□5□ | Position command pulse input ON | Fixed at 2nd gain | | |

*Auto switching mode 1 (Pn139.0=2)

Relationship between waiting time and switching time at gain switching

For example, assume where the position loop gain Pn102 is switched to the 2nd position loop gains Pn106 in the auto gain switching mode conditional on the positioning completion signal (/COIN) ON. The /COIN signal of the switching condition is ON, and the gain is linearly changed from Pn102 to Pn106 during the switching time Pn131 after waiting for the waiting time Pn135 from the time when the switching condition is satisfied.

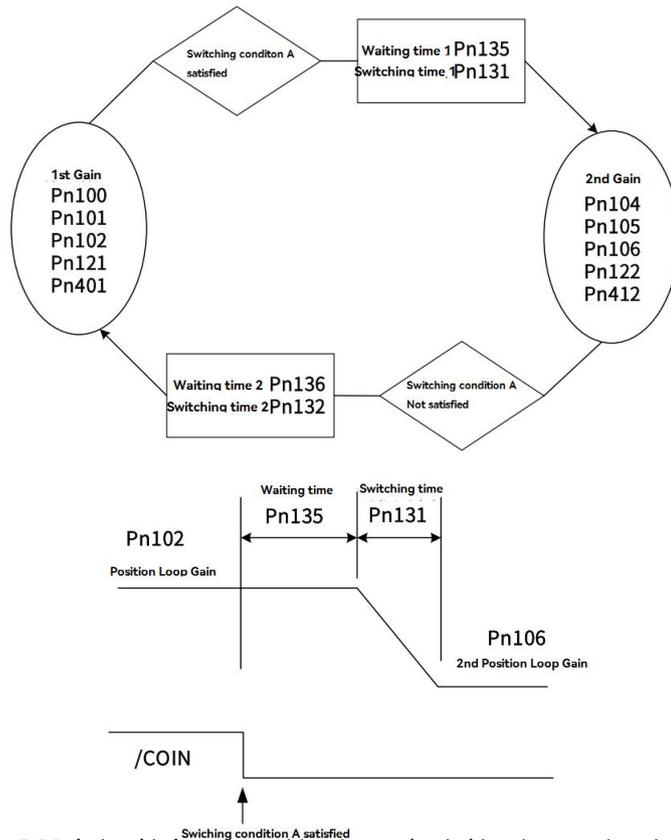


Figure 7-5 Relationship between waiting time and switching time at gain switchin

Note: Gain switching can be executed under PI or IP control mode (Pn10B).

4) Related parameters

Table 7-41 Parameters for adjustment application function

| Parameter | Name | When enabled | Classification |
|-----------|---|--------------|----------------|
| Pn100 | Speed Loop Gain | Immediately | Tuning |
| Pn101 | Speed Loop Integral Time Constant | | |
| Pn102 | Position Loop Gain | | |
| Pn401 | 1st Stage 1st Torque Command Filter Time Constant | | |
| Pn141 | Model Following Control Gain | | |
| Pn142 | Model Following Control Gain Correction | | |
| Pn121 | Friction Compensation Gain | | |
| Pn104 | 2nd Speed Loop Gain | | |
| Pn105 | 2nd Speed Loop Integral Time Constant | | |
| Pn106 | 2nd Position Loop Gain | | |
| Pn412 | 1st Stage 2nd Torque Command Filter Time Constant | | |
| Pn148 | 2nd Model Following Control Gain | | |
| Pn149 | 2nd Model Following Control Gain Correction | | |
| Pn122 | 2nd Friction Compensation Gain | | |

5) Related parameters for auto gain switching

Table 7-42 Parameters related to auto gain switching

| Parameter | Name | When enabled | Classification |
|-----------|------|--------------|----------------|
|-----------|------|--------------|----------------|

| | | | |
|-------|-------------------------------|-------------|--------|
| Pn131 | Gain Switching Time 1 | Immediately | Tuning |
| Pn132 | Gain Switching Time 2 | | |
| Pn135 | Gain Switching Waiting Time 1 | | |
| Pn136 | Gain Switching Waiting Time 2 | | |

6) Related monitoring

Table 7-43 Monitoring No.related to auto gain switching

| Monitoring No. | Monitoring name | Display value | Content |
|----------------|---------------------|---------------|--------------------------------------|
| Un014 | Active Gain Monitor | 1 | Displayed when the 1st gain is valid |
| | | 2 | Displayed when the 2nd gain is valid |

Note: "1" is displayed when the Tuning-less function is valid.

Table 7-44 Monitoring parameters related to auto gain switching

| Parameter | Analog monitoring | Monitoring name | Output value | Content |
|----------------|-------------------|-----------------------|--------------|--|
| Pn006 Pn007 | n. □□ 0B | Inactiue Gain Monitor | 1V 2V | The 1st gain is valid The 2nd gain is valid |

7.9.2 Manual Adjustment of Friction Compensation

The Friction compensation function is to correct viscous friction fluctuations and fixed load fluctuations.

The Friction compensation function can be automatically adjusted through advanced auto-tuning 1, advanced auto-tuning 2, and One-parameter tuning. The following describes the procedure when manual adjustment is required.

1) Parameters to be set

To use the Friction compensation function, the following parameters need to be set.

Table 7-45 Parameters for Friction compensation function

| Parameter | Content | When enabled | Classification |
|-----------|-----------------------------|--------------|----------------|
| Pn408 | n.0□□□ (Factory setting) | Immediately | Setup |
| | n.1□□□ | | |

Table 7-46 Parameters for Friction compensation function

| Parameter | Name | When enabled | Classification |
|-----------|--|--------------|----------------|
| Pn121 | Friction Compensation Gain | Immediately | Tuning |
| Pn123 | Friction Compensation Coefficient | | |
| Pn124 | Friction Compensation Frequency Correction | | |
| Pn125 | Friction Compensation Gain Correction | | |

2) Operation steps of Friction compensation function

The operation steps of the friction compensation function are as follows.

Note: When using the friction compensation function, please set the Moment of Inertia Ratio (Pn103) as correctly as possible. If the moment of inertia ratio is incorrect, it may cause vibration.

- Restore the following parameters related to friction compensation to the factory settings.

Friction Compensation Gain (Pn121) → Factory setting: 100

Friction Compensation Coefficient (Pn123) → Factory setting: 0

Friction Compensation Frequency Correction (Pn124) → Factory setting: 0

Friction Compensation Gain Correction (Pn125) → Factory setting: 100

Note: Please make the Friction Compensation Frequency Correction n (Pn124) and Friction Compensation Gain Correction (Pn125) always be the factory settings.

② To confirm the effect of the friction compensation function, please increase the Friction Compensation Coefficient (Pn123) gradually.

Note: Normally, please set the setting value of the Friction Compensation Coefficient (Pn123) below 95%. If the effect is not obvious enough, please increase the setting value of the Friction Compensation Gain (Pn121) by 10% within the range of no vibration

The effect of adjusting parameters:

Pn121: Friction Compensation Gain

Set parameters of response to external disturbances. The higher the setting value, the better the response to external disturbance, but if the setting value is too high, vibration may occur when the device has a resonance frequency.

Pn123: Friction Compensation Coefficient

Sets the parameters for the friction compensation effect. The higher the setting value, the better the effect, but if the setting value is too high, the response is more likely to vibrate. Generally, please set the setting value below 95%.

③ Adjustment effect: The adjustment result is shown as follows in the form of waveform diagrams before and after adjustment.

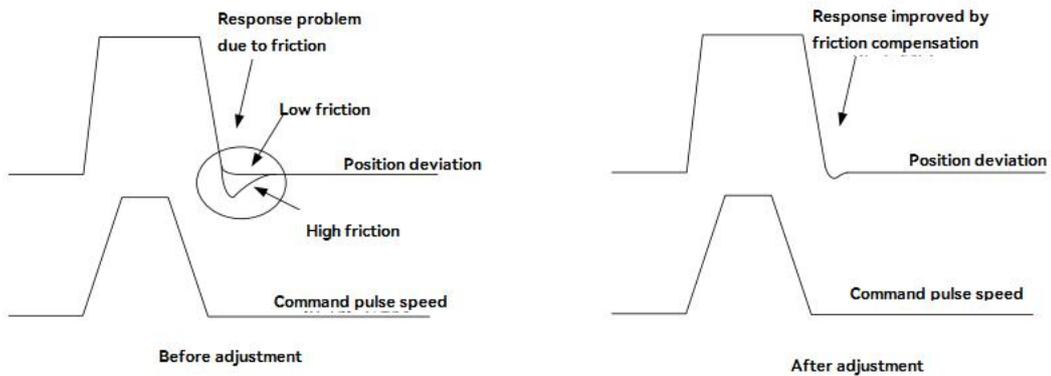


Figure 7-6 Waveforms to adjustment results before and after adjustment

7.9.3 Current Control Mode Selection Function

The current control mode selection function can reduce the high-frequency noise during the servo motor stop. The models can use this function are as follows. This function is valid in the factory setting mode, and is set as a valid condition in many occasions. When using this function, please set Pn009.1 = 1.

Table 7-47 Parameters for current control mode selection function

| Parameter | Content | When enabled | Classification |
|-----------|------------------------------|---|------------------------------------|
| Pn009 | n. □□0□ | Select Current control mode 1 | Restart the power supply Tuning |
| | n. □□1□ (Factory setting) | Select Current control mode 2 (low noise) | |

7.9.4 Current Gain Value Setting Function

The current gain value setting function is to adjust the current control parameters inside the servo drive according to the speed loop gain (Pn100) to reduce noise. By reducing the current gain value (when Pn13D is 2 000, the current gain is the internal setting value), the noise level can be reduced. But at the same time, it will cause the response characteristics of the servo drive. Therefore, please adjust within the range that can ensure the response characteristics. In addition, it is invalid during torque control (Pn000.1 = 2).



Selecting power supply control mode 2 may increase the load rate which is in stop.

Table 7-48 Parameters for Current gain value setting function

| Pn13D | Current Gain Value | | | Speed | Position | Torque | When enabled | Classification |
|-------|--------------------|------|-----------------|-------|----------|--------|--------------|----------------|
| | Setting range | Unit | Factory setting | | | | | |
| | 100 ~ 2000 | 1% | 2000 | | | | | |

Note: After changing this function, the response characteristics of the speed loop will also change, so it is necessary to re-adjust the servo.

7.9.5 Speed Detection Method Selection

The speed detection method selection can smooth the servo motor speed during operation. Please set Pn009.2 = 1 and select Speed detection 2 to make the motor speed smooth.

Table 7-49 Parameters for Speed detection method selection

| Parameter | Content | When enabled | Classification |
|-----------|--|--------------------------|----------------|
| Pn009 | n. <input type="checkbox"/> 0 <input type="checkbox"/> <input type="checkbox"/> (Factory setting) | Restart the power supply | Tuning |
| | Select Speed detection 1 | | |
| | n. <input type="checkbox"/> 1 <input type="checkbox"/> <input type="checkbox"/> | | |
| | Select Speed detection 2 | | |

Note: After changing the speed detection method, the response characteristics of the speed loop will also change, so it is necessary to re-adjust the servo.

7.10 Other Adjustments Functions

7.10.1 Feedforward

Feedforward is the function of performing feedforward compensation to shorten the positioning time during Position control.

Table 7-50 Parameters for Feedforward

| Pn109 | Feedforward | | | Position | When enabled | Classification |
|-------|----------------------------------|--------|-----------------|----------|--------------|----------------|
| | Setting range | Unit | Factory setting | | | |
| | 0 ~ 100 | 1% | 0 | | | |
| Pn10A | Feedforward Filter Time Constant | | | Position | When enabled | Classification |
| | Setting range | Unit | Factory setting | | | |
| | 0-6400 | 0.01ms | 0 | | | |

Note: If the feed-forward setting value is too large, it may cause mechanical vibration. Please lower the setting value to 80% or less.

7.10.2 P (Proportional) control

Select the P control from the upper device through the input signal (/P-CON).

However, when it is set to Speed control with zero-position fix function, it is usually not necessary to use this function for a position loop. When the /P-CON signal is turned ON, it becomes P control.

P control is set through Pn000.1 and input signal (/P-CON).

1) /P-CON input signal

Use /P-CON for switching signal of PI control/P control.

Table 7-51 /P-CON input signal

| Parameter | Contents | When enabled | Classification |
|-----------|----------|--------------|----------------|
|-----------|----------|--------------|----------------|

| | | | | |
|-------|------------------------------|-----------------------|-------------|--------|
| Pn139 | n. □□□0 (Factory setting) | Manual gain switching | Immediately | Tuning |
| | n. □□□2 | Auto gain switching | | |

7.10.3 Setting Mode Switch (P control/PI control switching)

The Mode switch is a function to automatically switch between P control and PI control.

Set switching conditions through Pn10B.0, and P control starts when the setting values of Pn10C, Pn10D, Pn10E, and Pn10F are exceeded.

If switching conditions and condition values are set, overshoot can be suppressed during acceleration and deceleration and the settling time can be shortened.

1) Related parameters

Select the switching condition of the Mode switching through Pn10B.0.

Table 7-52 Parameters for Setting mode switching

| Parameter | Select mode switch | Parameters that set conditional values | When enabled | Classification | |
|-----------|---------------------------------|--|--------------|----------------|-------|
| Pn10B | n. □□□ 0 (Factory setting 0) | Conditional on internal torque command | Pn10C | Immediately | Setup |
| | n. □□□ 1 | Conditional on speed command | Pn10D | | |
| | n. □□□ 02 | conditional on acceleration | Pn10E | | |
| | n. □□□ 03 | Conditional on positional deviation | Pn10F | | |
| | n. □□□ 04 | Mode switching not selected | - | | |

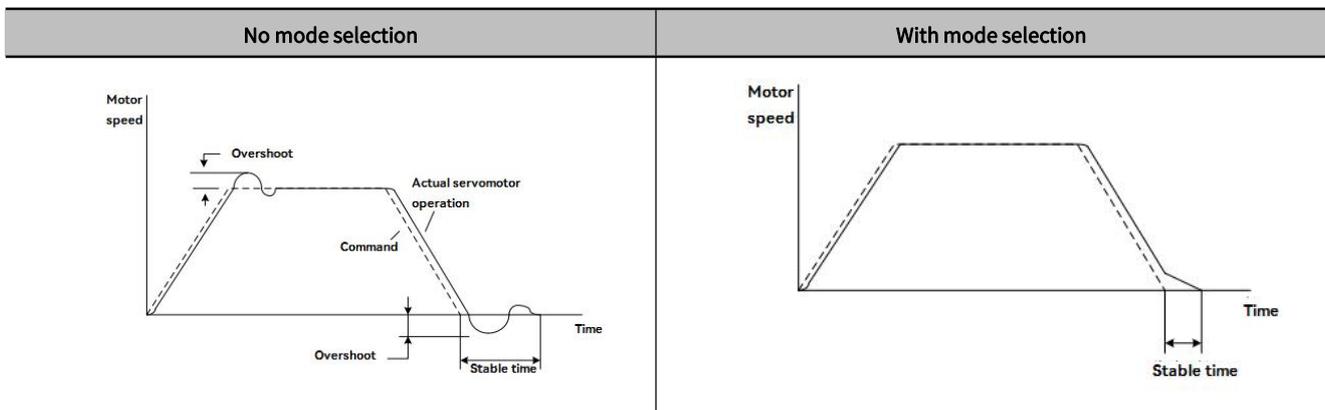
Table 7-53 Parameters for setting switching condition

| Parameter | Name | When enabled | Classification |
|-----------|---|--------------|----------------|
| Pn10C | Mode Switching Level for Torque Command | Immediately | Tuning |
| Pn10D | Mode Switching Level for Speed Command | | |
| Pn10E | Mode Switching Level for Acceleration | | |
| Pn10F | Mode Switching Level for Position Deviation | | |

Example: When the switching condition of the mode switching is used as the torque command (factory setting)

When the torque command exceeds the torque set in Pn10C, the speed loop will switch to P control.

The torque command value is set to 200% at the factory.



7.10.4 Torque Command Filter

A delay filter and a notch filter are serially configured in the torque command, and they act independently.

The notch filter is enabled/disabled through Pn408.

1) Torque command filter

If the vibration of the machine may be caused by the servo drive, if the following torque command filter time parameters are adjusted, the vibration may be eliminated. The smaller the value, the better the response, but it is limited by the mechanical conditions.

Table 7-54 Parameters for Torque command filter

| Pn401 | 1st Stage 1st Torque Command Filter Time Constant | | | When enabled | Classification |
|-----------|---|----------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Unit | Factory setting | Immediately | Tuning |
| 0 ~ 65535 | 0.01ms | 100 | | | |

Setting standard of Torque command filter

- Speed Loop Gain (Pn100[Hz]) and torque filter time constant (Pn401[ms])
- Adjustment value of stable control range $Pn401[ms] \leq 1000 / (2 \pi \cdot Pn100[Hz] \cdot 4)$
- Limit adjustment value $Pn401[ms] < 1000 / (2 \pi \cdot Pn100[Hz] \cdot 1)$

Table 7-55 Parameters for Filter frequency of the 2nd stage 2nd torque command

| Pn40F | 2nd Stage 2nd Torque Command Filter Frequency | | | When enabled | Classification |
|------------|---|----------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Unit | Factory setting | Immediately | Tuning |
| 100 ~ 5000 | 1Hz_ | 5000 | | | |

Table 7-56 Parameters for 2nd stage 2nd torque command filter Q value

| Pn410 | 2nd Stage 2nd Torque Command Filter Q Value | | | When enabled | Classification |
|----------|---|----------|-----------------|--------------|----------------|
| | Speed | Position | Torque | | |
| | Setting range | Unit | Factory setting | Immediately | Tuning |
| 50 ~ 100 | 0.01ms | 50 | | | |

➤ Note: When set to 5000, the filter becomes invalid.

2) Notch filter

The notch filter is a filter used to eliminate specific vibration frequency components caused by resonance of the ball screw shaft, etc.

The gain curve is shown in the figure below, and a specific frequency (hereinafter referred to as the notch frequency) is in the shape of a notch, which can reduce or eliminate the notch frequency.

The larger the value of the Q value of the notch filter, the more severe the notch and phase delay.

Note: Select the notch filter to be valid/invalid through Pn408.

Table 7-57 Parameters for the validity/invalidity of notch filters

| Parameter | Content | When enabled | Classification |
|-----------|------------------------------|------------------------------------|--------------------------|
| Pn408 | n. □□□0 [Factory setting] | Disable the 1st stage notch filter | Immediately Setup |
| | n. □□□1 | Enable the 1st stage notch filter | |
| | n. □0□□ [Factory setting] | Disable the 2nd stage notch filter | |
| | n. □1□□ | Enable the 2nd stage notch filter | |

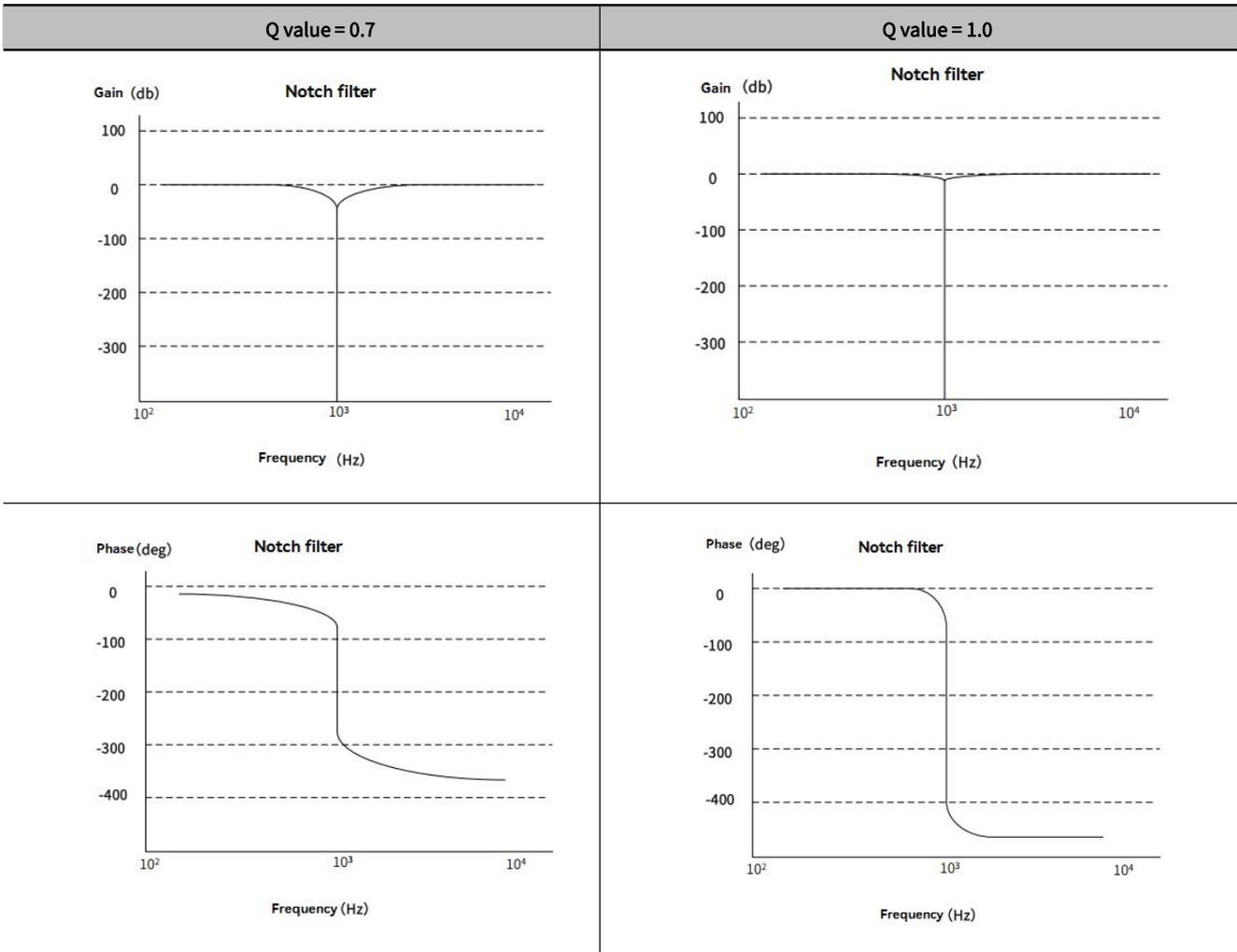
Table 7-58 Notch filter parameters by mechanical vibration frequency

| Parameter | Content | When enabled | Classification |
|-----------|----------------------------------|--------------|----------------|
| Pn409 | 1st Stage Notch Filter Frequency | Immediately | Tuning |

| | | | |
|-------|----------------------------------|--|--|
| Pn40A | 1st Stage Notch Filter Q Value | | |
| Pn40B | 1st Stage Notch Filter Depth | | |
| Pn40C | 2nd Stage Notch Filter Frequency | | |
| Pn40D | 2nd Stage Notch Filter Q Value | | |
| Pn40E | 2nd Stage Notch Filter Depth | | |

Note: 1. Do not set the Notch Filter Frequency (Pn409 or Pn40C) close to the response frequency of the speed loop. At least this frequency should be set as 4 times of the speed loop gain (Pn100) (but Pn103 should be set correctly). Incorrect setting may cause mechanical damage due to vibration.

2. Be sure to change the Notch Filter Frequency (Pn409 or Pn40C) when the servo motor stop. If making changes while the servo motor is running, it may cause vibration.





Chapter 8 Auxiliary Function



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8.1 Auxiliary Function List

Auxiliary functions refer to functions related to the operation and adjustment of the servo motor.

Displayed as a number starting with Fn on the operation panel.

The following table lists the overview and reference items of auxiliary functions.

Table 8-1 List of auxiliary functions

| Fn number | Function | Operation of the operation panel | By HCServoWorks | Reference Chapter |
|-----------|--|----------------------------------|-----------------|-------------------|
| Fn000 | Display Alarm History | 1 | 1 | 7.2 |
| Fn002 | JOG | 1 | 1 | 7.3 |
| Fn003 | Origin Search | 1 | 1 | 7.4 |
| Fn004 | Jog Program | 1 | 1 | 7.5 |
| Fn005 | Initialize Parameters | 1 | 1 | 7.6 |
| Fn006 | Clear Alarm History | 1 | 1 | 7.7 |
| Fn008 | Reset Absolute Encoder | 1 | 1 | — |
| Fn009 | Autotune Analog (Speed/Torque) Command Offset | 1 | 1 | — |
| Fn00A | Manually Adjust Speed Command Offset | 1 | 1 | — |
| Fn00B | Manually Adjust Torque Command Offset | 1 | 1 | — |
| Fn00C | Adjust Analog Monitor Output Offset | 1 | 1 | 7.8 |
| Fn00D | Adjust Analog Monitor Output Gain | 1 | 1 | 7.9 |
| Fn00E | Autotune Motor Current Detection Signal Offset | 1 | 1 | 7.10 |
| Fn00F | Manually Adjust Motor Current Detection Signal Offset | 1 | 1 | 7.11 |
| Fn010 | Write Prohibition Setting | 1 | 0 | 7.12 |
| Fn011 | Display Servomotor Model | 1 | 1 | 7.13 |
| Fn012 | Display Software Version | 1 | 1 | 7.14 |
| Fn013 | Multiturn Limit Setting after Multiturn Limit Disagreement Alarm | 1 | 1 | — |
| Fn01B | Initialize Vibration Detection Level | 1 | 1 | 7.15 |
| Fn030 | Software Reset | 1 | 1 | 7.16 |
| Fn200 | Tuning-less Level Setting | 1 | 1 | 6.2.2 |
| Fn201 | Advanced Autotuning without Command | 0 | 1 | 6.3 |
| Fn202 | Advanced Autotuning with Command | 0 | 1 | 6.4 |
| Fn203 | One-Parameter Tuning | 1 | 1 | 6.5 |
| Fn204 | Adjust Anti-resonance Control | 0 | 1 | 6.7 |
| Fn205 | Vibration Suppression | 0 | 1 | 6.8 |
| Fn206 | EasyFFT | 1 | 1 | — |
| Fn207 | Online Vibration Monitoring | 1 | 1 | — |

1: Operable 0: Not operable

8.2 Display of Alarm Record (Fn000)

The servo drive has a retroactive display function, which can display up to 10 alarm records that have occurred.

The number and time stamp of the alarm occurrence can be confirmed.

Time stamp is a function that measures the duration after the control power supply and main circuit power supply are turned on in units of 100ms, and displays the total operating time when an alarm occurs.

If it is operated 24 hours a day, 365 days a year, it can be continuously measured for about 13 years.

<Time stamp display example>

When displaying 36000

$$36000 \times 100 [ms] = 3600 [s] = 60 [min] = 1 [h]$$

So the total run time is 1 hour.

The procedure for displaying alarm records is as follows:

- ① Press (M) key to switch to auxiliary function mode "FN000"
- ② Long-press (S) for 1 sec., and the latest alarm will be displayed.
- ③ After short-pressing (S), the lower 4 digits of the alarm time stamp will be displayed, and short-press (S) to display the middle 4 digits of the alarm time stamp, then short-press (S) once to display the highest 2 digits of the alarm time stamp. Then short-press (S) again to display the alarm record currently viewed.
- ④ Press (V) key to display the previous alarm. Press (A) key to display the new alarm. The higher the number in the leftmost digit, the older the alarm displayed.
- ⑤ Press (S) for about 1 sec, then return to the auxiliary function "FN000"

<Supplements>

- When the same alarm occurs continuously, if the interval between error occurrences is less than 1 hour, it will not be saved, and if it exceeds 1 hour, the alarm will be saved.
- " □. _ _ _ " is displayed on the operation panel.

 **CAUTION**

• The overtravel prevention function is invalid during JOG operation. While operating, the operating range of the machinery used must be considered.

- Alarm records can only be deleted through " Clear Alarm History (Fn006)". Even if the alarm is reset or the main circuit power of the servo drive is cut off, the alarm history cannot be deleted.

8.3 JOG (Fn002)

JOG operation refers to the function to confirm the servo motor operation through speed control without connecting to the host device.

1) Setting items before operation

To perform JOG operation, make the following settings in advance.

- When the S- O N input signal is ON, please switch it to OFF.
- Pn50A.1 is set to "7" (always-ON " Valid "), please change it to a value other than " 7 ".

Table 8-2 Parameters for Jog (J O G) speed

| | Jogging Speed | Speed | Position | Torque | When enabled | Classification |
|---------------|---------------|---------------------|-----------------|--------|--------------|----------------|
| Pn 304 | Setting range | Unit | Factory setting | | Immediately | Setup |
| | 0~10000 | 1 min ⁻¹ | 500 | | | |

- Please set the JOG operation speed after considering the operation range of the machine used. JOG running speed is set by Pn304.

2) Operation steps

The following describes the operation steps when the servo motor rotation direction is set to Pn000.0=0 (CCW is forward-rotation). Acceleration and deceleration in the process of FN002 is subject to Pn 305 and Pn 306. For the usage of these two parameters, please refer to " Section 6.9 Soft Starting".

JOG operation are as follows:

- ① Press **M** key to switch to Auxiliary function “**FN000**”
- ② Press **△** or **▽** to display “**FN002**”
- ③ Press **S** to display “**JOG**”
- ④ Press **M** key to display “**JOG**” to enter into servo-ON
- ⑤ Press **△** key (forward-rotation) to **▽** key (reversed-rotation) and the servo motor rotates at the speed set by Pn304.
- ⑥ Press **M** key to enter into the servo-OFF. You can also press **S** for about 1 sec to turn off the servo.
- ⑦ Press **S** key for about 1 sec, then return to “**FN002**”

8.4 Origin Search (Fn003)

Origin search is a function to determine the position of the origin pulse (phase C) of the incremental encoder and stop at that position. This function is used when the motor shaft and mechanical position need to be positioned

Origin search can be performed under the following conditions.

- S-ON is not input.
- Parameter Pn50A.1 ≠ 7.

The servo motor speed 60min^{-1} .



- Please execute the origin search when the coupling is not connected.
- Forward-rotation drive prohibition (P-OT) and reverse-rotation drive prohibition (N-OT) are invalid when performing origin search.

POINTS

The operation steps of origin search and positioning are as follows:

- ① Press **M** key to switch to Auxiliary function mode “**FN000**”
- ② Press **△** or **▽** key to display “**FN003**”
- ③ Press **S** for 1 sec, Fn003(origin search) “**LSR**” is displayed for about 1 sec.
- ④ Press **M** key to enable the servo and then long-press **△** (forward-rotation) or **▽** (reverse-rotation) to origin search, then search direction changes according to the setting of Pn000.0. Then long-press **△** (forward-rotation) or **▽** (reverse-rotation) until the servo motor stops, and the “**CEB**” flashes on the panel, at this moment, the origin search is completed.
- ⑤ After the origin search is completed, press **M** key to disable the servo motor, and the panel displays “**CEB**”
- ⑥ Press **S** for 1 sec and return to the auxiliary function mode “**FN003**” (origin search)

8.5 JOG Program (Fn004)

JOG program refers to the function of setting and executing the continuous operation determined by the preset operation mode, moving distance, moving speed, acceleration and deceleration time, and the number of repeated operations.

This function is the same as JOG operation (Fn002) and no need to connect the upper device. Confirm the servo motor's operation and have the simple positioning.

1) Setting items before operation

To perform Program JOG operation, make the following settings in advance.

- Please consider the operating range and safe operating speed of the machine, and set the correct operating distance and operating speed.
- Please make the servo drive ready.
- Switch the S-ON input signal to OFF.

- When Pn50A.1 is set to "7" (Normally servo-ON "valid"), please change it to a value other than "7".

<Supplement>

- Position command filtering, in position control, can be performed.
- The Overtravel prevention function becomes valid.
- When using an absolute encoder, the SEN signal is always valid.

2) Related parameters

The parameters that can be set in the program JOG operation are as follows.

Table 8-3 Parameters for Program JOG operation setting

| Pn 530 | Program Jogging-Related Selections | | | Speed | Position | Torque | When enabled | Classification | | |
|--------|--|----------|---------------------|-------|-----------------|--------|--------------|----------------|-------------|-------------|
| | Setting range | | Unit | | Factory setting | | | | | Immediately |
| - | | - | | 0000 | | | | | | |
| Pn 531 | Program Jogging Travel Distance | | | Speed | Position | Torque | When enabled | Classification | | |
| | Setting range | | Unit | | Factory setting | | | | Immediately | Setup |
| | 1 ~ 1073741824 (2 ³⁰) | | 1 instruction unit | | 32768 | | | | | |
| Pn 533 | Program Jogging Movement Speed | | | Speed | Position | Torque | When enabled | Classification | | |
| | Setting range | | Unit | | Factory setting | | | | Immediately | Setup |
| | 1~10000 | | 1 min ⁻¹ | | 500 | | | | | |
| Pn 534 | Program Jogging Acceleration/Deceleration Time | | | | | | When enabled | Classification | | |
| | Speed | Position | Torque | | | | | | Immediately | Setup |
| | Setting range | | Unit | | Factory setting | | | | | |
| | 2~10000 | | 1ms | | 100 | | | | | |
| Pn 535 | Program Jogging Waiting Time | | | Speed | Position | Torque | When enabled | Classification | | |
| | Setting range | | Unit | | Factory setting | | | | Immediately | Setup |
| | 0~10000 | | 1ms | | 100 | | | | | |
| Pn 536 | Program Jogging Number of Movements | | | Speed | Position | Torque | When enabled | Classification | | |
| | Setting range | | Unit | | Factory setting | | | | Immediately | Setup |
| | 0~1000 | | 1 time | | 1 | | | | | |

Table 8-4 Pn530 parameters setting

| Parameter | Contents | Factory setting |
|-----------|--|-----------------|
| n.□□□0 | (Waiting time Pn535→Forward Travel DistancePn531)×Number of movements Pn536 | 0 |
| n.□□□1 | (Waiting time Pn535→Reverse Travel DistancePn531)×Number of movements Pn536 | |
| n.□□□2 | (Waiting time Pn535→Forward Travel Distance Pn531)×Number of movements Pn536 (Waiting time Pn535→Reverse Travel DistancePn531)×Number of movements Pn536 | |
| n.□□□3 | (Waiting time Pn535→Forward Travel Distance Pn531)×Number of movements Pn536 (Waiting time Pn535→Reverse Travel Distance Pn531)×Number of movements Pn536 | |
| n.□□□4 | (Waiting time Pn535→Forward Travel Distance Pn531→Waiting time Pn535→ReverseTravel Distance Pn531)×Number of movements Pn536 | |
| n.□□□5 | (Waiting time Pn535→Forward Travel Distance Pn531→Waiting time Pn535→Forward Travel Distance Pn531)×Number of movements Pn536 | |

3) How to set unlimited operation

- When Pn530.0=0/1/4/5, set the Number of movements (Pn536) to " 0 " to run infinitely.
- The program JOG operation mode follows the setting of Pn530.0. In various operating modes, only the number of movement is unlimited. Please refer to Table 8-3 and Table 8-4 for details.

4) Operation steps

The operation steps of Program JOG operation are as follows:

- ① Press  key to switch to auxiliary function mode "  "
- ② Press  or  key to display "  "
- ③ Press  key for about 1 sec or more
- ④ Press  key to enter into servo-ON
- ⑤ In accordance with the initial movement direction of the operation mode  or  key, it will start to act after the waiting time.
- ⑥ If the JOG operation of program finished, "  " will flash and then return to the Step 4.

8.6 Initialize Parameters (Fn005)



• Parameter setting value initialization must be done with the servo OFF. It cannot be executed while the servo is ON.

• **Restart the power supply** to make the setting effective.

POINTS

The parameter setting initialization operation steps are as follows:

- ① Press  key to switch to auxiliary function mode "  ".
- ② Press  or  key to display "  ".
- ③ Press  key for more than 1 second and display "  ".
- ④ Press  key to start parameter initialization. During initialization, the display will blink.
- ⑤ After initialization is complete, "  " will blink for about 1 second.
- ⑥ After displaying "donE", return to displaying "  ".
- ⑦ Press  key, return "  " is displayed.
- ⑧ To make the setting effective, please turn on the power of the servo drive again.

8.7 Clear Alarm History (Fn006)

Function to delete all alarm records recorded in the servo drive.

Alarm records can only be deleted by this function. Even if the alarm is reset or the main circuit power supply of the servo drive is cut off, the alarm history cannot be deleted.

The operation steps to delete the alarm records are as follows:

- ① Press  key to switch to auxiliary function mode "  ".
- ② Press  or  key to display "  ".
- ③ Press  key for more than 1 second, the display shows "  ".
- ④ Press  key to clear the alarm history. after clearing "  " will blink for about 1 second.
- ⑤ "donE" is displayed.

⑥ Press **(S)** key to return to " **Fn006** ".

8.8 Adjust Analog Monitor Output Offset (Fn00C)

Manually adjust the offset of the analog monitoring output (Torque command monitoring and Motor speed monitoring). The offset value of Torque command monitoring and Motor speed monitoring can be adjusted independently. The offset value has been adjusted at the factory, so it is generally not necessary to use this function.

1) Adjustment example

The example of offset amount adjustment for motor speed monitoring is shown below..

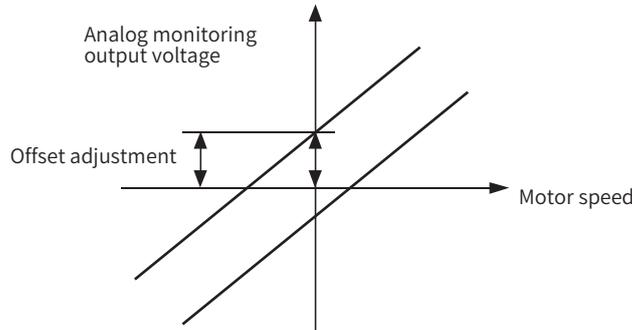


Figure 8-1 Example diagram of offset adjustment for Motor speed monitoring

Table 7-5 Offset specification for Motor speed monitoring

| Items | Specification |
|-----------------------|------------------|
| Zero-adjustment range | - 2 V ~ +2 V |
| Adjustment unit | 18 . 9 mV /L S B |

<Supplement>

- This function cannot be executed when set to Write Prohibition Setting (Fn010).
- Even if the Initialize Parameters (Fn005) is executed, the adjustment value cannot be initialized.
- When adjusting the offset, connect the actual measuring instrument with the analog monitoring output at zero output and perform the adjustment. The setting example of zero output is shown below.
- When the servo motor is not powered, set the monitor signal as the torque command.
- During speed control, set the monitor signal to position deviation.

2) Operation steps

The operation steps of zero adjustment of analog monitoring output are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **Fn000** ".
- ② Press **(^)** or **(v)** key to display " **Fn00C** ".
- ③ Press **(S)** key for about 1 sec , displaying " **Ch1.0** ".
- ④ Press **(M)** key to switch between the monitoring output of channel 1 and channel 2, and channel 2 is displayed as " **Ch2.0** ".
- ⑤ Press **(S)** key (less than 1 sec), zero adjustment data is displayed.
- ⑥ Press **(^)** key or **(v)** to change the data, and adjust the offset value of the analog monitoring output.
- ⑦ Press **(S)** key (less than 1 sec), to switch to display the channel of analog monitoring output.
- ⑧ Press **(S)** key for about 1 sec , return to " **Fn00C** ".

8.9 Adjust Analog Monitor Output Gain (Fn00D)

Manually adjust the gain of Analog monitoring output (Torque command monitoring and Motor speed monitoring).

The gains of torque command monitoring and motor speed monitoring can be adjusted independently. The gain has been adjusted at the factory, so generally there is no need to use this function.

1) Adjustment example

The example of gain adjustment for motor speed monitoring is shown below.

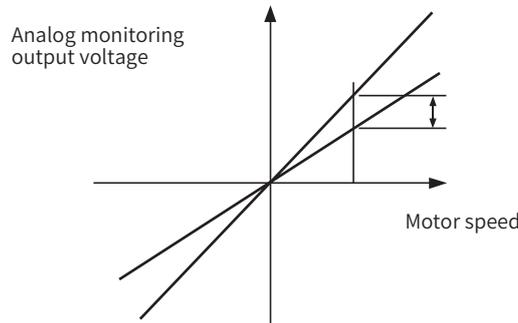


Figure 8-2 Example diagram of gain adjustment for motor speed monitoring

When setting the gain adjustment range, the 100% output value (gain adjustment value 0) can be used as the standard, and the adjustment can be made between 0.5 times and 1.5 times of the standard value.

<Example>

When setting to "-125":

$$100 + (-125 \times 0.4) = 50 [\%]$$

Therefore, the monitor output voltage is 0.5 times.

When setting to "125":

$$100 + (125 \times 0.4) = 150 [\%]$$

Therefore, the monitor output voltage is 1.5 times.

Table 8-6 Gain adjustment example for Motor speed monitoring

| Items | Specification |
|-----------------------|---------------|
| Zero-adjustment range | 50% ~ 150% |
| Adjustment unit | 0.4% /LSB |

<Supplement>

- This function cannot be executed when set to Write Prohibition Setting (Fn010).
- Even if the Initialize Parameters (Fn005) is executed, the adjustment value cannot be initialized.

2) Operation steps

The operation steps of zero-adjustment of analog monitoring output are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **[Fn000]** ".
- ② Press **(^)** or **(v)** key to display " **[Fn000]** ".
- ③ Press **(S)** key for about 1 sec, to display " **[Ch1.6]** ".
- ④ Press **(M)** key to switch between the Monitoring output of channel 1 and channel 2, and channel 2 is displayed as " **[Ch2.6]** ".
- ⑤ Press **(S)** key (less than 1 sec), to display gain adjustment data.
- ⑥ Press **(^)** or **(v)** key to change the data, to adjust the gain of the analog monitor output.
- ⑦ Press **(S)** key for about 1 sec, and return to " **[Fn000]** ".

8.10 Auto Tuning Motor Current Detection Signal Offset (Fn00E)



POINTS

- The automatic adjustment of the offset value of the motor current detection signal must be operated at servo OFF.
- When the torque fluctuation is significantly larger than other servo drives, perform automatic adjustment of the offset.

This function is only used when higher precision adjustment is required to further reduce torque ripple. Generally no adjustments are required

The operation steps of the automatic adjustment of the offset value of the motor current detection signal are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **FN000** ".
- ② Press **(^)** or **(v)** key to display " **FN00E** ".
- ③ Press **(S)** key for more than 1 sec , and " **Cur_o** " displays.
- ④ Press **(M)** key to realize the automatic adjustment of the offset. after clearing " **donE** " will blink for about 1 sec.
- ⑤ "donE" display and returned
- ⑥ Press **(S)** key, and return to " **FN00E** ".

8.11 Manually adjust Motor Current Detection Signal Offset (Fn00F)

This function is only used when higher precision adjustment is required to further reduce torque ripple. Generally no adjustment is required.



When performing manual adjustment, if this function executed by mistake, the characteristics may be reduced.

When performing manual adjustments, follow the precautions below.

POINTS

- Make the servo motor rotate at about 100 min⁻¹.
- Observe the torque command monitoring in the analog monitoring state, and reduce the fluctuation.

The operation steps of manual adjustment of the offset value of the motor current detection signal are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **FN000** ".
- ② Press **(▲)** or **(▼)** key to display " **FN00F** ".
- ③ To adjust the U-phase offset, press **(S)** key for about 1 sec, and " **Cu1.0** " displayed
- ④ Press **(S)** key (less than 1 sec), and display U-phase offset.
- ⑤ Press **(▲)** key or **(▼)** key to change the offset. The torque command must also be carefully adjusted while observing the monitor signal.
- ⑥ Press **(S)** key (less than 1 sec) to confirm U-phase current offset adjustment.
- ⑦ Adjust the offset of V- phase. Press **(S)** key for about 1 sec, and " **Cu2.0** " display.
- ⑧ Press **(S)** key (less than 1 sec), to display the offset value of V- phase.
- ⑨ Press **(▲)** or **(▼)** key to change the offset. The torque command must also be carefully adjusted while observing the monitor signal.
- ⑩ Press **(S)** key (less than 1 sec), and " **Cu2.0** " is displayed, to confirm the W-phase current offset adjustment.
- ⑪ Press **(S)** key for about 1 sec, and " **FN00F** " is displayed.

8.12 Writing Prohibition Setting (Fn010)

Function to prevent accidental writing of parameters.

1) Operation steps

Table 8-7 Parameter setting

| Parameter value | Functional operation |
|-----------------|---|
| 0000 | Writing permission (write prohibition disabled) |
| 0001 | Write prohibition (parameters cannot be written after turning on the power next time) |

The operation steps of the automatic adjustment of the offset value of the motor current detection signal are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **FN000** ".
- ② Press **(▲)** or **(▼)** key to display " **FN010** ".
- ③ Press **(S)** key for about 1 sec or more.
- ④ Press **(▲)** or **(▼)** key, and set it to any of the following values. Refer to Table 8-8.
- ⑤ " **done** " display and return to " **FN000** ".
- ⑥ Press **(S)** key for about a sec, and return to " **FN010** ".
- ⑦ To make the setting effective, please restart the power of the servo drive.

Note: This function of FN010 cannot be realized in the debugging software now.

2) Related parameters

All Pn□□□ and auxiliary functions (Fn□□□) listed in "Table 7-8 Auxiliary Function List of Writing Prohibition Setting" can be set as write-prohibited or write-permitted.

Table 8-8 Auxiliary Function List of Writing Prohibition Setting

| Fn No. | Function | Operation by operation panel | By HC ServoWorks HC ServoWorks.Y7 |
|--------|--|------------------------------|-----------------------------------|
| Fn002 | JOG | 1 | 1 |
| Fn003 | Origin Search | 1 | 1 |
| Fn004 | Jog Program | 1 | 1 |
| Fn005 | Initialize Parameters | 1 | 1 |
| Fn006 | Clear Alarm History | 1 | 1 |
| Fn008 | Reset Absolute Encoder | 1 | 1 |
| Fn009 | Auto tuning Analog (Speed/Torque) Reference Offset | 1 | 1 |
| Fn00A | Manually Adjust Speed Reference Offset | 1 | 1 |
| Fn00B | Manually Adjust Torque Reference Offset | 1 | 1 |
| Fn00C | Adjust Analog Monitor Output Offset | 1 | 1 |
| Fn00D | Adjust Analog Monitor Output Gain | 1 | 1 |
| Fn00E | Auto tuning Motor Current Detection Signal Offset | 1 | 1 |
| Fn00F | Manually Adjust Motor Current Detection Signal Offset | 1 | 1 |
| Fn013 | Multiturn Limit Setting after Multiturn Limit Disagreement Alarm | 1 | 1 |
| Fn01B | Initialize Vibration Detection Level | 1 | 1 |
| Fn200 | Tuning-less Level Setting | 1 | 1 |

- Note: When the Writing Prohibition Setting (Fn010) is valid, if the above auxiliary functions are executed, the display on the panel operator is as follows, and the corresponding operations cannot be performed. To perform these auxiliary functions, the Fn010 must be changed to disabled, and "no op" will be displayed on the panel, flashing for 1 second.

8.13 Display Servo Motor Model (Fn011)

To display the model, voltage, capacity, encoder type, and encoder resolution of the servo motor connected to the servo drive. If the servo drive is customized, the corresponding number of the product of this specification will also be displayed.

The operation steps are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **FN000** ".
- ② Press **(^)** or **(V)** key to display " **FN011** ".
- ③ Press **(S)** key for about 1 sec to display models and voltage, such as " **F0132** ": 01 means 220V, 3 means high inertia, 2 means X 6 series servo motor.
- ④ Press **(M)** key to display the capacity of the servo motor, such as " **P0040** ": 400W .
- ⑤ Press **(M)** key to display the encoder type and resolution, such as " **E0023** " for incremental 23-bit encoders, " **E0123** " is an absolute 23-bit encoder.
- ⑥ Press **(M)** key and the special specification number of the servo drive will display. " **40000** " indicates a standard product.
- ⑦ Press **(S)** key for about 1 sec and return to " **FN011** ".

8.14 Display Software Version (Fn012)

To display the software version of the servo drive and encoder.

The operation steps to display the software version of the servo drive and encoder are as follows.

- ① Press **(M)** key to switch to auxiliary function mode " **FND00** ".
- ② Press **(^)** or **(v)** key to display " **FND12** ".
- ③ Press **(S)** for more than 1 sec, the FPGA version will be displayed, such as " R.2A11 ".
- ④ Press **(M)** key to display the software version of the servo drive, such as "U. 2B03 ".
- ⑤ Press **(M)** key to display the model information version of the servo sheet, such as "P. 2B06 ".
- ⑥ Press **(S)** key and return to " **FND12** ".

8.15 Initialize Vibration Detection Level(Fn01B)

This function is to automatically set the Vibration Detection Level (Pn312) in order to detect the "Vibration Alarm (A.520)" and "Vibration Warning (A.911)" more accurately after detecting the mechanical vibration in the running state.

The vibration detection function can detect the vibration component at a certain speed of the servo motor. When the vibration exceeds the detection value calculated by the following detection formula, an alarm or warning will be displayed through the Vibration Detection Selection (Pn310).

$$\text{Detection value} = \text{Vibration detection value (Pn312}[\text{min}^{-1}]) \times \text{Detection sensitivity(Pn312}[\%]) / 100$$

<Remarks> _

- This function can only be set when the vibration is detected by the factory-set Vibration Detection Level (Pn312) and the "Vibration Alarm (A.520)" or "Vibration Warning (A.911)" is not displayed at the correct time.
- Depending on the state of the machine used, the detection sensitivity of vibration alarms and warnings may vary. In this case, fine-tune the Vibration Detection Sensitivity (Pn311) by referring to the detection formula above.



POINTS

- If the servo gain is not set properly, it may be difficult to detect vibration. And it may not be possible to detect all vibrations.
- Please set an appropriate Moment of Inertia Ratio (Pn103). If the settings are not correct, vibration alarms and vibration warnings may be falsely detected or may not be detected.
- To set this function, the customer must have the operation with the actual command.
- Execute after changing to the operating state where the vibration detection value is to be set. If the setting is made while the servo motor is rotating at low speed, vibration will be detected immediately after the servo is turned ON. If it is set when the servo motor is running at a speed less than 10% of the maximum speed, "Error" will be displayed.

1) Steps

The operation steps of the automatic adjustment of the motor current detection offset are as follows:

- ① Press **(M)** key to switch to auxiliary function mode " **FND00** ".
- ② Press **(^)** or **(v)** key to display " **FND13** ".
- ③ Press **(S)** key for about 1 sec, and " **dINIT** " displayed
- ④ Press **(M)** key, then " **dINIT** " flashes, it will detect and update the vibration value. The detection and update will continue until the MODE/SET key is pressed again.
- ⑤ Press **(M)** again at the appropriate time to finish the detection and updates. " **done** " displays after the setting is completed normally. " **Error** " will display when the setting cannot be completed normally.
- ⑥ Press **(S)** key to return to " **FND13** ".

2) Related parameters

The relevant parameters are as follows:

Table 8-9 Parameters for Vibration detection initialization

| Pn 311 | Vibration Detection Sensitivity | Speed | Position Torque | When enabled | Classification |
|--------|---------------------------------|-------|-----------------|--------------|----------------|
|--------|---------------------------------|-------|-----------------|--------------|----------------|

| | | | | | | |
|--------|----------------------------------|---------------------|-----------------|---------------|---------------------|-----------------------|
| | Setting range | Unit | Factory setting | Immediately | Setup | |
| | 50~500 | 1% | 100 | | | |
| Pn 312 | Vibration Detection Level | Speed | Position | Torque | When enabled | Classification |
| | Setting range | Unit | Factory setting | | Immediately | Setup |
| | 0~5000 | 1 min ⁻¹ | 50 | | | |

Note: Pn312 is set by the detection value of vibration detection, so adjustment is not required. The detection sensitivity is set by Pn311.

Table 8-10 P n310 Parameter setting

| Parameter | Content | When enabled | Classification | |
|-----------|---------|--|----------------|-------|
| Pn 310 | n.□□□ | Do not detect vibration d. (Factory setting) | Immediately | Setup |
| | n.□□□ | A warning occur after vibration is detected (A.911). | | |
| | n.□□□ | An Alarm occur(A. 520) after vibration is detected. | | |

8.16 Software Reset (Fn030)

This function resets the servo drive internally by software. Sometimes it is necessary to restart the power supply after changing the parameter setting. Using this function can make the setting effective without restarting the power supply.



POINTS

- This function must be operated at servo OFF.
- This function has nothing to do with the upper device and can reset the servo drive. Be sure to disconnect with the upper device.

The operation steps of software reset are as follows:

- ① Press **M** key to switch to auxiliary function mode " **FN000** ".
- ② Press **▲** or **▼** key to display " **FN030** ".
- ③ Press **S** key for about 1 sec to display " **SrSt1** ".
- ④ Press **▲** key until " **SrSt5** " displayed.
- ⑤ Press **M** key, the panel display disappears.
- ⑥ Press **S** key for about 1 sec and return to " **FN030** ".



Chapter 9 Monitoring Display

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9.1 Monitoring Display List

Monitoring display is to display the command value, the status of input and output signals, and the internal status of the servo drive. The monitoring display list is as follows .

Table8-1 Monitoring display list

| Un No. | Display content | Unit |
|---------------------|---|------------------------------|
| Un000 | Motor Speed | r/min |
| Un001 | Speed Command | r/min |
| Un002 | Torque Command (Related to rated torque) | % |
| Un003* ³ | Rotation Angle 1 (32-bit decimal display) | Number of pulses from origin |
| Un004 | Rotation Angle2 (Angle from origin (Electrical angle)) | deg |
| Un005* ¹ | Input Signal Monitoring | — |
| Un006* ² | Output Signal Monitoring | — |
| Un007 | Input Command Pulse Speed (Valid only for position control) | r/min |
| Un008 | Deviation Counter (Position deviation) (Valid only for position control) | Command unit |
| Un009 | Accumulated Load Ratio (100% rated torque: Display effective torque in 10s cycle) | % |
| Un00A | Regenerative Load Ratio (100% handleable regenerative power%: Display | % |
| Un00B | Power Consumed by DB Resistance (100% handleable power wiht the dynamic | % |
| Un00C | Input Command Pulse Counter (32-bit decimal display) | Command unit |
| Un00D | Feedback Pulse Counter (incremental data of 4 times of the number of encoder | Encoder pulse |
| Un00E | Fully-closed Loop Feedback Pulse Counter (incremental data of 4 times of the | External encoder pulse |
| Un012 | Total Operation Time | 100ms |
| Un013* ³ | Feedback Pulse Counter (32-bit decimal display) | Command unit |
| Un014 | Effective Gain Monitor | — |
| Un015 | Safety I/O Signal Monitor | — |
| Un020 | Rated Motor Speed | r/min |
| Un021 | Maximum Motor Speed | r/min |

Note: * 1 . Please refer to "Section 9.4 Input Signal Monitoring" .

* 2. Please refer to "Section 9.5 Output Signal Monitoring".

* 3. Please refer to " Section 9.3 How to Read 32-bit Decimal Display".

9.2 Operation Example of Monitoring Display

Please refer to " Section 5.2.8 Operation of Monitoring Display (Un□□□) " for details.

9.3 How to Read 32-bit Decimal Display

For details, please refer to " Section 5.2.6 Numerical setting " .

9.4 Input Signal Monitoring

The state of the input signal can be confirmed by " Input Signal Monitoring (Un005)". The confirmation procedure, the judgment method of the display, and the examples are as follows.

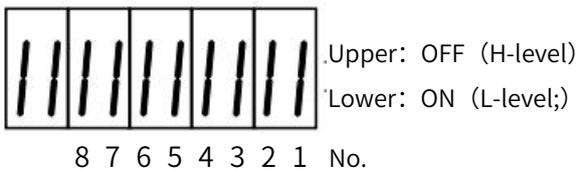
9.4.1 Confirmation of Input Signal Status

The steps to confirm the input signal status by Un005 are as follows:

- 1) Press **(M)** key to switch to the Monitoring function mode " **UN005** ".
- 2) After pressing **(S)** for 1 sec, the current status will be displayed. The state is displayed by the operation panel. For the judgment method of the display, please refer to "Section 8.4.2 Judgment Method of the Display State of the Input Signal".
- 3) Press **(S)** for about 1 sec and return to " **UN005** ".

9.4.2 How to Judge Display State of the Input Signal

The state of the assigned input signal is displayed by the lighting state of the segment (LED) on the operation panel. The relationship between input pins and LED numbers is shown below.



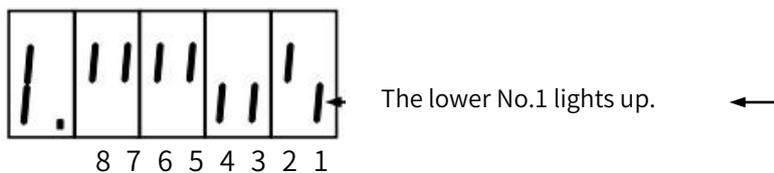
- The upper segment (LED) lights up when the input signal is OFF (open circuit).
- The lower segment (LED) lights up when the input signal is ON (short circuit).

| LED No. | Input pins No. | Factory setting |
|---------|----------------|---------------------------------|
| 1 | CN1-40 | /HomeSwitch |
| 2 | CN1-41 | Probe 1 |
| 3 | CN1-42 | P-OT |
| 4 | CN1-43 | N-OT |
| 5 | CN1-44 | Probe 2 |
| 6 | CN1-45 | - |
| 7 | CN1-46 | - |
| 8 | CN1-47 | External 24V power supply input |

9.4.3 Display Examples of Input Signal

A display example of an input signal is shown below:

- When the / HomeSwitch signal is ON



- When the /HomeSwitch signal is OFF



9.5 Output Signal Monitoring

The state of the output signal can be checked through "Output Signal Monitor (Un006)". The confirmation procedure, the judgment method of the display, and the display example are as follows.

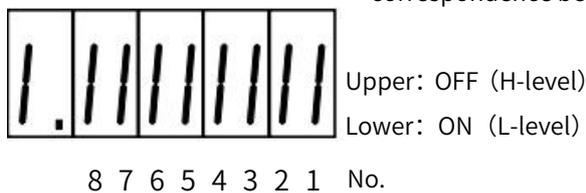
9.5.1 Confirmation of Output Signal Status

To confirm the Output Signal status through Un006 are as follows:

- 1) Press **(M)** key to switch to the monitoring function mode " **UN006** ".
- 2) After pressing **(S)** for 1 sec, the current status will be displayed. The state is displayed through the segments of the operation panel. For the judgment method of the display, please refer to " Section 8.5.2 Judgment Method of the Output Signal Display State".
- 3) Press and hold **(S)** key for about 1 sec, return to " **UN006** ".

9.5.2 Judgment Method of Output Signal Display Status

The assigned output signal is displayed by the lighting state of the segment (LED) of the operation panel. The correspondence between output pins and LED No. is shown in the table below.



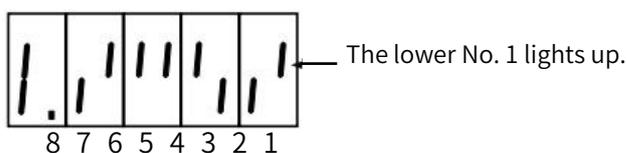
- The upper segment (LED) lights up when the output signal is OFF (open circuit) .
- The lower segment (LED) lights up when the output signal is ON (short circuit) .

| LED No. | Output pins | Factory setting |
|---------|-------------|-----------------|
| 1 | CN1-31, -32 | ALM |
| 2 | CN1-25, -26 | BK |
| 3 | CN1-27, -28 | — |
| 4 | CN1-29, -30 | — |
| 5 | CN1-37, -38 | — |
| 6 | — | — |
| 7 | — | — |
| 8 | — | — |

9.5.3 Examples of Output Signal Display

Display examples of output signals are shown below.

- When the ALM signal is activated (Alarm occurs at H-level)



9.6 Monitoring Display at Power-ON

If set Un number through Pn52F, the data of the Un number will be displayed on the operation panel when the power is turned on. However, if it has been set to FFF [Factory setting], the status (bb, run, etc.) will be displayed

when the power is turned on.

Table 9-2 Pn52F parameter setting

| Pn52F | Monitor Display at Startup | | | | |
|-------|----------------------------|------|-----------------|--------------|----------------|
| | | | Position | Speed | Torque |
| | Setting range | Unit | Factory setting | When enabled | Classification |
| | 0 - FFF | — | FFF | Immediately | Setup |



Chapter 10 Fully-closed Loop Function

| | | |
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10.1 Fully-closed Loop Model Establishment and Connection

The fully-closed loop system uses the auxiliary encoder to feed back the actual position of the mechanical end to the servo drive to improve the backlash of the guide screw of the transmission system, the flexibility of the coupling or belt drive, the temperature and thermal expansion of the transmission system, and the linearity of the transmission system Or end sliding and other factors to achieve high and accurate positioning.

Fully-closed loop encoder cables must use shielded twisted-pair cables.

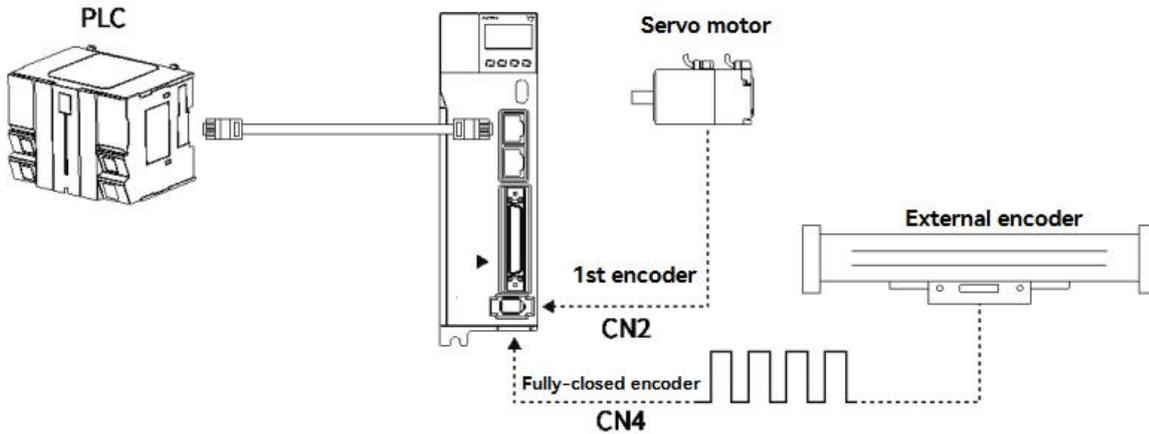


Figure 10-1 Fully-closed loop model diagram

Connect the fully-closed loop encoder (CN4) according to the pin definition in Table 9-1 after soldering, the first encoder (CN2) is connected to the servo motor, and the communication between the upper controller and the servo drive is established through a network cable connection. The CN4 pin diagram is as follows. (The position of CN4 is different for different servo drive, please refer to Section 1.4 and 1.5 for details)

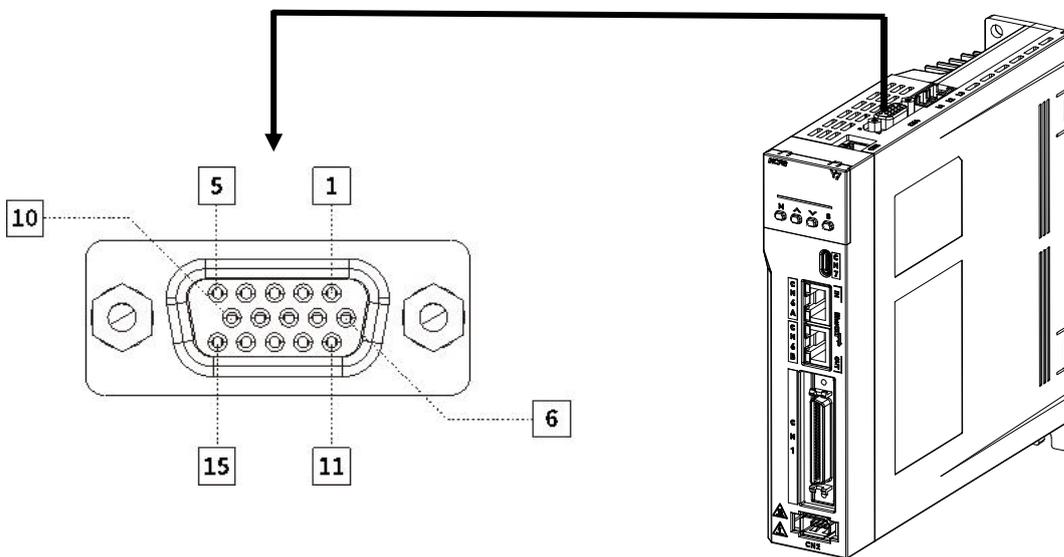


Figure 10-2 CN4 pins arrangements

Table 10-1 Pin definition of fully-closed loop grating ruler

| Pin | Incremental ABZ encoder with Differential hall sensors | SinCos encoder with Differential hall sensors and Z-signal | BISS Encoder | Tamagawa Encoder |
|-----|--|--|---|---|
| 1 | +5V output Current output $\leq 3.00\text{mA}$ _ | +5V output Current output $\leq 3.00\text{mA}$ _ | +5V output Current output $\leq 3.00\text{mA}$ _ | +5V output Current output $\leq 3.00\text{mA}$ _ |

| | | | | |
|-------|---------------------------|---------------------------|---------------------------|---------------------------|
| 2 | 0V output | 0V output | 0V output | 0V output |
| 3 | Hall U+ | Hall U+ | — | — |
| 4 | Hall U- | Hall U- | — | — |
| 5 | Hall V + | Hall V + | — | — |
| 6 | Incremental encoder A - | Sine encoder Sin - | BISS -C CLK - | Serial DATA - |
| 7 | Incremental encoder B- | Sine encoder Cos - | BIS SC DATA - | — |
| 8 | Incremental encoder Z - | Incremental encoder Z - | — | — |
| 9 | Hall W + | Hall W + | — | — |
| 10 | Hall V - | Hall V - | — | — |
| 11 | Incremental encoder A + | Sine encoder Sin + | BISS -C CLK+ | Serial DATA+ |
| 12 | Incremental encoder B + | Sine encoder Cos + | BIS SC DATA+ | — |
| 13 | Incremental encoder Z + | Incremental encoder Z + | — | — |
| 14 | Hall W - | Hall W - | — | — |
| 15 | Temperature sensor signal | Temperature sensor signal | Temperature sensor signal | Temperature sensor signal |
| Shell | Shield | Shield | Shield | Shield |

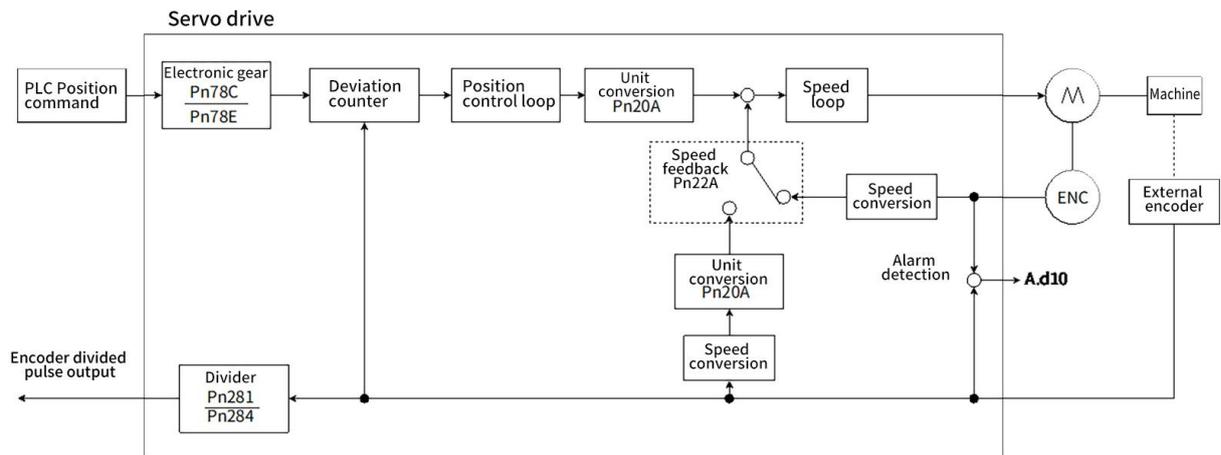


Figure 10-3 Fully-closed loop system control block diagram

10.2 Parameters Setting for Fully-closed Loop

| Parameter | Name | Setting range | Factory setting | Unit | When enabled |
|-----------|------------------|-------------------------------------|-----------------|------|---------------|
| Pn002.3 | External Encoder | 0-4_ | 0 | - | After restart |
| | 0 | Do not use | | | |
| | 1 | Use in standard running direction | | | |
| | 2 | Reserved parameters (Do not change) | | | |
| | 3 | Use in reverse direction | | | |
| | 4 | Reserved parameters (Do not change) | | | |

| | | | | | |
|----------------|--|----------------------------|--------|--------------------|--------------------------|
| Pn20A | Number of External Encoder Scale Pitches | 4-1048576_ | 3 2768 | 1 P/R ev | After restart |
| Pn22A.3 | Speed Feedback Selection | 0-1_ | 0 | - | After restart |
| | 0 | Use motor encoder speed | | | |
| | 1 | Use external encoder speed | | | |
| Pn281 | Encoder Output Resolution | 1-4096_ | 20 | 1 pulse edge/pitch | After restart |
| Pn284 | Number of Pulses corresponding to the Grating Pitch | 0 000-FFFF | 0 | Pulse/pitch | After restart |
| Pn51B | Motor-Load Position Deviation Overflow Detection Level | 0-1073741824 | 1000 | 1 command unit | Immediately |
| Pn607.0 | Second Encoder Type Selection | 0-5_ | 0 | - | After restart |
| | 0 | HCFA encoder | | | |
| | 1 | BISS encoder | | | |
| | 2 | YAS encoder | | | |
| | 3 | ABZ encoder | | | |
| | 4 | AB encoder | | | |
| | 5 | SinCOS encoder | | | |
| Pn20E | (Electronic Gear Ratio Numerator) | 1-1073741823_ | 4 | - | Effective after disabled |
| Pn210 | (Electronic Gear Ratio Denominator) | 1-1073741823_ | 1 | - | Effective after disabled |

10.3 Fully-closed Loop Setting Procedure

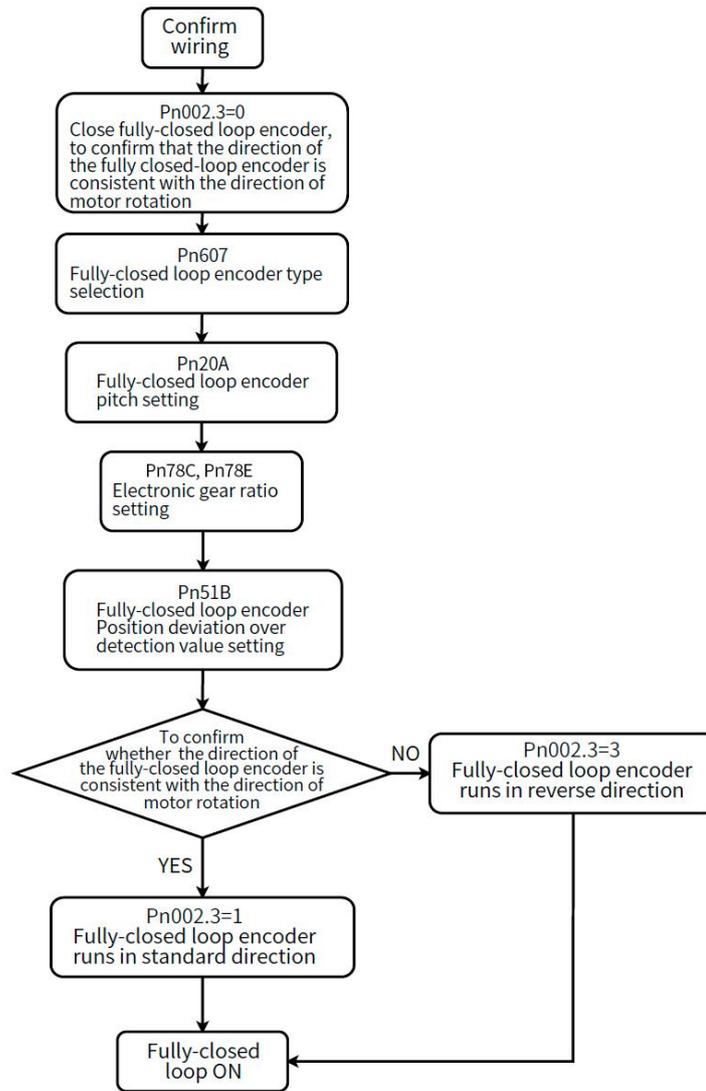


Figure 10-4 Fully-closed loop system setting procedures

10.4 Fully-closed Loop Parameter Setting

10.4.1 Fully-closed Loop Encoder Direction Setting

Table 10-2 Fully –closed loop encoder direction setting

| Parameter | Name | Setting range | Factory setting | Unit | When enabled |
|-----------|---|---------------|-----------------|------|---------------|
| Pn002.3 | Fully closed-loop encoder using direction setting | 0-4 | 0 | - | After restart |

| | |
|---|-------------------------------------|
| 0 | Do not use |
| 1 | Use in standard running direction |
| 2 | Reserved parameters (Do not change) |
| 3 | Use in reverse direction |
| 4 | Reserved parameters (Do not change) |

Before using the fully-closed loop function, please make sure that the direction of the fully-closed loop encoder is consistent with the direction of motor rotation. For the direction setting of the motor rotation (Pn000.0), refer to Section 5.3.4 and the steps are as follows:

1. Confirm that the fully-closed loop system has been built and the parameter setting is completed (At this time, Pn 002.3= 0, the feedback of the fully-closed loop encoder defaults to the feedback in the standard running direction);
2. Enter into the monitoring display of HCServoWorks, check "Feedback pulse counter" and "Fully-closed loop feedback pulse counter";
3. Perform speed J OG at this time, and check the monitoring panel of the host controller, and confirm whether the values of "Feedback pulse counter" and "Fully-closed loop feedback pulse counter" increase or decrease at the same time ;
4. If the feedback values of "Feedback pulse counter" and "Fully-closed loop feedback pulse counter" do not increase or decrease at the same time, parameter adjustment is required; the value of Pn 002.3 can be modified; after modification, repeat the above operation until the feedback value are the same.

Warning: For example, the feedback values of "Feedback pulse counter" and "Fully-closed loop feedback pulse counter" are not incremented or decremented at the same time. At this time, when the position mode is used, a speeding phenomenon will occur. Otherwise, the machine tool will be damaged.

10.4.2 Fully-closed Loop Encoder Pitch Setting

Table 10-3 Fully-closed loop encoder pitch setting

| Parameter | Name | Setting range | Factory setting | Unit | When enabled |
|-----------|--|---------------|-----------------|-------------|---------------|
| Pn20A | Number of External Encoder Scale Pitches | 4-1048576 | 32768 | Pitch / Rev | After restart |

Parameter function: The number of AB pulses corresponding to the fully-closed loop when the motor rotates one revolution;

The fully-closed-loop encoder pulse calculation method corresponding to one revolution of the motor can be estimated from physical quantities; If the fully-closed-loop encoder pitch (Pn20A) is not set correctly, the error between the feedback position of the fully-closed-loop encoder and the motor encoder will gradually increase due to long-term operation, and eventually alarm A.d10 occurs.

When the machine uses a screw drive and a fully-closed loop encoder to form a fully-closed loop control, it is necessary to use the lead of the screw and the resolution of the fully-closed loop encoder to calculate the number of pulses of the fully-closed loop encoder corresponding to one revolution of the motor. If the specifications of the screw rod and fully-closed loop encoder have been confirmed, the user can directly estimate Pn 20A from the theoretical value.

Example:

If the screw lead is 5 mm, the resolution of the grating ruler (fully-closed-loop encoder) is 1 μm;

$$\frac{5\text{mm}}{1\mu\text{m}} = \frac{5000\mu\text{m}}{1\mu\text{m}} = 5000 \text{ pulse} = \text{Pn20A}$$

When the motor has one revolution, the fully-closed loop encoder feedback has 5000 pulses.

10.4.3 Electronic Gear Ratio Setting

When using a fully-closed loop, the setting of the gear ratio will affect the number of feedback pulses of the fully-closed loop encoder;

Table 10-4 Electronic gear ratio setting

| Parameter | Name | Setting range | Factory setting | Unit | When enabled |
|-----------|-------------------------------------|---------------|-----------------|------|--------------------------|
| Pn78C | Electronic Gear Ratio (Numerator) | 1-1073741823 | 1 | - | Effective after disabled |
| Pn78E | Electronic Gear Ratio (Denominator) | 1-1073741823 | 1 | - | Effective after disabled |

Example: Pn 20A=5000

The gear ratio is set to 1:1, one motor revolution, and the fully-closed loop encoder feedback 5,000 pulses,

The gear ratio is set to 4 :1, one motor revolution, and the fully-closed loop encoder feed back 1250 pulses.

The gear ratio is set to 1: 2 , one motor revolution, and the fully-closed loop encoder feedback 10,000 pulses.

10.4.4 Selection of Fully-closed Loop Speed Feedback

When Pn 002.3=0 (No external encoder), this parameter cannot be used.

Table 10-5 Fully- closed loop speed feedback selection setting

| Parameter | Name | Setting range | Factory setting | Uunit | When enabled |
|-----------|--------------------------|----------------------------|-----------------|-------|---------------|
| Pn22A.3 | Speed Feedback Selection | 0-1 | 0 | - | After restart |
| | 0 | Use motor encoder speed | | | |
| | 1 | Use external encoder speed | | | |

10.4.5 JOG in Fully-closed Loop Control

After confirming that the wiring and parameter settings are correct:

1. Enter into the monitoring panel of the HCS ervoWorks, check the "Feedback pulse counter" and "Fully-closed loop feedback pulse counter" and record the current value.
2. Enter into the "JOG" of the HCServo Works, set the jogging speed on the JOG operation panel, and enable the servo drive. Refer to Section 9.4.1 to make sure that the direction of the fully-closed loop encoder is consistent with the direction of motor rotation.
3. Click the program JOG, and the operating conditions can be set by yourself;

Assume that the first encoder resolution = M, Fully-closed loop encoder pitch (Pn 20A) = N, Gear ratio X :Y ,

Program JOG moving distance = L, Program JOG moving speed = 500, Program JOG moving times = 1, Program JOG running mode = 0 (Forward-rotation);

Then the number of motor revolutions $R = \frac{L}{N} \times \frac{X}{Y}$, at this time the value of "Feedback pulse counter" should be $M \times R$, and the value of "Fully-closed loop feedback pulse counter" should be $N \times R$.

10.5 Fully-closed Loop Frequency Division Pulse Output Function

Table 10-6 Fully- closed loop frequency division pulse output function setting

| Parameter | Name | Setting range | Factory setting | Unit | When enabled |
|-----------|---|---------------|-----------------|-------------|---------------|
| Pn281 | Encoder Output Resolution | 1-4096 | 20 | Edge/Pitch | After restart |
| Pn284 | Number of Pulses corresponding to the Grating Pitch | 0000-FFFF | 0 | Pulse/Pitch | After restart |

Set the encoder output resolution of the encoder frequency division pulse output (PAO, /PAO, PBO, /PBO, refer to Section 2.6.1) signal sent by the servo drive to the upper device.

The number of frequency division pulse = $\frac{Pn281}{Pn284}$

Setting example:

Pn 281=4, Pn 284=1, gear ratio 1:1;

PLC sends a pulse command to servo drive A, then servo drive B receives 4 edges;

Pn 281=4, Pn 284=1, gear ratio 2 :1;

PLC sends a pulse command to servo drive A, then servo drive B receives 8 edges;

Pn 281=4, Pn 284=1, gear ratio 1: 2 ;

PLC sends a pulse command to servo drive A, then servo drive B receives 2 edges;

Pn 281=2, Pn 284=1, gear ratio 1:1;

PLC sends a pulse command to servo drive A, then servo drive B receives 2 edges;

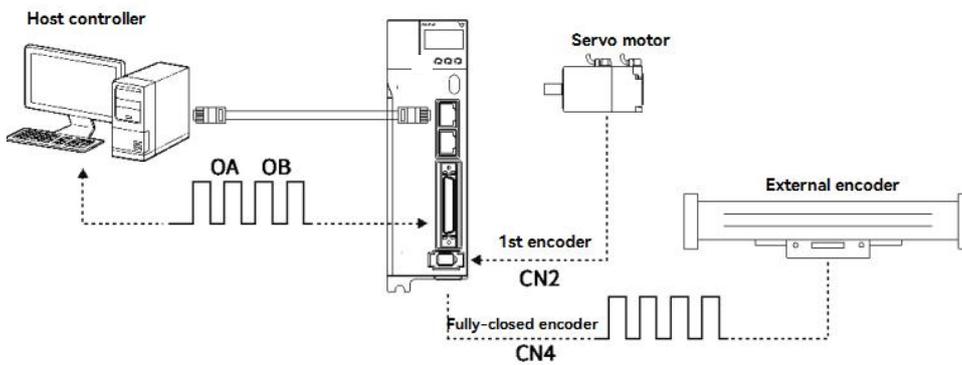


Figure 10-5 Diagram of frequency division pulse of fully-closed loop system

10.6 Fully-closed Loop Alarms and Solutions

Table 10-7 Fully- closed Loop Alarms and Solutions

| A.d10 Excessive Fully-closed loop position deviation | | |
|---|--|---|
| Trigger conditions and reasons | Condition | Fully-closed loop position deviation is too large |
| | Reason | 1. The setting value of Pn 51B is too small; 2. Whether the connector is loose or there is a problem with the connection |
| Inspection and troubleshooting | 1. Check whether the setting value of Pn 51B is reasonable, and it can be increased appropriately; 2. Check the wiring. | |
| A.CF1 Fully-closed loop encoder communication failure | | |
| Trigger conditions and reasons | Condition | Fully-closed loop encoder communication failure |
| | Reason | 1. There is something wrong with the CN4; 2. Wrong selection of fully – closed loop encoder type. |
| Inspection and troubleshooting | 1. Check whether there is any welding error in the C N4 2. Check the setting of Pn 607.0 | |



Chapter 11 Alarm Display

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11.1 When an Alarm Occurs

This section explains the processing method when an alarm occurs.

" Section 11.1.1 Alarm List" explains the alarm name, the alarm content, the stop method when the alarm occurs, and whether the alarm can be reset.

" Section 11.1.2 Causes and Troubleshooting of Alarms " explains the causes of alarms and their treatment methods

11.1.1 Alarm List

How to stop the alarm :

BM.1 : Depends onPn001.0. The factory setting is Dynamic Brake(DB) stop.

BM.2 : Depends onPn00B.1. The factory setting is zero-speed stop when the speed command is zero.

For torque control, generally use BM.1 to stop. By setting Pn00B.1 = 1, the same stop method as BM.1 can be set. When using multiple servo motors, this stop method can be used to prevent damage to the machine due to different stop methods.

Whether the alarm can be reset :

Yes: The alarm can be cleared by alarm reset. However, if the cause of the alarm is not completely eliminated, the alarm cannot be dismissed.

No: The alarm cannot be cleared by alarm reset .

The alarm list is as follows :

Table 11-1 List of alarms

| Alarm No. | Alert name | Content | How to stop when an alarm occurs | Whether the alarm can be reset |
|-----------|---|---|----------------------------------|--------------------------------|
| A.020 | Parameter Checksum Error | There is an error in the parameter data in the servo drive. | BM.1 | No |
| A.021 | Parameter Format Error | There is an error in the parameter data format in the servo drive.. | BM.1 | No |
| A.022 | System Checksum Error | There is an error in the parameter data in the servo drive. | BM.1 | No |
| A.030 | Main Circuit Detector Error | There is an error in the detection data for the main circuit | BM.1 | Yes |
| A.040 | Parameter Setting Error | A parameter setting is outside of the setting range | BM.1 | No |
| | Output Pin Definition Repeation | Output pin definition is repeated. | BM.1 | No |
| A.041 | Frequency Division Pulse Output Error | Encoder frequency division pulse number (Pn212) is outside of the setting range . | BM.1 | No |
| A.042 | Parameter Combination Error | The combination of some parameters exceeds the setting range. | BM.1 | No |
| A.044 | Semi-Closed/Fully-Closed Loop Control Parameter Setting Error | Optional modules and Pn00B.3, Pn002.3settings do not match . | BM.1 | No |
| A.050 | Combination Error | The capacities of the servo drive and Servo motor do not match. . | BM.1 | Yes |
| A.051 | Unsupported Device Alarm | An unsupported device was connected | BM.1 | No |
| A.0b0 | Invalid Servo ON Command Alarm | The /S-ON (Servo ON) signal was input from the host controller after a utility function that turns ON the Servomotor was executed.. | BM.1 | Yes |
| A.100 | Overcurrent detection | An overcurrent flowed through the power transistor or the heat sink overheated . | BM.1 | No |
| A.300 | Regeneration Error | There is an error related to regeneration | BM.1 | Yes |

| | | | | |
|----------------|---|--|------|-----|
| A.320 | Regenerative Overload | A regenerative overload occurred | BM.2 | Yes |
| A.330 | Main Circuit Power Supply Wiring Error | <ul style="list-style-type: none"> • The AC power supply input setting or DC power supply input setting is not correct. • The power supply wiring is not correct | BM.1 | Yes |
| A.400 | Overvoltage | The main circuit DC voltage is too high . | BM.1 | Yes |
| A.410 | Undervoltage | The main circuit DC voltage is too low | BM.2 | Yes |
| A.450 | Main Circuit Capacitor Overvoltage | The main circuit capacitor is aging or faulty . | BM.1 | no |
| A.510 | Overspeed | The motor exceeded the maximum speed. . | BM.1 | Yes |
| A.511 | Frequency Division Pulse Output Overspeed | The pulse output speed for the setting of Pn212 (Number of Encoder Output Pulses) was exceeded | BM.1 | Yes |
| A.520 | Vibration Alarm | Abnormal oscillation was detected in the motor speed. | BM.1 | Yes |
| A.521 | Autotuning Alarm | Vibration was detected during autotuning for the tuning-less function. | BM.1 | Yes |
| A.710 | Instantaneous Overload | The Servomotor was operating for several seconds to several tens of seconds under a torque that largely exceeded the rating.. | BM.2 | Yes |
| A.720 | Continuous Overload | The Servomotor was operating continuously under a torque that exceeded the rating. | BM.1 | Yes |
| A.730 A.731 | Dynamic Brake Overload | When the dynamic brake was applied, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor . | BM.1 | Yes |
| A.740 | Inrush Current Limiting Resistor Overload | The main circuit power supply was frequently turned ON and OFF.. | BM.1 | Yes |
| A.7A0 | Heatsink Overheating | The heat sink temperature of the servo drive exceeds 100°C . | BM.2 | Yes |
| A.7AB | Built-in Fan Stopped | The fan inside the servo drive stopped. . | BM.1 | Yes |
| A.810 | Encoder Backup Alarm | The power supplies to the encoder all failed and the position data was lost. | BM.1 | No |
| A.820 | Encoder Checksum Alarm | There is an error in the checksum results for encoder memory | BM.1 | No |
| A.830 | Encoder Battery Alarm | The battery voltage was lower than the specified level after the control power supply was turned ON.. | BM.1 | Yes |
| A.840 | Encoder Data Alarm | There is an internal data error in the encoder.. | BM.1 | No |
| A.850 | Encoder Overspeed | The encoder was operating at high speed when the power was turned ON. | BM.1 | No |
| A.860 | Encoder Overheated | The internal temperature of the encoder is too high . | BM.1 | No |
| A.8A0 | External Encoder Error | An error occurred in the external encoder | BM.1 | Yes |
| A.8A1 | External Encoder Module Error | An error occurred in the Serial Converter Unit. | BM.1 | Yes |
| A.8A2 | External Incremental Encoder Sensor Error | An error occurred in the external encoder. | BM.1 | Yes |
| A.8A3 | External Absolute Encoder Position Error | An error occurred in the position data of the external encoder | BM.1 | Yes |
| A.8A5 | External Encoder Overspeed | An overspeed error occurred in the external encoder | BM.1 | Yes |
| A.8A6 | External Encoder Overheated | An overheating error occurred in the external encoder | BM.1 | Yes |
| A.b31 | Current Detection Error1 | The error of U-phase current detection circuit occur. . | BM.1 | No |
| A.b32 | Current Detection Error2 | The error of V-phase current detection circuit occur. | BM.1 | No |
| A.b33 | Current Detection Error3 | The error of current detection circuit occur.. | BM.1 | No |
| A.bF0 | System Alarm 0 | Internal program error 0 occurred in the servo drive.. | BM.1 | No |
| A.bF1 | System Alarm 1 | Internal program error 1 occurred in the servo drive. . | BM.1 | No |

| | | | | |
|----------------------|---|--|------|-----|
| A.bF2 | System Alarm 2 | Internal program error 2 occurred in the servo drive. | BM.1 | No |
| A.bF3 | System Alarm 3 | Internal program error 3 occurred in the servo drive. . | BM.1 | No |
| A.bF4 | System Alarm 4 | Internal program error 4 occurred in the servo drive. | BM.1 | No |
| A.C10 | Servomotor Out of Control | The Servomotor ran out of control | BM.1 | Yes |
| A.C80 | Encoder Clear Error or Multiturn Limit Setting Error | The multiturn data for the absolute encoder was not correctly cleared or set. | BM.1 | No |
| A.C90 | Encoder Communications Error | Communications between the encoder and servo drive is not possible. | BM.1 | No |
| A.C91 | Encoder Communications Position Data Acceleration Rate Error | An error occurred in calculating the position data of the encoder | BM.1 | No |
| A.C92 | Encoder Communications Timer Error | An error occurred in the communications timer between the encoder and servo drive. | BM.1 | No |
| A.CA0 | Encoder Parameter Error | The parameters in the encoder are corrupted | BM.1 | No |
| A.Cb0 | Encoder Echoback Error | The contents of communications with the encoder are incorrect. | BM.1 | No |
| A.CC0 | Multiturn Limit Disagreement | Different multiturn limits have been set in the encoder and the servo drive. . | BM.1 | No |
| A. CF1 | Reception Failed Error in Feedback Option Module Communications | Receiving data from the Feedback Option Module failed | BM.1 | No |
| A. CF2 | Timer Stopped Error in Feedback Option Module Communications | An error occurred in the timer for communications with the Feedback Option Module. | BM.1 | No |
| A.d00 | Position Deviation Overflow | The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation while the servo was ON. | BM.1 | Yes |
| A.d01 | Position Deviation Overflow Alarm at Servo ON | The servo was turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF. . | BM.1 | Yes |
| A.d02 | Position Deviation Overflow Alarm for Speed Limit at Servo ON | If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) limits the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded before the limit is cleared | BM.2 | Yes |
| A.d10 | Motor-Load Position Deviation Overflow | There was too much position deviation between the motor and load during fully-closed loop control | BM.2 | Yes |
| A.E71 | Safety Option Module Detection Failure | Detection of the Safety Option Module failed. | BM.1 | No |
| A.E72 | Feedback Option Module Detection Failure | Detection of the Feedback Option Module failed. | BM.1 | No |
| A.E74 | Unsupported Safety Option Module | An unsupported Safety Option Module was connected. | BM.1 | No |
| A.E75 | Unsupported Feedback Option Module | An unsupported Feedback Option Module was connected. | BM.1 | No |
| A. Eb1 ^{*1} | Safety Function Signal Input Timing Error | An error occurred in the input timing of the safety function signal.. | BM.1 | No |
| A.F10 | Power Supply Line Open Phase | The voltage was low for more than one second for phase R, S, or T when the main power supply was ON | BM.2 | Yes |
| FL-1 ^{*2} | System Alarm | An internal program error occurred in the servo drive. | — | No |
| FL-2 ^{*2} | | | — | No |

| | | | | |
|--------|---|---|---|-----|
| A.---- | No Error Display | Normal operation. | — | — |
| A.F26 | Torque command and torque feedback difference error | Torque instruction and torque feedback deviation is too large | — | Yes |
| A.F28 | Position command error | Position command from the host controller is abnormal. | — | Yes |

Note: *1. The A.Eb1, A.EC□, alarms can occur when a Safety Module is connected

* 2. These alarms are not stored in the alarm history. They are only displayed on the panel display.

11.1.2 Causes and Troubleshooting

When the error occurs, the panel display will display “A.□□□ or CPF□□”. The causes of and corrections for the alarms are given in the following table. Contact HCFA representative if you cannot solve a problem with the correction given in the table.

Table 11-2 Alarms caused and troubleshooting -1

| Alarm No.: Alarm Name | Causes | Confirmation method | Corrections |
|---|---|---|---|
| A.020: Parameter Checksum Error (There is an error in the parameter data in the servo drive.) | The power supply voltage suddenly dropped. | Measure the power supply voltage | Set the power supply voltage within the specified range, and initialize the parameter settings |
| | The power supply was shut OFF while writing parameter settings. | Check the timing of shutting OFF the power supply | Initialize the parameter settings and then set the parameters again.. |
| | The number of times that parameters were written exceeded the limit. | Check to see if the parameters were frequently changed from the host controller. | The servo drive may be faulty. Replace the Servo drive. Reconsider the method for writing the parameters. |
| | A malfunction was caused by noise from the AC power supply, ground, static electricity, or other source | Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, noise may be the cause | Implement countermeasures against noise. |
| | Gas, water drops, or cutting oil entered the Servo drive and caused failure of the internal components. | Check the installation conditions | The servo drive may be faulty. Replace the Servo drive.. |
| | A failure occurred in the servo drive. | A Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, the servo drive may have failed | The servo drive may be faulty. Replace the Servo drive.. |
| A.021: Parameter Format Error (There is an error in the parameter data format in the servo drive) | The software version of the servo drive that caused the alarm is older than the software version of the parameters specified to write | Read the product information to see if the software versions are the same. If they are different, it could be the cause of the alarm. | Write the parameters from another servo drive with the same model and the same software version, and then turn the power OFF and ON again |
| | A failure occurred in the servo drive. | — | The servo drive may be faulty. Replace the Servo drive.. |
| A.022: System Checksum Error (There is an error in the parameter data in the servo drive) | The power supply voltage suddenly dropped. | Measuring power supply voltage | The servo drive may be faulty. Replace the Servo drive.. |
| | The power supply was shut OFF while setting a utility function | Check the timing of shutting OFF the power supply | The servo drive may be faulty. Replace the Servo drive.. |
| | A failure occurred in the servo drive. | Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, the SERVOPACK may have failed. | The servo drive may be faulty. Replace the Servo drive.. |

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| A.030 : Main circuit detection part failure | Servo drive failure | — | The servo drive may be faulty. Replace the Servo drive.. |
| A.040: Parameter Setting Error (A parameter setting is outside of the setting range.) | The capacity of the servo drive does not match the capacity of the servo motor | Confirm the capacity and combination of the servo drive and servo motor | Match the capacities of the servo drive and the servo motor. |
| | Servo drive failure | — | The servo drive may be faulty. Replace the Servo drive.. |
| | A parameter setting is outside of the setting range. | Confirm the setting range of the changed parameter | Make the changed parameter a value within the setting range. |
| A.041: Frequency division pulse output setting error | The electronic gear ratio is outside of the setting range | Confirm whether the electronic gear ratio is $0.001 < (Pn20E/Pn210) < 4000$ | Set the electronic gear ratio to $0.001 < (Pn20E/Pn210) < 4000$. |
| | Encoder frequency division pulse number (Pn212) does not meet the setting range and setting conditions | Check the setting of Pn212 | Set Pn212 to an appropriate value. |
| A.042 ^{*1} : Parameter Combination Error | The speed of program jogging went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the Servo motor was changed. | Check to see if the detection conditions*1 are satisfied | Decrease the setting of the electronic gear ratio (Pn20E/Pn210). |
| | The speed of program jogging went below the setting range when Pn533 or Pn585 (Program Jogging Movement Speed) was changed. | Check to see if the detection conditions*1 are satisfied | Increase the setting of Pn533 or Pn585. |
| | The movement speed of advanced autotuning went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the Servomotor was changed. | Check to see if the detection conditions*1 are satisfied | Decrease the setting of the electronic gear ratio (Pn20E/Pn210). |
| A.044: Semi-Closed/ Fully-Closed Loop Control Parameter Setting Error | The setting of the Fully-closed Module does not match the setting of Pn002 | Check Pn002.3 settings | Make sure that the setting of the Fully-closed Module agrees with the setting of Pn002 |
| A.050: Combination Error (The capacities of the servo drive and Servomotor do not match.) | The servo drive and Servomotor capacities do not match each other | Confirm $\frac{1}{4} \leq \frac{\text{Motor capacity}}{\text{Servo drive capacity}} \leq 4$ | Select a proper combination of the servo drive and servomotor capacities. |
| | A failure occurred in the encoder. | Replace with another servo motor, confirm that the alarm does not occur again | Replace servo motor or encoder. |
| | A failure occurred in the servo drive. | — | The servo drive may be faulty. Replace the Servo drive.. |
| A.051: Unsupported Device Alarm | An unsupported Serial Converter Unit or encoder (e.g., an external encoder) is connected to the servo drive. | Check the product combination specifications. | Change to a correct combination of models. |
| A.0b0: Invalid Servo ON Command Alarm | The /S-ON (Servo ON) signal was input from the host controller after a utility function that turns ON the Servomotor was executed | — | Turn the power supply to the servo drive OFF and ON again. Or, execute a software reset. |

Note: *1. When any of the following two conditional formulas of the detection conditional formula is satisfied, an alarm is detected.

$$Pn533 [\text{min} - 1] \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{Pn78C}{Pn78E} \quad \text{Max. motor speed} [\text{min} - 1] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{Pn78C}{Pn78E}$$

Table 11-3 Alarms caused and troubleshooting -2

| Alarm No.: Alarm Name | Causes | Confirmation method | Corrections |
|---|--|--|--|
| A.100: Overcurrent Detected (An overcurrent flowed through the power transistor or the heat sink overheated.) | The Main Circuit Cable is not wired correctly or there is faulty contact. | Check the wiring. | Correct the wiring. |
| | There is a short-circuit or ground fault in a Main Circuit Cable. | Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, and W | The cable may be shortcircuited. Replace the cable |
| | There is a short-circuit or ground fault inside the Servo motor. | Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, or W. | The servo motor may be faulty. Replace the servo motor |
| | There is a short-circuit or ground fault inside the servo drive. | Check for short-circuits across the Servomotor connection terminals U, V, and W on the servo drive, or between the ground and terminals U, V, or W. | The servo motor may be faulty. Replace the servo motor |
| | The regenerative resistor is not wired correctly or there is faulty contact. | Check the wiring. | Correct the wiring. |
| | The dynamic brake (DB, emergency stop executed from the servo drive) was frequently activated, or a DB overload alarm occurred | Check the power consumed by the DB resistor to see how frequently the DB is being used. Or, check the alarm display to see if a DB overload alarm (A.730 or A.731) has occurred. | Change the servo drive model, operating methods, or the mechanisms so that the dynamic brake does not need to be used so frequently |
| | The regenerative processing capacity was exceeded. | Use the regenerative load ratio (Un00A) to confirm the frequency of the regenerative resistor | Recheck the operating conditions and load. |
| | The servo drive regenerative resistance is too small. | Use the regenerative load ratio (Un00A) to confirm the frequency of the regenerative resistor | Change the regenerative resistance to a value larger than the servo drive minimum allowable resistance. |
| | A heavy load was applied while the Servomotor was stopped or running at a low speed. | Check to see if the operating conditions exceed Servo Drive specifications | Reduce the load applied to the Servomotor. Or, increase the operating speed |
| | A malfunction was caused by noise. | Improve the noise environment, e.g. by improving the wiring or installation conditions, and check to see if the alarm still occurs | Implement countermeasures against noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK' s main circuit wire size.. |
| | Servo drive failure | — | Turn the power supply to the servo drive OFF and ON again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.300: regeneration failure | Set the regenerative resistor capacity (Pn600) to a value other than "0", but there is no external regenerative resistor | Check the connection of external regenerative resistor and the value of Pn600. | Connect an external regenerative resistor, or set Pn600 to 0 when no regenerative resistor is required. |
| | There is no external regenerative resistor, and the wiring of the power terminals B2-B3 of the servo drive are disconnected | Confirm the wiring of the power terminal jumper | Connect the jumper wiring correctly. |

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| | The wiring of the external regenerative resistor is disconnected. | Check the wiring of the external regenerative resistor | Correctly wire the external regenerative resistor. |
| | Servo drive failure | — | If the control power supply is turned on again without the main circuit power supply being turned on, if the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.320: Regeneration Error | The power supply voltage exceeds the specified range | Measuring power supply voltage | Set the power supply voltage within the specified range. |
| | The external regenerative resistance value or regenerative resistor capacity is too small, or there has been a continuous regeneration state | Check the operating conditions or the capacity | Change the regenerative resistance value or capacity. Reconsider the operating conditions |
| | There was a continuous regeneration state because a negative load was continuously applied. | Check the load applied to the servomotor during operation. | Reconsider the system including the servo, machine, and operating conditions |
| | The setting of Pn600 (Regenerative Resistor Capacity) is smaller than the capacity of the External Regenerative Resistor | Check to see if a Regenerative Resistor is connected and check the setting of Pn600 | Correct the setting of Pn600. |
| | External regenerative resistor value is too large | Check if the regenerative resistor value is correct | Change it to the correct resistor value and capacitance. |
| | Servo drive failure | — | The servo drive may be faulty. Replace the servo drive. |
| A.330: Main circuit power wiring error * Detected when the main circuit power supply is turned on | The power supply voltage inside the servo drive is too high, and the regenerative resistor is disconnected | Measure the resistance value of the regenerative resistor with a measuring instrument | When using the built-in regenerative resistor of the servo drive, replace the servo drive. When using an external regenerative resistor, replace the regenerative resistor. |
| | DC power was supplied when an AC power supply input was specified in the settings | Confirm whether the power supply is DC power supply | Correct the power supply setting to match the actual power supply |
| | AC power was supplied when a DC power supply input was specified in the settings. | Check the power supply to see if it is an AC power supply. | Correct the power supply setting to match the actual power supply |
| | Set the regenerative resistor capacity (Pn600) to a value other than "0", but there is no external regenerative resistor | Confirm the connection of the external regenerative resistor and the value of Pn600 | Connect an external regenerative resistor, or set Pn600 to 0 when an external regenerative resistor is not required. |
| | The jumper wires of the servo power supply terminals B2-B3 of capacities other than the above are disconnected | Confirm the wiring of the power terminal jumper | Connect the jumper wires correctly. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |

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| A.400: Overvoltage (Detected in the main circuit power supply section of the servo drive) | • The servo drive for AC200V, the AC power supply voltage is 290V or higher, or the servo drive for AC400V has detected a power supply voltage of AC580V or higher • The servo drive for AC200V, the DC power supply voltage is above 410V, and the servo drive for AC400V has detected a DC power supply voltage of 830V or more | Measuring supply voltage | Correct the AC/DC power supply voltage to within specified range.. |
| | The power supply is unstable or has been affected by a lightning surge. | Measuring supply voltage | Improve the power supply condition, install a surge suppressor, etc., and turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| | The voltage for AC power supply was too high during acceleration or deceleration | Check the power supply voltage and the speed and torque during operation | Set the AC power supply voltage within the specified range |
| | The external regenerative resistance is too high for the operating conditions. | Check the operating conditions and the regenerative resistance | Select a regenerative resistance value that is appropriate for the operating conditions and load |
| | The moment of inertia ratio or mass ratio exceeded the allowable value | Check to see if the moment of inertia ratio or mass ratio is within the allowable range | Increase the deceleration time, or reduce the load. |
| | Servo drive failure | — | If the control power supply is turned on again without the main circuit power supply being turned on, if the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.410: Undervoltage (The undervoltage is detected by the main circuit power supply inside the servo drive) | For the AC200V servo drive, the AC power supply voltage is below 120V; for the AC400V servo drive, the AC power supply voltage is below 220V | Measuring powersupply voltage | Correct the power supply voltage to normal range. |
| | Power supply voltage drops during operation | Measuring powersupply voltage | Increase power supply capacity. |
| | A momentary power interruption occurred | Measuring powersupply voltage | If the momentary power failure holding time (Pn509) is changed, set it to a smaller value. |
| | The fuse of the servo drive is blown out. | — | Replace the servo drive and use the servo drive after connecting the reactor. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.450: Main circuit capacitor overvoltage | Servo drive failure | — | Replace the servo drive. |
| A.510: Overspeed (The motor speed above maximum speed) | The order of phases U, V, and W in the motor wiring is not correct. | Confirm the wiring of the servo motor | Make sure that the Servomotor is correctly wired. |
| | A reference value that exceeded the overspeed detection level was input | Check the input reference. | Reduce the reference value. Or, adjust the gain |
| | Motor speed exceeds maximum speed | Confirm the waveform of the motor speed | Reduce the speed command input gain, adjust the servo gain, or adjust the operating conditions. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |

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| A.511: Frequency division pulse output overspeed | The output frequency of frequency division pulse is too large, exceeding the limit value | Confirm the output setting of the division pulse | Reduce the setting of encoder frequency division pulse number (Pn212). |
| | The motor speed is too high, and the output frequency of the frequency division pulse exceeds the limit value | Confirm the output setting of the division pulse and the motor speed | Reduce motor speed. |
| A.520: vibration alert | Abnormal oscillation was detected in the motor speed | Check for abnormal motor noise, and check the speed and torque waveforms during operation | Reduce the motor speed. Or, reduce the setting of Pn100 (Speed Loop Gain). |
| | The moment of inertia ratio (Pn103) is larger than the actual value or has changed greatly | Check moment of inertia ratio | Correctly set the moment of inertia ratio (Pn103). |
| A.521: Autotuning Alarm (Vibration was detected while executing the custom tuning, Easy FFT, or the tuning-less function.) | The Servomotor vibrated considerably while performing the tuning-less function. | Check the waveform of the motor speed | Reduce the load so that the moment of inertia ratio is within the allowable value. Or increase the load level or reduce the rigidity level in the tuningless level settings. |
| | The Servomotor vibrated considerably while performing custom tuning or Easy FFT. | Check the waveform of the motor speed. | Check the operating procedure of corresponding function and implement corrections. |
| A.710: Instantaneous Overload A.720: Continuous Overload | The wiring is not correct or there is a faulty connection in the motor or encoder wiring. | Check the wiring. | Make sure that the Servomotor and encoder are correctly wired |
| | Operation was performed that exceeded the overload protection characteristics | Check the motor overload characteristics and Run command | Reconsider the load and operating conditions. Or, increase the motor capacity |
| | An excessive load was applied during operation because the Servomotor was not driven due to mechanical problems | Check the operation reference and motor speed. | Correct the mechanical problem. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.730: A.731: Dynamic Brake Overload (An excessive power consumption by the dynamic brake was detected.) | The Servomotor was rotated by an external force. | Check the operation status | Implement measures to ensure that the motor will not be rotated by an external force |
| | Rotational energy at DB stop exceeds Capacity across DB resistor | to Check the power consumed by the DB resistor to see how frequently the DB is being used. | Consider the following • Reduce the command speed of the servo motor. • Reduce the moment of inertia ratio. • Reduce the frequency of stopping with the dynamic brake |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.740: Inrush Current Limiting Resistor Overload (The main circuit power supply was frequently turned ON and OFF.) | The allowable frequency of the inrush current limiting resistor was exceeded when the main circuit power supply was turned ON and OFF | — | Reduce the frequency of turning the main circuit power supply ON and OFF |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |

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| A.7A0: heatsink overheating (The heat sink temperature of the servo drive exceeds 100°C) | Ambient temperature is too high | Measure the ambient temperature with a thermometer | Improve the installation conditions of the servo drive and reduce the ambient temperature. |
| | An overload alarm was reset by turning OFF the power supply too many times | Check the alarm display to see if there is an overload alarm. | Change the reset method of the alarm. |
| | The load is too large, or the regeneration capacity is exceeded during operation | Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity. | Reconsider the load and operating conditions. |
| | The installation direction of the servo drive and the distance from other servo drives are unreasonable | Confirm the installation status of the servo drive | Install according to the installation standard of the servo drive. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.7AB: Built-in Fan Stopped | The fan inside the servo drive stopped. | Check if a foreign object is inside the servo drive. | If the alarm still occurs after removing the foreign matter, the servo drive may be faulty. Replace the servo drive. |
| A.810: Encoder Backup Alarm (Detected at the encoder, but only when an absolute encoder is used.) | The power to the absolute encoder was turned ON for the first time | Check to see if the power supply was turned ON for the first time. | Set up the encoder. (Fn008). |
| | Reconnected after removing the encoder cable | Check to see if the power supply was turned ON for the first time. | Check the encoder connection and set up the encoder. (Fn008) |
| | Power is not being supplied both from the control power supply (+5 V) from the servo drive and from the battery power supply | Check the encoder connector battery and the connector status. | Replace the battery or implement similar measures to supply power to the encoder, and set up the encoder. (Fn008). |
| | Absolute encoder failure | — | If the alarm cannot be cleared even if the setting operation is performed again, replace the servo motor. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.820: Encoder Checksum Alarm (Detected at the encoder.) | Encoder failure | — | <ul style="list-style-type: none"> In the case of an absolute encoder. If the encoder is set again (Fn008) and alarms still occur frequently, it may be that the servo is faulty. Replace the servo motor. In the case of a rotary absolute encoder or an incremental encoder, the servo motor may be faulty. Replace the servo motor. . |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.830: Encoder Battery Alarm (The absolute encoder battery voltage was lower than the specified level.) | The battery connection is faulty or a battery is not connected. | Check the battery connection. | Correct the battery connection. |
| | The battery voltage is lower than the specified value (2.7 V). | Measure the voltage of the battery | Replace the battery. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive. |
| A.840: Encoder Data Alert * Detected on the | Encoder malfunction | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |

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| encoder side | Encoder malfunction due to interference such as noise | — | Correctly perform the wiring around the encoder. (Separation of the encoder cable and the main circuit cable of the servo motor, grounding treatment, etc.). |
| A.850: Encoder Overspeed (Detected at the encoder when the control power supply is turned ON.) | When the control power is turned on, the servo motor rotates at a speed of 200min-1 or more | Check the motor speed when the power supply is turned ON. | Reduce the Servomotor speed to a value less than 200 min-1, and turn ON the control power supply |
| | Encoder failure | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.860: Encoder overheating * Only detected when an absolute encoder is connected * Detected on the encoder side | The ambient temperature of the servo motor is too high | Measure the ambient temperature of the servo motor | Reduce the ambient temperature of the servo motor to 40°C or less |
| | The Servomotor load is greater than the rated load | Use the accumulated load ratio to check the load. | Operate the Servo Drive so that the motor load remains within the specified range |
| | Encoder failure | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |
| | Servo drive failure. | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.8A0: External encoder error | Setting the origin of the absolute linear encoder failed because the motor moved | Before you set the origin, use the fully-closed feedback pulse counter to confirm that the motor is not moving | The motor must be stopped while setting the origin position. |
| | External encoder failure | — | Replace external encoder. |
| A.8A1: External encoder error | External encoder failure | — | Replace external encoder. |
| | Serial conversion unit failure | — | Replace the serial conversion unit. |
| A.8A2: External encoder sensor error (incremental) | External encoder failure | — | Replace external encoder. |
| A.8A3: External encoder position error (absolute value) | A failure occurred in the external absolute encoder. | — | The external absolute encoder may be faulty. Refer to the encoder manufacturer' instruction manual for corrections. |
| A.8A5: External Encoder Overspeed | An overspeed error was detected in the external encoder | Check the maximum speed of the external encoder. | Keep the external encoder below its maximum speed |
| A.8A6: External Encoder Overheated | An overheating error was detected in the external encoder. | — | Replace external encoder. |
| A.b31: Current detection error 1 | U-phase current detection circuit failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.b32: Current detection error 2 | V-phase current detection circuit failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.b33: Current detection error 3 | Current detection circuit failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |

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| | The main circuit cable of the servo motor is disconnected | Check whether the main circuit cable of the servo motor is disconnected | Repair the motor cable. |
| A.bF0: System alarm 0 | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A. bF1: System alarm 1 | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A. bF2: System alarm 2 | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.bF3: System alarm 3 | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.bF4: System alarm 4 | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.C10: Servomotor Out of Control (Detected when the servo is turned ON.) | The order of phases U, V, and W in the motor wiring is not correct | Confirm the servo motor wiring | Make sure that the Servomotor is correctly wired |
| | Encoder failure | — | If the motor wiring is correct and the alarm still occurs after turning the power supply OFF and ON again, the Servomotor or linear encoder may be faulty. Replace the Servomotor or linear encoder |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.C80: Encoder Clear Error or Multiturn Limit Setting Error | Encoder failure | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive |
| A.C90: Encoder Communications Error | There is a faulty contact in the connector or the connector is not wired correctly for the encoder | Check the condition of the encoder connector. | Reconnect the encoder connector and check the encoder wiring |
| | There is a cable disconnection or shortcircuit in the encoder. Or, the cable impedance is outside the specified values. | Check the condition of the encoder connector. | Use the Encoder Cable within the specified specifications. |
| | One of the following has occurred: corrosion caused by improper temperature, humidity, or gas, a short-circuit caused by entry of water drops or cutting oil, or faulty contact in connector caused by vibration. | Check the operating environment. | Improve the operating environment, and replace the cable. If the alarm still occurs, replace the servo drive. |
| | Malfunction due to noise interference. | — | Correct the wiring around the encoder by separating the Encoder Cable from the Servomotor Main Circuit Cable or by grounding the encoder. |

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| | Servo drive failure | — | If the alarm does not occur when the control power is turned on after connecting the servo motor to another servo drive, the servo drive may be faulty. Replace the servo drive. |
| A.C91: Encoder Communications Position Data Acceleration Rate Error | Noise entered on the signal lines because the Encoder Cable is bent or the sheath is damaged | Check the condition of the Encoder Cable and connectors. | Check the Encoder Cable to see if it is installed correctly. |
| | The Encoder Cable is bundled with a highcurrent line or installed near a highcurrent line | Check the installation condition of the Encoder Cable | Confirm that there is no surge voltage on the Encoder Cable |
| | There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder | Check the installation condition of the Encoder Cable | Properly ground the machine to separate it from the FG of the encoder. |
| A.C92: Encoder Communications Timer Error | Noise entered on the signal line from the encoder. | — | Implement countermeasures against noise for the encoder wiring. |
| | Excessive vibration or shock was applied to the encoder | Check the operating conditions. | Reduce machine vibration. Correctly install the Servomotor or linea encoder |
| | Encoder failure | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.CA0: Encoder Parameter Error | Encoder failure | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A. Cb0 Encoder Echoback Error | The encoder is wired incorrectly or there is faulty contact. | Check the wiring of the encoder. | Make sure that the encoder is correctly wired. |
| | The specifications of the Encoder Cable are not correct and noise entered on it. | — | Use a shielded twistedpair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm ² |
| | The Encoder Cable is too long and noise entered on it | — | The maximum wiring distance is 50m. |
| | There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder | Check the condition of the Encoder Cable and connectors. | Properly ground the machine to separate it from the FG of the encoder |
| | Excessive vibration or shock was applied to the encoder. | Check the operating conditions | Reduce machine vibration. Correctly install the Servomotor or linear encoder |
| | Encoder failure | — | Turn on the power again. If the alarm still occurs, the servo motor may be faulty. Replace the servo motor. |

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| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.CC0: Multiturn Limit Disagreement | When using a Direct Drive Servomotor, the setting of Pn205 (Multiturn Limit) does not agree with the encoder. | Check the setting of Pn205 | Correct the setting of Pn205 (0 to 65,535). |
| | The multiturn limit of the encoder is different from that of the servo drive. Or, the multiturn limit of the servo drive has been changed. | Check the setting of Pn205 in the servo drive. | Change the setting if the alarm occurs. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty and replace the servo drive. |
| A.CF1: Reception Failed Error in Feedback Option Module Communications | The cable between the Serial Converter Unit and servo drive is not wired correctly or there is a faulty contact. | Check the wiring of the external encoder | Correctly wire the cable between the Serial Converter Unit and servo drive |
| | A specified cable is not being used between Serial Converter Unit and servo drive | Check the wiring specifications of the external encoder | Use a specified cable. |
| | The cable between the Serial Converter Unit and servo drive is too long | Measure the length of the cable that connects the Serial Converter Unit | The length of the cable between the Serial Converter Unit and servo drive must be 20 m or less. |
| | The sheath on cable between the Serial Converter Unit and Servo drive is broken. | Check the cable that connects the Serial Converter Unit | Replace the cable between the Serial Converter Unit and servo drive |
| A.d00: Position Deviation Overflow (The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation while the servo was ON.) | The Servomotor U, V, and W wiring is not correct. | Check the wiring of the Servomotor's Main Circuit Cables | Make sure that there are no faulty contacts in the wiring for the Servomotor and encoder |
| | Higher frequency of position commands Acceleration of position command is too large | Try to reduce the command pulse frequency and then try operating servo drive. | Reduce the position reference pulse frequency or the reference acceleration rate, or reconsider the electronic gear ratio |
| | | Try to reduce the command acceleration before running | Apply smoothing, i.e., by using Pn216 (Position Reference Acceleration/Deceleration Time Constant). |
| | The setting of Pn520 (Position Deviation Overflow Alarm Level) is too low for thev operating conditions. | Check Pn520 (Position Deviation Overflow Alarm Level) to see if it is set to an appropriate value | Correctly set Pn520. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A.d01: Position Deviation Overflow Alarm at Servo-ON | The servo was turned ON after the position deviation exceeded the setting of Pn526 while the servo was OFF | Check the position deviation while the servo is OFF. | Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON). |

| | | | |
|---|--|--|---|
| A.d02: Position Deviation Overflow Alarm for Speed Limit at Servo ON | If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) limits the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded | — | Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn520 (Position Deviation Overflow Alarm Level). Or, adjust the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) |
| A.d10: Motor-Load Position Deviation Overflow | The motor direction and external encoder installation orientation are backward. | Check the motor direction and the external encoder installation orientation. | Install the external encoder in the opposite direction, or change the setting of Pn002 (External Encoder Usage) to reverse the direction. |
| | There is an error in the connection between the load (e.g., stage) and external encoder coupling | Check the coupling of the external encoder | Check the mechanical coupling. |
| A.E71: Safety Option Module Detection Failure | There is a faulty connection between the Servo drive and the Safety Option Module. | Check the connection between the servo drive and the Safety Option Module. | Correctly connect the Safety Option Module |
| | The Safety Option Module was disconnected. | - | Execute Fn014 (Reset Option Module Configuration Error) from the Digital Operator or SigmaWin+ and then turn the power supply to the servo drive OFF and ON again. |
| | A failure occurred in the Safety Option Module. | - | Replace the Safety Option Module. |
| | Servo drive failure | - | Replace the servo drive. |
| A.E72: Feedback Option Module Detection Failure | There is a faulty connection between the Servo drive and the Feedback Option Module | Check the connection between the servo drive and the Feedback Option Module | Correctly connect the Feedback Option Module |
| | The Feedback Option Module was disconnected | - | Reset the Option Module configuration error and turn the power supply to the servo drive OFF and ON again |
| | A failure occurred in the Feedback Option Module. | - | Replace the Feedback Option Module. |
| | Servo drive failure | - | Replace the servo drive. |
| A.E74: Unsupported Safety Option Module | A failure occurred in the Safety Option Module | - | Replace the Safety Option Module |
| | An unsupported Safety Option Module was connected. | Refer to the catalog of the connected Safety Option Module. | Connect a compatible Safety Option Module. |
| A.E75: Unsupported Feedback Option Module | A failure occurred in the Feedback Option Module | - | Replace the Feedback Option Module |
| | An unsupported Feedback Option Module was connected. | Refer to the catalog of the connected Feedback Option Module. | Connect a compatible Feedback Option Module. |
| A.Eb1: Safety Function Signal Input Timing | The delay between activation of the /HWBB1 and /HWBB2 | Measure the time delay between the /HWBB1 and /HWBB2 signals. | The output signal circuits or devices for /HWBB1 and /HWBB2 or the servo drive input signal circuits may be faulty. Alternatively, the input |

| | | | |
|---|---|---|---|
| Error | input signals for the HWBB was ten second or longer. | | signal cables may be disconnected. Check to see if any of these items are faulty or have been disconnected. |
| A.F10: Power Supply Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) | The three-phase power supply wiring is not correct. | Check the power supply wiring. | Make sure that the power supply is correctly wired. |
| | The three-phase power supply is unbalanced. | Measure the voltage for each phase of the three-phase power supply. | Balance the power supply by changing phases. |
| | A single-phase power supply was input without specifying a single-phase AC power supply input (Pn00B.2 = 1) | Check the power supply and the parameter setting | Match the parameter setting to the power supply. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| A .F26 | The torque command reaches the maximum value | — | Correctly connect the U VW power cable of the servo motor. |
| A .F28 | Position command error | Check the values of 6064 and 607A | Input correct position command |
| FL-1 ^{*2} : System Alarm | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive. |
| FL-2 ^{*2} : System Alarm | Servo drive failure | — | |

Note: * 2. The alarm is not saved to the records. Displayed only on the panel.

11.2 Warning Display

This section explains how to deal with warnings.

This section provides a list of warnings and the causes of and corrections for warnings.

11.2.1 Warning List

The list of warnings is as follows:

Table 11-4 List of warnings

| Warning No. | Warning name | Content |
|-------------|---|---|
| A.900 | Position Deviation Overflow | The position deviation exceeded the percentage set with the following formula: $\frac{\text{Pn520} \times \text{Pn51E}}{100}$. |
| A.901 | Position Deviation Overflow Alarm at Servo ON | The position deviation when the servo was turned ON exceeded the percentage set with the following formula: $\frac{\text{Pn520} \times \text{Pn51E}}{100}$. |
| A.910 | Overload | This warning occurs before an overload alarm (A.710 or A.720) occurs. If the warning is ignored and operation is continued, an alarm may occur |
| A.911 | Vibration | Abnormal vibration was detected during motor operation. The detection level is the same as A.520. Set whether to output an alarm or a warning by setting Pn310 (Vibration Detection Selection). |
| A.920 | Regenerative Overload | This warning occurs before an A.320 alarm (Regenerative Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur |
| A.921 | Dynamic Brake Overload | This warning occurs before an A.731 alarm (Dynamic Brake Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur |
| A.930 | Absolute Encoder Battery Error | This warning occurs when the voltage of absolute encoder's battery is low. |
| A.94A | Data Setting Warning 1 | Data Setting Warning 1 |
| A.94B | Data Setting Warning 2 | Data Setting Warning 2 |
| A.94C | Data Setting Warning 3 | Data Setting Warning 3 |
| A.94D | Data Setting Warning 4 | Data Setting Warning 4 |
| A.94E | Data Setting Warning 5 | Data Setting Warning 5 |
| A.95A | Command Warning 1 | Command Warning 1 |
| A.95B | Command Warning 2 | Command Warning 2 |
| A.95D | Command Warning 3 | Command Warning 3 |
| A.95E | Command Warning 4 | Command Warning 4 |
| A.95F | Command Warning 5 | Command Warning 5 |
| A.971 | Command Warning 6 | Command Warning 6 |
| A.97A | Command Warning 7 | Command Warning 7 |

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| A.97B | Data Clamp Outside Data Range | Data Clamp Outside the Data Range |
| A.9A0 | Overtravel | Overtravel was detected while the servo was ON. |
| A.9B0 | Soft Limit Error | Incorrect soft limit setting, and check 607d |
| A.9B1 | Origin Offset Error | The origin offset is incorrect. And check 607d and 607c |
| A.9B2 | Synchronization Frame Loss | Synchronization frame data is lost. |
| A.9B3 | Bus Interruption | EtherCAT communication was interrupted. |
| A.9B4 | Network Initialization Failure | EtherCAT network initialization failed. |
| A.9B5 | Torque Limit Error | Torque limit error |
| A.9B7 | Inappropriate Servo Enable cCondition | When the hardware base is not blocked, some conditions are not met and cannot be enabled |
| A.9B8 | Hardware Base Locking | Do not connect +24V to any of the safety interface. |
| A.9B9 | Emergency Stop | Emergency stop warning occur. |

Note: 1. If it is not set to "Output Alarm Code and Warning Code (Pn001.3 = 1)", then no warning code will be output.

2. If it is set to " No Warning (Pn008.2 = 1)", warnings other than undervoltage warning (A.971) will not be detected .

11.2.2 Causes of Warnings and Troubleshooting

The following table lists the causes of the warnings and the troubleshooting. If the error still cannot be eliminated after handling according to the table below, please contact the agent or our company.

Table 11-5 Warning causes and troubleshooting

| Warning No.: Warning Name | Cause | Confirmation method | Correction |
|--|--|---|---|
| A.900: Position Deviation Overflow | The Servomotor U, V, and W wiring is not correct. | Check the wiring of the Servomotor's Main Circuit Cables. | Make sure that there are no faulty connections in the wiring for the Servomotor and encoder |
| | The gain of the servo drive is too low | Check the gains of the servo drive | increase the servo gain, e.g., by using autotuning without a host reference. |
| | The frequency of the position reference pulse is too high | Reduce the reference pulse frequency and try operating the servo drive. | Reduce the position reference pulse frequency or the reference acceleration rate, or reconsider the electronic gear ratio |
| | The acceleration of the position reference is too high | Reduce the reference acceleration and try operating the servo drive. | Apply smoothing, i.e., by using Pn216 (Position Reference Acceleration/ Deceleration Time Constant). |
| | Relative to the operating conditions, the position deviation excessive alarm value (Pn520) is low | Check if position deviation excessive alarm value(Pn520) is appropriate | Set correctlyPn520 value. |
| | Servo drive failure | — | Turn on the power again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive . |
| A.901: Position Deviation Overflow Alarm at Servo ON | The position deviation when the servo was turned ON exceeded the percentage set with the following formula: $\frac{Pn520 \times Pn51E}{100}$ | — | Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn528 (Position Deviation Overflow Warning Level at Servo ON) |
| A.910: Overload (warning before an A.710 or A.720 alarm occurs) | The wiring is not correct or there is a faulty connection in the motor or encoder wiring | Check the wiring | Make sure that the Servomotor and encoder are correctly wired. |
| | Operation was performed that exceeded the overload protection characteristics. | Check the motor overload characteristics and Run command. | Reconsider the load and operating conditions. Or, increase the motor capacity |
| | An excessive load was applied during operation because the Servomotor was not driven because of mechanical problems | Check the operation reference and motor speed. | Remove the mechanical problem |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive . |
| A.911: Vibration | Abnormal vibration was detected during motor operation | Check for abnormal motor noise, and check the speed and torque waveforms during operation | Reduce the motor speed. Or, reduce the servo gain with custom tuning. |
| | The setting of Pn103 (Moment of Inertia Ratio) is greater than the actual moment of inertia or was greatly changed. | Check the moment of inertia ratio or mass ratio. | Set Pn103 (Moment of Inertia Ratio) to an appropriate value. |
| A.920: Regenerative Overload (warning before | The power supply voltage exceeded the specified range | Measure the power supply voltage. | Set the power supply voltage within the specified range. |

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| an A.320 alarm occurs | There is insufficient external regenerative resistance, regenerative resistor capacity, or servo drive capacity, or there has been a continuous regeneration state | Check the operating conditions or the capacity using the software HCServoWorks ,etc. | Change the regenerative resistance value, regenerative resistance capacity, or Servo drive capacity. Reconsider the operating conditions using the HCServoWorks |
| | There was a continuous regeneration state because a negative load was continuously applied | Check the load applied to the Servomotor during operation. | Reconsider the system including the servo, machine, and operating conditions. |
| A.921: Dynamic Brake Overload (warning before an A.731 alarm occurs) | The servo motor is driven by external force | Check the running status | Do not drive the servo motor with external force . |
| | The rotational energy when the DB stops exceeds the capacity of the DB resistor | Check the power consumed by the DB resistor to see how frequently the DB is being used. | Reconsider the following: <ul style="list-style-type: none"> • Reduce the Servomotor command speed. • Decrease the moment of inertia or mass. • Reduce the frequency of stopping with the dynamic brake. |
| | Servo drive failure | — | It may be that the servo drive is faulty. Replace the servo drive . |
| A.930: Absolute Encoder Battery Error (The absolute encoder battery voltage was lower than the specified level.) (Detected only when an absolute encoder is connected. | Incorrect battery connection or not connected | Check the battery connection | Correct the battery connection |
| | The battery voltage is lower than the specified value (2.7 V) | Measure the voltage of the battery | Replace the battery . |
| | Servo drive failure | — | It may be that the servo drive is faulty . Replace the servo drive . |
| A.941: Change of Parameters Requires Restart | Parameters have been changed that require the power supply to be turned OFF and ON again | — | Turn the power supply to the servo drive OFF and ON again. |
| A.971: Undervoltage | For 200V Servo drive, AC supply voltage at 140V or less; For 400V Servo drive, AC supply voltage at 280V or less | Measuring supply voltage | Set the power supply voltage to normal range . |
| | The power supply voltage dropped during operation | Measuring supply voltage | Increase power supply capacity . |
| | A momentary power interruption occurred. | Measuring supply voltage | If you have changed the setting of Pn509 (Momentary Power Interruption Hold Time), decrease the setting |
| | The fuse of the servo drive is blown out | — | Replace the servo drive and use the servo drive after connecting the reactor . |

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| | Servo drive failure | — | It may be that the servo drive is faulty . Replace the servo drive . |
| A.9A0: Overtravel (Overtravel status detected) | Overtravel was detected while the servo was ON. | Check the status of the overtravel signals on the input signal monitor(Un005) | Even if an overtravel signal is not shown by the input signal monitor, momentary overtravel may have been detected. Take the following precautions. <ul style="list-style-type: none"> • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Implement countermeasures against noise |
| A.9B0 | Soft limit error | Check the 607D setting | Set the 607D within the correct range |
| A.9B1 | Origin Offset Error | The origin offset is incorrect. And check 607d and 607c | Set the 607Dand 607C within the correct range |
| A.9B2 | Synchronization Frame Loss | Check whether the twisted-pair shielded communication cable with shielding function is used; Check whether the servo drive is well grounded,; | 1. Please use twisted-pair shielded cable with shielding function; 2. Please follow the standard wiring precautions; 3. After setting synchronization cycle, change the EtherCAT communication state to the operation mode; 4. If the synchronization period deviation of the master station is relatively large, please adjust the master station or increase the synchronization loss fault tolerance of the slave station Pn785 |
| A.9B3 | Bus Interruption | Check whether the twisted-pair shielded communication cable with shielding function is used; Check whether the servo drive is well grounded,; | 1. Please use twisted-pair shielded cable with shielding function; 2. Please follow the standard wiring precautions; 3. After setting synchronization cycle, change the EtherCAT communication state to the operation mode; 4. If the synchronization period deviation of the master station is relatively large, please adjust the master station or increase the synchronization loss fault tolerance of the slave station Pn785 |
| A.9B4 | Network Initialization Failure | Device configuration file not burned Servo drive failure | Burn the corresponding xml file Replace the servo drive |
| A.9B5 | Current Loop Status Alarm | The torque command less than 30%, and the motor does not run | Correctly set torque command and maximum torque limit |
| A.9B7 : | Inappropriate Servo Enable Condition | When the hardware base is not blocked, the condition is not satisfied and cannot be enabled; the bus voltage is undervoltage | Check the bus voltage power supply ; And confirm the CN3 port |
| A.9B8 | Safety interface input not connected +24V | Check whether the safety function use signal STO (CN3) is connected | After confirm the security, restore the security interface |
| A.9B9 | Emergency Stop | Check Pn515.3 E-Stop signal distribution, and whether the corresponding DI terminal logic is set to active | Check the operation mode, and release the DI brake valid signal after confirming safety |

11.3 List of Warning Code

Table 11-6 Warning code list

| 603F Error Code | 213F Error Code | Warning meaning |
|-----------------|-----------------|----------------------------|
| 0x6320 | A.020 | Parameter Checksum Error 1 |
| 0x6320 | A.021 | Parameter Format Error 1 |
| 0x6320 | A.022 | System Checksum Error 1 |

| | | |
|--------|-------|---|
| 0x0030 | A.030 | Main Circuit Detector Error |
| 0x6320 | A.040 | Parameter Setting Error 1 |
| 0x0041 | A.041 | Encoder Output Pulse Setting Error |
| 0x6320 | A.042 | Parameter Combination Error |
| 0x6320 | A.044 | Semi-Closed/Fully-Closed Loop Control Parameter Setting Error |
| 0x6320 | A.04A | Parameter Setting Error 2 |
| 0x7122 | A.050 | Combination Error |
| 0x7122 | A.051 | Unsupported Device Alarm |
| 0x5441 | A.0b0 | Invalid Servo ON Command Alarm |
| 0x2311 | A.100 | Overcurrent Detected |
| 0x0300 | A.300 | Regeneration Error |
| 0x3230 | A.320 | Regenerative Overload |
| 0x0330 | A.330 | Main Circuit Power Supply Wiring Error |
| 0x3210 | A.400 | Overvoltage |
| 0x3220 | A.410 | Undervoltage |
| 0x3210 | A.450 | Main circuit capacitor overvoltage |
| 0x8400 | A.510 | Overspeed |
| 0x0511 | A.511 | Encoder Output Pulse Overspeed |
| 0x0520 | A.520 | Vibration Alarm |
| 0x0521 | A.521 | Autotuning Alarm |
| 0x3230 | A.710 | Instantaneous Overload |
| 0x3230 | A.720 | Continuous Overload |
| 0x3230 | A.730 | Dynamic Brake Overload |
| 0x3230 | A.731 | Dynamic Brake Overload |
| 0x3230 | A.740 | Inrush Current Limiting Resistor Overload |
| 0x4210 | A.7A0 | Heatsink Overheated |
| 0x07AB | A.7AB | Built-in Fan Stopped |
| 0x7305 | A.810 | Encoder Backup Alarm |
| 0x7305 | A.820 | Encoder Checksum Alarm |
| 0x7305 | A.830 | Encoder Battery Alarm |
| 0x7305 | A.840 | Encoder Data Alarm |
| 0x7305 | A.850 | Encoder Overspeed |
| 0x7305 | A.860 | Encoder Overheated |
| 0x08A0 | A.8A0 | External Encoder Error |
| 0x08A1 | A.8A1 | External Encoder Module Error |
| 0x08A2 | A.8A2 | External Incremental Encoder Sensor Error |
| 0x08A3 | A.8A3 | External Absolute Encoder Position Error |
| 0x08A5 | A.8A5 | External Encoder Overspeed |
| 0x08A6 | A.8A6 | External Encoder Overheated |
| 0x0B31 | A.b31 | Current Detection Error 1 |
| 0x0B32 | A.b32 | Current Detection Error 2 |
| 0x0B33 | A.b33 | Current Detection Error 3 |

| | | |
|--------|-------|---|
| 0x0BF0 | A.bF0 | System Alarm 0 |
| 0x0BF1 | A.bF1 | System Alarm 1 |
| 0x0BF2 | A.bF2 | System Alarm 2 |
| 0x0BF3 | A.bF3 | System Alarm 3 |
| 0x0BF4 | A.bF4 | System Alarm 4 |
| 0x0C10 | A.C10 | Servomotor Out of Control |
| 0x7305 | A.C80 | Encoder Clear Error |
| 0x7305 | A.C90 | Encoder Communications Error |
| 0x7305 | A.C91 | Encoder Communications Position Data Acceleration Rate Error |
| 0x7305 | A.C92 | Encoder Communications Timer Error |
| 0x7305 | A.CA0 | Encoder Parameter Error |
| 0x7305 | A.CB0 | Encoder Echoback Error |
| 0x7305 | A.CC0 | Multiturn Limit Disagreement |
| 0x8361 | A.d00 | Position Deviation Overflow |
| 0x8361 | A.d01 | Position Deviation Overflow Alarm at Servo ON |
| 0x8361 | A.d02 | Position Deviation Overflow Alarm for Speed Limit at Servo ON |
| 0x8611 | A.d10 | Motor-Load Position Deviation Overflow |
| 0x3130 | A.F10 | Power Supply Line Open Phase |
| 0x0900 | A.900 | Excessive Position Deviation |
| 0x0901 | A.901 | Excessive Position Deviation at Servo ON |
| 0x0910 | A.910 | Overload Alarm |
| 0x0911 | A.911 | Vibration |
| 0x0920 | A.920 | Regeneration Overload |
| 0x0921 | A.921 | Dynamic Brake Overload |
| 0x0930 | A.930 | Absolute Encoder Battery Failure |
| 0x094A | A.94A | Data Setting Alarm 1 |
| 0x094B | A.94B | Data Setting Alarm 2 |
| 0x094C | A.94C | Data Setting Alarm 3 |
| 0x094D | A.94D | Data Setting Alarm 4 |
| 0x094E | A.94E | Data Setting Alarm 5 |
| 0x095A | A.95A | Command Alarm 1 |
| 0x095B | A.95B | Command Alarm 2 |
| 0x095D | A.95D | Command Alarm 4 |
| 0x095E | A.95E | Command Alarm 5 |
| 0x095F | A.95F | Command Alarm 6 |
| 0x0971 | A.971 | Undervoltage Alarm |
| 0x097A | A.97A | Command Alarm 7 |
| 0x097B | A.97B | Data Clamp Outside Data Range |
| 0x5443 | A.9A0 | Overtravel |
| 0x6320 | A.9B0 | Soft Limit Error |
| 0x6320 | A.9B1 | Origin Offset Error |
| 0x09B2 | A.9B2 | Synchronization Frame Loss |

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|--------|-------|--------------------------------|
| 0x09B3 | A.9B3 | Bus Interruption |
| 0x09B4 | A.9B4 | Network Initialization Failure |
| 0x09B5 | A.9B5 | Torque Limit Error |

11.4 Causes and Troubleshooting Based on the Operation and Conditions

This section provides troubleshooting based on the operation and conditions of the Servomotor, including causes and corrections.

Table 11-6 Causes and troubleshooting

| Problem | Cause | Confirmation method | Correction |
|--|---|--|--|
| Servo motor does not start | Control power is not connected | Measure the voltage between control power supply terminals. | Correct the wiring so that the control power supply is turned ON |
| | The main circuit power is not turned ON. | Measure the voltage between the main circuit power input terminals. | Correct the wiring so that the main circuit power supply is turned ON. |
| | The I/O signal connector (CN1) pins are not wired correctly or are disconnected. | Turn OFF the power supply to the servo system. Check the wiring condition of the I/O signal connector (CN1) pins. | Correct the wiring of the I/O signal connector (CN1) pins. |
| | The wiring of the main circuit cable and encoder cable of the servo motor is disconnected | Check the wiring conditions. | Wire the cable correctly. |
| | There is an overload on the Servomotor. | Operate the Servomotor with no load and check the load status | Reduce the load or replace the Servomotor with a Servomotor with a larger capacity. |
| | The type of encoder that is being used does not agree with the setting of Pn002.2. | Check the type of the encoder that is being used and the setting of Pn002.2. | Set Pn002.2. according to the type of the encoder that is being used. |
| | No speed entered/position command | Check the allocation status of the input signals | Allocate an input signal so that the speed and position references are input correctly |
| | Input signal(Pn50A~Pn50D) is assigned incorrectly | Check the input signal allocations (Pn50A~Pn50D) | Correctly allocate the input signals (Pn50A~ Pn50D). |
| | The /S-ON (Servo ON) signal is OFF | Check Pn50A.0, Pn50A.1 settings | Set correctly Pn50A.0, Pn50A.1, and turn on /S-ON. |
| | /P-CONInput function setting error | Check the setting of Pn000.1. | Set correctly according to the purpose of the function . |
| | The SEN input is OFF. | Check the ON/OFF status of the SEN input. | If you are using an absolute encoder, turn ON the SEN signal. |
| | The reference pulse mode selection is not correct. | Check Pn200.0setting and the reference pulse form | Set Pn200.0so that is agrees with the reference pulse form. |
| | Speed control: The speed reference input is not appropriate. | Check between the speed reference input (VREF) and signal ground (SG) to see if the control method and the input agree. | Correctly set the control method and input method |
| | Torque control: The torque reference input is not appropriate | Check between the torque reference input (TREF) and signal ground (SG) to see if the control method and the input agree. | Correctly set the control method and input method |
| Position control: The reference pulse input is not appropriate. | Check Pn200.0and the sign and pulse signals | Correctly set the control method and input method | |
| The /CLR (Position Deviation Clear) input signal has not been turned OFF | Check /CLRinput signal(CN1-14, 15) | Turn OFF the /CLR signal. | |

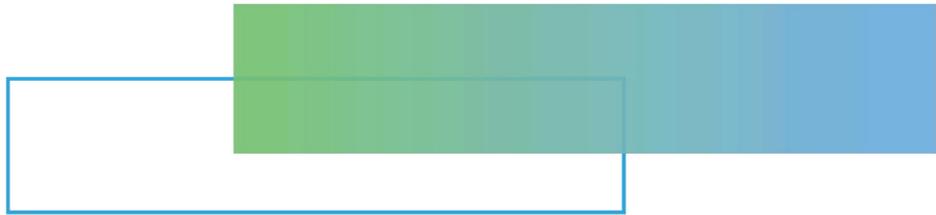
| | | | |
|--|---|---|--|
| | The P-OT (Forward Drive Prohibit) or N-OT (Reverse Drive Prohibit) signal is still OFF. | Check the P-OT and NOT signals. | Turn ON the P-OT and N-OT signals. |
| | The safety input signals (/HWBB1 or /HWBB2) were not turned ON | Check the /HWBB1 and /HWBB2 input signals | Turn ON the /HWBB1 and /HWBB2 input signals. If you are not using the safety function, connect the Safety Jumper Connector (provided as an accessory) to CN8 |
| | Servo drive failure | - | Replace the servo drive . |
| Servomotor Moves Instantaneously, and Then Stops | Servo motor wiring error | Check the wiring | Make the wiring correctly . |
| | Encoder wiring error | Check the wiring | Make the wiring correctly . |
| Servomotor Speed Is Unstable | There is a faulty connection in the Servomotor wiring. | The connector connections for the power line (U, V, and W phases) and the encoder or Serial Converter Unit may be Unstable. Check the wiring. | Tighten any loose terminals or connectors and correct the wiring |
| Servomotor Moves without a Command Input | Speed control: The speed reference input is not appropriate. | Check between the torque reference input (TREF) and signal ground (SG) to see if the control method and the input agree.. | Correctly set the control method and input method. |
| | Torque control: The torque reference input is not appropriate | Check whether the control mode is consistent with the input between V-REF and SG | Correctly set the control method and input method. |
| | The speed reference offset is not correct | This servo drive offset is adjusted incorrectly. | Adjust the offset of the servo drive . |
| | Position control: The reference pulse input is not appropriate | Check the command pulse form and sign + pulse signal of Pn200.0 | Correctly set the control method and input method |
| | Servo drive failure | — | Replace the servo drive . |
| Dynamic brake (DB) does not operate | The setting value of parameter Pn001.0 is incorrect. | Check the setting value of parameter Pn001.0. | Set Pn001.0 correctly. . |
| | DB resistor disconnected | Check the moment of inertia, motor speed, and dynamic brake frequency of use. If the moment of inertia, motor speed, or dynamic brake frequency of use is excessive, the dynamic brake resistance may be disconnected | Replace the servo drive. To prevent disconnection, reduce the load |
| | There was a failure in the dynamic brake drive circuit | - | There is a defective component in the dynamic brake circuit. Turn OFF the power supply to the servo system. Replace the servo drive . |
| Abnormal noise from servo motor | The Servomotor vibrated considerably while using the Tuning-less function (factory setting) | Check the waveform of the motor speed. | Reduce the load so that it is below the allowable moment of inertia ratio, or increase the load value of the Tuning-less value setting (Fn200), or reduce the rigidity value . |
| | The machine mounting is not secure. | Check the installation status of the servo motor | Tighten the mounting screws |
| | | Check to see if there is misalignment in the coupling | Align the coupling |
| | | Check to see if the coupling is balanced | Balance the coupling. |
| | Failure in bearing | Check for noise and vibration around the bearings. | Replace the servo motor . |
| Vibration comes from the driven machine | Check for any foreign matter, damage, or deformation in the machine's moving parts | Consult with the machine manufacturer. | |

| | | | |
|--|---|--|---|
| Noise interference occurred because of incorrect I/O signal cable specifications. | Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire) | Use cables that satisfy the specifications | |
| Noise interference occurred because an I/O signal cable is too long | Check the length of the I/O signal cable | The I/O signal cables must be no longer than 3 m | |
| Noise interference occurred because of incorrect Encoder Cable specifications. | Check the Encoder Cable to see if it satisfies specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire) | Use cables that satisfy the specifications | |
| Noise interference occurred because the Encoder Cable is too long. | Check the length of the Encoder Cable | Set the length of the encoder cable to 50m max.. | |
| Noise interference occurred because the Encoder Cable is damaged | Check the Encoder Cable to see if it is pinched or the sheath is damaged. | Replace the Encoder Cable and correct the cable installation environment. | |
| The Encoder Cable was subjected to excessive noise interference | Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line. | Correct the cable layout so that no surge is applied by high-current lines. | |
| There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder | Check to see if the machines are correctly grounded. | Properly ground the machines to separate them from the FG of the encoder | |
| There is a pulse counting error due to noise | Check to see if there is noise interference on the signal line from the encoder | Implement countermeasures against noise for the encoder wiring. | |
| The encoder was subjected to excessive vibration or shock | Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method) | Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder. | |
| Encoder failure | — | Replace the servo motor . | |
| Servomotor Vibrates at Frequency of Approx. 200 to 400Hz. | The servo gains are not balanced. | Check to see if the servo gains have been correctly tuned | Perform autotuning without a host reference. |
| | The setting of Pn100 (Speed Loop Gain) is too high. | Check the speed loop gain(Pn100) setting The factory setting: K _v = 40.0Hz | Set the correct speed loop gain (Pn100) . . |
| | The setting of Pn102 (Position Loop Gain) is too high. | Check position loop gain(Pn102) setting value factory setting: K _p = 40.0/s | Set the correct setting value of position loop gain (Pn102) . |
| | The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate | Check the setting value of the speed loop integral time constant (Pn101) Factory setting: T _i = 20.0ms | Set the correct speed loop integral time constant (Pn101) . . |
| | Moment of inertia ratio(Pn103) setting value is incorrect | Check the moment of inertia ratio(Pn103) setting value | Set the correct moment of inertia ratio (Pn103) . . |
| Large Motor Speed Overshoot on Starting and Stopping | The servo gains are not balanced. | Check to see if the servo gains have been correctly tuned | Perform autotuning without a host reference.. |
| | The setting of Pn100 (Speed Loop Gain) is too high. | Check the speed loop gain(Pn100) setting The Factory setting: K _v = 40.0Hz | Set the correct speed loop gain (Pn100).. |
| | Position loop gain(Pn102) setting value is too high | Check position loop gain(Pn102) setting The Factory setting: K _p = 40.0/s | Set the correct setting value of position loop gain (Pn102) . |

| | | | |
|--|---|---|---|
| | The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate. | Check the setting value of the speed loop integral time constant (Pn101). The Factory setting: $T_i = 20.0\text{ms}$ | Set the correct speed loop integral time constant(Pn101).. |
| | The setting of Pn103 (Moment of Inertia Ratio or Mass Ratio) is not appropriate | Check moment of inertia ratio(Pn103) . | Set the correct moment of inertia ratio (Pn103). . |
| Absolute Encoder Position Deviation Error (The position that was saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.) | Noise interference occurred because of incorrect Encoder Cable specifications | Check the Encoder Cable to see if it satisfies specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm^2 (stranded wire). | Use cables that satisfy the specifications. |
| | Noise interference occurred because the Encoder Cable is too long | Check the length of the encoder cable | Set the length of the encoder cable within 50 m . |
| | Noise interference occurs due to damaged encoder cable | Check whether the encoder cable is clamped or the sheath is damaged | Replace the encoder cable and change the laying environment of the encoder cable . |
| | Excessive noise interference on the encoder cable | Check whether the encoder cable is bundled with high- current wires or is too close | Change the environment where the encoder cable is laid so that it is not affected by the surge voltage of the high-current wire . |
| | There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder. | Check to see if the machines are correctly grounded | Properly ground the machines to separate them from the FG of the encoder. |
| | The pulse counting error of the servo drive due to noise interference | Check to see if there is noise interference on the I/O signal line from the encoder or Serial Converter Unit | Implement countermeasures against noise for the encoder or Serial Converter Unit wiring |
| | The encoder is affected by excessive vibration and shock | Check whether mechanical vibration occurs, and confirm the installation status of the servo motor (Accuracy of mounting surface and securing method) | Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder |
| | Encoder failure | — | Replace the servo motor . |
| | Servo drive failure | — | Replace the servo drive . |
| | Host Controller Multiturn Data or Absolute Encoder Position Data Reading Error | Check the error detection part of the host controller | |
| Check to see if the host controller is executing data parity checks | | | Perform parity checks for the multiturn data or absolute encoder position data. |
| Check for noise interference in the cable between the servo drive and the host controller. | | | Implement countermeasures against noise and then perform parity checks again for the multiturn data or absolute encoder position data |
| Overtravel Occurred | Forward Drive Prohibit or Reverse Drive Prohibit signal was input. | Check the voltage of the external power supply (+24V) for the input signal | Correct the external power supply (+24 V) voltage for the input signals. |
| | | Check the operating condition of the overtravel limit switches. limit switch | Make sure that the overtravel limit switches operate correctly . |
| | | Check the wiring of the overtravel limit switches. | Correct the wiring of the overtravel limit switches. |
| | | Check the settings of the overtravel input signal allocations (Pn50A/ Pn50B). | Set the parameters to correct values. |
| | Forward Drive Prohibit or Reverse Drive Prohibit signal malfunctioned. | Check for fluctuation in the external power supply(+24 V) voltage for the input signals. | |
| Check to see if the operation of the overtravel limit switches is unstable. | | | Stabilize the operating condition of the overtravel limit switches |

| | | | |
|---|--|---|---|
| | | Check the wiring of the overtravel limit switches (e.g., check for cable damage and loose screws) | Correct the wiring of the overtravel limit switches. |
| | There is a mistake in the allocation of the Forward Drive Prohibit or Reverse Drive Prohibit signal (Pn50A.3, Pn50B.0) | Check whether the P-OT signal is assigned to Pn50A.3 | If other signals are assigned to Pn50A.3, reassign the P-OT signal to this parameter . |
| | | Check whether the N-OT signal is assigned to Pn50B.0 | If other signals are assigned to Pn50B.0, reassign N-OT signal to this parameter . |
| | The selection of the Servomotor stopping method is not correct | Check Pn001.0 and Pn001.1 at servo OFF | Select a servo motor stopping method other than coast to stop . |
| | | Check Pn001.0 and Pn001.1 in torque control | Select a servo motor stopping method other than coast to stop . |
| Improper Stop Position for Overtravel (OT) Signal | The limit switch position and dog length are not appropriate. | — | Install the limit switch at the appropriate position. |
| | The overtravel limit switch position is too close for the coasting distance. | — | Install the overtravel limit switch at the appropriate position. |
| Position Deviation (without Alarm) | Noise interference occurred due to incorrect specifications of the encoder cable | Check the Encoder Cable to see if it satisfies specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire) | Use cables that satisfy the specifications. |
| | Noise interference occurred because the Encoder Cable is too long. | Check the length of the encoder cable | Set the length of the encoder cable within 50m . |
| | Noise interference occurs due to damaged encoder cable | Check whether the encoder cable is clamped or the sheath is damaged | Replace the encoder cable and change the laying environment of the encoder cable . |
| | The Encoder Cable was subjected to excessive noise interference | Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line | Correct the cable layout so that no surge is applied by high-current lines. |
| | There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder | Check to see if the machines are correctly grounded | Properly ground the machines to separate them from the FG of the encoder. |
| | The pulse counting error of the servo drive due to noise interference | Check to see if there is noise interference on the I/O signal line from the encoder or Serial Converter Unit. | Implement countermeasures against noise for the encoder wiring or Serial Converter Unit wiring. |
| | The encoder was subjected to excessive vibration or shock | Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method). | Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder. |
| | The coupling between the machine and Servomotor is not suitable | Check to see if position offset occurs at the coupling between machine and Servomotor | Correctly secure the coupling between the machine and Servomotor. |
| | Noise interference occurred because of incorrect I/O signal cable specifications | Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire). | Use cables that satisfy the specifications. |

| | | | |
|----------------------------|---|--|--|
| | If reference pulse input multiplication switching is being used, noise may be causing the I/O signals used for this function (/PSEL and /PSELA) to be falsely detected. | Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire) | Use cables that meet the specifications . |
| | Pulses are being lost because the filter for the referenc pulse input is not appropriate. | Check the length of the I/O signal cable | The I/O signal cables must be no longer than 3 m |
| | Encoder failure (The pulse does not change) | - | Replace the servo motor . |
| | Servo drive failure | - | Replace the servo drive . |
| Servo motor overheating | The surrounding air temperature is too high. | Measure the surrounding air temperature around the Servomotor | Reduce the surrounding air temperature to 40°C or less.. |
| | The surface of the servo motor is dirty | Visually check the surface for dirt. | Remove dirt, dust, oil, etc. on the surface of the servo motor . |
| | There is an overload on the servomotor. | Check the load status with a monitor. | Correct the settings for the polarity detectionrelated parameters. |



Chapter 12 Parameter List

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12.1 Auxiliary Function List

Table 12-1 Auxiliary function list

| Fn No. | Function | By operation panel | By HCServoWorks | Reference chapter |
|--------|--|--------------------|-----------------|-------------------|
| Fn000 | Display Alarm History | 1 | 1 | 8.2 |
| Fn002 | JOG | 1 | 1 | 8.3 |
| Fn003 | Origin search | 1 | 1 | 8.4 |
| Fn004 | JOG Program | 1 | 1 | 8.5 |
| Fn005 | Initialize Parameters | 1 | 1 | 8.6 |
| Fn006 | Clear Alarm History | 1 | 1 | 8.7 |
| Fn008 | Reset Absolute Encoder(initialization) and Encoder Alarm Reset | 1 | 1 | — |
| Fn009 | Auto Tuning Analog (Speed/Torque) Command Offset | 1 | 1 | — |
| Fn00A | Manual Adjustment of Speed Command Offset | 1 | 1 | — |
| Fn00B | Manual Adjustment of Torque Command Offset | 1 | 1 | — |
| Fn00C | Adjust Analog Monitor Output Offset | 1 | 1 | 8.8 |
| Fn00D | Adjust Analog Monitor Output Gain | 1 | 1 | 8.9 |
| Fn00E | Auto Tuning Motor Current Detection Signal Offset | 1 | 1 | 8.10 |
| Fn00F | Manually Adjust Motor Current Detection Signal Offset | 1 | 1 | 8.11 |
| Fn010 | Write Prohibition Setting | 1 | 0 | 8.12 |
| Fn011 | Display Servomotor Model | 1 | 1 | 8.13 |
| Fn012 | Display Software Version | 1 | 1 | 8.14 |
| Fn013 | Multiturn Limit Setting after Multiturn Limit Disagreement Alarm | 1 | 1 | — |
| Fn01B | Initialize Vibration Detection Level | 1 | 1 | 8.15 |
| Fn030 | Software Reset | 1 | 1 | 8.16 |
| Fn200 | Tuning-less Level Setting | 1 | 1 | 7.2.2 |
| Fn201 | Advanced Autotuning without Reference | 0 | 1 | 7.3 |
| Fn202 | Advanced Autotuning with Reference | 0 | 1 | 7.4 |
| Fn203 | One-Parameter Tuning | 1 | 1 | 7.5 |
| Fn204 | Adjust Anti-resonance Control | 0 | 1 | 7.7 |
| Fn205 | Vibration Suppression | 0 | 1 | 7.8 |
| Fn206 | Easy FFT | 1 | 1 | — |
| Fn207 | Online Vibration Monitoring | 1 | 1 | — |

1 : Operable 0 : Not operable

Note: When performing auxiliary functions, be sure to use the panel or HCServoWorks for Y7 series servo drive. If an auxiliary function will be performed at the same time, "no_oP" or "NO-OP" will be displayed

12.2 Parameter List

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|--|--|---|--|---------|---------------|----------------|-----------|-----------|
| Pn000 (2000h) | Basic Function Selections 0 | 0000 ~ 00B3H | — | 0010H | After restart | Setup | 5.4.2 | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Rotation Direction Selection | | | | | | Reference |
| | | 0 | Use CCW as the forward direction. | | | | | 5.4.2 |
| | | 1 | Use CW as the forward direction.(Reverse Rotation Mode) | | | | | |
| | | 2~3 | Reserved parameter | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Control Method Selection | | | | | | Reference |
| | | 0 | Reserved parameter (Do not change.) | | | | | — |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | Pn001 (2001h) | Basic Function Selections 1 | 0000 ~ 1122H | — | 0001H | After restart | Setup | 5.4 |
| n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | Stopping Method at Servo OFF and Gr.1 Alarms | | | | | | Reference |
| | | 0 | Stop the motor by applying the dynamic brake | | | | | 5.4.3 |
| | | 1 | Stop by applying dynamic brake and then release the dynamic brake | | | | | |
| 2 | | Coast the motor to a stop without the dynamic brake | | | | | | |
| n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | Overtravel Stopping Method | | | | | | Reference |
| | | 0 | DB or coast the motor to stop (stopping method same as Pn001.0) | | | | | 5.4.3 |
| | | 1 | Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then servo-lock the motor | | | | | |
| 2 | | Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast | | | | | | |
| n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | Main Circuit Power Supply AC/DC Input Selection | | | | | | Reference |
| | 0 | AC power input: From L1, L2, and L3 terminals | | | | | 5.4.1 | |
| 1 | DC power input: Directly input DC power from B1, N terminal or directly input DC power from P, N terminal | | | | | | | |
| n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Warning Code Output Selection | | | | | | Reference | |
| | 0 | Output only alarm codes on the ALO1, ALO2, and ALO3 terminals. | | | | | — | |
| 1 | Output both warning codes and alarm codes on the ALO1, ALO2, and ALO3 terminals. However, while a warning code is being output, the ALM (Servo Alarm) output signal will remain ON (normal state). | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|--|---|---|---------|---------------|----------------|-----------|-----------|
| Pn002 (2002h) | Basic Function Selections 2 | 0000 ~ 4113H | — | 0011H | After restart | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | | Absolute Encoder Usage | | | | | | Reference |
| | | 0 | Use the absolute encoder according to encoder specifications. | | | | | 6.1 |
| | | 1 | Use the absolute encoder as an incremental encoder | | | | | |
| | | External Encoder Usage | | | | | | Reference |
| | | 0 | Do not use an external encoder. | | | | | 10.4.1 |
| | | 1 | The external encoder moves in the forward direction for CCW motor rotation. | | | | | |
| | 2 | Reserved setting (Do not change.) | | | | | | |
| | 3 | The external encoder moves in the reverse direction for CCW motor rotation. | | | | | | |
| | 4 | Reserved setting (Do not change.) | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|-------------------------------------|---|---|-------|---------|--------------|----------------|-----------|
| Pn006 (2006h) | Application Function Selections 6 | 0000 ~ 005FH | — | 0002H | Immediately | Setup | — |
| | <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> | | | | | | |
| | Analog Monitor 1 Signal Selection | | | | | | Reference |
| | 00 | Motor speed (1V/1000min ⁻¹) | 7.1.2 | | | | |
| | 01 | Speed command (1V/1000min ⁻¹) | | | | | |
| | 02 | Torque command (1 V/100% rated torque) | | | | | |
| | 03 | Position deviation (0.05 V/command unit) | | | | | |
| | 04 | Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit) | | | | | |
| | 05 | Position command speed (1V/1000min ⁻¹) | | | | | |
| | 06 | Reserved setting (Do not change .) | | | | | |
| | 07 | Load-motor position deviation (0.01 V/command unit) | | | | | |
| | 08 | Positioning completion (positioning completed: 5 V, positioning not completed: 0 V) | | | | | |
| | 09 | Speed feedforward (1V/1000min ⁻¹) | | | | | |
| | 0A | Torque feedforward (1 V/100% rated torque) | | | | | |
| | 0B | Active gain (1st gain: 1 V, 2nd gain: 2 V) | | | | | |
| 0C | Completion of position reference distribution (completed: 5 V, not completed: 0 V) | | | | | | |
| 0D | External encoder speed (1V/1000min ⁻¹) | | | | | | |
| Reserved setting (Do not change .) | | | | | | | |
| Reserved setting (Do not change .) | | | | | | | |
| Pn007 (2007h) | Application Function Selections 7 | 0000 ~ 005FH | — | 0000H | Immediately | Setup | — |

n.

| Analog Monitor 2 Signal Selection | | Reference |
|--------------------------------------|--|-----------|
| 00 | Motor speed (1V/1000min ⁻¹) | 7..2 |
| 01 | Speed command (1V/1000min ⁻¹) | |
| 02 | Torque command (1 V/100% rated torque) | |
| 03 | Position deviation (0.05 V/command unit) | |
| 04 | Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit) | |
| 05 | Position command speed (1V/1000min ⁻¹) | |
| 06 | Reserved setting (Do not use.) | |
| 07 | Load-motor position deviation (0.01 V/command unit) | |
| 08 | Positioning completion (positioning completed: 5 V, positioning not completed: 0 V) | |
| 09 | Speed feedforward (1V/1000min ⁻¹) | |
| 0A | Torque feedforward (1 V/100% rated torque) | |
| 0B | Active gain (1st gain: 1 V, 2nd gain: 2 V, 3 rd : 3V, 4 th : 4V) | |
| 0C | Completion of position reference distribution (completed: 5 V, not completed: 0 V) | |
| 0D | External encoder speed (1V/1000min ⁻¹) | |
| Reserved settings (Do not change .) | | |
| Reserved settings (Do not change .) | | |

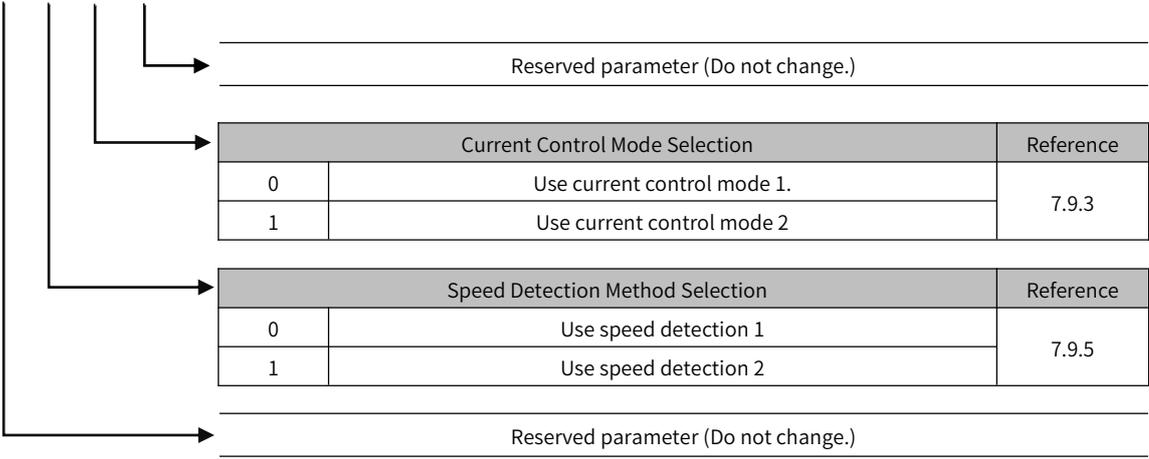
| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|---------|----------------------------|---------------|------|---------|---------------|----------------|-----------|
| | Basic Function Selections8 | 0000 ~ 7121H | — | 4000H | After restart | Setup | — |

n.

| Low Battery Voltage Alarm/Warning Selection | | Reference |
|---|--|-----------|
| 0 | Output alarm (A.830) for low battery voltage. | 6.1.2 |
| 1 | Output warning (A.930) for low battery voltage. | |
| Function Selection for Undervoltage | | Reference |
| 0 | Do not detect undervoltage | — |
| 1 | Detect undervoltage warning and limit torque at host controller | |
| 2 | Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in servo drive). | |
| Warning Detection Selection | | Reference |
| 0 | Detect warnings. | — |
| 1 | Do not detect warnings (except A.971) | |
| Reserved parameter (Do not change .) | | |

| | | | | | | | |
|-------|----------------|--------------|---|-------|---------------|--------|-----|
| Pn009 | Basic Function | 0000 ~ 0111H | — | 0010H | After restart | Tuning | 7.9 |
|-------|----------------|--------------|---|-------|---------------|--------|-----|

n. □ □ □ □



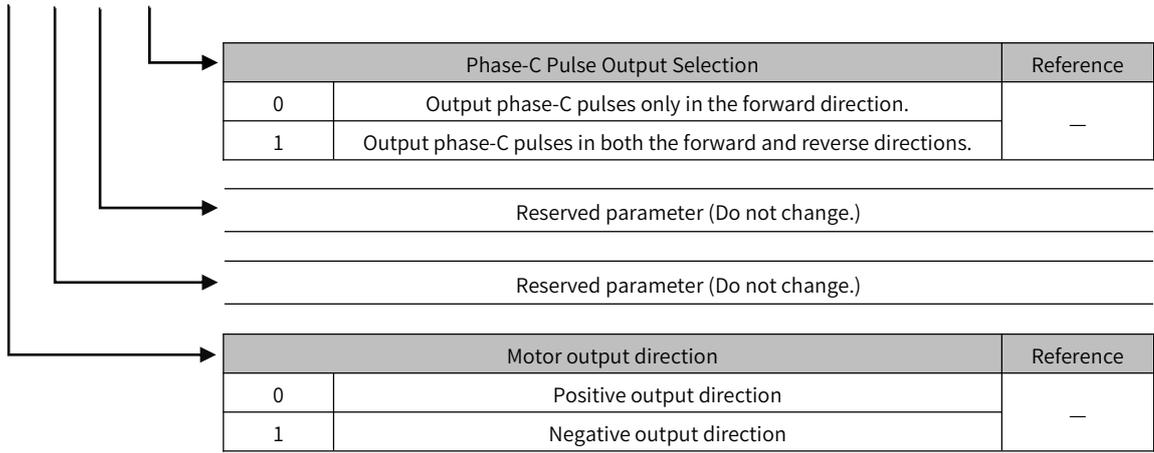
| Current Control Mode Selection | | Reference |
|--------------------------------|-----------------------------|-----------|
| 0 | Use current control mode 1. | 7.9.3 |
| 1 | Use current control mode 2 | |

| Speed Detection Method Selection | | Reference |
|----------------------------------|-----------------------|-----------|
| 0 | Use speed detection 1 | 7.9.5 |
| 1 | Use speed detection 2 | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|--|---|------|---------|---------------|----------------|-----------|-----------|
| Pn00B (200Bh) | Basic Function Selections B | 0000 ~ 1111H | — | 0000H | After restart | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | | |
| | | Operator Parameter Display Selection | | | | | | Reference |
| | 0 | Display only setup parameters. | | | | | | 5.2.5 |
| | 1 | Display all parameters. | | | | | | |
| | | Motor Stopping Method for BM.2 Alarms | | | | | | Reference |
| | 0 | Stop the motor by setting the speed command to 0. | | | | | | — |
| | 1 | Apply the dynamic brake or coast the motor to a stop (Stopping method same as Pn001.0) | | | | | | |
| | | Power Input Selection for Three-phase servo drive | | | | | | Reference |
| | 0 | Use a three-phase power supply input. | | | | | | 2.4.3 |
| 1 | Use a single-phase power supply input. | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | |
| Pn00C (200Ch) | Basic Function Selections C | 0000 ~ 0111H | — | 0000H | After restart | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | | |
| | | Function Selection for Test without a Motor | | | | | | Reference |
| | 0 | Disable tests without a motor. | | | | | | — |
| | 1 | Enable tests without a motor | | | | | | |
| | | Encoder Resolution for Tests without a Motor | | | | | | Reference |
| | 0 | Use 13 bits | | | | | | — |
| | 1 | Use 23 bits. | | | | | | |
| | | Encoder Type Selection for Tests without a Motor | | | | | | Reference |
| | 0 | Use an incremental encoder. | | | | | | — |
| 1 | Use an absolute encoder | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | |
|--|--|---|------------------------|-----------|---------------|----------------|-----------|--|--|-----------|---|------------------------------------|-------|---|-----------------------------|
| Pn00D (200Dh) | Basic Function Selections D | 0000 ~ 1001H | — | 0000H | After restart | Setup | — | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th colspan="2">Overtravel Warning Detection Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Do not detect overtravel warnings.</td> <td rowspan="2">5.4.3</td> </tr> <tr> <td>1</td> <td>Detect overtravel warnings.</td> </tr> </tbody> </table> | | | | | | Overtravel Warning Detection Selection | | Reference | 0 | Do not detect overtravel warnings. | 5.4.3 | 1 | Detect overtravel warnings. |
| Overtravel Warning Detection Selection | | Reference | | | | | | | | | | | | | |
| 0 | Do not detect overtravel warnings. | 5.4.3 | | | | | | | | | | | | | |
| 1 | Detect overtravel warnings. | | | | | | | | | | | | | | |
| Pn010 (2010h) | Axis Address Selection for UART/USB Communications | 0000 ~ 007FH | — | 0001H | After restart | Setup | — | | | | | | | | |
| Pn080 (2080h) | Reserved parameter | 0000 ~ 28B5H | — | 0000H | After restart | Setup | — | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th colspan="2">Polarity Sensor Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Active at high voltage</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Active at low voltage</td> </tr> </tbody> </table> | | | | | | Polarity Sensor Selection | | Reference | 0 | Active at high voltage | — | 1 | Active at low voltage |
| | | Polarity Sensor Selection | | Reference | | | | | | | | | | | |
| | | 0 | Active at high voltage | — | | | | | | | | | | | |
| 1 | Active at low voltage | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Pn081 (2081h) | Application Function Selections 81 | 0000 ~ 1111H | — | 0000H | After restart | Setup | — | | | | | | | | |

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| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|------------------|---------------------------------------|---------------|--------|---------|--------------|----------------|-----------|
| Pn100 (2100h) | Speed Loop Gain | 10 ~ 20000 | 0.1Hz | 400 | Immediately | Tuning | 7.6 |
| Pn101 (2101h) | Speed Loop Integral Time Constant | 15 ~ 51200 | 0.01ms | 2000 | Immediately | Tuning | 7.6 |
| Pn102 (2102h) | Position Loop Gain | 10 ~ 20000 | 0.1/s | 400 | Immediately | Tuning | 7.6 |
| Pn103 (2103h) | Moment of Inertia Ratio | 0 ~ 20000 | 1% | 100 | Immediately | Tuning | 7.6 |
| Pn104 (2104h) | 2nd Speed Loop Gain | 10 ~ 20000 | 0.1Hz | 400 | Immediately | Tuning | 7.9 |
| Pn105 (2105h) | 2nd Speed Loop Integral Time Constant | 15 ~ 51200 | 0.01ms | 2000 | Immediately | Tuning | 7.9 |
| Pn106 (2106h) | 2nd Position Loop Gain | 10 ~ 20000 | 0.1/s | 400 | Immediately | Tuning | 7.9 |
| Pn109 (2109h) | Feedforward | 0 ~ 100 | 1% | 0 | Immediately | Tuning | 7.10 |
| Pn10A (210Ah) | Feedforward Filter Time Constant | 0 ~ 6400 | 0.01ms | 0 | Immediately | Tuning | 7.10 |
| Pn10B | Gain Application Selections | 0000~5334H | — | 0000H | — | — | — |

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| Mode Switching Selection | | When enabled | Classification | Reference |
|--------------------------|---|--------------|----------------|-----------|
| 0 | Use the internal torque command as condition (level setting: Pn10C) | Immediately | Setup | 7.9.5 |
| 1 | Use the speed command as the condition (level setting: Pn10D) | | | |
| 2 | Use the acceleration reference as condition (level setting: Pn10E) | | | |
| 3 | Use the position deviation as the condition (level setting: Pn10F). | | | |
| 4 | Do not use mode switching | | | |

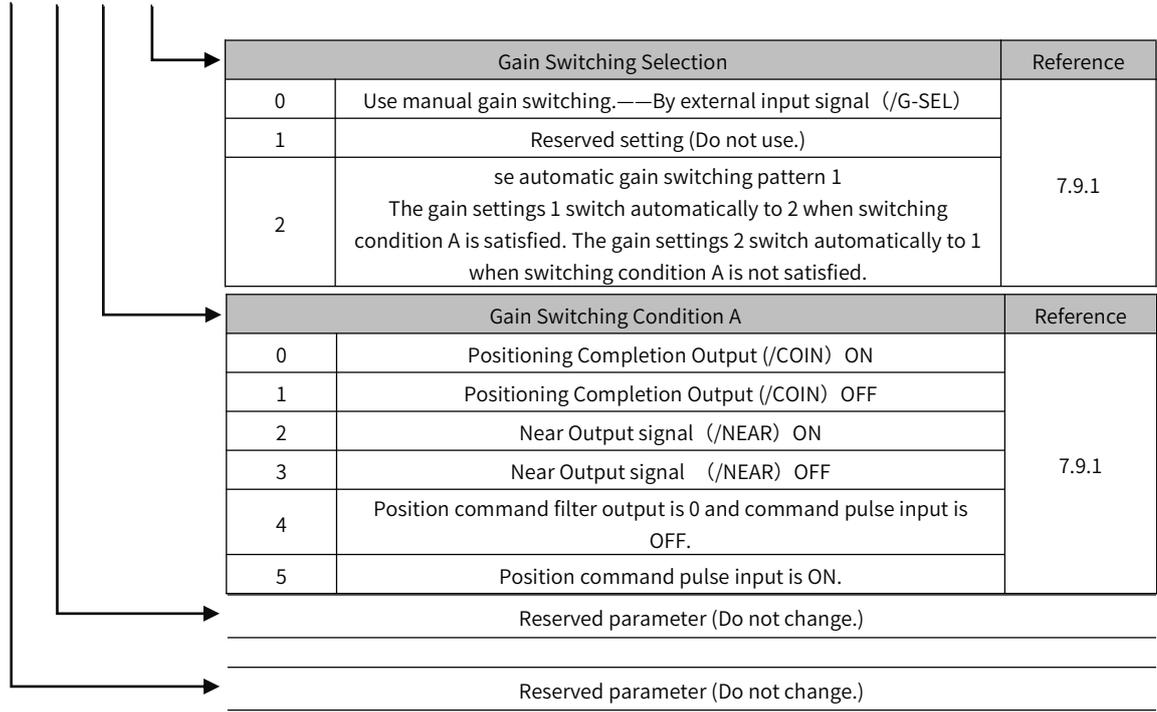
| Speed Loop Control Method | | When enabled | Classification | Reference |
|---------------------------|-------------|---------------|----------------|-----------|
| 0 | PI control | After restart | Setup | — |
| 1 | I-P control | | | |

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

| | | | | | | | |
|-------------------------|---|----------------------|----------------|----------------|---------------------|-----------------------|------------------|
| Pn10C (210Ch) | Mode Switching Level for Torque Command | 0 ~ 800 | 1% | 200 | Immediately | Tuning | 7.9.5 |
| Pn10D (210Dh) | Mode Switching Level for Speed Command | 0 ~ 10000 | 1min-1 | 0 | Immediately | Tuning | |
| Pn10E (210Eh) | Mode Switching Level for Acceleration | 0 ~ 30000 | 1min-1/s | 0 | Immediately | Tuning | |
| Pn10F (210Fh) | Mode Switching Level for Position Deviation | 0 ~ 10000 | 1 command unit | 0 | Immediately | Tuning | |
| Pn11F (211Fh) | Position Integral Time Constant | 0 ~ 50000 | 0.1ms | 0 | Immediately | Tuning | |
| Pn121 (2121h) | Friction Compensation Gain | 10 ~ 1000 | 1% | 100 | Immediately | Tuning | 7.9 |
| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
| Pn122 (2122h) | 2nd Friction Compensation Gain | 10 ~ 1000 | 1% | 100 | Immediately | Tuning | 7.9.2 |
| Pn123 (2123h) | Friction Compensation Coefficient | 0 ~ 100 | 1% | 0 | Immediately | Tuning | |
| Pn124 (2124h) | Friction Compensation Frequency Correction | -10000 ~ 10000 | 0.1Hz | 0 | Immediately | Tuning | |
| Pn125 (2125h) | Friction Compensation Gain Correction | 1 ~ 1000 | 1% | 100 | Immediately | Tuning | |
| Pn131 (2131h) | Gain Switching Time 1 | 0 ~ 65535 | 1ms | 0 | Immediately | Tuning | 7.9.1 |
| Pn132 (2132h) | Gain Switching Time 2 | 0 ~ 65535 | 1ms | 0 | Immediately | Tuning | |
| Pn135 (2135h) | Gain Switching Waiting Time 1 | 0 ~ 65535 | 1ms | 0 | Immediately | Tuning | |
| Pn136 (2136h) | Gain Switching Waiting Time 2 | 0 ~ 65535 | 1ms | 0 | Immediately | Tuning | |
| Pn139 (2139h) | Automatic Gain Switching Selections 1 | 0000 ~ 0052H | — | 0000H | Immediately | Tuning | 7.9.1 |

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| Gain Switching Selection | | Reference |
|--------------------------|---|-----------|
| 0 | Use manual gain switching.—By external input signal (/G-SEL) | 7.9.1 |
| 1 | Reserved setting (Do not use.) | |
| 2 | Use automatic gain switching pattern 1 The gain settings 1 switch automatically to 2 when switching condition A is satisfied. The gain settings 2 switch automatically to 1 when switching condition A is not satisfied. | |

| Gain Switching Condition A | | Reference |
|----------------------------|---|-----------|
| 0 | Positioning Completion Output (/COIN) ON | 7.9.1 |
| 1 | Positioning Completion Output (/COIN) OFF | |
| 2 | Near Output signal (/NEAR) ON | |
| 3 | Near Output signal (/NEAR) OFF | |
| 4 | Position command filter output is 0 and command pulse input is OFF. | |
| 5 | Position command pulse input is ON. | |

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

| | | | | | | | |
|-------------------------|--------------------|------------|----|------|-------------|--------|-------|
| Pn13D (213Dh) | Current Gain Level | 100 ~ 2000 | 1% | 2000 | Immediately | Tuning | 7.9.4 |
|-------------------------|--------------------|------------|----|------|-------------|--------|-------|

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|---|---|-------|---------|--------------|----------------|-----------|--|
| Pn140 (2140h) | Model Following Control-Related | 0000 ~ 1121H | — | 0100H | Immediately | Tuning | — | |
| | | | | | | | | |
| | Model Following Control Selection | | | | | | Reference | |
| | 0 | Do not use model following control | | | | | — | |
| | 1 | Use model following control. | | | | | | |
| | Vibration Suppression Selection | | | | | | Reference | |
| | 0 | Do not perform vibration suppression | | | | | — | |
| | 1 | Perform vibration suppression for a specific frequency. | | | | | | |
| | 2 | Perform vibration suppression for two specific frequencies. | | | | | | |
| | Vibration Suppression Adjustment Selection | | | | | | Reference | |
| | 0 | Auto-tuning without auxiliary functions. | | | | | 7.6 | |
| | 1 | Auto-tuning with auxiliary functions. | | | | | | |
| | Speed Feedforward (VFF)/Torque Feedforward (TFF) Selection | | | | | | Reference | |
| | 0 | Do not use model following control and speed/torque feedforward together. | | | | | 7.6 | |
| 1 | Use model following control and speed/torque feedforward together | | | | | | | |
| Pn141 (2141h) | Model Following Control Gain | 10 ~ 20000 | 0.1/s | 500 | Immediately | Tuning | 7.9 | |
| Pn142 (2142h) | Model Following Control Gain Correction | 500 ~ 2000 | 0.1% | 1000 | Immediately | Tuning | 7.9 | |
| Pn143 (2142h) | Model Following Control Offset (Forward) | 0 ~ 10000 | 0.1% | 1000 | Immediately | Tuning | 7.6 | |
| Pn144 (2144h) | Model Following Control Offset (Reverse Direction) | 0 ~ 10000 | 0.1% | 1000 | Immediately | Tuning | 7.6 | |
| Pn145 (2145h) | Vibration Suppression 1 Frequency A | 10 ~ 2500 | 0.1Hz | 500 | Immediately | Tuning | 7.6 | |
| Pn146 (2146h) | Vibration Suppression 1 Frequency B | 10 ~ 2500 | 0.1Hz | 700 | Immediately | Tuning | 7.6 | |
| Pn147 (2147h) | Model Following Control Speed Feedforward Compensatio | 0 ~ 10000 | 0.1% | 1000 | Immediately | Tuning | 7.6 | |
| Pn148 (2148h) | 2nd Model Following Control Gain | 10 ~ 20000 | 0.1/s | 500 | Immediately | Tuning | 7.9 | |
| Pn149 (2149h) | 2nd Model Following Control Gain Correction | 500 ~ 2000 | 0.1% | 1000 | Immediately | Tuning | 7.9 | |
| Pn14A (214Ah) | Vibration Suppression 2 Frequency | 10 ~ 2000 | 0.1Hz | 800 | Immediately | Tuning | — | |
| Pn14B (214Bh) | Vibration Suppression 2 Correction | 10 ~ 1000 | 1% | 100 | Immediately | Tuning | — | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | |
|-------------------------------------|--|--|--|-----------|---------------|----------------|-----------|---|--|-----------|---|--|-----|---|---------------------------------------|
| Pn14F (214Fh) | Control-Related Selections | 0000~0011H | — | 0011H | After restart | Tuning | — | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <table border="1"> <thead> <tr> <th colspan="2">Model Following Control Type Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Use model following control type 1</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Use model following control type 2.</td> </tr> </tbody> </table> | | | | | | Model Following Control Type Selection | | Reference | 0 | Use model following control type 1 | — | 1 | Use model following control type 2. |
| | | Model Following Control Type Selection | | Reference | | | | | | | | | | | |
| | | 0 | Use model following control type 1 | — | | | | | | | | | | | |
| | | 1 | Use model following control type 2. | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th colspan="2">Tuning-less Type Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Use tuning-less type 1.</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Use tuning-less type 2.</td> </tr> </tbody> </table> | | | | | | Tuning-less Type Selection | | Reference | 0 | Use tuning-less type 1. | — | 1 | Use tuning-less type 2. |
| | | Tuning-less Type Selection | | Reference | | | | | | | | | | | |
| | | 0 | Use tuning-less type 1. | — | | | | | | | | | | | |
| | | 1 | Use tuning-less type 2. | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
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| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Pn160 (2160h) | Anti-Resonance Control-Related Selections | 0000 ~ 0011H | — | 0010H | Immediately | Tuning | — | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <table border="1"> <thead> <tr> <th colspan="2">Anti-Resonance Control Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Do not use anti-resonance control.</td> <td rowspan="2">7.7</td> </tr> <tr> <td>1</td> <td>Use anti-resonance control</td> </tr> </tbody> </table> | | | | | | Anti-Resonance Control Selection | | Reference | 0 | Do not use anti-resonance control. | 7.7 | 1 | Use anti-resonance control |
| | | Anti-Resonance Control Selection | | Reference | | | | | | | | | | | |
| | | 0 | Do not use anti-resonance control. | 7.7 | | | | | | | | | | | |
| | | 1 | Use anti-resonance control | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th colspan="2">Anti-Resonance Control Adjustment Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Auto-tuning without auxiliary functions.</td> <td rowspan="2">7.6</td> </tr> <tr> <td>1</td> <td>Auto-tuning with auxiliary functions.</td> </tr> </tbody> </table> | | | | | | Anti-Resonance Control Adjustment Selection | | Reference | 0 | Auto-tuning without auxiliary functions. | 7.6 | 1 | Auto-tuning with auxiliary functions. |
| | | Anti-Resonance Control Adjustment Selection | | Reference | | | | | | | | | | | |
| | | 0 | Auto-tuning without auxiliary functions. | 7.6 | | | | | | | | | | | |
| | | 1 | Auto-tuning with auxiliary functions. | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
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| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Pn161 (2161h) | Anti-Resonance Frequency | 10 ~ 20000 | 0.1Hz | 1000 | Immediately | Tuning | 7.7 | | | | | | | | |
| Pn162 (2162h) | Anti-Resonance Gain Correction | 1 ~ 1000 | 1% | 100 | Immediately | Tuning | 7.7 | | | | | | | | |
| Pn163 (2163h) | Anti-Resonance Damping Gain | 0 ~ 300 | 1% | 0 | Immediately | Tuning | 7.7 | | | | | | | | |
| Pn164 (2164h) | Anti-Resonance Filter Time Constant 1 Correction | -1000 ~ 1000 | 0.01ms | 0 | Immediately | Tuning | 7.7 | | | | | | | | |
| Pn165 (2165h) | Anti-Resonance Filter Time Constant 2 Correction | -1000 ~ 1000 | 0.01ms | 0 | Immediately | Tuning | 7.7 | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|---|--|------------------------------|----------------|----------------|----------------|-----------|--|
| Pn170 (2170h) | Tuning-less FunctionRelated Selections | 0000 ~ 2411H | — | 1400H | — | — | — | |
| | n. □ □ □ □ | Tuning-less Selection | | Effective | Classification | Reference | | |
| | | 0 | Disable tuning-less function | After restart | Setup | 7.2 | | |
| | | 1 | Enable tuning-less function | | | | | |
| | | Speed Control Method | | Effective | Classification | Reference | | |
| | 0 | Use for speed control | After restart | Setup | — | | | |
| | 1 | Use for speed control and use host controller for position control | | | | | | |
| | Rigidity Level | | Effective | Classification | Reference | | | |
| | 0 ~ 4 | Set the rigidity level | Immediately | Setup | 7.2 | | | |
| | Tuning-less Load Level | | Effective | Classification | Reference | | | |
| 0 ~ 2 | Set the load level for the tuning-less function | Immediately | Setup | 7.2 | | | | |
| Pn190 (2190h) | Reserved (Do not change) | 0000 ~0011H | — | 0010H | Immediately | — | — | |
| | n. □ □ □ □ | Reserved parameter (Do not change.) | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | |
|--|--|---|-----------|---------|---------------|----------------|--|-------------------------|-----------|-----------|--|--------|---|--|---|---|
| Pn200 | Position Control Command Form Selections | 0000 ~ 1236H | — | 0100H | After restart | Setup | — | | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| Pn205 (2205h) | Multiturn Limit | 0 ~ 65535 | 1rev | 65535 | After restart | Setup | — | | | | | | | | | |
| Pn207 (2207h) | Position Control Function Selections | 0000 ~ 2210H | — | 0010H | After restart | Setup | — | | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th colspan="2">Position Control Option</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>N/A</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Use V-REF as a speed feed-forward input</td> </tr> </tbody> </table> | | | | | | Position Control Option | | Reference | 0 | N/A | — | 1 | Use V-REF as a speed feed-forward input | |
| | Position Control Option | | Reference | | | | | | | | | | | | | |
| | 0 | N/A | — | | | | | | | | | | | | | |
| 1 | Use V-REF as a speed feed-forward input | | | | | | | | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">/COIN (Positioning Completion Output) Signal Output Timing</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Output when the absolute value of the position deviation is the same or less than the setting of Pn522</td> <td rowspan="3">5.11.5</td> </tr> <tr> <td>1</td> <td>Output when the absolute value of the position error is the same or less than the setting of Pn522 and the reference after the position command filter is 0.</td> </tr> <tr> <td>2</td> <td>Output when the absolute value of the position error is the same or less than the setting of Pn522 and the command input is 0</td> </tr> </tbody> </table> | | | | | | /COIN (Positioning Completion Output) Signal Output Timing | | Reference | 0 | Output when the absolute value of the position deviation is the same or less than the setting of Pn522 | 5.11.5 | 1 | Output when the absolute value of the position error is the same or less than the setting of Pn522 and the reference after the position command filter is 0. | 2 | Output when the absolute value of the position error is the same or less than the setting of Pn522 and the command input is 0 |
| /COIN (Positioning Completion Output) Signal Output Timing | | Reference | | | | | | | | | | | | | | |
| 0 | Output when the absolute value of the position deviation is the same or less than the setting of Pn522 | 5.11.5 | | | | | | | | | | | | | | |
| 1 | Output when the absolute value of the position error is the same or less than the setting of Pn522 and the reference after the position command filter is 0. | | | | | | | | | | | | | | | |
| 2 | Output when the absolute value of the position error is the same or less than the setting of Pn522 and the command input is 0 | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | |
|------------------|---|----------------------------|--------------------|---------|-------------------------------|----------------|-----------|---|--|-----------|---|--------------------------|------|---|----------------------------|
| Pn20A (220Ah) | Number of External Encoder Scale Pitches | 4 ~ 1048576 | 1P/Rev | 32768 | After restart | Setup | 10.2 | | | | | | | | |
| Pn20E (220Eh) | Electronic Gear Ratio(Numerator) | 1 ~1073741824 | 1 | 4 | Only for models of pulse-type | Setup | — | | | | | | | | |
| Pn210 (2210h) | Electronic Gear Ratio (Denominator) | 1 ~1073741824 | 1 | 1 | Only for models of pulse-type | Setup | | | | | | | | | |
| Pn212 (2212h) | Number of Encoder Output Pulses | 16 ~1073741824 | 1P/Rev | 2048 | After restart | Setup | 5.11.6 | | | | | | | | |
| Pn216 | Position Command Acceleration /Deceleration Time Constant | 0 ~ 65535 | 0.1ms | 0 | Immediately | Setup | 6.10 | | | | | | | | |
| Pn217 | Average Position Command Movement Time | 0 ~ 10000 | 0.1ms | 0 | Immediately | Setup | | | | | | | | | |
| Pn218 | Command Pulse Input Multiplier | 1 ~ 100 | × 1 | 1 | Immediately | Setup | | | | | | | | | |
| Pn22A (222Ah) | Fully-closed Control Selections | 0000 ~ 0003H | — | 0000H | After restart | Setup | 10.2 | | | | | | | | |
| | <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>Reserved parameter (Do not change.)</p> <p>Reserved parameter (Do not change.)</p> <p>Reserved parameter (Do not change.)</p> <table border="1"> <thead> <tr> <th colspan="2">Fully-closed Control Speed Feedback Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Use motor encoder speed.</td> <td rowspan="2">10.2</td> </tr> <tr> <td>1</td> <td>Use external encoder speed</td> </tr> </tbody> </table> | | | | | | | Fully-closed Control Speed Feedback Selection | | Reference | 0 | Use motor encoder speed. | 10.2 | 1 | Use external encoder speed |
| | Fully-closed Control Speed Feedback Selection | | Reference | | | | | | | | | | | | |
| | 0 | Use motor encoder speed. | 10.2 | | | | | | | | | | | | |
| | 1 | Use external encoder speed | | | | | | | | | | | | | |
| Pn240 | Mini. time interval for Position deviation clear signal input | 0 ~ 2000 | ms | 0 | After restart | Setup | — | | | | | | | | |
| Pn281 (2281h) | Encoder Output Resolution | 1 ~ 4096 | 1 edge/ pitch | 20 | After restart | Setup | — | | | | | | | | |
| Pn284 | Number of pulses for grating pitch | 0000~FFFF | 1 edge/ pitch | 0 | After restart | Setup | | | | | | | | | |
| Pn2D0 | Reserved (Do not change) | 0 ~ 16777216 | — | 0 | — | — | — | | | | | | | | |
| Pn300 | Reserved | — | — | — | — | — | — | | | | | | | | |
| Pn301 | Reserved | — | — | — | — | — | | | | | | | | | |
| Pn302 | Reserved | — | — | — | — | — | | | | | | | | | |
| Pn303 | Reserved | — | — | — | — | — | | | | | | | | | |
| Pn304 (2304h) | Jogging Speed | 0 ~ 10000 | 1min ⁻¹ | 500 | Immediately | Setup | 8.4 | | | | | | | | |
| Pn305 (2305h) | Soft Start Acceleration Time | 0 ~ 10000 | 1ms | 0 | Immediately | Setup | 6.9 | | | | | | | | |
| Pn306 (2306h) | Soft Start Deceleration Time | 0 ~ 10000 | 1ms | 0 | Immediately | Setup | | | | | | | | | |
| Pn307 | Reserved (Do not change) | 0 ~ 65535 | 0.01ms | 0 | Immediately | Setup | — | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|---|--|--------------------|---------|---------------|----------------|-----------|-------------------------------|--|-----------|---|-------------------------|------|---|--|---|---|-------------------------------------|--|--|-------------------------------------|--|--|-------------------------------------|--|--|
| Pn310 (2310h) | Vibration Detection Selection | 0000 ~ 0002H | — | 0000H | Immediately | Setup | 8.15 | | | | | | | | | | | | | | | | | | | |
| | <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2">Vibration Detection Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Do not detect vibration</td> <td rowspan="3">8.15</td> </tr> <tr> <td>1</td> <td>Output a warning (A.911) if vibration is detected.</td> </tr> <tr> <td>2</td> <td>Output an alarm (A.520) if vibration is detected.</td> </tr> <tr> <td colspan="2">Reserved parameter (Do not change.)</td> <td></td> </tr> <tr> <td colspan="2">Reserved parameter (Do not change.)</td> <td></td> </tr> <tr> <td colspan="2">Reserved parameter (Do not change.)</td> <td></td> </tr> </tbody> </table> | | | | | | | Vibration Detection Selection | | Reference | 0 | Do not detect vibration | 8.15 | 1 | Output a warning (A.911) if vibration is detected. | 2 | Output an alarm (A.520) if vibration is detected. | Reserved parameter (Do not change.) | | | Reserved parameter (Do not change.) | | | Reserved parameter (Do not change.) | | |
| | Vibration Detection Selection | | Reference | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | Do not detect vibration | 8.15 | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | Output a warning (A.911) if vibration is detected. | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Output an alarm (A.520) if vibration is detected. | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn311 (2311h) | Vibration Detection Sensitivity | 50 ~ 500 | 1% | 100 | Immediately | Tuning | 8.15 | | | | | | | | | | | | | | | | | | | |
| Pn312 (2312h) | Vibration Detection Level | 0 ~ 5000 | 1min ⁻¹ | 50 | Immediately | Tuning | | | | | | | | | | | | | | | | | | | | |
| Pn324 (2324h) | Moment of Inertia Calculation Starting Level | 0 ~ 20000 | 1% | 300 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | |
| Pn400 (2400h) | Reserved (Do not change) | 10 ~ 100 | 0.1V | 30 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | |
| Pn401 (2401h) | 1st Stage1st Torque Command Filter Time Constant | 0 ~ 65535 | 0.01ms | 100 | Immediately | Tuning | — | | | | | | | | | | | | | | | | | | | |
| Pn402 (2402h) | Forward Torque Limit | 0 ~ 800 | 1% | 800 | Not available | Setup | — | | | | | | | | | | | | | | | | | | | |
| Pn403 (2403h) | Reverse Torque Limit | 0 ~ 800 | 1% | 800 | Not available | Setup | | | | | | | | | | | | | | | | | | | | |
| Pn404 (2404h) | Forward External Torque Limit | 0 ~ 800 | 1% | 100 | Not available | Setup | — | | | | | | | | | | | | | | | | | | | |
| Pn405 (2405h) | Reverse External Torque Limit | 0 ~ 800 | 1% | 100 | Not available | Setup | | | | | | | | | | | | | | | | | | | | |
| Pn406 (2406h) | Emergency Stop Torque | 0 ~ 800 | 1% | 800 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | |
| Pn407 (2407h) | Speed Limit during Torque Control | 0 ~ 10000 | 1min ⁻¹ | 10000 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|--|--|----------------------------------|----------------|----------------|----------------|-----------|-----|
| Pn408 (2408h) | Torque-Related Function Selections | 0000 ~ 1111H | — | 0000H | — | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Notch Filter Selection 1 | | Effective | Classification | Reference | | |
| | | 0 | Disable first stage notch filter | Immediately | Setup | — | | |
| | | 1 | Enable first stage notch filter | | | | | |
| | | Speed Limit Selection | | Effective | Classification | Reference | | |
| | 0 | Use the smaller of the maximum motor speed and the setting of Pn407 as the speed limit. | After restart | Setup | — | | | |
| | 1 | Use the smaller of the overspeed alarm detection speed and the setting of Pn407 as the speed limit | | | | | | |
| | Notch Filter Selection 2 | | Effective | Classification | Reference | | | |
| | 0 | Disable second stage notch filter | Immediately | Setup | — | | | |
| | 1 | Enable second stage notch filter | | | | | | |
| | Friction Compensation Function Selection | | Effective | Classification | Reference | | | |
| | 0 | Disable friction compensation | Immediately | Setup | 7.6 | | | |
| | 1 | Enable friction compensation. | | | | | | |
| | Pn409 (2409h) | First Stage Notch Filter Frequency | 50 ~ 5000 | 1Hz | 5000 | Immediately | Tuning | 7.6 |
| | Pn40A (240Ah) | First Stage Notch Filter Q Value | 50 ~ 1000 | 0.01 | 70 | Immediately | Tuning | |
| Pn40B (240Bh) | First Stage Notch Filter Depth | 0 ~ 1000 | 0.001 | 0 | Immediately | Tuning | | |
| Pn40C (240Ch) | 2nd Stage Notch Filter Frequency | 50 ~ 5000 | 1Hz | 5000 | Immediately | Tuning | | |
| Pn40D (240Dh) | 2nd Stage Notch Filter Q Value | 50 ~ 1000 | 0.01 | 70 | Immediately | Tuning | | |
| Pn40E (240Eh) | 2nd Stage Notch Filter Depth | 0 ~ 1000 | 0.001 | 0 | Immediately | Tuning | | |
| Pn40F (240Fh) | 2nd Stage Second Torque Command Filter Frequency | 100 ~ 5000 | 1Hz | 5000 | Immediately | Tuning | | |
| Pn410 (2410h) | 2nd Stage 2nd Torque Command Filter Q Value | 50 ~ 100 | 0.01 | 50 | Immediately | Tuning | | |
| Pn412 (2412h) | 1st Stage Second Torque Command Filter Time Constant | 0 ~ 65535 | 0.01ms | 100 | Immediately | Tuning | — | |
| Pn415 | T-REF Filter Time Constant | 0 ~ 65535 | 0.01ms | 0 | Immediately | Setup | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | |
|--|--|--|-----------|---------|---------------|----------------|-------------------------------------|-------------------------------------|-----------|-----------|--|--|-----|---------------------------------------|---------------------------------------|
| Pn423 (2423h) | Reserved (Do not change) | 0000 ~ 1111H | — | 0000H | Immediately | — | — | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | | | | | | | | |
| Pn424 (2424h) | Torque Limit at Main Circuit Voltage Drop | 0 ~ 100 | 1% | 50 | Immediately | Setup | — | | | | | | | | |
| Pn425 (2425h) | Release Time for Torque Limit at Main Circuit Voltage Drop | 0 ~ 1000 | 1ms | 100 | Immediately | Setup | — | | | | | | | | |
| Pn456 (2456h) | Sweep Torque Command Amplitude | 1 ~ 800 | 1% | 15 | Immediately | Tuning | — | | | | | | | | |
| Pn460 (2460h) | Notch Filter Adjustment Selections | 0000 ~ 0101 | — | 0101 | Immediately | Tuning | 7.6 | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | | | | | | | | | |
| | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Notch Filter Adjustment Selection 1</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Auto-tuning without auxiliary functions.</td> <td rowspan="2" style="text-align: center;">7.6</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Auto-tuning with auxiliary functions.</td> </tr> </tbody> </table> | | | | | | | Notch Filter Adjustment Selection 1 | | Reference | 0 | Auto-tuning without auxiliary functions. | 7.6 | 1 | Auto-tuning with auxiliary functions. |
| | Notch Filter Adjustment Selection 1 | | Reference | | | | | | | | | | | | |
| | 0 | Auto-tuning without auxiliary functions. | 7.6 | | | | | | | | | | | | |
| 1 | Auto-tuning with auxiliary functions. | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Notch Filter Adjustment Selection 2</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Auto-tuning without auxiliary functions.</td> <td rowspan="2" style="text-align: center;">—</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Auto-tuning with auxiliary functions.</td> </tr> </tbody> </table> | | | | | | | Notch Filter Adjustment Selection 2 | | Reference | 0 | Auto-tuning without auxiliary functions. | — | 1 | Auto-tuning with auxiliary functions. | |
| Notch Filter Adjustment Selection 2 | | Reference | | | | | | | | | | | | | |
| 0 | Auto-tuning without auxiliary functions. | — | | | | | | | | | | | | | |
| 1 | Auto-tuning with auxiliary functions. | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | |
| Pn476 | Gravity Compensation | -1000-1000 | 0.1% | 0 | After restart | Setup | 6.3 | | | | | | | | |
| Pn481 (2481h) | Polarity Detection Speed Loop Gain | 10-20000 | 0.1Hz | 400 | After restart | Setup | — | | | | | | | | |
| Pn482 | Polarity Detection Speed Loop | 15-51200 | 0.01ms | 3000 | After restart | Setup | — | | | | | | | | |
| Pn486 | Polarity Detection Command | 0-100 | ms | 25 | After restart | Setup | — | | | | | | | | |
| Pn487 | Polarity Detection Constant Speed Time | 0-300 | ms | 0 | After restart | Setup | — | | | | | | | | |
| Pn488 | Polarity Detection Command Waiting | 50-500 | ms | 100 | After restart | Setup | — | | | | | | | | |
| Pn490 | Polarity Detection Load Level | 0-20000 | % | 100 | After restart | Setup | — | | | | | | | | |
| Pn493 | Polarity Detection Command Speed | 0-1000 | min-1 | 50 | After restart | Setup | — | | | | | | | | |
| Pn494 | Polarity Detection Range | 1-65535 | 0.001rev | 250 | After restart | Setup | — | | | | | | | | |
| Pn495 | Polarity Detection Confirmation Force Command | 0-200 | % | 100 | After restart | Setup | — | | | | | | | | |
| Pn498 | Polarity Detection Allowable Error | 0-30 | deg | 10 | After restart | Setup | — | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|--|--|--------------------|---------|---------------|----------------|-----------|---|--|-----------|---|--|-------|---|--|---|--|---|--|---|--|---|--|---|---|---|--|---|--|---|--|---|--|---|--|
| Pn501 | Zero Clamping Level | 0 ~ 10000 | 1min ⁻¹ | 10 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn502 (2502h) | Rotation Detection Level | 1 ~ 10000 | 1min ⁻¹ | 20 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn503 (2503h) | Speed Coincidence Detection Signal Output Width | 0 ~ 100 | 1min ⁻¹ | 10 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn506 (2506h) | Brake Command-Servo OFF Delay Time | 0 ~ 50 | 10ms | 0 | Immediately | Setup | 5.4.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn507 (2507h) | Brake Command Output Speed Level | 0 ~ 10000 | 1min ⁻¹ | 10 | Immediately | Setup | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn508 (2508h) | Servo OFF-Brake Command Waiting Time | 10 ~ 100 | 10ms | 50 | Immediately | Setup | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn509 (2509h) | Momentary Power Interruption Hold Time | 20 ~ 50000 | — | 20 | Immediately | Setup | 5.4.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn50A | Input Signal Selections 1 | 0000 ~ FFF1H | — | 1881H | After restart | Setup | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1" style="width: 100%;"> <thead> <tr> <th colspan="2">Input Signal Allocation Mode</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Use the sequence input signal terminals with the default allocations</td> <td rowspan="2">5.5.1</td> </tr> <tr> <td>1</td> <td>Change the sequence input signal allocations.</td> </tr> </tbody> </table> | | | | | | | Input Signal Allocation Mode | | Reference | 0 | Use the sequence input signal terminals with the default allocations | 5.5.1 | 1 | Change the sequence input signal allocations. | | | | | | | | | | | | | | | | | | | | |
| | Input Signal Allocation Mode | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | Use the sequence input signal terminals with the default allocations | 5.5.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | Change the sequence input signal allocations. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1" style="width: 100%;"> <thead> <tr> <th colspan="2">P-OT (Forward Drive Prohibit) Signal Allocation</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Active when SI0(CN1-40) input signal is ON(at low level)</td> <td rowspan="14">5.4.3</td> </tr> <tr> <td>1</td> <td>Active when SI1(CN1-41) input signal is ON(at low level)</td> </tr> <tr> <td>2</td> <td>Active when SI2(CN1-42) input signal is ON(at low level)</td> </tr> <tr> <td>3</td> <td>Active when SI3(CN1-43) input signal is ON(at low level)</td> </tr> <tr> <td>4</td> <td>Active when SI4(CN1-44) input signal is ON(at low level)</td> </tr> <tr> <td>7</td> <td>Set the signal to always prohibit forward drive.</td> </tr> <tr> <td>8</td> <td>Set the signal to always enable forward drive</td> </tr> <tr> <td>9</td> <td>Active when SI0(CN1-40) input signal is OFF(at high level)</td> </tr> <tr> <td>A</td> <td>Active when SI1(CN1-41) input signal is OFF(at high level)</td> </tr> <tr> <td>B</td> <td>Active when SI2(CN1-42) input signal is OFF(at high level)</td> </tr> <tr> <td>C</td> <td>Active when SI3(CN1-43) input signal is OFF(at high level)</td> </tr> <tr> <td>D</td> <td>Active when SI4(CN1-44) input signal is OFF(at high level)</td> </tr> </tbody> </table> | | | | | | | P-OT (Forward Drive Prohibit) Signal Allocation | | Reference | 0 | Active when SI0(CN1-40) input signal is ON(at low level) | 5.4.3 | 1 | Active when SI1(CN1-41) input signal is ON(at low level) | 2 | Active when SI2(CN1-42) input signal is ON(at low level) | 3 | Active when SI3(CN1-43) input signal is ON(at low level) | 4 | Active when SI4(CN1-44) input signal is ON(at low level) | 7 | Set the signal to always prohibit forward drive. | 8 | Set the signal to always enable forward drive | 9 | Active when SI0(CN1-40) input signal is OFF(at high level) | A | Active when SI1(CN1-41) input signal is OFF(at high level) | B | Active when SI2(CN1-42) input signal is OFF(at high level) | C | Active when SI3(CN1-43) input signal is OFF(at high level) | D | Active when SI4(CN1-44) input signal is OFF(at high level) |
| | P-OT (Forward Drive Prohibit) Signal Allocation | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Active when SI0(CN1-40) input signal is ON(at low level) | 5.4.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Active when SI1(CN1-41) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Active when SI2(CN1-42) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Active when SI3(CN1-43) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Active when SI4(CN1-44) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Set the signal to always prohibit forward drive. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Set the signal to always enable forward drive | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Active when SI0(CN1-40) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | Active when SI1(CN1-41) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | Active when SI2(CN1-42) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | Active when SI3(CN1-43) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | Active when SI4(CN1-44) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|--|--|--|-----------|---------------|----------------|-----------|---|--|-----------|---|--|-------|---|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|--|
| Pn50B (250Bh) | Input Signal Selections 2 | 0000 ~ FFFFH | — | 8882H | After restart | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <table border="1"> <thead> <tr> <th colspan="2">N-OT (Reverse Drive Prohibit) Signal Allocation</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Active when SI0(CN1-40) input signal is ON(at low level)</td> <td rowspan="13">5.4.3</td> </tr> <tr> <td>1</td> <td>Active when SI1(CN1-41) input signal is ON(at low level)</td> </tr> <tr> <td>2</td> <td>Active when SI2(CN1-42) input signal is ON(at low level)</td> </tr> <tr> <td>3</td> <td>Active when SI3(CN1-43) input signal is ON(at low level)</td> </tr> <tr> <td>4</td> <td>Active when SI4(CN1-44) input signal is ON(at low level)</td> </tr> <tr> <td>7</td> <td>Set the signal to always prohibit reverse drive.</td> </tr> <tr> <td>8</td> <td>Set the signal to always enable reverse drive.</td> </tr> <tr> <td>9</td> <td>Active when SI0(CN1-40) input signal is OFF(at high level)</td> </tr> <tr> <td>A</td> <td>Active when SI1(CN1-41) input signal is OFF(at high level)</td> </tr> <tr> <td>B</td> <td>Active when SI2(CN1-42) input signal is OFF(at high level)</td> </tr> <tr> <td>C</td> <td>Active when SI3(CN1-43) input signal is OFF(at high level)</td> </tr> <tr> <td>D</td> <td>Active when SI4(CN1-44) input signal is OFF(at high level)</td> </tr> </tbody> </table> | | | | | | N-OT (Reverse Drive Prohibit) Signal Allocation | | Reference | 0 | Active when SI0(CN1-40) input signal is ON(at low level) | 5.4.3 | 1 | Active when SI1(CN1-41) input signal is ON(at low level) | 2 | Active when SI2(CN1-42) input signal is ON(at low level) | 3 | Active when SI3(CN1-43) input signal is ON(at low level) | 4 | Active when SI4(CN1-44) input signal is ON(at low level) | 7 | Set the signal to always prohibit reverse drive. | 8 | Set the signal to always enable reverse drive. | 9 | Active when SI0(CN1-40) input signal is OFF(at high level) | A | Active when SI1(CN1-41) input signal is OFF(at high level) | B | Active when SI2(CN1-42) input signal is OFF(at high level) | C | Active when SI3(CN1-43) input signal is OFF(at high level) | D | Active when SI4(CN1-44) input signal is OFF(at high level) | |
| | | N-OT (Reverse Drive Prohibit) Signal Allocation | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 | Active when SI0(CN1-40) input signal is ON(at low level) | 5.4.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1 | Active when SI1(CN1-41) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 2 | Active when SI2(CN1-42) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 3 | Active when SI3(CN1-43) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 4 | Active when SI4(CN1-44) input signal is ON(at low level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 7 | Set the signal to always prohibit reverse drive. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 8 | Set the signal to always enable reverse drive. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 9 | Active when SI0(CN1-40) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | A | Active when SI1(CN1-41) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | B | Active when SI2(CN1-42) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | C | Active when SI3(CN1-43) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | D | Active when SI4(CN1-44) input signal is OFF(at high level) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn50C | Input Signal Selections 3 | 0000 ~ FFFFH | — | 8888H | After restart | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|---------|--|--|--|---------|---------------|----------------|-----------|-----------|
| Pn50D | Input Signal Selections 4 | 0000 ~ FFFFH | — | 8888H | After restart | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Reserved parameter (Do not change.) | | | | | | |
| | | /HomeSwitch Signal Allocation | | | | | | Reference |
| | | 0 | Active when SI0(CN1-40) input signal is ON(at low level) | | | | — | |
| | | 8 | Set the signal to be "Inactive" | | | | | |
| | | 9 | Active when SI0(CN1-40) input signal is OFF(at high level) | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | | |
| | Pn50E (250Eh) | Output Signal Selections 1 | 0000 ~ 4444H | — | 0000H | After restart | Setup | — |
| | | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | /COIN (Positioning Completion Output) Signal Allocation | | | | | |
| | | 0 | Disabled (the above signal output is not used). | | | | — | |
| | | 1 | Output the signal from the CN1-25, 26 output terminal | | | | | |
| | | 2 | Output the signal from the CN1-27, 28 output terminal | | | | | |
| | | 3 | Output the signal from the CN1-29, 30 output terminal | | | | | |
| | | 4 | Output the signal from the CN1-37, 38 output terminal | | | | | |
| | | /V-CMP (Speed Coincidence Detection Output) Signal Allocation | | | | | | Reference |
| | | 0 ~ 4 | Same as the /COIN (Positioning Completion) signal allocations. | | | | — | |
| | | /TGON (Rotation Detection Output) Signal Allocation | | | | | | Reference |
| | 0 ~ 4 | Same as the /COIN (Positioning Completion) signal allocations | | | | — | | |
| | /S-RDY (Servo Ready) Signal Allocation | | | | | | Reference | |
| | 0 ~ 4 | Same as the /COIN (Positioning Completion) signal allocations. | | | | — | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|-------------------------------------|--|--|---|---------|---------------|----------------|-----------|-----------|
| Pn50F (250Fh) | Output Signal Selections 2 | 0000 ~ 4444H | — | 0010H | After restart | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | /CLT (Torque Limit Detection Output) Signal Allocation | | | | | | Reference |
| | | 0 | Disabled (the above signal output is not used). | | | | | — |
| | | 1 | Output the signal from the CN1-25, 26 output terminal | | | | | |
| | | 2 | Output the signal from the CN1-27, 28 output terminal | | | | | |
| | 3 | Output the signal from the CN1-29, 30 output terminal | | | | | | |
| | 4 | Output the signal from the CN1-37, 38 output terminal | | | | | | |
| | /VLT (Speed Limit Detection) Signal Allocation | | | | | | Reference | |
| | 0 ~ 4 | Same as the /CLT (Torque Limit Detection Output) signal allocations. | | | | | — | |
| | /BK (Brake Output) Signal Allocation | | | | | | Reference | |
| | 0 ~ 4 | Same as the /CLT (Torque Limit Detection Output) signal allocations. | | | | | — | |
| | /WARN (Warning Output) Signal Allocation | | | | | | Reference | |
| | 0 ~ 4 | Same as the /CLT (Torque Limit Detection Output) signal allocations | | | | | — | |
| | Pn510 (2510h) | Output Signal Selections 3 | 0000 ~ 0444H | — | 0000H | After restart | Setup | — |
| | | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | /NEAR (Near Output) Signal Allocation | | | | | |
| 0 | | | Disabled (the above signal output is not used). | | | | | — |
| 1 | | | Output the signal from the CN1-25, 26 output terminal | | | | | |
| 2 | | | Output the signal from the CN1-27, 28 output terminal | | | | | |
| 3 | | | Output the signal from the CN1-29, 30 output terminal | | | | | |
| 4 | | Output the signal from the CN1-37, 38 output terminal | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|--|--|--|---------|---------------|----------------|-----------|-----------|
| Pn511 (2511h) | Input Signal Selection 5 | 0000 ~ FFFFH | — | 6543H | After restart | Setup | — | |
| | n. □ □ □ □ | | | | | | | |
| | | Origin Return Deceleration LS Signal Allocation (/DEC) | | | | | | Reference |
| | | 0 | Active when SI0(CN1-40) input signal is ON(at low level) | | | | | — |
| | | 1 | Active when SI1(CN1-41) input signal is ON(at low level) | | | | | |
| | | 2 | Active when SI2(CN1-42) input signal is ON(at low level) | | | | | |
| | | 3 | Active when SI3(CN1-43) input signal is ON(at low level) | | | | | |
| | | 4 | Active when SI4(CN1-44) input signal is ON(at low level) | | | | | |
| | | 7 | The signal is always enabled. | | | | | |
| | | 8 | The signal is always inactive. | | | | | |
| | | 9 | Active when SI0(CN1-40) input signal is OFF(at high level) | | | | | |
| | | A | Active when SI1(CN1-41) input signal is OFF(at high level) | | | | | |
| | | B | Active when SI2(CN1-42) input signal is OFF(at high level) | | | | | |
| | | C | Active when SI3(CN1-43) input signal is OFF(at high level) | | | | | |
| | | D | Active when SI4(CN1-44) input signal is OFF(at high level) | | | | | |
| | External Probe 1 Signal Allocation (/EXT1) | | | | | | Reference | |
| | 1 | Active when SI4(CN1-41) input signal is “Edge trigger” | | | | | — | |
| | 4 | Active when SI4(CN1-41) input signal is “Rising-edge trigger” | | | | | | |
| | A | Active when SI4(CN1-41) input signal is “Edge trigger” inversion | | | | | | |
| | D | Active when SI4(CN1-41) input signal is “Falling-edge trigger” | | | | | | |
| | External Probe 2 Signal Allocation (/EXT2) | | | | | | Reference | |
| | 2 | Active when SI5(CN1-44) input signal is “Edge trigger” | | | | | — | |
| | 5 | Active when SI5(CN1-44) input signal is “Rising-edge trigger” | | | | | | |
| | B | Active when SI5(CN1-44) input signal is “Edge trigger” inversion | | | | | | |
| | E | Active when SI5(CN1-44) input signal is “Falling-edge trigger” | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|------------------|--|--|---|---------|---------------|----------------|-----------|-----------|
| Pn512 (2512h) | Output Signal Inverse Settings | 0000 ~ 1111H | — | 0000H | After restart | Setup | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | | |
| | | Output Signal Inversion for CN1-25, 26 terminal | | | | | | Reference |
| | | 0 | The signal is not inverted | | | | — | |
| | | 1 | The signal is inverted | | | | | |
| | | Output Signal Inversion for CN1-27, 28 terminal | | | | | | Reference |
| | | 0 | The signal is not inverted | | | | — | |
| | | 1 | The signal is inverted | | | | | |
| | | Output Signal Inversion for CN1-29,30 terminal | | | | | | Reference |
| | | 0 | The signal is not inverted | | | | — | |
| | | 1 | The signal is inverted | | | | | |
| | | Output Signal Inversion for CN1-37, 38 terminal | | | | | | Reference |
| | | 0 | The signal is not inverted | | | | — | |
| | | 1 | The signal is inverted | | | | | |
| | Pn513 | Output Signal Selection 4 | 0000 ~ 0333H | — | 0000H | After restart | Setup | 6.2 |
| | | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | |
| | | 1st Position Output Comparison | | | | | | Reference |
| | | 0 | Inactive (Do not use the signal output above) | | | | 6.2 | |
| | | 1 | Output the signals above from CN1-25, 26 terminal | | | | | |
| | | 2 | Output the signals above from CN1-27, 28 terminal | | | | | |
| | | 3 | Output the signals above from CN1-29, 30 terminal | | | | | |
| | | 4 | Output the signals above from CN1-37, 38 terminal | | | | | |
| | | 2nd Position Output Comparison | | | | | | Reference |
| | | 0 | Inactive (Do not use the signal output above) | | | | 6.2 | |
| | | 1 | Output the signals above from CN1-25, 26 terminal | | | | | |
| | | 2 | Output the signals above from CN1-27, 28 terminal | | | | | |
| | | 3 | Output the signals above from CN1-29, 30 terminal | | | | | |
| | | 4 | Output the signals above from CN1-37, 38 terminal | | | | | |
| | | 3rd Position Output Comparison | | | | | | Reference |
| | | 0 | Inactive (Do not use the signal output above) | | | | 6.2 | |
| | | 1 | Output the signals above from CN1-25, 26 terminal | | | | | |
| | | 2 | Output the signals above from CN1-27, 28 terminal | | | | | |
| | | 3 | Output the signals above from CN1-29, 30 terminal | | | | | |
| | | 4 | Output the signals above from CN1-37, 38 terminal | | | | | |
| | 4th Position Output Comparison | | | | | | Reference | |
| | 0 | Inactive (Do not use the signal output above) | | | | 6.2 | | |
| | 1 | Output the signals above from CN1-25, 26 terminal | | | | | | |
| | 2 | Output the signals above from CN1-27, 28 terminal | | | | | | |
| | 3 | Output the signals above from CN1-29, 30 terminal | | | | | | |
| | 4 | Output the signals above from CN1-37, 38 terminal | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------|---|---|----------------|------------|---------------|----------------|-----------|-------------------------|--|-----------|---|---|-----|---|---|---|---|---|---|---|---|-------------------------|--|-----------|---|---|-----|---|---|---|---|---|---|---|---|-------------------------|--|-----------|---|---|-----|---|---|---|---|---|---|---|---|-------------------------|--|-----------|---|---|-----|---|---|---|---|---|---|---|---|
| Pn517 | ECAT Force Output Function | 0000 ~ 4444H | — | 0000H | After restart | Setup | 6.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <p>n. □ □ □ □</p> <table border="1"> <thead> <tr> <th colspan="2">Force Output Function 0</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Inactive (Do not use the signal output above)</td> <td rowspan="5">6.4</td> </tr> <tr> <td>1</td> <td>Output the signals above from CN1-25, 26 terminal</td> </tr> <tr> <td>2</td> <td>Output the signals above from CN1-27, 28 terminal</td> </tr> <tr> <td>3</td> <td>Output the signals above from CN1-29, 30 terminal</td> </tr> <tr> <td>4</td> <td>Output the signals above from CN1-37, 38 terminal</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Force Output Function 1</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Inactive (Do not use the signal output above)</td> <td rowspan="5">6.4</td> </tr> <tr> <td>1</td> <td>Output the signals above from CN1-25, 26 terminal</td> </tr> <tr> <td>2</td> <td>Output the signals above from CN1-27, 28 terminal</td> </tr> <tr> <td>3</td> <td>Output the signals above from CN1-29, 30 terminal</td> </tr> <tr> <td>4</td> <td>Output the signals above from CN1-37, 38 terminal</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Force Output Function 2</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Inactive (Do not use the signal output above)</td> <td rowspan="5">6.4</td> </tr> <tr> <td>1</td> <td>Output the signals above from CN1-25, 26 terminal</td> </tr> <tr> <td>2</td> <td>Output the signals above from CN1-27, 28 terminal</td> </tr> <tr> <td>3</td> <td>Output the signals above from CN1-29, 30 terminal</td> </tr> <tr> <td>4</td> <td>Output the signals above from CN1-37, 38 terminal</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Force Output Function 3</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Inactive (Do not use the signal output above)</td> <td rowspan="5">6.4</td> </tr> <tr> <td>1</td> <td>Output the signals above from CN1-25, 26 terminal</td> </tr> <tr> <td>2</td> <td>Output the signals above from CN1-27, 28 terminal</td> </tr> <tr> <td>3</td> <td>Output the signals above from CN1-29, 30 terminal</td> </tr> <tr> <td>4</td> <td>Output the signals above from CN1-37, 38 terminal</td> </tr> </tbody> </table> | | | | | | | Force Output Function 0 | | Reference | 0 | Inactive (Do not use the signal output above) | 6.4 | 1 | Output the signals above from CN1-25, 26 terminal | 2 | Output the signals above from CN1-27, 28 terminal | 3 | Output the signals above from CN1-29, 30 terminal | 4 | Output the signals above from CN1-37, 38 terminal | Force Output Function 1 | | Reference | 0 | Inactive (Do not use the signal output above) | 6.4 | 1 | Output the signals above from CN1-25, 26 terminal | 2 | Output the signals above from CN1-27, 28 terminal | 3 | Output the signals above from CN1-29, 30 terminal | 4 | Output the signals above from CN1-37, 38 terminal | Force Output Function 2 | | Reference | 0 | Inactive (Do not use the signal output above) | 6.4 | 1 | Output the signals above from CN1-25, 26 terminal | 2 | Output the signals above from CN1-27, 28 terminal | 3 | Output the signals above from CN1-29, 30 terminal | 4 | Output the signals above from CN1-37, 38 terminal | Force Output Function 3 | | Reference | 0 | Inactive (Do not use the signal output above) | 6.4 | 1 | Output the signals above from CN1-25, 26 terminal | 2 | Output the signals above from CN1-27, 28 terminal | 3 | Output the signals above from CN1-29, 30 terminal | 4 | Output the signals above from CN1-37, 38 terminal |
| | Force Output Function 0 | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | Inactive (Do not use the signal output above) | 6.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | Output the signals above from CN1-25, 26 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | Output the signals above from CN1-27, 28 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | Output the signals above from CN1-29, 30 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | Output the signals above from CN1-37, 38 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Force Output Function 1 | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | Inactive (Do not use the signal output above) | 6.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | Output the signals above from CN1-25, 26 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | Output the signals above from CN1-27, 28 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | Output the signals above from CN1-29, 30 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | Output the signals above from CN1-37, 38 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Force Output Function 2 | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | Inactive (Do not use the signal output above) | 6.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | Output the signals above from CN1-25, 26 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | Output the signals above from CN1-27, 28 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | Output the signals above from CN1-29, 30 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | Output the signals above from CN1-37, 38 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Force Output Function 3 | | Reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Inactive (Do not use the signal output above) | 6.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Output the signals above from CN1-25, 26 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Output the signals above from CN1-27, 28 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Output the signals above from CN1-29, 30 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Output the signals above from CN1-37, 38 terminal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn518 (2518h) | Reserved (Do not change) | 0000 ~ 0003 | — | 0000 | — | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn51B (251Bh) | Motor-Load Position Deviation Overflow Detection Level | 0 ~ 1073741824 | 1 command unit | 1000 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn51E (251Eh) | Position Deviation Overflow Warning Level | 10 ~ 100 | 1% | 100 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn520 (2520h) | Position Deviation Overflow Alarm Level | 1 ~ 1073741823 | 1 command unit | 52428800 | Immediately | Setup | 7.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn522 (2522h) | Positioning Completed Width | 1 ~ 1073741824 | 1 command unit | 50 | Immediately | Setup | 5.11.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn524 (2524h) | Near Signal Width | 1 ~ 1073741824 | 1 command unit | 1073741824 | Immediately | Setup | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn526 (2526h) | Position Deviation Overflow Alarm Level at Servo ON | 1 ~ 1073741823 | 1 command unit | 52428800 | Immediately | Setup | 7.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn528 (2528h) | Position Deviation Overflow Warning Level at Servo ON | 10 ~ 100 | 1% | 100 | Immediately | Setup | 7.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | |
|-------------------------------------|---|--|--------------------|---------|---------------|----------------|-----------|-----------------------------------|--|---|---|---|---|---|--|---|--|---|---|---|---|
| Pn529 (2529h) | Speed Limit Level at Servo ON | 0 ~ 10000 | 1min ⁻¹ | 10000 | Immediately | Setup | 7.1 | | | | | | | | | | | | | | |
| Pn52A (252Ah) | Multiplier per Fullyclosed Rotation | 0 ~ 100 | 1% | 20 | Immediately | Tuning | 10.2 | | | | | | | | | | | | | | |
| Pn52B (252Bh) | Overload Warning Level | 1 ~ 100 | 1% | 20 | Immediately | Setup | 5.4.7 | | | | | | | | | | | | | | |
| Pn52C (252Ch) | Base Current Derating at Motor Overload Detection | — | 1% | 100 | After restart | Setup | 5.4.7 | | | | | | | | | | | | | | |
| Pn52D | Default single-phase power supply | 10-100 | 1% | 50 | After restart | Setup | — | | | | | | | | | | | | | | |
| Pn52F | Monitor Display at Startup | 0000 ~ 0FFF | — | 0FFF | Immediately | Setup | — | | | | | | | | | | | | | | |
| Pn530 (2530h) | Program Jogging Relate Selections | 0000 ~ 0005H | - | 0000H | Immediately | Setup | 8.5 | | | | | | | | | | | | | | |
| | <p>The diagram shows four bits of a binary value, labeled 'n. □ □ □ □'. Arrows from these bits point to the 'Program Jogging Operation Pattern' table and three 'Reserved parameter (Do not change.)' rows below it.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2">Program Jogging Operation Pattern</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>(Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536</td> </tr> <tr> <td>1</td> <td>(Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536</td> </tr> <tr> <td>2</td> <td>(Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536</td> </tr> <tr> <td>3</td> <td>(Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536</td> </tr> <tr> <td>4</td> <td>(Waiting time Pn535 → Forward by travel distance Pn531 → Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536</td> </tr> <tr> <td>5</td> <td>(Waiting time Pn535 → Reverse by travel distance Pn531 → Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536</td> </tr> </tbody> </table> | | | | | | | Program Jogging Operation Pattern | | 0 | (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 | 1 | (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 | 2 | (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 | 3 | (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 | 4 | (Waiting time Pn535 → Forward by travel distance Pn531 → Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 | 5 | (Waiting time Pn535 → Reverse by travel distance Pn531 → Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 |
| | Program Jogging Operation Pattern | | | | | | | | | | | | | | | | | | | | |
| | 0 | (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 | | | | | | | | | | | | | | | | | | | |
| | 1 | (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 | | | | | | | | | | | | | | | | | | | |
| | 2 | (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 | | | | | | | | | | | | | | | | | | | |
| | 3 | (Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 | | | | | | | | | | | | | | | | | | | |
| 4 | (Waiting time Pn535 → Forward by travel distance Pn531 → Waiting time Pn535 → Reverse by travel distance Pn531) × Number of movements Pn536 | | | | | | | | | | | | | | | | | | | | |
| 5 | (Waiting time Pn535 → Reverse by travel distance Pn531 → Waiting time Pn535 → Forward by travel distance Pn531) × Number of movements Pn536 | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | | | | | |
| Pn531 (2531h) | Program Jogging Travel Distance | 1 ~ 1073741824 | 1 command unit | 32768 | Immediately | Setup | 8.5 | | | | | | | | | | | | | | |
| Pn533 (2533h) | Program Jogging Movement Speed | 1 ~ 10000 | 1min ⁻¹ | 500 | Immediately | Setup | | | | | | | | | | | | | | | |
| Pn534 (2534h) | Program Jogging Acceleration/Deceleration | 2 ~ 10000 | 1ms | 100 | Immediately | Setup | | | | | | | | | | | | | | | |
| Pn535 (2535h) | Program Jogging Waiting Time | 0 ~ 10000 | 1ms | 100 | Immediately | Setup | | | | | | | | | | | | | | | |
| Pn536 (2536h) | Program Jogging Number of Movements | 0 ~ 1000 | 1 time | 1 | Immediately | Setup | | | | | | | | | | | | | | | |
| Pn550 (2550h) | Analog Monitor 1 Offset Voltage | -10000 ~ 10000 | 0.1V | 0 | Immediately | Setup | | 7.1 | | | | | | | | | | | | | |
| Pn551 (2551h) | Analog Monitor 2 Offset Voltage | -10000 ~ 10000 | 0.1V | 0 | Immediately | Setup | | | | | | | | | | | | | | | |
| Pn552 (2552h) | Analog Monitor 1 Magnification | -10000 ~ 10000 | 0.01倍 | 100 | Immediately | Setup | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|------------------|-------------------------------------|-------------------------------|-------|---------|--------------|----------------|-----------|
| Pn553 (2553h) | Analog Monitor 2 Magnification | -10000 ~ 10000 | 0.01倍 | 100 | Immediately | Setup | 7.1 |
| Pn560 (2560h) | Residual Vibration Detection Width | 1 ~ 3000 | 0.1% | 400 | Immediately | Setup | 7.8 |
| Pn561 (2561h) | Overshoot Detection Level | 0 ~ 100 | 1% | 100 | Immediately | Setup | 7.3 |
| Pn587 (2587h) | Reserved (Do not change) | 0000 ~ 0001H | - | 0000H | Immediately | Setup | — |
| | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | |
| Pn600 (2600h) | Regenerative Resistor Capacity*1 | Depends on model 0-65536*2 | 10W | 0 | Immediately | Setup | 5.4.8 |
| Pn601 (2601h) | Reserved (Do not change) | 0-65535 | — | 0 | — | — | — |

Note: *1. Generally set to "0". When installing an external regenerative resistor, set the capacity (W) of the regenerative resistor.

*2. The upper limit value is the maximum output capacity (W) of the applicable servo drive.

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|-------------------------------------|---|--|------|---------|---------------|----------------|-----------|---|
| Pn602 | Encoder Selection | 0000 ~ 1115H | — | 0000H | After restart | — | — | |
| | | | | | | | | |
| | Encoder Selection 1 | | | | | | Reference | |
| | 0 | — | | | | | | — |
| | 1 | Use the 2nd encoder interface as the 1st encoder interface | | | | | | — |
| | Reserved parameter (Do not change.) | | | | | | | |
| | Motor Parameter Source Selection | | | | | | Reference | |
| | 0 | Use electronic label function | | | | | | — |
| | 1 | Use other servo motors. | | | | | | — |
| | CLR Signal Input Selection | | | | | | Reference | |
| 0 | Use CN1-14, CN1-15 as CLR input (FPGA program selection for version AA02 or more) | | | | | | — | |
| 1 | Use CN1-46, CN1-47 as CLR input | | | | | | — | |
| Pn603 (2603h) | Reserved (Do not change) | 0003-02EFH | — | 0223H | After restart | — | — | |
| | | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | |
| | Reserved parameter (Do not change.) | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | |
| Pn604 (2604h) | Serial Baud Rate | 192 ~ 65535 | — | 192 | After restart | Setup | — | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | | |
|---|---|---------------|-----------|---------|---------------|-------------------------|-----------------------|-----------|--|------|------|---|----|------|----|-----|----|-----|----|----|----|--------|----|--|
| Pn605 (2605h) | Encoder Shift Function | 0000 ~ 03FFH | — | 0000H | After restart | Setup | — | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">1st Encoder Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>HCFA</td> <td rowspan="6">—</td> </tr> <tr> <td>1</td> <td>BISS</td> </tr> <tr> <td>2</td> <td>YAS</td> </tr> <tr> <td>3</td> <td>ABZ</td> </tr> <tr> <td>4</td> <td>AB</td> </tr> <tr> <td>5</td> <td>SinCOS</td> </tr> </tbody> </table> | | | | | | 1st Encoder Selection | | Reference | 0 | HCFA | — | 1 | BISS | 2 | YAS | 3 | ABZ | 4 | AB | 5 | SinCOS | | |
| | 1st Encoder Selection | | Reference | | | | | | | | | | | | | | | | | | | | | |
| 0 | HCFA | — | | | | | | | | | | | | | | | | | | | | | | |
| 1 | BISS | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | YAS | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | ABZ | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | AB | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | SinCOS | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th colspan="2">Encoder Speed Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>2.5M</td> <td rowspan="7">—</td> </tr> <tr> <td>1</td> <td>1M</td> </tr> <tr> <td>2</td> <td>2M</td> </tr> <tr> <td>3</td> <td>3M</td> </tr> <tr> <td>4</td> <td>4M</td> </tr> <tr> <td>5</td> <td>5M</td> </tr> <tr> <td>6</td> <td>8M</td> </tr> </tbody> </table> | | | | | | Encoder Speed Selection | | Reference | 0 | 2.5M | — | 1 | 1M | 2 | 2M | 3 | 3M | 4 | 4M | 5 | 5M | 6 | 8M | |
| Encoder Speed Selection | | Reference | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 2.5M | — | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1M | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 2M | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 3M | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 4M | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 5M | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 8M | | | | | | | | | | | | | | | | | | | | | | | |
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| Encoder Resolution | | Reference | | | | | | | | | | | | | | | | | | | | | | |
| Represented by 2n bits, such as 23 bit-encoder, just enter 23 directly | | — | | | | | | | | | | | | | | | | | | | | | | |
| Pn606 (2606h) | Encoder Shift Function 2 | 0000 ~ C8C8H | — | 0000H | After restart | Setup | — | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | | |
|---|--|---------------|-----------|---------|---------------|-------------------------|-----------------------|-----------|--|------|------|------|----|------|----|-----|----|-----|----|----|----|--------|----|--|
| Pn607 (2607h) | 2 nd Encoder Selection | 0000 ~ 0005H | — | 0000H | After restart | Setup | — | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">2nd Encoder Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>HCFA</td> <td rowspan="6">10.2</td> </tr> <tr> <td>1</td> <td>BISS</td> </tr> <tr> <td>2</td> <td>YAS</td> </tr> <tr> <td>3</td> <td>ABZ</td> </tr> <tr> <td>4</td> <td>AB</td> </tr> <tr> <td>5</td> <td>SinCOS</td> </tr> </tbody> </table> | | | | | | 2nd Encoder Selection | | Reference | 0 | HCFA | 10.2 | 1 | BISS | 2 | YAS | 3 | ABZ | 4 | AB | 5 | SinCOS | | |
| | 2nd Encoder Selection | | Reference | | | | | | | | | | | | | | | | | | | | | |
| 0 | HCFA | 10.2 | | | | | | | | | | | | | | | | | | | | | | |
| 1 | BISS | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | YAS | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | ABZ | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | AB | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | SinCOS | | | | | | | | | | | | | | | | | | | | | | | |
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| Encoder Speed Selection | | Reference | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 2.5M | — | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1M | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 2M | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 3M | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 4M | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 5M | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 8M | | | | | | | | | | | | | | | | | | | | | | | |
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| Encoder Resolution | | Reference | | | | | | | | | | | | | | | | | | | | | | |
| Represented by 2n bits, such as 23 bit-encoder, just enter 23 directly | | — | | | | | | | | | | | | | | | | | | | | | | |
| Pn608 (2608h) | 2 nd Encoder Resolution | 0000 ~ FFFFH | — | 0000H | After restart | Setup | — | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| Pn609 | Reserved (Do not change) | 0000 ~ FFFFH | — | 0000H | — | — | — | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | |
|------------------------------|--|--------------------------|-----------|---------|---------------|----------------|-----------|-------------------------------------|--|-----------|---|------------|-----|---|--------------------|---|--------------------|---|--------------------|
| Pn60A | Frequency Division Output Pulse Setting | 0000-01FF | — | 0 | — | — | — | | | | | | | | | | | | |
| | <p>Z-pulse width setting</p> | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">AB reverse direction setting</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>A before B</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>B before A</td> </tr> </tbody> </table> | | | | | | | AB reverse direction setting | | Reference | 0 | A before B | — | 1 | B before A | | | | |
| AB reverse direction setting | | Reference | | | | | | | | | | | | | | | | | |
| 0 | A before B | — | | | | | | | | | | | | | | | | | |
| 1 | B before A | | | | | | | | | | | | | | | | | | |
| Pn60B | Reserved(Do not change) | 0-65535 | — | 0 | After restart | | | | | | | | | | | | | | |
| Pn60C | Line Count of Sin/Cos Encoder | 0-65535 | Pluse | 0 | After restart | | | | | | | | | | | | | | |
| Pn60D | Delay Disabled Count | 0~50 | 2ms | 0 | After restart | | | | | | | | | | | | | | |
| Pn60E | Torque Overload Threshold Setting | 0-65535 | % | 0 | After restart | | | | | | | | | | | | | | |
| Pn60F | User Torque Overload Time | 0-65535 | 10ms | 0 | After restart | | | | | | | | | | | | | | |
| Pn610 | Position Comparison Output | 0-3 | — | 0 | After restart | — | — | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">Position Comparison Output Function</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>OFF</td> <td rowspan="4">6.2</td> </tr> <tr> <td>1</td> <td>Forward comparison</td> </tr> <tr> <td>2</td> <td>Reverse comparison</td> </tr> <tr> <td>3</td> <td>Two-way comparison</td> </tr> </tbody> </table> | | | | | | | Position Comparison Output Function | | Reference | 0 | OFF | 6.2 | 1 | Forward comparison | 2 | Reverse comparison | 3 | Two-way comparison |
| | Position Comparison Output Function | | Reference | | | | | | | | | | | | | | | | |
| 0 | OFF | 6.2 | | | | | | | | | | | | | | | | | |
| 1 | Forward comparison | | | | | | | | | | | | | | | | | | |
| 2 | Reverse comparison | | | | | | | | | | | | | | | | | | |
| 3 | Two-way comparison | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| Pn611 | 1 st Setting Position | -1073741824 ~ 1073741823 | pluse | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn613 | 2 nd Setting Position | -1073741824 ~ 1073741823 | pluse | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn615 | 3 rd Setting Position | -1073741824 ~ 1073741823 | pluse | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn617 | 4 th Setting Position | -1073741824 ~ 1073741823 | pluse | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn619 | Active Time of the 1st Setting Position Output Signal | 0-65535 | ms | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn61A | Active Time of the 2nd Setting Position Output Signal | 0-65535 | ms | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn61B | Active Time of the 3rd Setting Position Output Signal | 0-65535 | ms | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |
| Pn61C | Active Time of the 4th Setting Position Output Signal | 0-65535 | ms | 0 | Immediately | — | 6.2 | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | | | | | | | |
|------------------|---|--------------------------|--------------|---------|---------------|----------------|-----------|----------------------------|--|-----------|---|----------|---|---|---------|---|--|-----------|---|--------------|---|---|--------------|
| Pn61F | Selections | 0000 ~ FFFF | — | 0000 | After restart | Setup | — | | | | | | | | | | | | | | | | |
| | <p>n. □ □ □ □</p> <table border="1"> <thead> <tr> <th colspan="2">Torque Overload Selections</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disabled</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Enabled</td> </tr> </tbody> </table> <p>Reserved parameter (Do not change.)</p> <table border="1"> <thead> <tr> <th colspan="2">Adapter Board Hall Signal Input Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Single-ended</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Differential</td> </tr> </tbody> </table> <p>Reserved parameter (Do not change.)</p> | | | | | | | Torque Overload Selections | | Reference | 0 | Disabled | — | 1 | Enabled | Adapter Board Hall Signal Input Selection | | Reference | 0 | Single-ended | — | 1 | Differential |
| | Torque Overload Selections | | Reference | | | | | | | | | | | | | | | | | | | | |
| | 0 | Disabled | — | | | | | | | | | | | | | | | | | | | | |
| | 1 | Enabled | | | | | | | | | | | | | | | | | | | | | |
| | Adapter Board Hall Signal Input Selection | | Reference | | | | | | | | | | | | | | | | | | | | |
| | 0 | Single-ended | — | | | | | | | | | | | | | | | | | | | | |
| | 1 | Differential | | | | | | | | | | | | | | | | | | | | | |
| | Pn621 (2621h) | Reserved (Do not change) | - | - | 0 | After restart | — | — | | | | | | | | | | | | | | | |
| | Pn622 (2622h) | Reserved (Do not change) | 0000H-0011H | min-1/s | 10000 | After restart | — | — | | | | | | | | | | | | | | | |
| Pn623 (2623h) | Reserved (Do not change) | 1-30000 | min-1/s | 10000 | After restart | — | — | | | | | | | | | | | | | | | | |
| Pn624 (2624h) | Reserved (Do not change) | 1-30000 | min-1 | 10 | After restart | — | — | | | | | | | | | | | | | | | | |
| Pn625 (2625h) | Reserved (Do not change) | 0-10000 | 10ms | 100 | After restart | — | — | | | | | | | | | | | | | | | | |
| Pn626 (2626h) | Reserved (Do not change) | 0 ~ 1073741824 | Command unit | 100 | After restart | — | — | | | | | | | | | | | | | | | | |
| Pn628 (2628h) | Reserved (Do not change) | 1-10000 | min-1 | 10 | After restart | — | — | | | | | | | | | | | | | | | | |
| Pn700 | Error Code | 0-65535 | — | 0 | — | — | — | | | | | | | | | | | | | | | | |
| Pn701 | Control Word | 0-65535 | — | 0 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn702 | Status Word | 0-65535 | — | 0 | — | — | — | | | | | | | | | | | | | | | | |
| Pn703 | Quick-stop Mode Selection | 0-7 | — | 2 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn704 | Close Option | 0-1 | — | 0 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn705 | Operation Disabled Option | 0-1 | — | 1 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn706 | Pause Mode Selection | 0-4 | — | 1 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn707 | Failure Response Option | 0-0 | — | 0 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn708 | Mode Selection | 0-10 | — | 0 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn709 | Operation Mode Display | 0-10 | — | 0 | — | — | — | | | | | | | | | | | | | | | | |
| Pn70A | Position Command | -2147483648-2147483647 | cnt | 0 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn70C | Position Feedback | -2147483648-2147483647 | cnt | 0 | Immediately | — | — | | | | | | | | | | | | | | | | |
| Pn70E | Position Feedback | -2147483648-2147483647 | cnt | 0 | — | — | — | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|---------|--|------------------------|--------------------|-------------|--------------|----------------|-----------|
| Pn710 | Excessive Position Deviation Threshold | -2147483648-2147483647 | cnt | 0 | Immediately | — | — |
| Pn712 | Position Deviation Time Window | 0-65535 | ms | 0 | Immediately | — | — |
| Pn713 | Position Reached Threshold | -2147483648-2147483647 | cnt | 50 | Immediately | — | — |
| Pn715 | Position Reached Time Window | 0-65535 | ms | 0 | Immediately | — | — |
| Pn716 | User Speed Command | -2147483648-2147483647 | cnt/s | 0 | Immediately | — | — |
| Pn718 | Speed Feedback | -2147483648-2147483647 | cnt/s | 0 | — | — | — |
| Pn71A | Speed Reached Threshold | 0-65535 | cnt/s | 10 | Immediately | — | — |
| Pn71B | Speed Reached Time Window | 0-65535 | ms | 0 | Immediately | — | — |
| Pn71C | Target Torque | -32768-32767 | 0.1% | 0 | Immediately | — | — |
| Pn71D | Maximum Torque | 0-65535 | 0.1% | 8000 | Immediately | — | — |
| Pn71E | Target Torque | -32768-32767 | 0.1% | 0 | Immediately | — | — |
| Pn71F | Motor Rated Torque | -2147483648-2147483647 | mN | 0 | Immediately | — | — |
| Pn721 | Torque Feedback | -32768-32767 | 0.1% | 0 | — | — | — |
| Pn722 | Target Position | -2147483648-2147483647 | cnt | 0 | Immediately | — | — |
| Pn724 | Origin Offset | -2147483648-2147483647 | cnt | 0 | Immediately | — | — |
| Pn726 | Minimum Software Absolute Position Limit | -2147483648-2147483647 | cnt | -2147483648 | Immediately | — | — |
| Pn728 | Maximum Software Absolute Position Limit | -2147483648-2147483647 | cnt | 2147483647 | Immediately | — | — |
| Pn72A | Command Polarity | 0-1 | - | 0 | Immediately | — | — |
| Pn72B | Maximum Profile Velocity | -2147483648-2147483647 | cnt/s | 2147483647 | Immediately | — | — |
| Pn72D | Maximum Motor Speed | -2147483648-2147483647 | cnt/s | 10000 | Immediately | — | — |
| Pn72F | Profile Velocity | -2147483648-2147483647 | cnt/s | 0 | Immediately | — | — |
| Pn731 | Profile Acceleration | -2147483648-2147483647 | cnt/s ² | 10485760 | Immediately | — | — |
| Pn733 | Profile Deceleration | -2147483648-2147483647 | cnt/s ² | 10485760 | Immediately | — | — |
| Pn735 | Quick-stop Deceleration | -2147483648-2147483647 | cnt/s ² | 10485760 | Immediately | — | — |
| Pn737 | Motor Operation Curve Type | -32768-32767 | - | 0 | Immediately | — | — |
| Pn738 | Torque Slope | -2147483648-2147483647 | - | 1000 | Immediately | — | — |
| Pn73A | Return-to-zero Mode | 0-35 | - | 0 | Immediately | — | — |
| Pn73B | Deceleration Point Search Signal Speed | -2147483648-2147483647 | - | 10485760 | Immediately | — | — |
| Pn73D | Origin Search Signal Speed | -2147483648-2147483647 | - | 524288 | Immediately | — | — |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|---------|---------------------------------------|------------------------|--------------------|----------|--------------|----------------|-----------|
| Pn73F | Return-to-zero Acceleration | -2147483648-2147483647 | cnt/s ² | 10485760 | Immediately | — | — |
| Pn741 | Return-to-zero Acceleration | -2147483648-2147483647 | cnt | 0 | Immediately | | |
| Pn743 | Speed Offset | -2147483648-2147483647 | cnt/s | 0 | Immediately | | |
| Pn745 | Torque Offset | -2147483648-2147483647 | 0.1% | 0 | Immediately | | |
| Pn747 | Probe Function | 0-65535 | - | 0 | Immediately | | |
| Pn748 | Probe Status | 0-65535 | - | 0 | — | | |
| Pn749 | Probe 1 Rising-edge Position Feedback | -2147483648-2147483647 | - | 0 | — | | |
| Pn74B | Probe 2 Rising-edge Position Feedback | -2147483648-2147483647 | - | 0 | — | | |
| Pn74D | Interpolation Sub-mode Selection | -3-0 | - | 0 | Immediately | | |
| Pn74E | Interpolation Data Record | -2147483648-2147483647 | - | 0 | Immediately | | |
| Pn752 | Positive Maximum Torque Limit | 0-65535 | - | 8000 | Immediately | | |
| Pn753 | Negative Maximum Torque Limit | 0-65535 | - | 8000 | Immediately | | |
| Pn754 | Position Deviation | -2147483648-2147483647 | - | 0 | — | | |
| Pn756 | Position Command | -2147483648-2147483647 | - | 0 | Immediately | | |
| Pn758 | Digital Input | -2147483648-2147483647 | - | 0 | — | | |
| Pn75A | Physical Output | -2147483648-2147483647 | - | 0 | Immediately | | |
| Pn75C | Physical Output Enabled | -2147483648-2147483647 | - | 0 | Immediately | | |
| Pn75E | Target Speed | -2147483648-2147483647 | cnt/s | 0 | Immediately | | |
| Pn760 | Support Servo Operation Mode | -2147483648-2147483647 | - | 896 | Immediately | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | |
|-------------------------------------|--|--|---|---------|---------------|----------------|-----------|-----------|
| Pn781 | Function Conversion Selection 0 | 0000-FFFFH | — | 0000H | After restart | — | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Soft Limit Selection | | | | | | Reference |
| | | 0 | Disable soft limit | | | | | — |
| | | 1 | Enabled soft limit | | | | | |
| | | Modulus Function Selection | | | | | | Reference |
| | 0 | Disable modulus function | | | | | — | |
| | 1 | Enable modulus function | | | | | | |
| | Unit Conversion Selection | | | | | | Reference | |
| | 0 | Disabled | | | | | — | |
| | 1 | Convert to rpm | | | | | | |
| | Origin-return Power Failure Save Selection | | | | | | Reference | |
| | 0 | Disable origin-return power failure save selection | | | | | — | |
| | 1 | Enable origin-return power failure save selection | | | | | | |
| | Pn782 | Frame-loss Judgment Window Value | 0-65535 | - | 0 | Immediately | | |
| | Pn785 | Sync Error Counting Limit | 2-20 | - | 9 | Immediately | | |
| | Pn786 | Station Address Setting | 0-255 | - | 0 | After restart | | |
| Pn787 | Function Conversion Selection 1 | 0-65535 | - | 0 | After restart | — | — | |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Overtravel Selection | | | | | | Reference |
| | | 0 | Disable overtravel selection | | | | | — |
| | | 1 | Enable overtravel selection for different controllers | | | | | |
| | | Note: If Omron platform used, set this to 1 | | | | | | |
| | Master Type Selection | | | | | | Reference | |
| | 0 | Codesys and other platform | | | | | — | |
| | 1 | Omron platform | | | | | | |
| | DDR Motor Function | | | | | | Reference | |
| | 0 | Disabled | | | | | — | |
| 1 | Enabled | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference | | | | | | | | | | |
|--|--|---|-----------|---------|---------------|----------------|---------------------------------------|---|-----------|-----------|-------------------|--|---|--------------------------|---|---|---|
| Pn78A | Modulus Function Position Upper Limit Setting | 0-4294967296 | - | 0 | After restart | | | | | | | | | | | | |
| Pn78C | Eelectronic GearRatio Numerator | 1-1073747823 | - | 1 | After restart | | | | | | | | | | | | |
| Pn78E | Electronic Gear Ratio Denominator | 1-1073747823 | - | 1 | After restart | | | | | | | | | | | | |
| Pn790 | EtherCAT Function Conversion Selection 0 | 0000H-FFFFH | — | 0000H | Immediately | — | — | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">2nd Encoder Feedback</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disable 2nd encoder feedback</td> <td rowspan="3">—</td> </tr> <tr> <td>1</td> <td>Enable positive feedback to the 2nd encoder</td> </tr> <tr> <td>2</td> <td>Enable negative feedback to the 2nd encoder</td> </tr> </tbody> </table> | | | | | | | 2nd Encoder Feedback | | Reference | 0 | Disable 2nd encoder feedback | — | 1 | Enable positive feedback to the 2nd encoder | 2 | Enable negative feedback to the 2nd encoder |
| | 2nd Encoder Feedback | | Reference | | | | | | | | | | | | | | |
| | 0 | Disable 2nd encoder feedback | — | | | | | | | | | | | | | | |
| | 1 | Enable positive feedback to the 2nd encoder | | | | | | | | | | | | | | | |
| | 2 | Enable negative feedback to the 2nd encoder | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">2nd Encoder Single-turn Feedback</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disable 2nd encoder single-turn feedback</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Enable 2nd encoder single-turn feedback</td> </tr> </tbody> </table> | | | | | | | 2nd Encoder Single-turn Feedback | | Reference | 0 | Disable 2nd encoder single-turn feedback | — | 1 | Enable 2nd encoder single-turn feedback | | |
| | 2nd Encoder Single-turn Feedback | | Reference | | | | | | | | | | | | | | |
| | 0 | Disable 2nd encoder single-turn feedback | — | | | | | | | | | | | | | | |
| 1 | Enable 2nd encoder single-turn feedback | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th colspan="2">Node Address Function Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Controller</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Servo</td> </tr> </tbody> </table> | | | | | | | Node Address Function Selection | | Reference | 0 | Controller | — | 1 | Servo | | | |
| Node Address Function Selection | | Reference | | | | | | | | | | | | | | | |
| 0 | Controller | — | | | | | | | | | | | | | | | |
| 1 | Servo | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th colspan="2">Parameter Write into EEPROM Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Write into EEPROM</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>Do not write into EEPROM</td> </tr> </tbody> </table> | | | | | | | Parameter Write into EEPROM Selection | | Reference | 0 | Write into EEPROM | — | 1 | Do not write into EEPROM | | | |
| Parameter Write into EEPROM Selection | | Reference | | | | | | | | | | | | | | | |
| 0 | Write into EEPROM | — | | | | | | | | | | | | | | | |
| 1 | Do not write into EEPROM | | | | | | | | | | | | | | | | |
| Pn791 | EtherCAT Function Conversion Selection 1 | 0000H-FFFFH | — | 0000H | After restart | — | — | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th colspan="2">DO Disconnection Output Logic Selection</th> <th>Reference</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>DO disconnection hold</td> <td rowspan="2">—</td> </tr> <tr> <td>1</td> <td>DO disconnection without output</td> </tr> </tbody> </table> | | | | | | | DO Disconnection Output Logic Selection | | Reference | 0 | DO disconnection hold | — | 1 | DO disconnection without output | | |
| | DO Disconnection Output Logic Selection | | Reference | | | | | | | | | | | | | | |
| | 0 | DO disconnection hold | — | | | | | | | | | | | | | | |
| 1 | DO disconnection without output | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | |
| Reserved parameter (Do not change.) | | | | | | | | | | | | | | | | | |

| PRM No. | Name | Setting range | Unit | Default | When enabled | Classification | Reference |
|---------|--|-------------------------------------|------|---------|--------------|----------------|-----------|
| Pn792 | EtherCAT Function Conversion Selection 2 | 0000H-FFFFH | — | 0000H | Immediately | — | — |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | |
| | | Reserved parameter (Do not change.) | | | | | |
| | | Reserved parameter (Do not change.) | | | | | |
| Pn793 | EtherCAT Function Conversion Selection 3 | 0000H-FFFFH | — | 0000H | Immediately | — | — |
| | n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | | | | | | |
| | | Reserved parameter (Do not change.) | | | | | |
| | | Reserved parameter (Do not change.) | | | | | |
| | | Reserved parameter (Do not change.) | | | | | |

12.3 Parameter List for Object Dictionary 2000H

| Index | PRM No. | Parameter name | Unit | Data type | Data range | Default | When to set | When enabled |
|-------|---------|-----------------------------------|------|-----------|------------|---------|-------------|---------------|
| 2000h | Pn000 | Basic Function Selections 0 | — | UINT | 0-179 | 0 | Set at stop | After restart |
| 2001h | Pn001 | Application Function Selections 1 | — | UINT | 0-4386 | 1 | Set at stop | After restart |
| 2002h | Pn002 | Application Function Selections 2 | — | UINT | 0-16659 | 17 | Set at stop | After restart |
| 2006h | Pn006 | Application Function Selections 6 | — | UINT | 0-95 | 2 | Set at stop | Immediately |
| 2007h | Pn007 | Application Function Selections 7 | — | UINT | 0-95 | 0 | Set at stop | After restart |
| 2008h | Pn008 | Application Function Selections 8 | — | UINT | 0-28961 | 16384 | Set at stop | After restart |
| 2009h | Pn009 | Application Function Selections 9 | — | UINT | 0-273 | 16 | Set at stop | After restart |
| 200Ah | Pn00A | Application Function Selections A | — | UINT | 0-4676 | 0 | Set at stop | After restart |
| 200Bh | Pn00B | Application Function Selections B | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 200Ch | Pn00C | Application Function Selections C | — | UINT | 0-273 | 0 | Set at stop | After restart |

| | | | | | | | | |
|-------|-------|---|----------------------|------|--------------|------|------------------|---------------|
| 200Dh | Pn00D | Application Function Selections D | — | UINT | 0-4113 | 0 | Set at stop | After restart |
| 200Eh | Pn00E | Application Function Selections E | — | UINT | 0-1 | 0 | Set at stop | After restart |
| 200Fh | Pn00F | Application Function Selections F | — | UINT | 0-8209 | 0 | Set at stop | After restart |
| 2010h | Pn010 | Reserved (Do not change) | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 2021h | — | Reserved (Do not change) | — | UINT | 0-4369 | 1 | Set at stop | After restart |
| 2022h | — | Reserved (Do not change) | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 2040h | — | Reserved (Do not change) | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 2080h | Pn080 | Application Function Selections 80 | — | UINT | 0-10421 | 0 | Set at stop | After restart |
| 2081h | Pn081 | Application Function Selections 81 | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 2100h | Pn100 | Speed Loop Gain | 0.1hz | UINT | 10-20000 | 400 | Set at operation | Immediately |
| 2101h | Pn101 | Speed Loop Integral Time Constant | 0.01ms | UINT | 15-51200 | 2000 | Set at operation | Immediately |
| 2102h | Pn102 | Position Loop Gain | 0.1/s | UINT | 10-20000 | 400 | Set at operation | Immediately |
| 2103h | Pn103 | Moment of Inertia Ratio | % | UINT | 0-20000 | 100 | Set at operation | Immediately |
| 2104h | Pn104 | Second Speed Loop Gain | 0.1hz | UINT | 10-20000 | 400 | Set at operation | Immediately |
| 2105h | Pn105 | Second Speed Loop Integral Time Constant | 0.01ms | UINT | 15-51200 | 2000 | Set at operation | Immediately |
| 2106h | Pn106 | Second Position Loop Gain | 0.1/s | UINT | 10-20000 | 400 | Set at operation | Immediately |
| 2109h | Pn109 | Feedforward | % | UINT | 0-100 | 0 | Set at operation | Immediately |
| 210Ah | Pn10A | Feedforward Filter Time Constant | 0.01ms | UINT | 0-6400 | 0 | Set at operation | Immediately |
| 210Bh | Pn10B | Gain Application Selections | — | UINT | 0-21300 | 0 | Set at operation | Immediately |
| 210Ch | Pn10C | Mode Switching Level for Torque Command | % | UINT | 0-800 | 200 | Set at operation | Immediately |
| 210Dh | Pn10D | Mode Switching Level for Speed Command | min ⁻¹ | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 210Eh | Pn10E | Mode Switching Level for Acceleration | min ⁻¹ /s | UINT | 0-30000 | 0 | Set at operation | Immediately |
| 210Fh | Pn10F | Mode Switching Level for Position Deviation | 指令单位 | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 211Fh | Pn11F | Position Integral Time Constant | 0.1ms | UINT | 0-50000 | 0 | Set at operation | Immediately |
| 2121h | Pn121 | Friction Compensation Gain | % | UINT | 10-1000 | 100 | Set at operation | Immediately |
| 2122h | Pn122 | Second Friction Compensation Gain | % | UINT | 10-1000 | 100 | Set at operation | Immediately |
| 2123h | Pn123 | Friction Compensation Coefficient | % | UINT | 0-100 | 0 | Set at operation | Immediately |
| 2124h | Pn124 | Friction Compensation Frequency Correction | 0.1HZ | INT | -10000-10000 | 0 | Set at operation | Immediately |
| 2125h | Pn125 | Friction Compensation Gain Correction | % | UINT | 1-1000 | 100 | Set at operation | Immediately |
| 2131h | Pn131 | Gain Switching Time 1 | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2132h | Pn132 | Gain Switching Time2 | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2135h | Pn135 | Gain Switching Waiting Time 1 | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2136h | Pn136 | Gain Switching Waiting Time 2 | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |

| | | | | | | | | |
|-------|-------|--|----------------|-------|--------------|-------|------------------|---------------|
| 2139h | Pn139 | Automatic Gain Switching Selections 1 | — | UINT | 0000H-0052H | 0000H | Set at operation | Immediately |
| 213Dh | Pn122 | Current Gain Level | % | UINT | 100-2000 | 2000 | Set at operation | Immediately |
| 213Fh | — | Error Code | | UINT | 0-4294967295 | 0 | — | — |
| 2140h | Pn140 | Model Following Control-Related Selections | — | UINT | 0000H-1121H | 0100H | Set at operation | Immediately |
| 2141h | Pn141 | Model Following Control Gain | 0.1/s | UINT | 10-20000 | 500 | Set at operation | Immediately |
| 2142h | Pn142 | Model Following Control Gain Correction | 0.001 | UINT | 500-2000 | 1000 | Set at operation | Immediately |
| 2143h | Pn143 | Model Following Control Bias in the Forward Direction | 0.001 | UINT | 0-10000 | 1000 | Set at operation | Immediately |
| 2144h | Pn144 | Model Following Control Bias in the Reverse Direction | 0.001 | UINT | 0-10000 | 1000 | Set at operation | Immediately |
| 2145h | Pn145 | Vibration Suppression 1 Frequency A | 0.1HZ | UINT | 10-2500 | 500 | Set at operation | Immediately |
| 2146h | Pn146 | Vibration Suppression 1 Frequency B | 0.1HZ | UINT | 10-2500 | 700 | Set at operation | Immediately |
| 2147h | Pn147 | Model Following Control Speed Feedforward Compensation | 0.001 | UINT | 0-10000 | 1000 | Set at operation | Immediately |
| 2148h | Pn148 | Second Model Following Control Gain | 0.1/s | UINT | 10-20000 | 500 | Set at operation | Immediately |
| 2149h | Pn149 | Second Model Following Control Gain Correction | 0.001 | UINT | 50-2000 | 1000 | Set at operation | Immediately |
| 214Ah | Pn14A | Vibration Suppression 2 Frequency | 0.1HZ | UINT | 10-2000 | 800 | Set at operation | Immediately |
| 214Bh | Pn14B | Vibration Suppression 2 Correction | % | UINT | 10-1000 | 100 | Set at operation | Immediately |
| 214Fh | Pn14F | Control-Related Selections | — | UINT | 0-17 | 17 | Set at stop | After restart |
| 2160h | Pn160 | Anti-Resonance Control-Related Selections | — | UINT | 0-17 | 17 | Set at operation | Immediately |
| 2161h | Pn161 | Anti-Resonance Frequency | 0.1HZ | UINT | 10-20000 | 1000 | Set at operation | Immediately |
| 2162h | Pn162 | Anti-Resonance Gain Correction | % | UINT | 1-1000 | 100 | Set at operation | Immediately |
| 2163h | Pn163 | Anti-Resonance Damping Gain | % | UINT | 0-300 | 0 | Set at operation | Immediately |
| 2164h | Pn164 | Anti-Resonance Filter Time Constant 1 Correction | 0.01m s | INT | -1000-1000 | 0 | Set at operation | Immediately |
| 2165h | Pn165 | Anti-Resonance Filter Time Constant 2 Correction | 0.01m s | INT | -1000-1000 | 0 | Set at operation | Immediately |
| 2166h | — | Reserved (Do not change) | — | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 2170h | Pn170 | Tuning-less Function-Related Selections | — | UINT | 0-9233 | 5120 | Set at stop | After restart |
| 2181h | — | Mode Switching Level for Speed Command | 1mm/s | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 2190h | Pn190 | Reserved (Do not change) | — | UINT | 0-17 | 16 | Set at operation | Immediately |
| 2200h | Pn200 | Position Control Command Form Selections | — | UINT | 0-4662 | 256 | Set at stop | After restart |
| 2205h | Pn205 | Multiturn Limit | Rev | UINT | 0-65535 | 65535 | Set at stop | After restart |
| 2207h | Pn207 | Position Control Function Selections | — | UINT | 0-8720 | 16 | Set at stop | After restart |
| 220Ah | Pn20A | Number of External Encoder Scale Pitches | 1 scale pitch/ | UDINT | 4-1048576 | 32768 | Set at stop | After restart |

| | | | Rev | | | | | |
|-------|-------|---|---------------------|-------|---------------|------|------------------|---------------|
| 220Eh | Pn20E | Electronic Gear Ratio (Numerator) | 1 | UDINT | 1-1073741824 | 1 | Set at stop | After restart |
| 2210h | Pn210 | Electronic Gear Ratio (Denominator) | 1 | UDINT | 1-1073741824 | 1 | Set at stop | After restart |
| 2212h | Pn212 | Number of Encoder Output Pulses | P/Rev | UDINT | 16-1073741824 | 2048 | Set at stop | After restart |
| 2216h | Pn216 | Position Command Acceleration/Deceleration Time Constant | 0.1ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2217h | Pn217 | Average Position Command Movement Time | 0.1ms | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 2218h | Pn218 | Command Pulse Input Multiplier | ms | UINT | 0-2000 | 1 | Set at operation | Immediately |
| 222Ah | Pn22A | Fully-closed Control Selections | — | UINT | 0-3 | 0 | Set at stop | After restart |
| 2233h | — | Reserved (Do not change) | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2240h | Pn240 | Mini. time interval for Position deviation clear signal input | ms | UINT | 0-2000 | 0 | Set at stop | After restart |
| 2281h | Pn281 | Encoder Output Resolution | 1 edge/ pitch | UINT | 1-4096 | 20 | Set at stop | After restart |
| 2282h | — | Reserved (Do not change) | 0.01u m | UDINT | 0-6553600 | 0 | Set at stop | After restart |
| 2284h | Pn284 | Number of Pulses corresponding to the Grating Pitch | 1 pulse /pitch | UINT | 0-65535 | 0 | Set at stop | After restart |
| 22D0 | Pn2D0 | Reserved (Do not change) | — | UDINT | 0-16777216 | 0 | Set at stop | After restart |
| 2300h | Pn300 | Speed Command Input Gain | 0.01V | UINT | 150-3000 | 600 | Set at operation | Immediately |
| 2304h | Pn304 | Jogging Speed | min ⁻¹ | UINT | 0-10000 | 500 | Set at operation | Immediately |
| 2305h | Pn305 | Soft Start Acceleration Time | ms | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 2306h | Pn306 | Soft Start Deceleration Time | ms | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 2307h | Pn307 | Reserved (Do not change) | 0.01m s | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 230Ah | — | Deceleration Time at Zero-speed Stop | ms | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 230Bh | — | Holding Time at Zero-speed Stop | ms | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 230Ch | — | Reserved (Do not change) | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2310h | Pn310 | Vibration Detection Selections | — | UINT | 0-2 | 0 | Set at operation | Immediately |
| 2311h | Pn311 | Vibration Detection Sensitivity | % | UINT | 0-500 | 100 | Set at operation | Immediately |
| 2312h | Pn312 | Vibration Detection Level | min ⁻¹ | UINT | 0-5000 | 50 | Set at operation | Immediately |
| 2324h | Pn324 | Moment of Inertia Calculation Starting Level | % | UINT | 0-20000 | 300 | Set at operation | Immediately |
| 2400h | Pn400 | Reserved (Do not change) | 0.1V | UINT | 0-10-100 | 30 | Set at operation | Immediately |
| 2401h | Pn401 | First Stage First Torque Command Filter Time Constant | 0.01m s | UINT | 0-65535 | 100 | Set at operation | Immediately |
| 2402h | Pn402 | Forward Torque Limit | % | UINT | 0-800 | 800 | Set at operation | Immediately |

| | | | | | | | | |
|-------|-------|--|-------------------|------|----------|-------|------------------|-------------|
| 2403h | Pn403 | Reverse Torque Limit | % | UINT | 0-800 | 800 | Set at operation | Immediately |
| 2404h | Pn404 | Forward External Torque Limit | % | UINT | 0-800 | 100 | Set at operation | Immediately |
| 2405h | Pn405 | Reverse External Torque Limit | % | UINT | 0-800 | 100 | Set at operation | Immediately |
| 2406h | Pn406 | Emergency Stop Torque | % | UINT | 0-800 | 800 | Set at operation | Immediately |
| 2407h | Pn407 | Speed Limit during Torque Control | min ⁻¹ | UINT | 0-10000 | 10000 | Set at operation | Immediately |
| 2408h | Pn408 | Torque-Related Function Selections | — | UINT | 0-4369 | 0 | Set at operation | Immediately |
| 2409h | Pn409 | First Stage Notch Filter Frequency | HZ | UINT | 50-5000 | 5000 | Set at operation | Immediately |
| 240Ah | Pn40A | First Stage Notch Filter Q Value | 0.01 | UINT | 50-1000 | 70 | Set at operation | Immediately |
| 240Bh | Pn40B | First Stage Notch Filter Depth | 0.001 | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 240Ch | Pn40C | Second Stage Notch Filter Frequency | HZ | UINT | 50-5000 | 5000 | Set at operation | Immediately |
| 240Dh | Pn40D | Second Stage Notch Filter Q Value | 0.01 | UINT | 50-1000 | 70 | Set at operation | Immediately |
| 240Eh | Pn40E | Second Stage Notch Filter Depth | 0.001 | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 240Fh | Pn40F | Second Stage Second Torque Command Filter Frequency | HZ | UINT | 100-5000 | 5000 | Set at operation | Immediately |
| 2410h | Pn410 | Second Stage Second Torque Command Filter Q Value | 0.01 | UINT | 50-100 | 50 | Set at operation | Immediately |
| 2412h | Pn412 | First Stage Second Torque Command Filter Time Constant | 0.01ms | UINT | 0-65535 | 100 | Set at operation | Immediately |
| 2415h | Pn415 | T-REF Filter Time Constant | 0.01ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2416h | — | Reserved (Do not change) | — | UINT | 0-65535 | 5000 | Set at operation | Immediately |
| 2417h | — | Reserved (Do not change) | 0.1Hz | UINT | 50-5000 | 70 | Set at operation | Immediately |
| 2418h | — | Reserved (Do not change) | 0.01 | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 2419h | — | Reserved (Do not change) | 0.001 | UINT | 0-65535 | 5000 | Set at operation | Immediately |
| 241Ah | — | Reserved (Do not change) | 1Hz | UINT | 50-5000 | 70 | Set at operation | Immediately |
| 241Bh | — | Reserved (Do not change) | 0.01 | UINT | 50-1000 | 0 | Set at operation | Immediately |
| 241Ch | — | Reserved (Do not change) | 0.001 | UINT | 0-65535 | 5000 | Set at operation | Immediately |
| 241Dh | — | Reserved (Do not change) | 1Hz | UINT | 50-5000 | 70 | Set at operation | Immediately |
| 241Eh | — | Reserved (Do not change) | 0.01 | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 241Fh | — | Reserved (Do not change) | 0.001 | UINT | 0-1000 | 0 | Set at operation | Immediately |
| 2423h | Pn423 | Reserved (Do not change) | — | UINT | 0-4369 | 0 | Set at operation | Immediately |
| 2424h | Pn424 | Torque Limit at Main Circuit Voltage Drop | % | UINT | 0-100 | 50 | Set at operation | Immediately |
| 2425h | Pn425 | Release Time for Torque Limit at Main Circuit Voltage Drop | ms | UINT | 0-1000 | 100 | Set at operation | Immediately |
| 2426h | — | Reserved (Do not change) | 0.1ms | UINT | 0-5100 | 0 | Set at operation | Immediately |
| 2427h | — | Reserved (Do not change) | min ⁻¹ | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 2456h | Pn456 | Sweep Torque Command Amplitude | % | UINT | 1-800 | 15 | Set at operation | Immediately |

| | | | | | | | | |
|-------|-------|---|-------------------|------|-----------|-------|------------------|---------------|
| 2460h | Pn460 | Notch Filter Adjustment Selections | — | UINT | 0-257 | 257 | Set at operation | Immediately |
| 2476h | Pn476 | Gravity Compensation Torque | 0.10% | INT | -100-1000 | 0 | Set at operation | Immediately |
| 2480h | — | Reserved (Do not change) | 1mm/s | UINT | 0-10000 | 10000 | Set at operation | Immediately |
| 2481h | Pn481 | Polarity Detection Speed Loop Gain | 0.1HZ | UINT | 10-20000 | 400 | Set at operation | Immediately |
| 2482h | Pn482 | Polarity Detection Speed Loop Integral Time Constant | 0.01ms | UINT | 15-51200 | 3000 | Set at operation | Immediately |
| 2483h | — | Reserved (Do not change) | 1% | UINT | 0-800 | 30 | Set at operation | Immediately |
| 2484h | — | Reserved (Do not change) | 1% | UINT | 0-800 | 30 | Set at operation | Immediately |
| 2485h | — | Reserved (Do not change) | 1mm/s | UINT | 0-100 | 20 | Set at operation | Immediately |
| 2486h | Pn486 | Polarity Detection Reference Acceleration/Deceleration Time | ms | UINT | 0-100 | 25 | Set at operation | Immediately |
| 2487h | Pn487 | Polarity Detection Constant Speed Time | ms | UINT | 0-300 | 0 | Set at operation | Immediately |
| 2488h | Pn488 | Polarity Detection Reference Waiting Time | ms | UINT | 50-500 | 100 | Set at operation | Immediately |
| 248Eh | — | Polarity Detection Range | 1mm | UINT | 1-65535 | 10 | Set at operation | Immediately |
| 2490h | Pn490 | Polarity Detection Load Level | % | UINT | 0-20000 | 100 | Set at operation | Immediately |
| 2493h | Pn493 | Polarity Detection Command Speed | min ⁻¹ | UINT | 0-1000 | 50 | Set at stop | After restart |
| 2494h | Pn494 | Polarity Detection Movable Range | 0.001rev | UINT | 1-65535 | 250 | Set at stop | After restart |
| 2495h | Pn495 | Polarity Detection Confirmation Force Command | % | UINT | 0-200 | 100 | Set at operation | Immediately |
| 2498h | Pn498 | Polarity Detection Allowable Error Range | deg | UINT | 0-30 | 10 | Set at operation | Immediately |
| 249Fh | — | Reserved (Do not change) | 1mm/s | UINT | 0-10000 | 0 | Set at operation | Immediately |
| 2501h | Pn501 | Zero Clamping Level | min ⁻¹ | UINT | 1-10000 | 10 | Set at operation | Immediately |
| 2502h | Pn502 | Rotation Detection Level | min ⁻¹ | UINT | 1-10000 | 20 | Set at operation | Immediately |
| 2503h | Pn503 | Speed Coincidence Detection Signal Output Width | min ⁻¹ | UINT | 0-100 | 10 | Set at operation | Immediately |
| 2506h | Pn506 | Brake Command-Servo OFF Delay Time | 10ms | UINT | 0-50 | 0 | Set at operation | Immediately |
| 2507h | Pn507 | Brake Command Output Speed Level | min ⁻¹ | UINT | 0-10000 | 100 | Set at operation | Immediately |
| 2508h | Pn508 | Servo OFF-Brake Command Waiting Time | 10ms | UINT | 10-100 | 50 | Set at operation | Immediately |
| 2509h | Pn509 | Momentary Power Interruption Hold Time | 1ms | UINT | 20-50000 | 20 | Set at operation | Immediately |
| 250Ah | Pn50A | Input Signal Selections 1 | — | UINT | 0-65521 | 10369 | Set at stop | After restart |
| 250Bh | Pn50B | Input Signal Selections 2 | — | UINT | 0-65535 | 34947 | Set at stop | After restart |
| 250Ch | Pn50C | Input Signal Selections 3 | — | UINT | 0-65535 | 34947 | Set at stop | After restart |
| 250Dh | Pn50D | Input Signal Selections 4 | — | UINT | 0-65535 | 34947 | Set at stop | After restart |
| 250Eh | Pn50E | Output Signal Selections1 | — | UINT | 0-17476 | 0 | Set at stop | After restart |
| 250Fh | Pn50F | Output Signal Selections2 | — | UINT | 0-17476 | 256 | Set at stop | After restart |

| | | | | | | | | |
|-------|-------|--|-------------------|-------|--------------|------------|------------------|---------------|
| 2510h | Pn510 | Output Signal Selections 3 | — | UINT | 0-17476 | 0 | Set at stop | After restart |
| 2511h | Pn511 | Output Signal Selections5 | — | UINT | 0-65535 | 6213H | Set at stop | After restart |
| 2512h | Pn512 | Output Signal Inverse Settings | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 2513h | Pn513 | Output Signal Selections 4 | — | UINT | 0-4369 | 0 | Set at stop | After restart |
| 2515h | Pn515 | Output Signal Selections 6 | — | UINT | 0-65535 | 34952 | Set at stop | After restart |
| 2517h | Pn517 | ECAT Forced Output Function | — | UINT | 0-17476 | 0 | Set at stop | After restart |
| 2518h | Pn518 | Reserved (Do not change) | — | UINT | 0-4 | 0 | Set at stop | After restart |
| 251Bh | Pn51B | Motor-Load Position Deviation Overflow Detection Level | Comm and unit | UDINT | 0-1073741824 | 1000 | Set at operation | Immediately |
| 251Eh | Pn51E | Position Deviation Overflow Warning Level | % | UINT | 10-100 | 100 | Set at operation | Immediately |
| 2520h | Pn520 | Position Deviation Overflow Alarm Level | Comm and unit | UDINT | 1-107374182 | 5242880 | Set at operation | Immediately |
| 2522h | Pn522 | Positioning Completed Width | Comm and unit | UDINT | 0-1073741824 | 50 | Set at operation | Immediately |
| 2524h | Pn524 | Near Signal Width | Comm and unit | UDINT | 1-107374182 | 1073741824 | Set at operation | Immediately |
| 2526h | Pn526 | Position Deviation Overflow Alarm Level at Servo ON | Comm and unit | UDINT | 1-107374182 | 5242880 | Set at operation | Immediately |
| 2528h | Pn528 | Position Deviation Overflow Warning Level at Servo ON | % | UINT | 10-100 | 100 | Set at operation | Immediately |
| 2529h | Pn529 | Speed Limit Level at Servo ON | min ⁻¹ | UINT | 0-10000 | 10000 | Set at operation | Immediately |
| 252Ah | Pn52A | Multiplier per Fullyclosed Rotation | % | UINT | 0-100 | 20 | Set at operation | Immediately |
| 252Bh | Pn52B | Overload Warning Level | % | UINT | 1-100 | 20 | Set at operation | Immediately |
| 252Ch | Pn52C | Base Current Derating at Motor Overload Detection | % | UINT | 10-100 | 100 | Set at stop | After restart |
| 252Dh | Pn52D | Reserved (Do not change) | % | UINT | 10--100 | 50 | Set at stop | After restart |
| 252Fh | Pn52F | Reserved (Do not change) | — | UINT | 0-4095 | 4095 | Set at operation | Immediately |
| 2530h | Pn530 | Program JoggingRelated Selections | — | UINT | 0-5 | 0 | Set at operation | Immediately |
| 2531h | Pn531 | Program Jogging Travel Distance | Comm and unit | UDINT | 1-107374182 | 32768 | Set at operation | Immediately |
| 2533h | Pn533 | Program Jogging Movement Speed | min ⁻¹ | UINT | 1-10000 | 500 | Set at operation | Immediately |
| 2534h | Pn535 | Program Jogging Acceleration/Deceleration Time | ms | UINT | 2-10000 | 100 | Set at operation | Immediately |
| 2535h | Pn535 | Program Jogging Waiting Time | ms | UINT | 0-10000 | 100 | Set at operation | Immediately |
| 2536h | Pn536 | Program Jogging Number of Movements | 1 time | UINT | 0-1000 | 1 | Set at operation | Immediately |
| 2548h | — | Reserved (Do not change) | — | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2550h | Pn550 | Analog Monitor 1 Offset Voltage | 0.1V | INT | -10000-10000 | 0 | Set at operation | Immediately |
| 2551h | Pn551 | Analog Monitor 2 Offset | 0.1V | INT | -10000-10000 | 0 | Set at operation | Immediately |

| | | Voltage | | | | | | |
|-------|-------|---|--------|------|------------------------|-------|------------------|---------------|
| 2552h | Pn552 | Analog Monitor 1 Magnification | × 0.01 | INT | -10000-10000 | 100 | Set at operation | Immediately |
| 2553h | Pn553 | Analog Monitor 2 Magnification | × 0.01 | INT | -10000-10000 | 100 | Set at operation | Immediately |
| 255Ah | — | Reserved (Do not change) | 1min | UINT | 0-1440 | 0 | Set at operation | Immediately |
| 2560h | Pn560 | Residual Vibration Detection Width | 0.001 | UINT | 1-3000 | 400 | Set at operation | Immediately |
| 2561h | Pn561 | Overshoot Detection Level | % | UINT | 0-100 | 100 | Set at operation | Immediately |
| 2581h | — | Reserved (Do not change) | 1mm/s | UINT | 1-10000 | 20 | Set at operation | Immediately |
| 2582h | — | Reserved (Do not change) | 1mm/s | UINT | 0-100 | 10 | Set at operation | Immediately |
| 2583h | — | Reserved (Do not change) | 1mm/s | UINT | 0-10000 | 10 | Set at operation | Immediately |
| 2584h | — | Reserved (Do not change) | 1mm/s | UINT | 0-10000 | 10000 | Set at operation | Immediately |
| 2585h | — | Reserved (Do not change) | 1mm/s | UINT | 1-10000 | 50 | Set at operation | Immediately |
| 2586h | — | Reserved (Do not change) | — | UINT | 0-100 | 0 | Set at operation | Immediately |
| 2587h | Pn587 | Reserved (Do not change) | — | UINT | 0-1 | 0 | Set at operation | Immediately |
| 2600h | Pn600 | Regenerative Resistor Capacity | 10W | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2601h | Pn601 | Reserved (Do not change) | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2602h | Pn602 | Encoder Selection | — | UINT | 0-4373 | 0 | Set at stop | After restart |
| 2603h | Pn603 | Reserved (Do not change) | — | UINT | 3-751 | 0751 | Set at stop | After restart |
| 2604h | Pn604 | Reserved (Do not change) | — | UINT | 192-65535 | 192 | Set at stop | After restart |
| 2605h | Pn605 | Encoder Shift Function | — | UINT | 0-1023 | 0 | Set at stop | After restart |
| 2606h | Pn606 | Encoder Shift Function | — | UINT | 0-51400 | 0 | Set at stop | After restart |
| 2607h | Pn607 | Second Encoder Type Selection | — | UINT | 0-5 | 0 | Set at stop | After restart |
| 2608h | Pn608 | 2nd Encoder Resolution | — | UINT | 0-5 | 0 | Set at stop | After restart |
| 2609h | Pn609 | Reserved (Do not change) | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 260Ah | Pn60A | Z-pulse width setting | — | UINT | 0-511 | 0 | Set at stop | After restart |
| 260Bh | Pn60B | Reserved (Do not change) | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 260Ch | Pn60C | Line Count of Sin/Cos Encoder | Pluse | UINT | 0-65535 | 0 | Set at stop | After restart |
| 260Dh | Pn60D | Delay Disabled Count | 2ms | UINT | 0-50 | 0 | Set at stop | After restart |
| 260Eh | Pn60E | Torque Overload Threshold Setting | % | UINT | 0-65535 | 0 | Set at stop | After restart |
| 260Fh | Pn60F | User Torque Overload Time | 10ms | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2610h | Pn610 | Position Comparison Output | — | UINT | 0-3 | 0 | Set at stop | After restart |
| 2611h | Pn611 | 1st Setting Position | Pluse | DINT | -1073741824-1073741823 | 0 | Set at operation | Immediately |
| 2613h | Pn613 | 2nd Setting Position | Pluse | DINT | -1073741824-1073741823 | 0 | Set at operation | Immediately |
| 2615h | Pn615 | 3rd Setting Position | Pluse | DINT | -1073741824-1073741823 | 0 | Set at operation | Immediately |
| 2617h | Pn617 | 4th Setting Position | Pluse | DINT | -1073741824-1073741823 | 0 | Set at operation | Immediately |
| 2619h | Pn619 | Active Time of the 1st Setting Position Output Signal | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |

| | | | | | | | | |
|-------|-------|---|----------------------|-------|----------------------------|-------|------------------|---------------|
| 261Ah | Pn61A | Active Time of the 2nd Setting Position Output Signal | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 261Bh | Pn61B | Active Time of the 3rd Setting Position Output Signal | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 261Ch | Pn61C | Active Time of the 4th Setting Position Output Signal | ms | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 261Fh | Pn61F | Selections | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2621h | Pn621 | Reserved (Do not change) | — | UINT | 0-17 | 0 | Set at stop | After restart |
| 2622h | Pn622 | Reserved (Do not change) | — | UINT | 1-30000 | 10000 | Set at operation | Immediately |
| 2623h | Pn623 | Reserved (Do not change) | min ⁻¹ /s | UINT | 1-30000 | 10000 | Set at operation | Immediately |
| 2624h | Pn624 | Reserved (Do not change) | min ⁻¹ | UINT | 1-10000 | 100 | Set at operation | Immediately |
| 2625h | Pn625 | Reserved (Do not change) | 10ms | UINT | 0-10000 | 100 | Set at operation | Immediately |
| 2626h | Pn626 | Reserved (Do not change) | Comm and unit | DINT | 0-1073741824 | 100 | Set at operation | Immediately |
| 2628h | Pn628 | Reserved (Do not change) | min ⁻¹ | UINT | 1-10000 | 10 | Set at operation | Immediately |
| 2781h | Pn781 | Function Conversion Selection 0 | — | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 2782h | Pn782 | Frame-loss Judgment Window Value | — | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 10F1h | — | Sync Frame Count Limit | — | UINT | 2-20 | 9 | Set at operation | Immediately |
| 2786h | Pn786 | Station Address Setting | — | UINT | 0-255 | 1 | Set at operation | Immediately |
| 2787h | Pn787 | Function Conversion Selection 1 | — | UINT | 0-65535 | 0 | Set at operation | Immediately |
| 278Ah | Pn78A | Modulus Function Position Upper Limit Setting | — | UDINT | 0-4294967296 | 0 | Set at stop | After restart |
| 2790h | Pn790 | EtherCAT Function Conversion Selection 0 | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2791h | Pn791 | EtherCAT Function Conversion Selection 1 | — | UINT | 0-65535 | 0 | Set at stop | After restart |
| 2792h | Pn792 | EtherCAT Function Conversion Selection 2 | — | UINT | 0-65535 | 0 | Set at stop | Immediately |
| 2793h | Pn793 | EtherCAT Function Conversion Selection 3 | — | UINT | 0-65535 | 0 | Set at stop | Immediately |
| 2794h | — | Second Encoder Feedback Value | Pluse | DINT | -2147483648 ~2147483647 | 0 | — | — |

12.4 Parameter List for Object Dictionary 6000H

| Index | Sub-index | Type | Name | Data type | Access type | Mapping type | Unit |
|-------|-----------|------|----------------------------|-----------|-------------|--------------|------|
| 603Fh | | VAR | Error Code | UINT | ro | T | — |
| 6040h | | VAR | Control Word | UINT | rw | R | — |
| 6041h | | VAR | Status Word | UINT | ro | T | — |
| 605Ah | | VAR | Quick-stop Option Code | INT | rw | R | — |
| 605Dh | | VAR | Halt Option Code | INT | rw | R | — |
| 6060h | | VAR | Modes of Operation | SINT | rw | R | — |
| 6061h | | VAR | Modes of Operation Display | SINT | ro | T | — |

| | | | | | | | |
|-------|---|-------|---|-------|----|---|------------------------------|
| 6062h | | VAR | Position Demand Value | DINT | ro | T | User command unit |
| 6063h | | VAR | Motor Position Feedback | DINT | ro | T | Encoder unit |
| 6064h | | VAR | User Position Feedback | DINT | ro | T | User command unit |
| 6065h | | VAR | Excessive User Position Deviation Threshold | UDINT | rw | R | User command unit |
| 6067h | | VAR | Position Reach Threshold | UDINT | rw | R | User command unit |
| 6068h | | VAR | Position Arrival Time | UINT | rw | R | ms |
| 606Ch | | VAR | User Actual Speed Feedback | DINT | ro | T | User command |
| 606Dh | | VAR | Speed Reach Threshold | UINT | rw | R | User command |
| 606Eh | | VAR | Speed Arrival Time | UINT | rw | R | ms |
| 6071h | | VAR | Target Torque | INT | rw | R | 0.1% |
| 6072h | | VAR | Max. Torque | UINT | rw | R | 0.1% |
| 6074h | | VAR | Torque Demand Value | INT | ro | T | 0.1% |
| 6076h | | VAR | Motor Rated Torque | UDINT | ro | T | — |
| 6077h | | VAR | Actual Torque Feedback | INT | ro | T | 0.1% |
| 607Ah | | VAR | Target Position Value | DINT | rw | R | User command |
| 607Ch | | VAR | Homing Offset | DINT | rw | R | User command |
| 607Dh | 0 | ARRAY | Soft Limit: Maximum Number of Sub-indexes | UINT | ro | N | — |
| | 1 | ARRAY | Soft Limit: Minimum Position Limit | DINT | rw | R | User command |
| | 2 | ARRAY | Soft Limit: Maximum Position Limit | DINT | rw | R | User command |
| 607Eh | | VAR | Command Polarity | USINT | rw | R | — |
| 607Fh | | VAR | Maximum Profile Velocity | UDINT | rw | T | User command |
| 6080h | | VAR | Maximum Motor Speed | UDINT | rw | T | rpm |
| 6081h | | VAR | Profile Velocity | UDINT | rw | R | User command /s |
| 6083h | | VAR | Profile Acceleration | DINT | rw | R | User command /s ² |
| 6084h | | VAR | Profile Deceleration | UDINT | rw | R | User command /s ² |
| 6085h | | VAR | Quick-stop Deceleration | UDINT | rw | R | User command /s ² |
| 6086h | | VAR | Motion Profile Type | INT | rw | R | — |
| 6087h | | VAR | Torque Slope | UDINT | rw | R | 0.1%/s |
| 6091h | 0 | ARRAY | Electronic Gear Ratio: Maximum Number of Sub-indexes | UINT | ro | R | — |
| | 1 | ARRAY | Electronic Gear Ratio: Numerator | UDINT | rw | R | — |
| | 2 | ARRAY | Electronic Gear Ratio: Denominator | UDINT | rw | R | — |
| 6098h | | VAR | Homing Mode | SINT | rw | R | — |
| 6099h | 0 | ARRAY | Homing Speed: Maximum Number of Sub-indexes | UINT | ro | N | User command /s |
| | 1 | ARRAY | Search Deceleration Point Signal Speed in Homing Mode | UDINT | rw | R | User command /s |
| | 2 | ARRAY | Search Origin Switch Signal Speed in Homing Mode | UDINT | rw | R | User command /s |
| 609Ah | | VAR | Homing Acceleration | UDINT | rw | R | User command /s ² |
| 60B0h | | VAR | Position Offset | DINT | rw | R | User command |
| 60B1h | | VAR | Speed Offset | DINT | rw | R | User command /s |

| | | | | | | | |
|-------|---|-------|--|-------|----|---|-----------------|
| 60B2h | | VAR | Torque Offset | INT | rw | R | 0.1% |
| 60B8h | | VAR | Probe Function | UINT | rw | R | — |
| 60B9h | | VAR | Probe Status Word | UINT | ro | T | — |
| 60BAh | | VAR | Probe 1 Rising Edge Position Feedback | DINT | ro | T | — |
| 60BBh | | VAR | Probe 1 Falling Edge Position Feedback | DINT | ro | T | — |
| 60BCh | | VAR | Probe 2 Rising Edge Position Feedback | DINT | ro | T | — |
| 60BDh | | VAR | Probe 2 Falling Edge Position Feedback | DINT | ro | T | — |
| 60D5h | | VAR | Probe 1 Rising Edge Count Value | UINT | ro | T | — |
| 60D6h | | VAR | Probe 1 Falling Edge Count Value | UINT | ro | T | — |
| 60D7h | | VAR | Probe 2 Rising Edge Count Value | UINT | ro | T | — |
| 60D8h | | VAR | Probe 2 Falling Edge Count Value | UINT | ro | T | — |
| 60E0h | | VAR | Forward Maximum Torque Limit | UINT | rw | R | 0.1% |
| 60E1h | | VAR | Negative Maximum Torque Limit | UINT | rw | R | 0.1% |
| 60F4h | | VAR | User Position Deviation | DINT | ro | T | User command |
| 60FCh | | VAR | Motor Position Command Feedback | DINT | ro | T | User command |
| 60FDh | | VAR | DI Input Status | UDINT | ro | T | — |
| 60FEh | 0 | ARRAY | DO Output: Maximum Number of Sub-indexes | UINT | ro | N | — |
| | 1 | ARRAY | Forced DO Output Status | UDINT | rw | R | — |
| | 2 | ARRAY | Bit Mask | UDINT | rw | R | — |
| 60FFh | | VAR | Target Speed | UDINT | rw | R | User command /s |
| 6502h | | VAR | Supported Servo Operation Mode | UDINT | ro | T | — |

12.5 6000H Object Dictionary Description

Object 213F_h: Servo Drive Error Code

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 213F _h | Sub-index | 00 _h |
| Name | Error Code | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Uint32 | Data range | 0~4294967295 |
| Operation mode | — | Default setting | 0 |

Display the error code of the servo drive, which is consistent with the d error code displayed on the panel

Object 603F_h: Error Code

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 603F _h | Sub-index | 00 _h |
| Name | Error Code | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | ALL | Default setting | 0 |

Display protocol error codes

Note: This is not the fault code of the servo drive. Pls refer to 213Fh for the servo drive error code.

Object 6040_h: Control Word

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6040 _h | Sub-index | 00 _h |
| Name | Control Word | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | ALL | Default setting | 0 |

Used to enable, clear the alarm, start the given command in each mode, etc.

| bit | Definition | |
|---------------|-----------------------------------|--|
| 0 | Servo ready | 0: Invalid 1: Valid |
| 1 | Main circuit voltage | 0: Invalid 1: Valid |
| 2 | Quick-stop | 0: Invalid 1: Valid |
| 3 | Servo operation | 0: Invalid 1: Valid |
| 4 | Related to operation control mode | |
| 5 | Related to operation control mode | |
| 6 | Related to operation control mode | |
| 7 | Fault reset | Rising edge is valid (When set to 1, other control commands are invalid) |
| 8 | Pause | 0: Invalid 1: Valid |
| 9~15 Reserved | | |

Object 6041_h: Status Word

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6041 _h | Sub-index | 00 _h |
| Name | Status Word | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | ALL | Default setting | 0 |

| bit | Definition | |
|-----|--------------------------------------|--|
| 0 | No error | 0: Invalid 1: Valid. The servo can be enabled at valid. |
| 1 | Waiting for the servo to be enabled | 0: Invalid 1: Valid. The servo can be enabled at valid. |
| 2 | Servo running status | 0: Not running 1: Running. The servo have been enabled at valid. |
| 3 | Servo fault | 0: Error occur 1: No error |
| 4 | Main circuit voltage | 0: Not econnected 1: Connected. The servo can be enabled at valid. |
| 5 | Quick-stop | 0: Invalid 1: Valid |
| 6 | Servo ready | 0: Invalid 1: Valid. The servo can be enabled at valid. |
| 7 | Warning | 0: No waning 1: Warning occurs |
| 8 | For manufacturer' s use | N/A |
| 9 | Remote control | 0: Invalid 1: Valid. Control word is effective at valid. |
| 10 | Position arrival | 60400010h bit8 (Pause) =0, 0: Position not arrival. 1: Position arrival; 60400010h bit8 (Pause) =1, 0: In deceleration. 1: Speed is 0 |
| 11 | Software internal position overlimit | 0: Soft limit not reached. 1: Soft limit reached. |
| 12 | Related to opeation control mode | 0: Not follow target position.1: Follow target position. |
| 13 | Related to opeation control mode | 0: No position deviation alarm. 1: Position deviation alarm occurs |
| 14 | For manufacturer' s use | N/A |
| 15 | Homing completed | 0: Invalid.1: Homing completed For the absolute system, after Pn781.3=1, the value of bit15 will be stored after homing returns successfully (power-off hold) |

Note: Each bit of the status word must be combined with other bits to form a certain control command. The following are the basic status words (X represents any value)

| | |
|--|--|
| Not ready to switch: XXXX XXXX X0XX 0000 | Switch on disable: XXXX XXXX X0XX 0000 |
| Ready to switch on: XXXX XXXX X01X 0001 | Switch on: XXXX XXXX X01X 0011 |
| Quick stop active: XXXX XXXX X00X 0111 | Operation enable: XXXX XXXX X01X 0111 |
| Fault: XXXX XXXX X0XX 1000 | Fault reaction active: XXXX XXXX X0XX 1111 |

Object 605A_h: Quick-stop Option Code

| Object description | | Object entry description | |
|--------------------|------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 605A _h | Sub-index | 00 _h |
| Name | Quick-stop Option Code | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint16 | Data range | 0~7 |
| Operation mode | ALL | Default setting | 2 |

When Control word 6040hbit2=0, the quick-stop mode is determined by 605Ah

| Setting value | Stop method |
|---------------|---|
| 0 | Coast to stop |
| 1 | Emergency stop with Pn406, keep free running |
| 2 | Emergency stop with Pn406, keep free running |
| 3 | Emergency stop with Pn406, keep free running |
| 4 | Not defined |
| 5 | Emergency stop with Pn406, keep position locked |
| 6 | Emergency stop with Pn406, keep position locked |
| 7 | Emergency stop with Pn406, keep position locked |

Object 605D_h: Halt Option Code

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 605D _h | Sub-index | 00 _h |
| Name | Halt Option Code | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint16 | Data range | 0~4 |
| Operation mode | ALL | Default setting | 1 |

After the control word 6040hbit8 pause function is valid, the pause effect is determined by 605Dh.

| Setting value | Stop method |
|---------------|--|
| 0 | Not supported. |
| 1 | Decelerate by 6084h deceleration time, then keep position locked |
| 2 | Decelerate by 6085h deceleration time, then keep position locked |

For 6084 deceleration, in homing mode, use the deceleration time set by 609A to decelerate; in torque mode, it will use the deceleration time set by 6087 to decelerate

Object 6060_h: Modes of Operation

| Object description | | Object entry description | |
|--------------------|--------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6060 _h | Sub-index | 00 _h |
| Name | Modes of Operation | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~10 |
| Operation mode | ALL | Default setting | 0 |

Select the control mode to run

| Setting value | Definition | Notes |
|---------------|--|---|
| 0 | Reserved | Reserved |
| 1 | Profile position mode (PP) | Refer to “5.7 Profile Position Mode (PP) ” |
| 2 | Velocity mode | Not supported |
| 3 | Profile velocity mode (PV) | Refer to “5.8 Profile Velocity Mode (PV) ” |
| 4 | Profile torque mode (PT) | Refer to “5.9 Profile Torque Mode (PT) ” |
| 5 | Reserved | Reserved |
| 6 | Homing mode (HM) | Refer to “5.10 Homing Mode (HM) ” |
| 7 | Interpolated position mode(IP) | Not supported |
| 8 | Cyclic synchronous position mode (CSP) | Refer to “5.11 Cyclic synchronous Position Mode (CSP) ” |
| 9 | Cyclic synchronous velocity mode (CSV) | Refer to “5.12 Cyclic Synchronous Velocity Mode (CSV) ” |
| 10 | Cyclic synchronous torque mode (CST) | Refer to “5.13 Cyclic Synchronous Torque Mode (CST) ” |

Object 6061_h: Modes of Operation Display

| Object description | | Object entry description | |
|--------------------|----------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6061 _h | Sub-index | 00 _h |
| Name | Modes of Operation Display | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Uint16 | Data range | 0~10 |
| Operation mode | ALL | Default setting | 0 |

Displays the control mode of servo drive

| Setting value | Definition | Notes |
|---------------|--|---|
| 0 | Reserved | Reserved |
| 1 | Profile position mode (PP) | Refer to “5.7 Profile Position Mode (PP) ” |
| 2 | Velocity mode | Not supported |
| 3 | Profile velocity mode (PV) | Refer to “5.8 Profile Velocity Mode (PV) ” |
| 4 | Profile torque mode (PT) | Refer to “5.9 Profile Torque Mode (PT) ” |
| 5 | Reserved | Reserved |
| 6 | Homing mode (HM) | Refer to “5.10 Homing Mode (HM) ” |
| 7 | Interpolated position mode(IP) | Not supported |
| 8 | Cyclic synchronous position mode (CSP) | Refer to “5.11 Cyclic synchronous Position Mode (CSP) ” |
| 9 | Cyclic synchronous velocity mode (CSV) | Refer to “5.12 Cyclic Synchronous Velocity Mode (CSV) ” |
| 10 | Cyclic synchronous torque mode (CST) | Refer to “5.13 Cyclic Synchronous Torque Mode (CST) ” |

Object 6062_h: Position Demand Value

| Object description | | Object entry description | |
|--------------------|-----------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6062 _h | Sub-index | 00 _h |
| Name | Position Demand Value | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP、HM、CSP | Default setting | 0 |

Display real-time position commands (User Unit)

Object 6063_h: Motor Position Feedback

| Object description | | Object entry description | |
|--------------------|-------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6063 _h | Sub-index | 00 _h |
| Name | Motor Position Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 0 |

Display motor real-time absolute position feedback

Object 6064_h: User Position Feedback

| Object description | | Object entry description | |
|--------------------|------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6064 _h | Sub-index | 00 _h |
| Name | User Position Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 0 |

Display the real-time user absolute position feedback

Object 6065_h: Excessive User Position Deviation Threshold

| Object description | | Object entry description | |
|--------------------|---|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6065 _h | Sub-index | 00 _h |
| Name | Excessive User Position Deviation Threshold | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint32 | Data range | 0-4294967295 |
| Operation mode | PP/CSP/HM | Default setting | 0 |

When the difference between user position command 6062_h and user position feedback 6064_h exceeds $\pm 6065_{\text{h}}$, an excessive position deviation fault occurs

Object 6067_h: Position Reach Threshold

| Object description | | Object entry description | |
|--------------------|--------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6067 _h | Sub-index | 00 _h |
| Name | Position Reach Threshold | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | 0-4294967295 |
| Operation mode | PP/CSP/HM | Default setting | 50 |

When the difference between the user position command 6062h and the user's actual position feedback 6064h is within $\pm 6067h$, and the time reaches 6068h, the position is considered to be reached. In the Profile position mode, the status word 6041h bit10=1.

In Profile position mode, when the servo is enabled, this bit becomes valid.

Object 6068_h: Position Arrival Time

| Object description | | Object entry description | |
|--------------------|-----------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6068 _h | Sub-index | 00 _h |
| Name | Position Arrival Time | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | PP/CSP/HM | Default setting | 0 |

When the difference between the user position command 6062h and the user's actual position feedback 6064h is within $\pm 6067h$, and the time reaches 6068h, the position is considered to be reached. In the Profile position mode, the status word 6041h bit10=1.

In Profile position mode, when the servo is enabled, this bit becomes valid.

Object 606C_h: User Actual Speed Feedback

| Object description | | Object entry description | |
|--------------------|----------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 606C _h | Sub-index | 00 _h |
| Name | User Actual Speed Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 0 |

Display the user's actual speed feedback.

Object 606D_h: Speed Reach Threshold

| Object description | | Object entry description | |
|--------------------|-----------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 606D _h | Sub-index | 00 _h |
| Name | Speed Reach Threshold | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | PV/CSV | Default setting | 0 |

When the difference between the target speed 60FFh and the user's actual speed 606Ch is within $\pm 606Dh$, and the time reaches 606Eh, the speed is considered to be reached. In the Profile velocity mode, the status word 6041h bit10=1.

In Profile velocity mode, when the servo is enabled, this bit becomes valid.

Object 606E_h: Speed Arrival Time

| Object description | | Object entry description | |
|--------------------|--------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 606E _h | Sub-index | 00 _h |
| Name | Speed Arrival Time | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | PV/CSV | Default setting | 0 |

When the difference between the target speed 60FFh and the user's actual speed feedback 606Ch is within $\pm 606Dh$, and the time reaches 606Eh, the speed is considered to be reached. In the Profile speed mode, the status word 6041h bit10=1.

In Profile velocity mode, when the servo is enabled, this bit becomes valid.

Object 6071_h: Torque Target Value

| Object description | | Object entry description | |
|--------------------|---------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6071 _h | Sub-index | 00 _h |
| Name | Torque Target Value | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint16 | Data range | -32768~32767 |
| Operation mode | PT/CST | Default setting | 0 |

Torque reference in PT/CST mode, Unit: 0.1%.

100% corresponds to the rated torque of the motor.

Object 6072_h: Max. Torque

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6072 _h | Sub-index | 00 _h |
| Name | Maximum Torque | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | ALL | Default setting | 8000 |

Maximum Torque command, Unit: 0.1%.

Set the maximum torque of the motor.

Object 6074_h: Torque Demand Value

| Object description | | Object entry description | |
|--------------------|---------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6074 _h | Sub-index | 00 _h |
| Name | Torque Demand Value | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint16 | Data range | -32768~32767 |
| Operation mode | ALL | Default setting | 0 |

Display the real-time user defined torque value, 100% corresponds to the rated torque of the motor.

Object 6077_h: Actual Torque Feedback

| Object description | | Object entry description | |
|--------------------|------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6077 _h | Sub-index | 00 _h |
| Name | Actual Torque Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint16 | Data range | -32768~32767 |
| Operation mode | ALL | Default setting | 0 |

Display the real-time servo internal torque feedback. 100% corresponds to the rated torque of the motor

Object 607A_h: Target Position Value

| Object description | | Object entry description | |
|--------------------|-----------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 607A _h | Sub-index | 00 _h |
| Name | Target Position Value | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP/CSP | Default setting | 0 |

Set the servo target position in Profile position mode and Cyclic synchronous position mode;

For an absolute command, after the positioning is completed, the user's absolute position 6064h = 607Ah;

For a relative command, after the positioning is completed, the user displacement increment = 607Ah.

Object 607C_h: Homing Offset

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 607C _h | Sub-index | 00 _h |
| Name | Homing Offset | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | HM | Default setting | 0 |

After the homing return completed, the stop position of the motor is the mechanical origin. By setting 607Ch, the relationship between the mechanical origin and the mechanical zero can be set: Mechanical origin = Mechanical zero-point + 607C (homing offset; when 607C=0, the mechanical origin and the mechanical Zero-point coincidence.

Making homing offset valid: After power-on and homing return completed, the status word 6041h bit15=1;

In the homing mode, the host controller should first select the homing method (6098h), and set the homing speed (6099-1h 6099-2h), and the homing acceleration (609Ah). After the homing trigger signal is given, the mechanical origin and the mechanical zero point will be set. Position, speed and torque control are completed inside the servo drive;

You can also use the zero return mode 35, take the current position as the mechanical origin, and after triggering the zero return (6040h control word: 0x0F → 0x1F), the user's current position 6064h= 607C (Note: the motor shaft does not actually rotate);

Mechanical origin: A fixed position on the machine, corresponding to the origin switch, limit switch, motor Z signal, etc. Mechanical Zero-point: The absolute 0 position.

Object 607D_h: Soft Limit

| Object description | | Object entry description | |
|--------------------|-----------------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 607D _h | Sub-index | 00 _h |
| Name | Soft Limit: Number of Sub-indexes | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | UInt8 | Data range | 0~512 |
| Operation mode | ALL | Default setting | 2 |

| Object description | | Object entry description | |
|--------------------|------------------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 607D _h | Sub-index | 01 _h |
| Name | Soft Limit: Minimum Position Limit | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | -2147483648 |

Soft limit function:

Bit0 of Pn781 is the software limit selections:

0: Disabled;

1: Enabled;

Set the minimum value of the software absolute position limit, -2147483648 means that the minimum software absolute position limit = (607D-01h) has no limit in negative direction.

| Attributes | Value | Attributes | Value |
|----------------|------------------------------------|-------------------|------------------------|
| Index | 607D _h | Sub-index | 02 _h |
| Name | Soft Limit: Maximum Position Limit | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | -2147483648 |

Soft limit function:

Bit0 of Pn781 is the software limit selections:

0: Disabled;

1: Enabled;

Set the minimum value of the software absolute position limit. 2147483647 means that the maximum software absolute position limit = (607D-02h) is unlimited in positive direction.

Object 607E_h: Command Polarity

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 607E _h | Sub-index | 00 _h |
| Name | Command Polarity | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint8 | Data range | 0~1 |
| Operation mode | ALL | Default setting | 0 |

To set the polarity of torque command, torque feedback, position command, position feedback, speed command, speed feedback, external limit signal 60FDh-00h bit1 (POT), 60FDh-01h bit2 (NOT), it is necessary to set the servo state machine when the transition machine is set to 0 again by Init-PreOP-SafeOP-OP.

When using, the speed, position, and torque polarity should all be 0 (Bit5~7 are all 0) or set to 224 (Bit5~7 are all 1)

| Bit | Definition |
|-----|---|
| 0 | Reserved |
| 1 | Reserved |
| 2 | Reserved |
| 3 | Reserved |
| 4 | Reserved |
| 5 | Set the torque command 6071h/60B2h×(-1), torque feedback 6074h/6077h×(-1), and the motor turns in the reverse direction |
| 6 | Set the speed command 60FF _n /60B1 _n ×(-1), speed feedback 606B _n /606B _n ×(-1), and the motor turns in the reverse direction |
| 7 | Set the position command 607A _n /60B0 _n ×(-1), position feedback 6062 _n /6064 _n ×(-1), and the motor turns in the reverse direction |

Object 607F_h: Maximum Profile Velocity

| Object description | | Object entry description | |
|--------------------|--------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 607F _h | Sub-index | 00 _h |
| Name | Maximum Profile Velocity | Access properties | rw |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 2147483647 |

Set the user's maximum running speed, which mainly plays the role of limiting protection.

Object 6080_h: Maximum Motor Speed

| Object description | | Object entry description | |
|--------------------|---------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6080 _h | Sub-index | 00 _h |
| Name | Maximum Motor Speed | Access properties | rw |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 10000 |

Set the maximum motor running speed and also the maximum speed limit in CST mode

Object 6081_h: Profile Velocity

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6081 _h | Sub-index | 00 _h |
| Name | Profile Velocity | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP | Default setting | 0 |

The speed of the constant speed operation of the displacement command in the profile position mode.

Object 6083_h: Profile Acceleration

| Object description | | Object entry description | |
|--------------------|----------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6083 _h | Sub-index | 00 _h |
| Name | Profile Acceleration | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP/PV | Default setting | 10485760 |

User command unit/S²

Object 6084_h: Profile Deceleration

| Object description | | Object entry description | |
|--------------------|----------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6084 _h | Sub-index | 00 _h |
| Name | Profile Deceleration | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP/PV/CSP/CSV | Default setting | 10485760 |

User command unit /S²

Object 6085_h: Quick-stop Deceleration

| Object description | | Object entry description | |
|--------------------|-------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6085 _h | Sub-index | 00 _h |
| Name | Quick-stop Deceleration | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP/PV/CSP/CSV | Default setting | 10485760 |

User command unit /S²

Object 6087_h: Torque Slope

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 6087 _h | Sub-index | 00 _h |
| Name | Torque Slope | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PT/CST | Default setting | 1000 |

Torque command acceleration in profile torque mode, its meaning is: torque command increment per second (Unit: 1%/s)

Object 6091_h: Electronic Gear Ratio

| Object description | | Object entry description | |
|--------------------|--|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6091 _h | Sub-index | 00 _h |
| Name | Electronic Gear Ratio: Number of indexes | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Uint8 | Data range | 0~512 |
| Operation mode | ALL | Default setting | 2 |

| Attributes | Value | Attributes | Value |
|----------------|----------------------------------|-------------------|-----------------|
| Index | 6091 _h | Sub-index | 01 _h |
| Name | Electronic Gear Ratio: Numerator | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Uint32 | Data range | 1~1073741823 |
| Operation mode | ALL | Default setting | 1 |

| Attributes | Value | Attributes | Value |
|----------------|------------------------------------|-------------------|-----------------|
| Index | 6091 _h | Sub-index | 02 _h |
| Name | Electronic Gear Ratio: Denominator | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Uint32 | Data range | 1~1073741823 |
| Operation mode | ALL | Default setting | 1 |

Servo electronic gear ratio = 6091h=6091h : 01 (motor revolutions)/6091h : 02 (servo drive shaft revolutions)

Object 6098_h: Homing Mode

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6098 _h | Sub-index | 00 _h |
| Name | Homing Mode | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint16 | Data range | 0~35 |
| Operation mode | Hm | Default setting | 0 |

In the CANOpen protocol, 31 homing methods are specified according to the origin switch signal, limit switch signal and encoder Z signal.

Object 6099_h: Homing Speed

| Object description | | Object entry description | |
|--------------------|-----------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6099 _h | Sub-index | 00 _h |
| Name | Number of Sub-indexes | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Uint8 | Data range | 0~512 |
| Operation mode | HM | Default setting | 2 |

| Attributes | Value | Attributes | Value |
|----------------|---|-------------------|------------------------|
| Index | 6099 _h | Sub-index | 01 _h |
| Name | Search Deceleration Point Signal Speed in Homing Mode | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | HM | Default setting | 1048576 |

| Attributes | Value | Attributes | Value |
|----------------|--|-------------------|------------------------|
| Index | 6099 _h | Sub-index | 02 _h |
| Name | Search Origin Switch Signal Speed in Homing Mode | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | HM | Default setting | 524288 |

Object 609A_h: Homing Acceleration

| Object description | | Object entry description | |
|--------------------|---------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 609A _h | Sub-index | 00 _h |
| Name | Homing Acceleration | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | HM | Default setting | 10485760 |

User command unit/S²**Object 60B0_h: Position Offset**

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60B0 _h | Sub-index | 00 _h |
| Name | Position Offset | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | CSP | Default setting | 0 |

Set the position offset in synchronous cycle position mode, servo target position=607Ah+60B0h

Object 60B1_h: Speed Offset

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60B1 _h | Sub-index | 00 _h |
| Name | Speed Offset | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | CSP/CSV | Default setting | 0 |

Set the position offset in synchronous cycle speed mode, servo target speed 60FFh+60B1h

Object 60B2_h: Torque Offset

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60B2 _h | Sub-index | 00 _h |
| Name | Torque Offset | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | CSP/CSV/CST | Default setting | 0 |

Set the position offset in synchronous cycle torque mode, the servo target torque is 6071h+60B2h.

Object 60B8_h: Probe Function

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 60B8 _h | Sub-index | 00 _h |
| Name | Probe Function | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | — | Default setting | 0 |

| Bit | Description |
|-----|---|
| 0 | Probe 1 0: Disabled 1: Enabled |
| 1 | Probe 1 trigger mode 0: Single trigger 1: Continuous trigger |
| 2 | Probe 1 trigger signal selection 0: DI4 trigger 1: Z signal trigger |
| 3 | Reserved |
| 4 | Probe 1 rising edge latch 0: Disabled 1: Enabled |
| 5 | Probe 1 falling edge latch 0: Disabled 1: Enabled |
| 6 | Reserved |
| 7 | Reserved |
| 8 | Probe 2 0: Disabled 1: Enabled |
| 9 | Probe 2 trigger mode 0: Single trigger 1: Continuous trigger |
| 10 | Probe 2 trigger signal selection 0: DI4 trigger 1: Z signal trigger |
| 11 | Reserved |
| 12 | Probe 2 rising edge latch 0: Disabled 1: Enabled |
| 13 | Probe 2 falling edge latch 0: Disabled 1: Enabled |
| 14 | Reserved |
| 15 | Reserved |

Object 60B9_h: Probe Status Word

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 60B9 _h | Sub-index | 00 _h |
| Name | Probe Status Word | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | — | Default setting | 0 |

| Bit | Description |
|-----|---|
| 0 | Probe 1 0: Disabled 1: Enabled |
| 1 | Probe 1 rising edge latch 0: Disabled 1: Enabled |
| 2 | Probe 1 falling edge latch 0: Disabled 1: Enabled |
| 3 | Reserved |
| 4 | Reserved |
| 5 | Reserved |
| 6 | Probe 1 trigger signal selection 0: DI4 trigger 1: Z signal trigger |
| 7 | Probe 1 trigger DI level selection 0: DI4 low level trigger 1: DI4 high level trigger |
| 8 | Probe 2 0: Disabled 1: Enabled |
| 9 | Probe 2 rising edge latch 0: Disabled 1: Enabled |
| 10 | Probe 2 falling edge latch 0: Disabled 1: Enabled |
| 11 | Reserved |
| 12 | Reserved |
| 13 | Reserved |
| 14 | Probe 2 trigger signal selection 0: DI5 trigger 1: Z signal trigger |
| 15 | Probe 2 trigger DI level selection 0: DI5 low level trigger 1: DI5 high level trigger |

Object 60BA_h: Probe 1 Rising Edge Position Feedback

| Object description | | Object entry description | |
|--------------------|---------------------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60BA _h | Sub-index | 00 _h |
| Name | Probe 1 Rising Edge Position Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | — | Default setting | 0 |

Records the position feedback when the rising edge of probe 1 is valid (Command unit, 6064h).

Object 60BB_h: Probe 1 Falling Edge Position Feedback

| Object description | | Object entry description | |
|--------------------|--|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60BB _h | Sub-index | 00 _h |
| Name | Probe 1 Falling Edge Position Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | — | Default setting | 0 |

Records the position feedback when the falling edge of probe 1 is valid (Command unit, 6064h).

Object 60BC_h: Probe 2 Rising Edge Position Feedback

| Object description | | Object entry description | |
|--------------------|---------------------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60BC _h | Sub-index | 00 _h |
| Name | Probe 2 Rising Edge Position Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | — | Default setting | 0 |

Records the position feedback when the rising edge of probe 2 is valid (Command unit, 6064h).

Object 60BD_h: Probe 2 Falling Edge Position Feedback

| Object description | | Object entry description | |
|--------------------|--|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60BD _h | Sub-index | 00 _h |
| Name | Probe 2 Falling Edge Position Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | — | Default setting | 0 |

Records the position feedback when the falling edge of probe 2 is valid (Command unit, 6064h).

Object 60E0_h: Forward Maximum Torque Limit

| Object description | | Object entry description | |
|--------------------|------------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 60E0 _h | Sub-index | 00 _h |
| Name | Forward Maximum Torque Limit | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | ALL | Default setting | 8000 |

Limit the positive maximum torque limit of the servo, Unit: 0.1%.

Object 60E1_h: Negative Maximum Torque Limit

| Object description | | Object entry description | |
|--------------------|-------------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 60E1 _h | Sub-index | 00 _h |
| Name | Negative Maximum Torque Limit | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Uint16 | Data range | 0~65535 |
| Operation mode | ALL | Default setting | 8000 |

Limit the negative maximum torque limit of the servo, Unit: 0.1%.

Object 60F4_h: User Position Deviation

| Object description | | Object entry description | |
|--------------------|-------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60F4 _h | Sub-index | 00 _h |
| Name | User Position Deviation | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP/HM/CSP | Default setting | 0 |

Records real-time position deviation (User position unit)

Object 60FC_h: Motor Position Command Feedback

| Object description | | Object entry description | |
|--------------------|---------------------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60FC _h | Sub-index | 00 _h |
| Name | Motor Position Command Feedback | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PP/HM/CSP | Default setting | 0 |

Records the real-time position command of the motor

User position command (6062h) × Position factor (6093h) = Motor position command 60FCh (Encoder unit)

Object 60FD_h: DI Input Status

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|--|
| Attributes | Value | Attributes | Value |
| Index | 60FD _h | Sub-index | 00 _h |
| Name | DI Input Status | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 8329216 0111 1111 0001 1000 0000 0000 |

Display DI input status

| Bit | Definition |
|-------|--|
| 0 | Negative limit switch (DI pin 43, the defaults is 0 when no level input) |
| 1 | Positive limit switch (DI pin 42, the default is 0 when no level is input) |
| 2 | Origin switch (DI pin 40, the default is to 0 when no level is input) |
| 3~9 | Reserved (Low level by default, that is 0) |
| 10 | Z pulse (no setting required) |
| 11 | Probe 1 (Default:1) |
| 12 | Probe 2 (Default:1) |
| 13 | Reserved (Low level by default, that is 0) |
| 14 | Reserved (Low level by default, that is 0) |
| 15 | Reserved (Low level by default, that is 0) |
| 16 | DI0 (Default:1) |
| 17 | DI1 (Default:1) |
| 18 | DI2 (Default:1) |
| 19 | DI3 (Default:1) |
| 20 | DI4 (Default:1) |
| 21 | DI5 (Default:1) |
| 22 | DI6 (Default:1) |
| 23 | Reserved (Low level by default, that is 0) |
| 24 | Reserved (Low level by default, that is 0) |
| 25~30 | Reserved (Low level by default, that is 0) |

Object 60FE_h: Forced DO Output

| Object description | | Object entry description | |
|--------------------|-----------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 60FE _h | Sub-index | 00 _h |
| Name | Number of Sub-indexes | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | UInt8 | Data range | 0~512 |
| Operation mode | ALL | Default setting | 2 |

| Attributes | Value | Attributes | Value |
|----------------|-------------------------|-------------------|------------------------|
| Index | 60FE _h | Sub-index | 01 _h |
| Name | Forced DO Output Status | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 0 |

| Attributes | Value | Attributes | Value |
|----------------|-------------------|-------------------|------------------------|
| Index | 60FE _h | Sub-index | 02 _h |
| Name | Bit Mask | Access properties | Rw |
| Data structure | / | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | ALL | Default setting | 0 |

Force DO output (4 DO outputs are provided for EtherCAT servo at present)

| Bit | Definition |
|-------|-----------------------------------|
| 0 | 0, DO0 not output; 1, DO0 output |
| 1 | 0, DO1 not output ; 1, DO1 output |
| 2 | 0, DO2 not output ; 1, DO2 output |
| 3 | 0, DO3 not output ; 1, DO3 output |
| 4~15 | Reserved |
| 16~24 | Reserved |

Object 60FF_h: Target Speed

| Object description | | Object entry description | |
|--------------------|-------------------|--------------------------|------------------------|
| Attributes | Value | Attributes | Value |
| Index | 60FF _h | Sub-index | 00 _h |
| Name | Target Speed | Access properties | rw |
| Data structure | Variable | PDO mapping type | RxPDO |
| Data type | Sint32 | Data range | -2147483648~2147483647 |
| Operation mode | PV/CSV | Default setting | 0 |

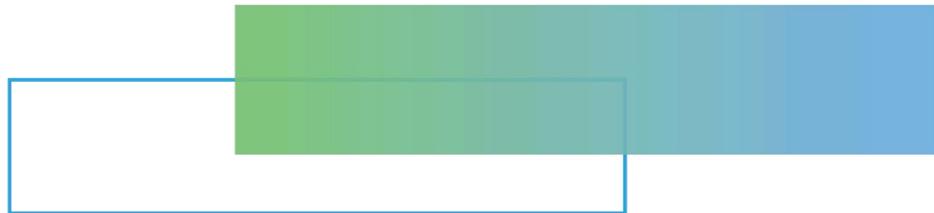
Set profile speed/synchronous cycle speed mode, User speed command

Object 6502_h: Supported Servo Operation Mode

| Object description | | Object entry description | |
|--------------------|--------------------------------|--------------------------|-----------------|
| Attributes | Value | Attributes | Value |
| Index | 6502 _h | Sub-index | 00 _h |
| Name | Supported Servo Operation Mode | Access properties | ro |
| Data structure | Variable | PDO mapping type | TxPDO |
| Data type | Uint32 | Data range | 0~4294967295 |
| Operation mode | ALL | Default setting | 1005 |

Display the operation mode supported by the servo drive.

| bit | Definition | Notes |
|-------|--|---------------|
| 0 | Profile position mode (PP) | |
| 1 | Velocity mode | Not supported |
| 2 | Profile velocity mode (PV) | |
| 3 | Profile torque mode (PT) | |
| 4 | Reserved | |
| 5 | Homing mode (HM) | |
| 6 | Interpolated position mode(IP) | Not supported |
| 7 | Cyclic synchronous position mode (CSP) | |
| 8 | Cyclic synchronous velocity mode (CSV) | |
| 9 | Cyclic synchronous torque mode (CST) | |
| 10~31 | Reserved | |



Chapter 13 Application Examples



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13.1 Application Examples with HCFA Q-series PAC

13.1.1 Create a Project

1. Double click Codesys V3.5 and click [New Project], as shown in Figure 13-2.



Figure 13-1 Create a project

2. Select [Standard project] to define the name and storage path, then click [OK], as shown in Figure 13-2

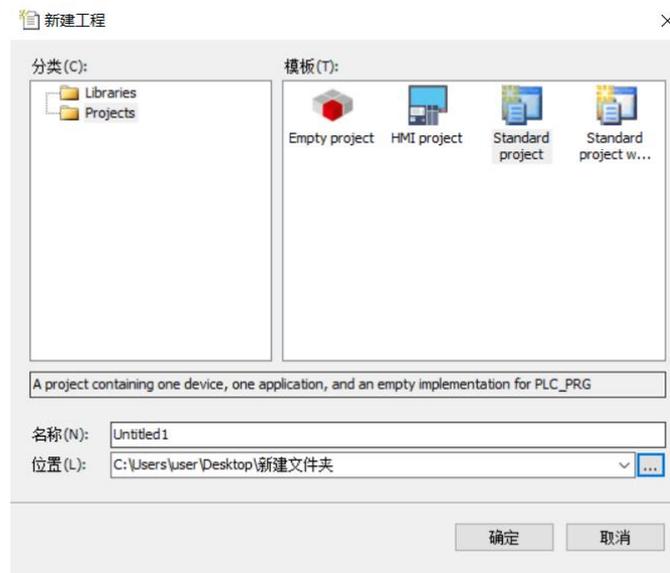


Figure 13-2 Project classification

3. Select [HCQ1-1300-D], and then select [Structured Text (ST)] in PLC_PRG (P), and click [OK], as shown in Figure 13-3.



Figure 13-3 Project description

13.1.2 Host Controller Communication Setting

1. The default IP address of PORT1 is 192.168.188.100, the default IP address of PORT2 is 192.168.88.100 in Q1-1300-D. PORT2 used in this example. In the Ethernet settings, click [Properties] → [Internet Protocol Version 4 (TCP/IPv4)] → to modify the IP address of the host controller so that it is in the same network segment as the IP address of Q1-1300-D (the IP address set here cannot be the same as the IP address of Q1-1300-D), and finally click [OK], as shown in Figure 13-4.

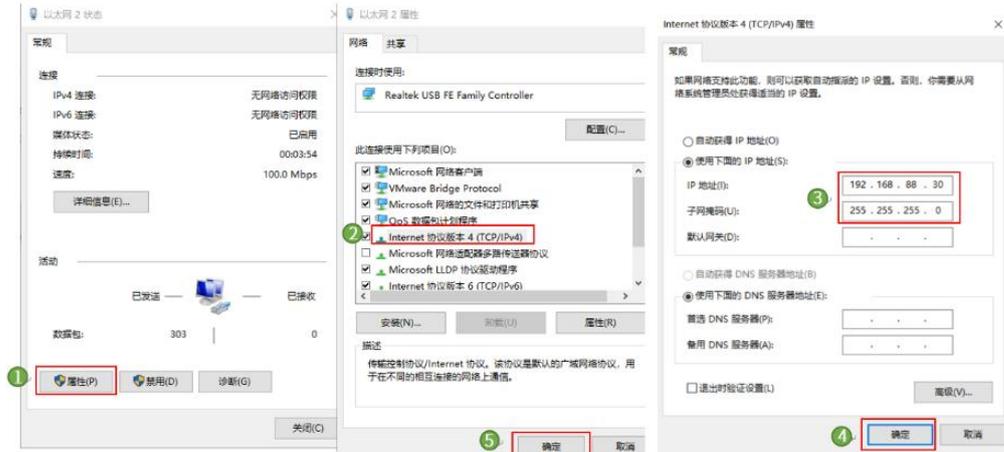


Figure 13-4 Project description

2. Double-click [Device], as shown in Figure 13-5, and click [Scan Network].

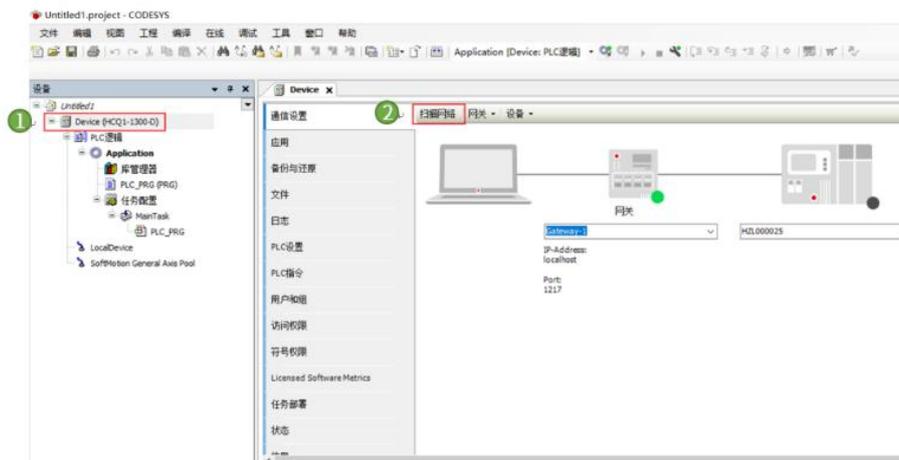


Figure 13-5 Internet connection

3. As shown in Figure 13-6, select the scanned [HCQ1-1300D] and click [OK], and then the computer is connected to the controller.



Figure 13-6 Connection

13.1.3 Project Editing

1. Right-click [Device] and select [Add Device]. Select [EtherCAT Master SoftMotion] on the pop-up screen, and click [Add Device], then click [Close] after adding, as shown in Figure 13-7. At this time, the EtherCAT master station has been added.

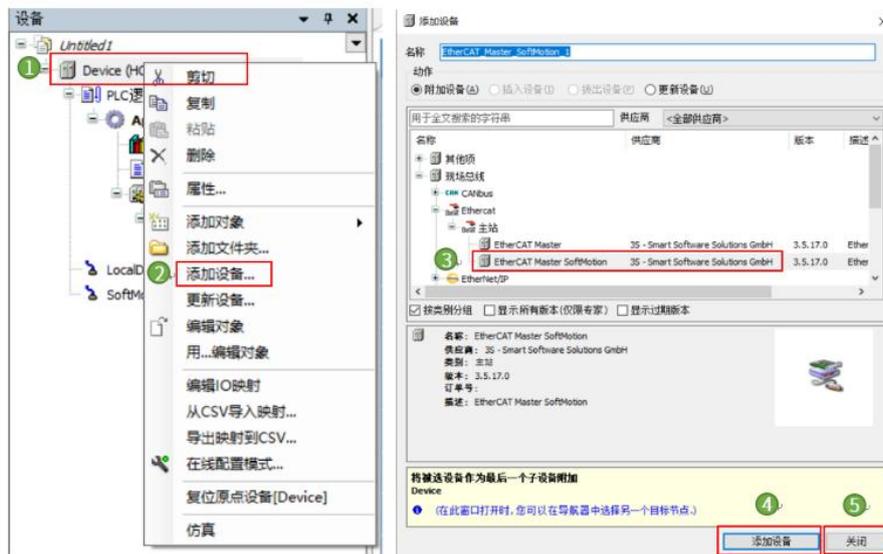


Figure 13-7 EtherCAT master station adding

2. Right-click [EtherCAT_Master_SoftMotionm] and select [Add Device]. Select [LocalEtherCATDevice] in the pop-up screen, and click [Add Device], and click [Close] after adding, as shown in Figure 13-8.

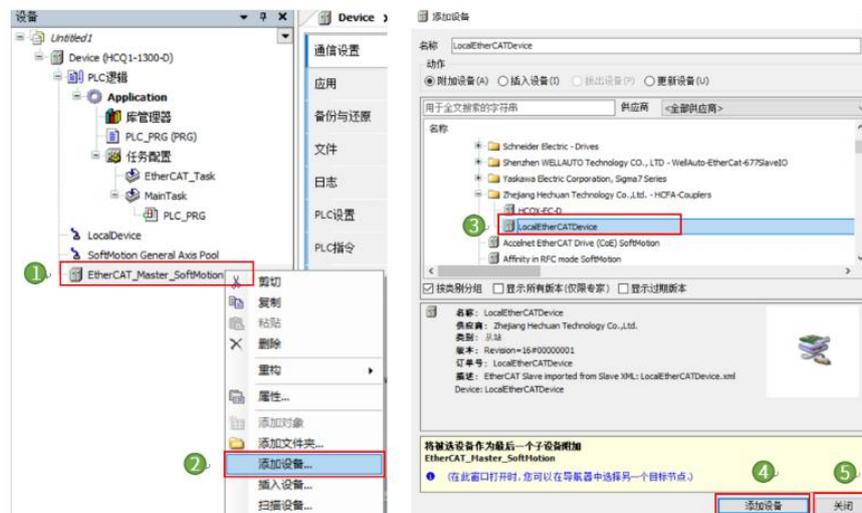


Figure 13-8 LocalEtherCATDevice adding

3. Right-click [EtherCAT_Master_SoftMotionm] and select [Add Device]. Select [HCFA Y7 Servo Driver] in the pop-up screen, click [Add Device], and click [Close] after adding, as shown in Figure 13-9. If there is no [HCFA Y7 Servo Driver], please add the corresponding XML.

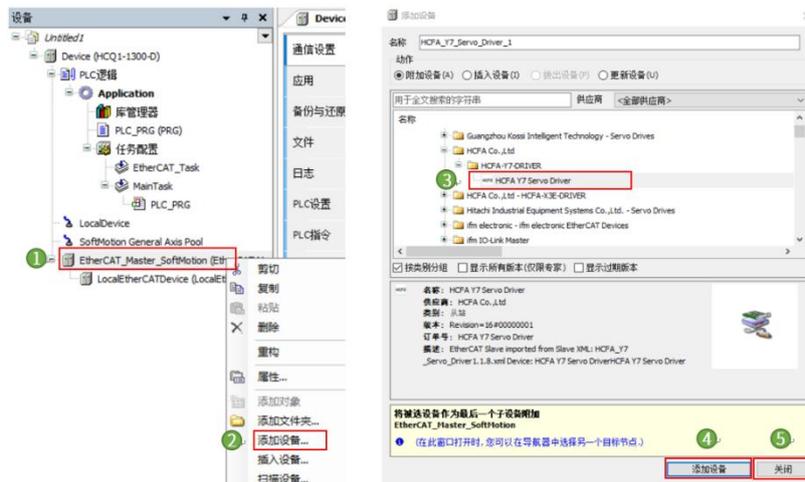


Figure 13-9 Y7S servo adding

4. Right-click [HCFA Y7 Servo Driver], select [Add SoftMotion CiA402 axis], as shown in Figure 13-10.

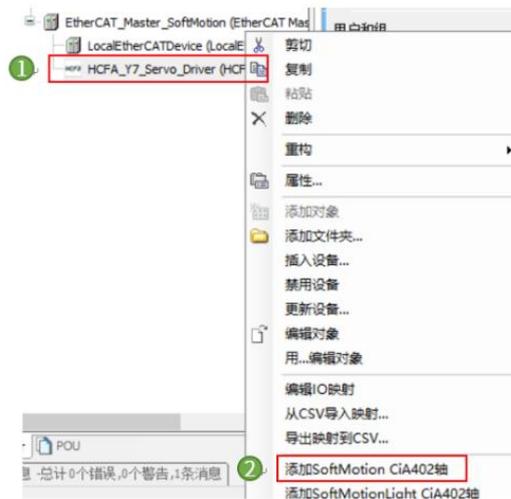


Figure 13-10 CiA402 axis adding

5. Double-click to open [SM_Drive_GenericDSP402], as shown in Figure 13-11. Enter into [8388608] in increments to indicate that 8388608 pulses per motor revolution, and enter into [10] in units in application, indicating that the terminal load moves 10 for per motor revolution.

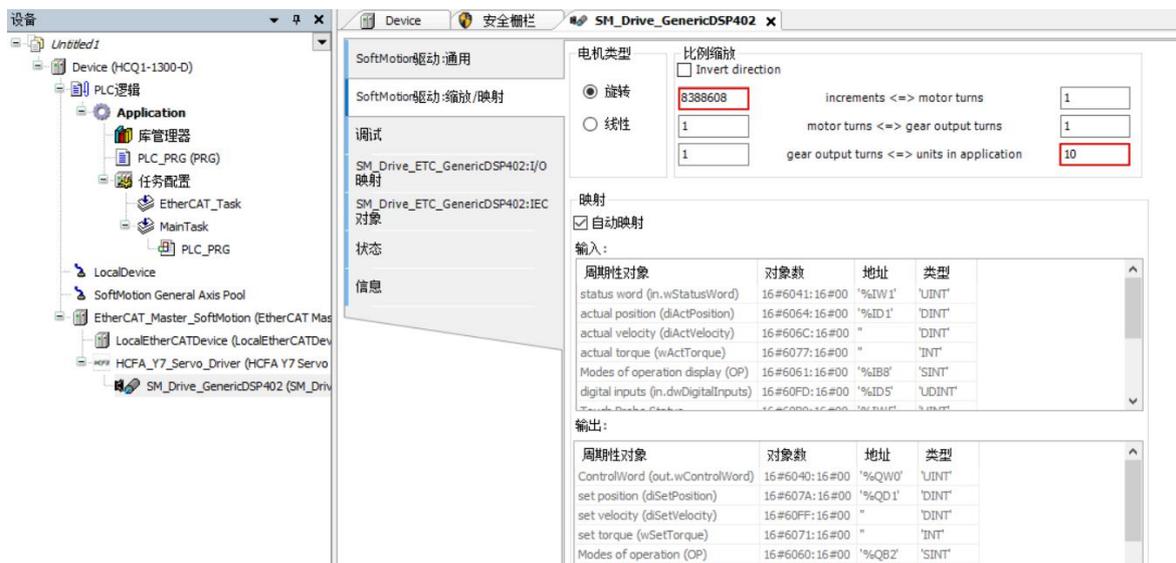


Figure 13-11 DSP402 axis configuration

6. Double-click [EtherCAT_Master_SoftMotionm], as shown in Figure 13-12, and click [Browse]



Figure 13-12 EtherCAT NIC setting

7. In the pop-up screen, select the MAC address in [ecat1], and click [OK], as shown in Figure 13-13.

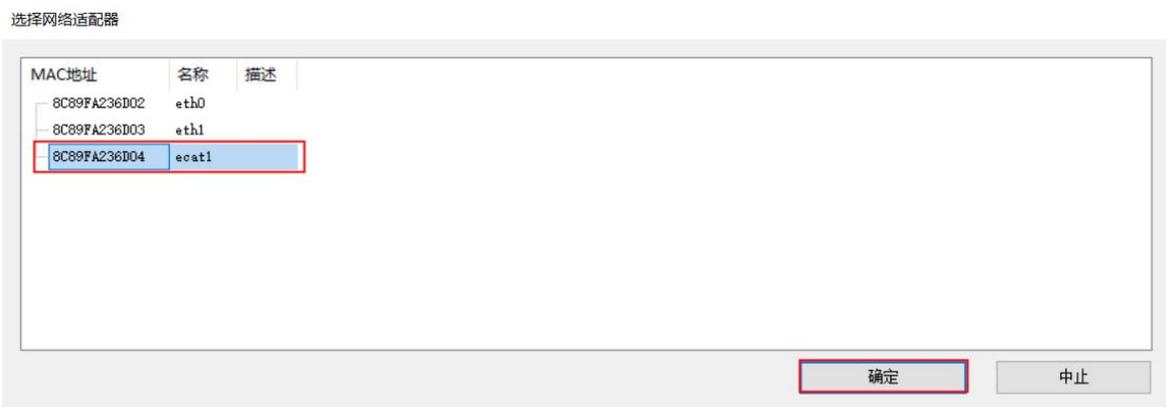


Figure 13-13 Network adapter selection

8. In the menu bar, right-click [PLC_PRG] in MainTask, and select [Delete], as shown in Figure 13-14.

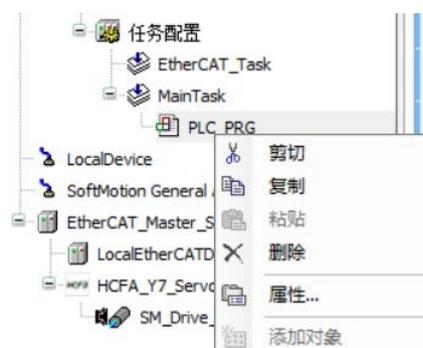


Figure 13-14 Delete POU of the Main Task

9. Put [PLC_PRG] at ① to [EtherCAT_Task] at ②, as shown in Figure 13-15.

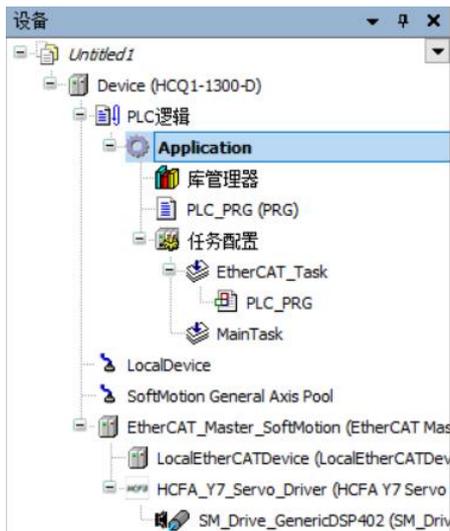


Figure 13-15 Adding EtherCAT POU

10. Double-click to open [PLC_PRG], edit the test code as shown in the figure, and click [Compile- Code Generation], as shown in Figure 13-16.

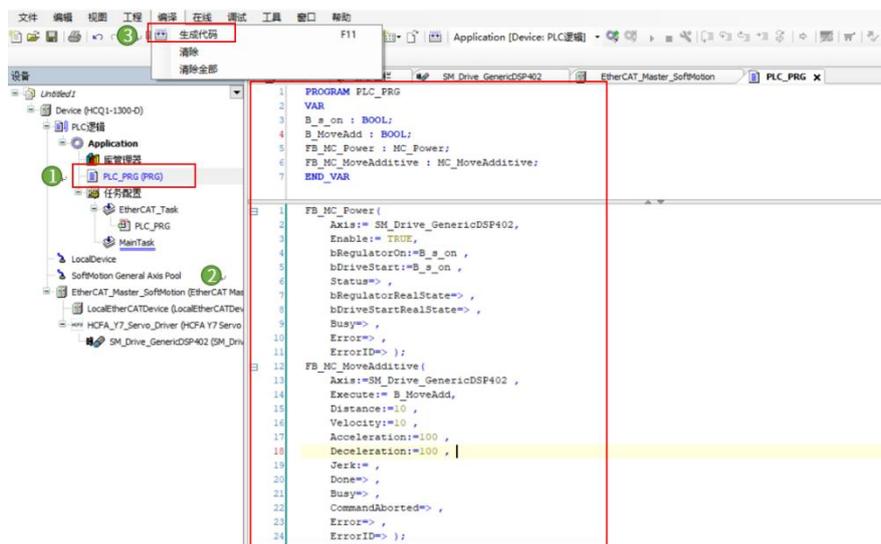


Figure 13-16 Test code

13.1.4 Controller Login

1. After compiling, click [Online-Login], as shown in Figure 13-17.

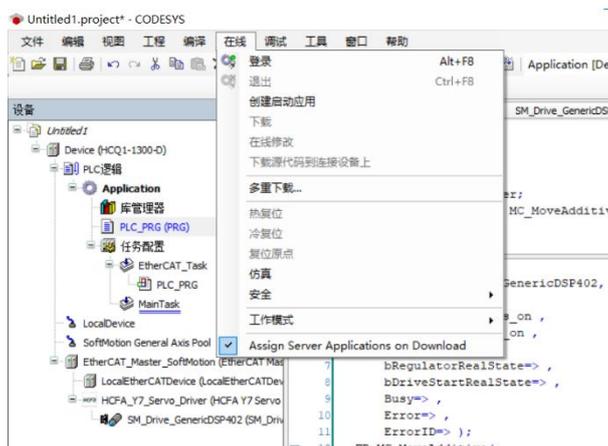


Figure 13-17 Controller login

2. A window will pop up, as shown in Figure 13-18, click [Yes], and the PLC program will be overwritten with the latest code.

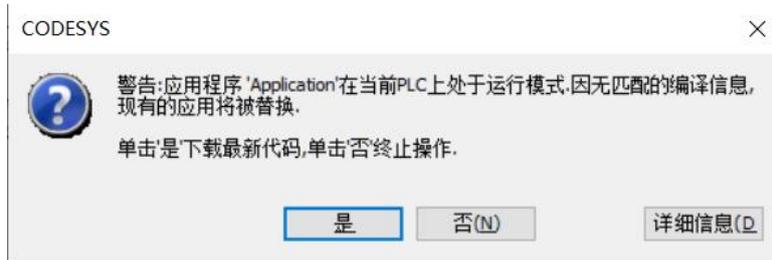


Figure 13-18 Download window

13.1.5 Test Run

1. After the login completed, click [Start] to run the PLC, as shown in Figure 13-19.

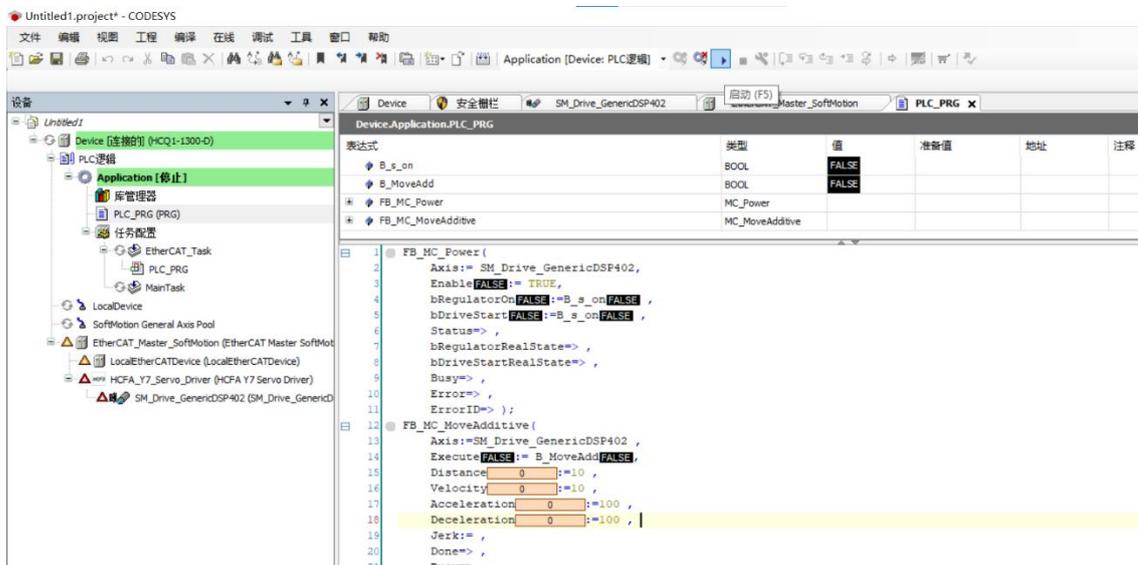


Figure 13-19 Start PLC

2. In the case of safety, please left-click the position ①, and after TRUE appears, select [Write all values of 'Device.Application'] as shown in Figure 13-20, and the servo smotor will be enabled.

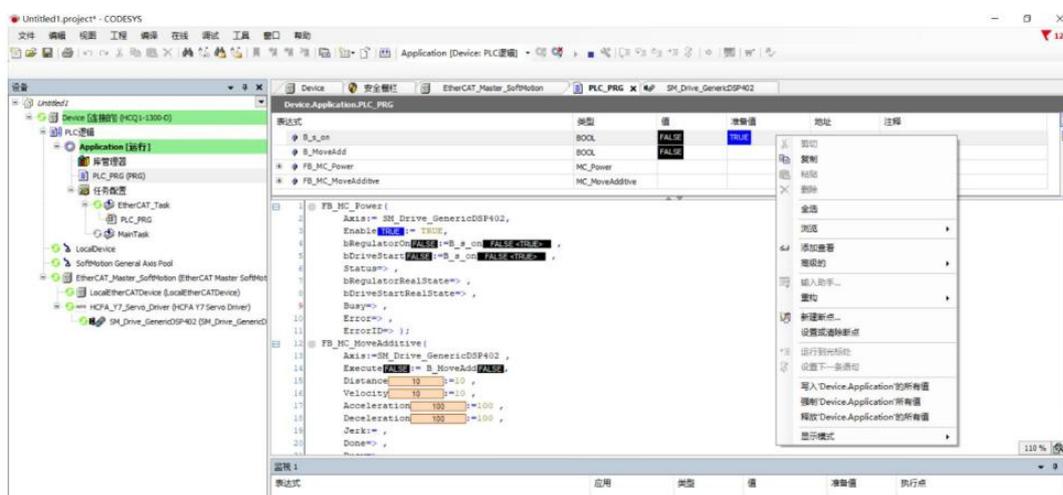


Figure 13-20 Servo motor enabled

3. In the same way, as shown in Figure 13-21, after operating the B_Moveadd variable, the motor rotates forward one revolution. So far, the test run of the servo motor is completed.

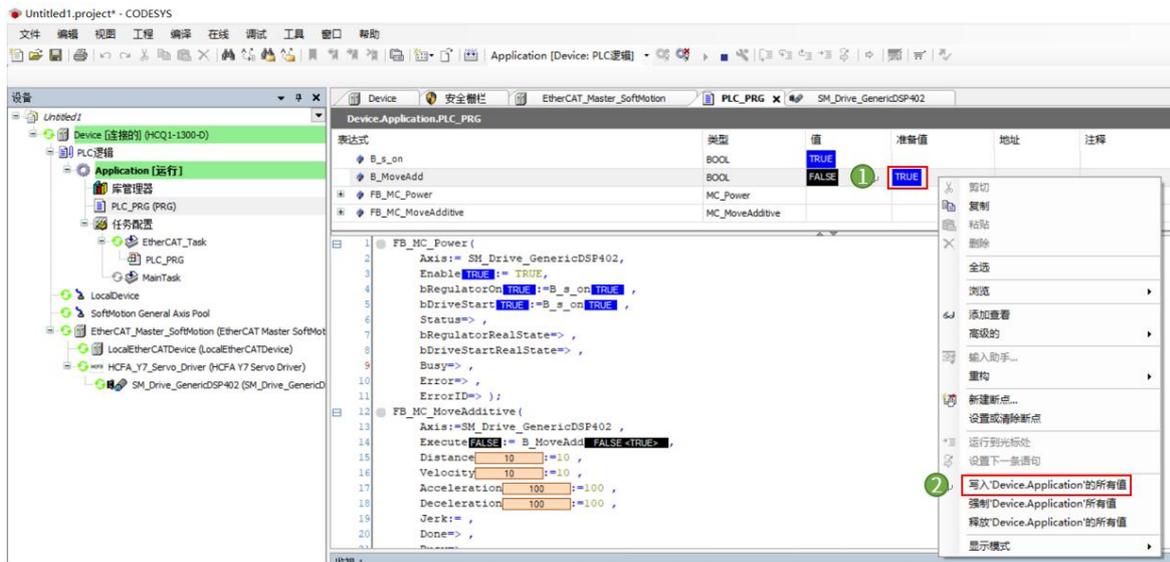


Figure 13-21 Test run

13.2 Application Examples with Omron PLC NJ-501-1300

13.2.1 Connect to Omron PLC

1. PLC connection includes USB connection and network connection. When it is USB connection, select "USB direct connection" → Connect.

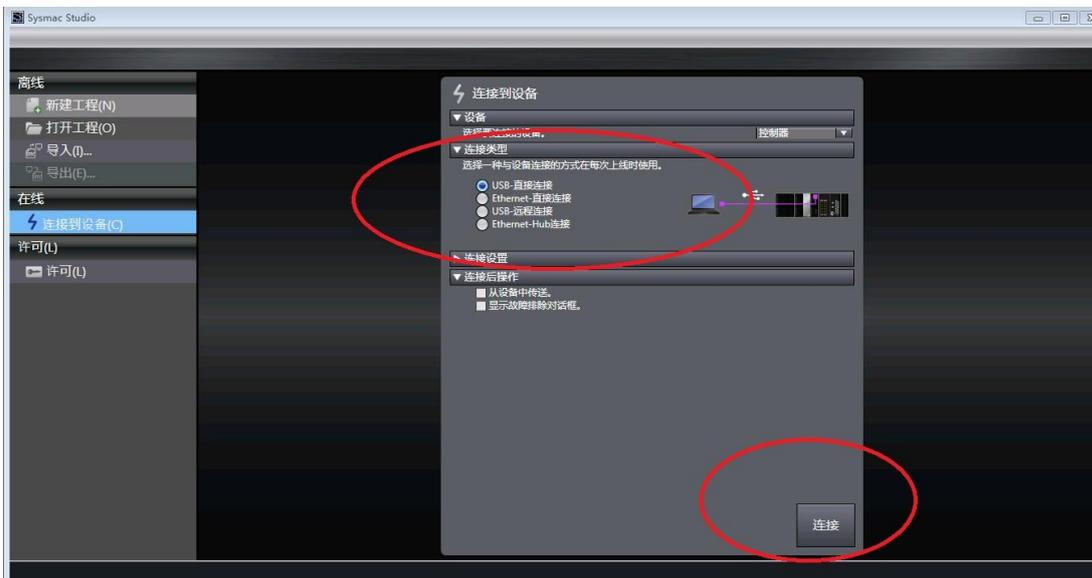


Figure 13-22 USB connection

2. When connected to the network (EtherCAT network port): Set the computer IP address to the same network segment as in the PLC: Computer-Local Connection→Properties→Internet Protocol Version 4 (TCP/IPv4) Properties→Use the following IP address, as shown in the figure below : The default is 192.168.250.X (X is a value from 2 to 255, and the factory default address of Omron CPU is 192.168.250.1).

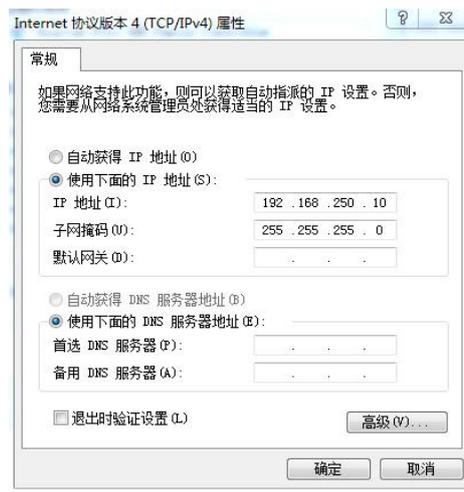


Figure 13-23 Network setting

3. Open the Sysmac studio, select "Connect to Device" → "Connection Type", select "Ethernet-Hub Connection" → "Connection Settings" and enter the IP address: 192.168.250.1 → Finally click "Connect" to enter the PLC programming screen.

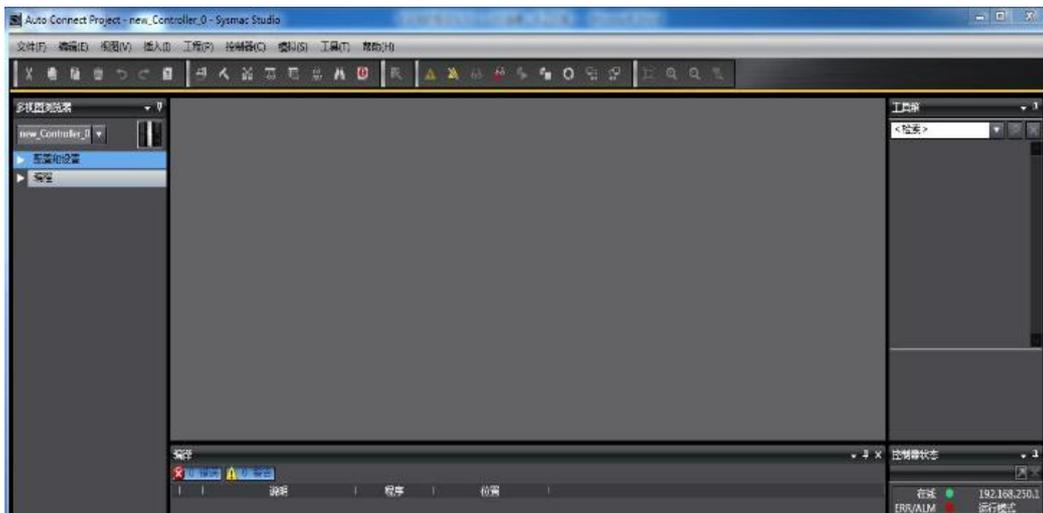
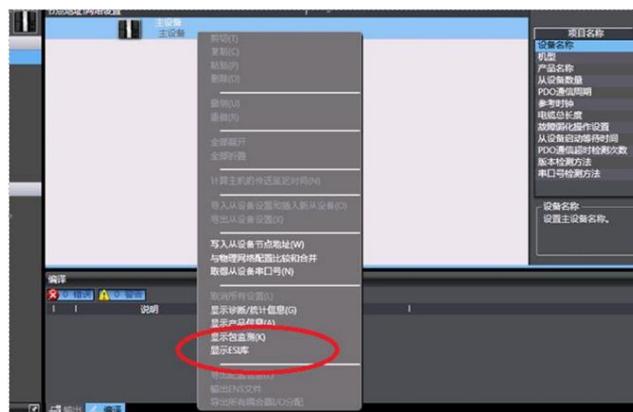


Figure 13-24 PLC connection

13.2.2 Adding HCFA Servo Drive

1. Add the HCFA Y7 EtherCAT servo drive XML file: Click "Configuration and Settings" → double-click "EtherCAT" → right click and select "Master Device" → display the ESI library and open "this folder" → copy the XML file of HCFA Y7 EtherCAT to this the folder. Restart Sysmac Studio to make the XML effective.

Notes: The XML file of HCFA Y7 series will be continuously updated without your notice.



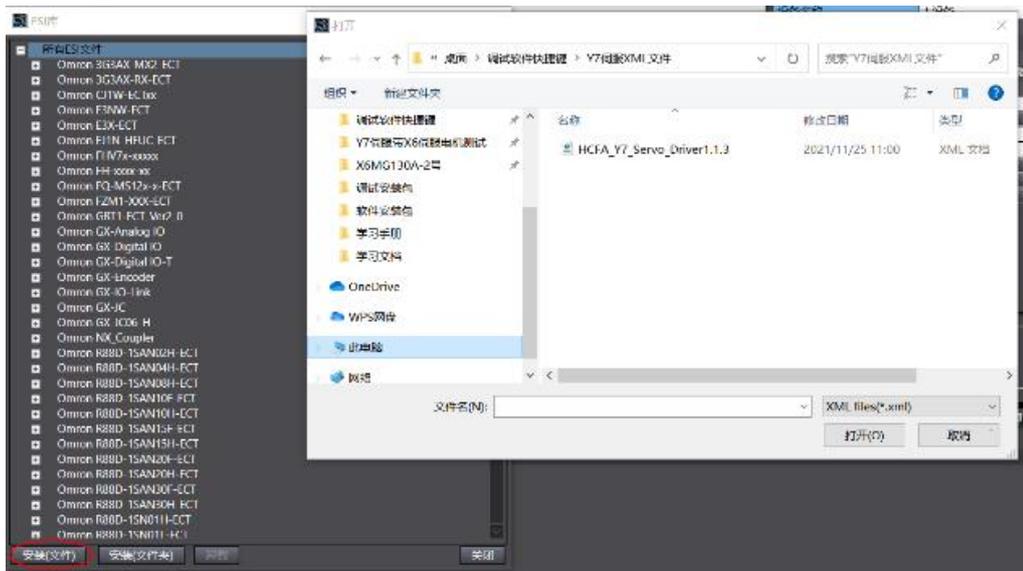
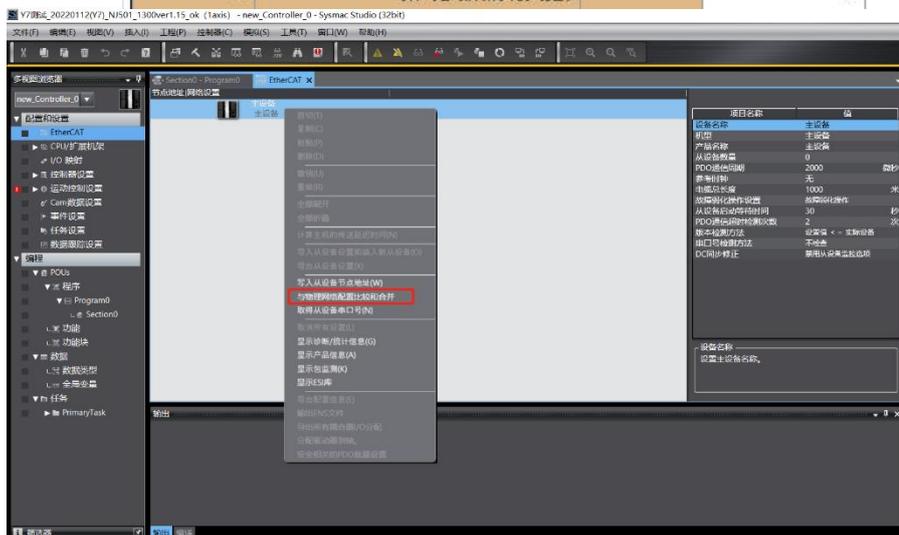


Figure 13-25 Y7 xml file installation

13.2.3 EtherCAT Parameter Setting

1. Add Y7 slave station (PLC must be online): At this time, both Pn787.0 and Pn787.1 in the parameters need to be set to 1; After reconnecting the PLC, expand "Configuration and Settings" → double-click "EtherCAT" → Right-click to select "Master Device" → Compare and merge with the physical network configuration → Find the error message "Node address out of range" → Click "Display dialog box for writing slave device node address" → "Slave device node address writing" pop up → Write node address "1" → Click "Write" → Then disconnect power supply from the Y7 drive → Restart the Y7 drive and the node address writing complete successfully.

| | | | |
|---------|-------------------|---|------|
| Pn786 | SiteAddressAlias | - | 0 |
| - Pn787 | FunctionSwitch 1 | - | 0011 |
| 0 | OvertravelSwitch | - | 1 |
| 1 | HostSetTypes | - | 1 |
| 2 | DDRMotor Function | - | 0 |
| 3 | 预约参数(请勿变更) | - | 0 |



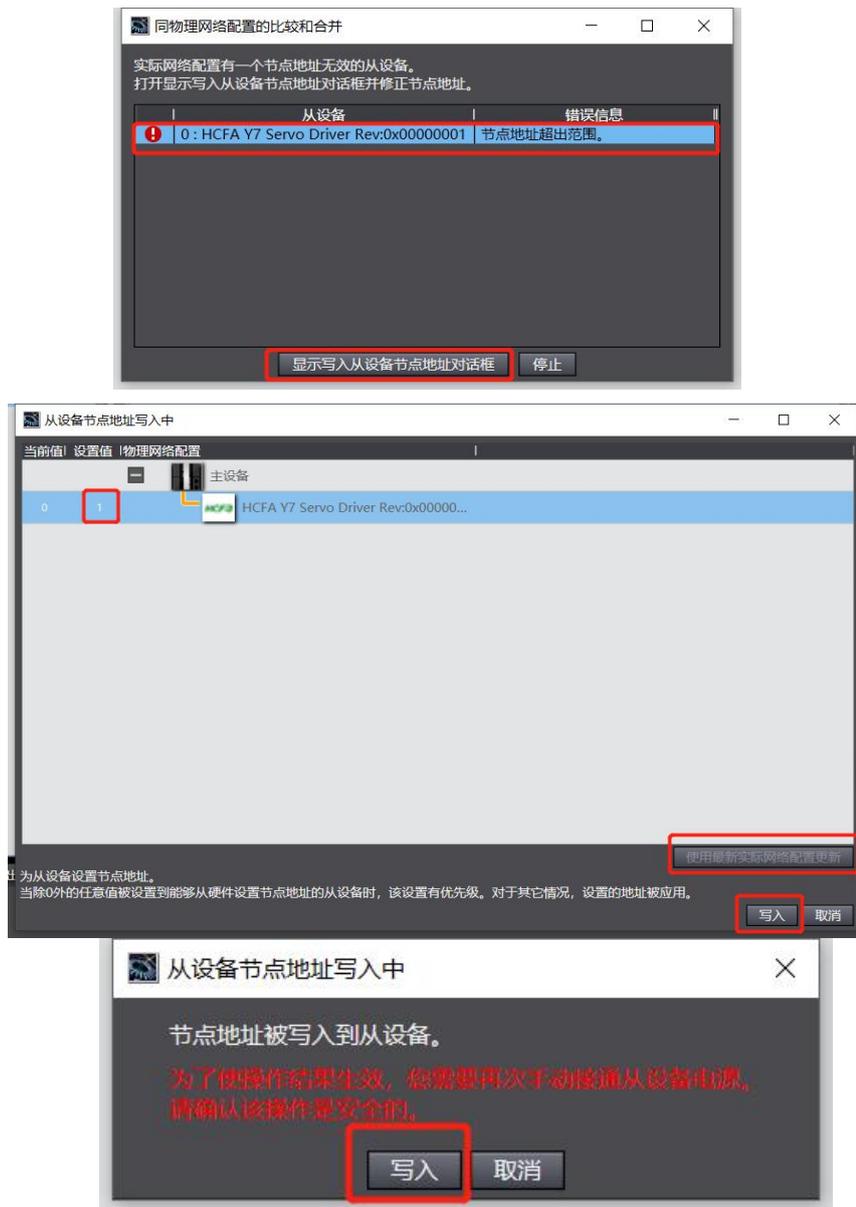


Figure 13-26 Y7 scanning

2. Operate as the previous steps, and add Y7 slave station (PLC must be online), and reconnect the PLC, expand "Configuration and Settings" → Double-click "EtherCAT" → Right-click to select "Master Device" → compare and merge with the physical network configuration → After discovering the Y7 slave station, click "Apply Physical Network Configuration (A)" → Click "Apply".

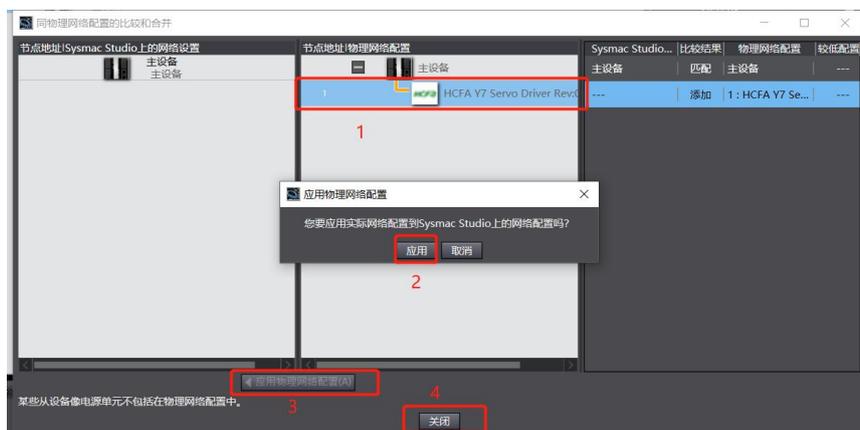


Figure 13-27 Y7 servo drive adding

3. You can also modify Pn790.2=1 through the host controller, and then modify Pn786 to write the node address of the servo:

| | | | |
|---------|-------------------------------|---|-------|
| - Pn790 | EcatFunctionSwitch 0 | - | 0000 |
| 0 | 第二编码器反馈 | - | 0 |
| 1 | 第二编码器单圈值反馈 | - | 0 |
| 2 | 节点地址功能开关 | - | 1 |
| 3 | 预约参数(请勿变更) | - | 0 |
| - Pn791 | EcatFunctionSwitch 1 | - | 0000H |
| 0 | 预约参数(请勿变更) | - | 0 |
| 1 | 预约参数(请勿变更) | - | 0 |
| 2 | 预约参数(请勿变更) | - | 0 |
| 3 | PowerOffSaveSwitch | - | 0 |
| Pn782 | SyncLostWindow | - | 0 |
| Pn785 | 10F1 Sync Error Counter Limit | - | 9 |
| Pn786 | SiteAddressAlias | - | 1 |
| - Pn787 | FunctionSwitch 1 | - | 0011 |
| 0 | OvertravelSwitch | - | 1 |
| 1 | HostSetTypes | - | 1 |
| 2 | DDRMotor Function | - | 0 |

i 节点地址功能开关
 值范围: 0-1
 出厂设定: 0
 0: 控制器。
 1: 伺服。

i SiteAddressAlias
 值范围: 0-255
 出厂设定: 0

Figure 13-28 Modify the server node address by the host controller

4. Add motion axis (PLC needs to be offline): Main menu "Controller" → Offline → Expand "Motion Control Settings" → Axis Settings → Add → Motion Control Axis".

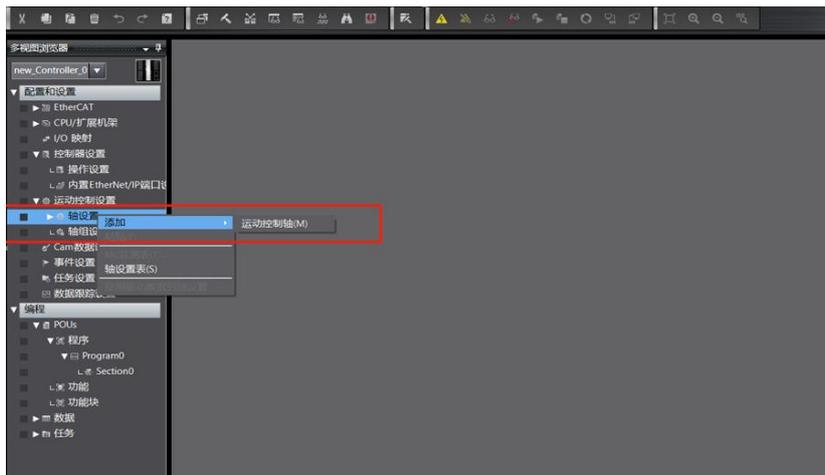


Figure 13-29 Motion control axis adding

5. Set motion control axis parameters

1) Servo axis adding:

Set the axis type to servo axis in the axis setting, and "Output device 1" is configured as Y7 servo drive, as shown in the figure below:



Figure 13-30 Servo axis adding

2) Set PDO parameters:

Enable DC synchronization and select the appropriate PDO mapping parameter group: EtherCAT → Node address/network setting → Y7 slave station E001 → distributed clock is valid, select "Enable (DC-Synchron)" → Edit PDO mapping settings, and select the appropriate PDO mapping group (Note that only the first group of Rx/Tx PDOs can be edited, other groups cannot) → Select the appropriate Rx/Tx PDO parameters, and click "OK" to exit

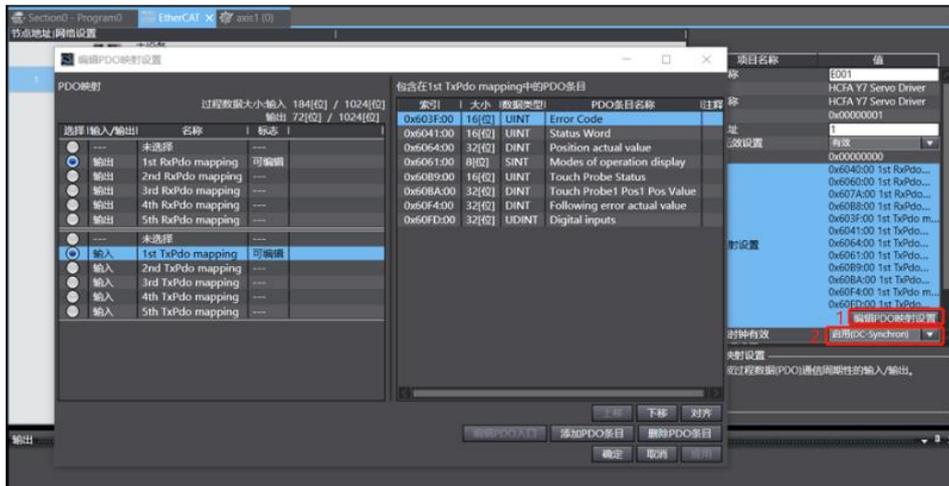
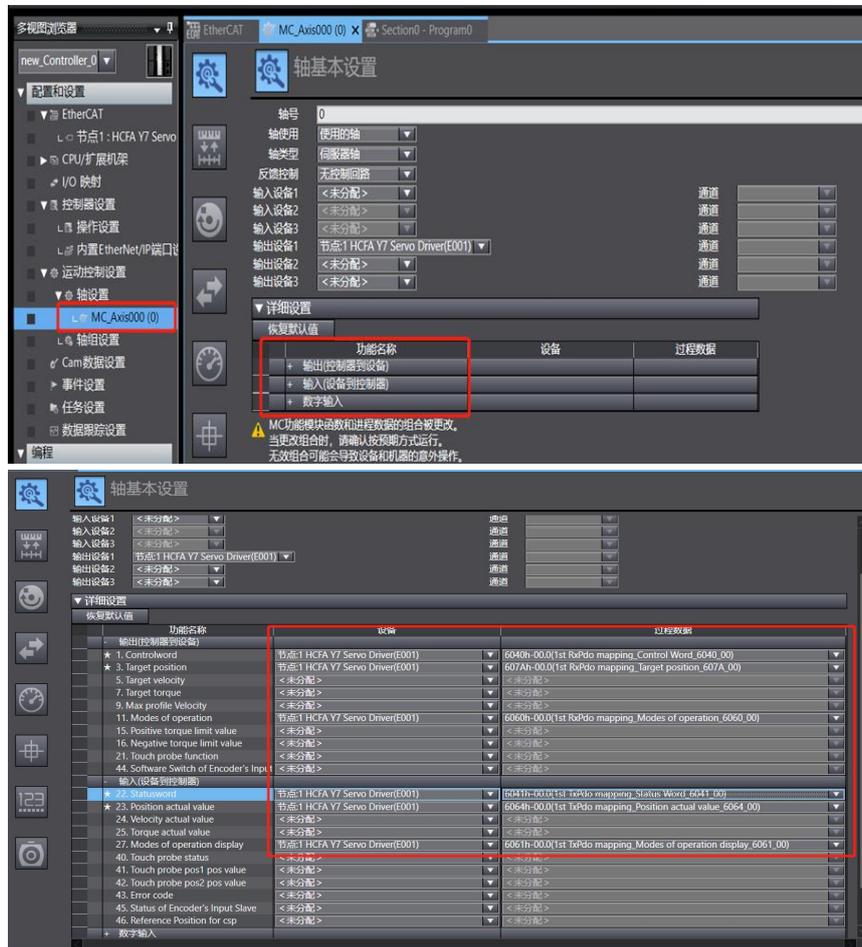


Figure 13-31 PDO parameter configuration

3) Mapping motion control axis PDO parameters

Y7 servo drive must manually configure PDO parameters, double-click MC_Axis000 (0), enter into the axis basic setting → Click detailed settings → Set related parameters about output (controller to device), input (controller to device), digital input, shown as follows.



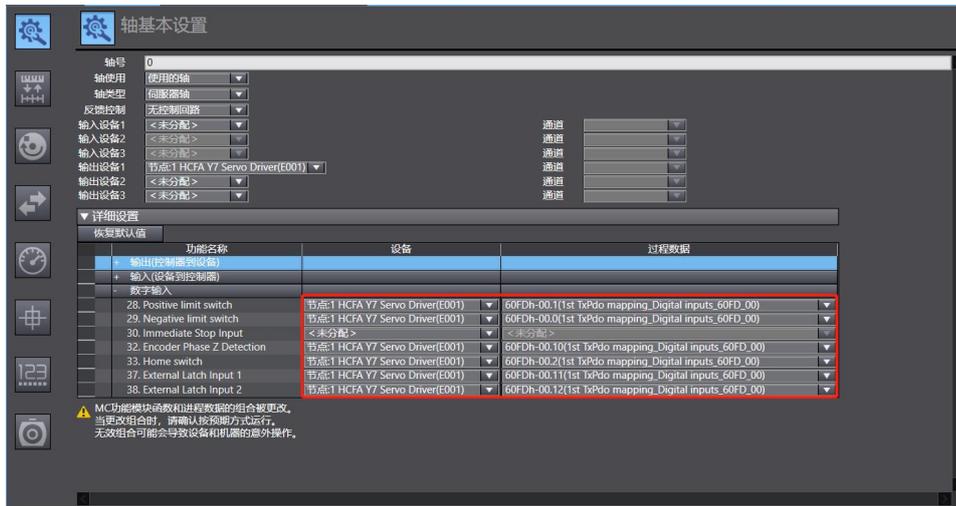


Figure 13-32 Mapping motion axis PDO parameters

Notes: Due to the limitation of Omron background configuration, all Y7 servo axis settings need to be manually configured.

4) Unit conversion settings:

MC_Axis000 (0) → Unit conversion setting→ Set appropriate parameters, shown as follows:

The travelling distance per motor revolution: Currently HCFA generally uses a 23bit resolution encoder, which should be set to 8388608.

Per Motor revolution command: Can be set according to the demand. Per motor revolution command=8388608 means 10000 PLC pulses command, the motor rotate one revolution, that is, when the command is constant at 500000, the corresponding motor speed is 3000rpm.

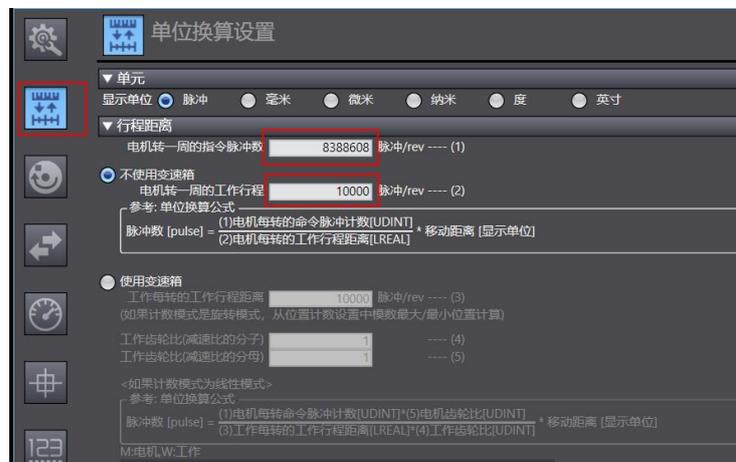


Figure 13-33 Unit conversion settings

5) Operation settings:

According to the actual setting, the maximum acceleration and deceleration is 0: Means the maximum acceleration and deceleration, and the torque is 0: Means no warning. If there is no special requirement, use the default value.

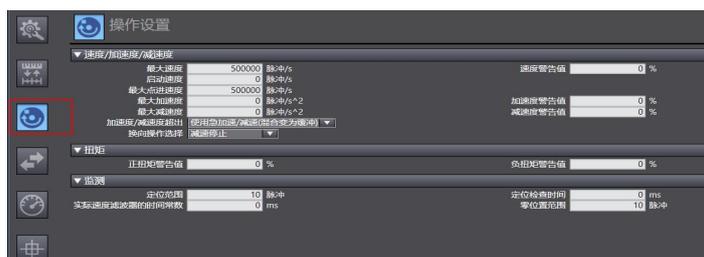


Figure 13-34 Operation setting

6) Limit setting:

Set the parameters according to the actual use.

Notes: The limit becomes valid when the homing return completed.



Figure 13-35 Limit setting

7) Homing return setting

This homing is customized by Omron, and has nothing to do with the built-in homing method of the servo driver. However, when using the servo, the relevant parameters (positive and negative limit, origin switch, etc.) must be set. The external signal can be directly connected to the servo driver, and it is not necessary to connect to the PLC. But the relevant parameters of Omron homing method must be set according to the following. After setting the homing speed, origin offset, use MC_home in PLC programming to return to the origin.

Note: The origin proximity signal in Omron is the origin switch signal in HCFA Y7 servo drive.

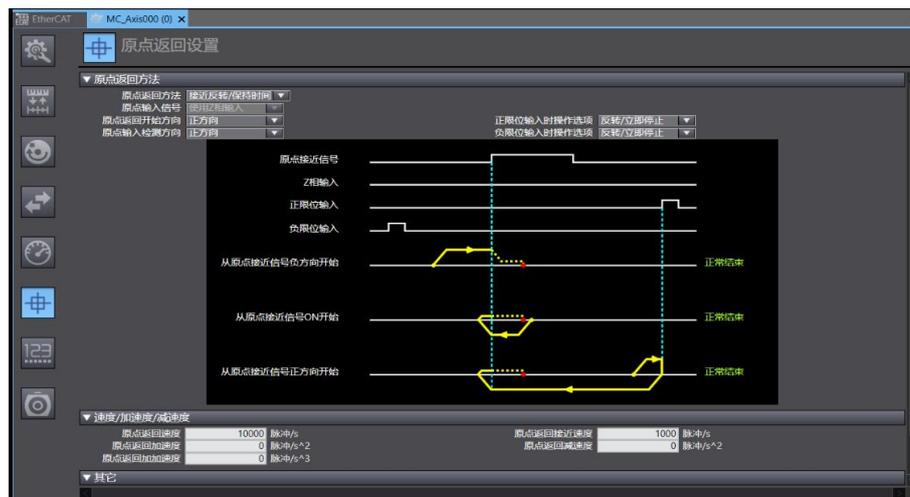


Figure 13-36 Homing return setting

Set the homing return as belows:

Table 13-1 Combination of the servo and host controller

| NJ series software description | Corresponding function | Terminal configuration |
|--------------------------------|------------------------|------------------------|
| Origin proximity signal | Origin switch | S10 (PIN40) |
| Positive limit input | P-OT | S12 (PIN42) |
| Negative limit input | N-OT | S13 (PIN43) |

According to the actual mechanical situation, select the homing method of the upper controller, and set the homing speed, acceleration, and origin offset

Notes: Homing introduction

Function block: MC_Home and MC_HomeWithParameter:

1. The parameters of MC_Home can be set as above; MC_HomeWithParameter Parameters are set at the function block.
2. There is no difference between the two homing functions, both including 10 homing modes.

| MC_Home | MC_HomeWithParameter |
|--|---|
| 接近反转/原点接近输入 OFF 接近反转/原点接近 ON 原点接近输入 OFF 原点接近输入 ON 限位输入 OFF 接近反转/原点输入掩码距离 仅限位输入 接近反转/保持时间 无原点接近输入/保持原点输入 零位置预设 | 指定要改写的原点复位动作。 0: 指定为附近避让、近原点输入 OFF 1: 指定为附近避让、近原点输入 ON 4: 指定为近原点输入 OFF 5: 指定为近原点输入 ON 8: 指定为极限输入 OFF 9: 指定为附近避让、原点输入屏蔽距离 11: 仅极限输入 12: 指定为附近避让、接触时间 13: 指定为无近原点输入、接触原点输入 14: 原点预设 |

Figure 13-37 Homing introduction

Origin proximity input OFF: Start to find the origin signal after meeting the falling edge of the origin proximity switch.

Origin proximity input ON: Start to find the origin signal when meeting the rising edge of the origin proximity switch.

Nearby avoidance/ proximity reverse: When the homing return starts, the origin approach signal is ON, and it will run in reverse immediately after meeting the falling edge of the origin proximity signal;

Origin input mask/shielding distance: After the upper controller receives the origin signal (such as the edge change of the origin approach signal), if within the set distance, the origin signal is shielded, and then the origin signal is received after the distance;

Hold time/contact time: After the upper controller receives the origin signal (such as the edge change of the origin approach signal), it shields the origin signal within the set time, and starts to receive the origin signal after this period of time;

Zero position preset/origin preset: that is, the current position is taken as the origin, the motor does not move, and the host controller writes the origin offset into the position command/position feedback in the host controller.

Note: All homing methods ultimately find the origin signal at low speed. If there is a high-speed running segment, the origin signal is shielded during the deceleration process from high speed to low speed.

13.2.4 Sync Cycle Setting

Double-click "Task Setting" to enter the setting → Select the appropriate cycle, there are 4 choices: 500 microseconds, 1 millisecond (by default), 2 milliseconds, and 4 milliseconds, and set some other parameters (if necessary), it is recommended not to lower than 1ms, the cycle time > the number of slave stations X0.1ms.

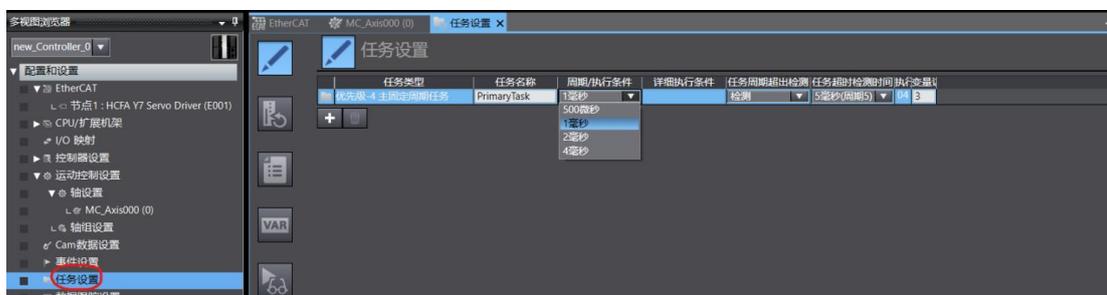


Figure 13-38 Sync cycle setting

13.2.5 Test Run

1. Write PLC program (take graphic diagram as an example)

Programming→POUs→Program→Program0→Double-click Section0 (if this part not displayed, select to insert the ladder diagram in Program0) to enter the programming screen.

Note: In order to make the running effectively, enabled command (MC_Power), motion command (such as jog command MC_MoveJog, absolute position command MC_MoveAbsolute, relative position command MC_MoveRelation, axis stop command MC_Stop, axis return command MC_Home) are necessary. For the specific usage of the command application, press F1 to check the help.

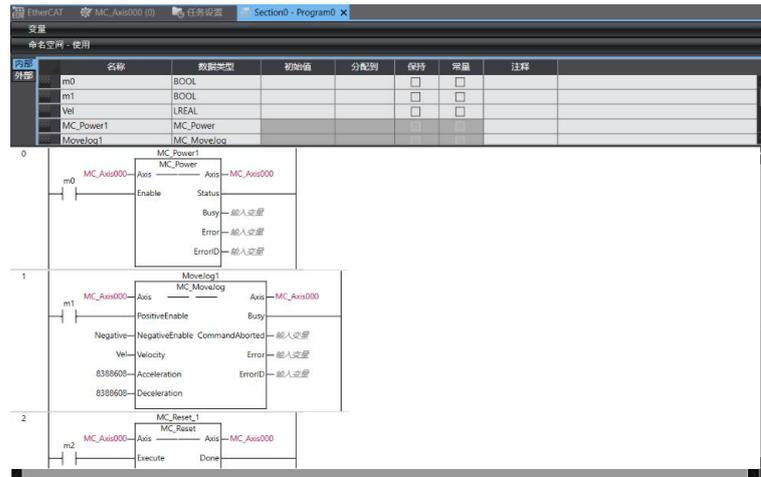


Figure 13-39 Program example

2. Project compiling(offline)

In Main menu, Project (P) → Recompile Controller (R).

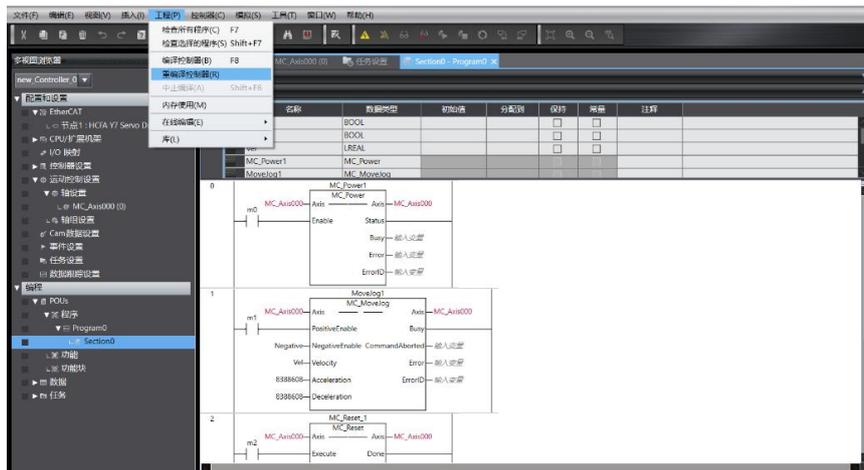


Figure 13-40 Programming compiling

3. Download project to PLC

In Main menu, Controller (C) → Online → Transferring (A) → Transfer to Controller (T). If there is an error, there will be a red alarm dot in the sysmac Studio. Some alarms can be cleared through the built-in function of the software: In main menu, Tools (T) → Troubleshooting (T) →click "Reset all" in the pop-up screen

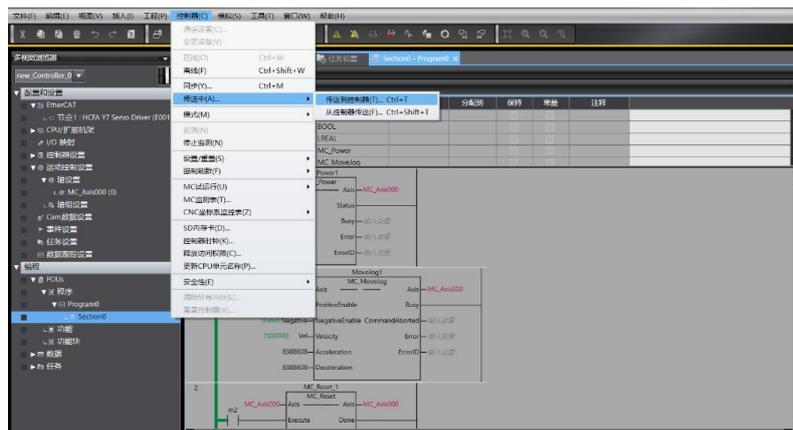


Figure 13-41 Program download

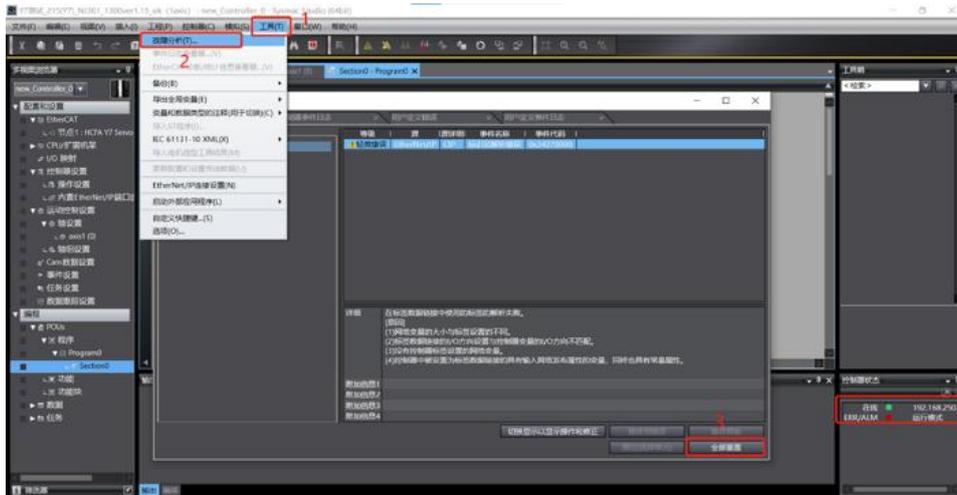


Figure 13-42 Troubleshooting

4. Data monitoring

You can monitor the PDO parameters related to the servo slave station in "Configuration and Settings" - "I/O Mapping". You can monitor the DI, DO, and various states of the servo slave station in the main menu → controller → "MC inspection table".

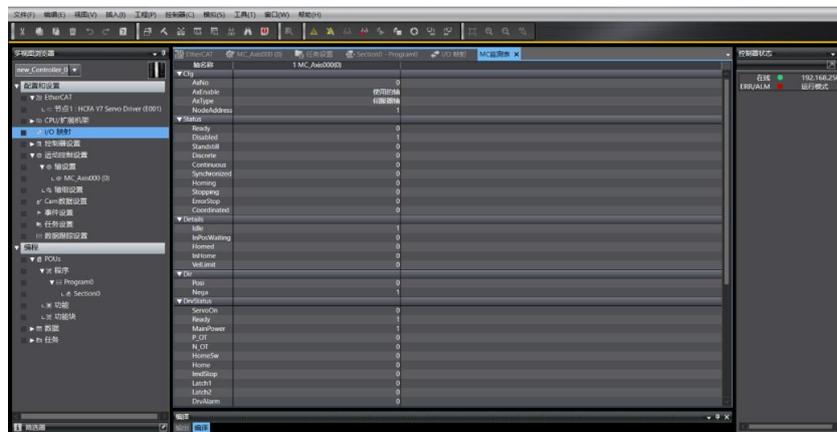
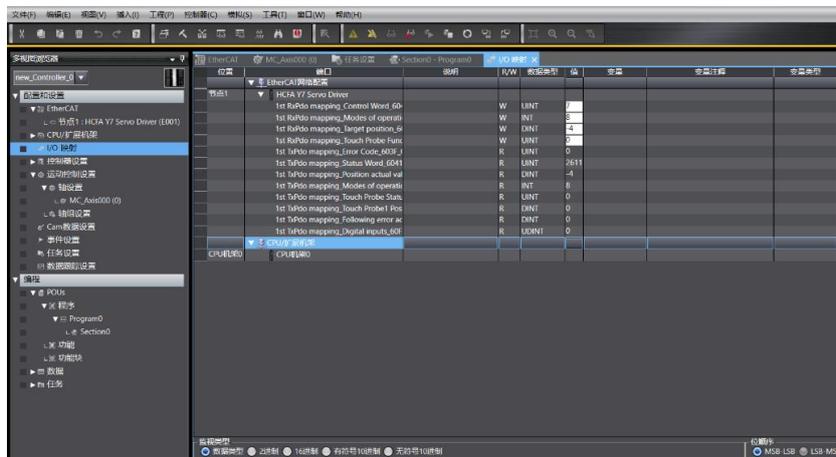


Figure 13-43 Data monitoring

5. Project exporting

When the edited Omron PLC project needs to be used on other computers, the project needs to be exported (means

to "save as").

Method: Programming → File (F) → Export (E), select the file name, save type, save location to "Save as".

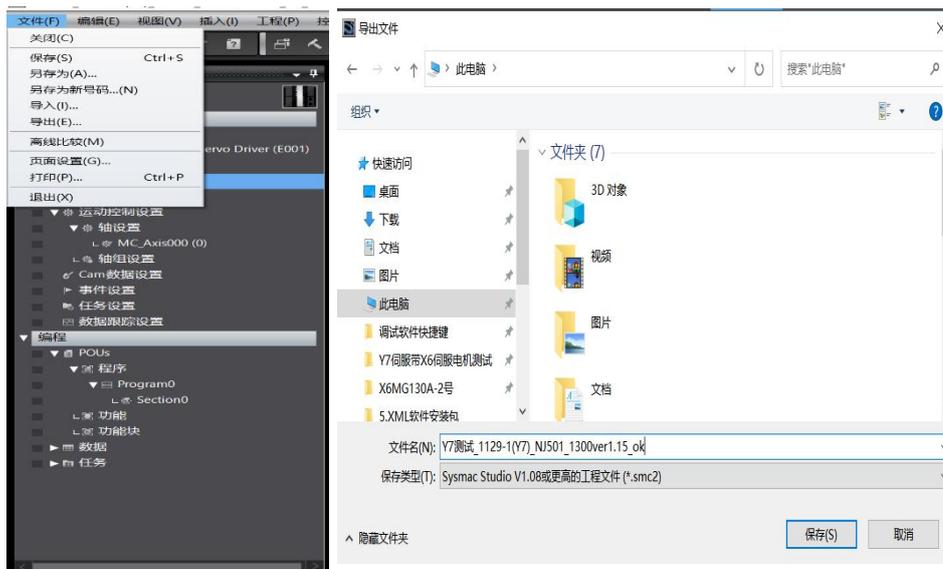


Figure 13-44 Project exporting

13.3 Application Examples with Beckhoff PLC_CX2020

13.3.1 Create a connection

1. Put the Y7 description file in the TwinCAT3 root directory: C:\TwinCAT\3.1\Config\Io\EtherCAT, right-click the TwinCAT3 to select System→Config to switch the TwinCAT3 state to ensure that the description file is updated successfully.

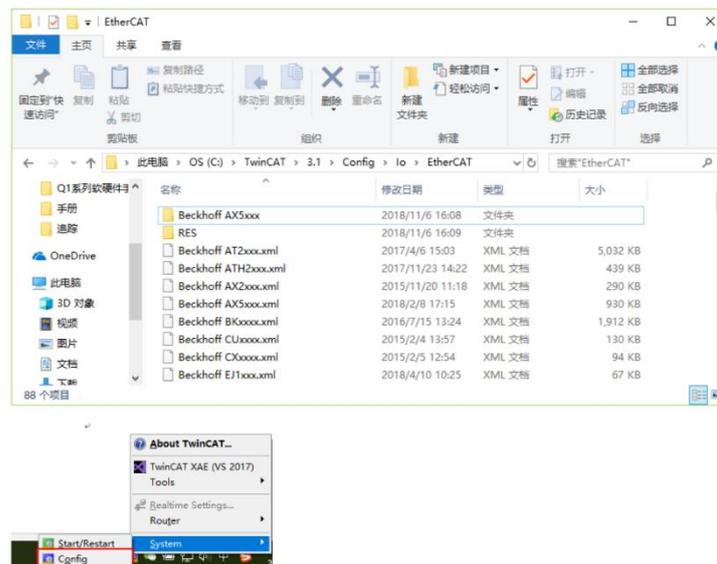


Figure 13-45 Saving description file

2. New TwinCAT3 solution

After completing the connection between PC (or Beckhoff controller IPC) and Y7 servo drive, click the TwinCAT3 to select TwinCAT XAE. After opening the TwinCAT3 software, select File→New→Project, select the TwinCAT Project under the Template on the left in the pop-up dialog box New Project, set the solution name and storage path, and click OK to complete the creation.

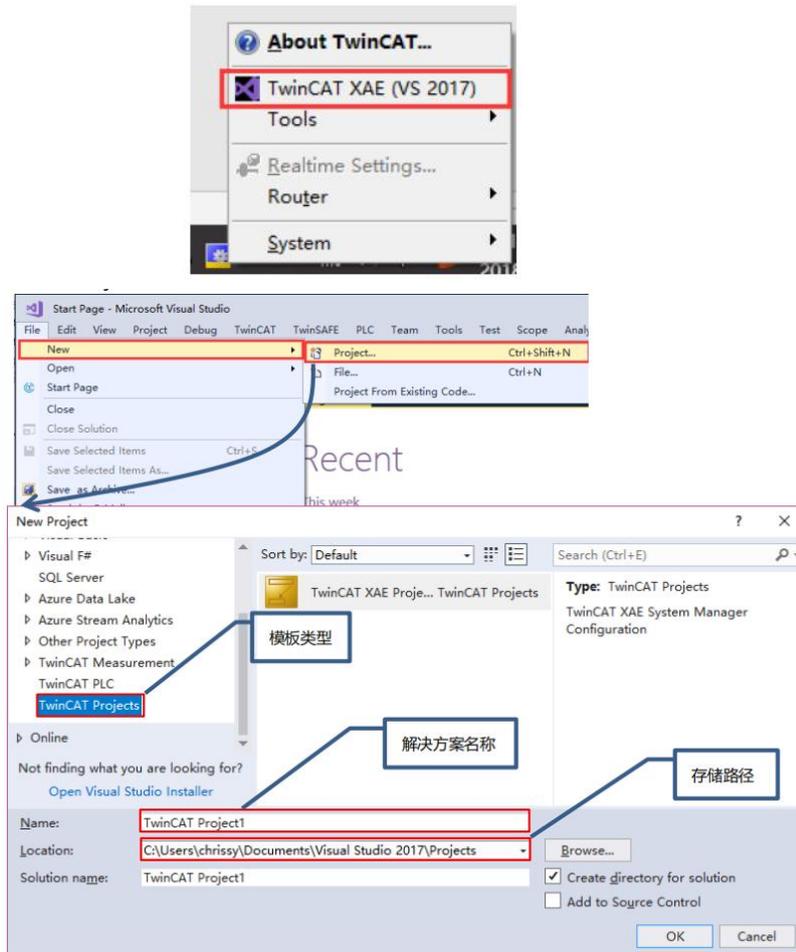


Figure 13-46 New project

3. Servo drive scanning

Scan IO after switching TwinCAT3 to configuration mode.

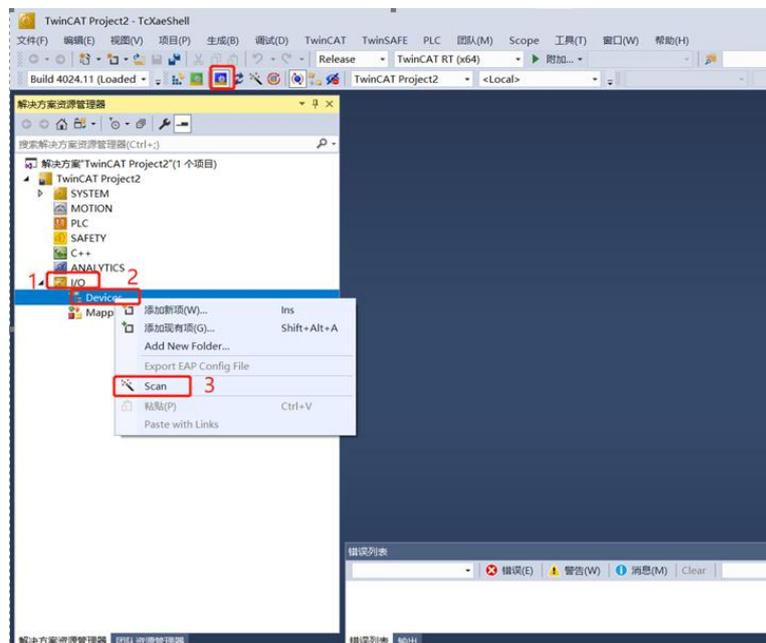


Figure 13-47 Servo screen scanning

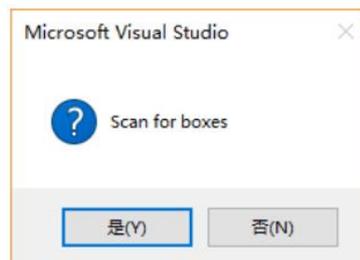
A dialog box pops up: Not all types of devices can be found automatically, click "OK"



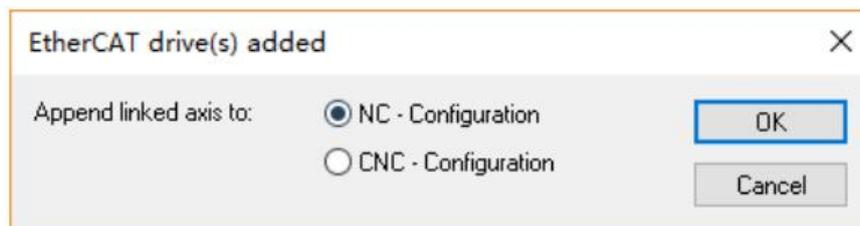
EtherCAT bus found, click "OK"



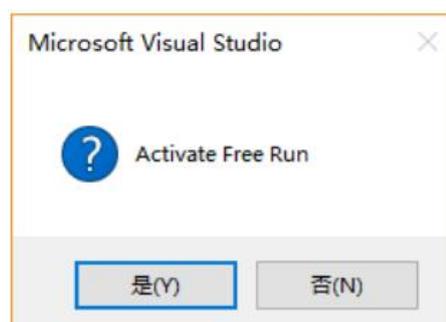
Scan for boxes? Click "Yes" .



When the motion control device is scanned, the system will ask whether to associate the scanned axis with the NC configuration, click "OK" to complete the mapping.



Click "Yes" to activate the Freerun debugging mode. In the debugging mode, the user can test the IO without a program.



After completing the above steps, you can see that the Y7 servo drive has been successfully scanned in menu "I/O" → "Devices".

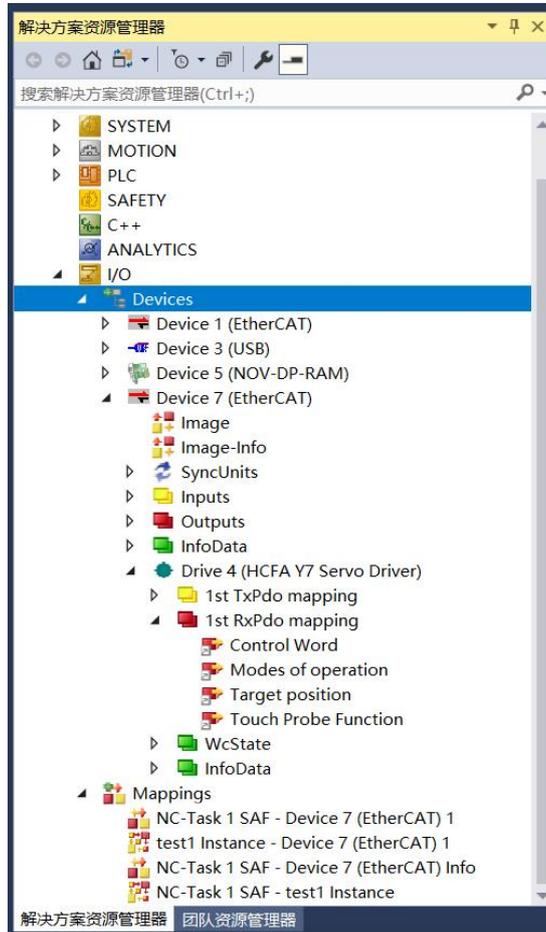


Figure 13-48 Scanning completed

13.3.2 EtherCAT Parameter Setting

1. Change the servo drive to work in DC mode If the default is DC and no modification is required

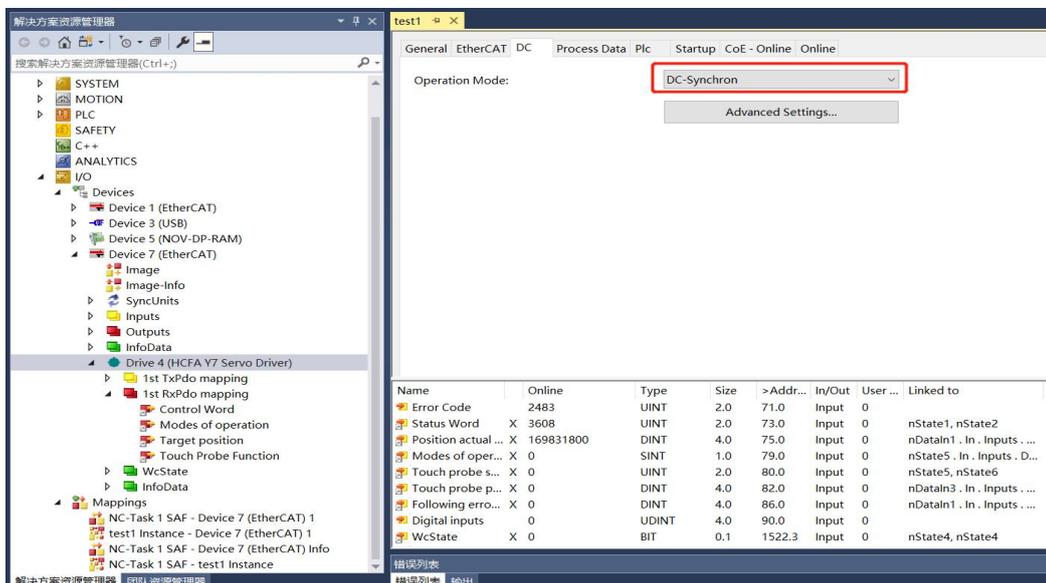
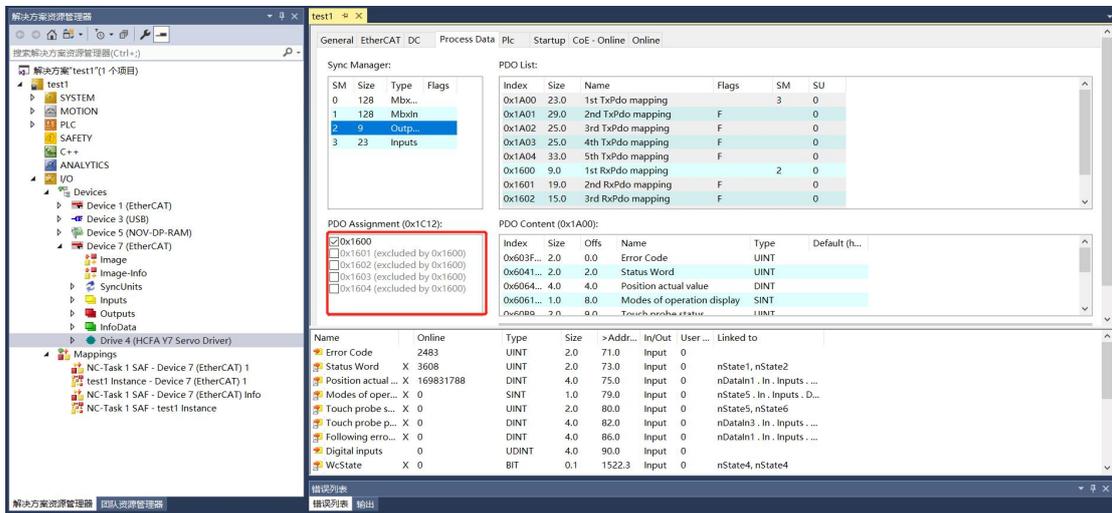


Figure13-49 Operation mode changing

2. Select the desired PDO mapping

Click the scanned Y7 servo drive, and find "Process Data" in the setting.



The operation mode of the servo drive is added by default in the first group of PDOs. Right-click "Operation Mode" and select Clear Link(s) to clear the original link. After that, the process data needs to be linked to the operation mode in the program.

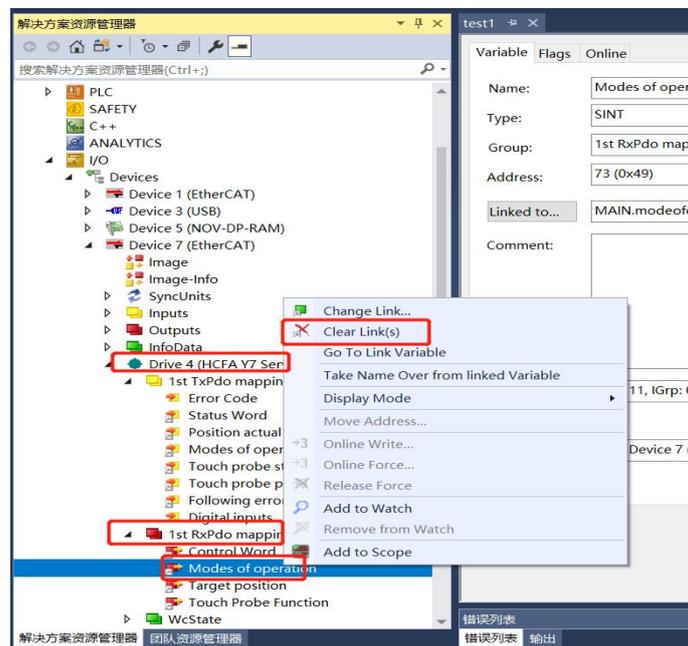


Figure 13-50 Select PDO mapping

3. Set encoder parameters

Find "Motion" → "Axes" → "Axis1" → "Enc" → "Paramter" to set the encoder parameters.

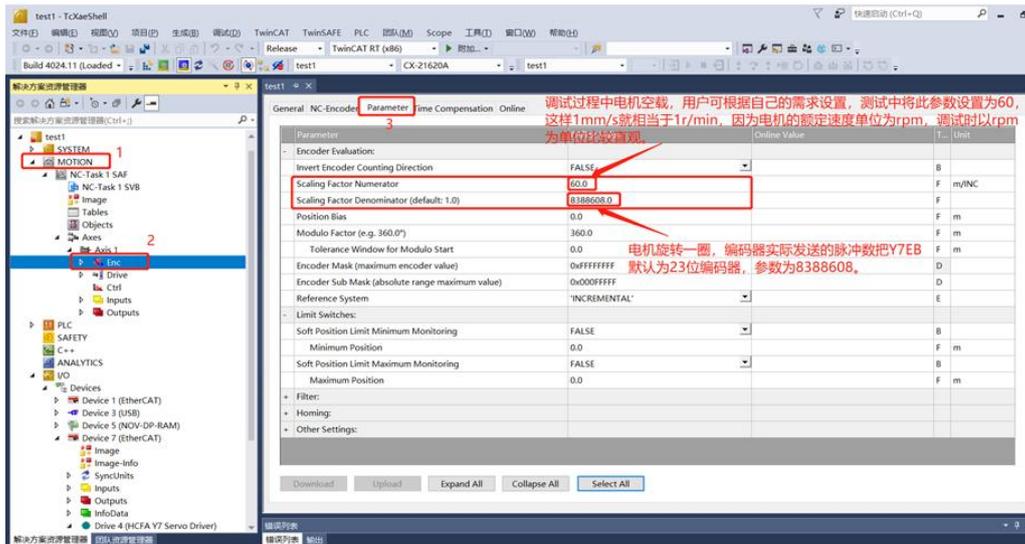


Figure 13-51 Encoder parameter setting

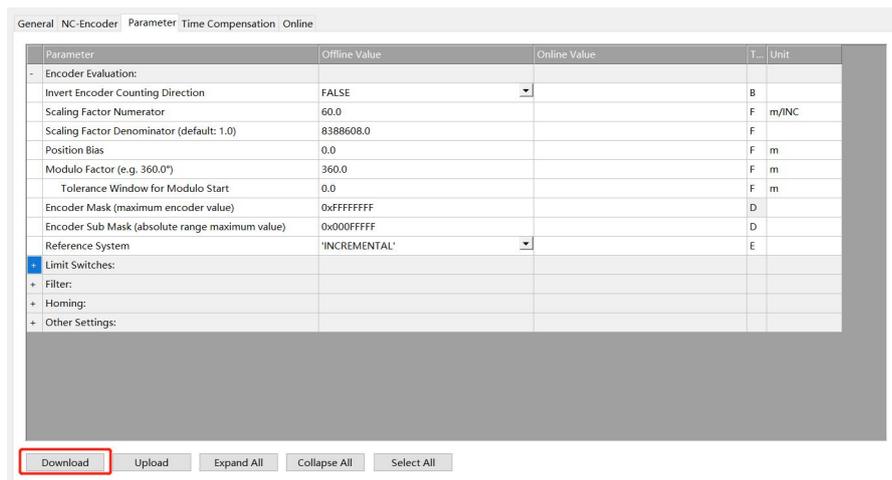
Scaling Factor indicates the distance corresponding to the encoder pulse of each position feedback

Scaling Factor Numerator Indicates the displacement of the actuator per motor revolution ;

Scaling Factor Denominator Indicates the number of pulses sent by the encoder per motor revolution ;

Encoder Sub Mask (absolute range maximum value) : The encoder submask is related to the maximum feedback value. For example, for a 16-bit incremental encoder, it will change to 0 if it exceeds 65535 in the positive direction. At this time, the NC will handle the zero-crossing problem, and the position is increasing steadily, at this time, SubMask should be set to 0x000FFFFF. Generally, set the position feedback increment per motor revolution of some other servo drive (including Y7 series) 36000. If single-turn reset is enabled, then SubMask should be set to 35999, otherwise NC may make mistakes at position accumulation.

The parameters setting are as follows. After the setting completed, select a single parameter that needs to be modified, and update the download data one by one or directly activate the configuration to download all parameters in the “Download” .



A dialog box pops up that Changes are temporary and will lost after restart! Click "OK" and you can see that the offline value will be written into the online value.

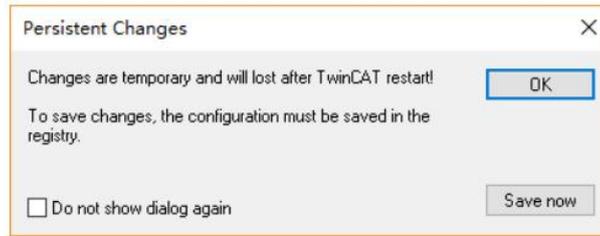
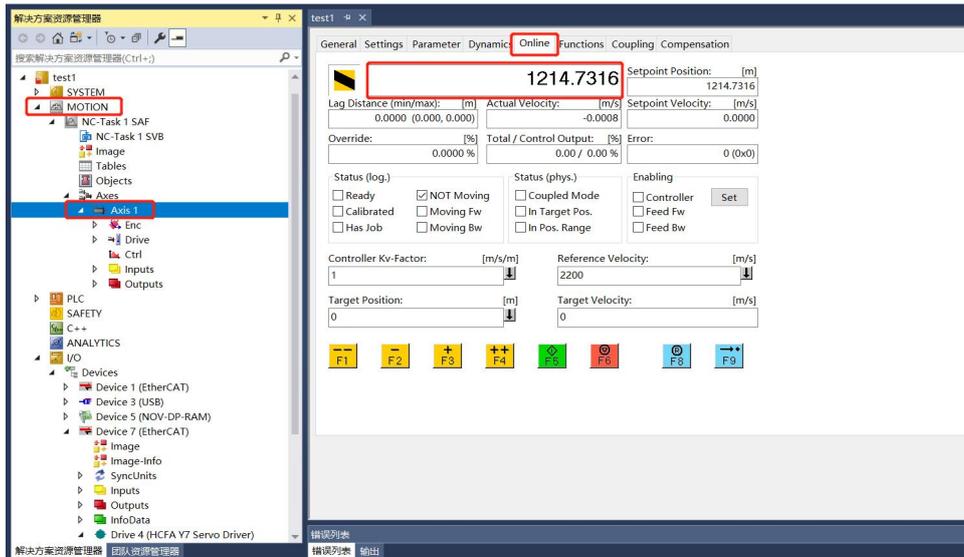


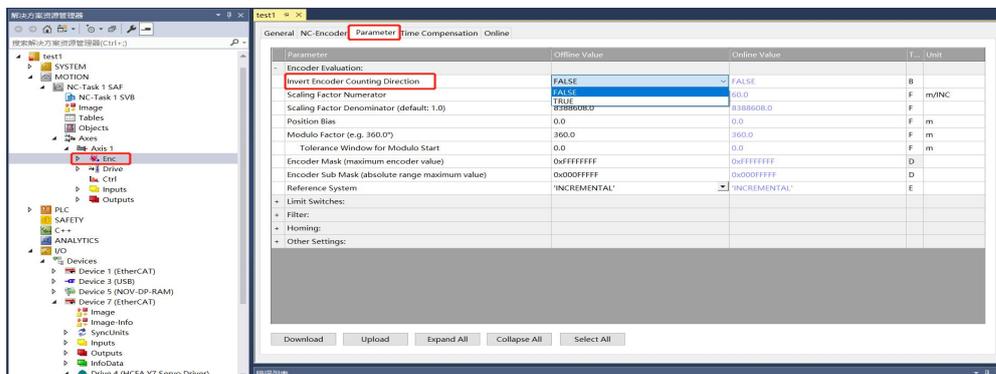
Figure 13-52 Parameter download

4. Check the encoder feedback direction

After selecting "Motion"→"Axes"→"Axis1"→"Online", manually rotate the motor forward to check whether the encoder value increases positively. If the motor rotates positively, but the feedback value decreases, you need to adjust the polarity of the motor and encoder counting direction.



The figure below shows how to adjust the counting direction of the encoder.



The following figure shows the polarity adjustment of the motor, which needs to be completed at the same time as the previous step, so as not to cause encoder count errors

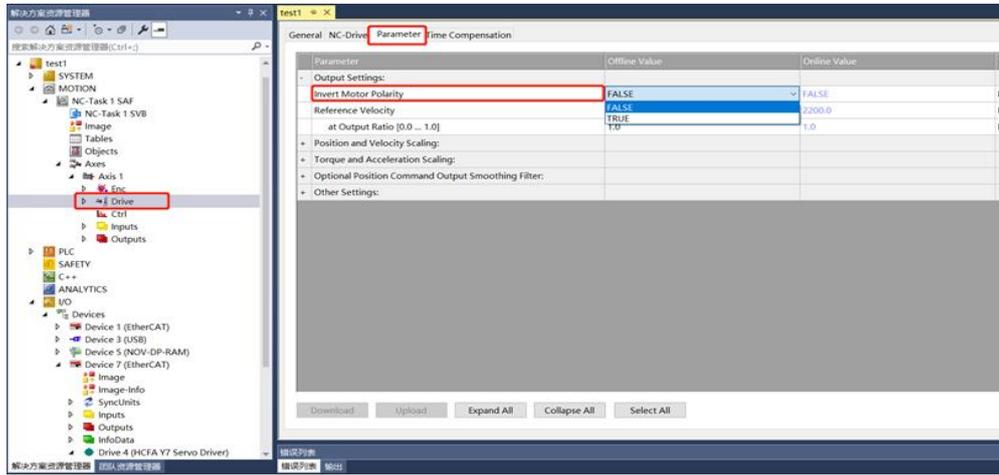
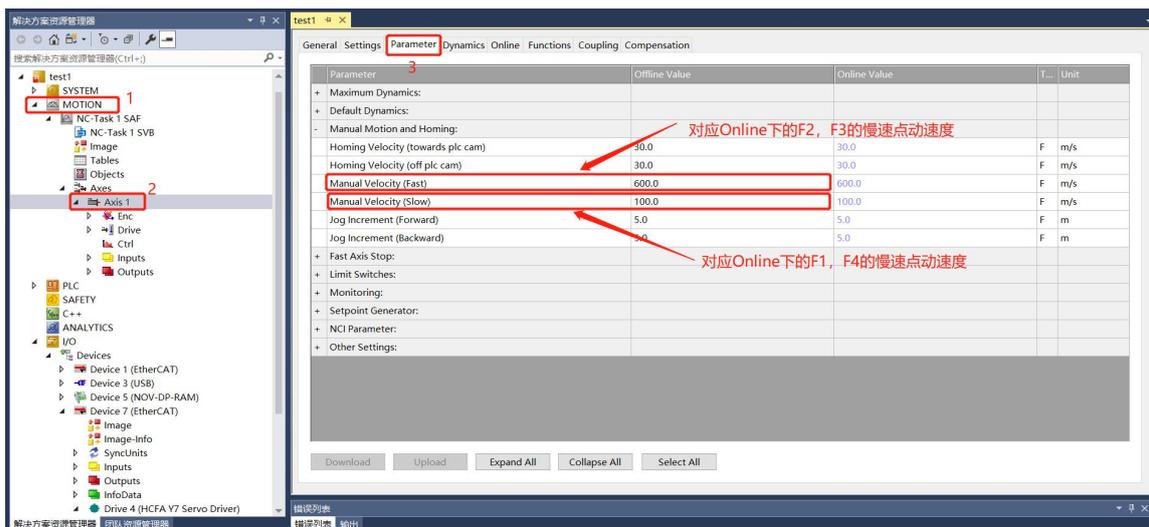


Figure 13-53 Check feedback

5. Modify NC manual debugging speed

Take Y7 series 750W servo drive with a rated speed of 3000rpm as the example. Users can modify the speed of manual debugging on the NC-Online in "Motion"→"Axes"→"Axis1"→"Parameter"→"Manual Motion and Homing".



Fi

Figure 13-54 Modify NC manual debugging speed

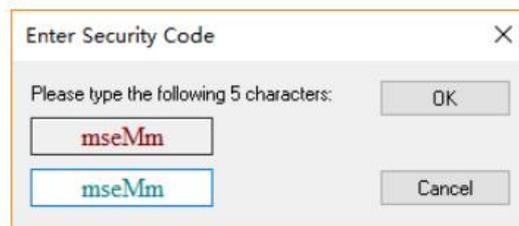
13.3.3 Test Run

1. Enable the project and commission the servo drive on the NC interface

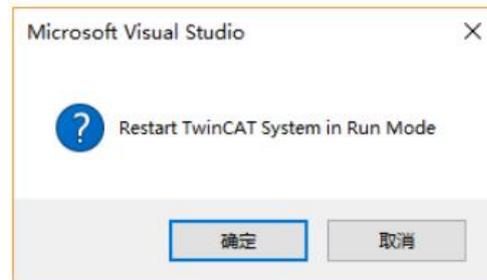
Find the activation button on the toolbar to activate the currently configured project to the running state.



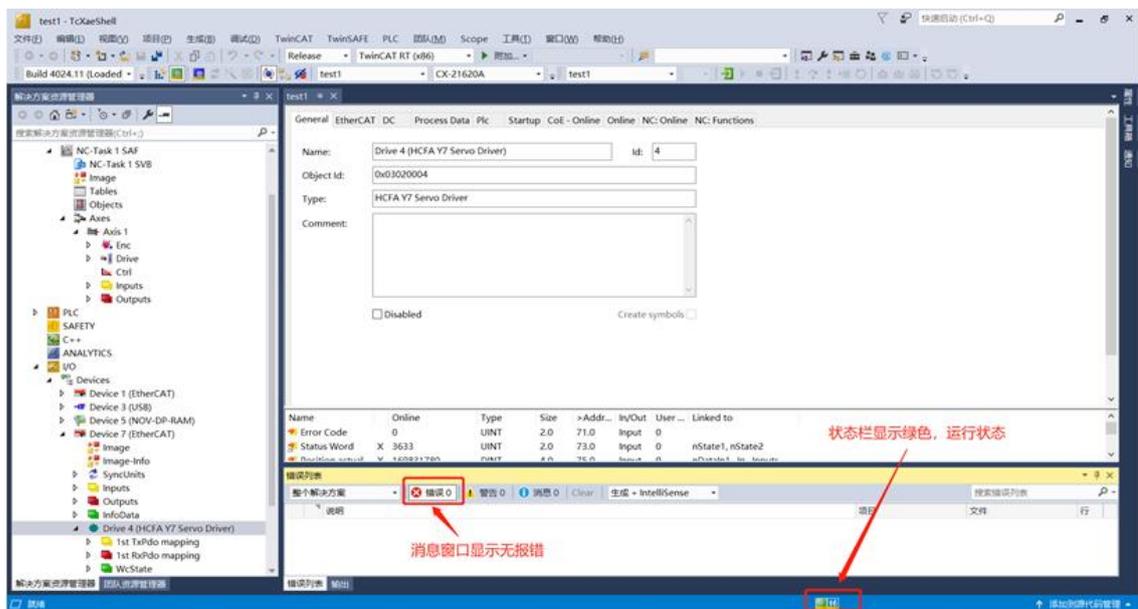
The system will pop up a dialog box prompting you to enter a five-digit verification code. The verification code is case-sensitive. This is because Beckhoff's NC is charged, but a seven-day free trial is provided. Enter the verification code correctly to obtain a seven-day temporary authorization. Enter it correctly according to the prompts After the verification code turns from blue to green, click "OK".



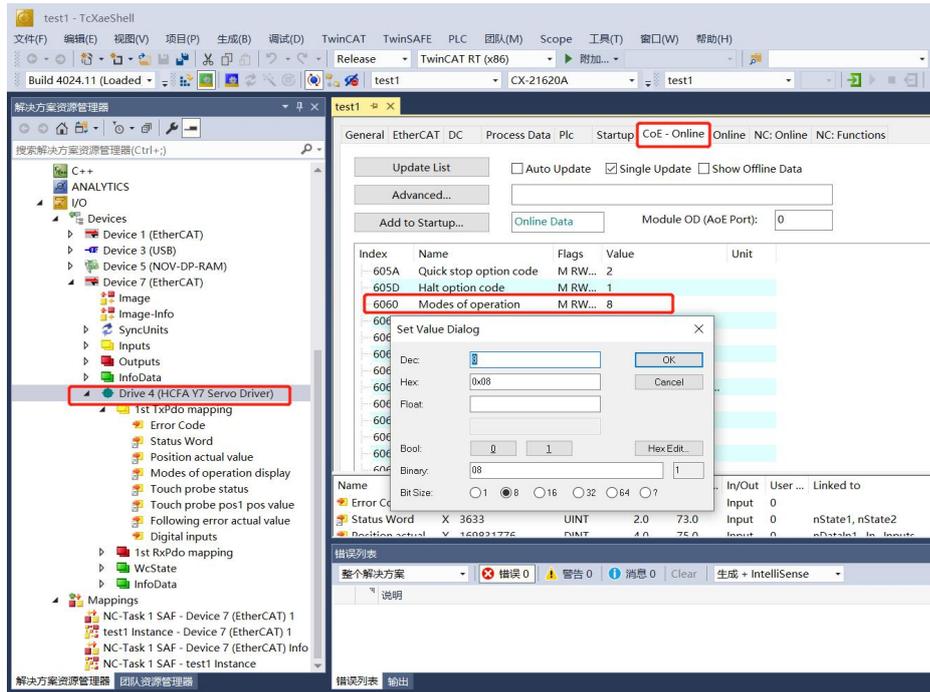
The system prompts whether to switch TwinCAT to the running mode, click OK



After switching the running state correctly, the screen is displayed as follows:



Specify the working mode on the COE interface of the axis that needs to be debugged, select "I/O"→"Devices" to expand the EtherCAT master station, find the Y7 drive, click to find the CoE-Online on the right, and click to find 6060 Mode of Operation, double-click to modify the working mode to CSP, which is the given number 8.



After setting the working mode, enter into "Motion" → "Axes" → "Axis1" → "Online" for programless debugging.

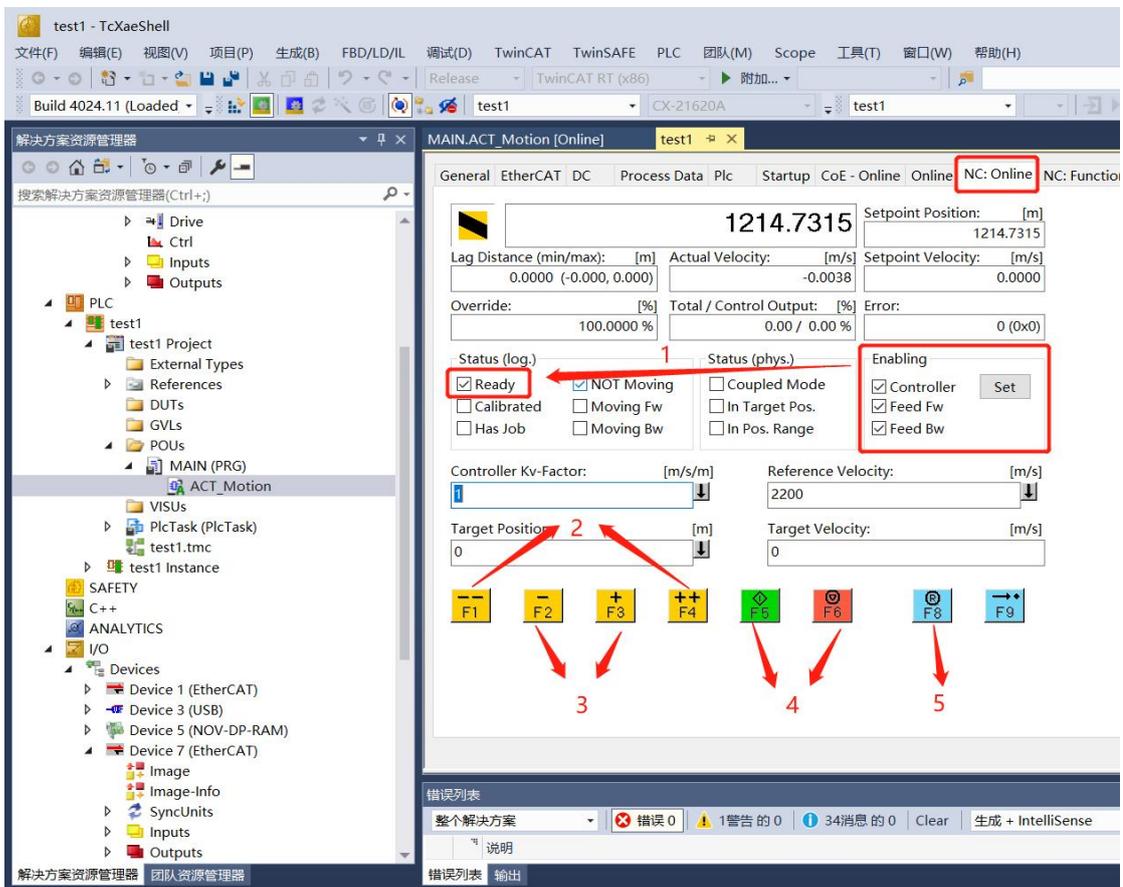
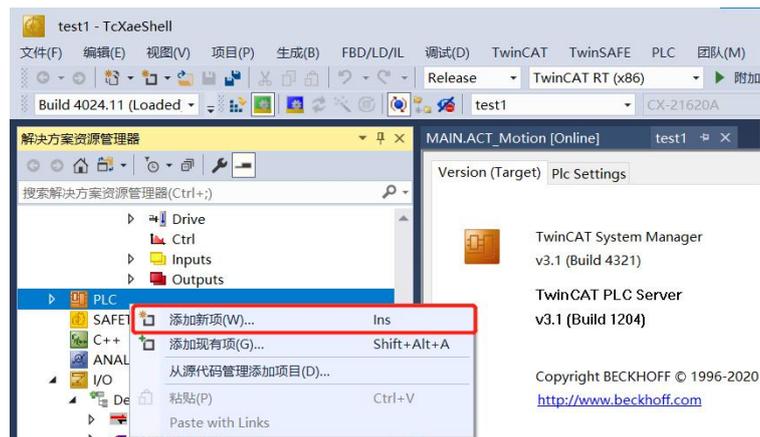


Figure 13-55 Running status

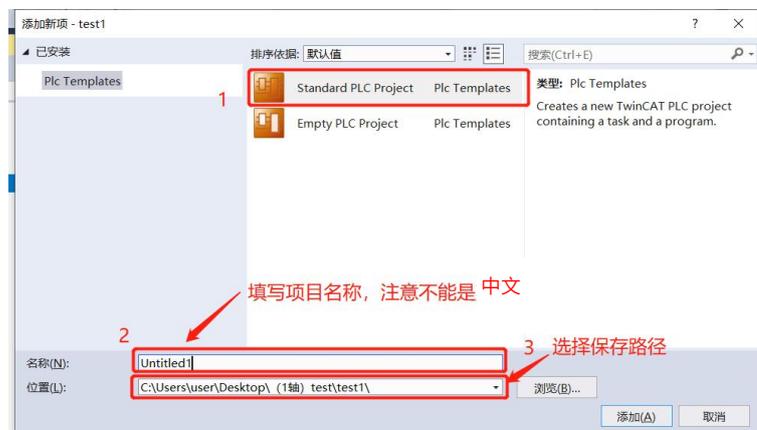
- ① Select the Set on the right side of Enabling in the Online, select all in the pop-up dialog box to Status (log.) ;
Tick before ready, at this time the drive and motor have no error and are ready to execute motion control commands, manual debugging with F1-F4 ;
- ② F1 means reverse fast jog, F4 means forward fast jog, the speed is set in Parameter;
- ③ F2 means reverse slow jog, F3 means forward slow jog, the speed is set in Parameter;
- ④ F5 means to start, F6 means to stop;
- ⑤ F8 means reset, when an error occurs, you can reset it by F8.

2. Write test program

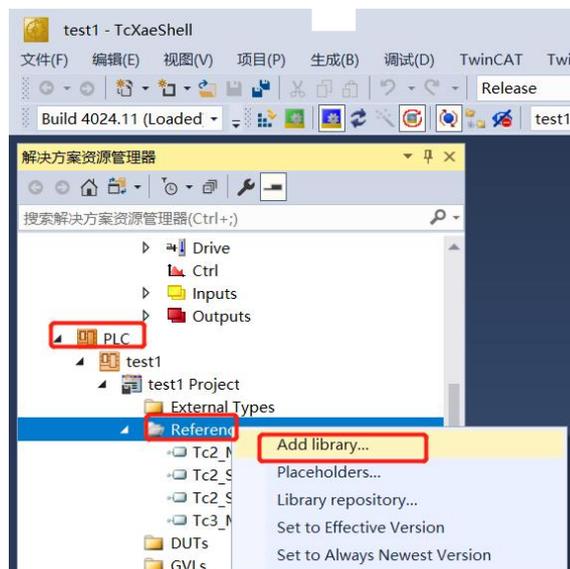
First create a new PLC project, select the "PLC" and find "Add New Project".



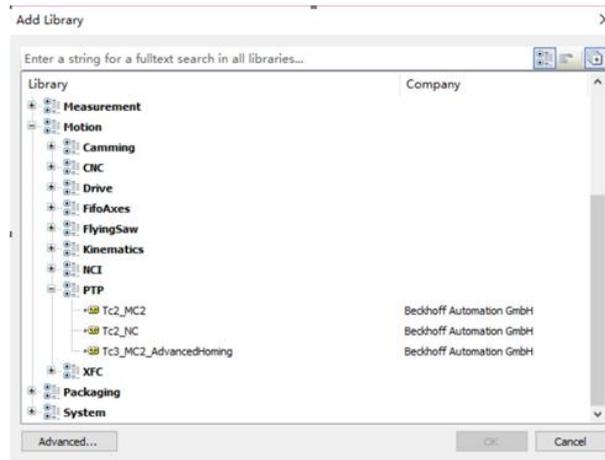
In the new PLC project dialog box, choose to create a new standard PLC project. This project will contain a task and a default created "Main" program. Fill in the project name, modify the save path, and click "Add"



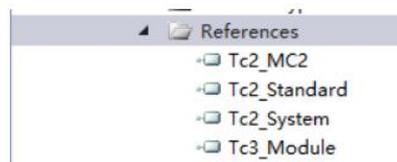
Add motion control library, find "PLC" → "Reference" → "Add Library"



Find Tc2_MC2 on Add library, select "OK" in the lower right corner to add.



After the addition is complete, the library is referenced under "Reference".



Next, write a sample program. Through this program, multiple axes can be jogged by switching the variables linked on the I/O interfaces of the function block Jog1. It should be noted that MC_Jog itself has multiple working modes. Please refer to the Beckhoff help system for details.

```

MAIN* x MAIN (PRG)
1 PROGRAM MAIN
2 VAR
3
4     ModeOfOperation AT%Q:SINT:=0;
5     axis1,axis2,axis3:axis_ref;
6     power1,power2,power3:MC_Power;
7     jog1:MC_Jog;
8     power_on:BOOL;
9     Jog_fw:BOOL;
10    Jog_bw:BOOL;
11 END_VAR

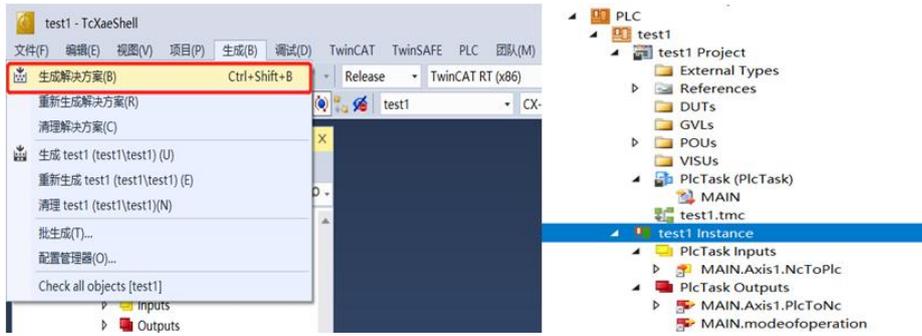
1 power1(
2     Axis:=axis1 ,
3     Enable:=power_on ,
4     Enable_Positive:=TRUE ,
5     Enable_Negative:=TRUE ,
6     Override:=100 ,
7 );
8 power2(
9     Axis:=axis2 ,
10    Enable:=power_on ,
11    Enable_Positive:=TRUE ,
12    Enable_Negative:=TRUE ,
13    Override:=100 ,
14 );
15 power3(
16    Axis:=axis3 ,
17    Enable:=power_on ,
18    Enable_Positive:=TRUE ,
19    Enable_Negative:=TRUE ,
20    Override:=100 ,
21 );
22 jog1(
23    Axis:=axis1 ,
24    JogForward:=Jog_fw ,
25    JogBackwards:=Jog_bw ,
26    Mode:=2 ,
27    Position:=1000 ,
28    Velocity:=100 ,
29    Acceleration:= ,
30    Deceleration:= ,
31    Jerk:= ,
32 );

```

Figure 13-56 Writing test programs

3. Compile and complete the variable mapping

Compile the written program. After the compilation completed, the compilation result will display. When no error occurs, the external variables will automatically generate input and output interfaces under "Instance".



Variable mapping completed.

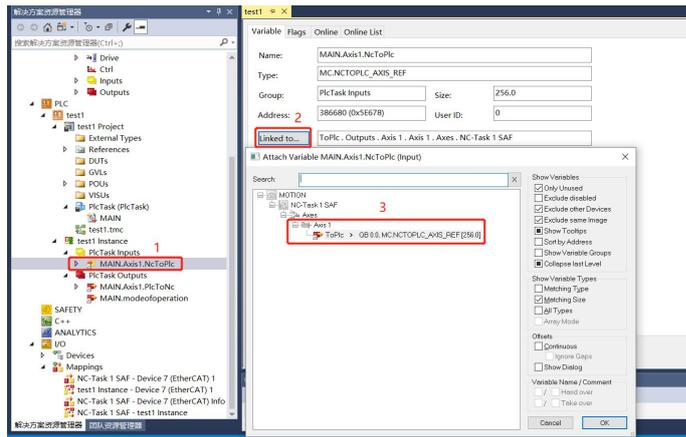


Figure 13-57 Variable mapping.

4. Online debugging

Activate the project and log in.

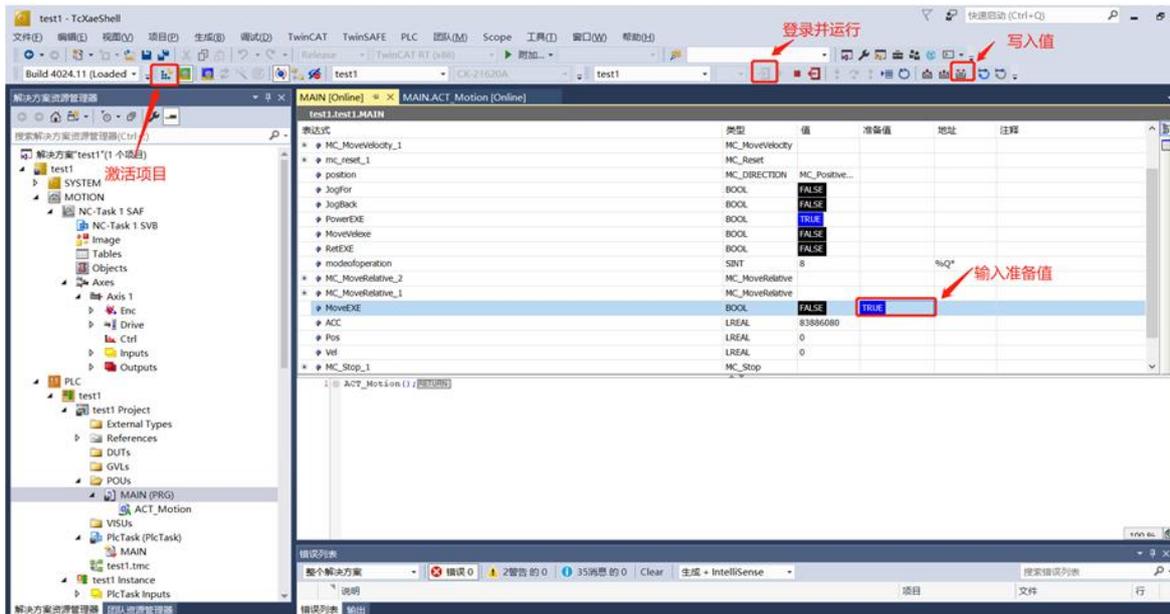


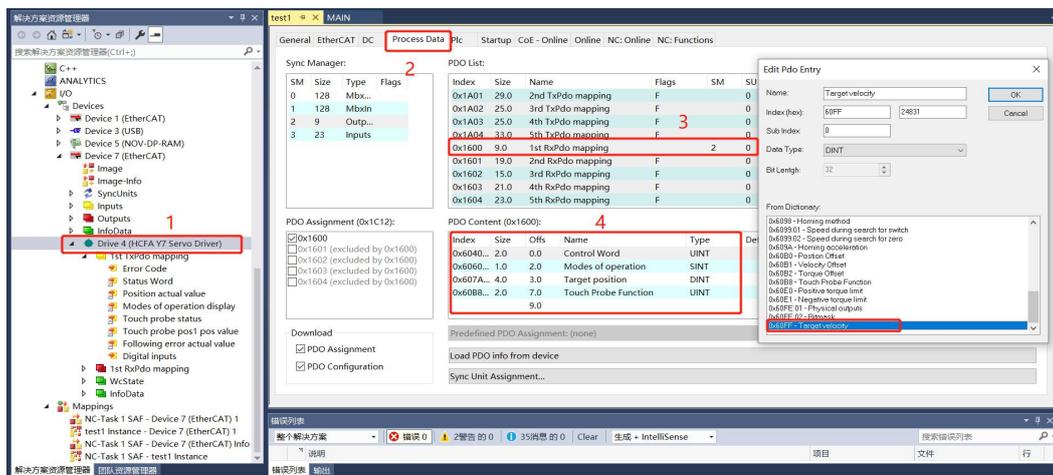
Figure 13-58 Activate and run the project

For other motion control instructions, please refer directly to the instructions provided by Beckhoff.

5. Control the drive through the control word (not recommended and make a brief description, please refer to the EtherCAT communication specification for details)

Take working mode CSP as an example:

- 1) Add the process data that needs to be used in PDO. The data that is not provided in PDO needs to be directly modified by the user in COE or written by calling the ADSWRITE function block.



After the addition is complete, the interface of the variable will appear on the left, and then the variable mapping can be completed.

- 2) Edit external variables in the program, complete the variable mapping and activate the project.

Edit the sample program as follows:

```

MAIN [Online]:2    MAIN [Online]:1    MAIN-1 [x]
1  PROGRAM MAIN
2  VAR
3      ErrorCode AT%I+:UINT;
4      Statusword AT%I+:UINT;
5      controlword AT%Q+:UINT;
6      ModeOfOperation AT%Q+:SINT:=8;
7      Targetposition AT%Q+:DINT;
8      TargetVelocity AT%Q+:DINT;
9  END_VAR
10

```

Compiling, variable mapping and project activated, please refer to the previous section.

- 3) Set the control data, and realize the control of the motor directly through the program

Once logged in , follow the instructions in EtherCAT Communication Specifications.pdf

Write 8 into the working mode;

The control word is respectively written into 0-6-7-15 to enable;

After that, you can set the values according to your own needs in the target position and target speed respectively.

13.4 Application Examples with Keyence PLC KV-7500

13.4.1 Parameter Setting

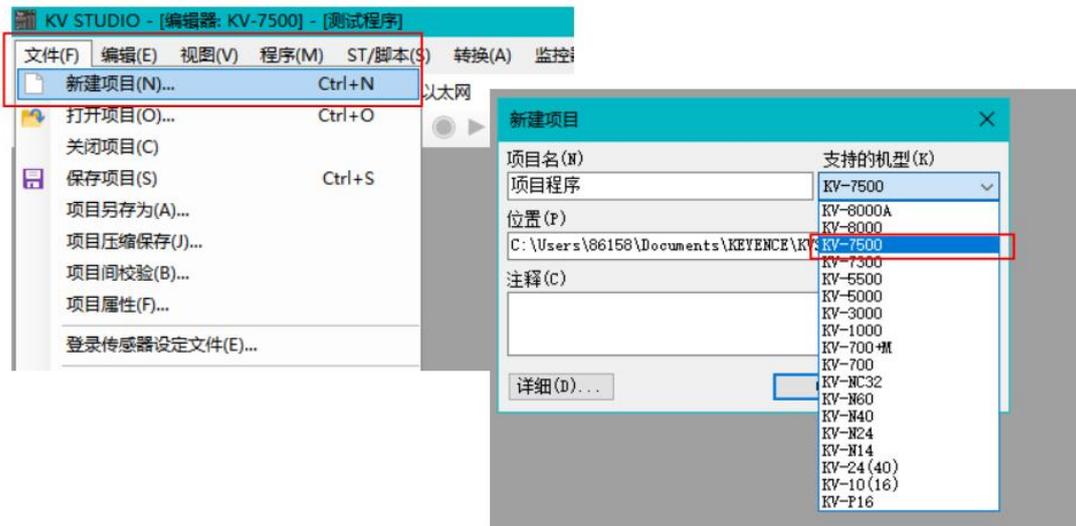
For the parameter setting of Y7_EtherCAT servo drive, if there are multiple servo drives used, the network cables must be inserted in strict accordance with the order of the top-in and bottom-out network ports. The parameter setting of Y7_EtherCAT servo Drive is shown in the table below:

| Parameter | Default | Modification | Notes |
|-----------|---------|--------------|---|
| Pn002.2 | 0 | 1 | Use the absolute encoder as an increment, if in the absolute value system, no need to modify. |

| | | | |
|---------|---|---|---|
| Pn00B.2 | 0 | 1 | Change the power supply mode to single-phase power supply. If three-phase power supply is used, no need to modify |
| Pn50A.3 | 1 | 8 | Positive limit, this test shields the limit, and it is allocated according to the actual situation |
| Pn50B.0 | 2 | 8 | Negative limit, this test shields the limit, and it is allocated according to the actual situation |

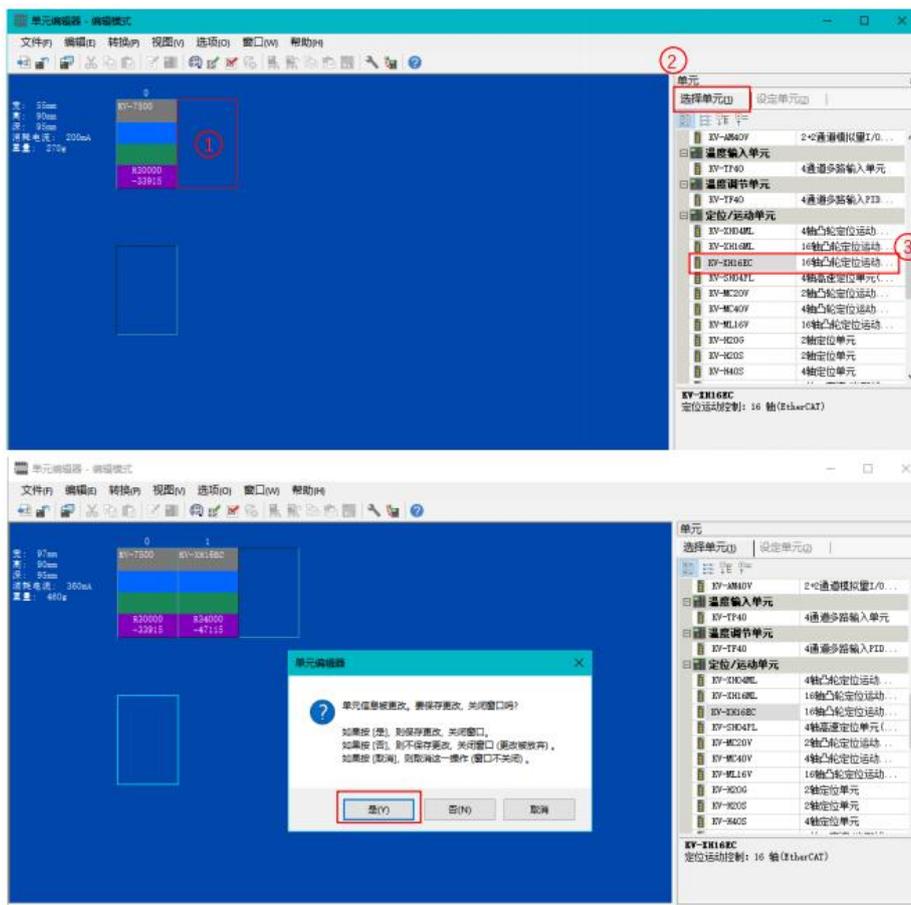
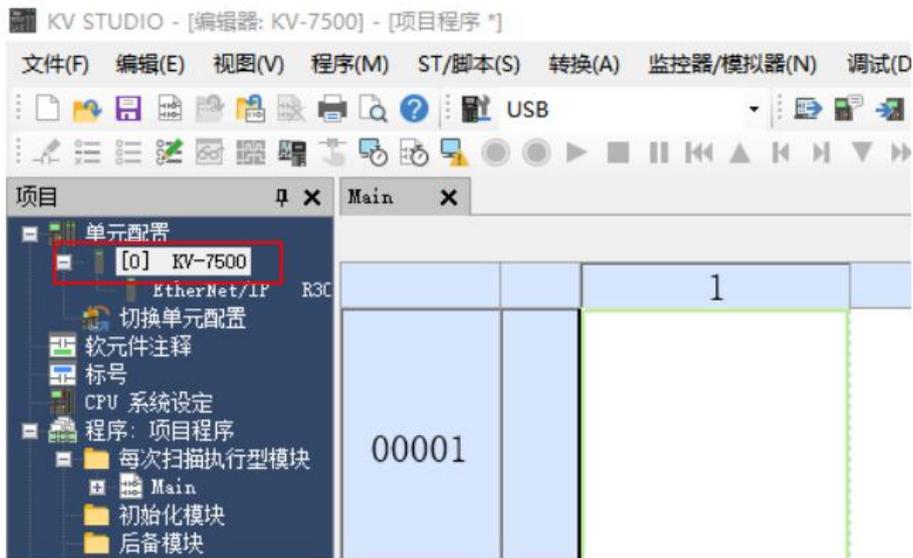
13.4.2 New Project

Open the software KV STUDIO, create a new project in [File], and select [KV-7500] from the [Supported Models] in the pop-up window, and name the new project and select a storage position, and finally click [OK].



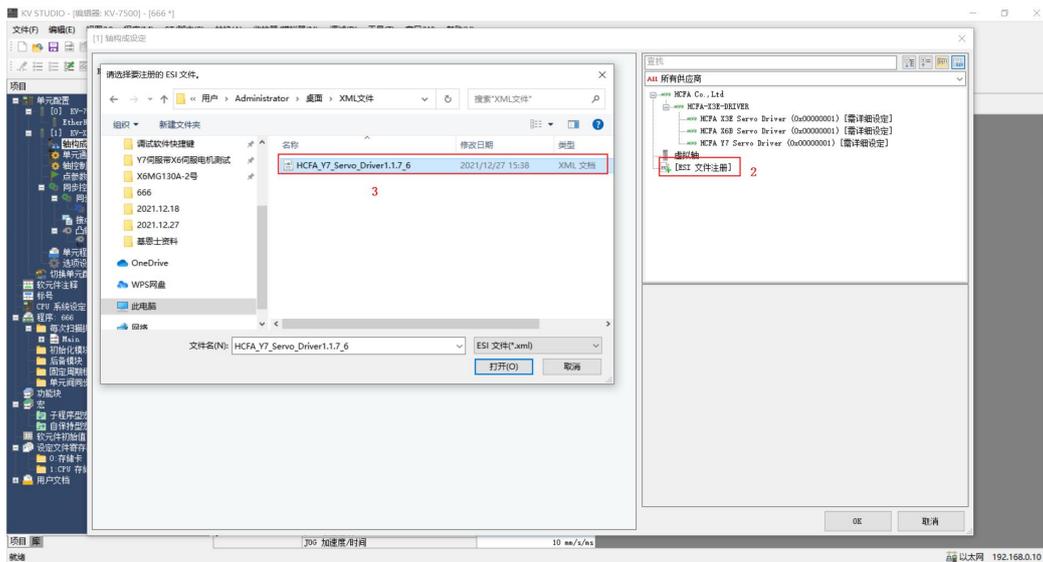
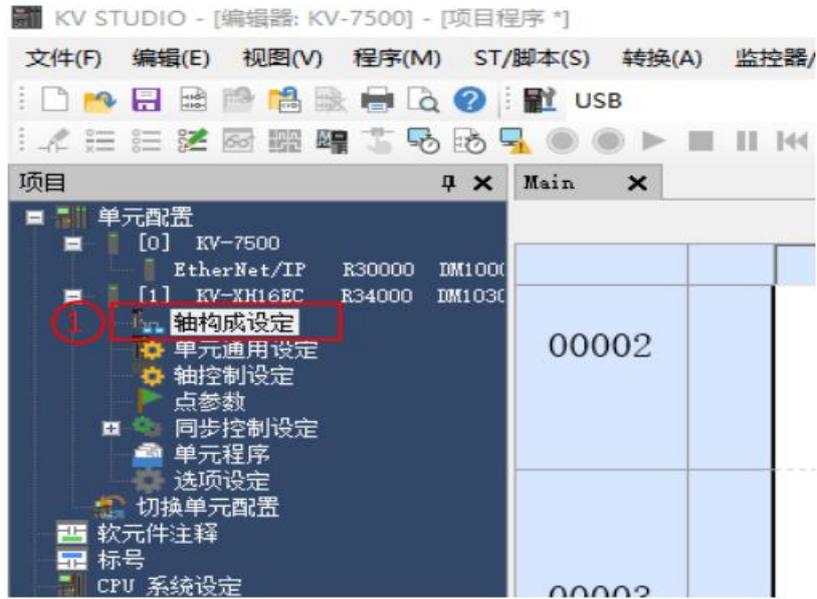
13.4.3 Motion Control Unit Adding

Double-click [KV-7500] under [Unit Configuration] in the project bar, open the unit editor, click on the right side of KV-7500, find the positioning motion unit [KV-XH16EC] in [Select Unit] on the right side of the window, double-click to add and save the units.



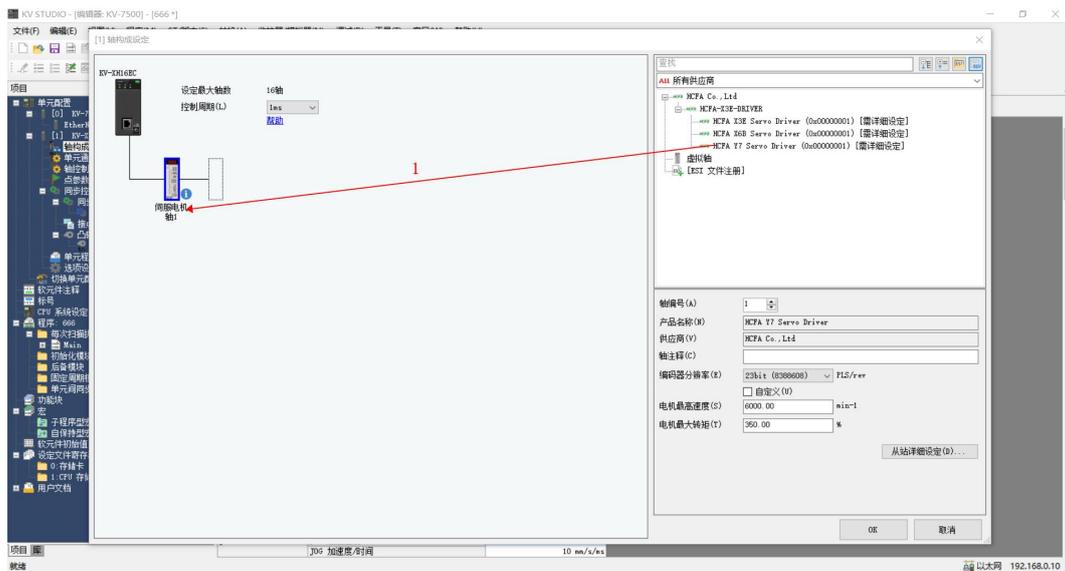
13.4.4 Description File Adding

Expand [KV-XH16EC], open [Shaft Structure Setting], click [ESI File Registration] in the pop-up window, find the corresponding description file and install.

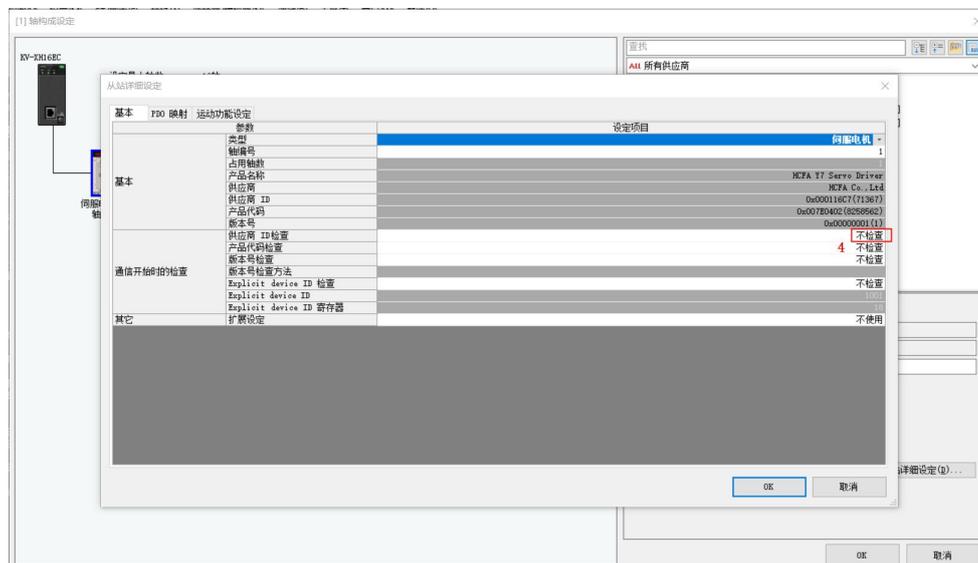
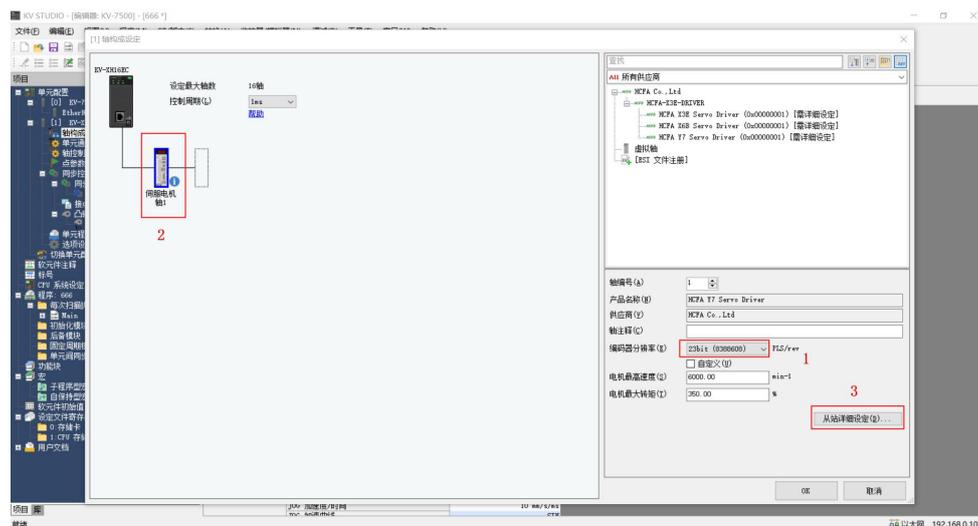


13.4.5 Slave Configuration

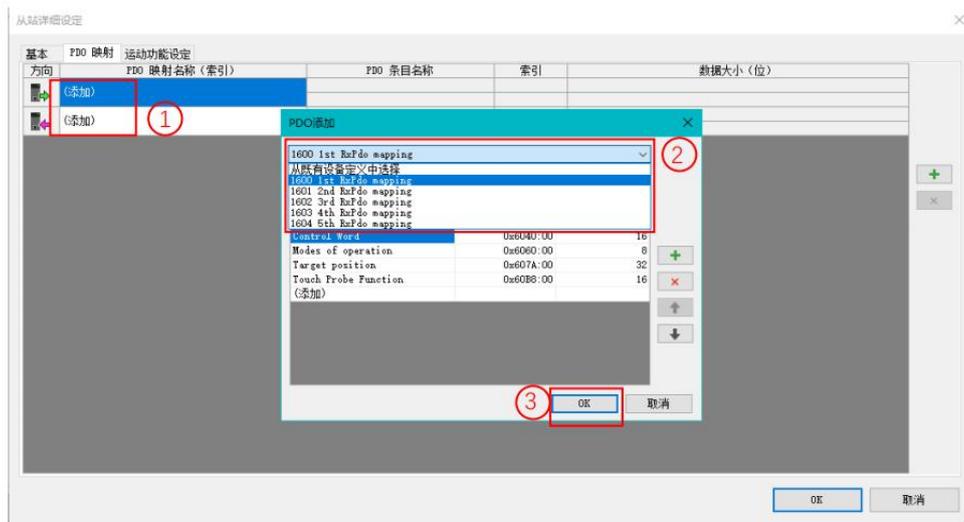
According to the actual installation sequence, drag the Y7 servo to the bottom of KV-XH16EC.



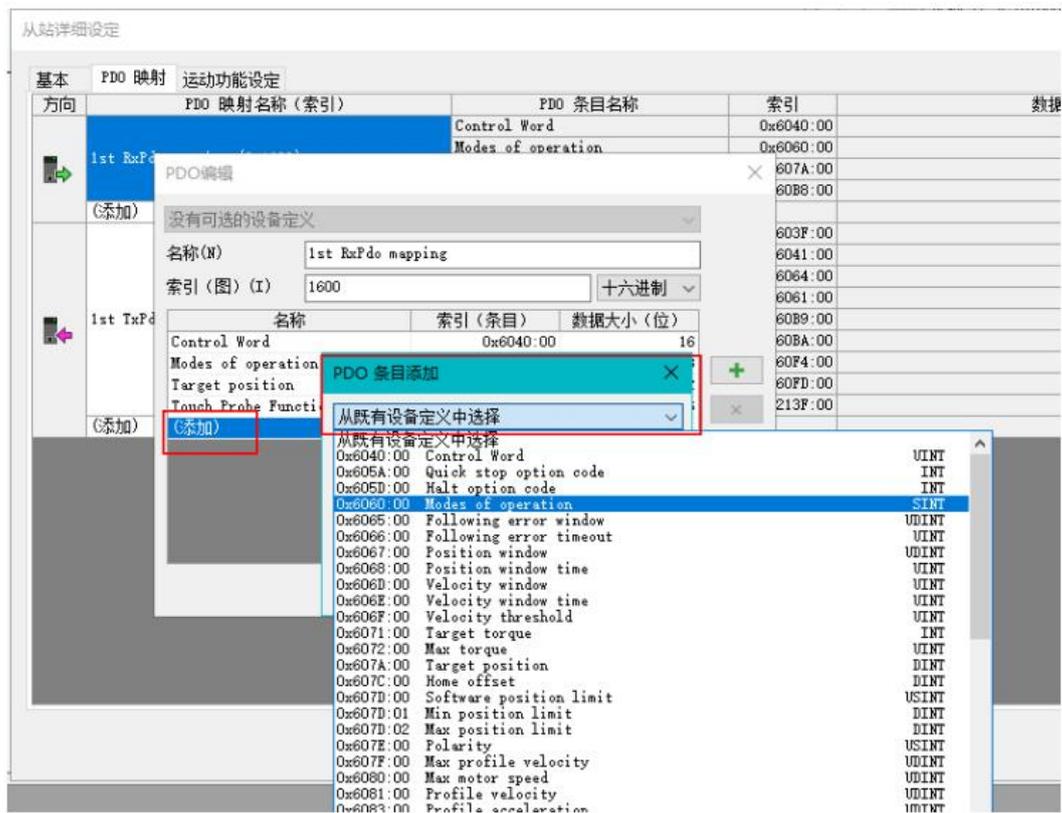
Click the added Y7 drive, change the [Encoder Resolution] on the right to 23bit (if you use other series of driver, please choose according to the resolution of the drive), and then open the [Slave Station Detailed Settings] of Y7, in the basic settings, set [Vendor ID Check] to be disabled.



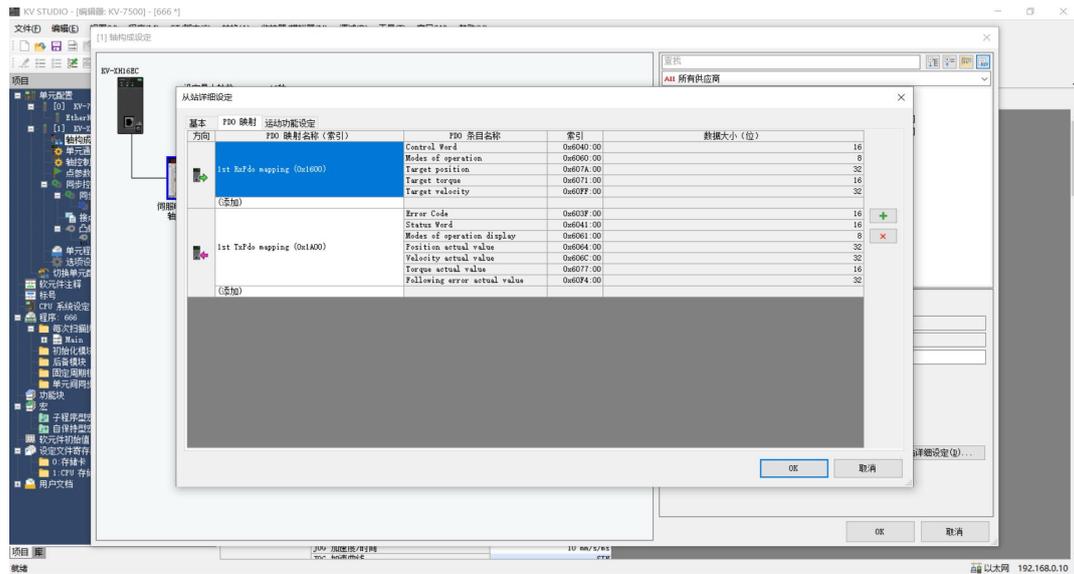
Configure the required PDO parameters in [PDO Mapping], click Add, select the appropriate PDO and add the required object dictionary according to the needs in the pop-up dialog box [PDO] and finally click [OK].



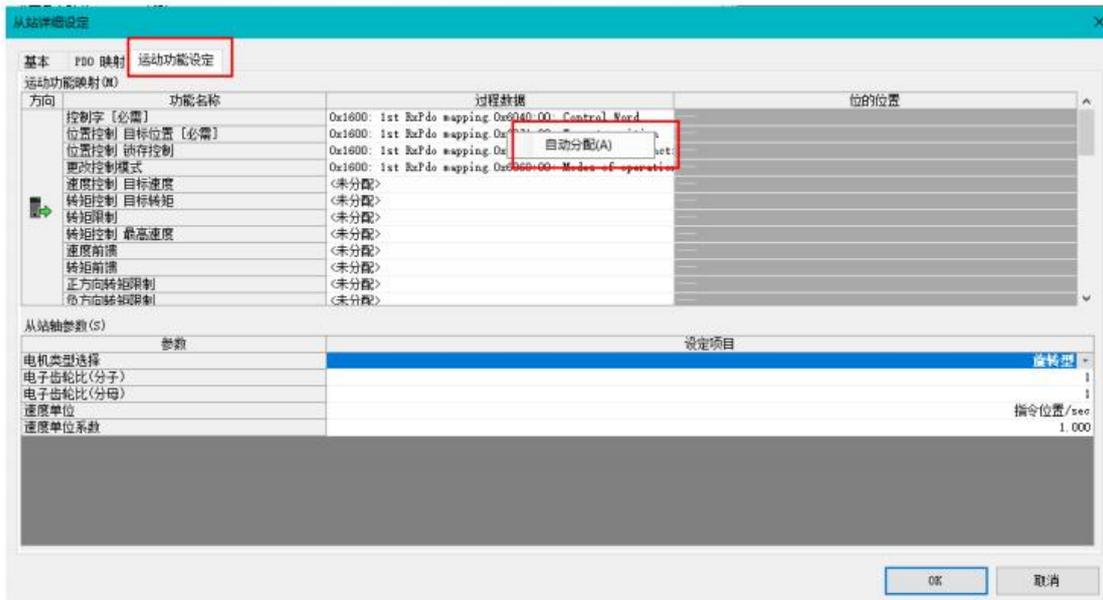
For the PDO parameters that are not given in the PDO list, users can click [Add] if they need to use them, or select the required PDO in the pop-up PDO entry addition through the [+] on the right to add; The unnecessary PDO parameters can be deleted through the [X] on the right side.



After following the steps above to add PDO parameters, shown as below:

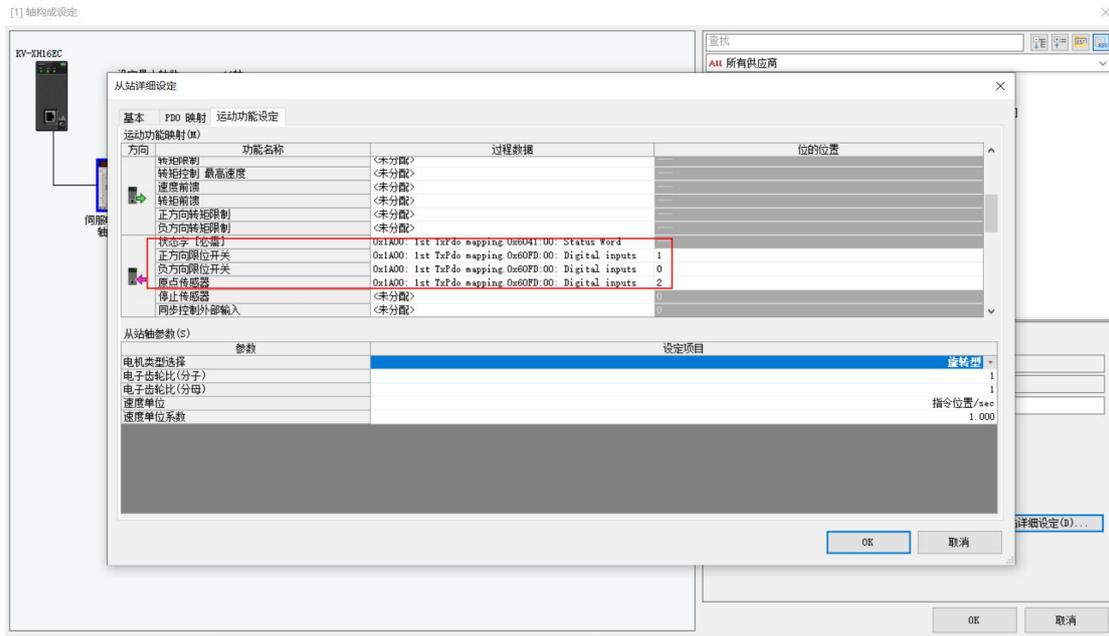


Finally, click [Motion Function Setting], right-click a [Auto Assign] (automatically assign the function selected by the PDO parameter to the address mapping area of the PLC), and click [OK] to complete the setting.



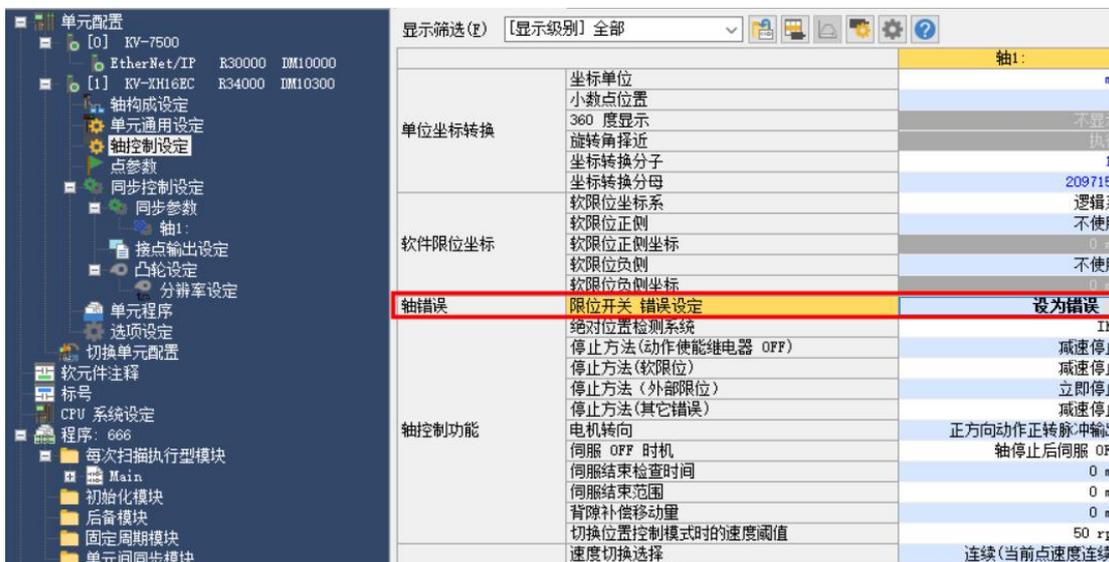
13.4.6 Servo DI Assignment

In [Axis Configuration Setting], open the [Slave Station Detailed Setting] of Y7 and select [Motion Control Function Setting] to configure the DI of Y7 servo. For the corresponding description of Y7 object dictionary 60FD, please refer to: Y7 object dictionary 60FD.



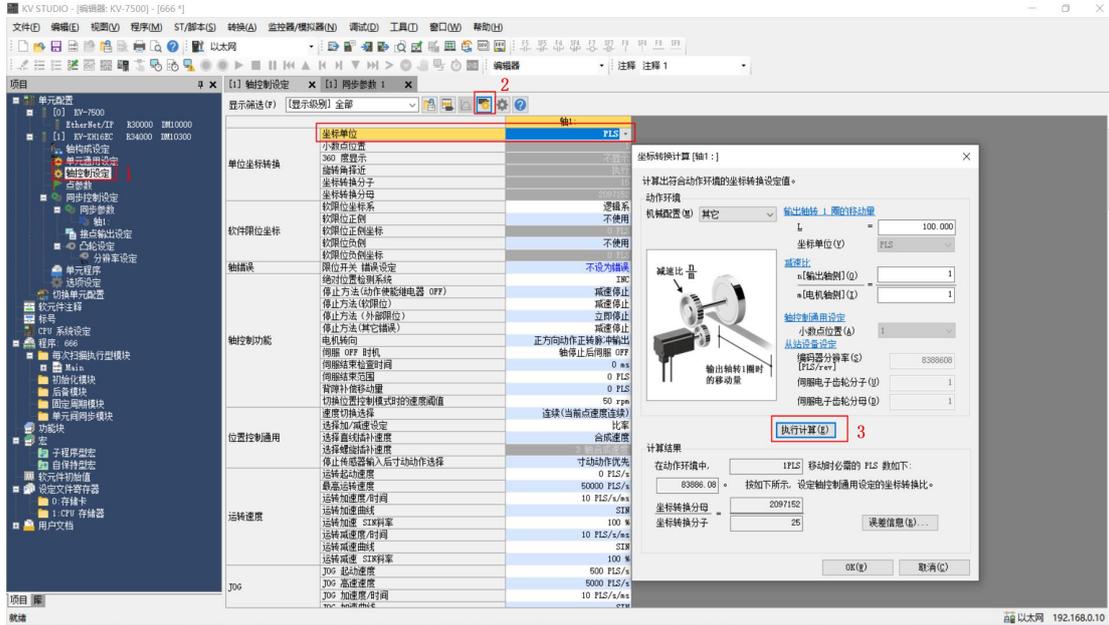
13.4.7 Servo Limit Switch Configuration

Regarding the processing of the servo limit, connect the limit to the Y7 servo drive and map it to the PLC, because the homing mode selects to the PLC homing, and the alarm processing mechanism of the final limit is placed on the PLC side, find the left axis control setting → axis Error → Limit switch error setting, select [Set as error]:



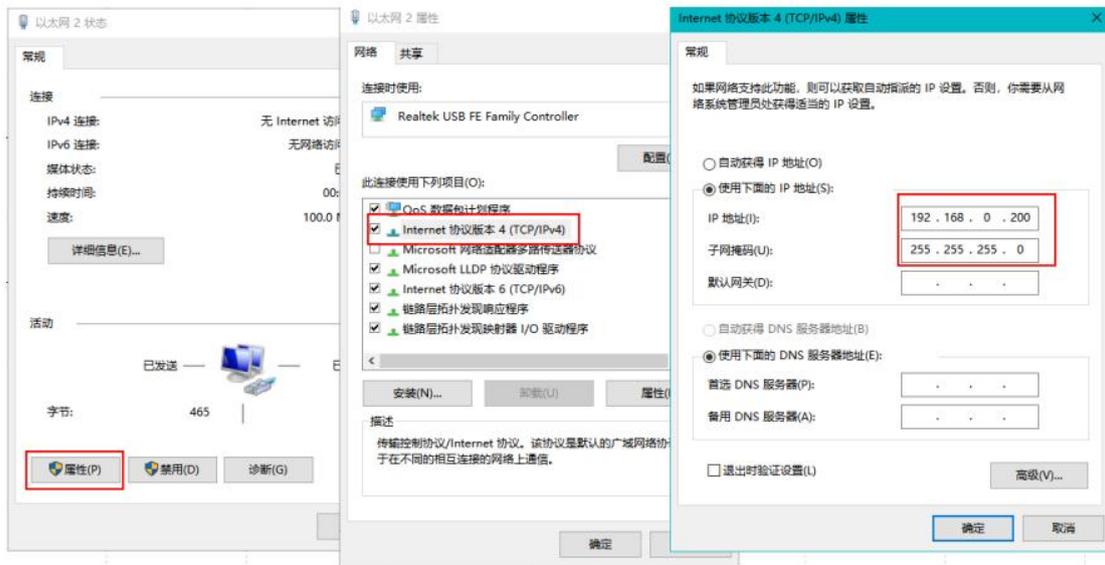
13.4.8 Coordinate Configuration Conversion

Open [Axis Control Settings] in the unit configuration, click the icon in the toolbar on the right side of the axis control settings, and configure the axis 1 (Y7 axis). In the pop-up dialog box [Coordinate Transformation Calculation], fill in the parameters according to the actual situation (such as mechanical configuration and reduction ratio, etc.), and click [Execute Calculation] after completion, the parameters will be valid, then click [OK] to save.

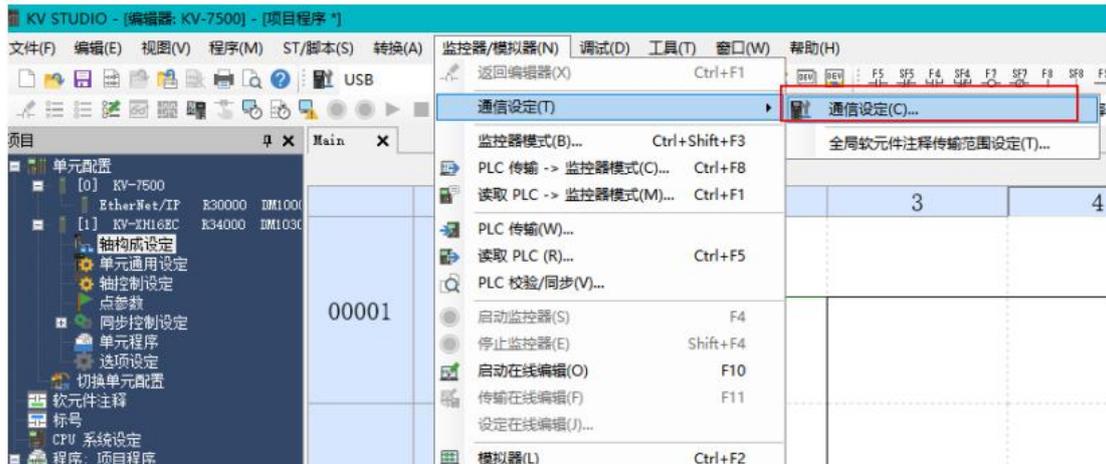


13.4.9 Communication Setting

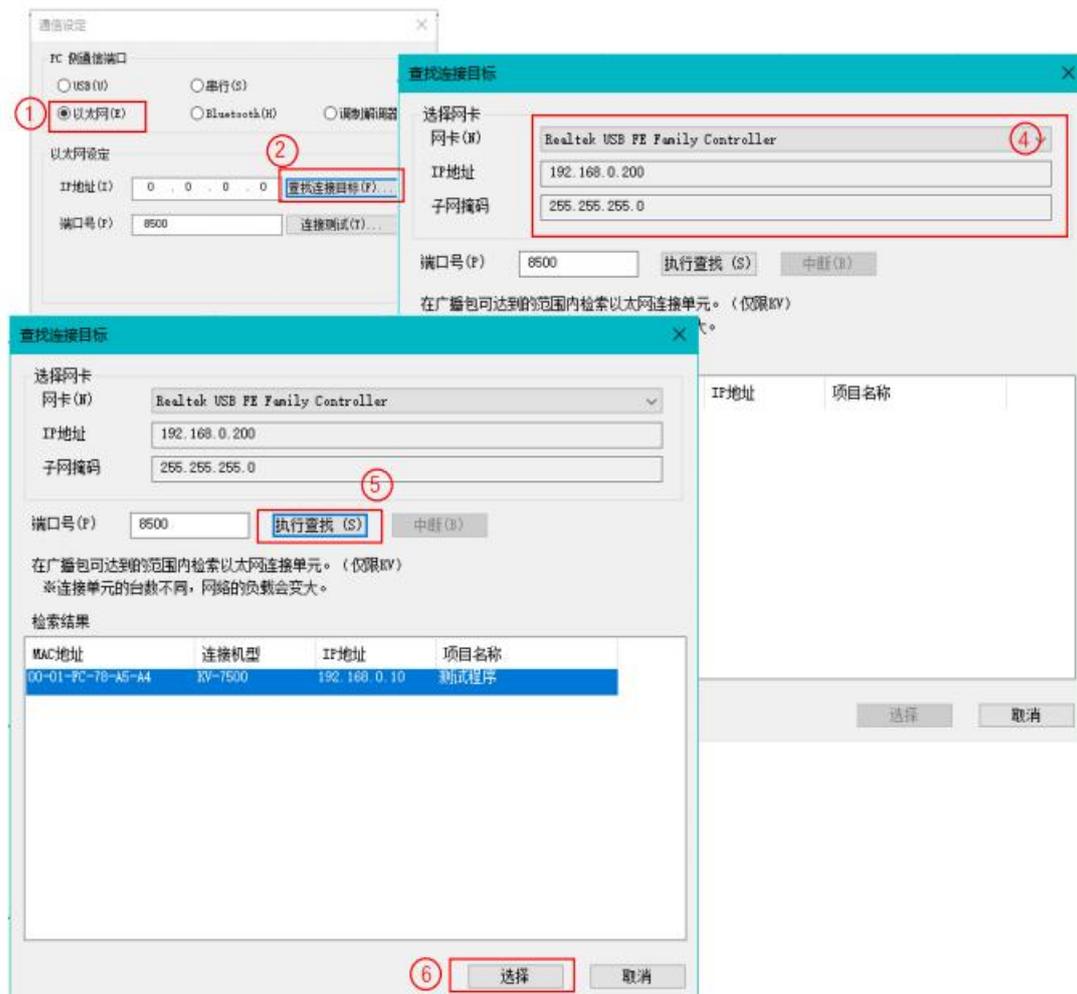
The default IP address of KV-7500 is 192.168.0.10. First, we need to change the IP address of the computer to the same network segment. After finishing, click OK.



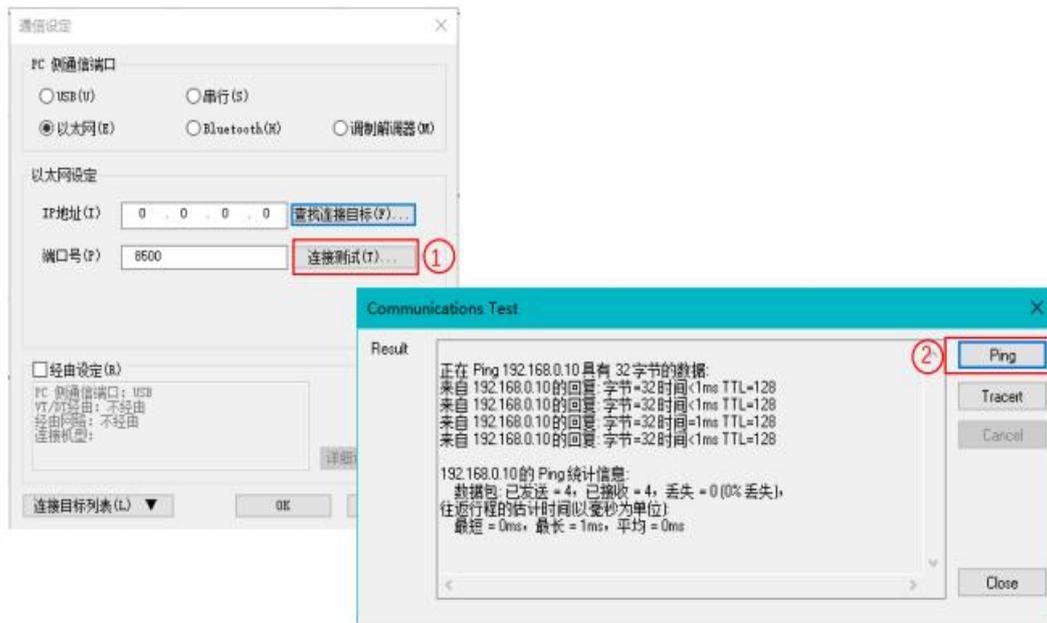
Get back to the software, pull down the menu bar [Monitor/Simulator], and select Communication Settings.



Select [Ethernet] in [PC side communication port] (if KV-7500 uses other methods to connect to the computer, please select the corresponding port); open [Find connection target], according to the IP address (corresponding to the IP address set in the previous step), pull down the network card, and select the correct network card; click [Execute Search] to search for KV-7500.

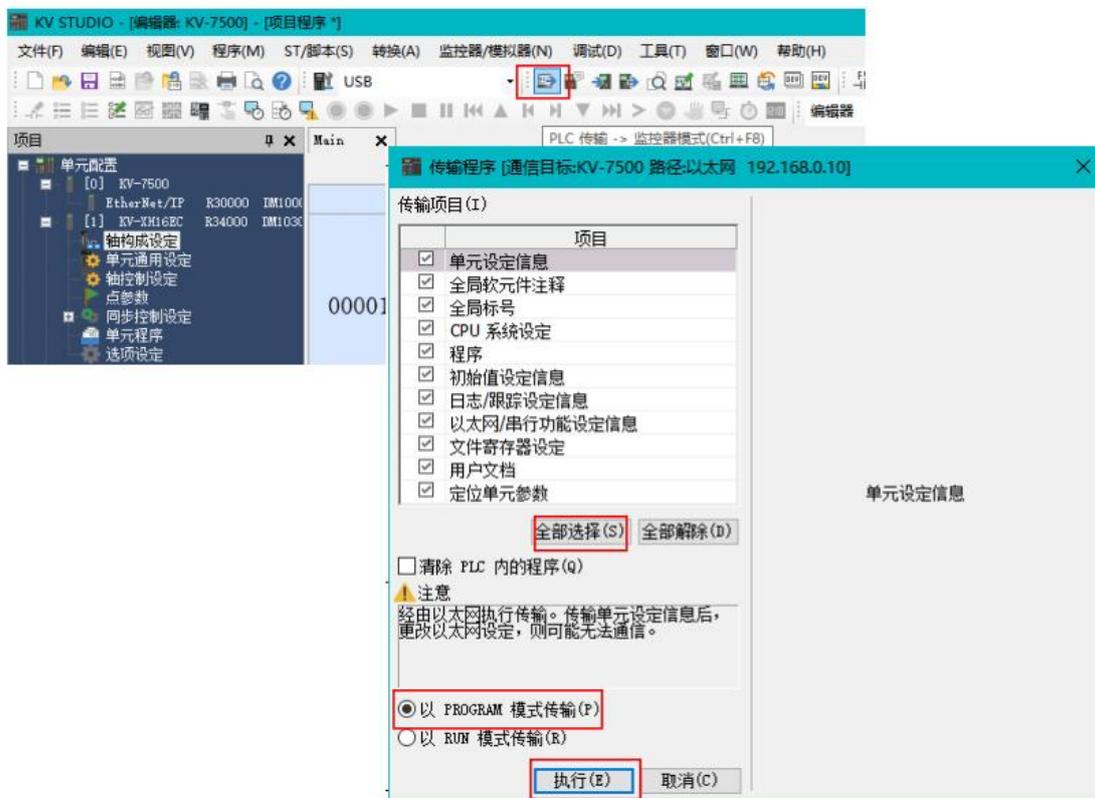


After the communication is successful, you can perform [Connection Test], click the [Ping] button on the right, and the communication is completed successfully as shown in the figure below.



13.4.10 Log in and Debugging

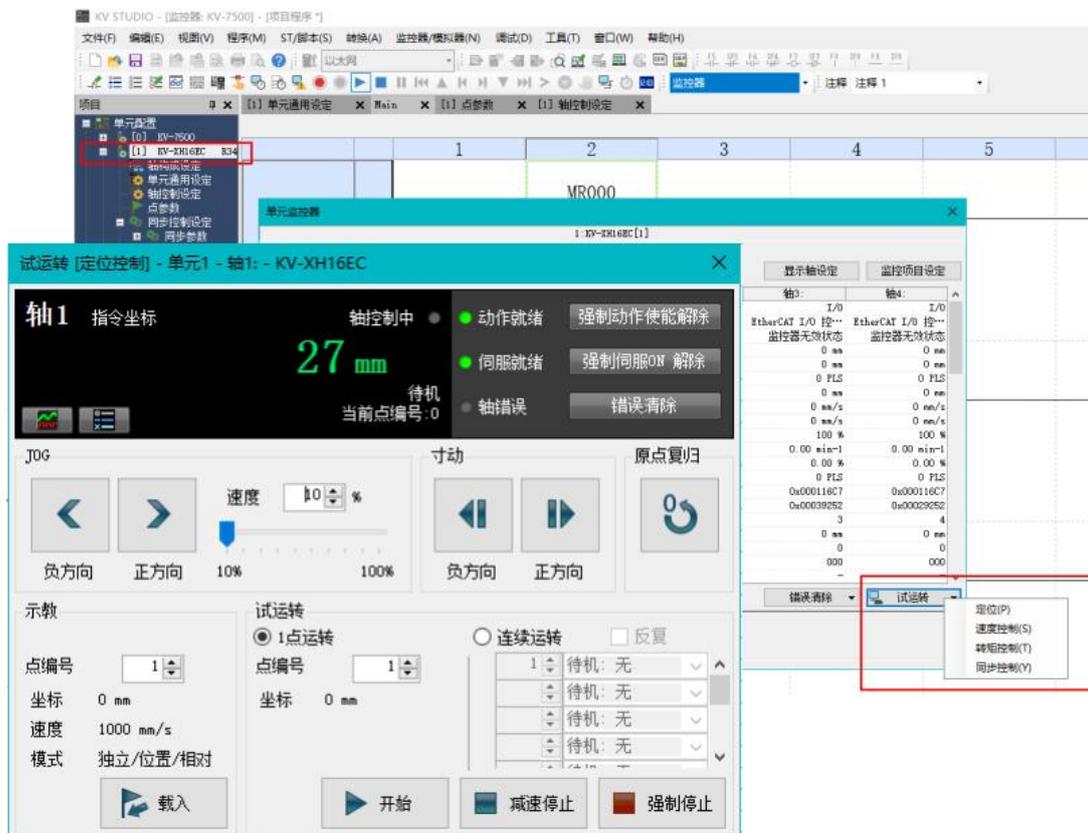
Click [PLC Transmission Monitor Mode] in the toolbar or use the shortcut key Ctrl+F8, select all [Projects] in the pop-up window, select [Transfer in PROGRAM Mode], click [Execute], and download the program to KV-7500 .



After connecting and downloading the program for the first time, the CONNECT light of KV-XH16EC is off, indicating that the communication has failed, and it is necessary to re-power on and perform communication settings and re-download the program to KV-7500. As shown in the figure below, if the three lights are on, it means the communication is completed successfully.



In the monitor state, click the item column [KV-XH16EC], open the unit monitor to view the Y7 servo, click [Test Run], and test run the servo shaft in different modes.



13.4.11 Y7 Parameter Setting

First open HCServoWorks.Y7 (HCFY Y7 debugging software), select New Project→Add Online, select Y7 servo drive, select the serial port according to the way to connect to the PC, and click OK.