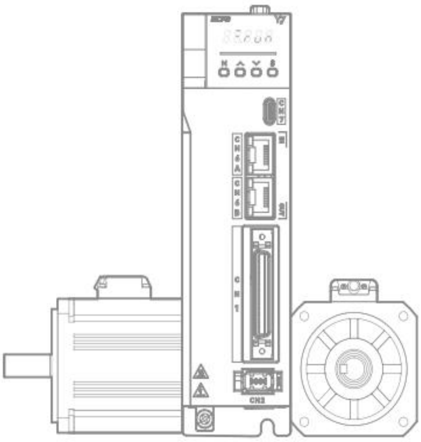
Y7 Smart High-end Servo System

EtherCAT bus type

User Manual



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

Catalog

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

①Although every effort has been made to perfect the manual, please feel free to ask us if you have any doubts about the contents.
②The 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.
③This 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.
④If you plan to obtain safety specifications for the equipment equipped with this product, please consult with us in advance.
⑤To 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：

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

🛇	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 holde 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 overtuning 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.

<table>
<tr><td></td><td>Please store the products in a place that conforms to the storage environment specified in this manual.</td><td>There is a risk of a malfunction.</td></tr>
<tr><td colspan="3">About other precautions on use</td></tr>
<tr><td rowspan="2">🛇</td><td colspan="2">When disposing of the battery, please insulate the battery with tape, etc. and dispose of it according to the regulations of the relevant department.</td></tr>
<tr><td colspan="2">Please dispose of it as industrial waste when it is disposed of.</td></tr>
<tr><td colspan="3">About maintenance and spot checks</td></tr>
<tr><td rowspan="4">❗</td><td>Do not disassemble for repair work other than by our company.</td><td>There is a risk of a malfunction.</td></tr>
<tr><td>The main circuit power switch should not be turned on and off frequently.</td><td>There is a risk of a malfunction.</td></tr>
<tr><td>If the drive fails, disconnect the control power and main circuit power.</td><td>There is a risk of a fire accident.</td></tr>
<tr><td>Be sure to cut off the main power when not in use for a long time.</td><td>There is a risk of injury accidents</td></tr>
<tr><td colspan="3">About maintenance and spot checks</td></tr>
<tr><td colspan="3">〈Warranty Period〉
- 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.</td></tr>
<tr><td colspan="3">〈Guarantee content〉
- 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 faliure occurs, repair will be charged even if the product is in warranty period,
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.
- 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.</td></tr>
</table>

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).

Control modes available for this parameter.
Position: Position Control
Speed: Speed control
Torque: Torque control

Numeric Settings

Pn300	Speed command input gain			Position Speed Torque	
	Setting range	Set unit	Default setting	When Enabled	Classification
	150-3000	0.01V	600 (6.00V)	After restart	Backup

Parameter number

Parameters of Settable range

The "minimum" setting unit (setting increment) set in the parameter

Indicates the factory parameter setting value

Effective time after changing the parameter number

Parameter classification

Function selection type

Parameters		Meaning	When Enabled	Classification
PN002	n. □0□□□□ Default Settings	Use the encoder according to encoder specifications.	After restart	Backup
	n. □1□□	Use the encoder as an incremental encoder		

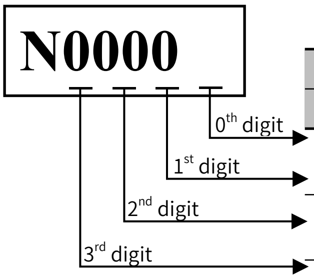
n. □□□□ indicates the function selection type, □ indicates the set value of each unit, and here indicates that the second digit is "1".

Function selection instructions

Effective time after changing the parameter number

Parameter classification

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

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.

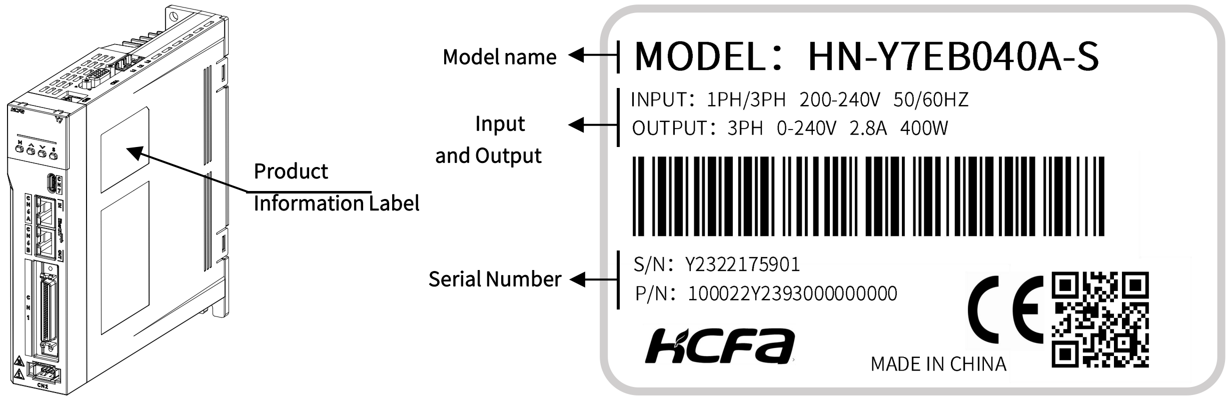
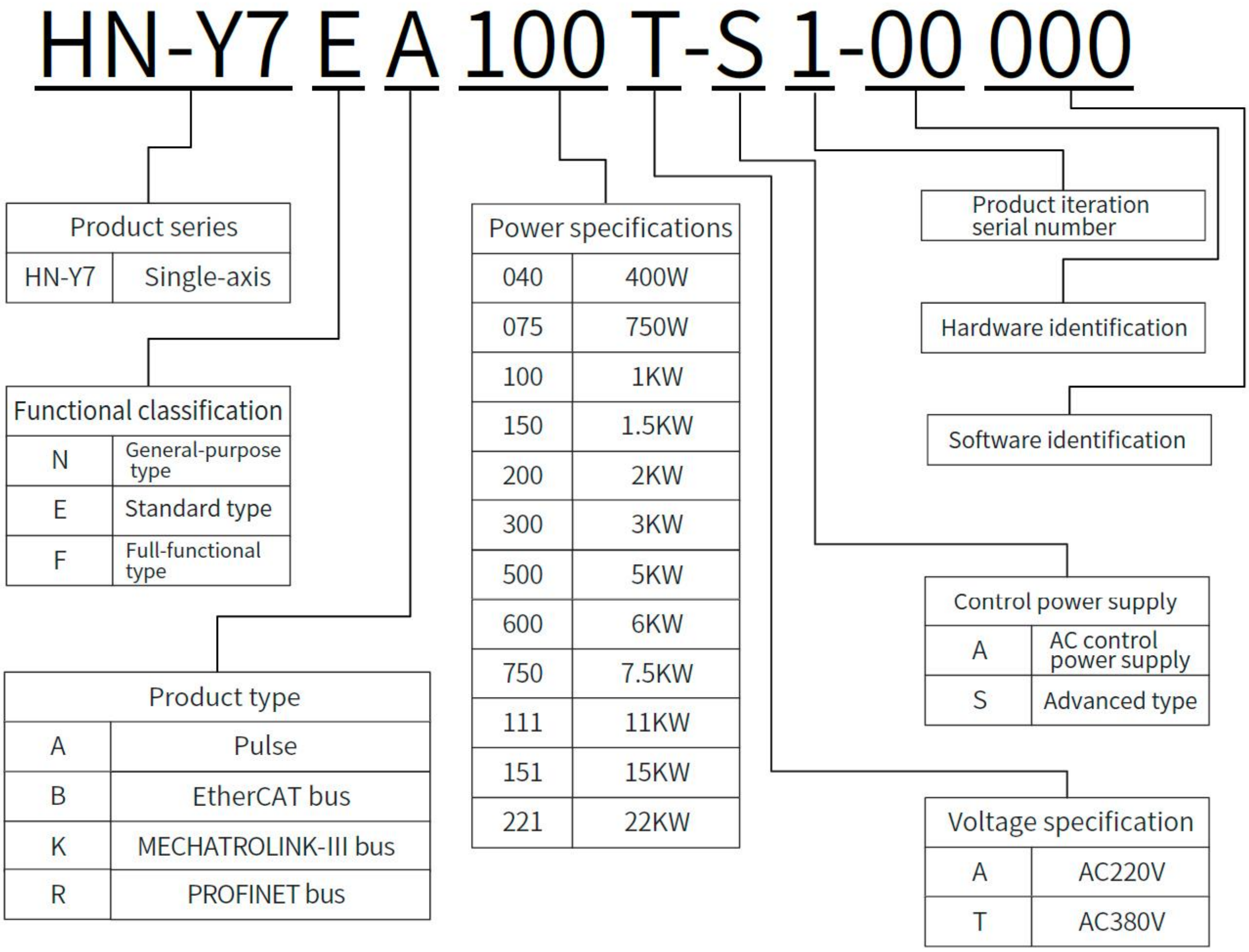


Figure 1-1 Y7S nameplate information diagram

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

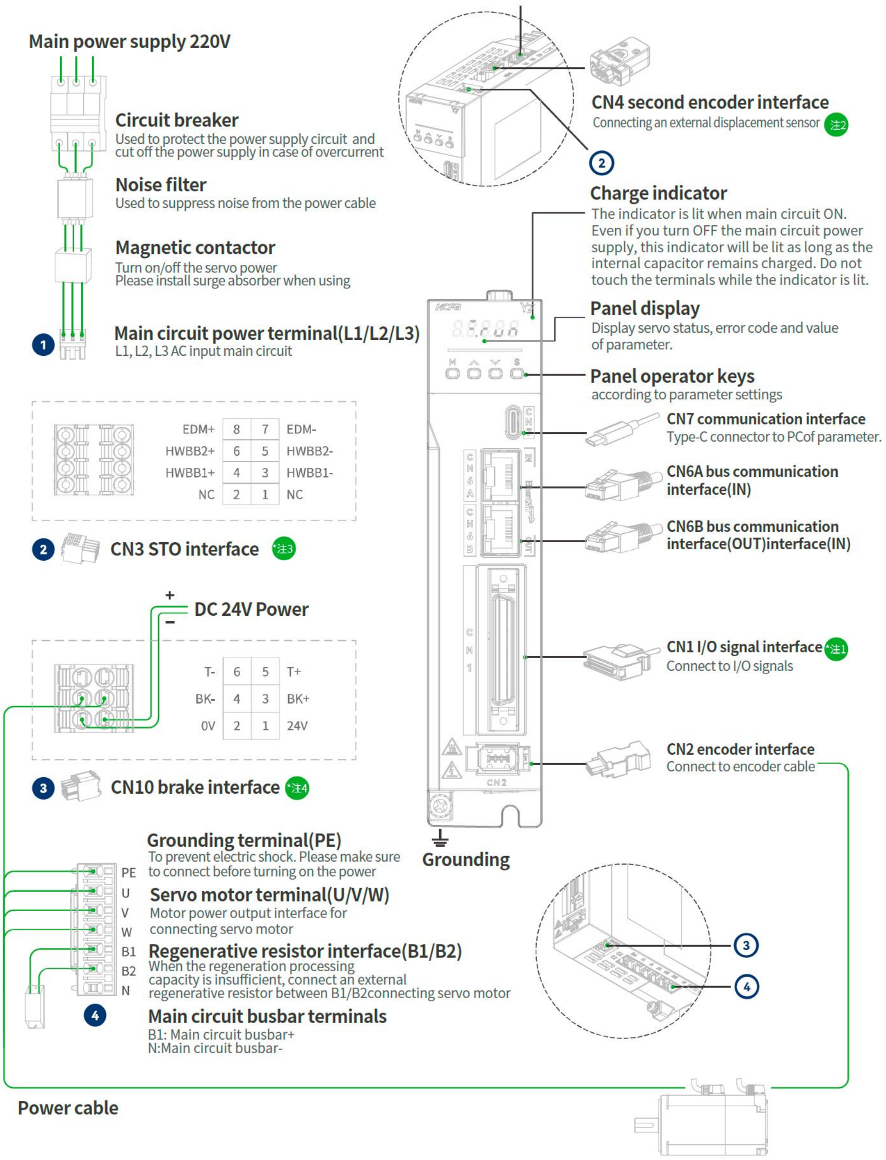
Software identification

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



Note 1: Only not supported by NB models

Note 2: Only supported by full-functional type models

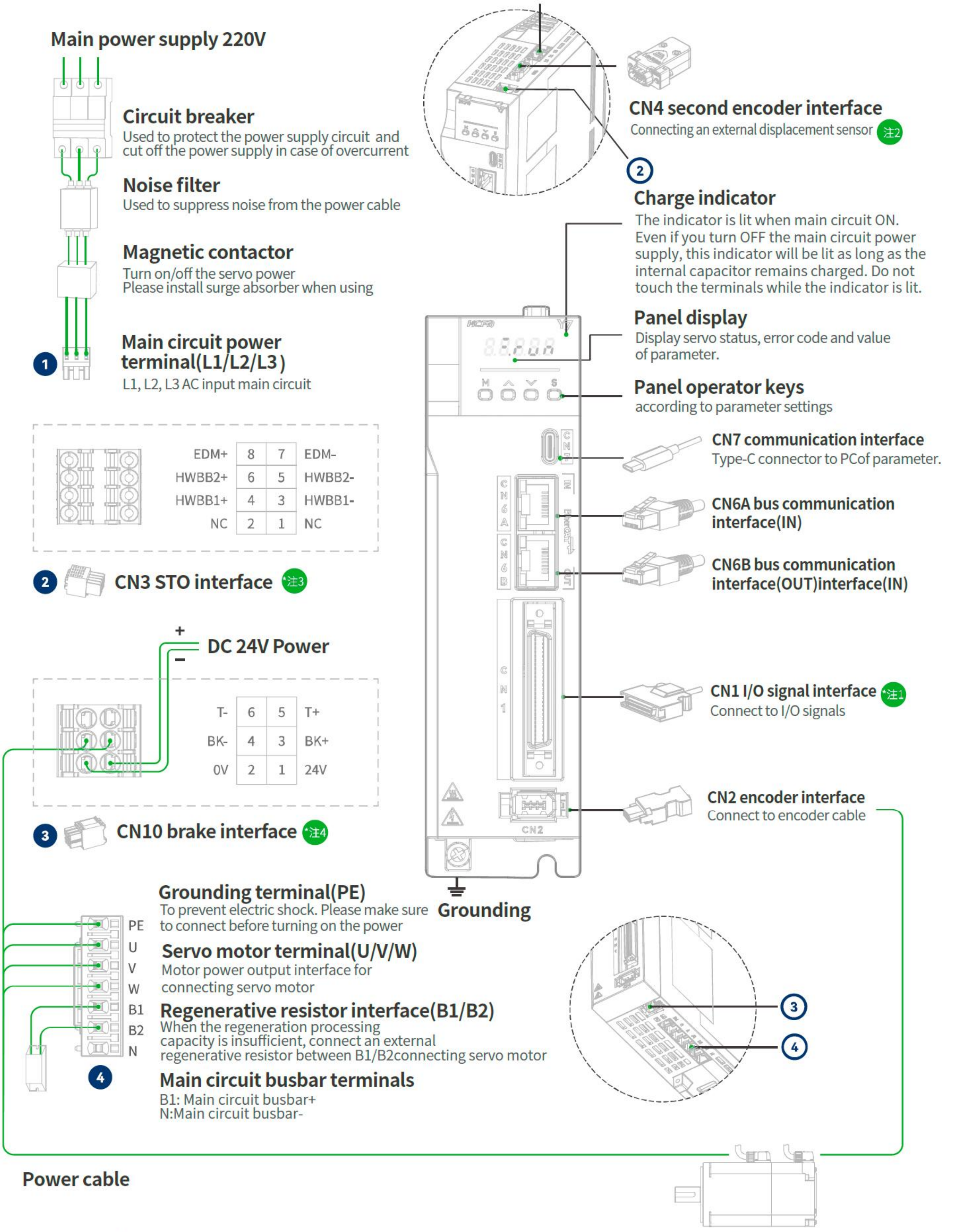
Note 3: Only not supported by N type models

Note 4: Only not supported by NA models

❶① represents the corresponding installation position for the accessories

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

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



Main power supply 220V

Circuit breaker
Used to protect the power supply circuit and cut off the power supply in case of overcurrent

Noise filter
Used to suppress noise from the power cable

Magnetic contactor
Turn on/off the servo power
Please install surge absorber when using

Main circuit power terminal(L1/L2/L3)
L1, L2, L3 AC input main circuit

EDM+	8	7	EDM-
HWBB2+	6	5	HWBB2-
HWBB1+	4	3	HWBB1-
NC	2	1	NC

CN3 STO interface 注3

DC 24V Power

T-	6	5	T+
BK-	4	3	BK+
0V	2	1	24V

CN10 brake interface 注4

Grounding terminal(PE)
To prevent electric shock. Please make sure to connect before turning on the power

Servo motor terminal(U/V/W)
Motor power output interface for connecting servo motor

Regenerative resistor interface(B1/B2)
When the regeneration processing capacity is insufficient, connect an external regenerative resistor between B1/B2connecting servo motor

Main circuit busbar terminals
B1: Main circuit busbar+
N:Main circuit busbar-

Power cable

CN4 second encoder interface
Connecting an external displacement sensor 注2

Charge indicator
The indicator is lit when main circuit ON. Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the terminals while the indicator is lit.

Panel display
Display servo status, error code and value of parameter.

Panel operator keys
according to parameter settings

CN7 communication interface
Type-C connector to PCof parameter.

CN6A bus communication interface(IN)

CN6B bus communication interface(OUT)interface(IN)

CN1 I/O signal interface 注1
Connect to I/O signals

CN2 encoder interface
Connect to encoder cable

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

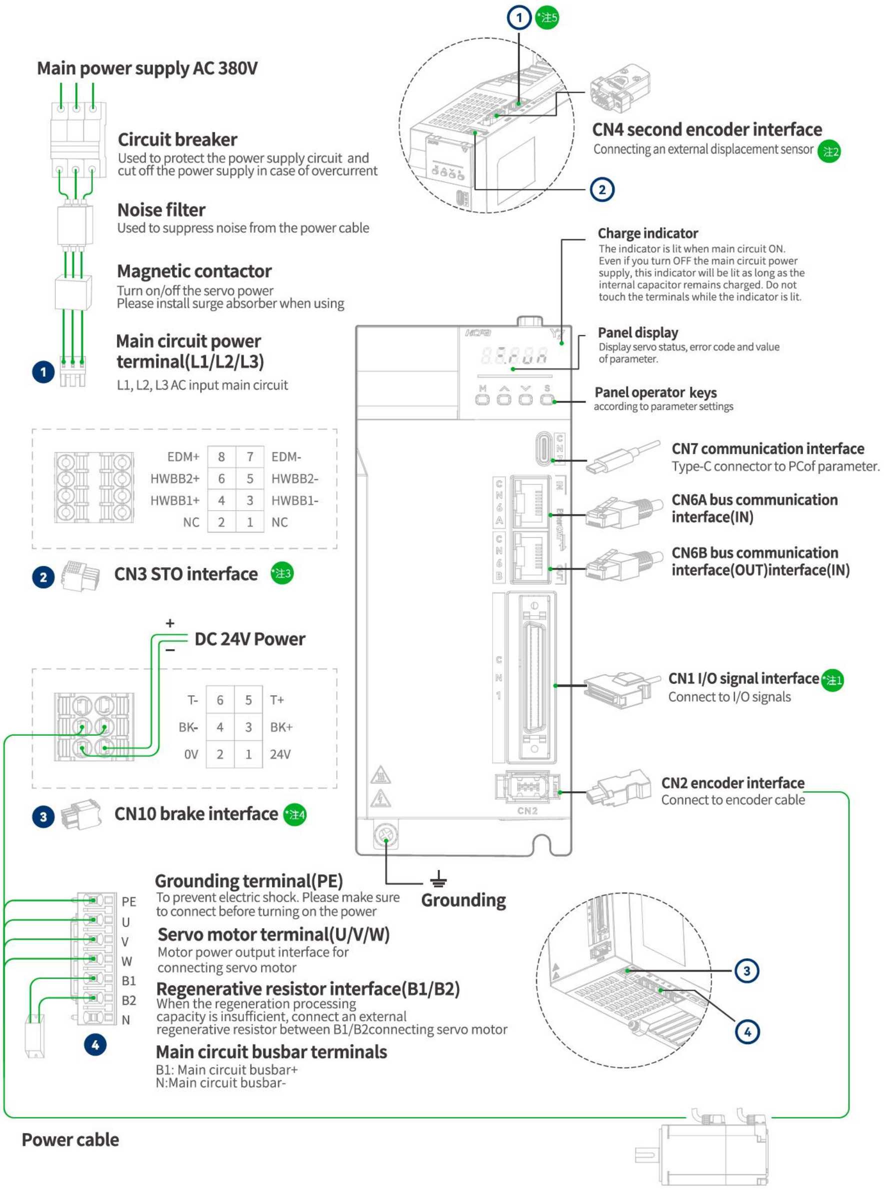
Note 4: Only not supported by NA models

❶① 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



Note 1: Only not supported by NB models

Note 2: Only supported by full-functional type models

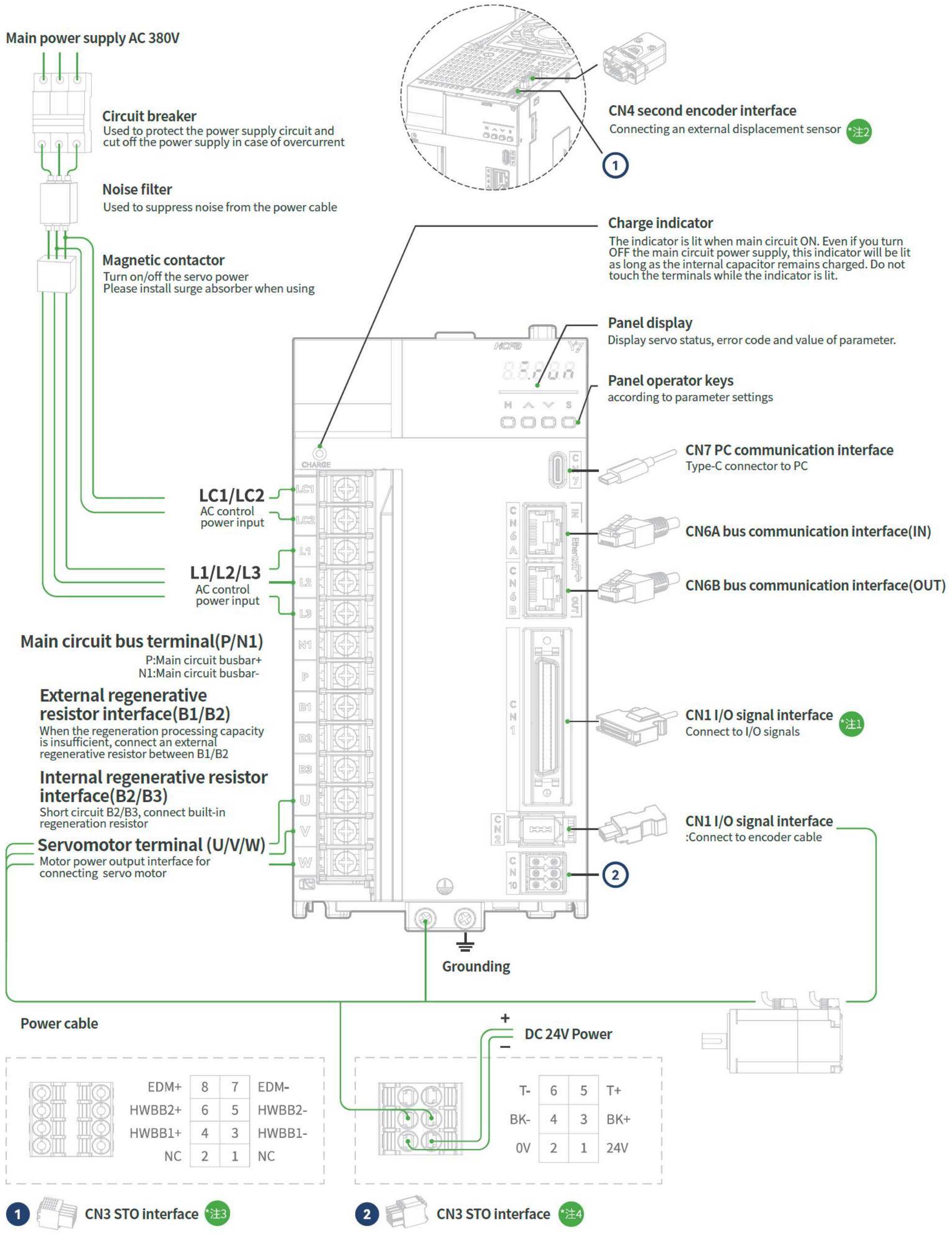
Note 3: Only not supported by N type models

Note 4: Only not supported by NA models

1① represents the corresponding installation position for the accessories

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

1.2.2 AC380V 5kW Servo Unit Part Name Diagram



Main power supply AC 380V

Circuit breaker
Used to protect the power supply circuit and cut off the power supply in case of overcurrent

Noise filter
Used to suppress noise from the power cable

Magnetic contactor
Turn on/off the servo power
Please install surge absorber when using

CN4 second encoder interface
Connecting an external displacement sensor 注2

Charge indicator
The indicator is lit when main circuit ON. Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the terminals while the indicator is lit.

Panel display
Display servo status, error code and value of parameter.

Panel operator keys
according to parameter settings

CN7 PC communication interface
Type-C connector to PC

CN6A bus communication interface(IN)

CN6B bus communication interface(OUT)

LC1/LC2
AC control power input

L1/L2/L3
AC control power input

Main circuit bus terminal(P/N1)
P:Main circuit busbar+
N1:Main circuit busbar-

External regenerative resistor interface(B1/B2)
When the regeneration processing capacity is insufficient, connect an external regenerative resistor between B1/B2

Internal regenerative resistor interface(B2/B3)
Short circuit B2/B3, connect built-in regeneration resistor

Servomotor terminal (U/V/W)
Motor power output interface for connecting servo motor

CN1 I/O signal interface 注1
Connect to I/O signals

CN1 I/O signal interface
:Connect to encoder cable

Grounding

Power cable

DC 24V Power

EDM+	8	7	EDM-
HWBB2+	6	5	HWBB2-
HWBB1+	4	3	HWBB1-
NC	2	1	NC

T-	6	5	T+
BK-	4	3	BK+
0V	2	1	24V

❶ CN3 STO interface 注3

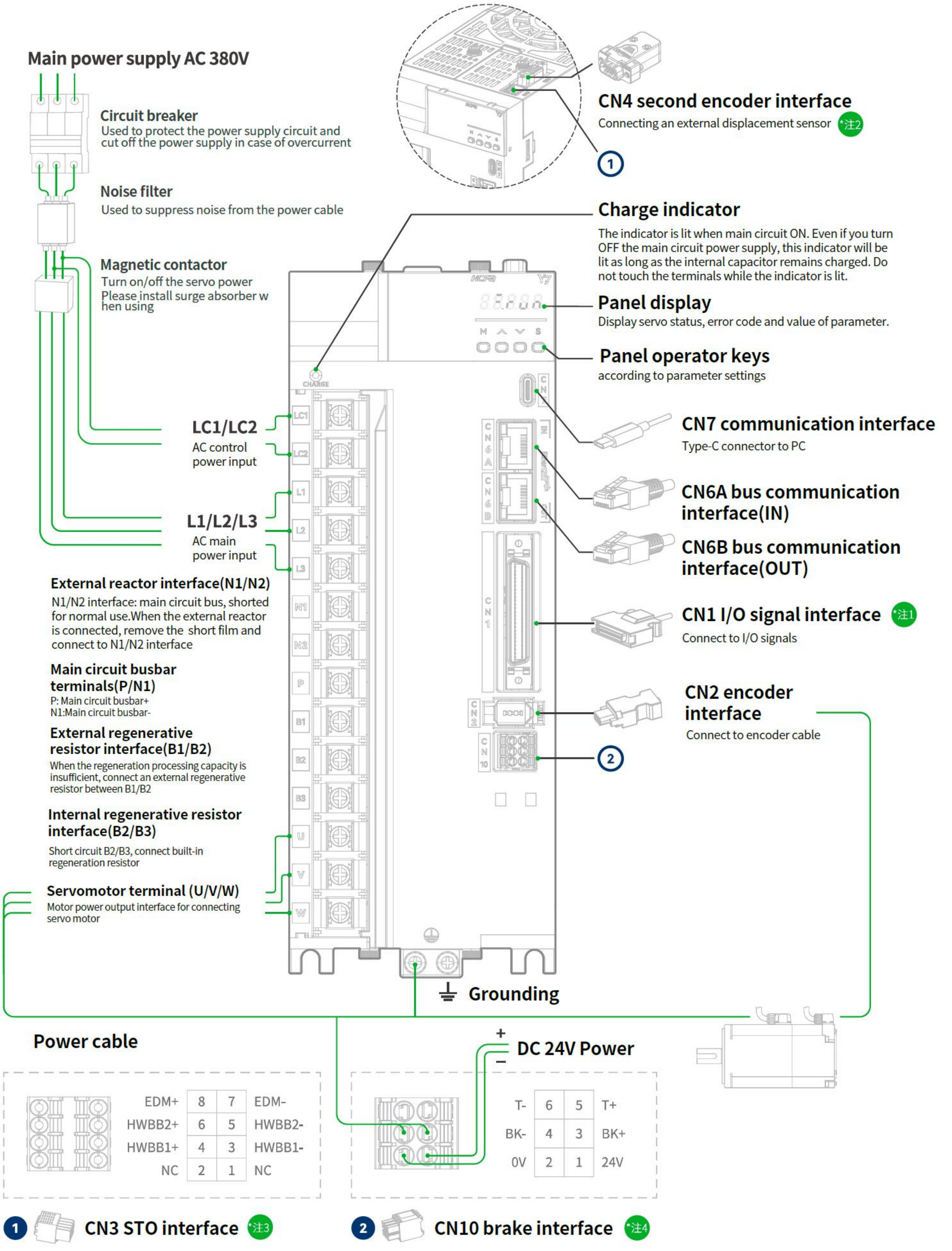
❷ CN3 STO interface 注4

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
❶ ①

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

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



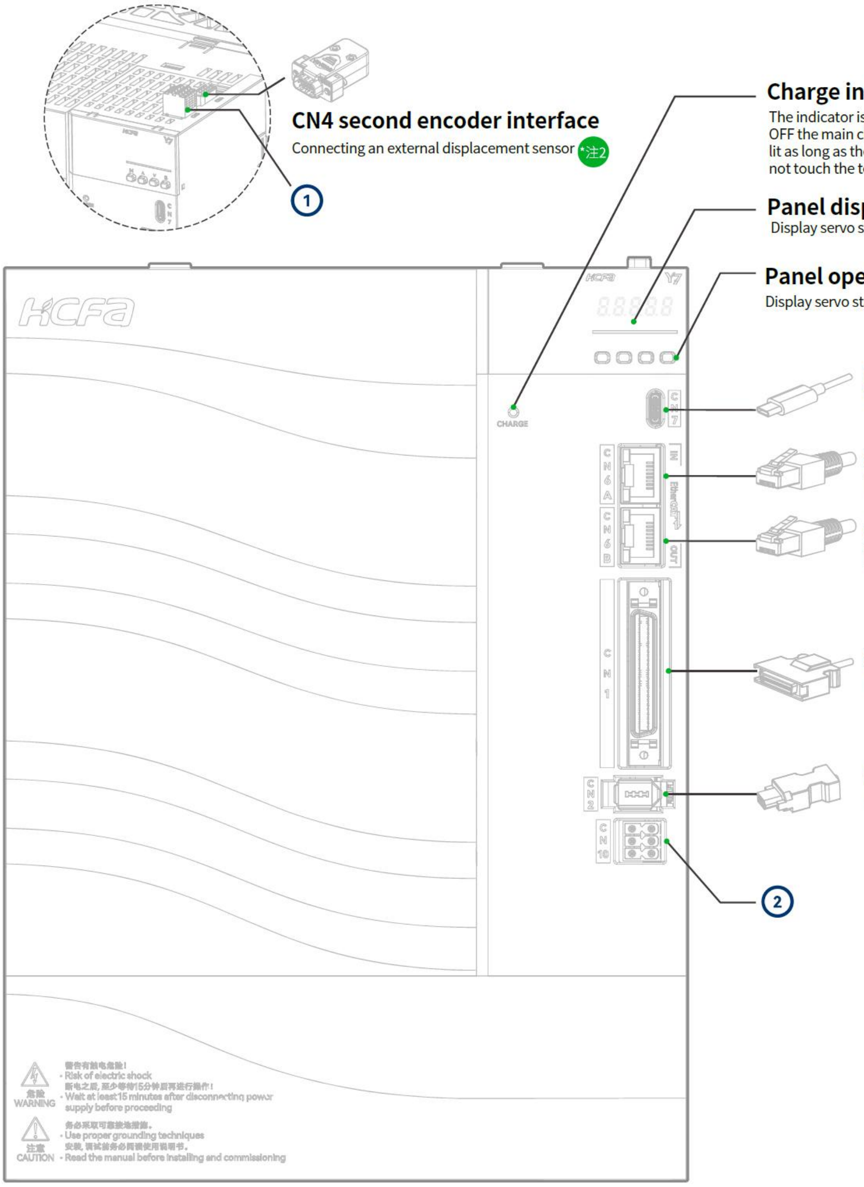
EDM+	8	7	EDM-
HWBB2+	6	5	HWBB2-
HWBB1+	4	3	HWBB1-
NC	2	1	NC

T-	6	5	T+
BK-	4	3	BK+
0V	2	1	24V

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



CN4 second encoder interface
Connecting an external displacement sensor *注2

Charge indicator
The indicator is lit when main circuit ON. Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the terminals while the indicator is lit.

Panel display
Display servo status, error code and value of parameter.

Panel operator keys
Display servo status, error code and value of parameter.

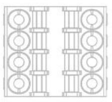
CN7 communication interface
Type-C connector to PC

CN6A bus communication interface(IN)

CN6B bus communication interface(OUT)

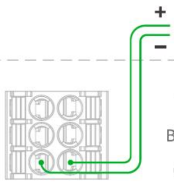
CN1 I/O signal interface *注1
Connect to I/O signals

CN2 encoder interfac
Connect to encoder cable



EDM+	8	7	EDM-
HWBB2+	6	5	HWBB2-
HWBB1+	4	3	HWBB1-
NC	2	1	NC

① **CN3 STO interface** *注3



T-	6	5	T+
BK-	4	3	BK+
0V	2	1	24V

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

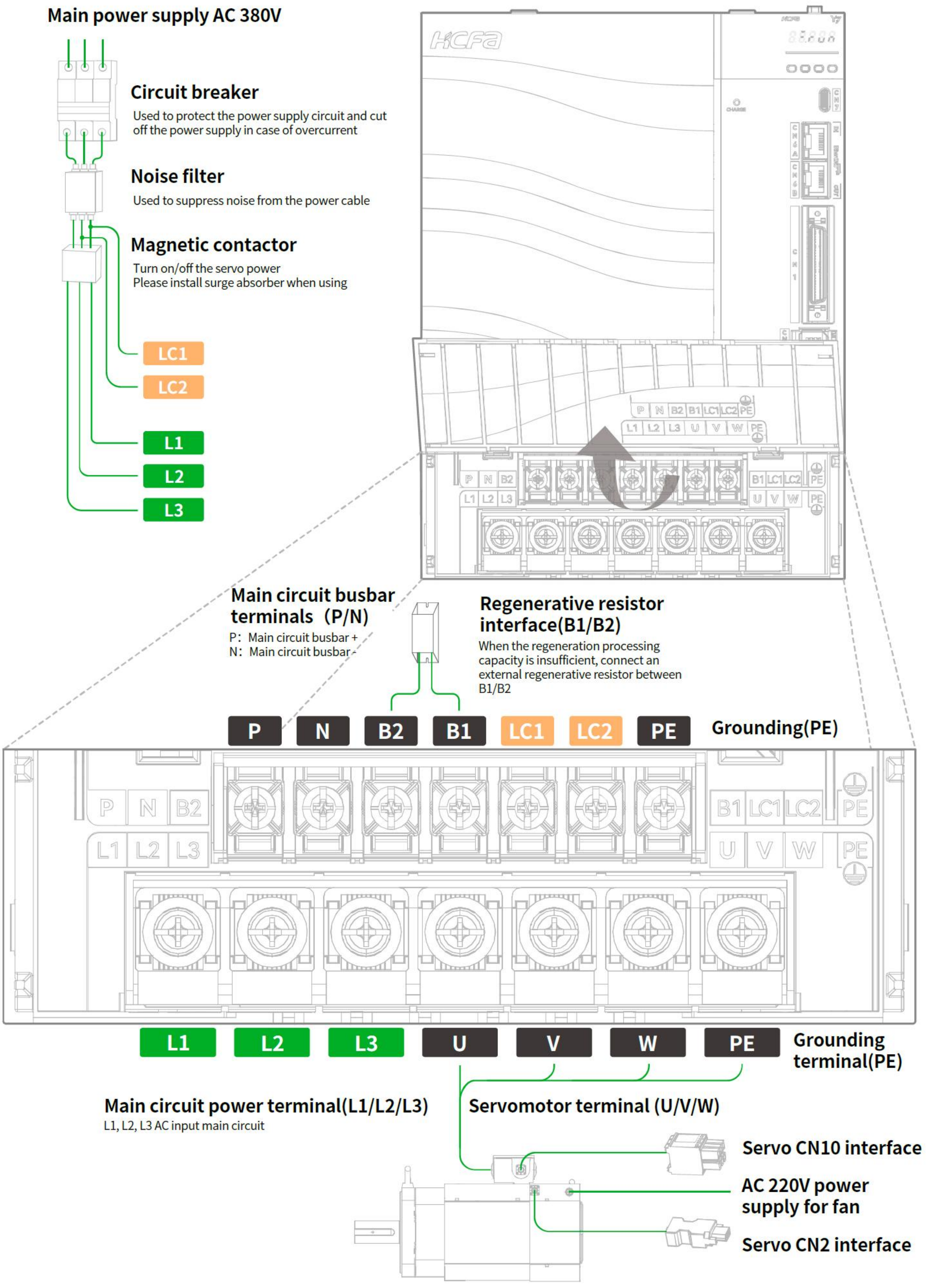


Figure 1-9 AC380V 11kW/15kW/22kW Servo Drive Part Name Diagram

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

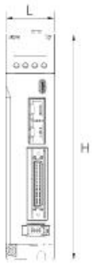
	Analog input voltage range		DC±10V (default 6V corresponding to the rated speed can be modified through parameters)
	Torque limiting function		Parameter setting, parameter setting+I/O control, analog input
Internal speed control	Control method		I/O control
	Movement speed selection		Support three different 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	For PC communication (for "HCServoWorks.Y7" connection)
		Industrial Networks	RS485

1.5 Y7S Servo Unit External Dimensions

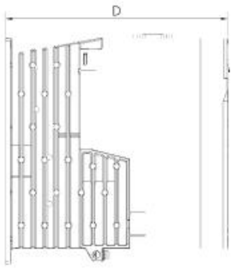
1.5.1 Y7S Servo Unit Configuration

<table>
<tr><td rowspan="2">Servo Drive (AC220V)</td><td colspan="5">SIZE A</td><td colspan="5">SIZE B</td><td colspan="5">SIZE D</td></tr>
<tr><td colspan="5">HN-Y7□□040A-S</td><td colspan="5">HN-Y7□□075A-S
HN-Y7□□100A-S</td><td colspan="5">HN-Y7□□150A-S
HN-Y7□□200A-S</td></tr>
<tr><td rowspan="2">Servo Drive (AC380V)</td><td colspan="3">SIZE C</td><td colspan="3">SIZE D</td><td colspan="3">SIZE E</td><td colspan="3">SIZE F</td><td colspan="3">SIZE G</td></tr>
<tr><td colspan="3">HN-Y7□□100T-S
HN-Y7□□150T-S</td><td colspan="3">HN-Y7□□200T-S
HN-Y7□□300T-S</td><td colspan="3">HN-Y7□□500T-S</td><td colspan="3">HN-Y7□□600T-S
HN-Y7□□750T-S</td><td colspan="3">HN-Y7□□111T-S
HN-Y7□□151T-S
HN-Y7□□221T-S</td></tr>
</table>

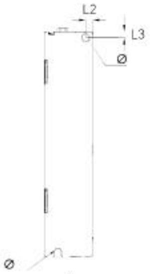
1.5.2 Y7S Series Drive Mounting Dimensions



Main view



Left view



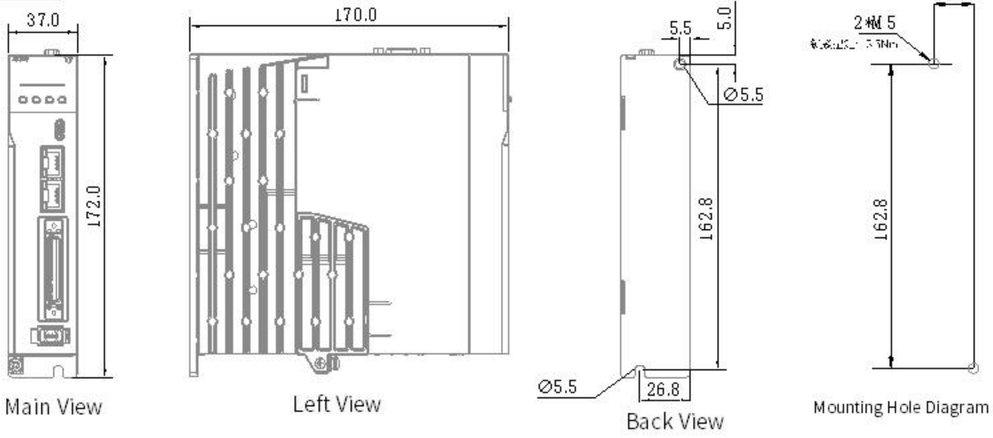
Back View

Mounting hole diagram

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

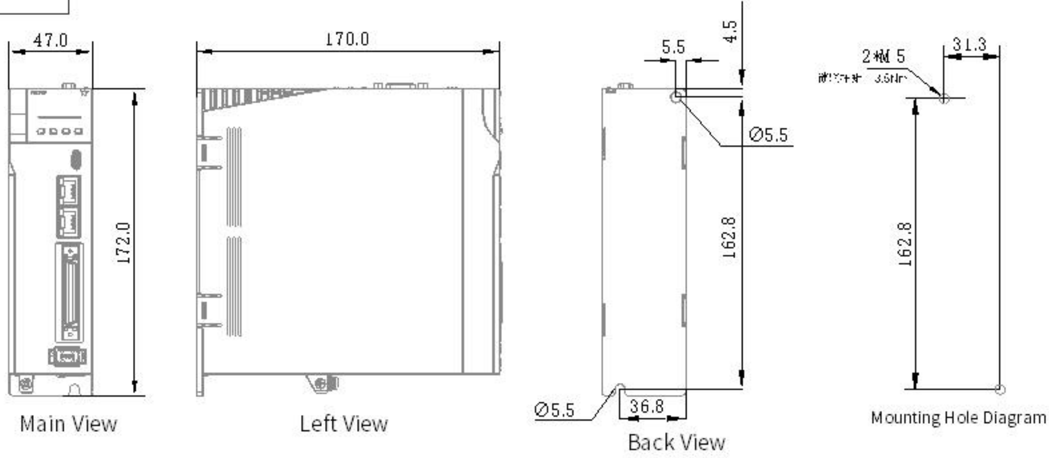
1.5.3 SIZE A Servo Unit External Dimension Drawing

Weight(KG)
0.76



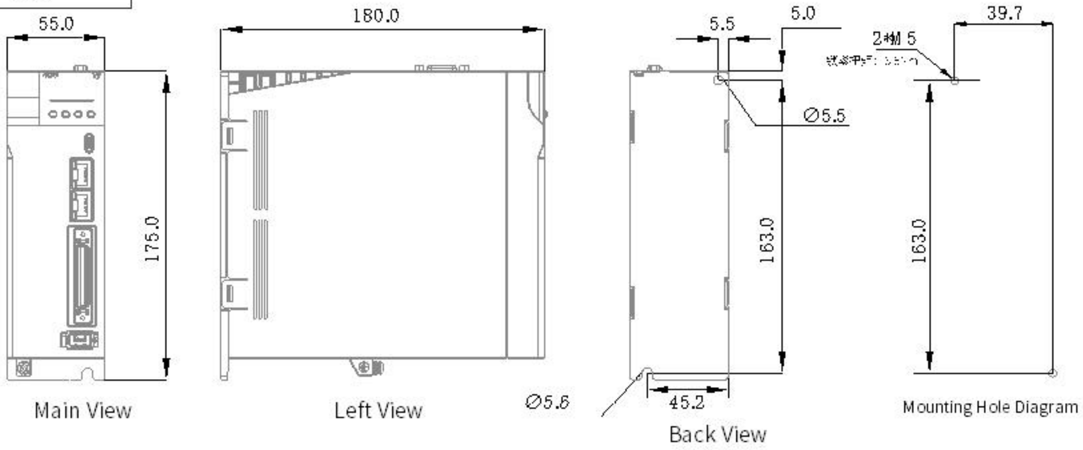
1.5.4 SIZE B Servo Unit External Dimension Drawing

Weight (KG)
1.01



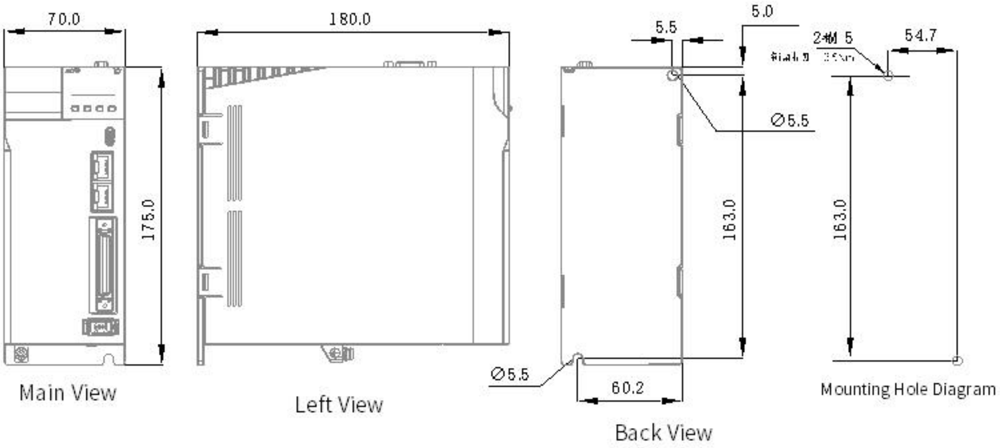
1.5.5 SIZE C Servo Unit External Dimension Drawing

Weight (KG)
1.21



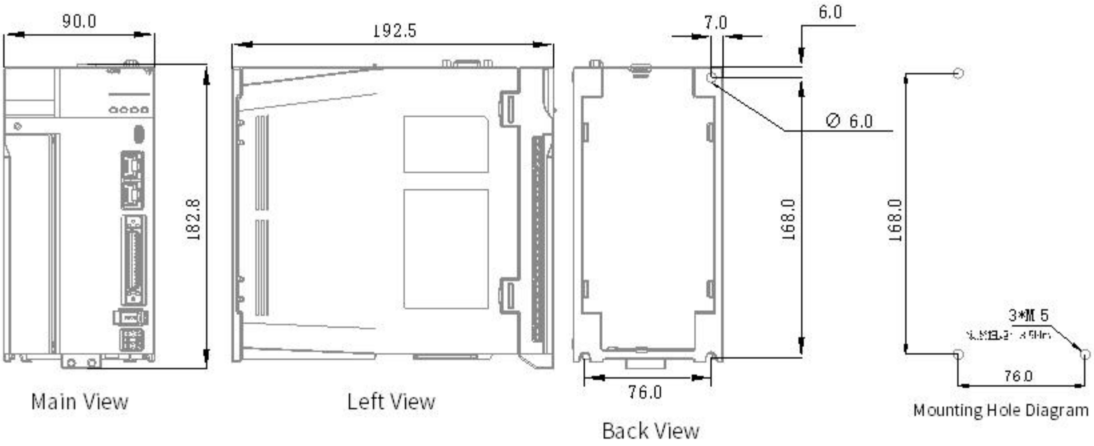
1.5.6 SIZE D Servo Unit External Dimension Drawing

Weight(KG)	
1.45	1.5



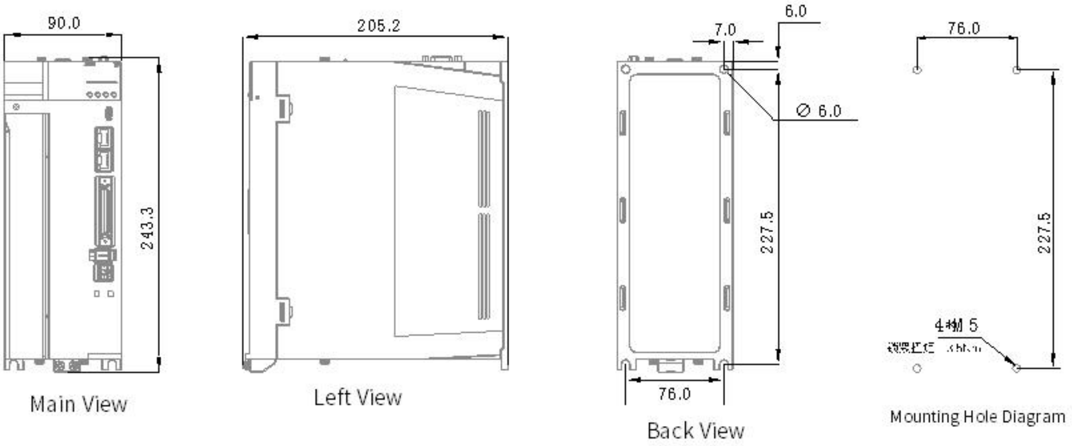
1.5.7 SIZE E Servo Unit External Dimension Drawing

Weight(KG)
2.2



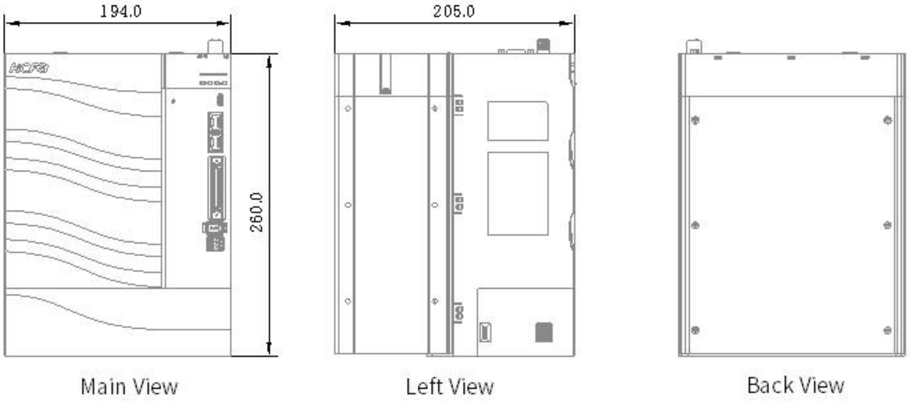
1.5.8 SIZE F Servo Unit External Dimension Drawing

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.

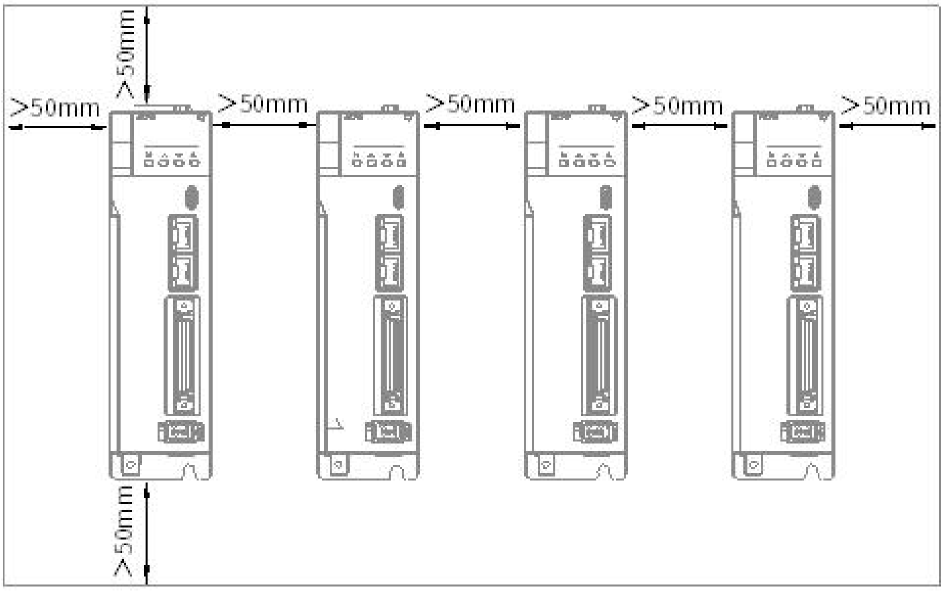
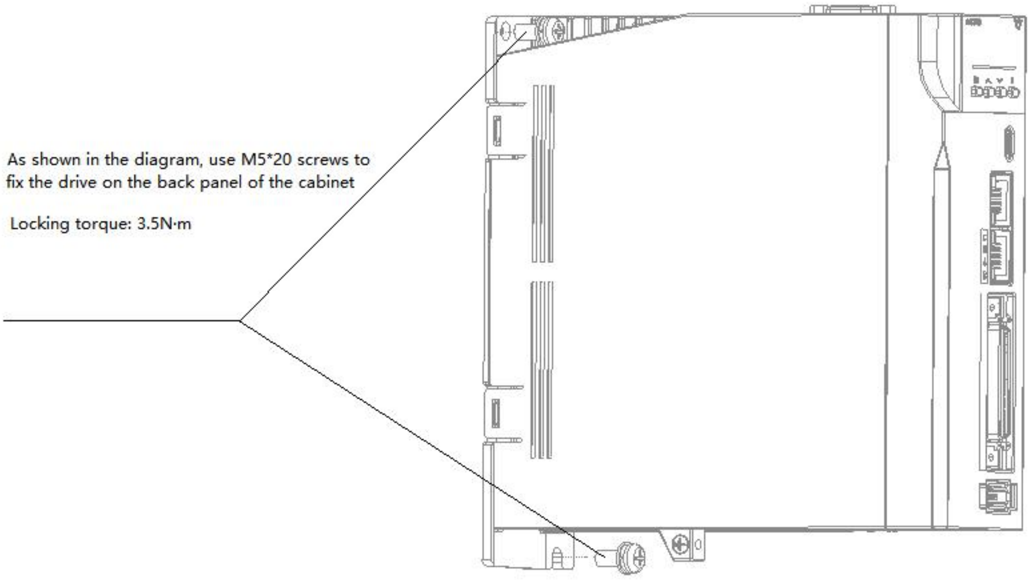


Figure 1-10 Y7S Servo Unit Installation Diagram

1.6.2 Structural Installation Instructions



As shown in the diagram, use M5*20 screws to fix the drive on the back panel of the cabinet

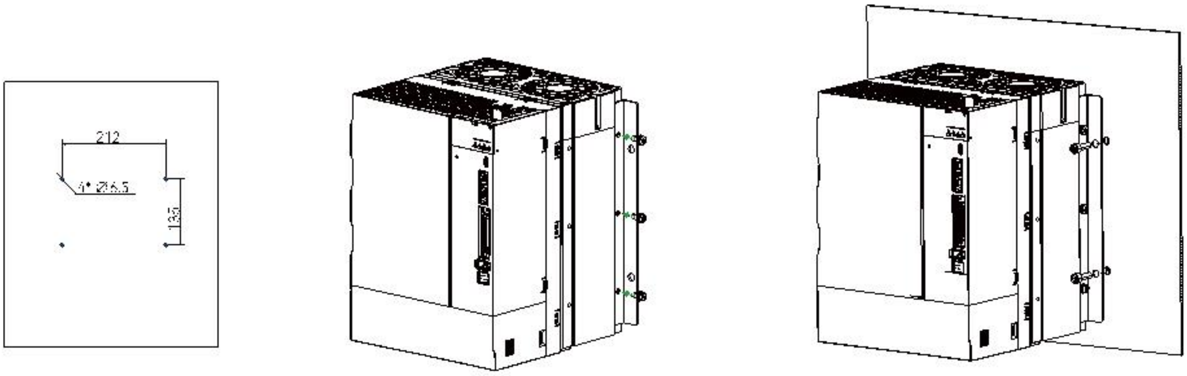
Locking torque: 3.5N·m

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 Φ6.5 holes in the back panel of the electrical cabinet, the specific dimensions are shown in the figure

Step2

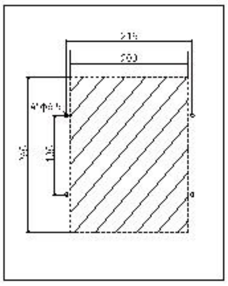
Take out the mounting bracket and six M5*12 screws from the package, fix the mounting bracket on both sides of the drive with screws, as shownin the figure

Step3

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

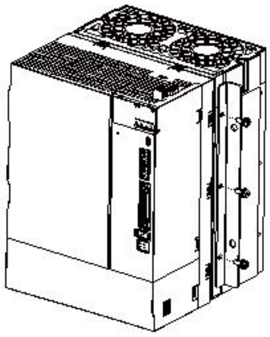
Figure 1-11 Y7S Servo Unit Installation Diagram

Rack-mounted:



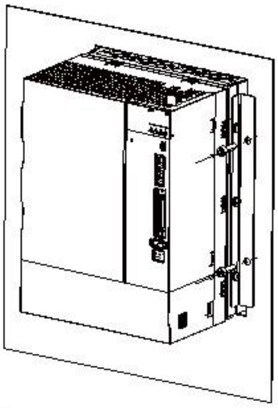
Step1

Make four Φ6.5 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



Step3

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

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

❗ **Points**

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.。
- 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

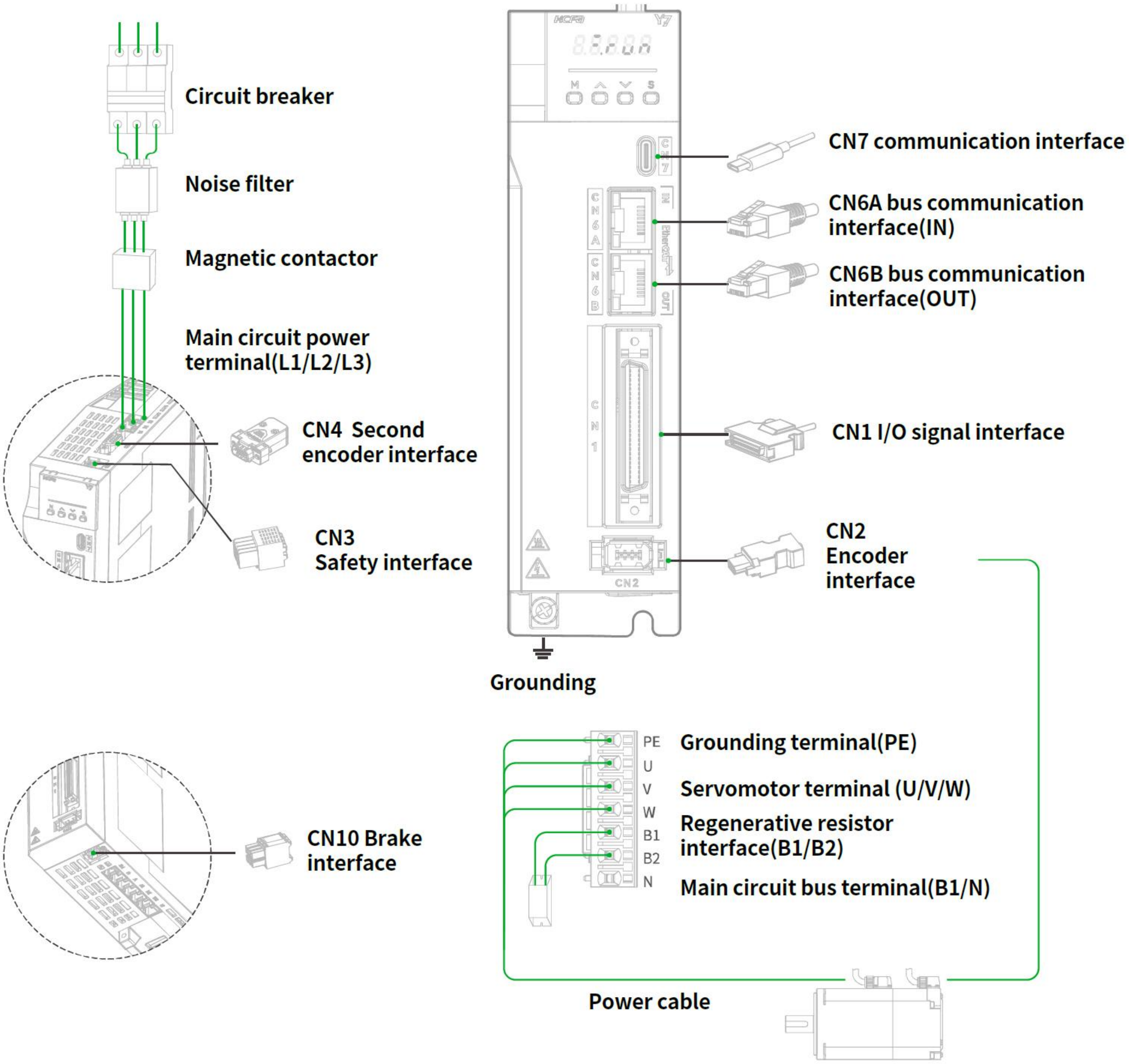


Figure 2-1 Connector Type Terminal Drive Wiring Diagram

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

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

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

2.3 Fence Type Terminal Definition Diagram

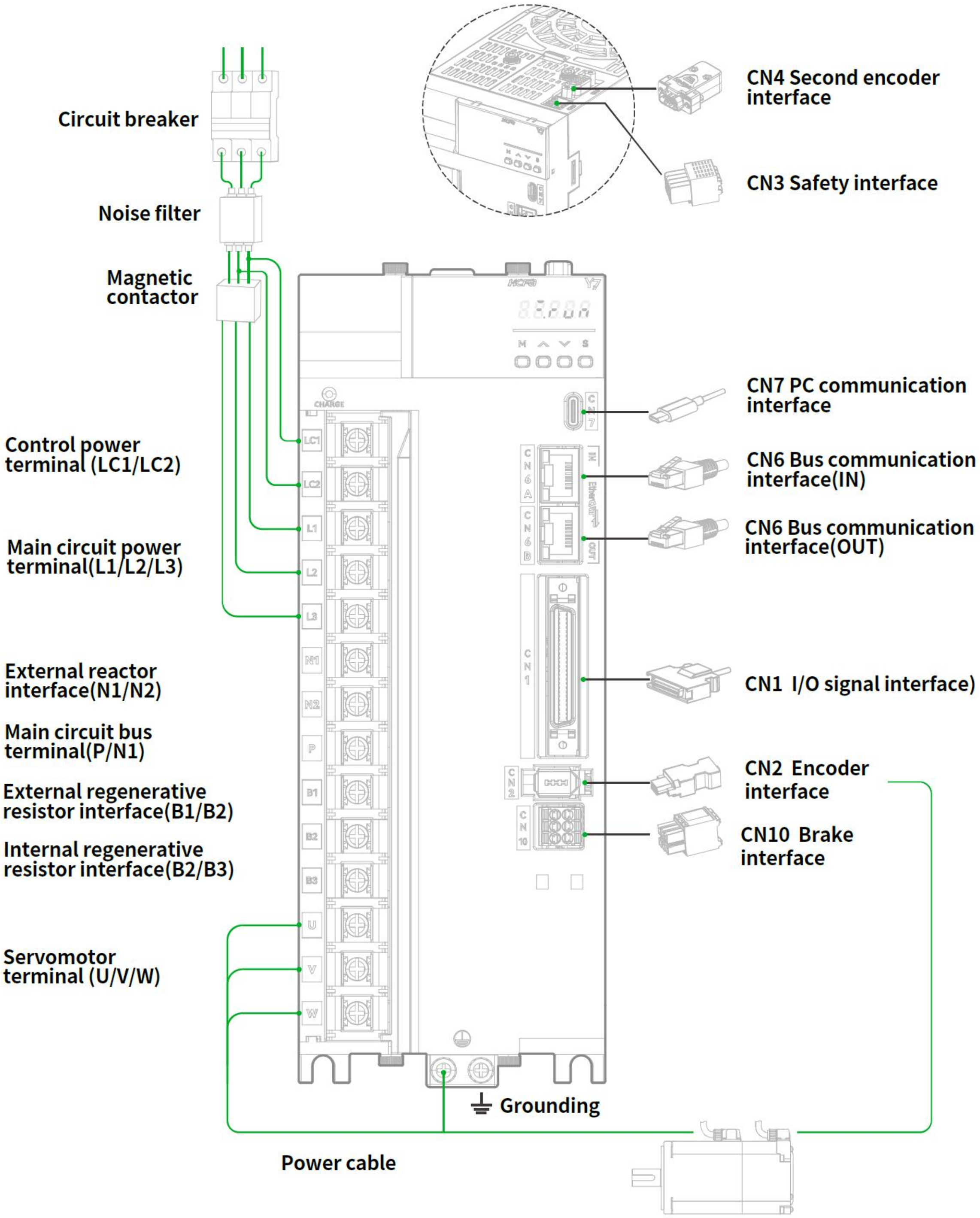


Figure 2-2 Fence Type Terminal Drive Wiring Diagram

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-			
		FG	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-	BISS-C CLK-	Sine encoder Sin -	Serial DATA-
		7	Incremental encoder B-	BISS-C DATA-	Sine encoder encoder Cos-	-
		8	Incremental encoder Z -			
		9	Hall W +			
		1 0	Hall V -			
		1 1	Incremental encoder A +	BISS-C CLK+	Sine encoder Sin +	Serial DATA+
		1 2	Incremental encoder B+	BISS-C DATA+	Sine encoder Cos +	-
		1 3	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

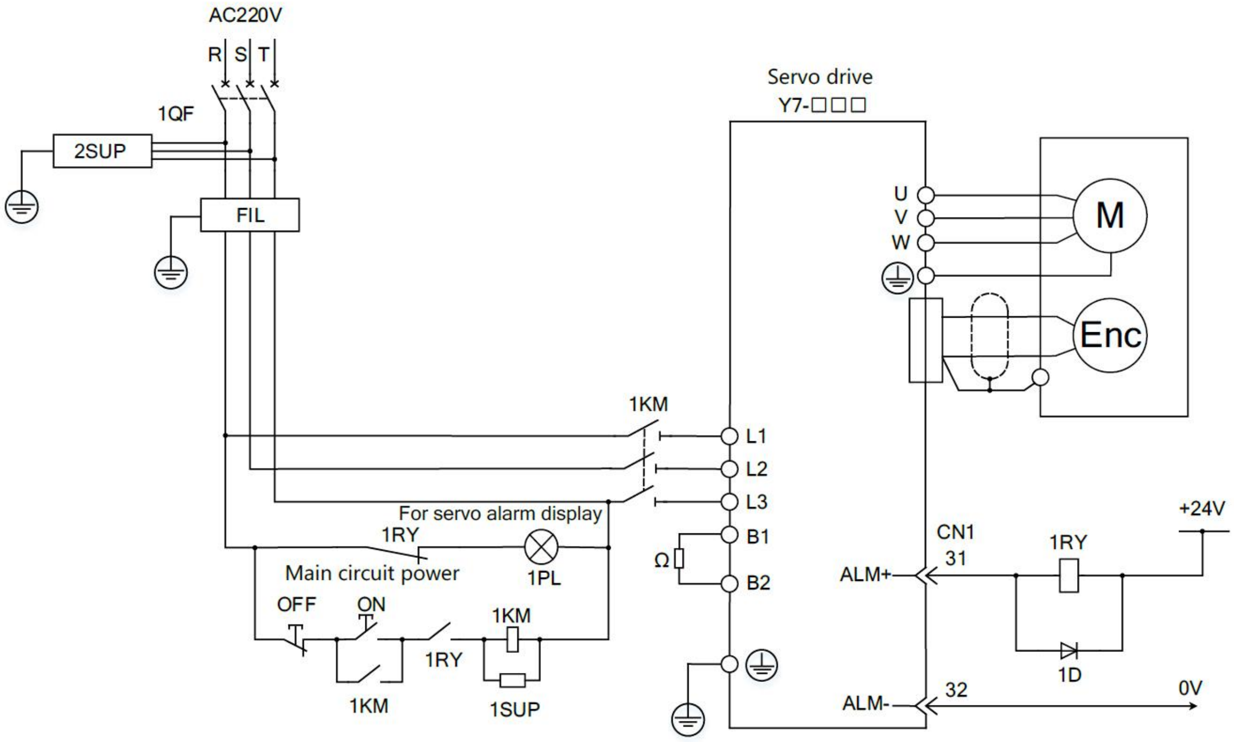
・Make sure that the power supply specifications are suitable for the input power supply.

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

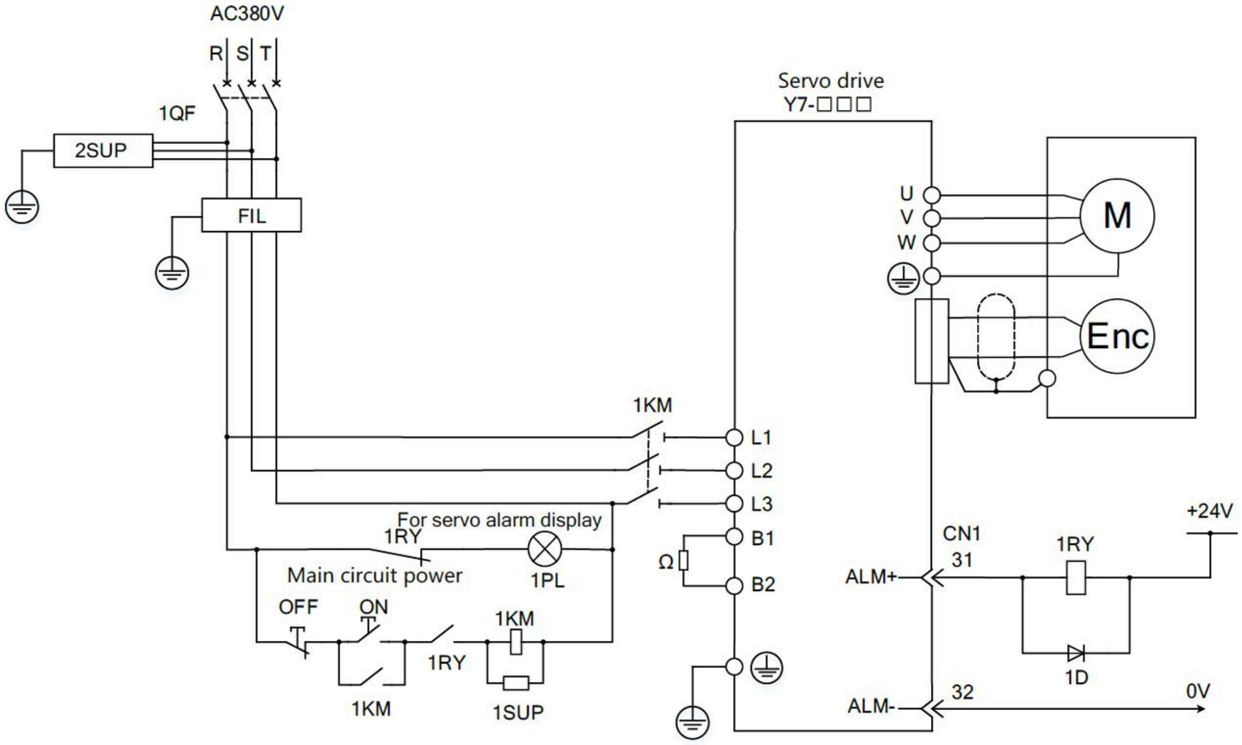


1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor
Ω: Brake resistor
1D: Flywheel diode
1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber

Figure 2-4 Three-phase 220V Wiring

2.4.2 Example of Main Circuit Wiring for Standard AC380V Power Input

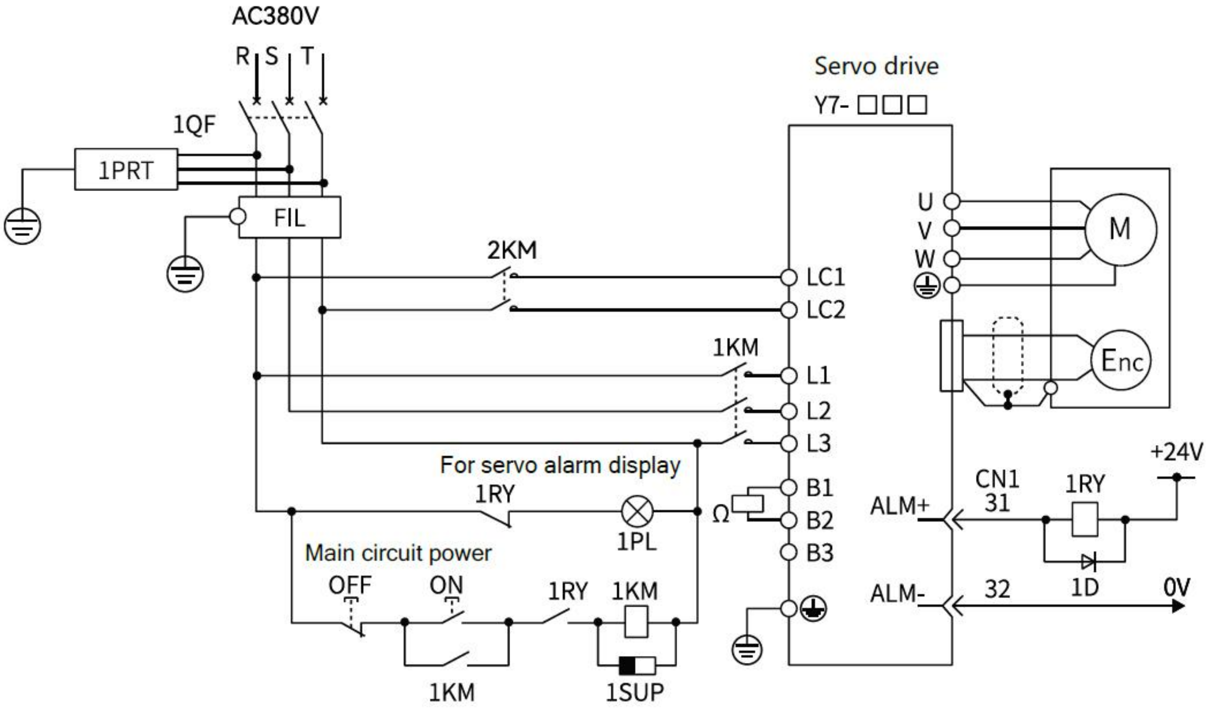
Model Name：HN-Y7□□100T-S、HN-Y7□□150T-S、HN-Y7□□200T-S、HN-Y7□□300T-S



1QF：Circuit breaker for wiring
FIL：Noise filter
1KM：Magnetic contactor
Ω：Brake resistor
1D：Flywheel diode

1RY：Relay
1PL：Indicator
1SUP：Surge absorber
2SUP：Surge absorber

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]	Use with three-phase power input	After restart	Setup
	n. □1□□	Use with single-phase power input		

Please observe the following precautions when using.

Danger

· 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.

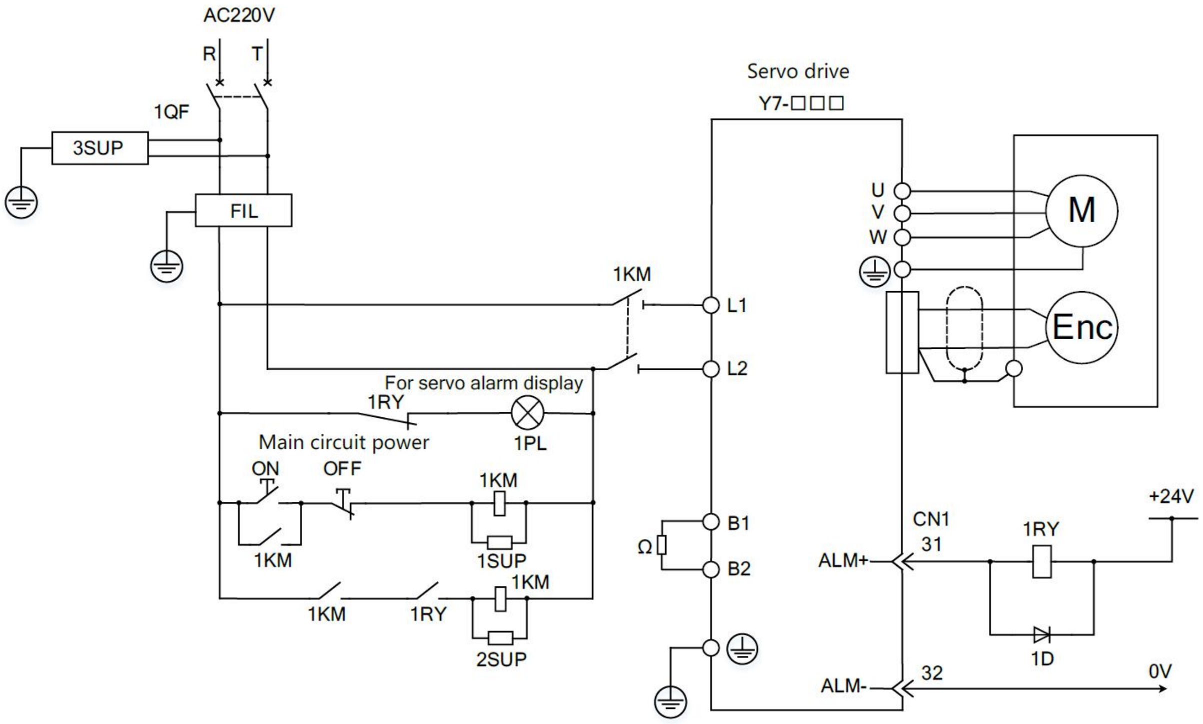
Table 2-6 Main Circuit Power Input Terminal

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



1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor
Ω: Brake resistor
1D: Flywheel diode
1RY: Relay
1PL: Indicator
1SUP: Surge absorber
2SUP: Surge absorber
3SUP: Surge absorber

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□□	Use with AC power input	After restart	Setup
	n. □1□□	Use with DC power input		

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

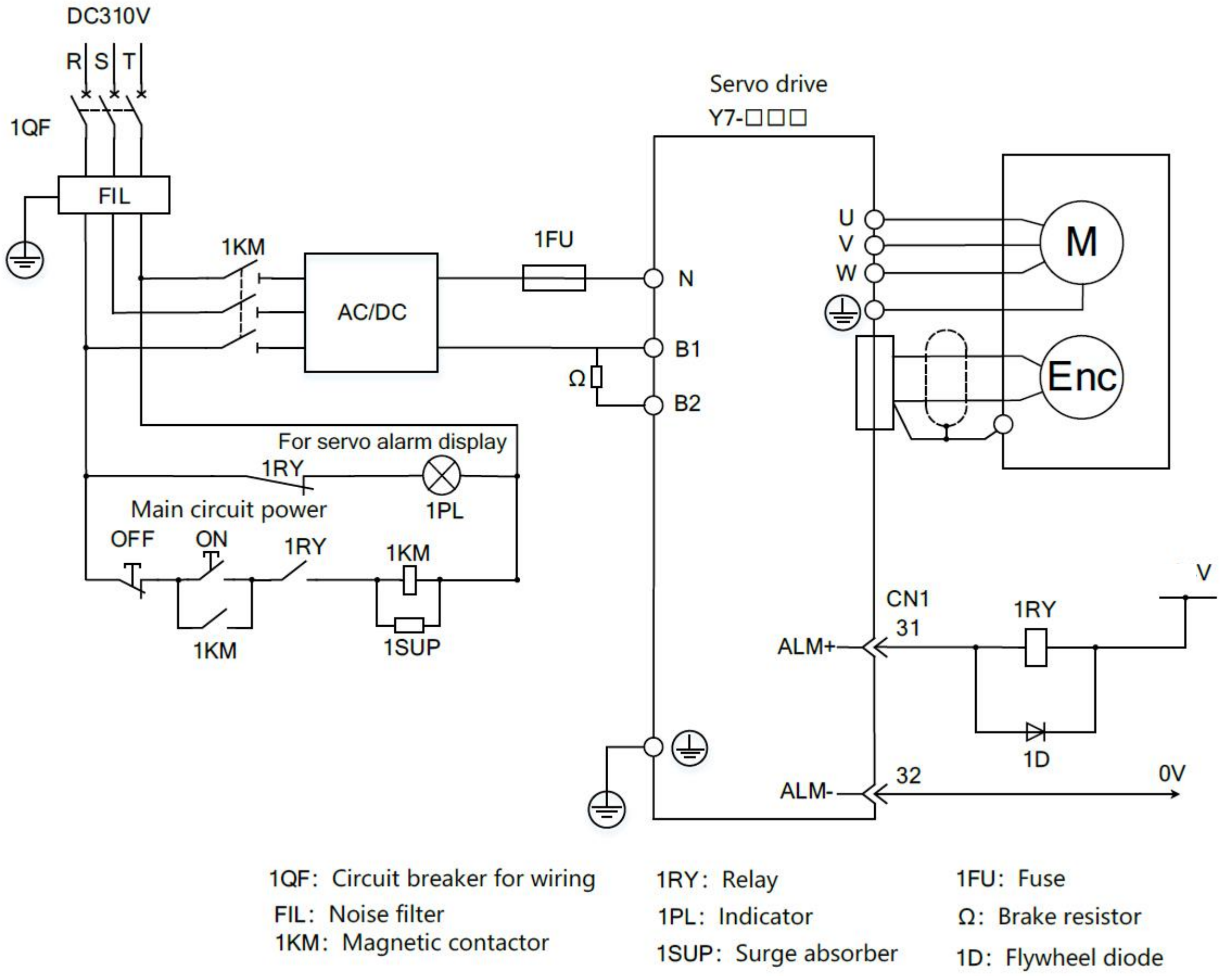
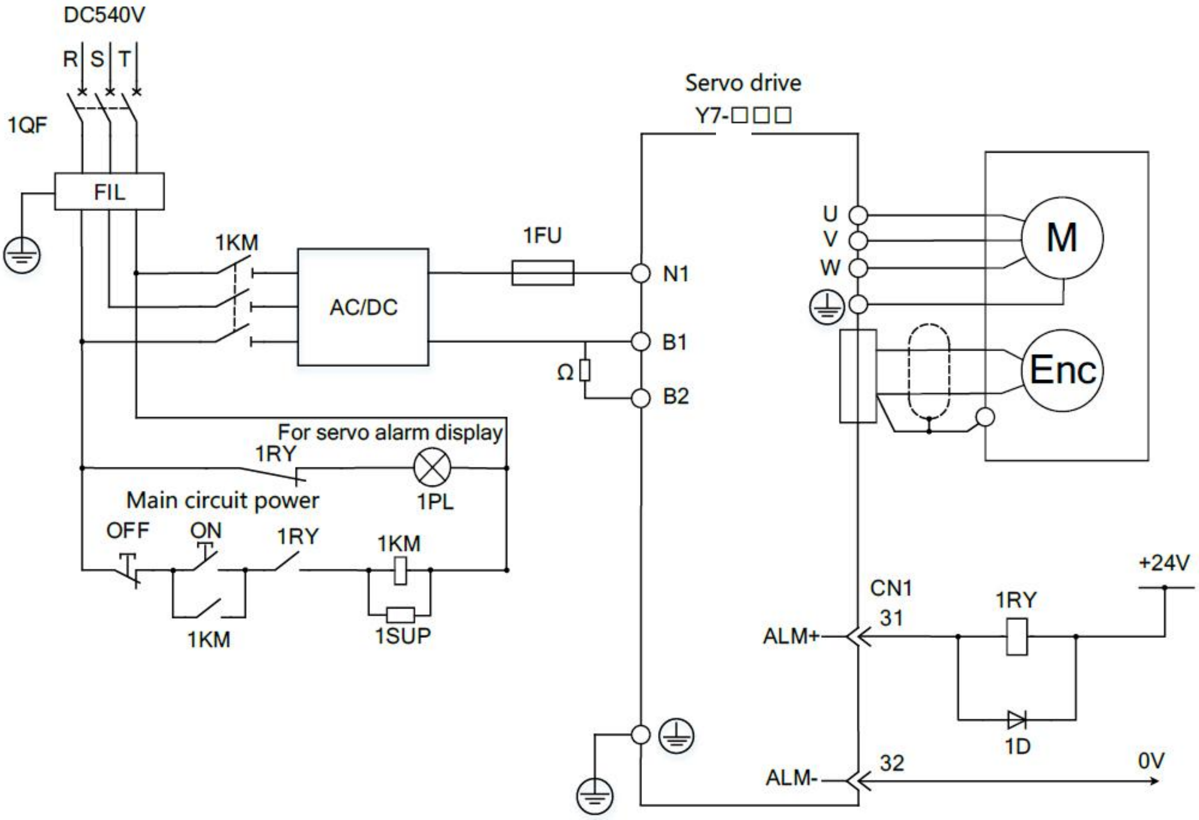


Figure 2-7 DC310V Input HN-Y7□□□□□A-S Wiring

➢ 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

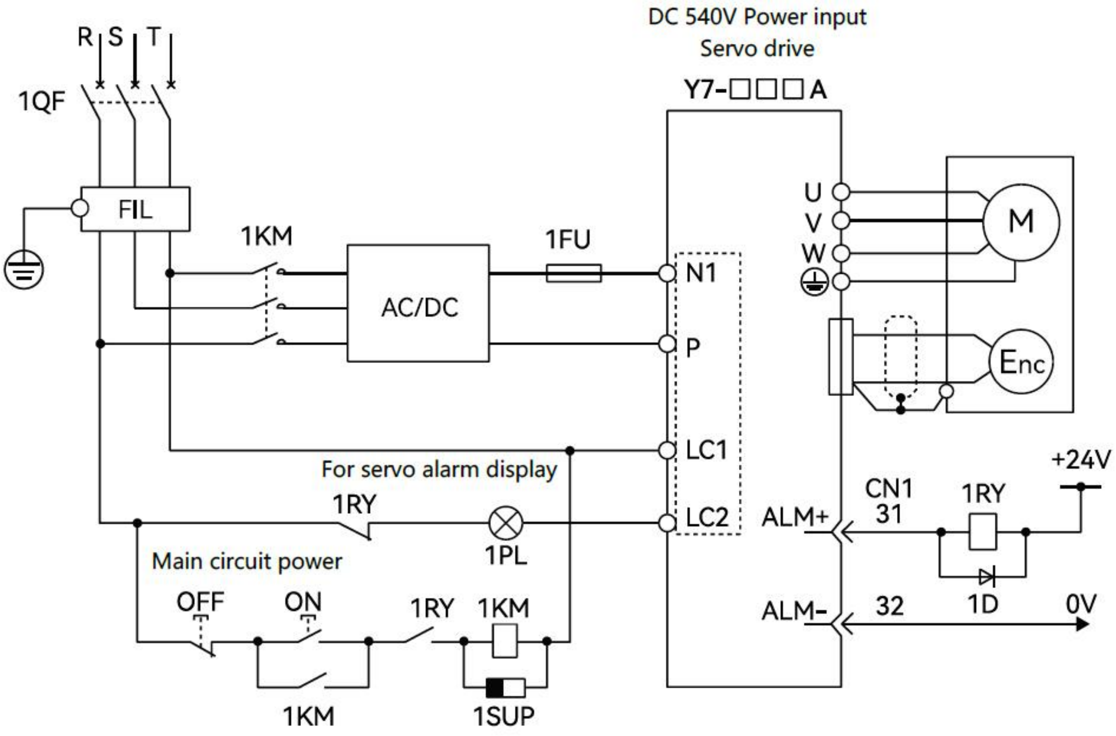


1QF: Circuit breaker for wiring
FIL: Noise filter
1KM: Magnetic contactor
1RY: Relay
1PL: Indicator
1SUP: Surge absorber
1FU: Fuse
Ω: Brake resistor
1D: Flywheel diode

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.

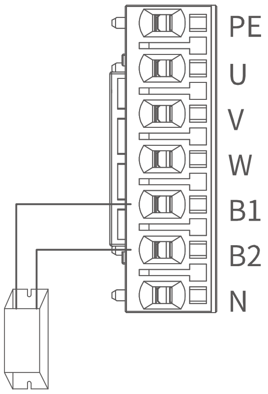


Figure 2-9 Model Below 3kw Regenerative Resistor Wiring

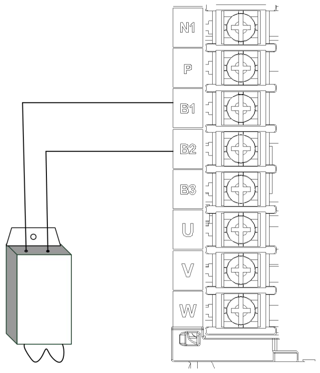


Figure 2-10 Model Above 5kw Regenerative Resistor Wiring (With B3)

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 valueΩ)		40	40	35	20	20

2.5.2 AC380V regenerative resistor basic specifications

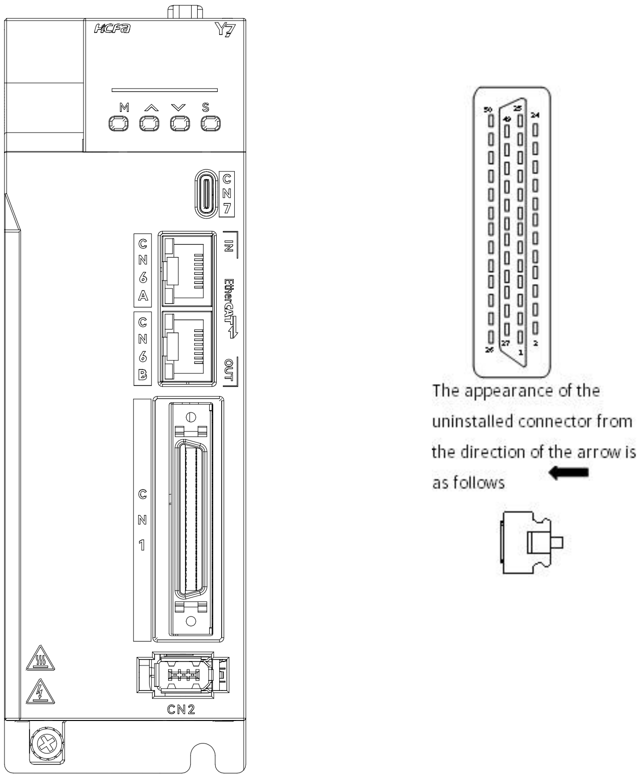
Table 2-14 AC380V Regenerative Resistor Specifications

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 valueΩ)		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 resister 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

			1	SG	GND				26	OUT3-	Assignable output signal
2	SG	GND	3	PL1	12V Internal Power Supply for Open Collector Reference Output	27	OUT4+	High speed output	28	OUT4-	High speed output
4	SEN	SEN signal input-	5	V-REF	Analog Speed Reference Input	29	OUT1+	Assignable output signal	30	OUT1-	Assignable output signal
6	SG	GND	7	Null	Null	31	OUT2+	Assignable output signal	32	OUT2-	Assignable output signal
8	Null	Null	9	T-REF	Analog Torque Reference Input	33	PA0	Encoder Divided Pulse Output, Phase A	34	/PA0	Encoder Divided Pulse Output, Phase A
10	SG	GND	11	Null	Null	35	PB0	Encoder Divided Pulse Output, Phase B	36	/PB0	Encoder Divided Pulse Output, Phase B
12	Null	Null	13	PL2	12V Internal Power Supply for Open Collector Reference Output	37	OUT5+	High speed output	38	OUT5-	High speed output
14	CLR	Position Deviation Clear input Input	15	Null	Null	39	DAC0	Analog Output 1	40	SI0	Homing signal drive input
16	Null	Null	17	Null	Null	41	SI1	Probe 1	42	SI2	Disabled Forward Side Drive Input
18	PL3	12V Internal Power Supply for OpenCollector Reference Output	19	PC0+	Encoder Divided Pulse Output, Phase C	43	SI3	Disabled Reverse Side Drive Input	44	SI4	Probe 2
20	/PC0	Divided Pulse Output, Phase C phase	21	Null	Null	45	Null	Null	46	Null	Null
22	Null	Null	23	Null	Null	47	DI (COM)	External 24V Power Input	48	DAC1	Analog Output 2
24	Null	Null	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 N-OT	42 43	Prohibition of forward drive Prohibition of reverse drive	When the mechanical movement exceeds the movable range, the drive of the servo motor is stopped (overtravel prevention function).
	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-0T, N-0T 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)	
Parameter Assignment			40	41	42	43	44	Always active	Always inactive
/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-0T	0	1	2	3	4	7	8
	H	/P-0T	9	A	B	C	D		
Reverse Drive Prohibit Setting of Pn50B.0	L	N-0T	0	1	2	3	4	7	8
	H	/N-0T	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

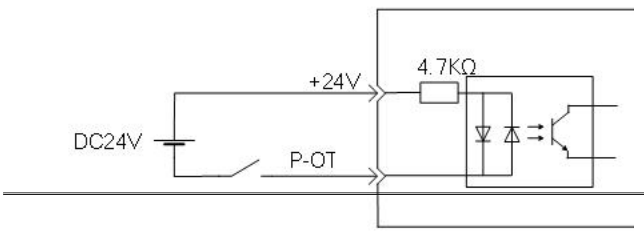
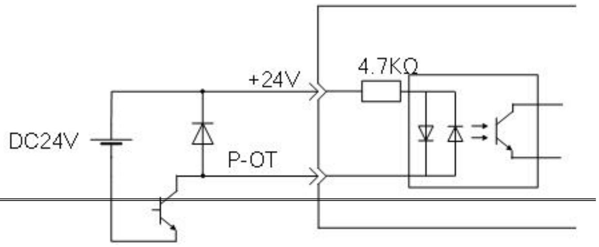
- Note: If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all of the allocated signals will operate accordingly. This may result in unexpected operation.

2.6.4 Input Circuit

The following describes terminals 40 to 47 of the CN1 port

1) Relay/Collector Input Circuit

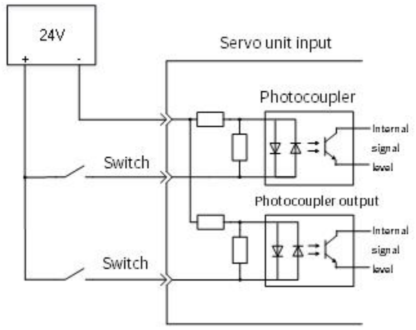
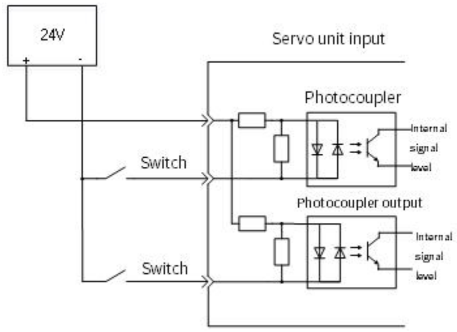
The connection is made via a relay or an open-collector transistor circuit. When using a relay connection, please choose a relay for small current; if you do not use a relay for small current, it will cause poor contact

Example of a Relay Circuit	Example of Open Collector Loop
	

- 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.

Common Emitter (NPN) Connection	Common Collector (PNP) Connection
	

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

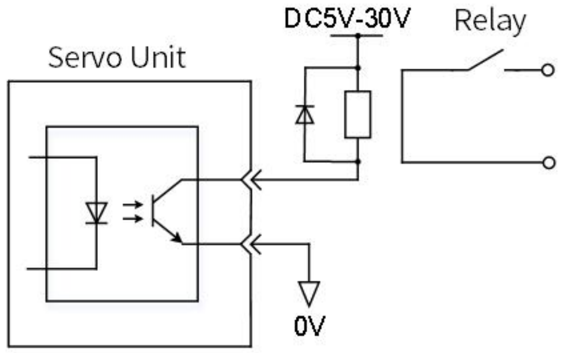
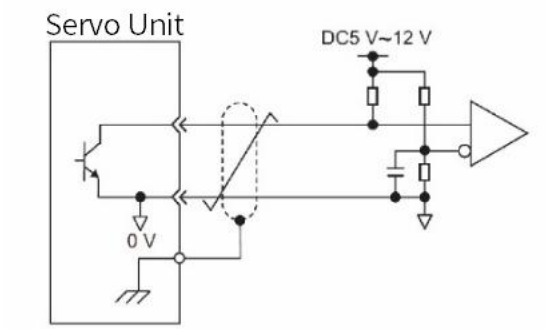
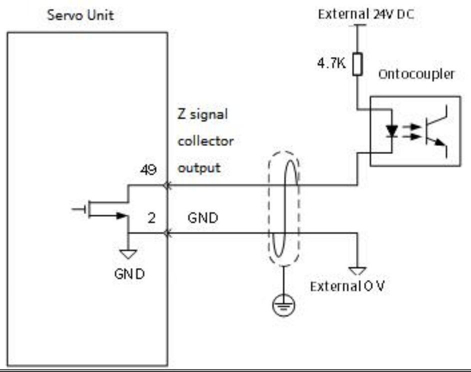
The signal output circuits of the servo unit are the following two types.

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.

Example of a Relay Circuit	Example of Differential Loop
	
Z Signal Collector Output	
	

- Note: The specifications of the photocoupler output circuit are as follows:
- · Maximum allowable voltage: DC30V
- · Current range: DC5mA ~ DC50m

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

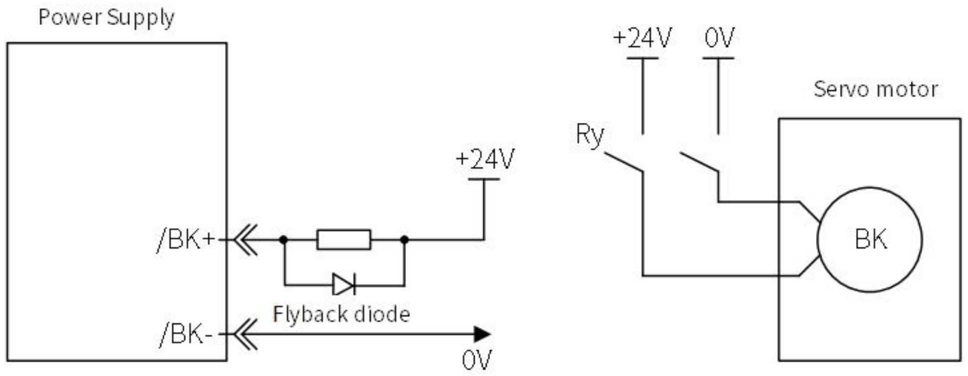


Figure 2-13 Brake Signal Connection

- 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)

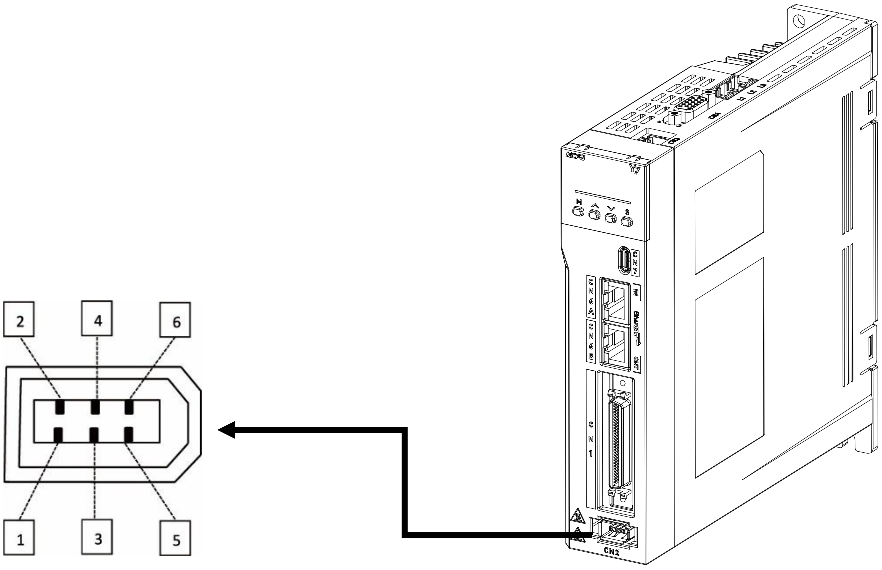


Figure 2-14 Pin Arrangement of Encoder Connector

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

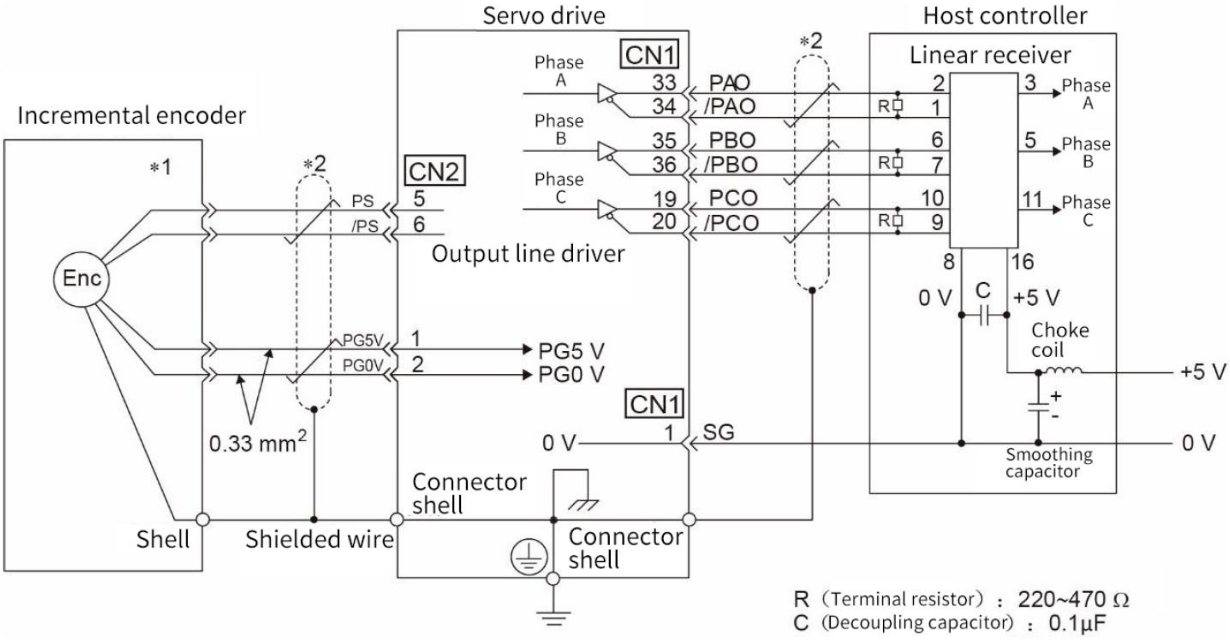


Figure 2-15 Incremental Encoder, Servo Drive and Host Device Connection Diagram

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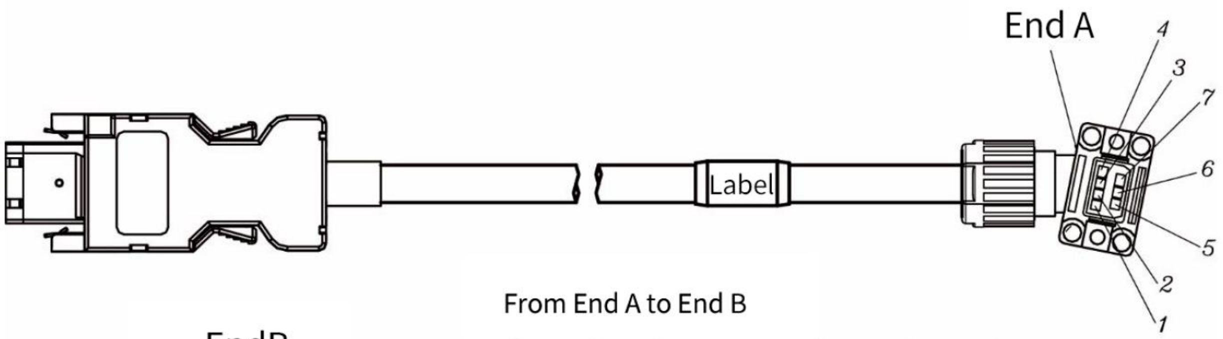
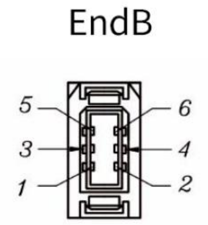
- Note: *1. The connector wiring pin number of the incremental encoder varies depending on the servo motor used.
- *2. Indicates shielded twisted-pair wire.

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

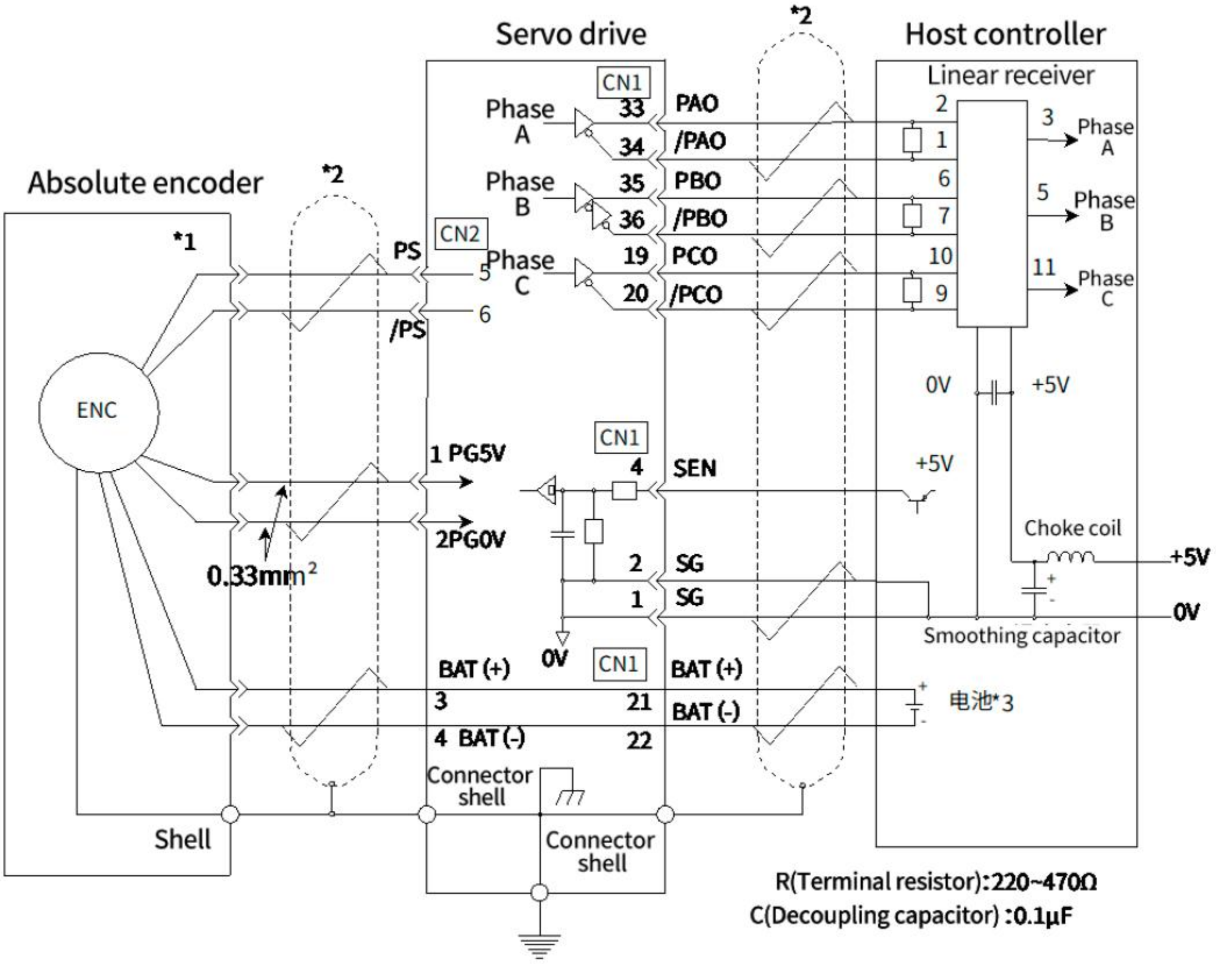


Figure 2-16 Absolute Encoder, Servo Drive and Host Controller Connection Diagram

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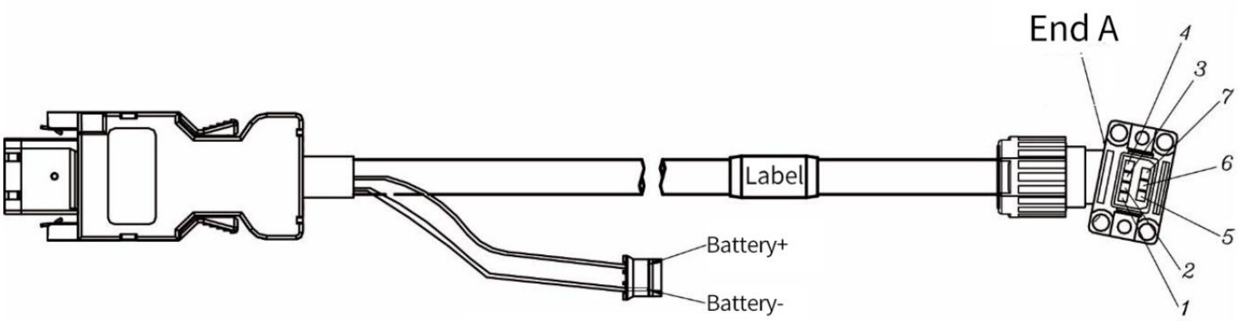
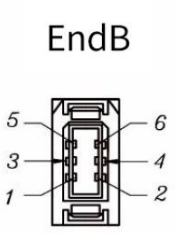
- Note: *1. The connector wiring pin number of the absolute encoder varies depending on the servo motor used.
- *2. Indicates shielded twisted-pair wire.
- *3. When using an absolute encoder, install a battery on either side of the encoder cable with a battery unit or on the host side to supply power.

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



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
Battery-		Green		
3		——	3	——
4		White(black dotted)	6	−D0
5		Yellow(red dotted)	Battery Yellow (+)	BATT
6		Black	Iron shell	SHIELD
7		White(red dotted)	5	+D0

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)

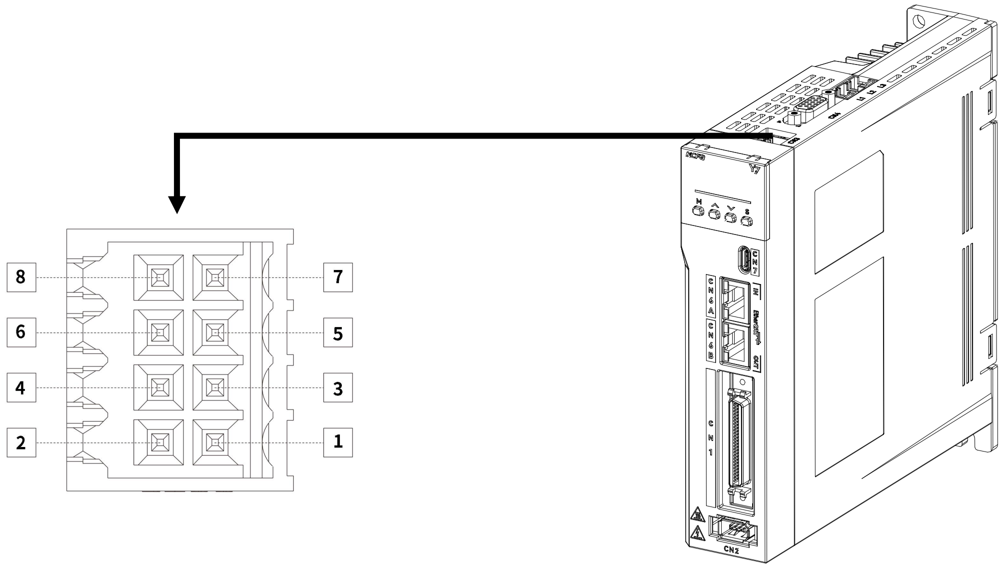


Figure 2-17 Pin Arrangement of Safety Function Signals (CN3)

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

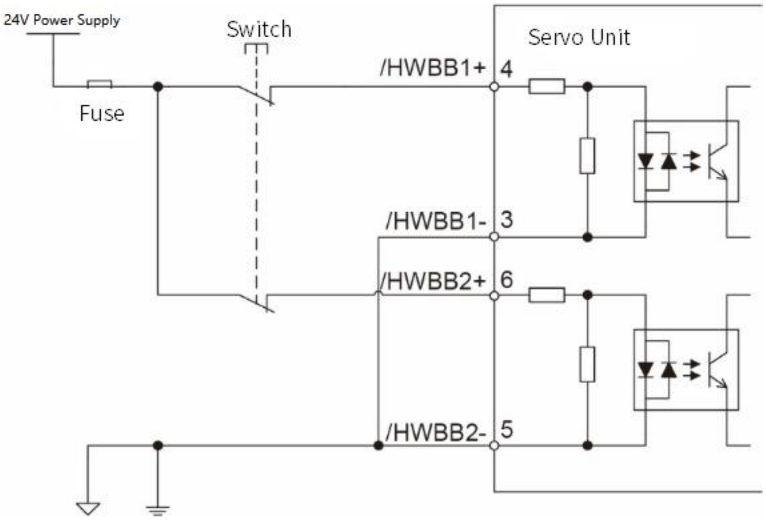
Signal name	Pin	Function
—	1	Do not make any connections
—	2	
/HWBB1-	3	For a hard wire base block input. The base block (motor power turned OFF) is in effect when the signal is OFF.
/HWBB1+	4	

/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.

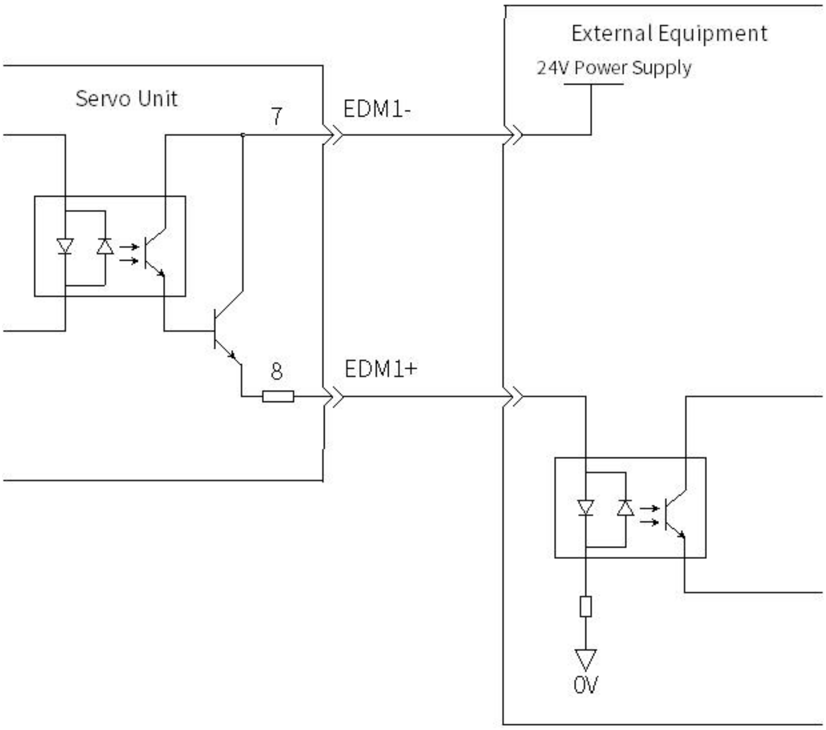
Input Signal Connection Example



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:

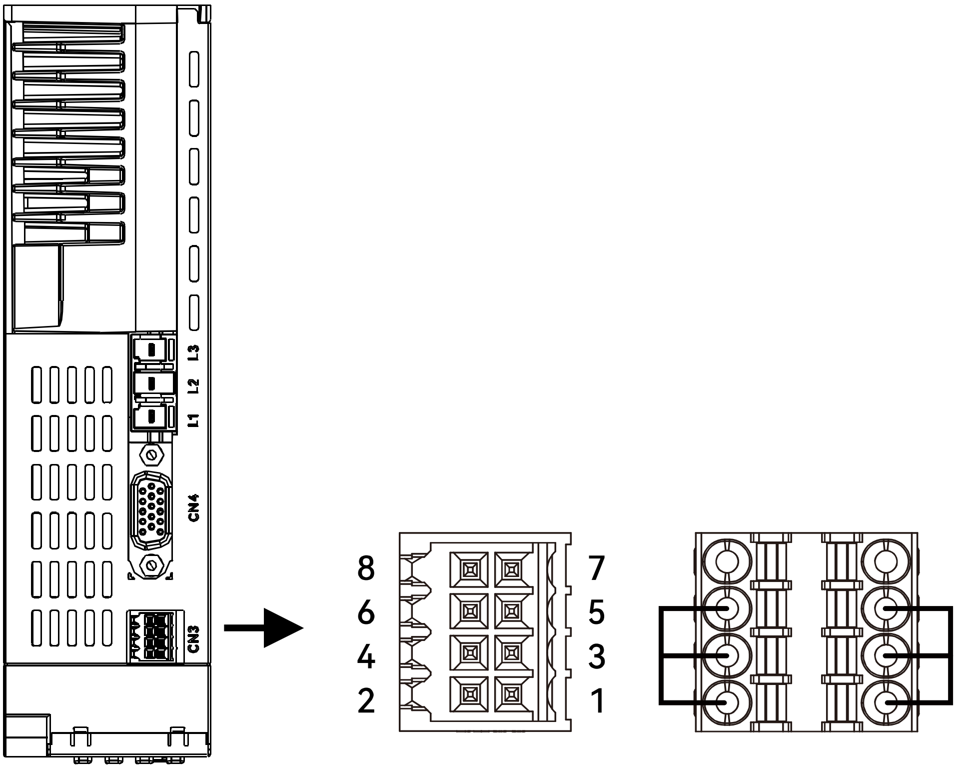


Figure 2-18 Safety Terminal Wiring

2.9 The Second Encoder Interface (CN4)

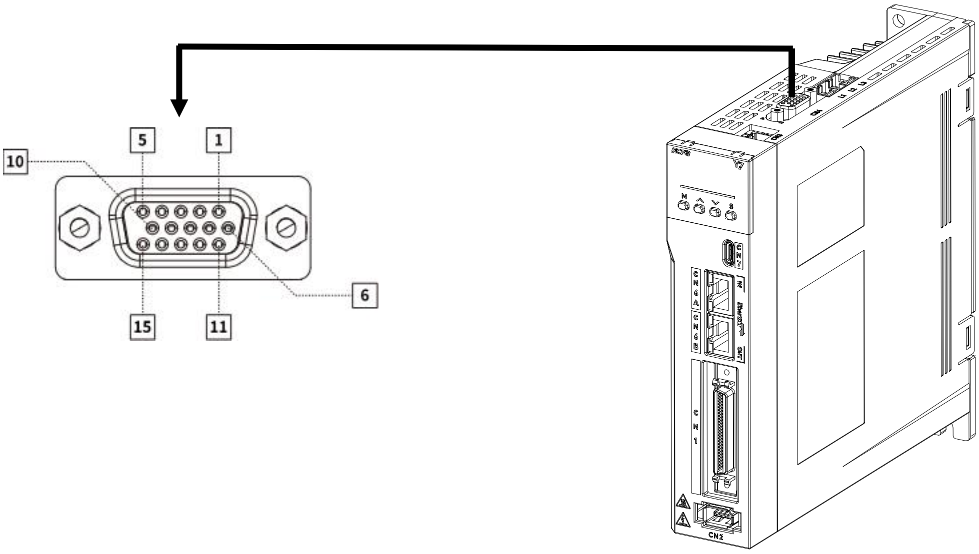


Figure 2-19 CN4 Pin Arrangement

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)

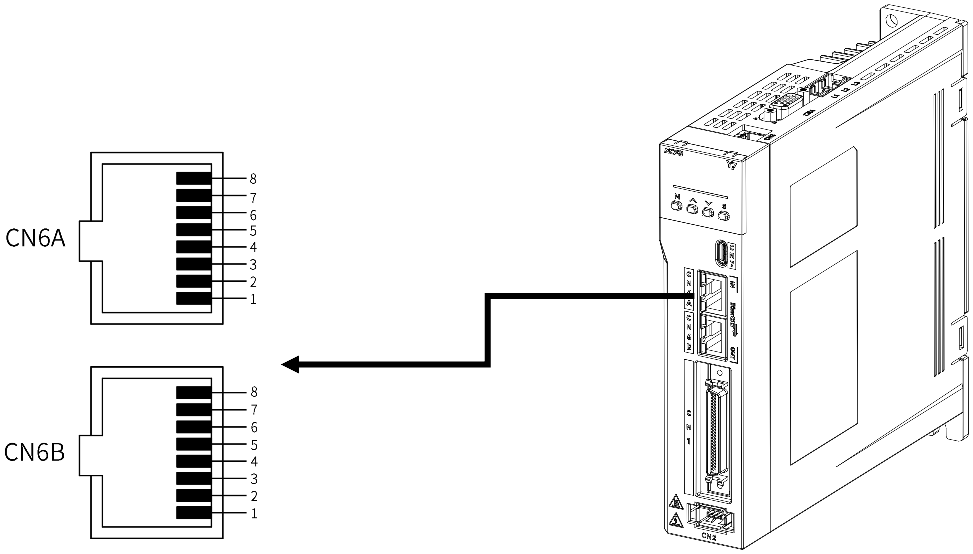


Figure 2-20 CN6 RJ45 Interface Pin Arrangement

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)

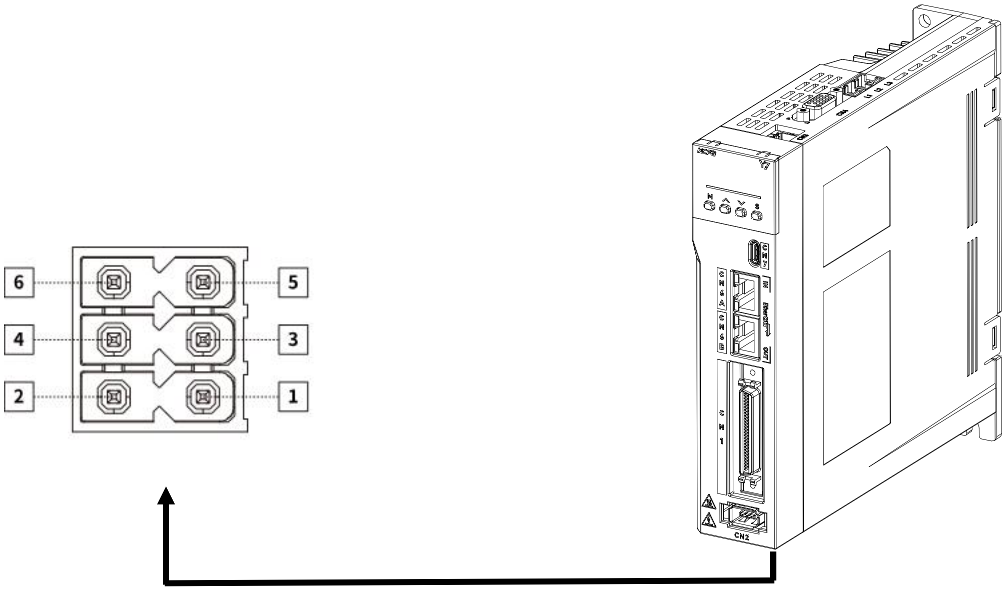


Figure 2-21 CN10 Brake Input Interface Pin Arrangement

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-

2.11.1 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:

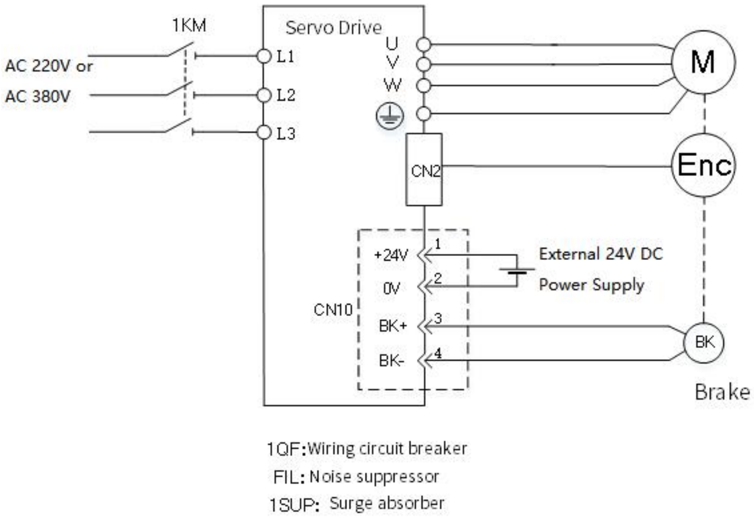


Figure 2-22 Brake CN10 Connection

➢ 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.

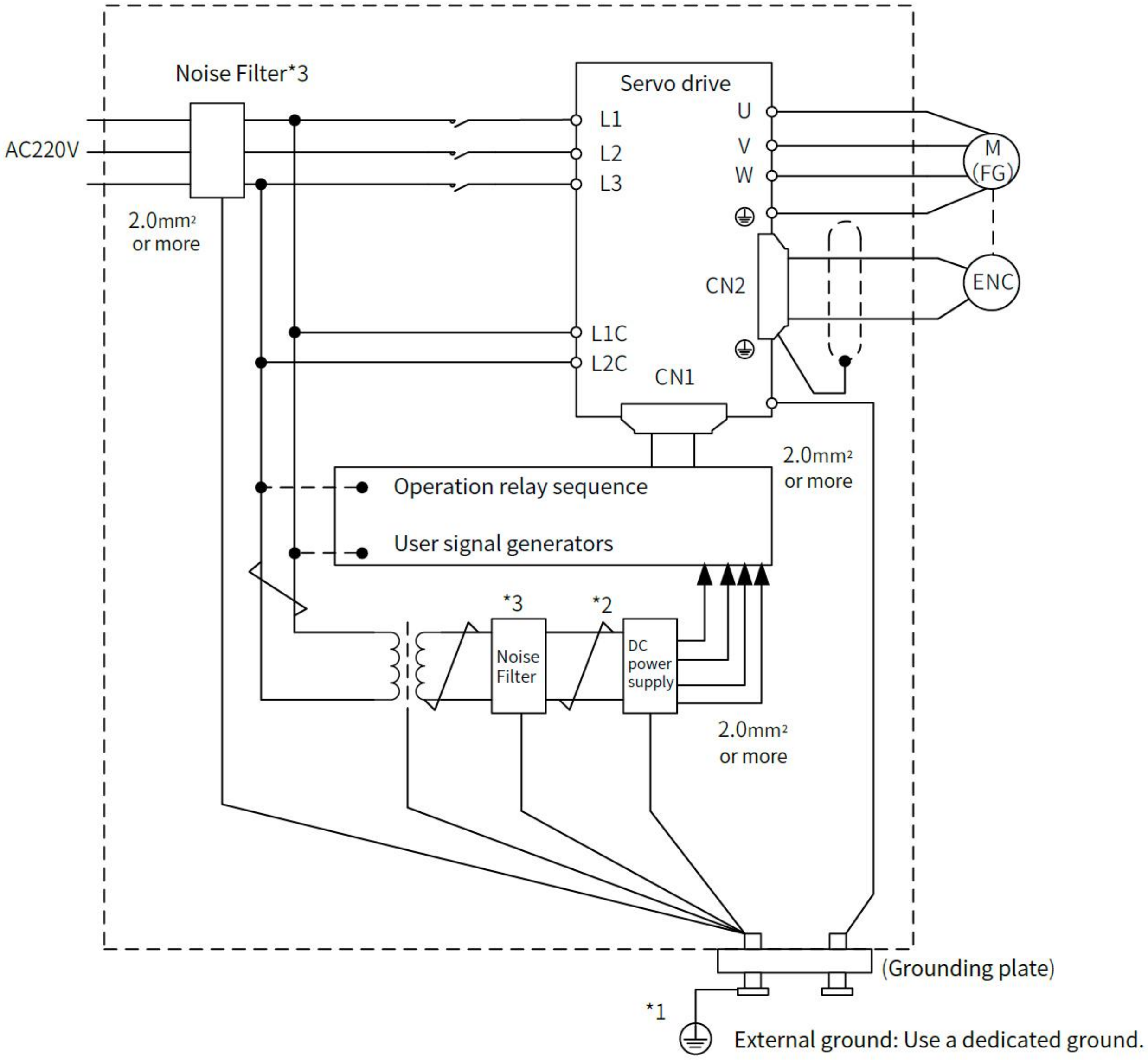


Figure 2-23 Wiring Example of Noise Countermeasure

- 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.

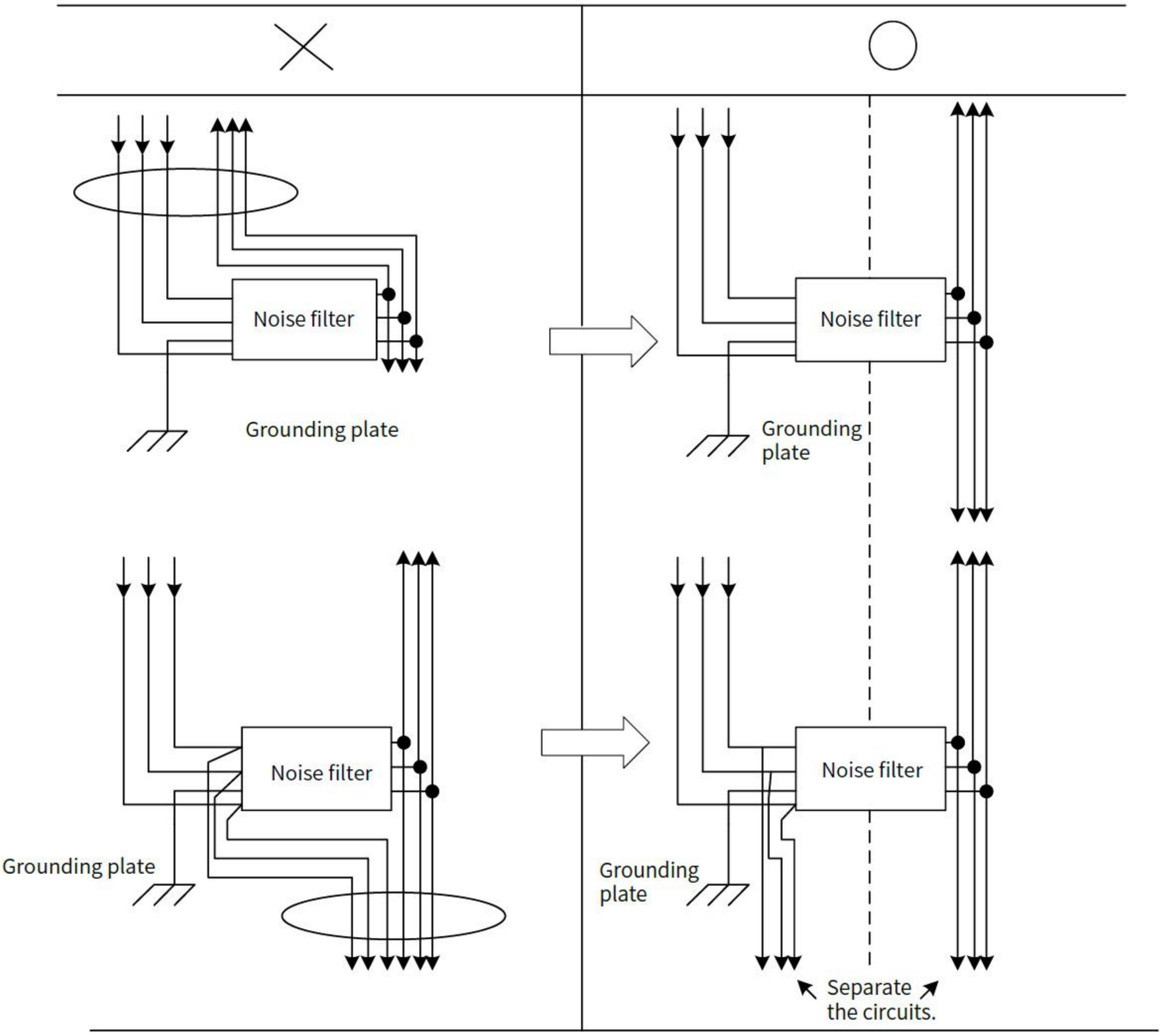


Figure 2-24 Noise Filter Wiring

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.

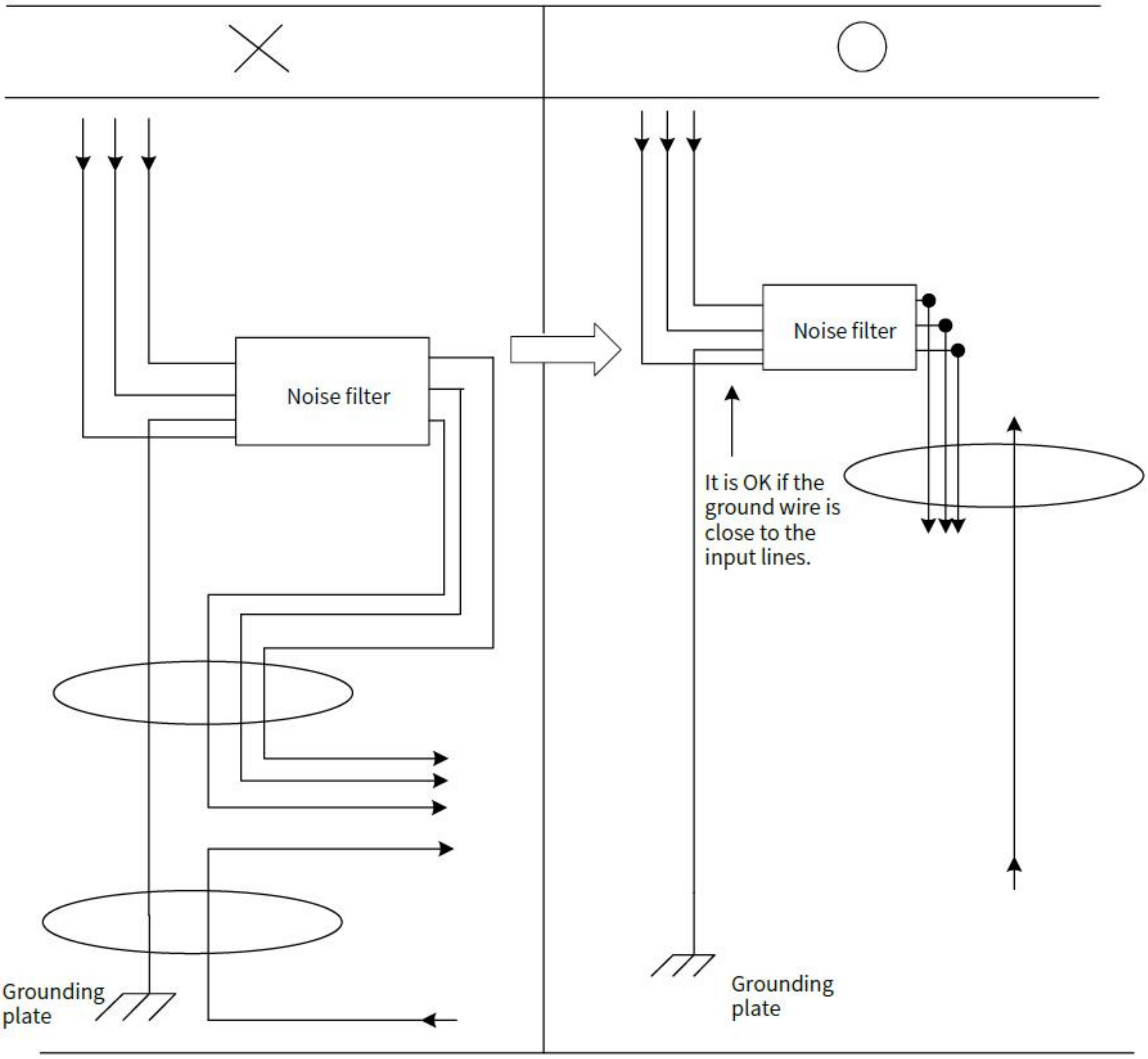


Figure 2-25 Noise Filter Grounding

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

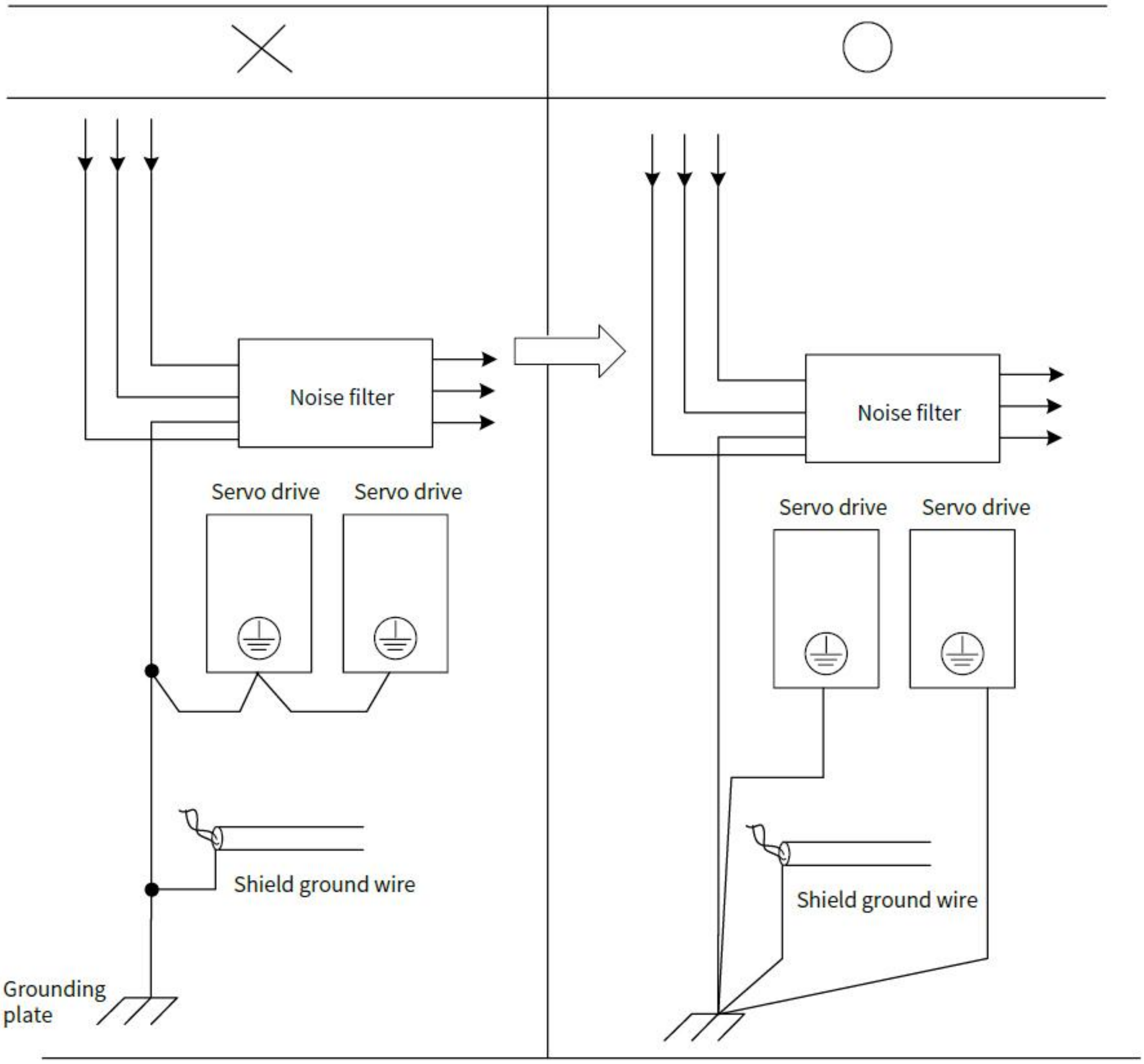


Figure 2-26 Noise Filter Grounding

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.

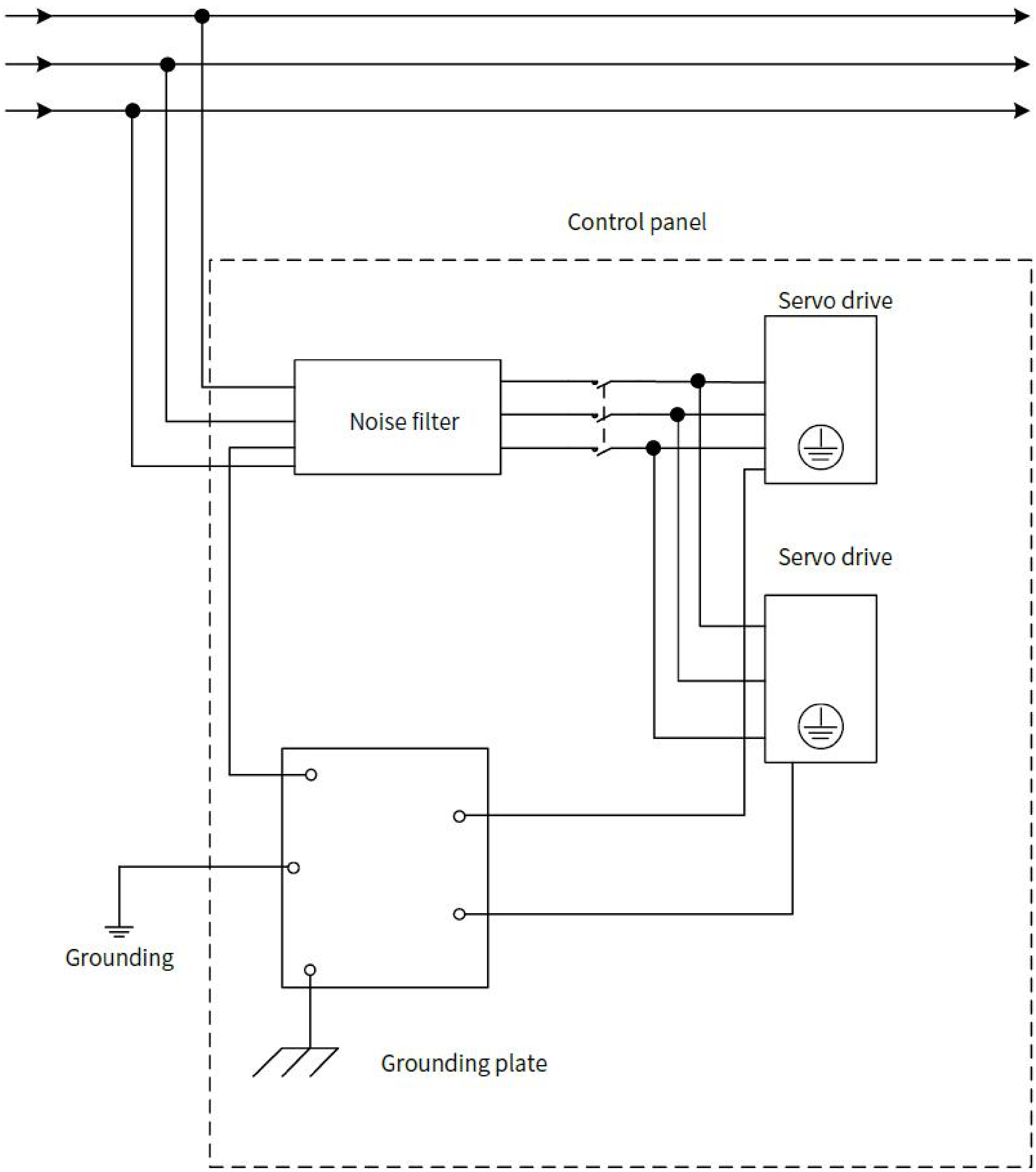
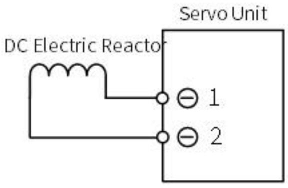


Figure 2-27 Noise Filter and Control Panel Grounding

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

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 µs processing 1000 digital I/Os

100 µs 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 1us

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
Proifile 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:

14byte	46~1500byte	4byte
EtherCAT Header	EtherCAT Data	FCS

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): Opeational state

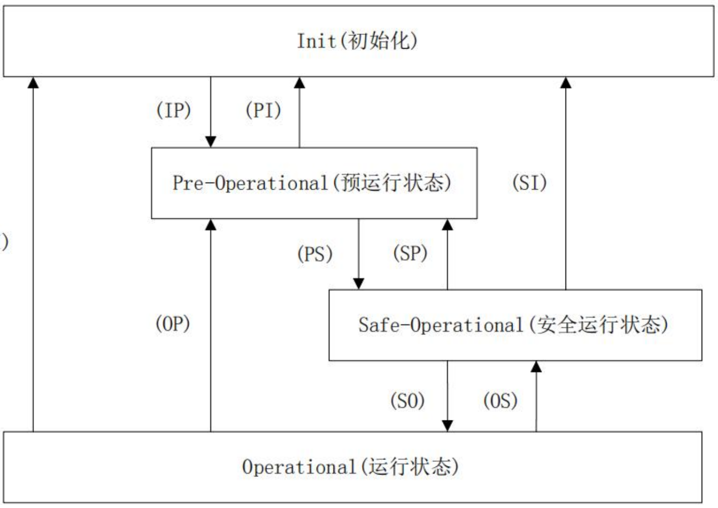


Figure 3-2 EtherCAT State Machine

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	Operati on
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 status60B9h)	60B90010
	Touch probe 1 rising edge position feedback (60BAh)	60BA0020
	Touoch 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

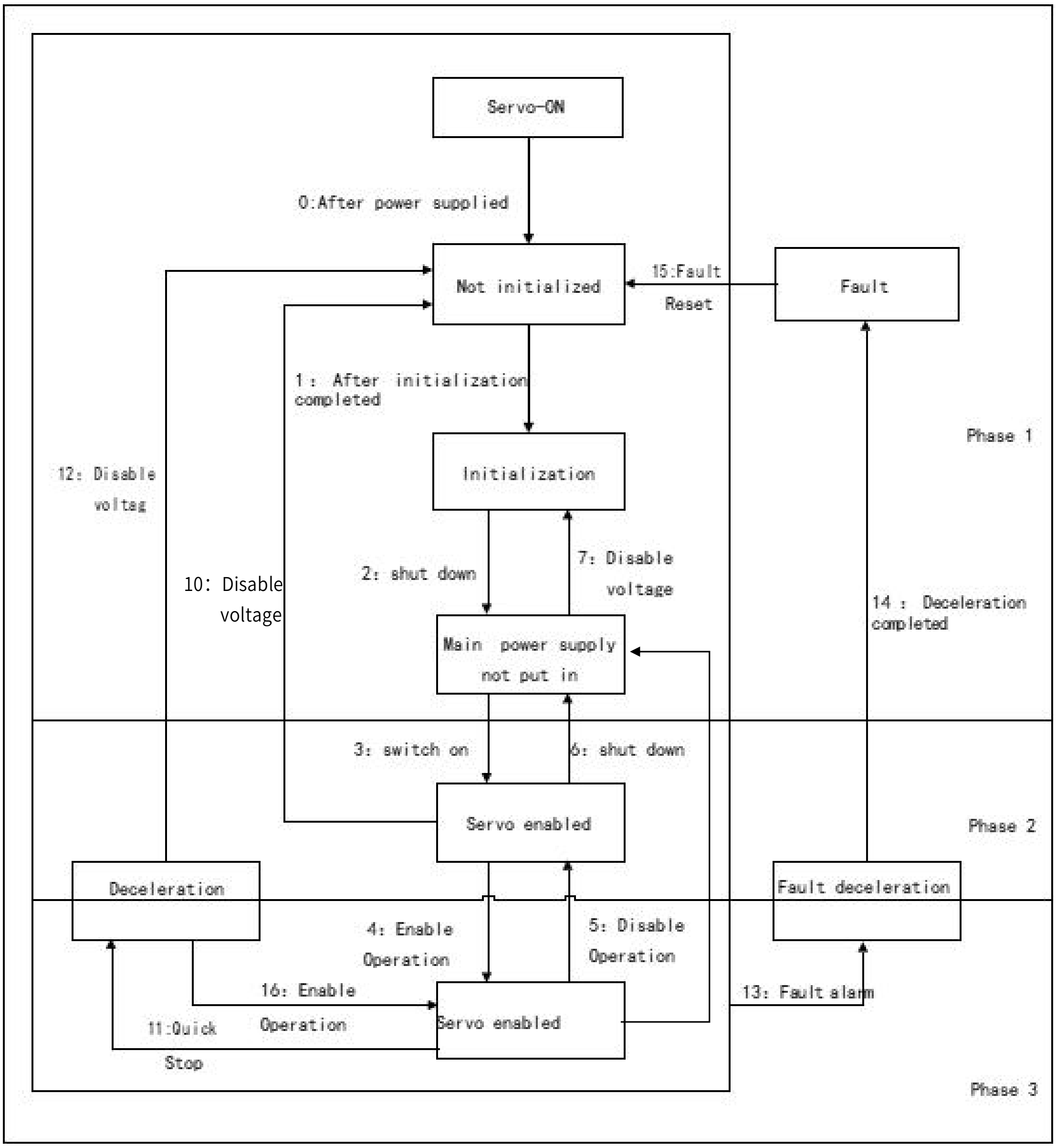


Figure 3-3 CiA402 Control Process State Machine

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

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 serovo 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

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

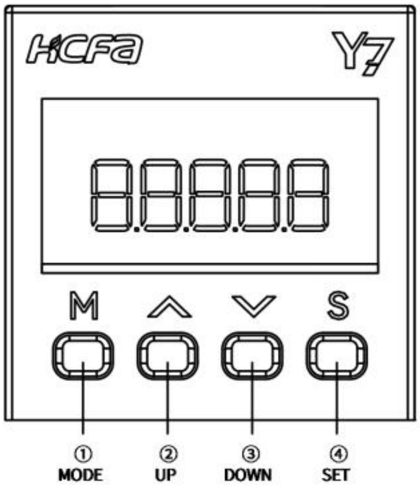


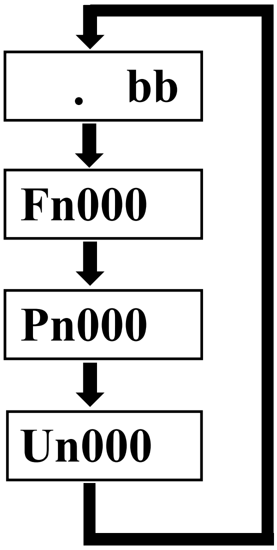
Figure 3-1 Panel Operator

Table 5-2 Panel Operator Keys

Key nuhmber	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		0.9b3
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 daa bit is used for judging signal status, and the short codes are for motor status.

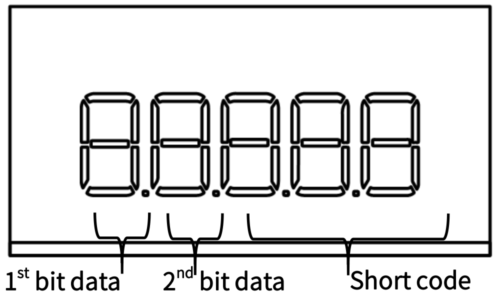


Figure 3-2 Display Status After Power is On

Table 5-4 Data Bit Interpreting table

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

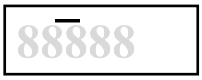
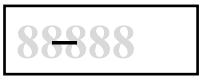
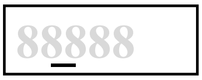
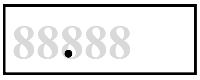
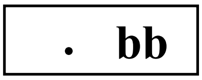
		—	Pre-operation status
		—	Safe running status
		—	Running status
Second data bit b		Position control, speed control, torque control	Lit when the speed exceeds the set value of Pn502, and not lit when it is lower than the set value of Pn502
Second data bit g		Position control	Lit when there is a pulse 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		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		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
	Base Block Active Indicates the servo is OFF.
	Operation in Progress Indicates the servo is ON.
	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 Auxiliaryy function is used for the functional operation of the servo unit, take the Origin Search " Fn003 " operation as an example

(1) Press Ⓜ key to switch to Utility mode " FN000 " is displayed.

(2) Press ∧⃝ or ∨⃝ key to select to " FN003 ".

(3) Press Ⓢ 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 Ⓜ 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 Ⓜ to disable the motor, and the panel displays " -.CSR " .

(6) After pressing the key Ⓢ 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)	Only parameters for setting are displayed	After restart	Setup
	n. □□□1	show all parameters		

5.2.6 Numeric Settings

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

(1) Press Ⓜ key to switch to parameter setting mode " PN000 " is displayed.

(2) Press Ⓢ After selecting the digit to be changed, press the ∧⃝ or ∨⃝ key to select " Pn78C ".

Ⓢ

(3) Press and hold the key for about 1 second, and the current setting value of "Pn20E" shown on the screen will be displayed "_0001".

(4) Press the key Ⓢ to move the flashing digit left and right, and then press the ∧ or ∨ key to set the last four digits 8608, and the panel displays "_8608".

(5) Press the key Ⓢ to move the flashing number to the leftmost, and press Ⓢ key again to switch to the first four-digit setting page, and the panel displays "-0000".

(6) Press the key Ⓢ to move the flashing digit left and right, and then press ∧ or ∨ key, set the first four digits to 0838, the panel will display "-0838".

(7) So far Pn 78C is the first four digits + last four digits = 08388608.

(8) After pressing the Ⓢ 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 Ⓢ 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 Ⓜ key to switch to parameter setting mode "Pn000" is displayed.

(2) Press and hold the key Ⓢ to display the original set value of "Pn000" shown on the screen, and the panel displays "n0000".

(3) Press Ⓢ key for once to move the digit to the left by one (flashing) to select Pn 000.1, and the panel displays "n0000

(4) Press the ∧ or ∨ key to change the setting value to "N.0010", and the panel display is "n0010".

(5) Press and hold the key Ⓢ for about 1 second to confirm the set value, and the panel value flashes three times quickly.

(6) Press and hold the key Ⓢ 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 Ⓜ key to switch to Auxiliary mode "Un000" is displayed.

(2) Press Ⓢ After pressing the key for 1 second, the current motor speed will be displayed "0000" (display 0 000 means the speed is 0).

(3) Press and hold the key Ⓢ 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	Classfication
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

2. Please connect the AC power supply to the L1/L2/L3 terminals and LC1/LC2 terminals of the servo unit.

3. 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.

4. 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.

5. 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.

6. When DC power is input, please install a fuse on the power supply line.

7. 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.

8. 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.

9. 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	Classfication
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.		

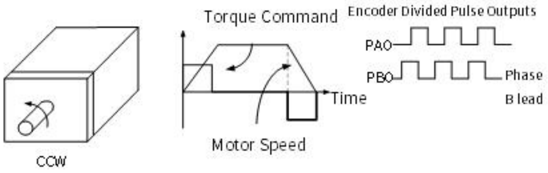
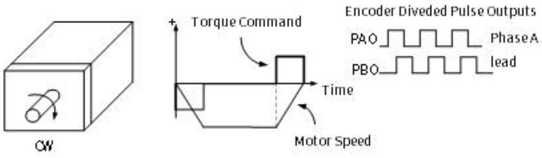
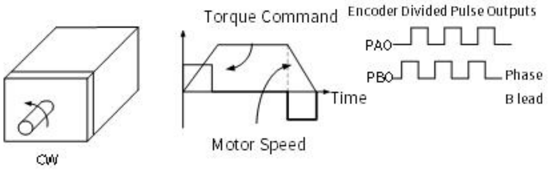
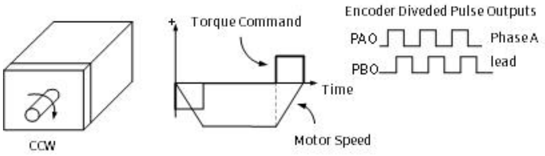
➢ Note: 1. If you use a single-phase power supply input without specifying a single-phase AC power supply (Pn00B = n.□1□□), an A.F10 alarm (Power Supply Line Open Phase) will occur

2. 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)	Forward command		P-OT
		Reverse command		N-OT
	n.□□□1 Use CW as the Forward direction.(Reverse Rotation Mode)	Forward command		P-OT
		Reverse command		N-OT

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

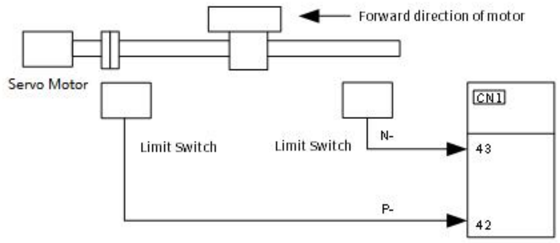
5.4.3 Overtravel Setting

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 movemen

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

Caution

· **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		Speed Position Torque	When Enabled	Classification
	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		

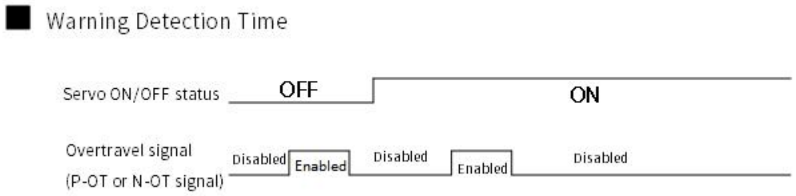


Figure 5-1 Overtravel Detected Timing Chart

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:

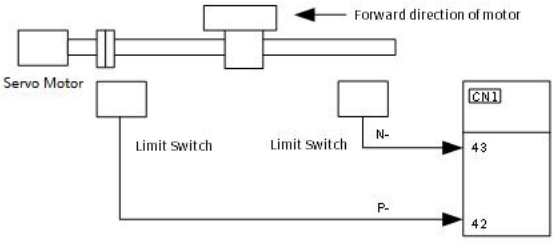


Figure 5-4 Cases for Holding Brake

Electromagnetic brake control timing chart:

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

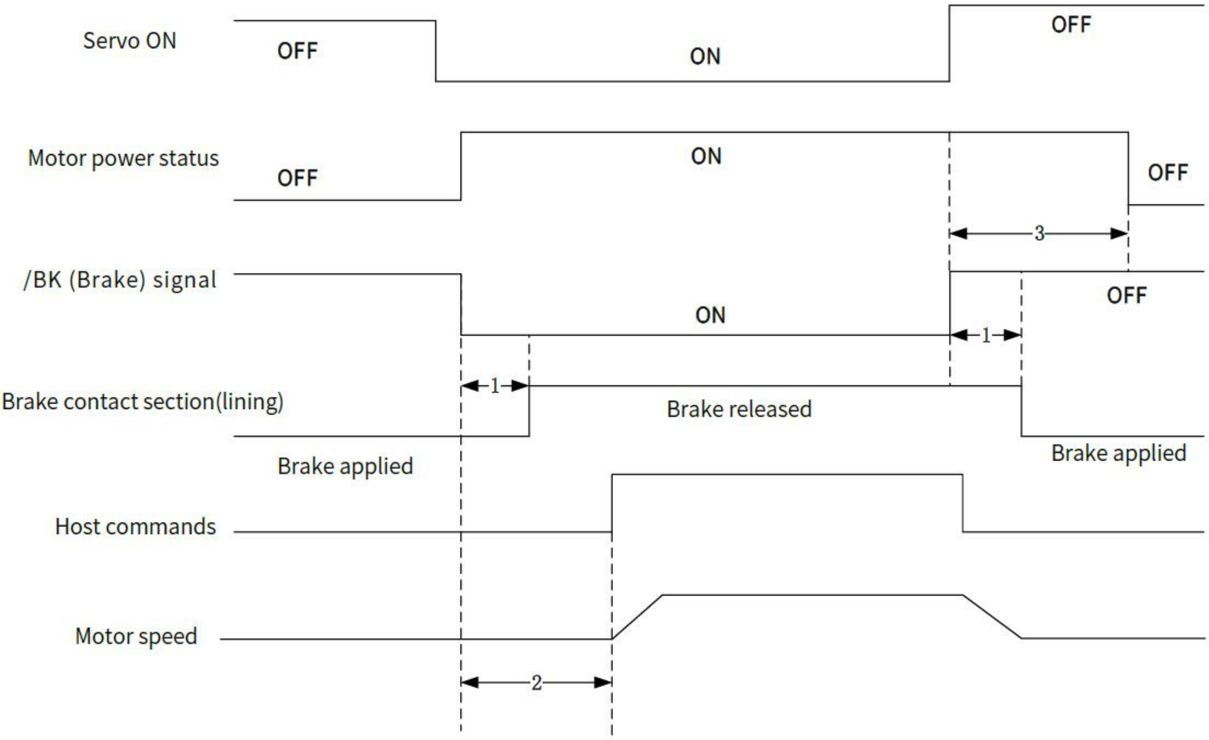


Figure 5-5 Electromagnetic Brake Timing Chart

- ➢ 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 Speed Position Torque			When Enabled	Classification
	Setting range	Setting unit	default setting	Immediately	Setup
	0~50	10ms	10		

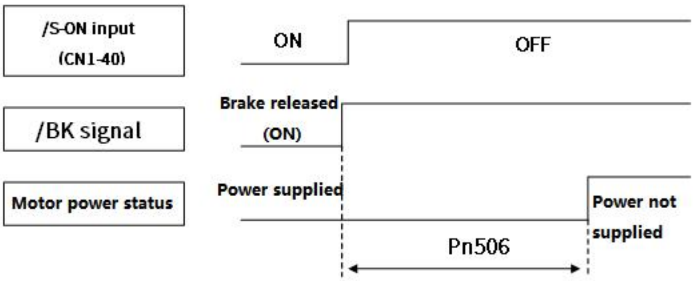


Figure 5-6 Brake Signal（/BK）Output Timing Chart(Servo motor stops)

- ➢ 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)"

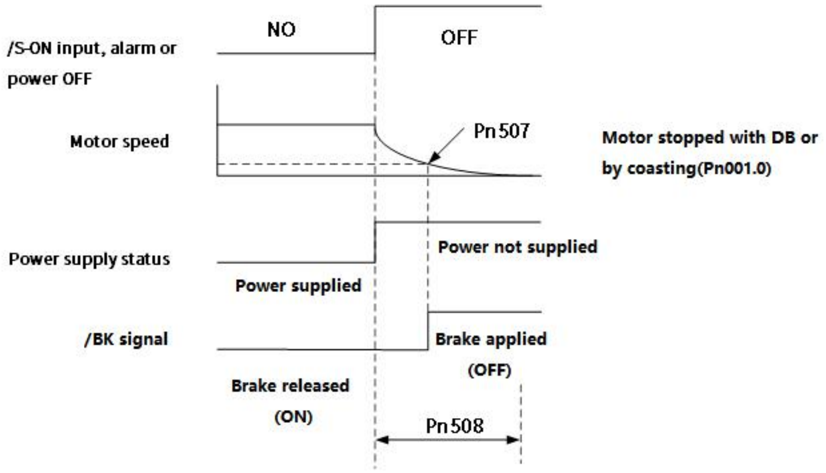


Figure 5-7 Signal Brake（/BK）Output Timing Chart(When motor is operating)

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 Speed Position Torque			When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-10000	1min^{-1}	100		
Pn508	Servo OFF-Brake Command Waiting Time Speed Position Torque			When Enabled	Classification
	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		
	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 Speed Position Torque			When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately	Setup
	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。

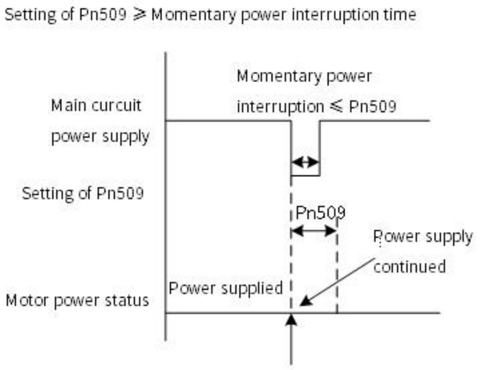


Figure 5-8　Main Circuit Power Supply and Servo Motor Power Status（Pn509 value⩾momentary power interruption time)

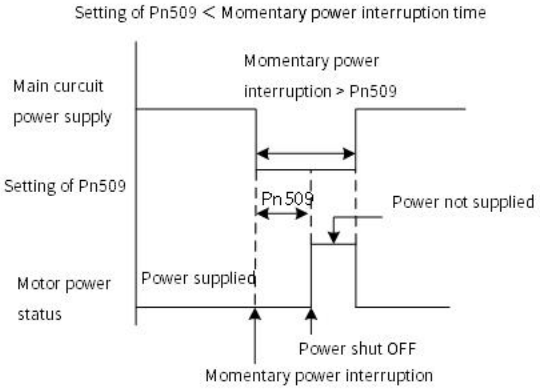


Figure 5-9　Main Circuit Power Supply and Servo Motor Power Status（Pn509 value⩽momentary power interruption time)

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 proection 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 Speed Position Torque			When Enabled	Classification
	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 Speed Position Toruqe			When Enabled	Classification
	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 Speed Position Torque			When Enabled	Classification
	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 (×10 W) (50 W ×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 results 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	Speed Position Torque		When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-10000	1min^{-1}	20		

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.

Table5-30 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		Position	When Enabled	Classification
	Setting range	Setting unit	Default setting	After restart	Setup
	1-1073741824	—	1		
Pn78E	**Electronic gear ratio denominator**		**Position**	**When Enabled**	**Classification**
	Setting range	Setting unit	Default setting	After restart	Setup
	1-1073741824	—	1		

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

$$\text{Electronic gear ratio}\frac{B}{A}=\frac{Pn78C}{Pn78\text{E}}=\frac{\text{Encoder resolution}}{\text{Pulses per load shaft revolution}}\times\frac{m}{n}$$

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 aceeleration(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.

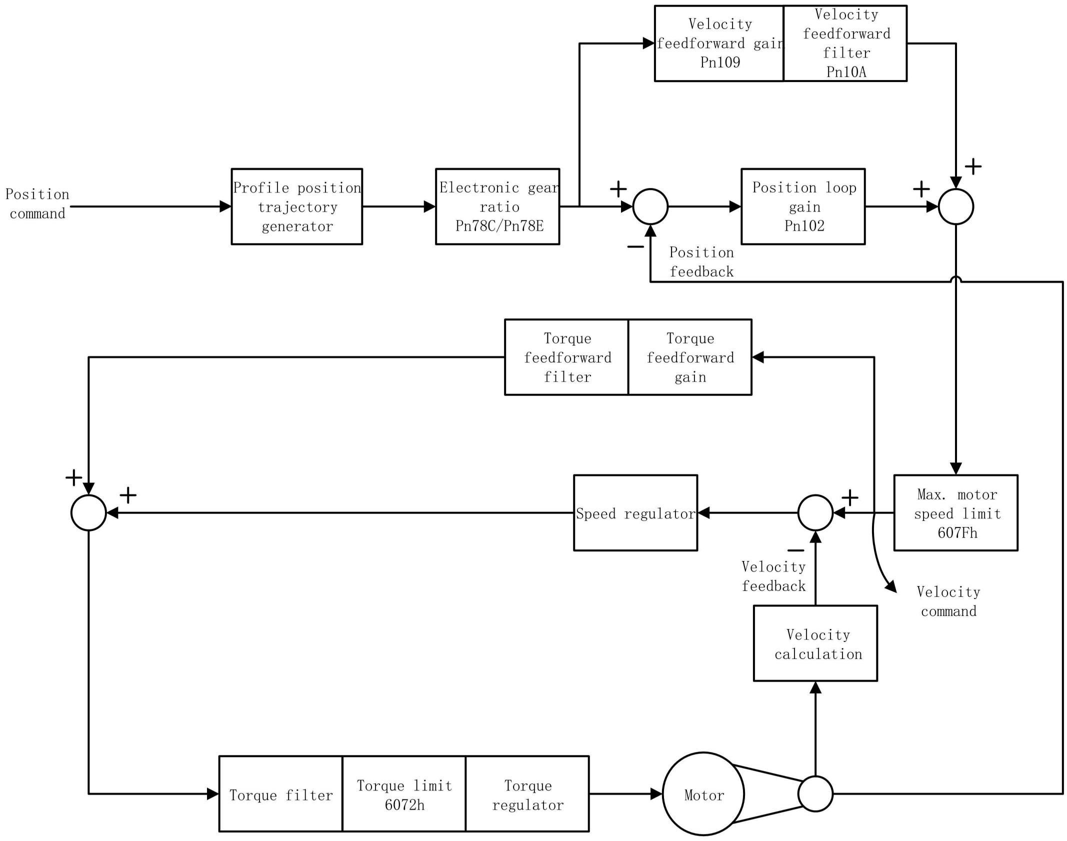


Figure 5-10 Blocking Diagram for Profile Position Mode

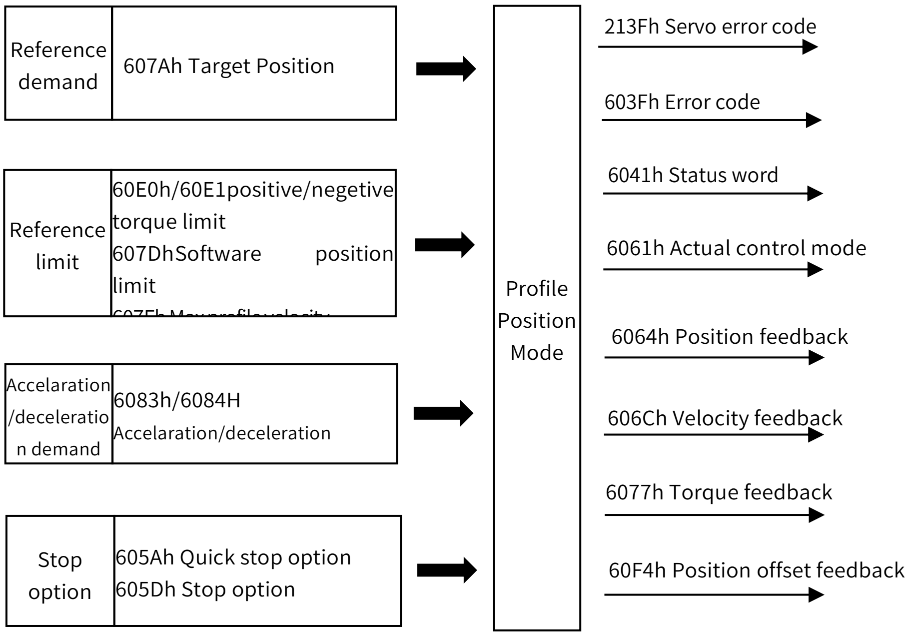


Figure 5-11 Profile Position Mode Input/Output

5.7.1 Control Word in Profile Position Mode(60400010h)

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(decelaration)
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 exucutes 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	Descrption
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: Disbaled, 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: Sotware 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 Ralated 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 decelaration 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.

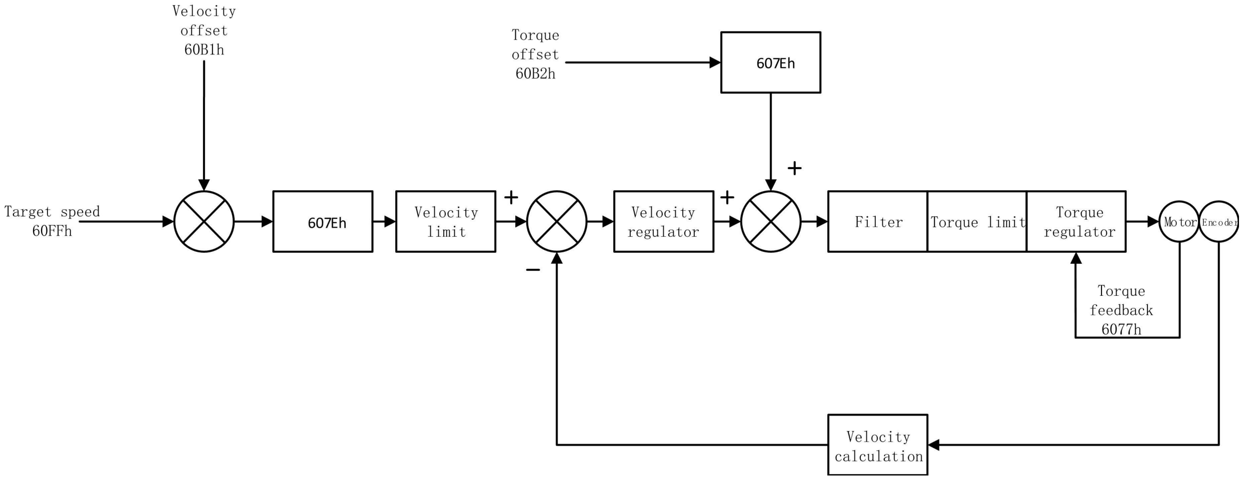


Figure 5-12 Block Diagram for Profile Velocity Mode

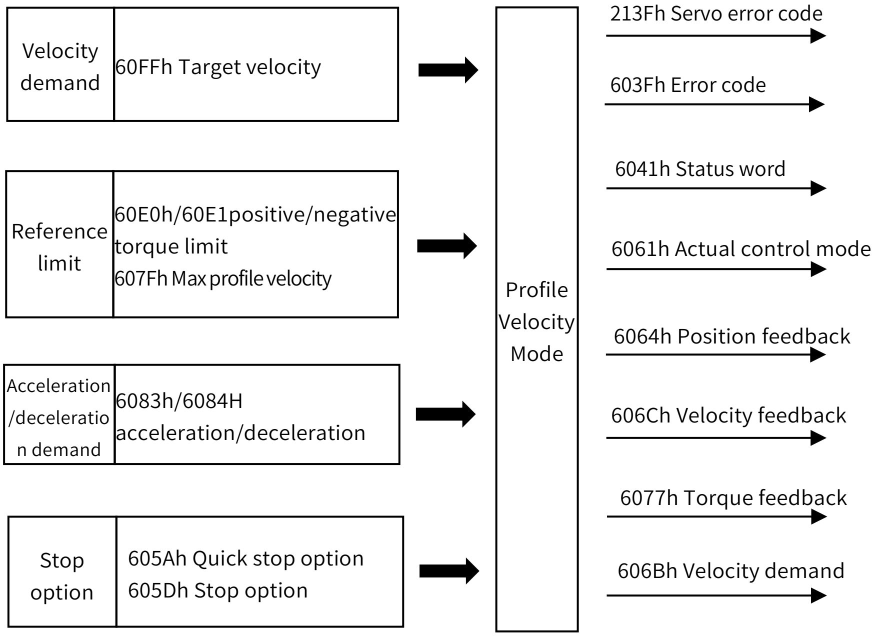


Figure 5-13 Profile Velocity Mode Input/output

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 exucutes 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: Disbaled, 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: Disbaled, 1: Enabled. When enabled it indicates Servo has been enabled.
3	Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Disbaled, 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: Sotware 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 Ralated 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	Acecess	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.

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

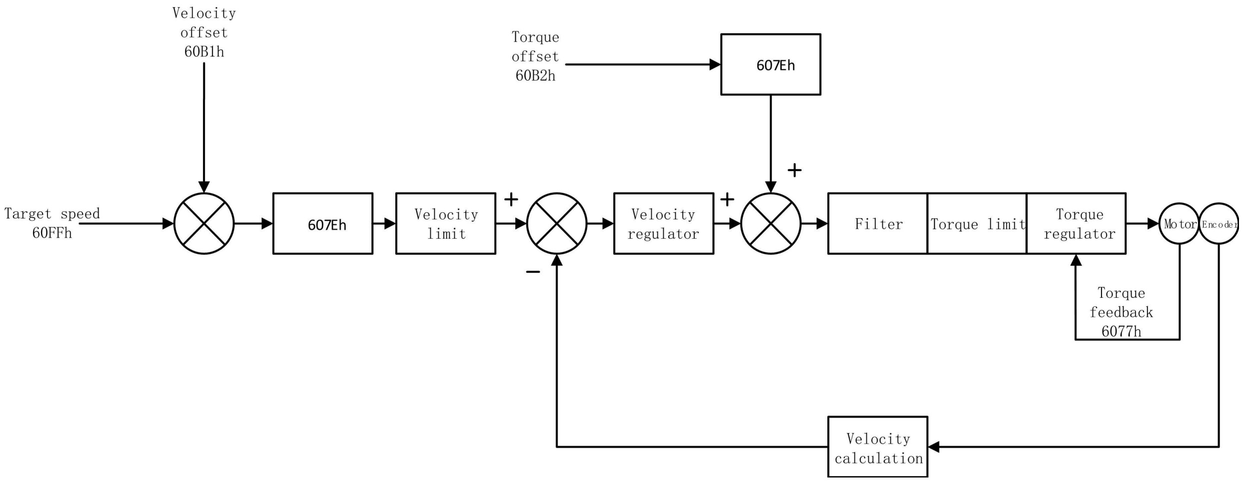


Figure 5-14 Block Diagram for Profile Torque Mode

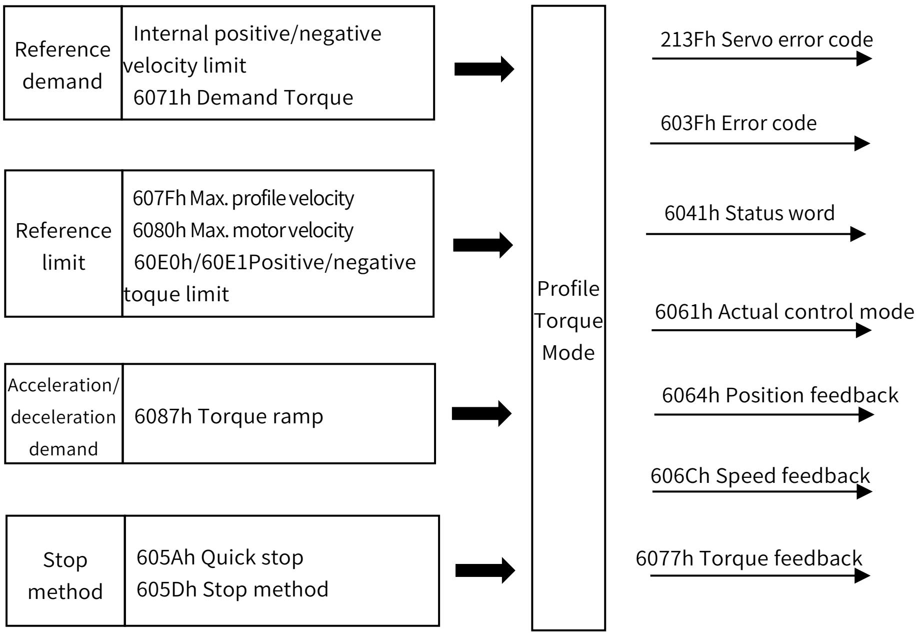


Figure 5-15 Profile Torque Mode Input and Output

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 exucutes 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: Sotware limit position is reached
12、13	Reserved for PT mode	-
14、15	Customized	-

5.9.3 Ralated 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.

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

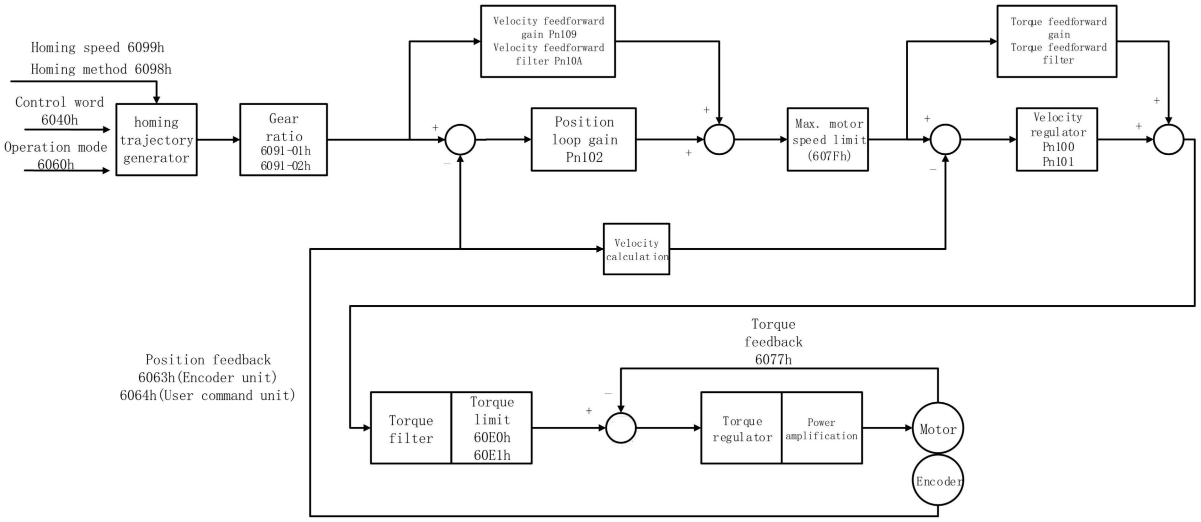


Figure 5-16 Block Diagram for Home Mode

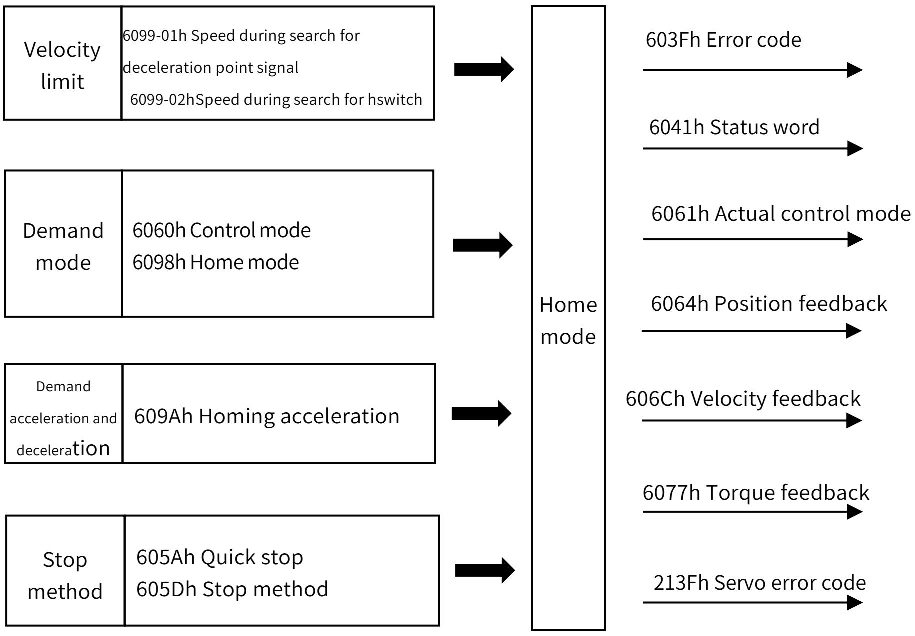


Figure 5-17　Home Mode Input and Output

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 exucutes 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: Disbaled, 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: Disbaled, 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: Sotware 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 Ralated 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 inpositive 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

	find nearest Z pulse position as the origin.
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 nagetive 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering 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 ecountering OFF→ON status of HSW as origin in negattive direction.
29	Similar to Method 13, but not to find Z pulse position but the position when ecountering OFF→ON status of HSW as origin in posititve direction.
30	Similar to Method 14, but not to find Z pulse position but the position when ecountering 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

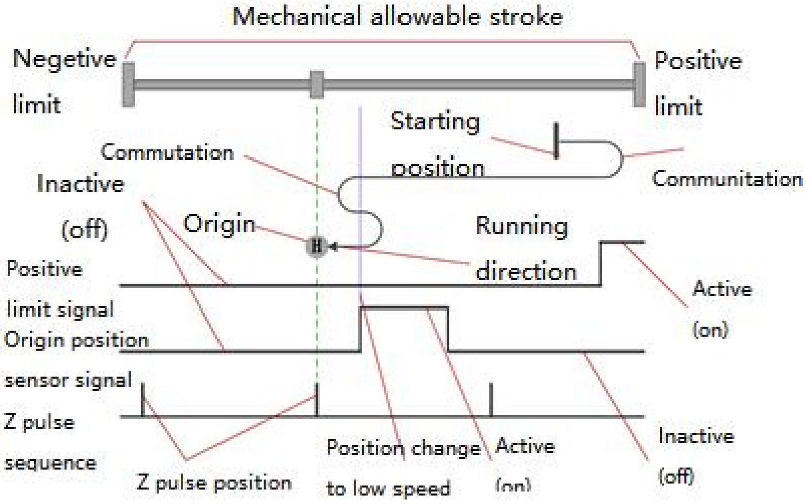


Figure 5-18 Meaning of Icons in Home Mode

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. Beacause 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

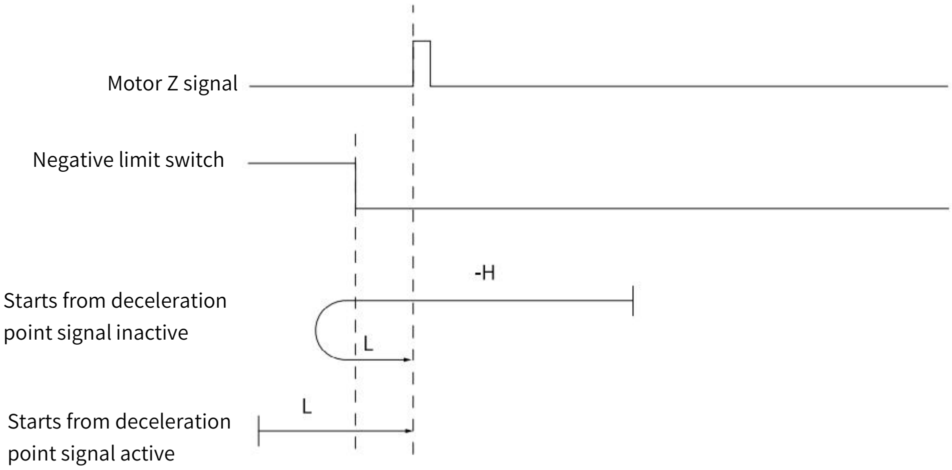


Figure 5-19 Home Mode 1 Trajectory and Signal Status

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

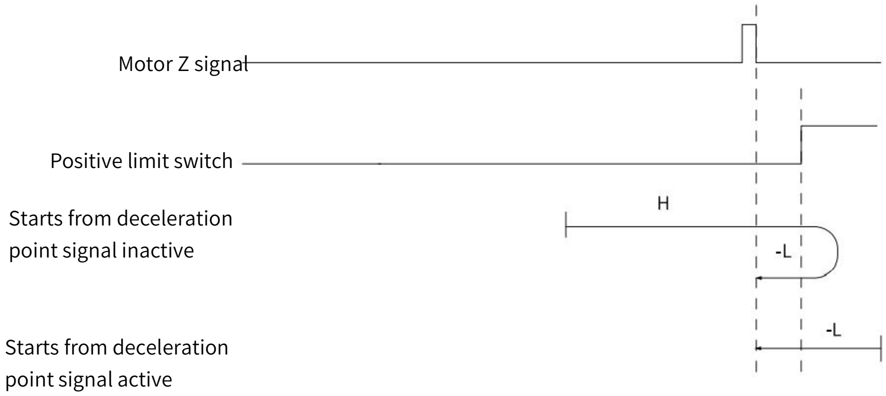


Figure 5-20 Home Mode 2 Trajetory and Signal Status

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

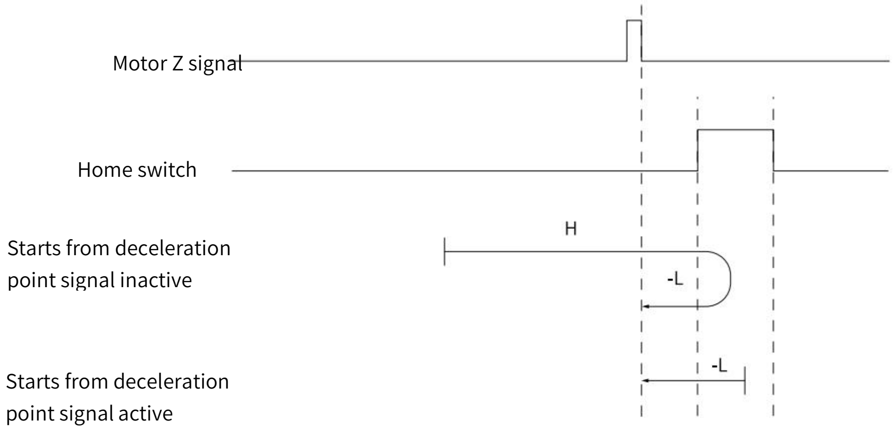


Figure 5-21 Home Mode 3 Trajectory and Signal Status

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

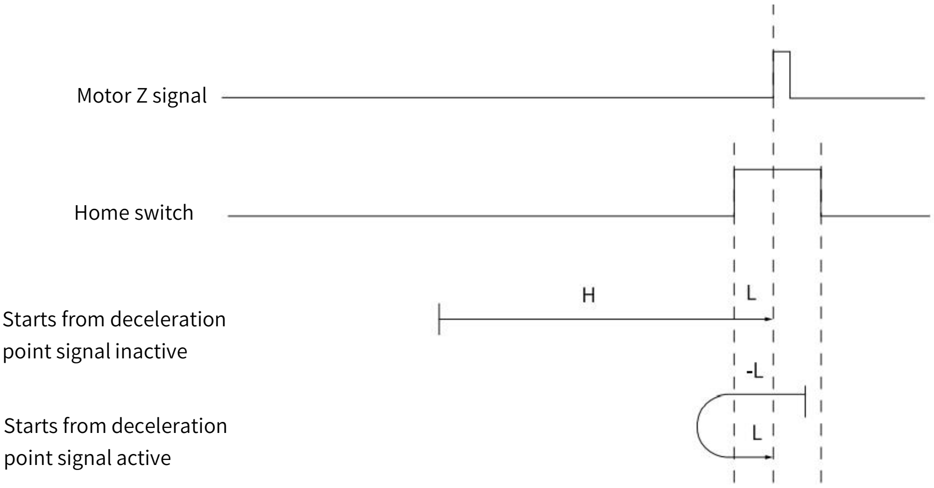


Figure 5-22 Home Mode 4 Trajectory and Signal Status

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

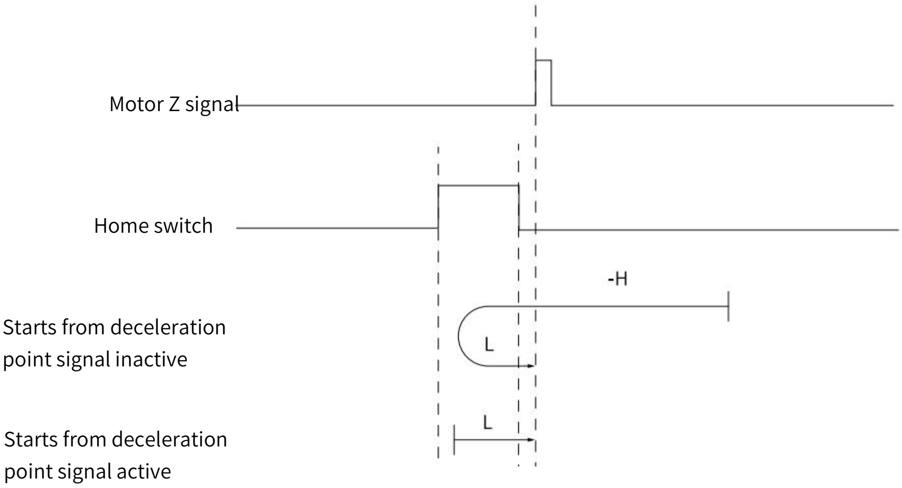


Figure 5-23 Home Mode 5 Trajectory and Signal Status

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.

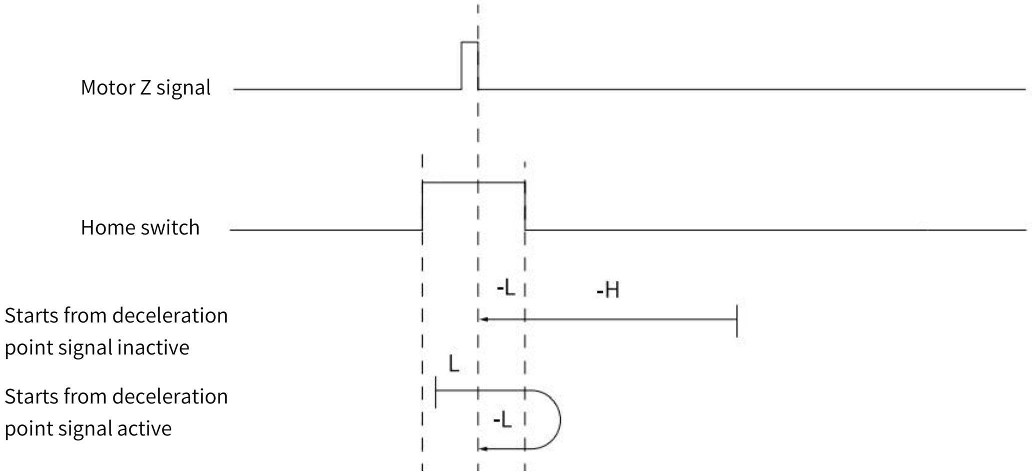


Figure 5-24 Home Mode 6 Trajectory and Signal Status

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.

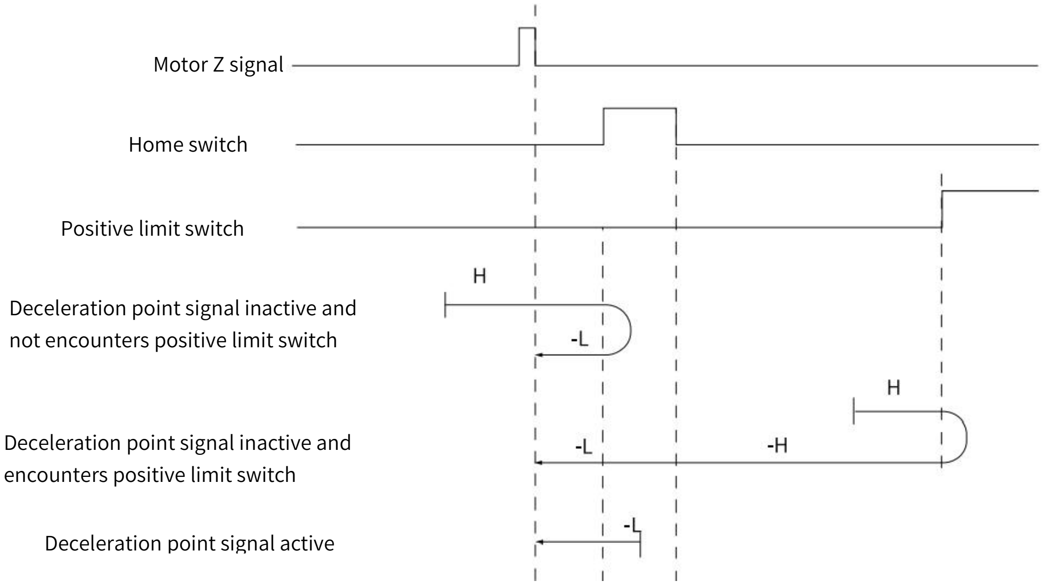


Figure 5-25 Home Mode 7 Trajectory and Signal Status

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 positve 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.

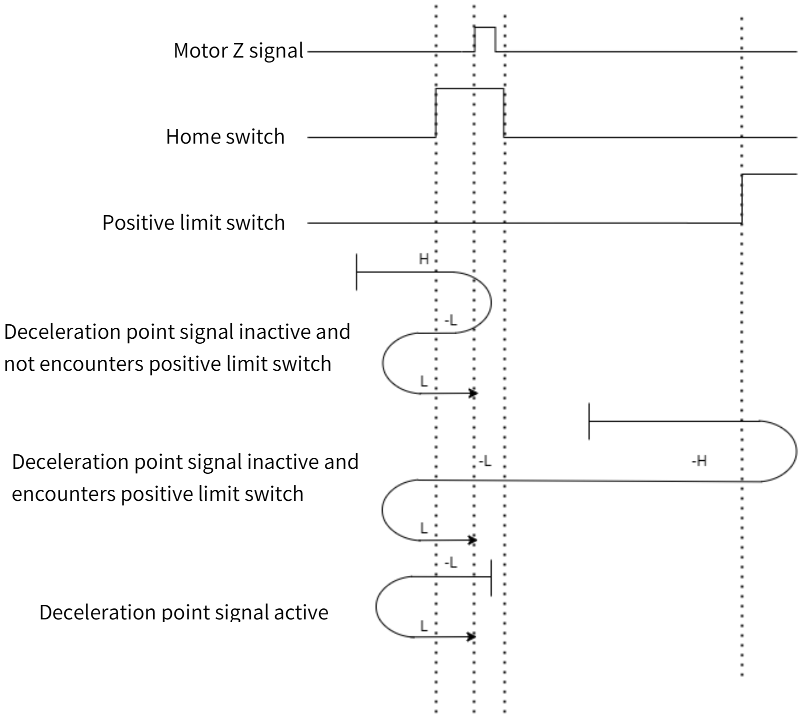


Figure 5-26 Home Mode 8 Trajectory and Signal Status

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.

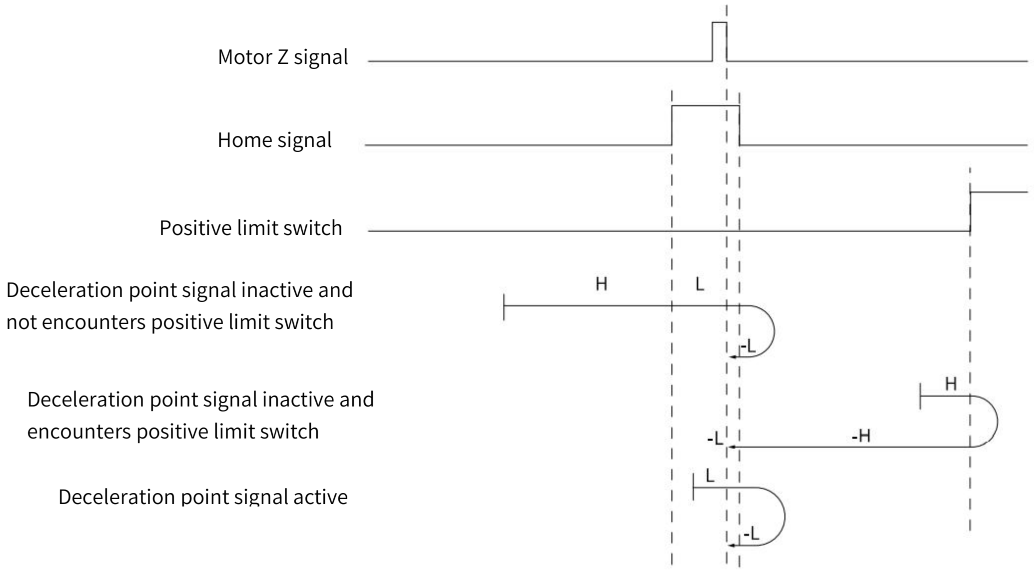


Figure 5-27 Home Mode 9 Trajectory and Signal Status

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.

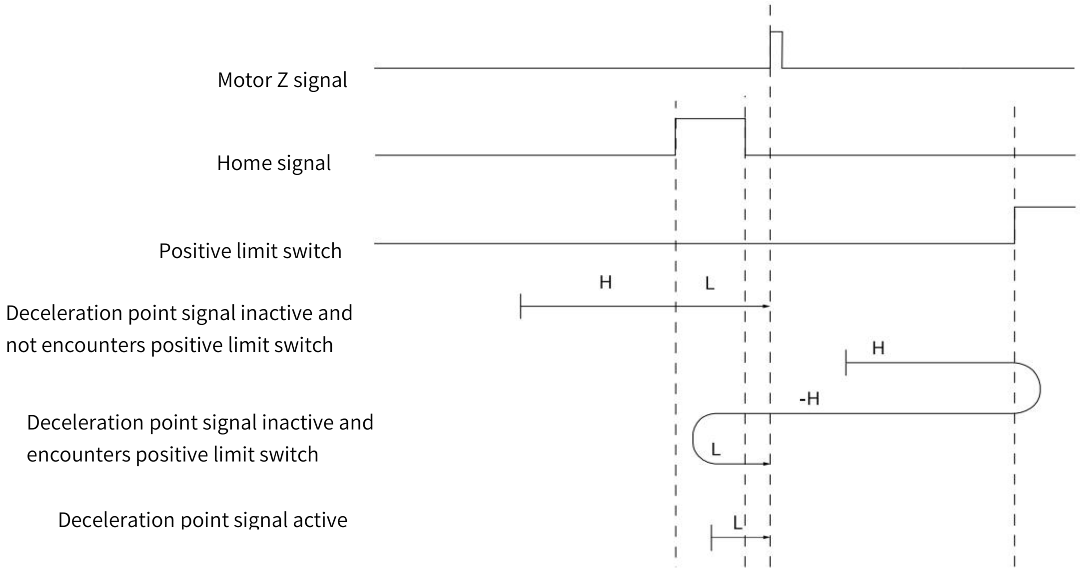


Figure 5-28 Home Mode 10 Trajectory and Signal Status

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.

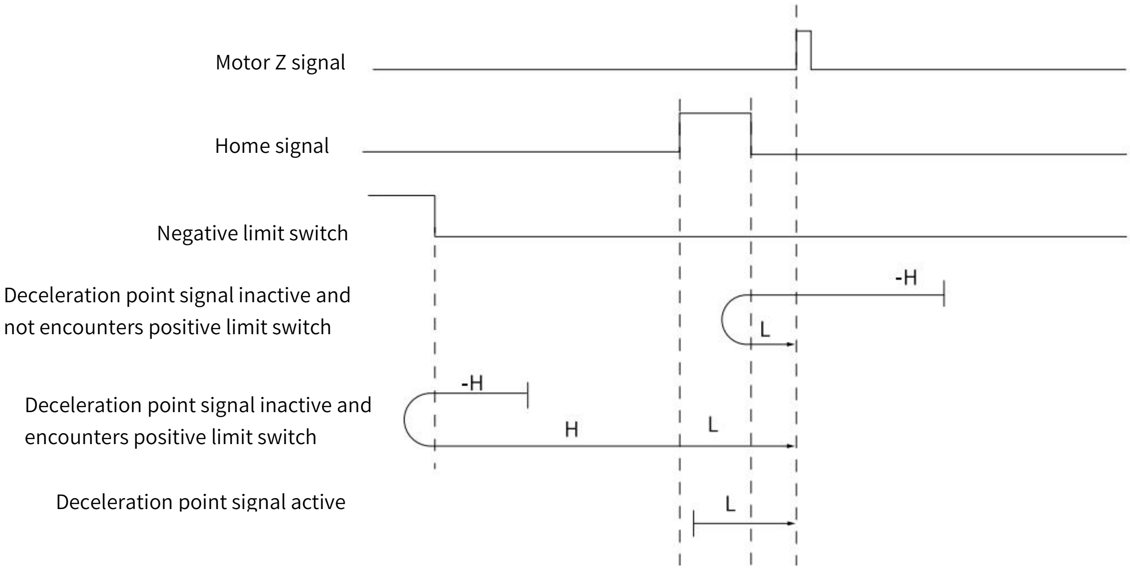


Figure 5-29 Home Mode 11 Trajectory and Signal Status

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.

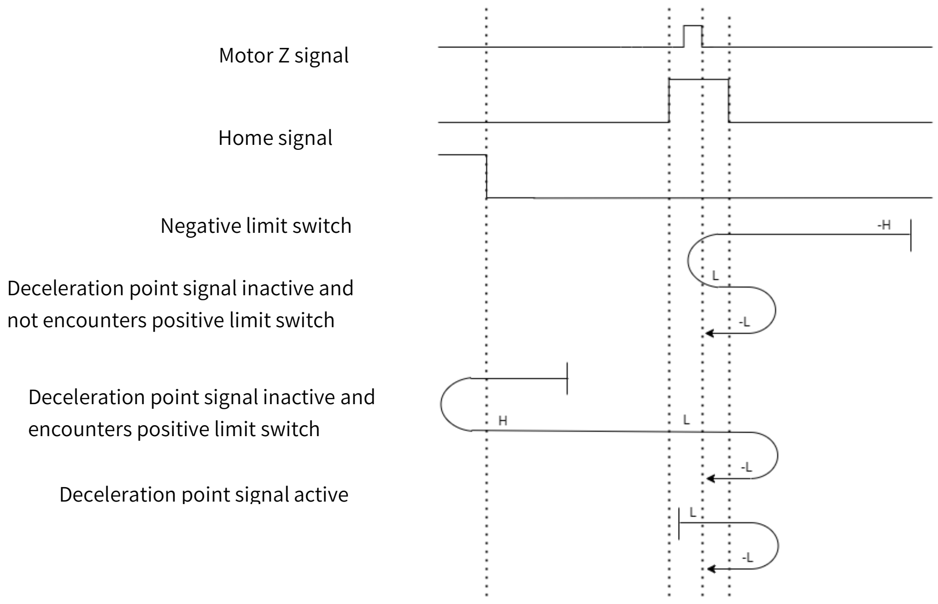


Figure 5-30 Home Mode 12 Trajectory and Signal Status

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.

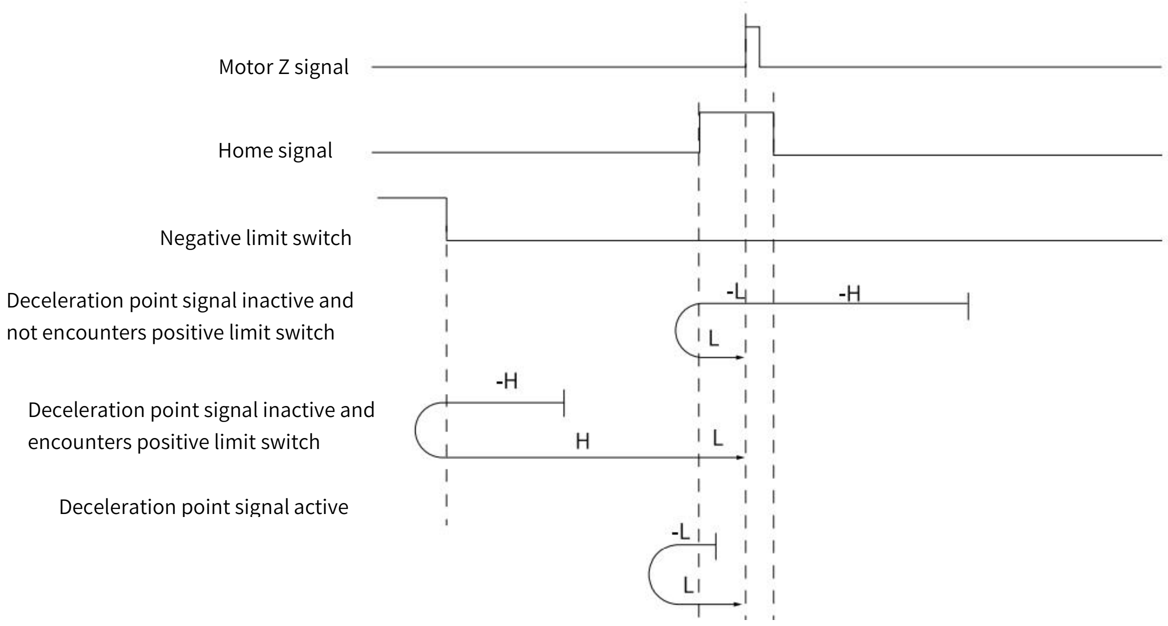


Figure 5-31 Home Mode 13 Trajectory and Signal Status

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.

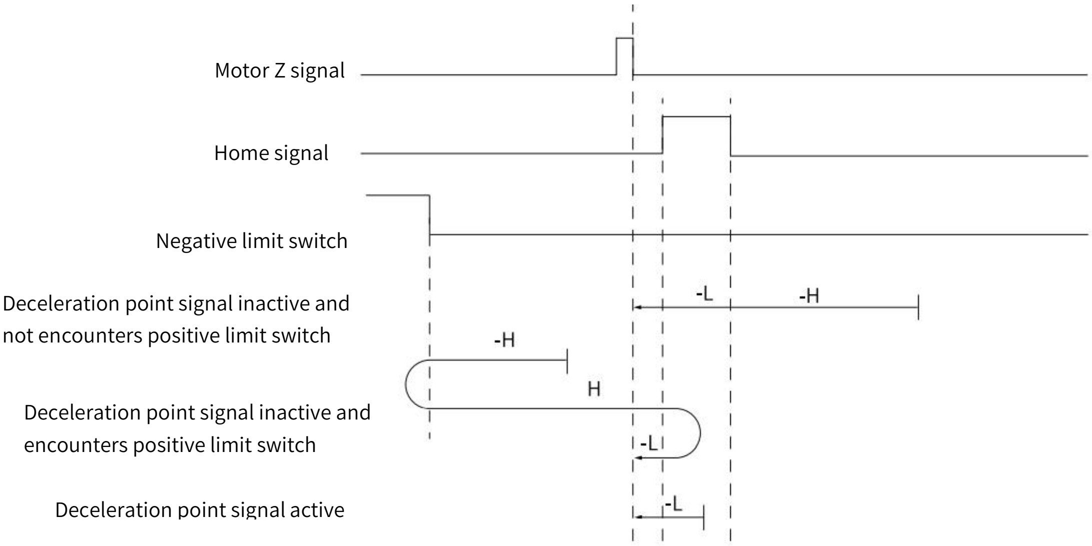


Figure 5-32 Home Mode 14 Trajectory and Signal Status

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

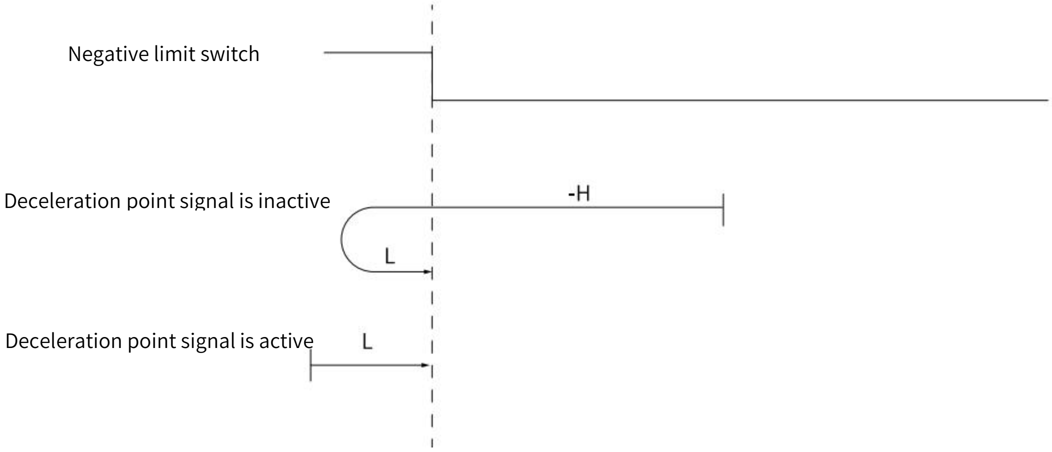


Figure 5-33 Origin Mode 17 Trajectory and Signal Status

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.

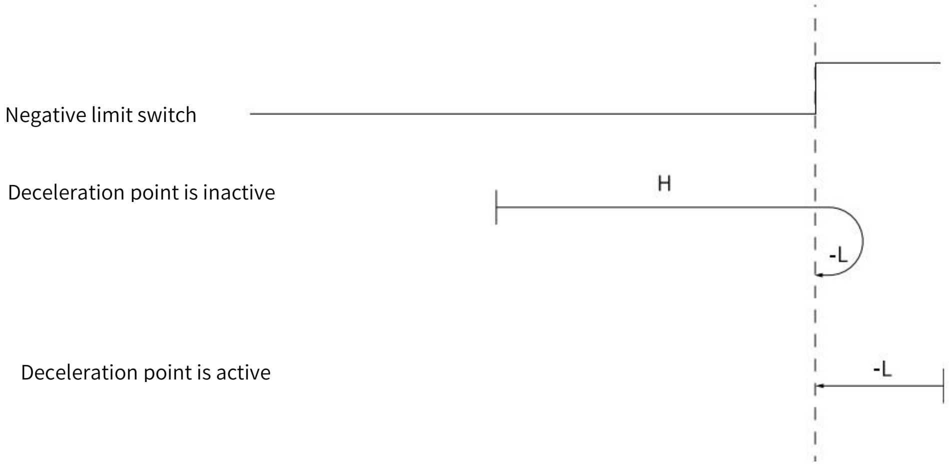


Figure 5-34 Home Mode 18 Trajectory and Signal Status

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.

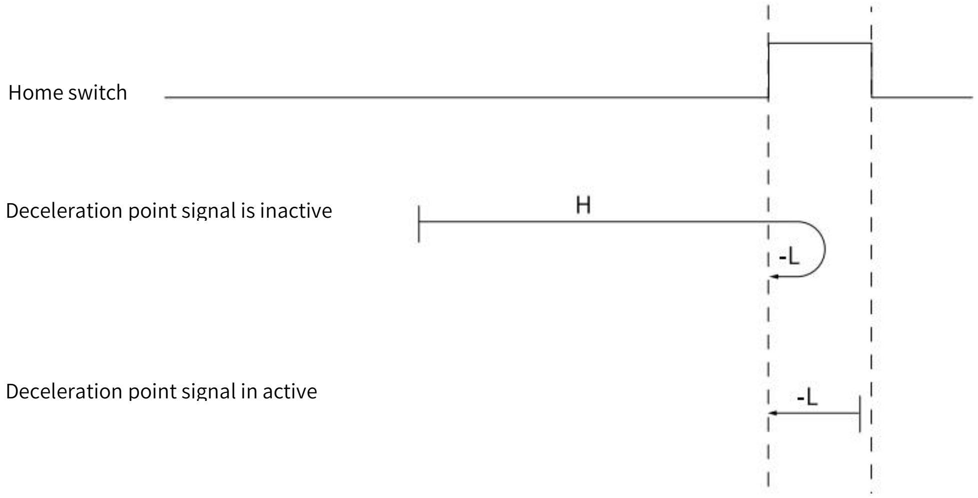


Figure 5-35 Home Mode 19 Trajectory Signal and Status

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 strop and the stop position is the origin.

The figure 5-36 shows.

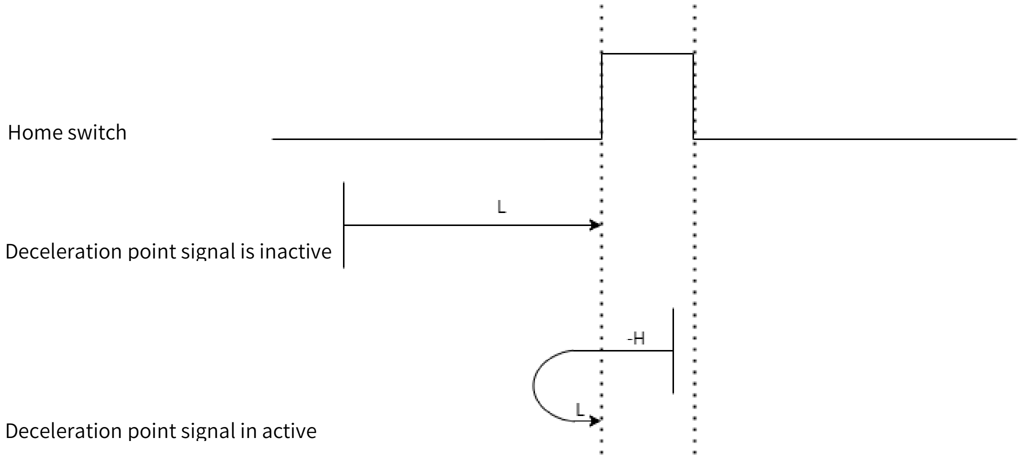


Figure 5-36 Home Mode 20 Trajectory Signal and Status

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, delecerate 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.

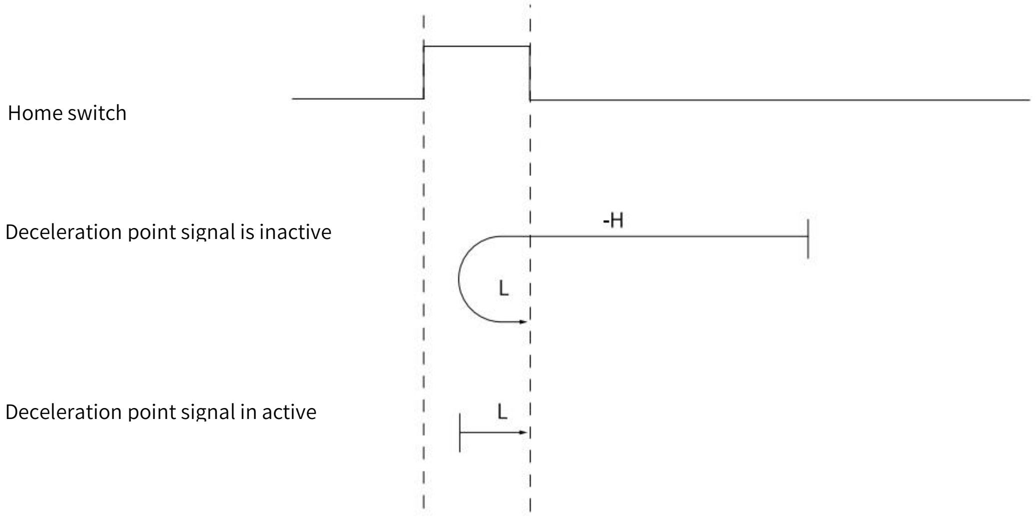


Figure 5-37 Home Mode 21 Trajectory Signal and Status

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, delecerate to stop the stop position is the origin.

The figure 5-38 shows.

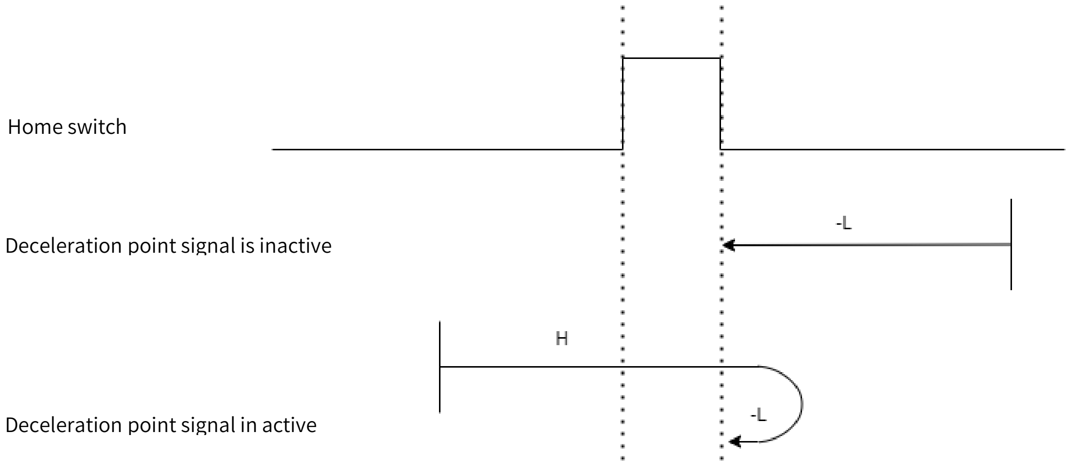


Figure 5-38 Home Mode 22 Trajectory Signal and Status

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.

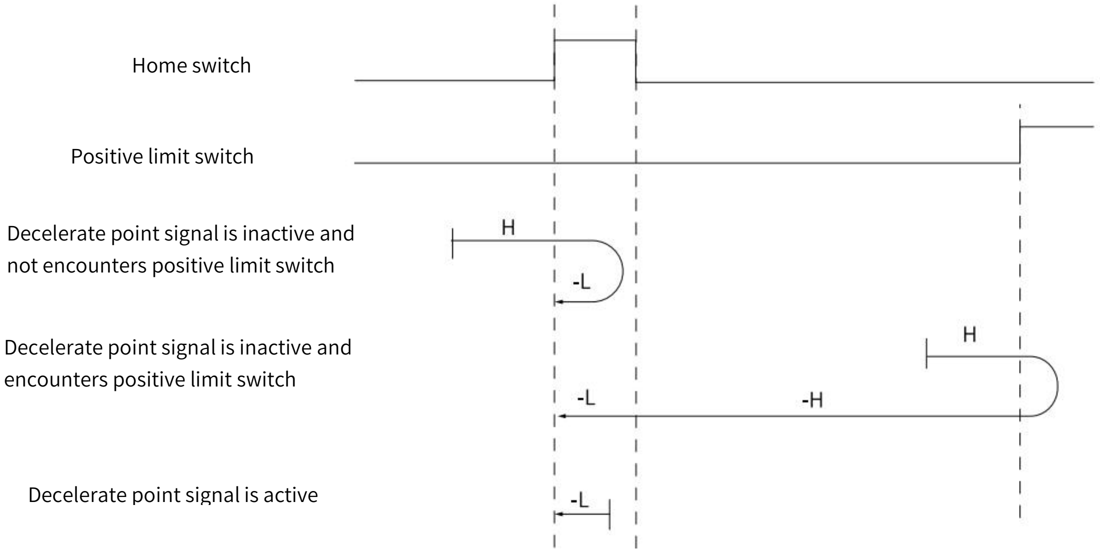


Figure 5-39 Home Mode 23 Trajectory and Signal Status

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.

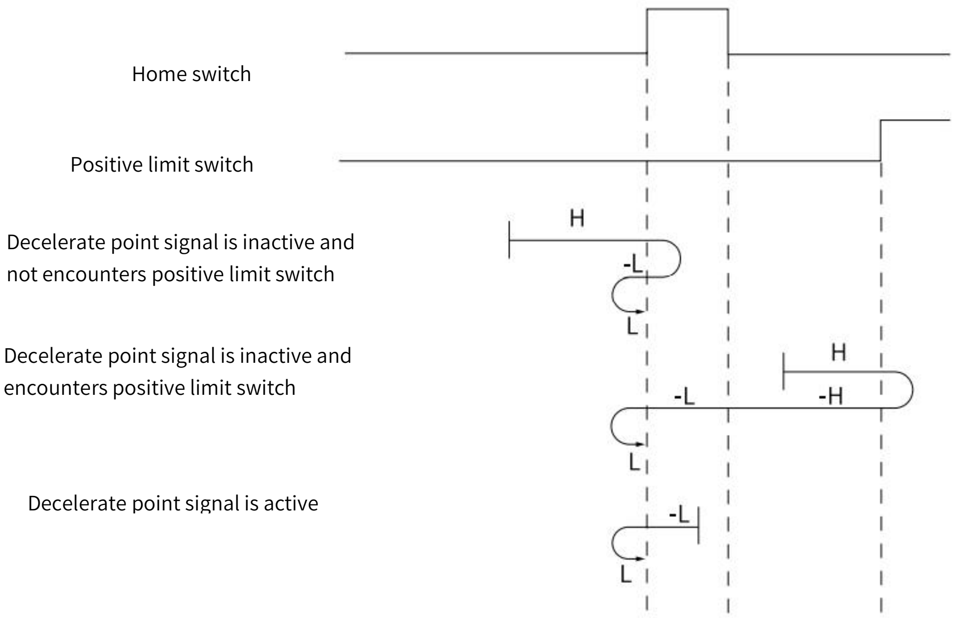


Figure 5-40 Home Mode 24 Trajectory an d Signal Status

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, 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.

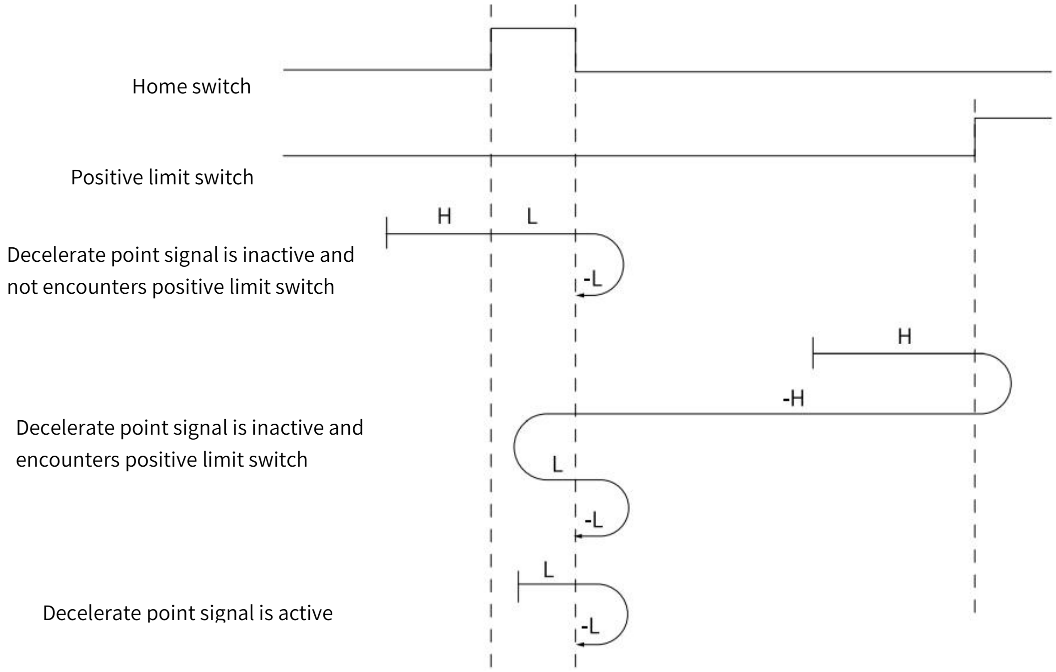


Figure 5-41 Home Mode 25 Trajectory an d Signal Status

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.

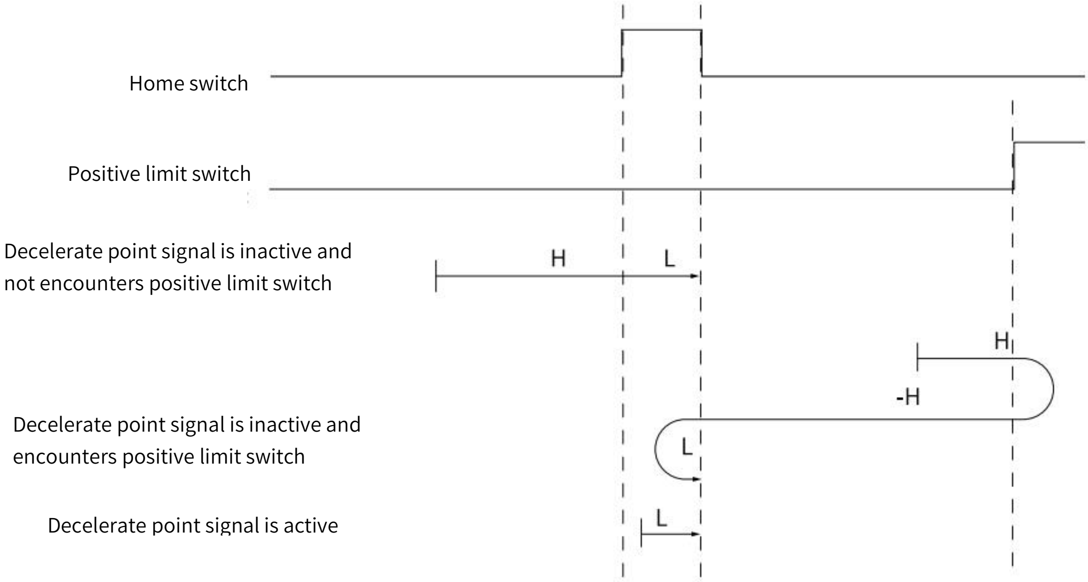


Figure 5-42 Home Mode 26 Trajectory and Signal Status

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.

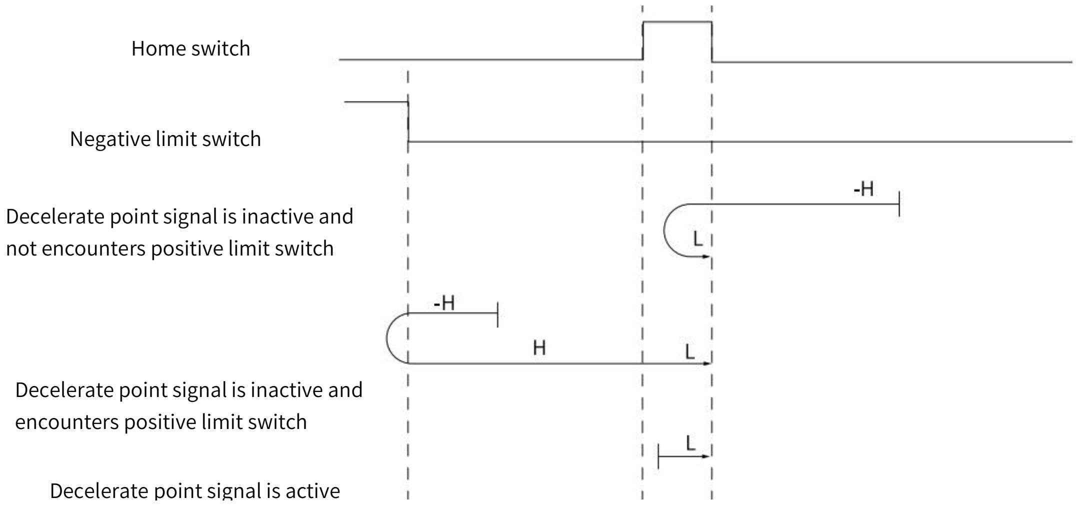


Figure 5-43 Home Mode 27 Trajectory and Signal Status

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 ecnountering 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.

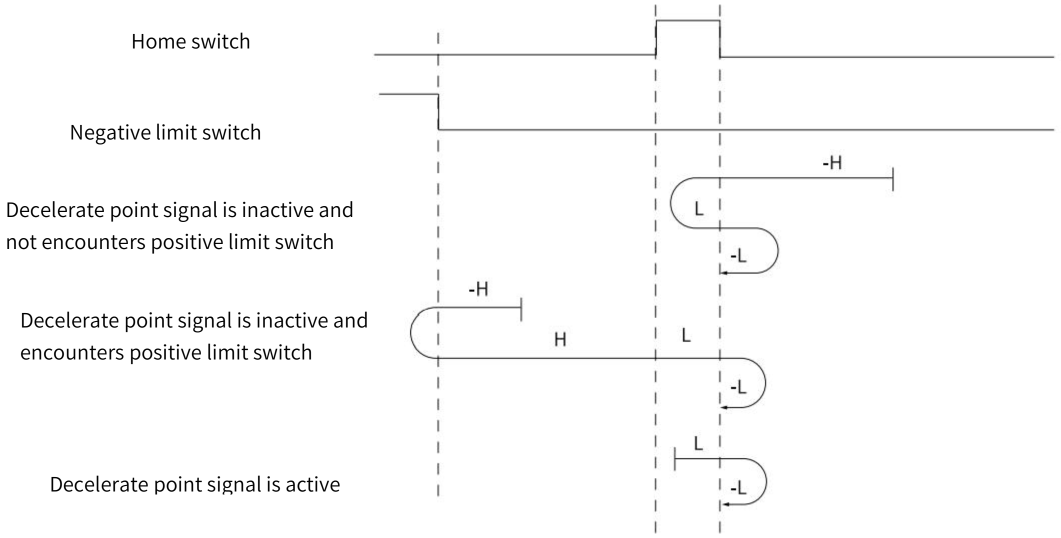


Figure 5-44 Home Mode 28 Trajectory 28 and Signal Status

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 ecnountering 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

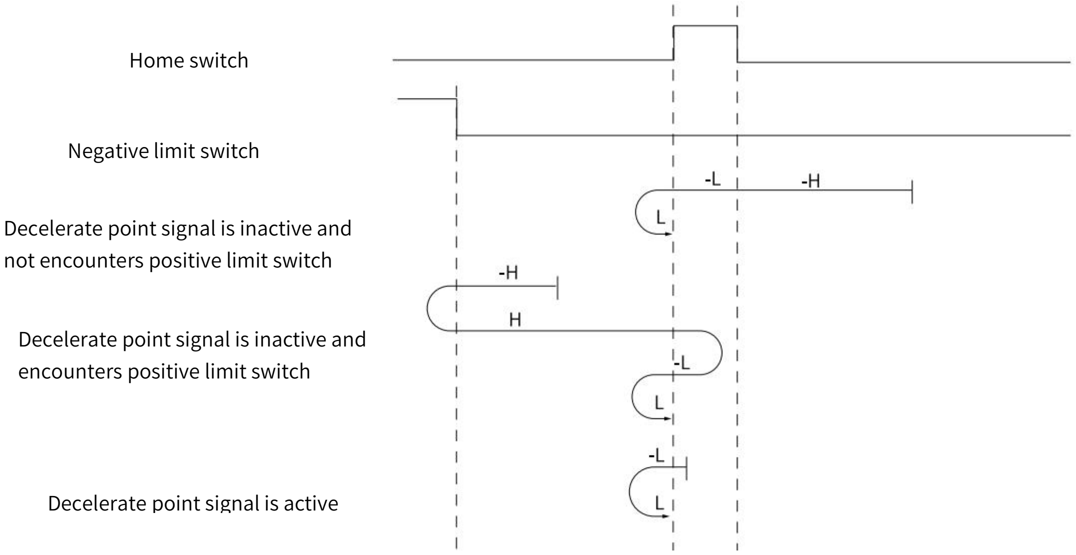


Figure 5-45 Home Mode 29 Trajectory and Signal Status

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

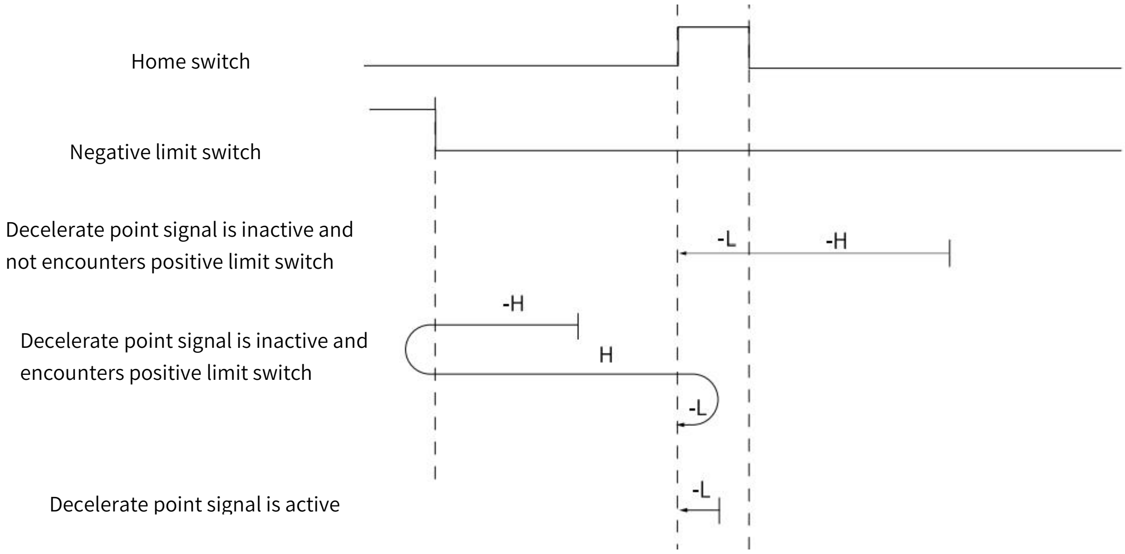


Figure 5-46 Home Mode 30 Trajectory and Signal Status

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

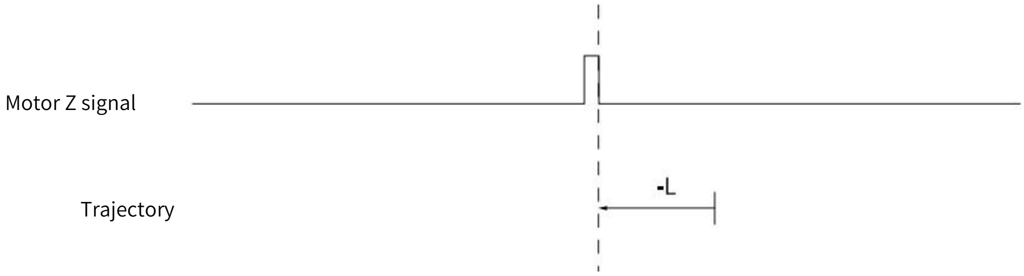


Figure 5-47 Home Mode 33 Trajectory and Signal Status

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

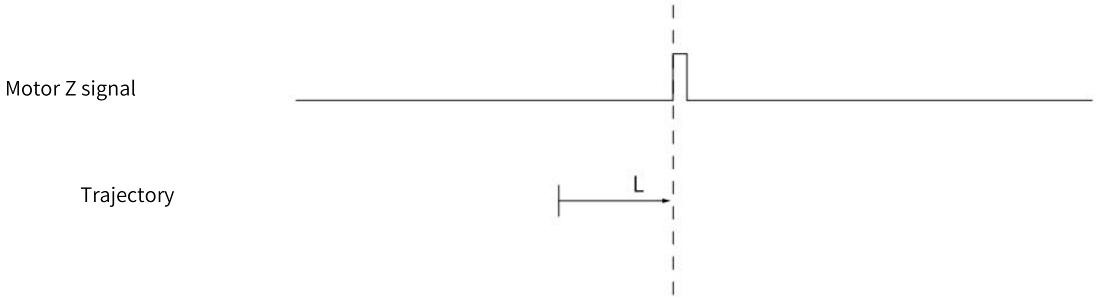


Figure 5-48 Home Mode 34 Trajectory and Signal Status

35) Mode 35, take current position as origin

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

The figure 5-49 shows.

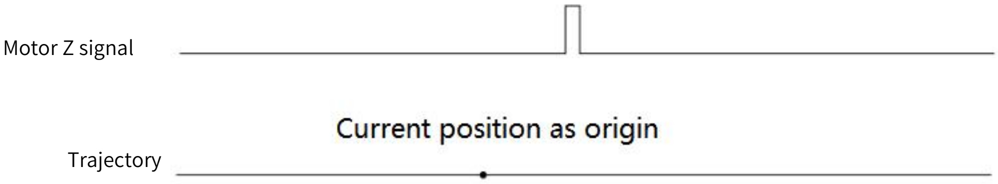


Figure 5-49 Home Mode 35 Trajectory and Signal Status

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

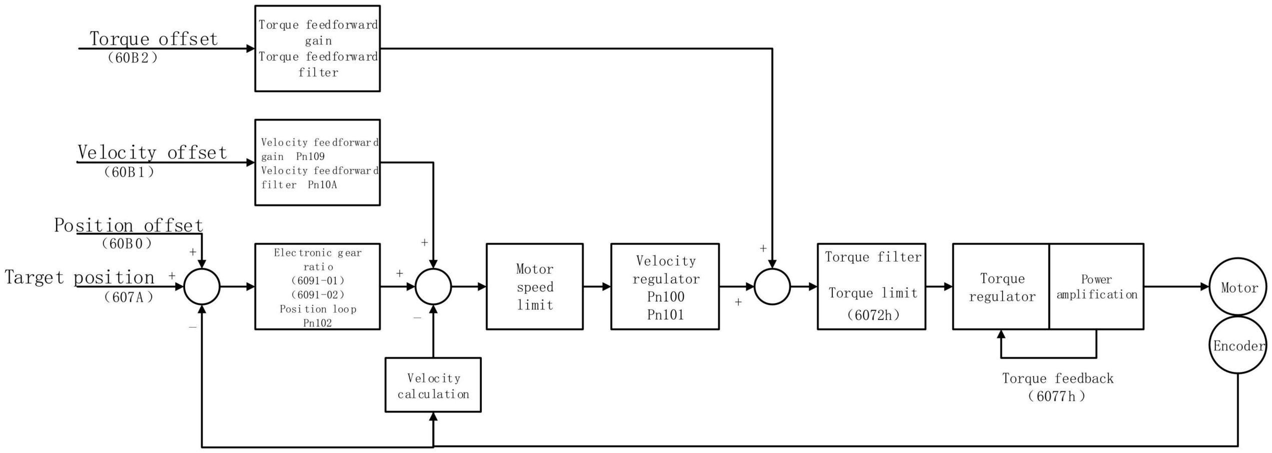


Figure 5-50 Cyclic Synchronous Position Mode Block Diagram

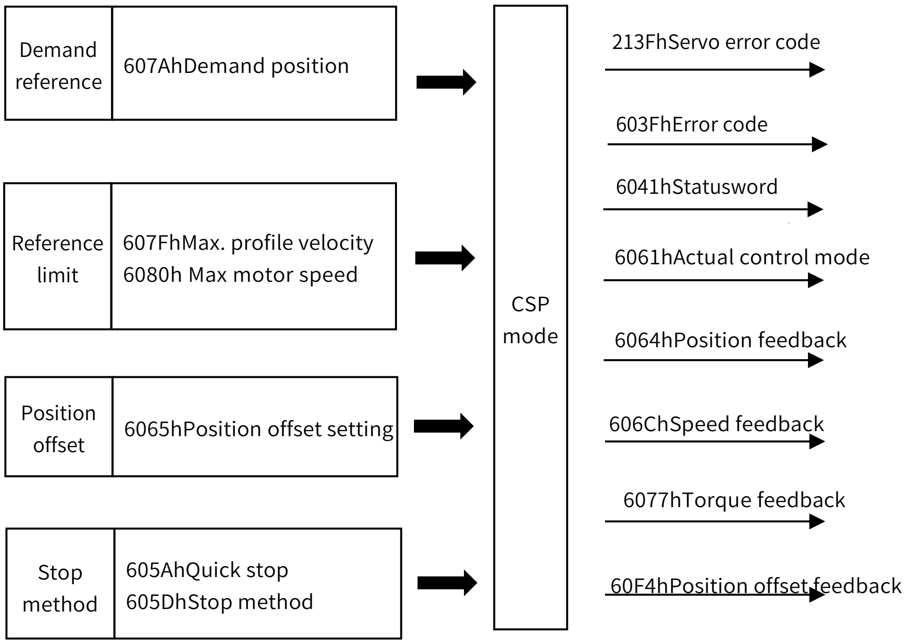


Figure 5-51 Cyclic Synchronous Position Mode Input and Output

5.11.1 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 exucutes 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	-

5.11.2 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: Sotware 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	Defualt 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 communcication 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 postion	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		Position	When enabled	Classification
	Setting range	Setting unit	Default setting	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.

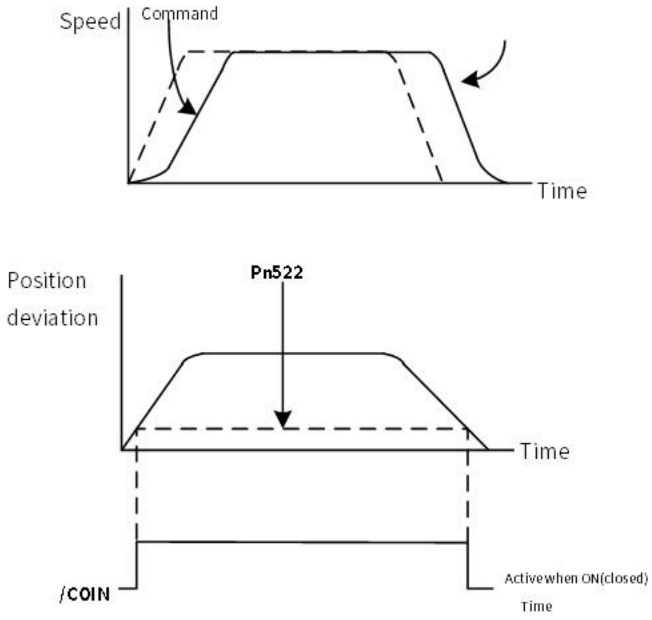


Figure 5-53 /COIN Signal Output Timing Chart

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)	/COIN signal output time	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

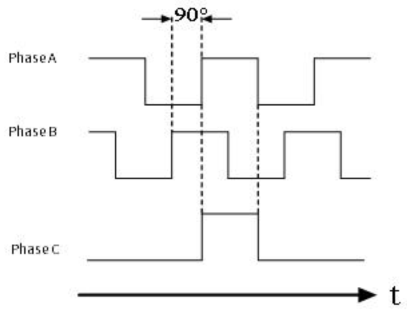
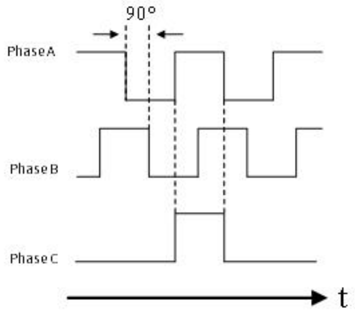
The encoder divided pulse output is a signal that is output from the encoder and processed inside the servo unit. It is then output externally in the form of two phase pulse signals (phases A and B) with a 90° phase differential. At the host controller, it is used as the position feedback.

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

Forward rotation (Phase B leads by 90°)	Reversing rotation(Phase A leads by 90°)
	

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 Position Speed Torque			When Enabled	Classification
	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

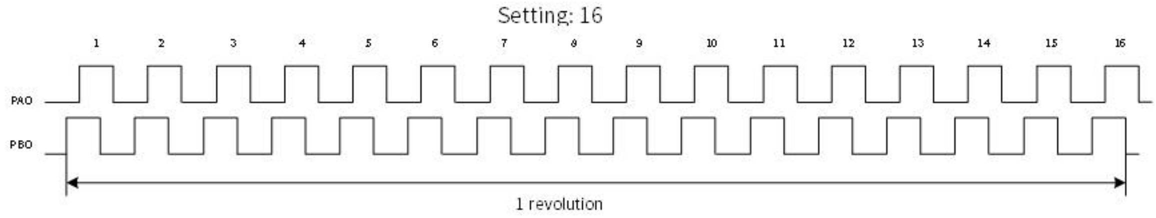


Figure 5-54 Encoder Divided Pulse when Pn212=16

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

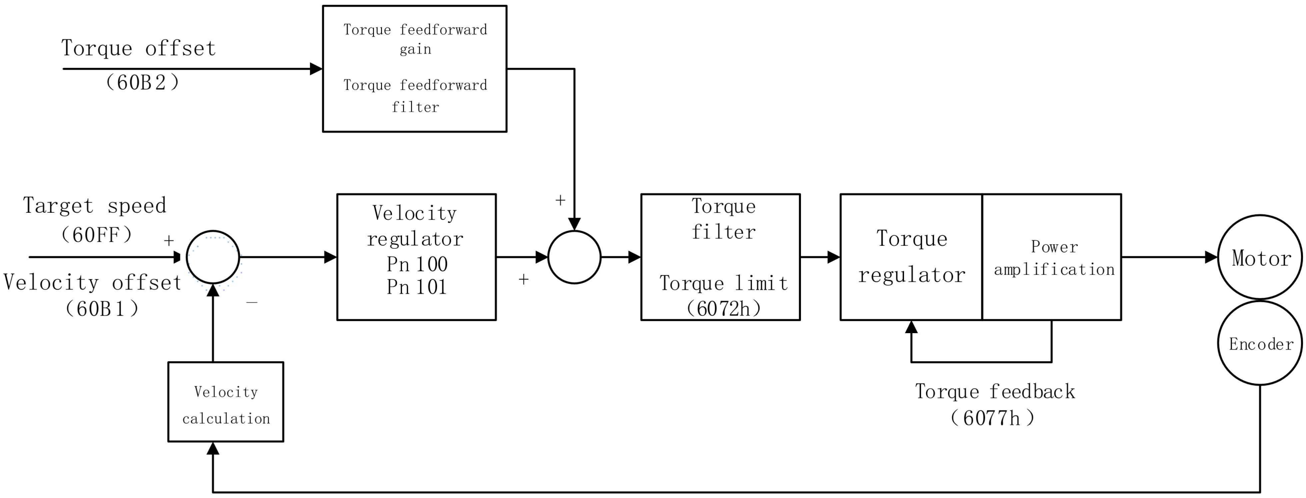


Figure 5-55 Cyclic Synchronous Velocity Mode Input and Output

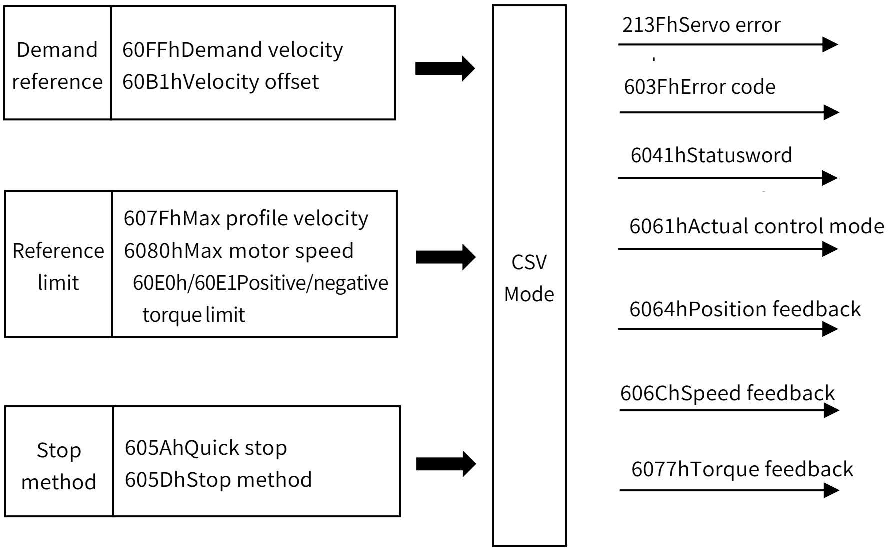


Figure 5-56 Cyclic Synchronous Velocity Mode Input and Output

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 exucutes 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: Sotware 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 communcication 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		Velocity Position Torque	When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-65535	0.01ms	0		

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

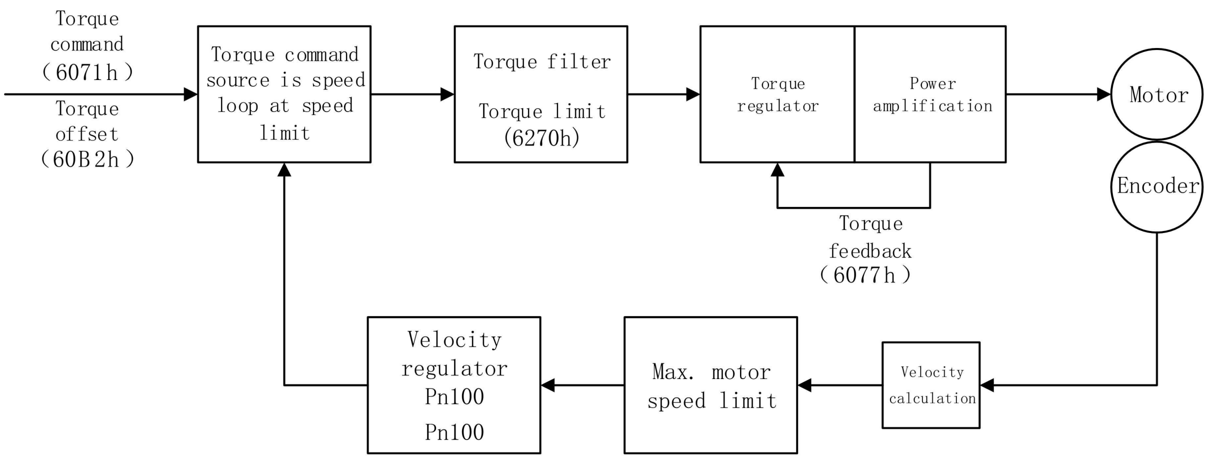


Figure 5-57 Cyclic Synchronous Torque Mode Block Diagram

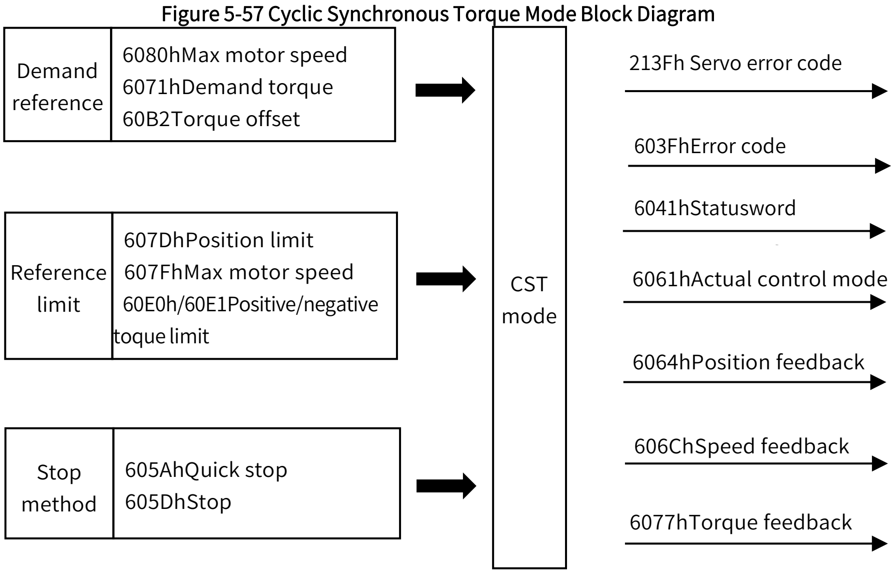


Figure 5-58 Cyclic Synchronous Torque Mode Input and Output

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 exucutes 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: Sotware 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	Defualt 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 communcication 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 deley 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**		**Position** **Speed** **Toruqe**	**When Enabled**	**Classification**
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-65535	0.01ms	0		

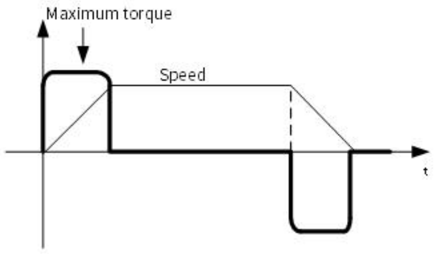
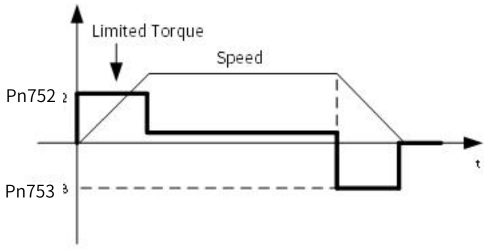
5.13.6 Internal Torque Limit

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**		**Position** **Speed** **Torque**	**When Enabled**	**Clasiification**
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-8000	0.1%	8000		
Pn753	**Reverse torque limit**		**Position** **Speed** **Torque**	**When Enabled**	**Classfication**
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-8000	0.1%	8000		

The torque waveform is as follows:

Without Internal Torque Limits	With Internal Torque Limits
	

Chapter 6Application Function

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)	Use the absolute encoder normally.	After restart	Setup
	n. □1□□	Use an absolute encoder as an incremental encoder .		

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 date from the servo unit
			ON（H level）	Requests the absolute data from the servo unit

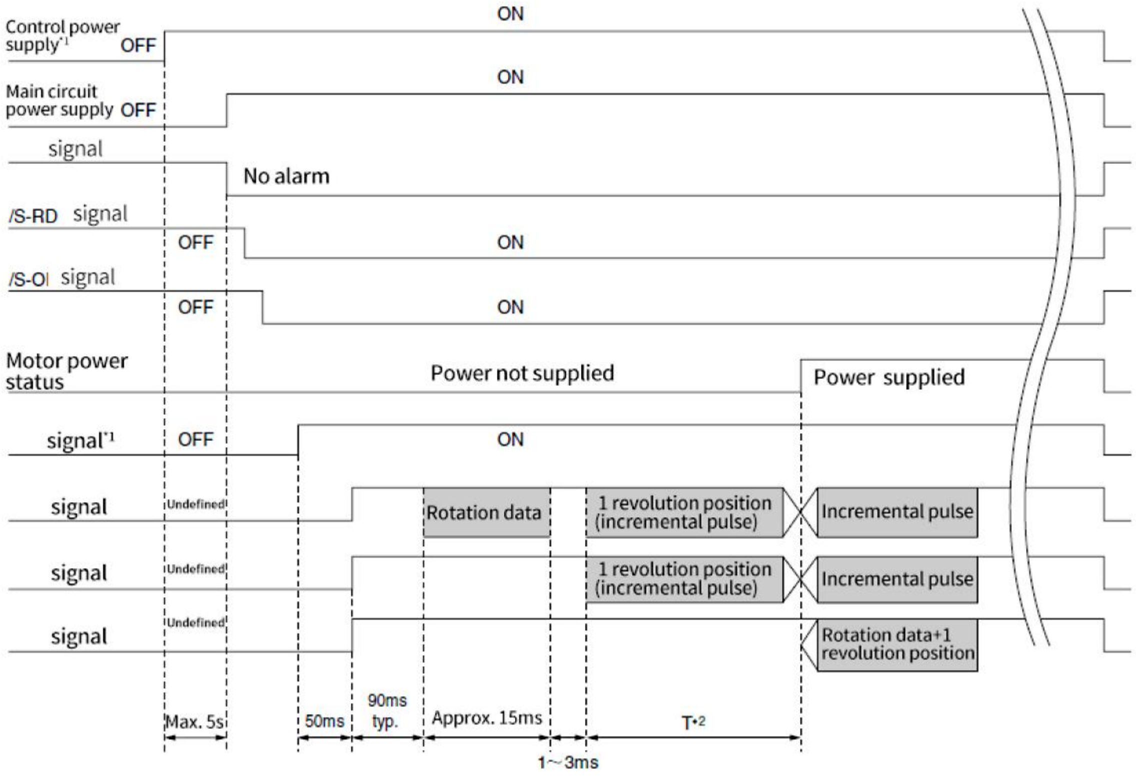


Figure 6-1 Absolute Data Output from Servo Unit Timing Chart

- 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)	Output alarm (A.830) for low battery voltage.	After restart	Setup
	n. □□□1	Output warning (A.930) for low battery voltage.		

・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.

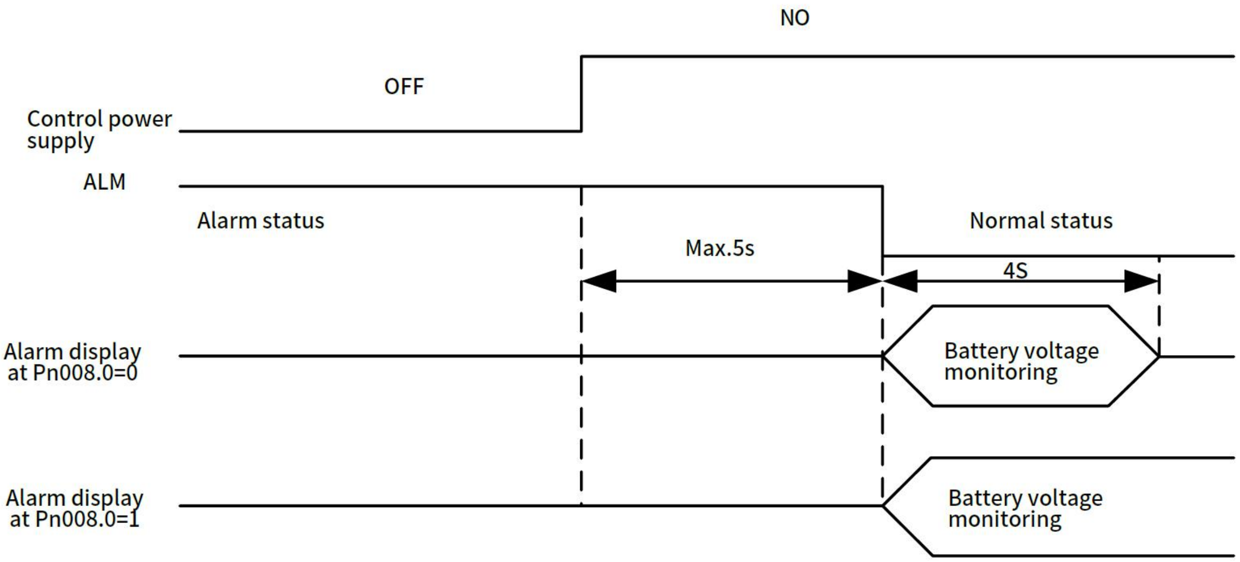
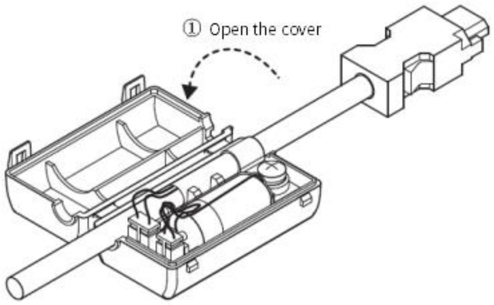


Figure 6-2 Alarm Display Timing Chart

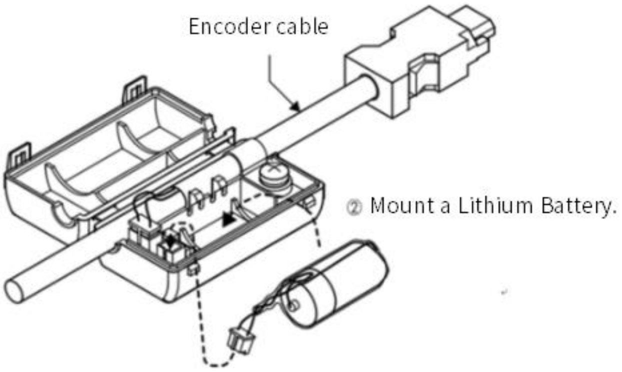
Battery replacement procedure when using an encoder cable with a battery unit

(1) Only turn on the control power supply of the servo unit.

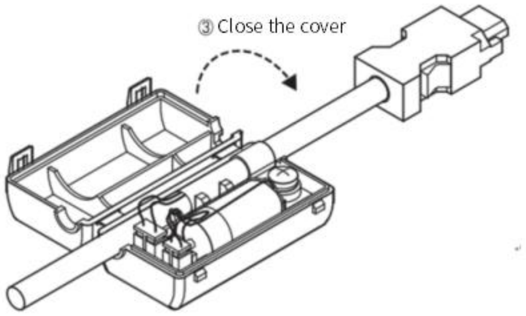
(2) Open the cover of the battery unit.



(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".

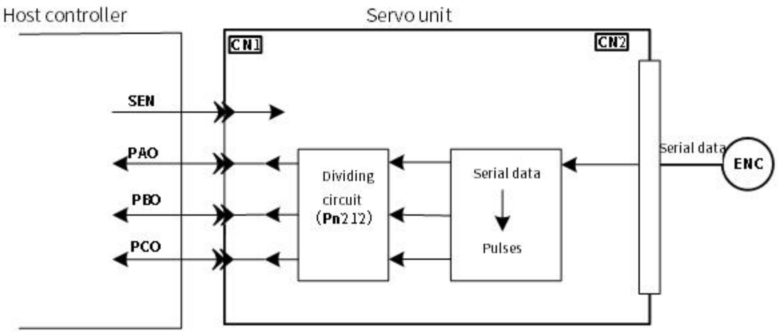


Figure 6-3 Absolute Data Output from Servo Unit Conceptual Diagram

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.

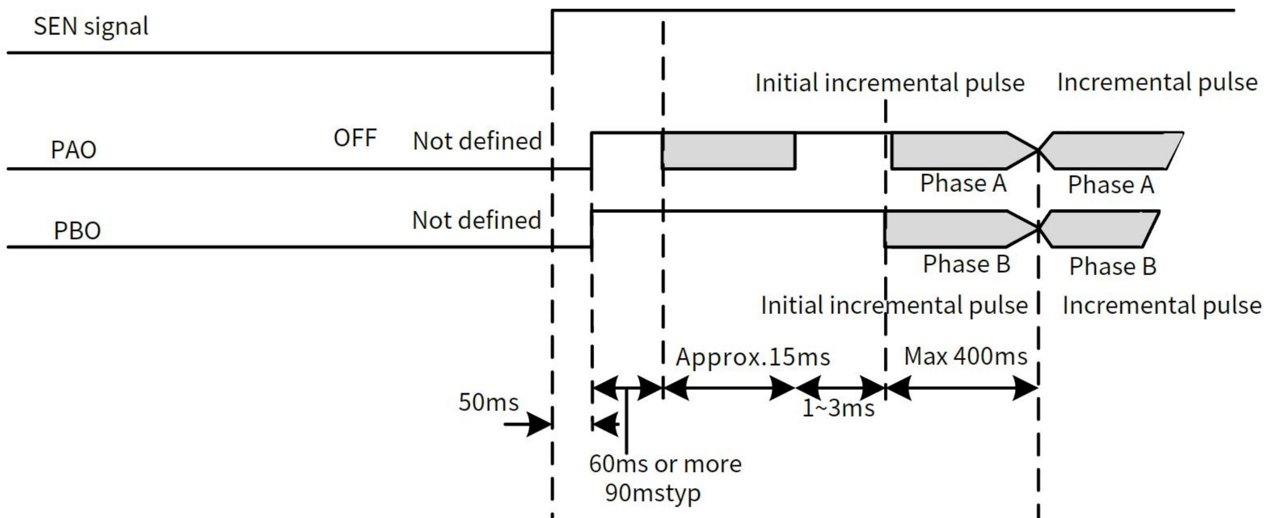


Figure 6-4 Sequence of Reading and Outputting of the Position Data from Absolute Encoder Timing Chart

＜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	$\frac{680 \times \mathrm{Pn212}}{16383}$

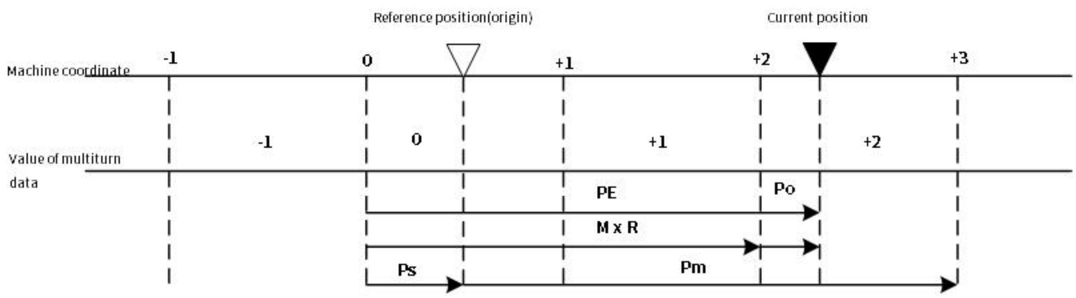


Figure 6-5 Position Data from Absolute Encoder PM Output Method

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:

  $P_E = -M \times R + P_O$

  $P_S = M_S \times R + P_S'$

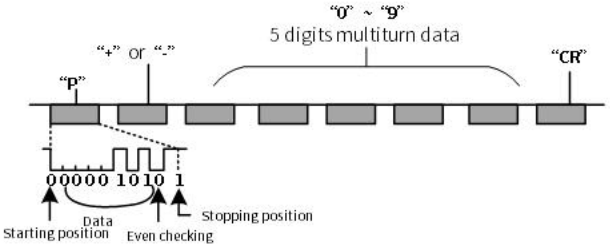
  $P_M = P_E - P_S$

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

SEN Signal	
PAO Output	

6.1.4 Initialization of Absolute Encoder(When Alarming)

Danger

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Ⓜkey to select the Utility function Fn000, and the panel displays "FN000"

(2) Press the ⋀or⋁key , the panel displays "FN008".

(3) Press the key Ⓢ for about 1 second, the panel displays "PGCL1"

(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 Ⓜ key to start resetting the absolute encoder. After the resetting is completed, the panel will display "donE" 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 × 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

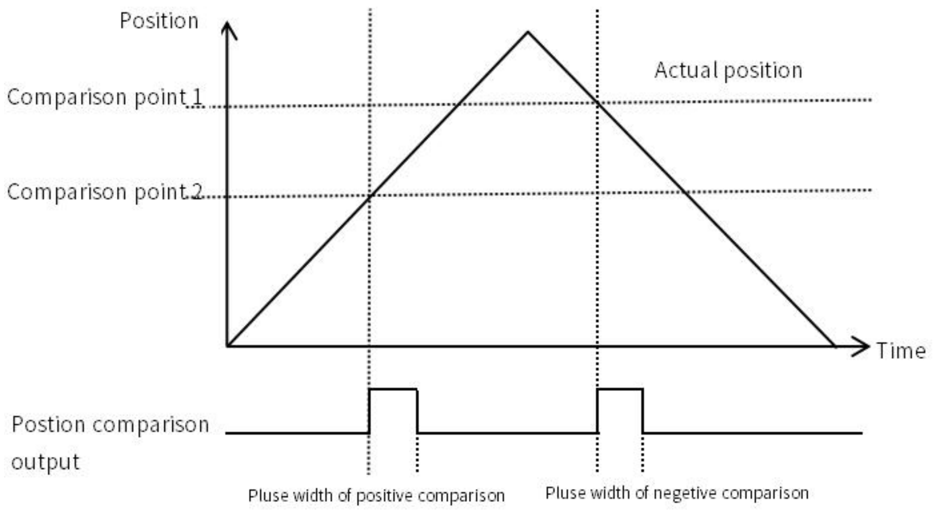


Figure 6-6 Operation Chart

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.

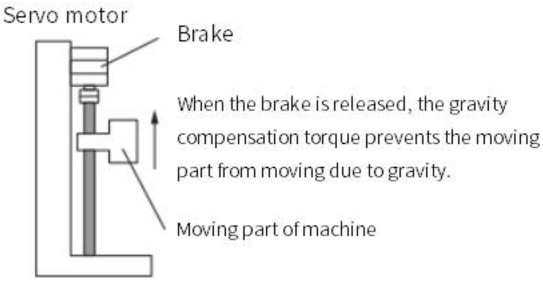


Figure 6-7 Operating Diagram

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.

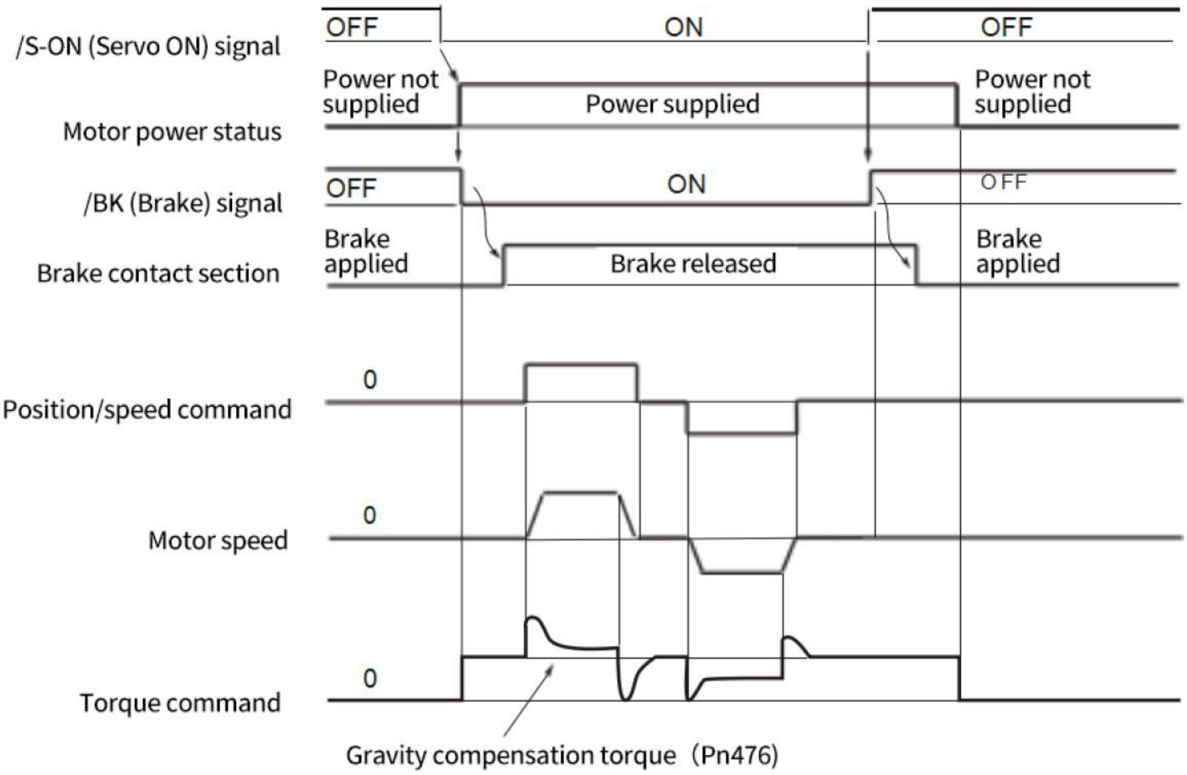


Figure 6-8 Brake Application Timing Chart

6.3.1 Required Parameters Setting

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

Table 6-11 Parameter Setting

<table>
<tr><th>Parameter</th><th colspan="3">Description</th><th>When Enabled</th></tr>
<tr><td>Pn 609.1=0</td><td colspan="3">Disable gravity compensation.</td><td rowspan="2">After restart</td></tr>
<tr><td>Pn 609.1=2</td><td colspan="3">Enable gravity compensation.</td></tr>
<tr><td rowspan="2">Pn 476</td><td>Setting range</td><td>Setting unit</td><td>Default setting</td><td>When Enabled</td></tr>
<tr><td>-1000 ~ 1000</td><td>0.1%</td><td>0</td><td>Immediately</td></tr>
</table>

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 supprots 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	—	—

3rd 2nd 1st 0

n. □ □ □ □

Forced DO 0		Reference
0	Disbaled(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$_h$);

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

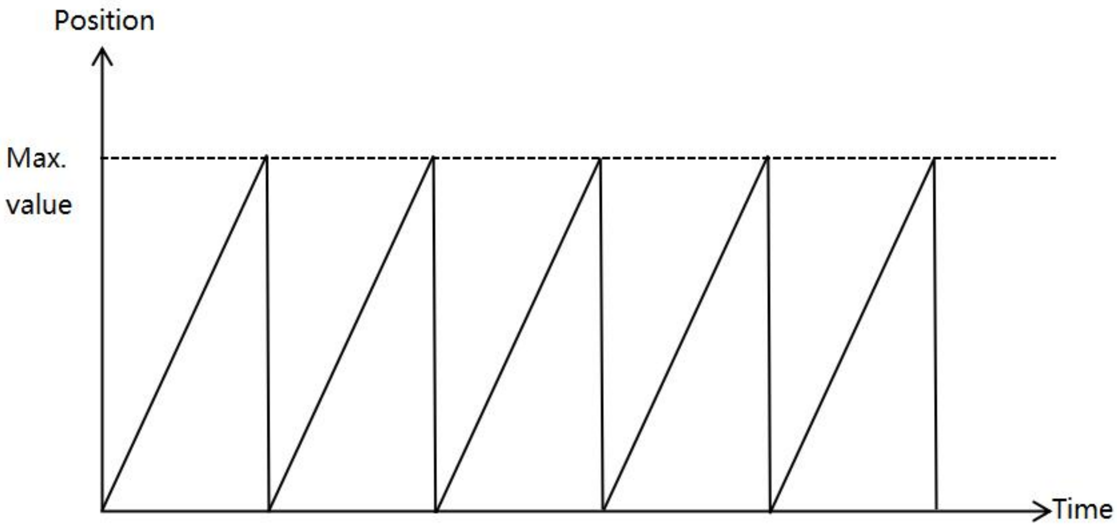


Figure6-9 6064 Waveform Diagram after Modulus Enabled

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: Continous 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.

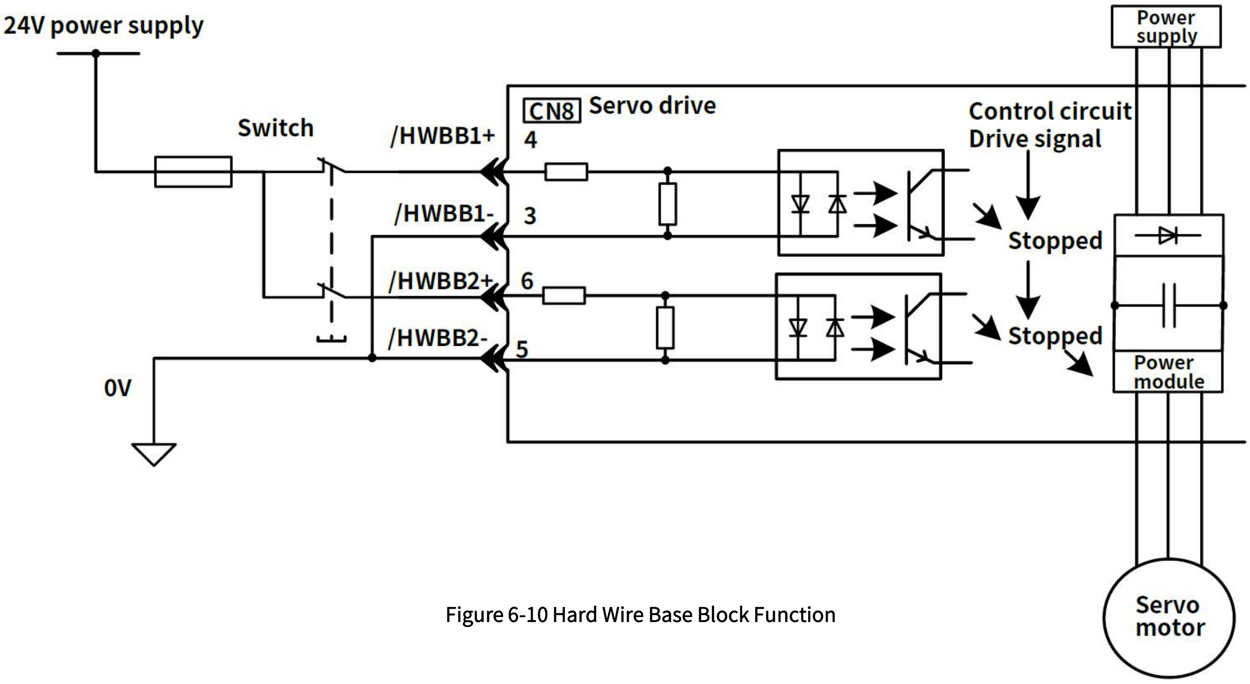


Figure 6-10 Hard Wire Base Block Function

➢ 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).

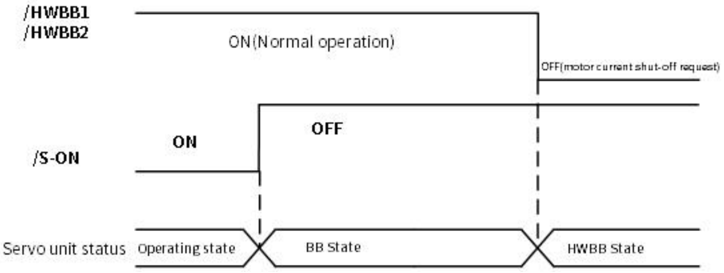


Figure 6-11 Hard Wire Base Block State Timing Chart

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。

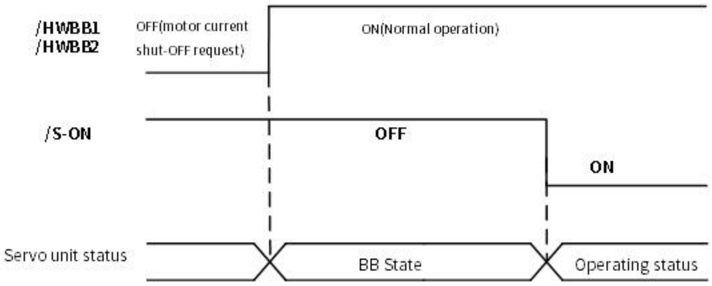


Figure 6-12 Hard Wire Base Block State Timing Chart

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.

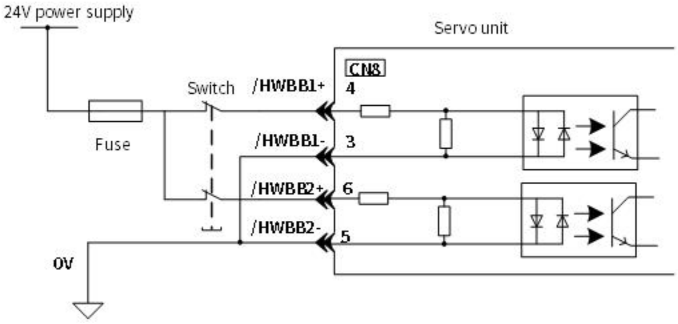


Figure 6-13 Resetting from HWBB State Timing Chart

- 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:

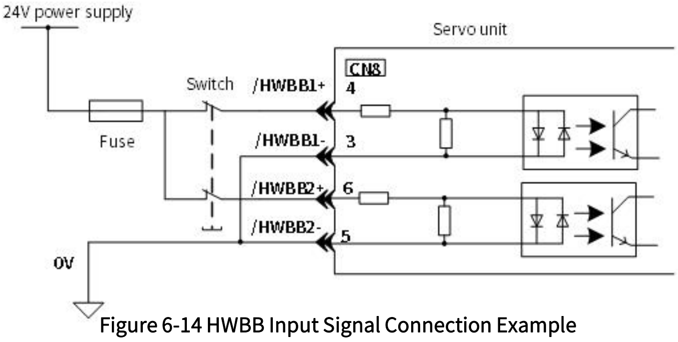


Figure 6-14 HWBB Input Signal Connection Example

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

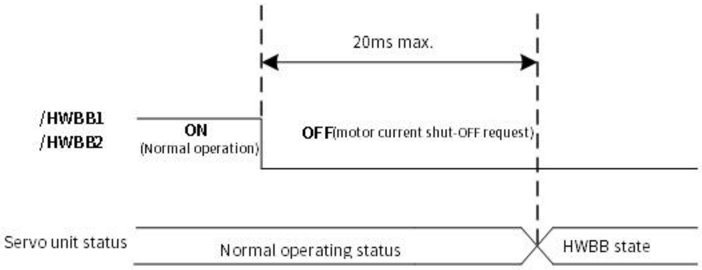


Figure 6-15 Base Block Function Operation Timing Chart

- ➢ 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.)

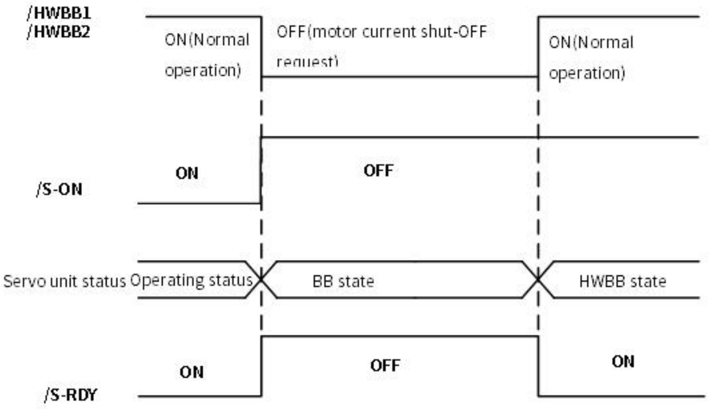


Figure 6-16 Servo Ready Output（/S-RDY）Timing Chart

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			
/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:

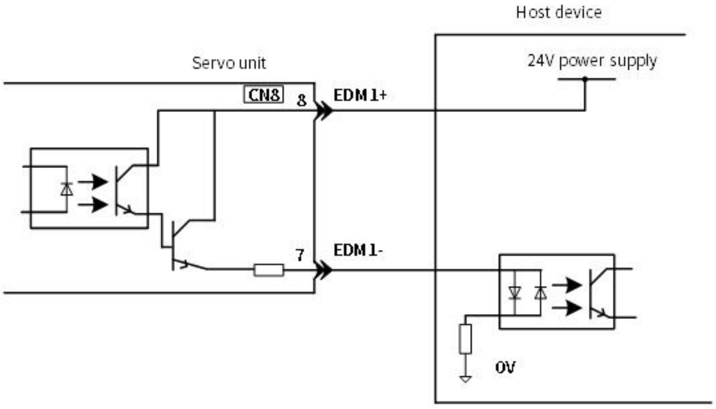


Figure 6-17 Common Emitter Output Signal (EDM1 Signal)

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:

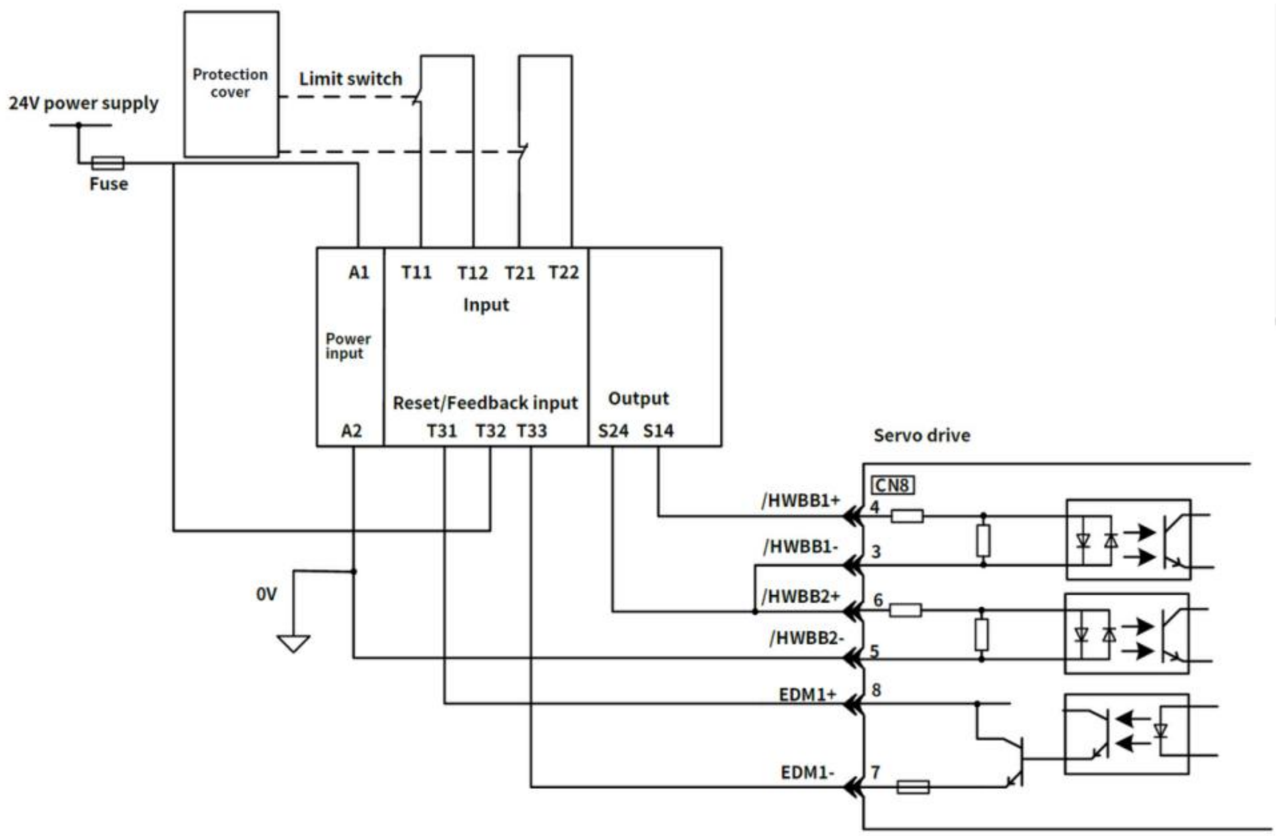


Figure 6-18 Connection Example of HWBB Operating when Safety Unit is used and the Guard is Opened

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. I ncorrect 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.

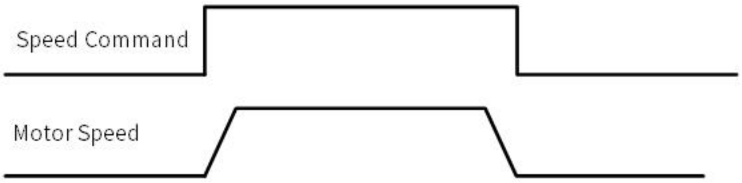


Figure 6-19 Soft Start Speed Command and Servo Motor Rate

Table 6-24 Soft Start Parameter Setting Table

Pn305	Soft Start Acceleration Time		Speed	When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately	Setup
	0-10000	1ms	0		
Pn306	Soft Start Deceleration Time		Speed	When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately	Setup
	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.

$$\text{Actual acceleration time} = \frac{\text{Target speed}}{\text{Maximum speed}} \times \text{Soft start(Acceleration speed Pn305)}$$

$$\text{Actual deceleration time} = \frac{\text{Target speed}}{\text{Maximum speed}} \times \text{Soft start(Acceleration speed Pn306)}$$

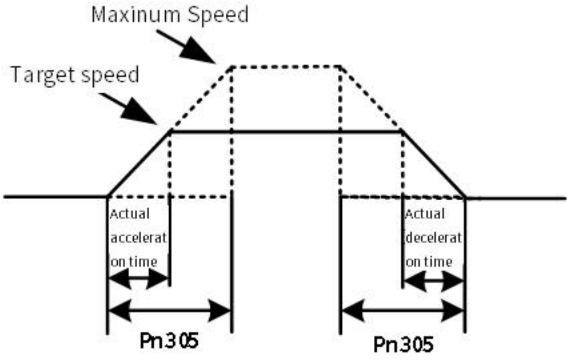


Figure 6-20 Pn305, Pn306 command Acceleration/Deceleration time

6.10 Smooth Function

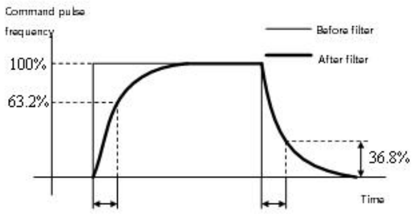
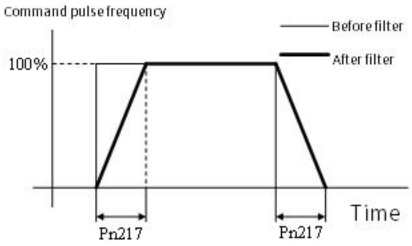
Apply a filter to the pulse input command to make command smoother

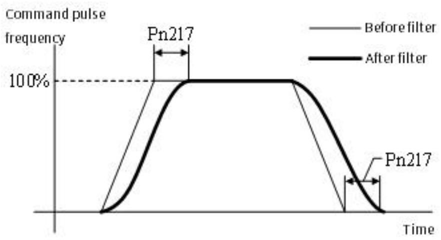
Table 6-25 Pn216, Pn217 Filter Command Table

Pn216	Position Reference Acceleration/Deceleration Time Constant Position			When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately after the motor stops	Setup
	0-65535	0.1ms	0		
Pn217	Position command moving average time Position			When Enabled	Classification
	Setting range	Setting unit	Default setting	Immediately after the motor stops	Setup
	0-10000	0.1ms	0		

Pn216 and Pn217 functions are as follows:

Table 6-26 Timing difference between Pn216 and Pn217

Acceleration and Deceleration Filter	Average Movement Filter
	

	Command pulse frequency Pn217 100% Before filter After filter Pn217 Time

Chapter 7 Tuning

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 dirve. 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) • 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	x	✓
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. • Gain (position loop gain, speed loop gain, etc.) • Filter (torque command filter, notch filter) • Friction compensation • Adjust Anti-resonance Control • vibration suppression	Position control	x	✓
One-parameter tuning	Input the position command or speed command from the host device, and perform the following adjustments. • 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	x	✓
Vibration suppression function	To suppress aftershock generated during positioning	Position control	x	✓

√: 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
Pn006 Pn007	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.
	n.□□06	Reserved parameters (Do not change)	-	-
	n.□□07	Motor-Load Position Deviation	0.01V/1 command unit	-
	n.□□08	Positioning Completion	Position completed: 5V Positioning not complated: 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 complated: 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.

$$Output\ voltage\ of\ analog\ monitoring\ 1\ =$$

$$(-1)\times\{\mathrm{Analog\ monitor\ 1\ signal\ selection}(\mathrm{Pn007}=\mathrm{n.00}\square\square)\times\mathrm{Analog\ monitor\ 1\ magnification}(\mathrm{Pn552})+\mathrm{Analog\ monitor\ 1\ offset\ voltage}(\mathrm{Pn550})\}$$

$$Output\ voltage\ of\ analog\ monitoring\ 2 =$$

$$(-1)\ \times\{\mathrm{Analog\ monitor\ 2\ signal\ selection}(\mathrm{Pn007}=\mathrm{n.00}\square\square)\times\mathrm{Analog\ monitor\ 2\ magnification}(\mathrm{Pn553})$$
$$+\mathrm{Analog\ monitor\ 2\ offset\ voltage}(\mathrm{Pn551})\}$$

3) Related parameters

Change the Monitor magnification and offset by the following parameters.

Table 7-3 Related parameters

Pn550	Analog Monitor 1 Offset Voltage Speed Position Torque			When enabled	Classification
	Setting range	Set unit	Factory setting	Immediately	Setup
	-10000 ~ 10000	0.1V	0		
Pn551	Analog Monitor 2 Offset Voltage Speed Position Torque			When enabled	Classification
	Setting range	Immediately	Factory setting	Immediately	Setup
	-10000 ~ 10000	0.1V	0		
Pn552	Analog Monitor 1 Magnification Speed Position Torque			When enabled	Classification
	Setting range	Immediately	factory setting	Immediately	Setup
	-10000 ~ 10000	x0.01	100		
Pn553	Analog Monitor 2 Magnification Speed Position Torque			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 □□)

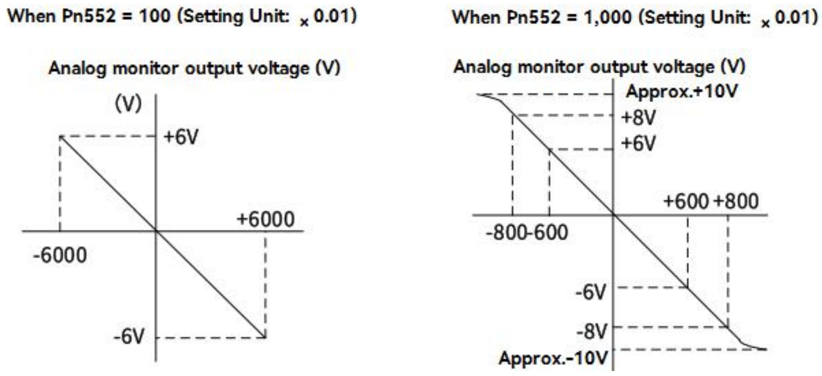


Figure 7-1 Analog detection output

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 drvie 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 $Pn102 = 400 \ \frac{Pn78C}{Pn78E} = \frac{1}{1}$

$$Pn520 = \frac{600}{60} \times \frac{1048576}{400/10} \times \frac{1}{1} \times 2 = 2621440 \times 2$$

$$= 5242880(Pn520 \ Factory \ setting) \times \ （1.2 \sim 2）$$

② When confirming the setting value of Pn102, please set the parameter display to "Display all parameters" (Pn00B.0 = 1).

$$\text{Position deviation“Command unit”} = \frac{Motor \ Speed[min^{-1}]}{60} \times \frac{Encoder \ resolution * 1}{\frac{Pn102\left[\frac{0.1}{s}\right]}{10} * 2} \times \frac{Pn78C}{Pn78E}$$

Alarm value for excessive position deviation (Pn 520) [setting unit: 1 command unit]

$$Pn520 > \frac{Max. \ Motor \ Speed[min^{-1}]}{60} \times \frac{Encoder \ resolution * 1}{\frac{Pn102\left[\frac{0.1}{s}\right]}{10} * 2} \times \frac{Pn78C}{Pn78E} \times (1.2 \sim 2)$$

" ×(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 Position			When enabled	Classification
	Setting range	Unit	Factory setting	Immediately	Setup
	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	Immediately	Setup
	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	Immediately	Setup
	10 ~ 100	1%	100		
Pn529	Speed Limit Level at Servo ON Position			When enabled	Classification
	Setting range	Unit	Factory setting	Immediately	Setup
	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	△	•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

①Press Ⓜkey to switch to Auxiliary function mode "FN000"

②Press ⋀or ⋁ key to "FN200"

③After long-pressing Ⓢ for 1 sec., switch to the load value of tuning-less "d 1"

④Press Ⓜkey to switch to the rigidity setting screen of tuning-less" L 4 "

⑤Press ⋀ 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 Ⓢ to automatically adjust the frequency of the notch filter to the vibration frequency.

⑥Press Ⓜ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.

⑦Press Ⓢ 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 asbout 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

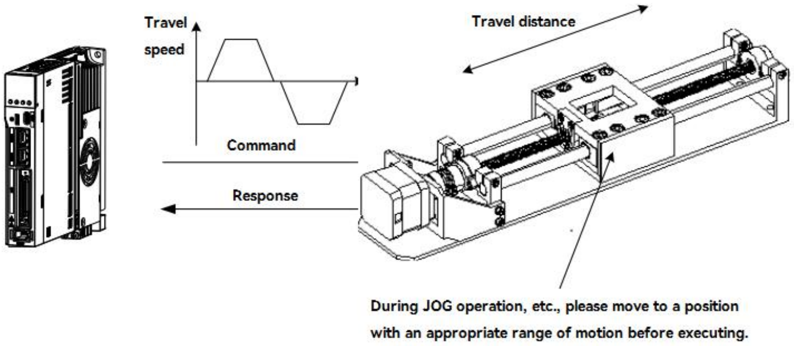
Mode	Content
Mode 1	Adjust gain, notch filter, A-mode vibration
Mode 2	Adjust the gain, model tracking, notch filtering, Anti-Resonance, and vibration suppression
Mode 3	Adjust gain, notch filter, Anti-Resonance, and vibration suppression

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.



During JOG operation, etc., please move to a position with an appropriate range of motion before executing.

Figure 7-2 Automatic operation specification

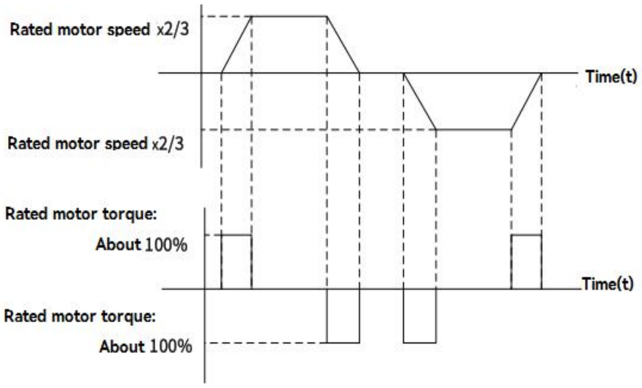


Figure 7-3 Example of automatic operation

- Maximum speed: Motor rated speed × (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 advanved 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		Speed Position Torque	When enabled	Classification
	Setting range	Unit	Factory setting	Immediately	Setup
	0-100	1%	100		

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	•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 estimatied 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.	•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)"	• 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	•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	•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 ordamage.

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 □0 (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

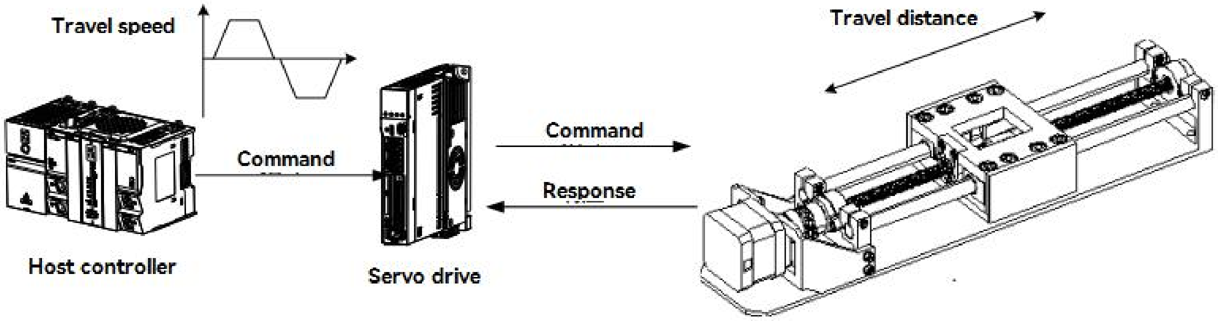


Figure 7-4 Example of automatic operation

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

• Ther 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		Position Speed Torque	When enabled	Classification
	Setting range	Unit	Factory setting	Immediately	Setup
	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□	Adjust Anti-resonance Control without the use of auxiliary functions	Immediately	Tuning
	n.□□1□ (Factory setting)	Adjust Anti-resonance Control with auto tunning by auxiliary function		

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	• Change mode from "Mode = 2" to "Mode = 3" •When mechanical vibration occurs, please use theAnti-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	•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	Auto tuning of the 1st-stage notch filter without auxiliary functions	Immediately	Tuning
	n.□□□1 (Factory setting)	Auto tuning of the 1st-stage notch filter by auxiliary function		
	n. □0□□	Auto tuning of the 2nd-stage notch filter without auxiliary functions		
	n. □1□□ (Factory setting)	Auto tuning of the 2nd-stage notch filter by auxiliary function		

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□	Auto tuning of Adjust Anti-resonance Control without auxiliary functions	Immediately	Tuning
	n.□□1□ (Factory setting)	Auto tuning of Adjust Anti-resonance Control with auxiliary function		

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□□	Auto tuning of Vibration suppression function without auxiliary functions	Immediately	Tuning
	n. □1□□ (Factory setting)	Auto tuning of Vibration suppression function with auxiliary function		

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

Mode Friction compensation function selection		"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)	Do not use Model tracking control and Speed/torque feedforward simultaneously	Immediately	Tuning
	n.1□□□	Using Model tracking control and Speed/torque feedforward simultaneously		

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 cas , 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	odel 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	Immediately	Setup
	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)	Do not use Model tracking control and Speed/torque feedforward simultaneously	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
Pn1 39	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.

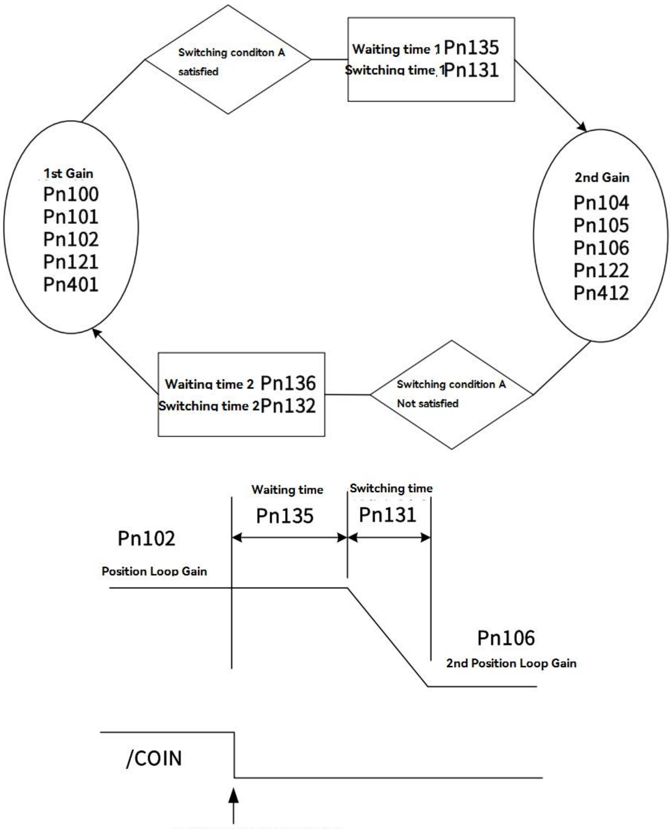


Figure 7-5 Relationship between waiting time and switching time at gain switchin

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Note: Gain switching can be executed under PI or IP control mode (Pn10B).

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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	Inactiuve Gain Monitor	1V	The 1st gain is valid
			2V	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)	Without friction compensation function	Immediately	Setup
	n.1□□□	Use friction compensation function		

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.

① 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.

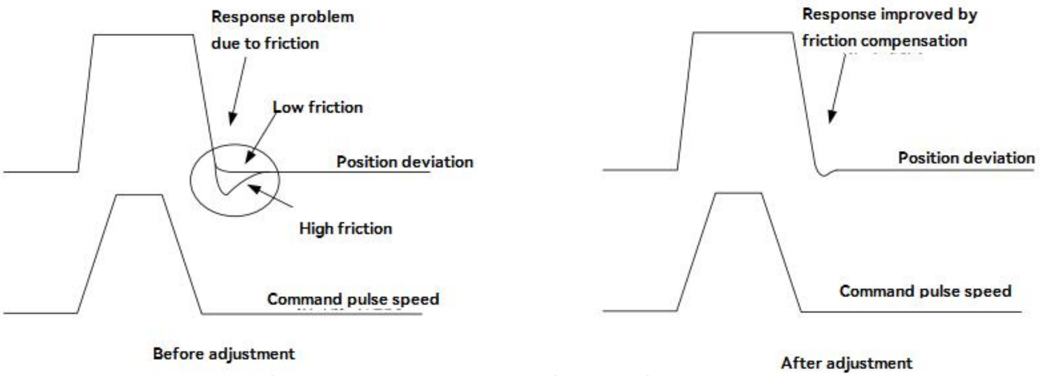

Figure 7-6 Waveforms to adjustment results before and after adjustment

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).

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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	Immediately	Tuning
	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. □0□□ (Factory setting)	Select Speed detection 1	Restart the power supply	Tuning
	n. □1□□	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	Immediately	Tuning
	0 ~ 100	1%	0		
Pn10A	Feedforward Filter Time Constant Position			When enabled	Classification
	Setting range	Unit	Factory setting	Immediately	Tuning
	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	-		

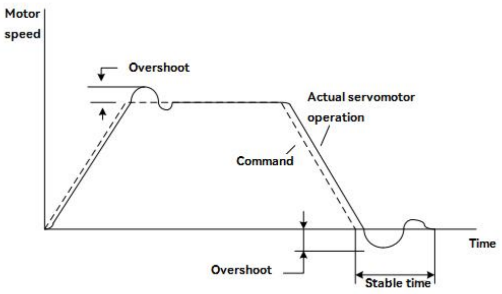
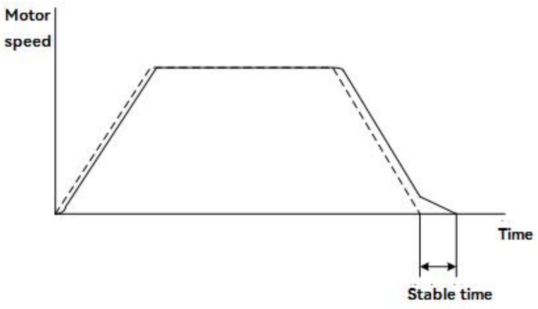
Table 7-53 Parameters for setting switching condition

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.

No mode selection	With mode selection
	

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 Speed Position Torque			When enabled	Classification
	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] ≤1000/ （2 π Pn100[Hz]·4）
- Limit adjustment value Pn401[ms]<1000/ （2 π ·Pn100[Hz]·1）

Table 7-55 Parameters for Filter frequency of the 2nd stage 2nd torque command

Pn40F	2nd Stage 2nd Torque Command Filter Frequency Speed Position Torque			When enabled	Classification
	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 2ond Torque Command Filter Q Value Speed Position Torque			When enabled	Classification
	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		

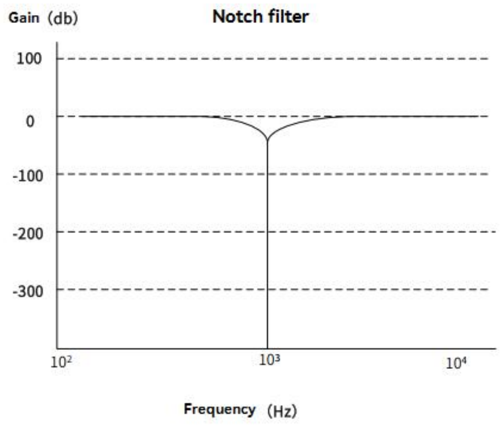
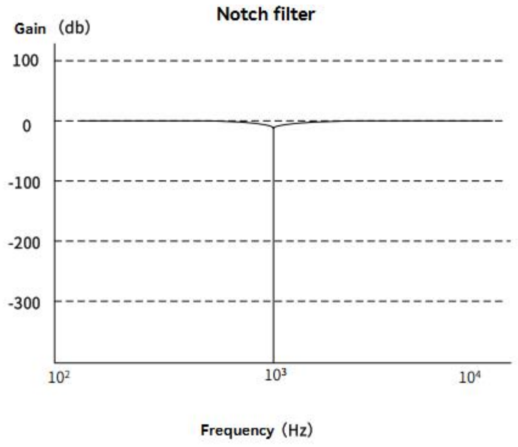
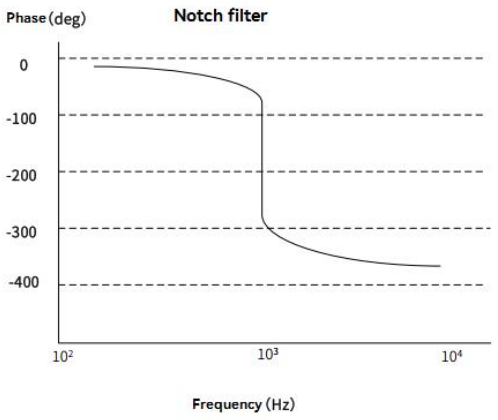
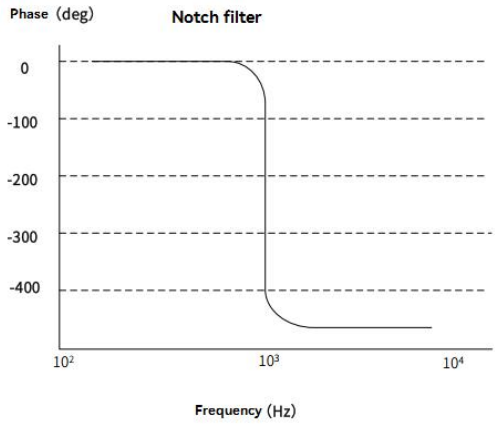
Table 7-58 Notch filter parameters by mechanical vibration frequency

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 isrunning, it may cause vibration.

Q value = 0.7	Q value = 1.0
	
	

Chapter 8 Auxiliary Function

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

$$36000x100[ms]=3600[s]=60[min]=1[h]$$

So the total run time is 1 hour.

The procedure for displaying alarm records is as follows:

①Press Ⓜ key to switch to auxiliary function mode “FN000”

②Long-press Ⓢ for 1 sec., and the latest alarm will be displayed.

③After short-pressing Ⓢ , the lower 4 digits of the alarm time stamp will be displayed, and short-press Ⓢ to display the middle 4 digits of the alarm time stamp, then short-press Ⓢ once to display the highest 2 digits of the alarm time stamp. Then short-press Ⓢ again to display the alarm record currently viewed.

④Press Ⓥ key to display the previous alarm. Press ⌃ key to display the new alarm. The higher the number in the leftmost digit, the older the alarm displayed.

⑤Press Ⓢ 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 J OG 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

Pn 304	Jogging Speed	Speed	Position Torque	When enabled	Classification
	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:

①Press Ⓜ key to switch to Auxiliary function "FN000"

②Press ∧ or ∨ to display "FN002"

③Press Ⓢ to display "= JOG"

④Press Ⓜ key to display "- JOG" to enter into servo-ON

⑤Press ∧ key (forward-rotation) to ∨ key (reversed-rotation) and the servo motor rotates at the speed set by Pn304.

⑥Press Ⓜ key to enter into the servo-OFF. You can also press Ⓢfor about 1 sec to turn off the servo.

⑦Press Ⓢ 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 $^{-1}$.

POINTS

- 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。

The operation steps of origin search and positioning are as follows:

①Press Ⓜ key to switch to Auxiliary function mode "FN000"

②Press ∧ or ∨ key to display "FN003"

③Press Ⓢ for 1 sec, Fn003(origin search)" -.CSR" is displayed for about 1 sec.

④Press Ⓜ key to enable the servo and then long-press ∧ (forward-rotation) or ∨(reverse-rotation) to origin search, then search dirction changes according to the setting of Pn000.0. Then long-press ∧(forward-rotation) or ∨(reverse-rotation) until the servo motor stops, and the "·C26" flashes on the panel, at this moment, the origin search is completed.

⑤After the origin search is completed, press Ⓜ key to disable the servo motor, and the panel displays "·C26"

⑥Press Ⓢ for 1 sec and return to the auxiliary function mode "FN003" (origin serach)

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 (FnO02) and no need to connecte 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 0FF.

- 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
	Settiing range	Unit	Factory setting	Immediately	Setup
	-	-	0000		
Pn 531	Program Jogging Travel Distance	Speed	Position Torque	When enabled	Classification
	Settiing 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
	Settiing range	Unit	Factory setting	Immediately	Setup
	1～10000	1 min^{-1}	500		
Pn 534	Program Jogging Acceleration/Deceleration Time Speed Position Torque			When enabled	Classification
	Settiing range	Unit	Factory setting	Immediately	Setup
	2～10000	1ms	100		
Pn 535	Program Jogging Waiting Time	Speed	Position Torque	When enabled	Classification
	Settiing range	Unit	Factory setting	Immediately	Setup
	0～10000	1ms	100		
Pn 536	Program Jogging Number of Movements	Speed	Position Torque	When enabled	Classification
	Settiing range	Unit	Factory setting	Immediately	Setup
	0～1000	1 time	1		

Table 8-4 Pn530 parameters setting

Parameter		Contents	Factory setting
Pn 530	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:

①Press Ⓜ key to switch to auxiliary function mode “FN000”

②Press ∧ or Ⓥ key to display “FN004”

③Press Ⓢ key for about 1 sec or more

④Press Ⓜ key to enter into servo-ON

⑤In accordance with the initial movement direction of the operation mode ∧ or Ⓥ key, it will start to act after the waiting time.

⑥If the JOG operation of program finished, “End” will flash and then return to the Step 4.

8.6 Initialize Parameters (Fn005)

POINTS

• 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.

The parameter setting initialization operation steps are as follows:

①Press Ⓜ key to switch to auxilairy function mode " FN000 ".

②Press ∧ or Ⓥ key to display " FN005 ".

③Press Ⓢ key for more than 1 second and display " P.INIT ".

④Press Ⓜ key to start parameter initialization. During initialization, the display will blink.

⑤After initialization is complete, " donE ” will blink for about 1 second.

⑥After displaying "donE", return to displaying " P.INIT ".

⑦Press Ⓢ key, return " FN005 " is displayed.

⑧To 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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ∧ or Ⓥ key to display " FN006 ".

③Press Ⓢ key for more than 1 second , the display shows " TRCLR ".

④Press Ⓜ key to clear the alarm history. after clearing" donE ” will blink for about 1 second.

⑤"donE" is displayed.

⑥Press Ⓢ 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..

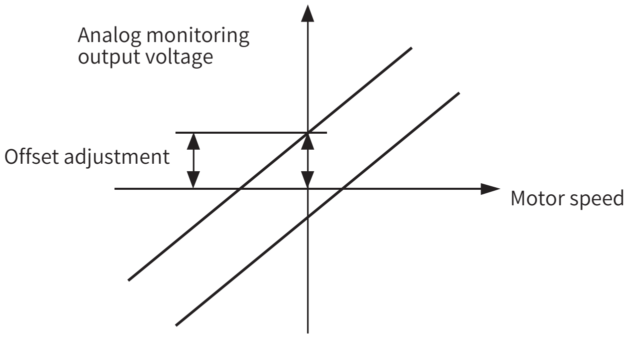


Figure 8-1 Example diagram of offset adjustment for Motor speed monitoring

Table 7-5 Offsert 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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ⋀ or Ⓥ key to display " FN00C ".

③Press Ⓢ key for about 1 sec , displaying " Ch1_o ".

④Press Ⓜ key to switch between the monitoring output of channel 1 and channel 2, and channel 2 is displayed as " Ch2_o ".

⑤Press Ⓢ key (less than 1 sec), zero adjustment data is displayed.

⑥Press ⋀ key or Ⓥ to change the data, and adjust the offset value of the analog monitoring output.

⑦Press Ⓢ key (less than 1 sec), to switch to display the channel of analog monitoring output.

⑧Press Ⓢ 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.

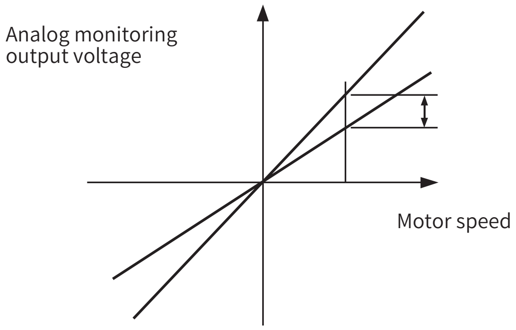


Figure 8-2 Example diagram of gain adjustment for motor speed monitoring

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% /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.

2) Operation steps

The operation steps of zero-adjustment of analog monitoring output are as follows:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ∧ or ∨ key to display " FN003 ".

③Press Ⓢ key for about 1 sec , to display " Ch1_G ".

④Press Ⓜ key to switch between the Monitoring output of channel 1 and channel 2, and channel 2 is displayed as " Ch2_G ".

⑤Press Ⓢ key (less than 1 sec), to display gain adjustment data.

⑥Press ∧ or ∨ key to change the data, to adjust the gain of the analog monitor output.

⑦Press Ⓢ key for about 1 sec , and return to" FN003 ".

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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ⋀ or ⋁ key to display " FN00E ".

③Press Ⓢ key for more than 1 sec , and " CuR_o " displays.

④Press Ⓜ key to realize the automatic adjustment of the offset. after clearing" donE ” will blink for about 1 sec.

⑤"donE" display and returned

⑥Press Ⓢ 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.

POINTS

When performing manual adjustment, if this function executed by mistake, the characteristics may be dreduced.

When performing manual adjustments, follow the precautions below.

- 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:

①Press Ⓜ key to switch to auxilairy function mode " FN000 ".

②Press ∧ or ∨ key to display " FN00F ".

③To adjust the U-phase offset, press Ⓢ key for about 1 sec , and " Cu1_o " displayed

④Press Ⓢ key (less than 1 sec), and display U-phase offset.

⑤Press ∧ key or ∨ key to change the offset. The torque command must also be carefully adjusted while observing the monitor signal.

⑥Press Ⓢ key (less than 1 sec) to confirm U-phase current offset adjustment.

⑦Adjust the offset of V- phase. Press Ⓢ key for about 1 sec , and " Cu2_o "display.

⑧Press Ⓢ key (less than 1 sec), to display the offset value of V- phase.

⑨Press ∧ or ∨ key to change the offset. The torque command must also be carefully adjusted while observing the monitor signal.

⑩Press Ⓢ key (less than 1 sec), and " Cu2_o " is displayed, to confirm the W-phase current offset adjustment.

⑪Press Ⓢ 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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ∧ or ∨ key to display " FN010 ".

③Press Ⓢ key for about 1 sec or more.

④Press ∧ or ∨ key, and set it to any of the following values. Refer to Table 8-8 .

⑤" donE " display and return to " P000_ ".

⑥Press Ⓢ 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.Y 7
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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ⋀ or ⋁ key to display " FN011 ".

③Press Ⓢ 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.

④Press Ⓜ key to display the capacity of the servo motor, such as " P0040 ” : 400W .

⑤Press Ⓜ key to display the encoder type and resolution, such as " E0023 "for incremental 23-bit encoders," E0123 ” is an absolute 2 3-bit encoder.

⑥Press Ⓜ key and the special specification number of the servo drive will displaye. " Y0000 ” indicates a standard product.

⑦Press Ⓢ 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.

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ∧ or ∨ key to display " FN012 ".

③Press Ⓢ for more than 1 sec , the FPGA version will be displayed, such as " R.2A11 ".

④Press Ⓜ key to display the software version of the servo drive, such as "U. 2B03 ".

⑤Press Ⓜ key to display the model information version of the servo sheet, such as "P .2B06 ".

⑥Press Ⓢ key and return to" FN012 ".

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).

$$\text{Detection value=Vibration detection value}\quad (\text{Pn312}[\text{min}^{-1}])\ \times \text{Detection sensitivity}(\text{Pn312}[\%])/100$$

<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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ∧ or ∨ key to display " FN01B ".

③Press Ⓢ key for about 1 sec , and " dINIT " displayed

④Press Ⓜ 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.

⑤Press Ⓜ 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.

⑥Press Ⓢ key to return to " FN01B ".

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:

①Press Ⓜ key to switch to auxiliary function mode " FN000 ".

②Press ⋀ or Ⓥ key to display " FN030 ".

③Press Ⓢ key for about 1 sec to display " SrSt1 ".

④Press ⋀ key until " SrStS " displayed.

⑤Press Ⓜ key, the panel display disappears.

⑥Press Ⓢ key for about 1 sec and return to" FN030 ".

Chapter 9 Monitoring Display

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:

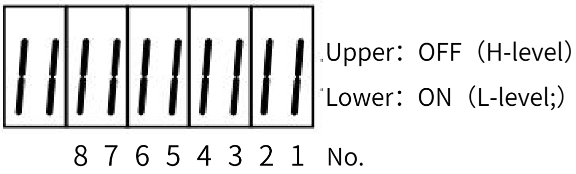
1) Press Ⓜ key to switch to the Monitoring function mode " UN005 ".

2) After pressing Ⓢ 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 Ⓢ 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.



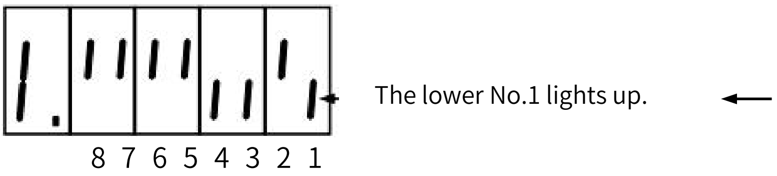
- The upper segment (LED) lights up when the input signal is OFF (open circuit).
- The lower segment (LED) lights up when the input signal is ON (short circuit).

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

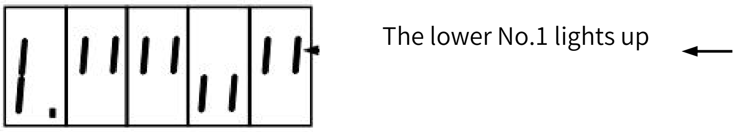
9.4.3 Display Examples of Input Signal

A display example of an input signal is shown below:

- When the / HomeSwitch signal is ON



- When the /HomeSwich 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:

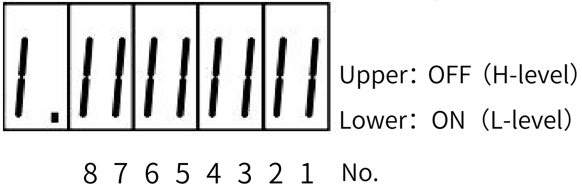
1) Press Ⓜ key to switch to the monitoring function mode " UN006 ".

2) After pressing Ⓢ 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 " Sectoin 8.5.2 Judgment Method of the Output Signal Display State".

3) Press and hold Ⓢ 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 operatoin panel. The correspondence between output pins and LED No. is shown in the table below.



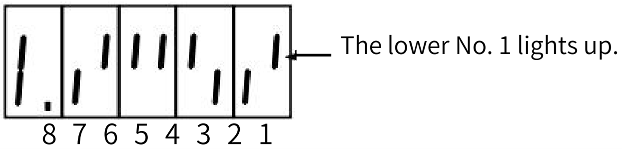
- The upper segment (LED) lights up when the output signal is OFF (open circuit) .
- The lower segment (LED) lights up when the output signal is ON (short circuit) .

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

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.

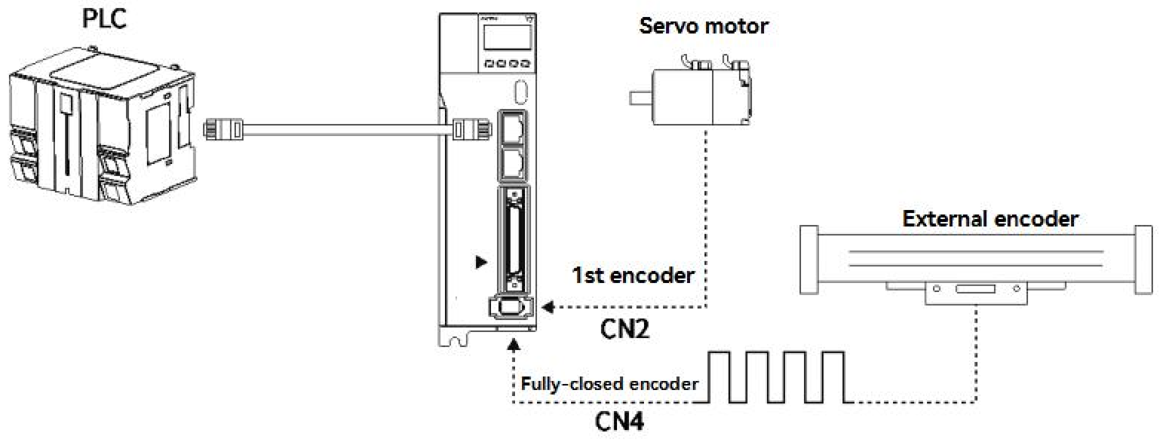


Figure 10-1 Fully-closed loop model diagram

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)

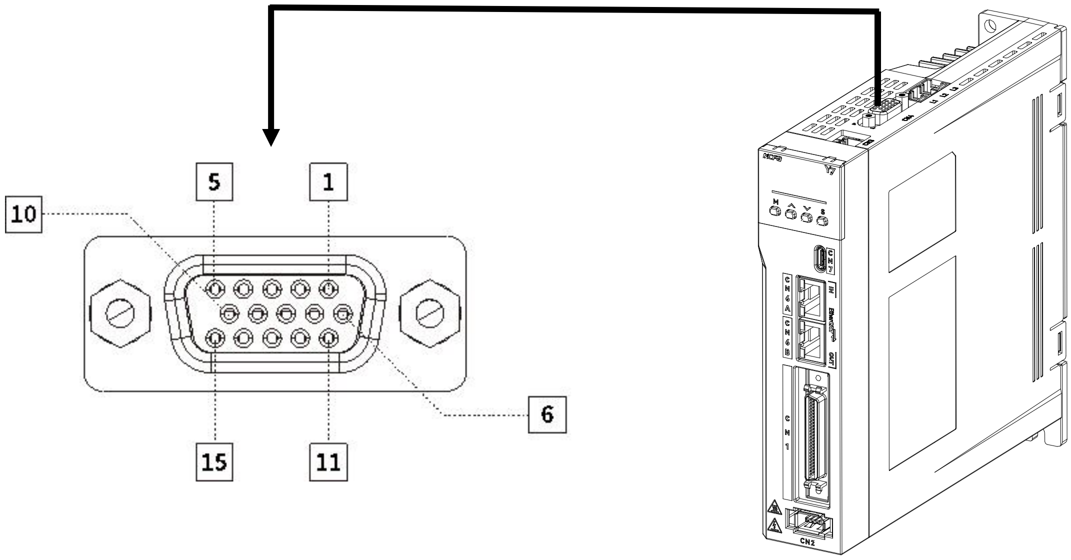


Figure 10-2 CN4 pins arrangements

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⩽3 00mA _	+5V output Current output⩽3 00mA _	+5V output Current output⩽3 00mA _	+5V output Current output⩽3 00mA _

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 +	—	—
1 0	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

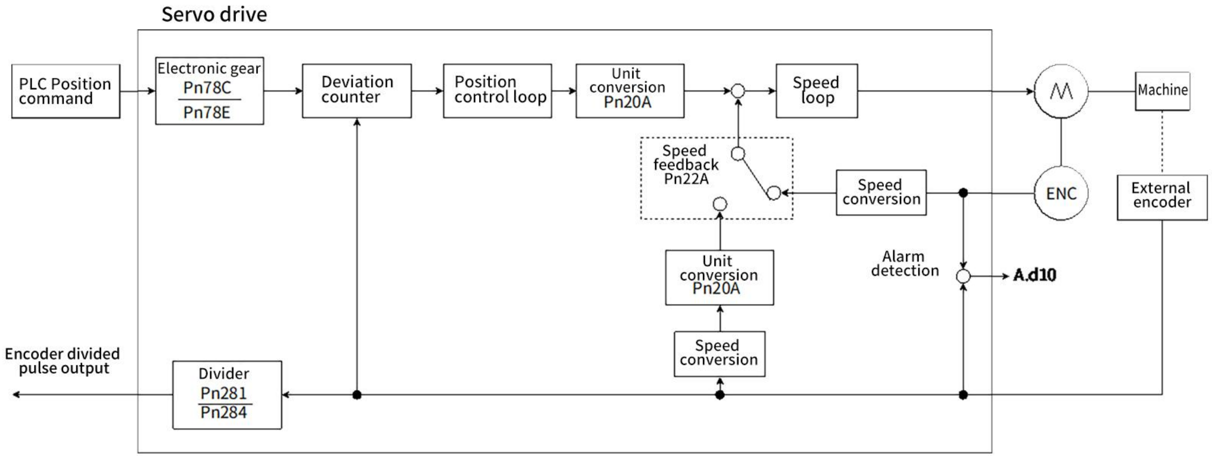


Figure 10-3 Fully-closed loop system control block diagram

10.2 Parameters Setting for Fully-closed Loop

<table>
<tr><th>Parameter</th><th>Name</th><th>Setting range</th><th>Factory setting</th><th>Unit</th><th>When enabled</th></tr>
<tr><td rowspan="2">Pn002.3</td><td>External Encoder</td><td>0-4 _</td><td>0</td><td>-</td><td>After restart</td></tr>
<tr><td colspan="5"><table>
<tr><td>0</td><td>Do not use</td></tr>
<tr><td>1</td><td>Use in standard running direction</td></tr>
<tr><td>2</td><td>Reserved parameters (Do not change)</td></tr>
<tr><td>3</td><td>Use in reverse direction</td></tr>
<tr><td>4</td><td>Reserved parameters (Do not change)</td></tr>
</table></td></tr>
</table>

Pn20A	Number of External Encoder Scale Pitches	4-1048576 _	3 2768	1 P/R ev	After restart
Pn22A.3	Speed FeedbackSelection	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

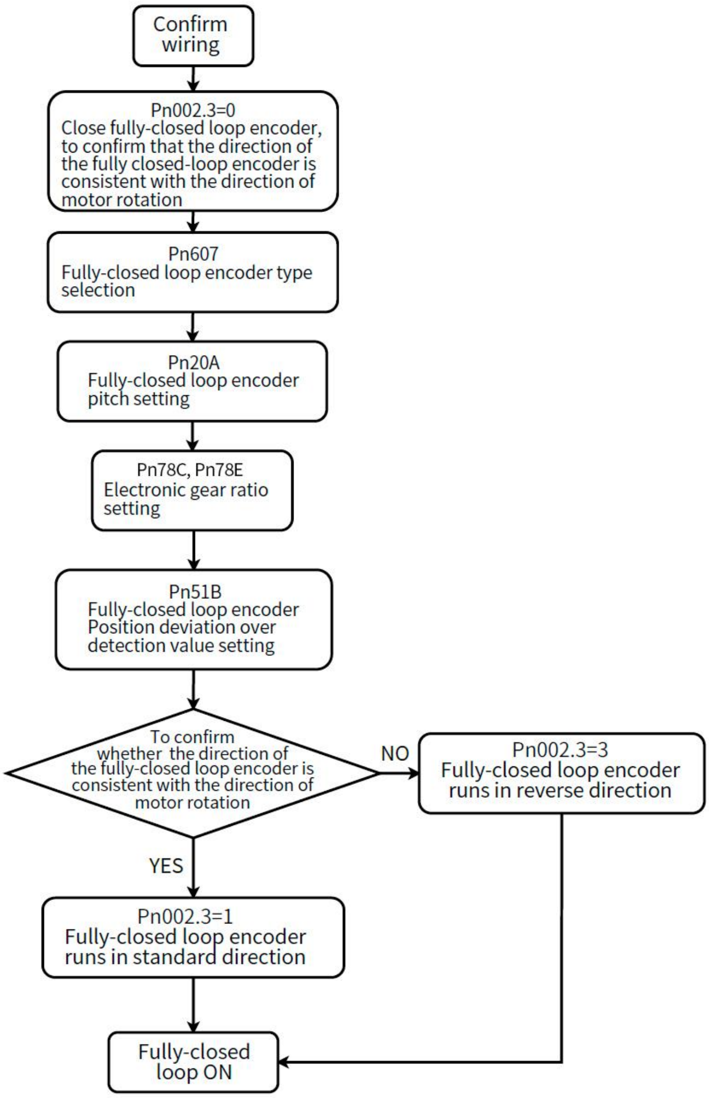


Figure 10-4 Fully-closed loop system setting procedures

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;

$$\frac{5mm}{1\mu m}=\frac{5000\mu m}{1\mu m}=5000\ pulse=Pn20A$$

When the motor has one revolution, the fully-closed loop encoder feedsback 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 J OG 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× R, and the value of "Fully-closed loop feedback pulse counter" should be N×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;

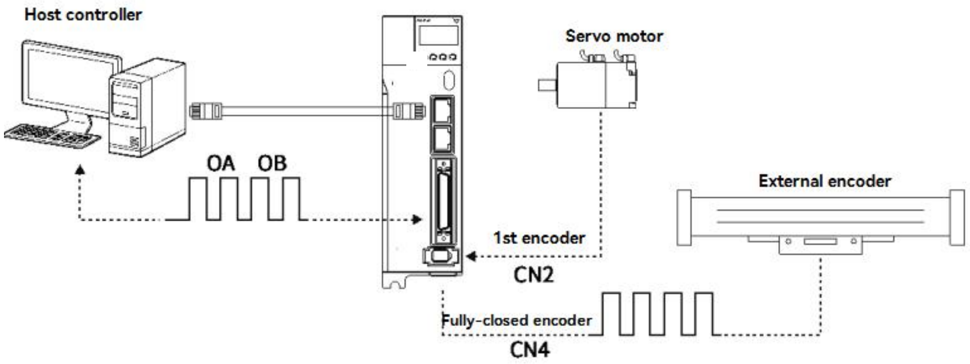


Figure 10-5 Diagram of frequency division pulse of fully-closed loop system

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 troubeshooting	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 troubeshooting	1. Check whether there is any welding error in the C N4 2. Check the setting of Pn 607.0	

Chapter 11 Alarm Display

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 ourside 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	• 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 drvie 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) isexceeded before the limit iscleared	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 form 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 Check the timing of shutting OFF the power supply	Set the power supply voltage within the specified range, and initialize the parameter settings
	The power supply was shut OFF while writing parameter settings.		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..

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.
	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.
A.041: Frequency division pulse output setting error	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.

$$\text{Pn533 [min} - 1] \times \frac{\text{Encoder resolution}}{6 \times 10^{5}} \leq \frac{Pn78\text{C}}{Pn78\text{E}} \qquad \text{Max. motor speed [min} - 1] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{Pn78C}{Pn78E}$$

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 groundand 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.

	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 Resisto 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 supplie 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.

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 8 3 0V 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 an 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 overspee detection leve 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.

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 overloa 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.

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	—	・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.

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.

	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.

	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.

	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 powe 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: $\frac{\mathbf{Pn520 \times Pn51E}}{\mathbf{100}}$.
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: $\frac{\mathbf{Pn520 \times Pn51E}}{\mathbf{100}}$.
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

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	ncrease 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: $\frac{\text{Pn520} \times \text{Pn51E}}{100}$	—	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.

an A.320 alarm occurs	There is insufficient external regenerative resistance, regenerative resistor capacity, or servo drive capacity, or therehas 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: • 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 at140V or less; For 400VServo drive, ACsupply 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 .

	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. • 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

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 Opeation 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.1settings	Set correctlyPn50A.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	Theservo 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 o 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 Servomoto 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: Kv = 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: Kp = 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: Ti = 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: Kv = 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: Kp = 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: Ti = 20.0ms	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	Correct the error detection section 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.	Eliminate fluctuation from 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

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. □ □ □ □

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	

Control Method Selection		Reference
0	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
Pn001 (2001h)	Basic Function Selections 1	0000 ～ 1122H	—	0001H	After restart	Setup	5.4

n. □ □ □ □

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	

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	

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	

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 an 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. □ □ □ □

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	—

n. □ □ □ □

	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,3rd: 3V, 4th :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
Pn008 (2008h)	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. □ □ □ □

Reserved parameter (Do not change.)

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	

Reserved parameter (Do not change.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn00B (200Bh)	Basic Function Selections B	0000 ～ 1111H	—	0000H	After restart	Setup	—

n. □ □ □ □

	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.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn00C (200Ch)	Basic Function Selections C	0000 ～ 0111H	—	0000H	After restart	Setup	—

n. □ □ □ □

	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. □ □ □ □

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

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. □ □ □ □

Reserved parameter (Do not change.)

Polarity Sensor Selection		Refeerence
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	—

n. □ □ □ □

Phase-C Pulse Output Selection		Reference
0	Output phase-C pulses only in the forward direction.	—
1	Output phase-C pulses in both the forward and reverse directions.	

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

Motor output direction		Reference
0	Positive output direction	—
1	Negative output direction	

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	—	—	—

n. □ □ □ □

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

n. □ □ □ □

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	se 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	—

n. □ □ □ □

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	—

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Model Following Control Type Selection		Reference
0	Use model following control type 1	—
1	Use model following control 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.)

Pn160 (2160h)	Anti-Resonance Control-Related Selections	0000 ～ 0011H	—	0010H	Immediately	Tuning	—

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Anti-Resonance Control Selection		Reference
0	Do not use anti-resonance control.	7.7
1	Use anti-resonance control	

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.)

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	—	—	—

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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

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn190 (2190h)	Reserved （Do not change）	0000 ~0011H	—	0010H	Immediately	—	—

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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	—

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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
Pn205 (2205h)	Multiturn Limit	0 ～ 65535	1rev	65535	After restart	Setup	—
Pn207 (2207h)	Position Control Function Selections	0000 ～ 2210H	—	0010H	After restart	Setup	—

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Reserved parameter (Do not change.)

Position Control Option		Reference
0	N/A	—
1	Use V-REF as a speed feed-forward input	

Reserved parameter (Do not change.)

/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

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Reserved parameter (Do not change.)

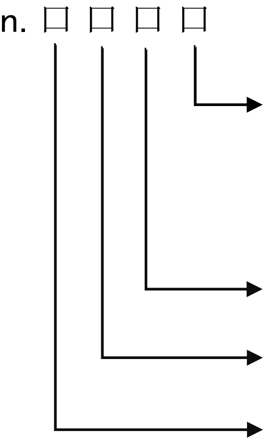
Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

Fully-closed Control Speed Feedback Selection		Reference
0	Use motor encoder speed.	10.2
1	Use external encoder speed	

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
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



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.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
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	—

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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.			

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
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)	2 nd 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 Stage2nd 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	—	—

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- Reserved parameter (Do not change.)
- 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

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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.)

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

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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.)

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)	

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn50B (250Bh)	Input Signal Selections 2	0000 ～ FFFFH	—	8882H	After restart	Setup	—

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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.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn50C	Input Signal Selections 3	0000 ～ FFFFH	—	8888H	After restart	Setup	—

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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	—

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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.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn50E (250Eh)	Output Signal Selections 1	0000 ～ 4444H	—	0000H	After restart	Setup	—

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/COIN (Positioning Completion 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	

/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	—

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/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	—

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/NEAR (Near 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	

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	—

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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	—

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	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	

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn513	Output Signal Selection 4	0000 ～ 0333H	—	0000H	After restart	Setup	6.2

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	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
Pn515	Input Signal Selections 6	0000 ～ FFFFH	—	8888H	After restart	Setup	—

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Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

Reserved parameter (Do not change.)

E-Stop Signal Allocation		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)	

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn517	ECAT Force Output Function	0000 ～ 4444H	—	0000H	After restart	Setup	6.4

n.□□□□

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

n. □ □ □ □

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.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
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	—
	n. □ □ □ □ Reserved parameter (Do not change.) 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	—	—

n.□□□□

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	—	—

n.□□□□

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	—

n. □ □ □ □

1st Encoder Selection		Reference
0	HCFA	—
1	BISS	
2	YAS	
3	ABZ	
4	AB	
5	SinCOS	

Encoder Speed Selection		Reference
0	2.5M	—
1	1M	
2	2M	
3	3M	
4	4M	
5	5M	
6	8M	

Encoder Resolution	Reference
Represented by 2n bits, such as 23 bit-encoder, just enter 23 directly	—

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn606 (2606h)	Encoder Shift Function 2	0000 ~ C8C8H	—	0000H	After restart	Setup	—

n. □ □ □ □

2nd Encoder Data Length

1st Encoder Data Length

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn607 (2607h)	2nd Encoder Selection	0000 ~ 0005H	—	0000H	After restart	Setup	—

n. □ □ □ □

2nd Encoder Selection		Reference
0	HCFA	10.2
1	BISS	
2	YAS	
3	ABZ	
4	AB	
5	SinCOS	

Encoder Speed Selection		Reference
0	2.5M	—
1	1M	
2	2M	
3	3M	
4	4M	
5	5M	
6	8M	

Encoder Resolution	Reference
Represented by 2n bits, such as 23 bit-encoder, just enter 23 directly	—

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn608 (2608h)	2nd Encoder Resolution	0000 ～ FFFFH	—	0000H	After restart	Setup	—

n. □ □ □ □

2nd Encoder Resolution

2nd Encoder Decimal Point

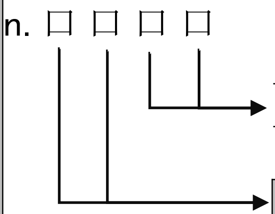
PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn609	Reserved（Do not change)	0000 ～ FFFFH	—	0000H	—	—	—

n. □ □ □ □

Bit0, 1, 2: Reserved (Do not change) , Bit3：Use hall as the start angle (used in incremental motor)

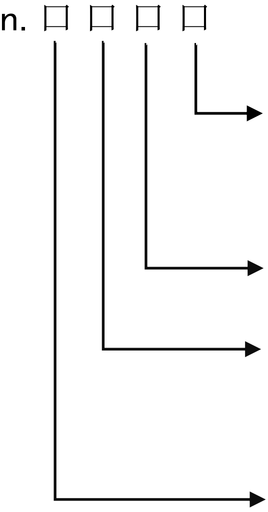
bit4： F26 Torque command and feedback excessive deviation alarm (Default: 0, closed) bit5：Gravity compensation (Default: 0, closed)，bit6：Reserved （ Do not change ），bit7： Delay disabled selection (Default: 0, off)

Bit8~bit15： Sincos/AB encoder standard value, setting range 0~255, Default: 0

<table>
<tr><th>PRM No.</th><th>Name</th><th>Setting range</th><th>Unit</th><th>Default</th><th>When enabled</th><th>Classification</th><th>Reference</th></tr>
<tr><td rowspan="2">Pn60A</td><td>Frequency Division Output Pulse Setting</td><td>0000-01FF</td><td>—</td><td>0</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td colspan="7">


Z-pulse width setting
<table>
<tr><th colspan="2">AB reverse direction setting</th><th>Reference</th></tr>
<tr><td>0</td><td>A before B</td><td rowspan="2">—</td></tr>
<tr><td>1</td><td>B before A</td></tr>
</table>
</td></tr>
<tr><td>Pn60B</td><td>Reserved(Do not change)</td><td>0-655535</td><td>—</td><td>0</td><td>After restart</td><td></td><td></td></tr>
<tr><td>Pn60C</td><td>Line Count of Sin/Cos Encoder</td><td>0-65535</td><td>Pluse</td><td>0</td><td>After restart</td><td></td><td></td></tr>
<tr><td>Pn60D</td><td>Delay Disabled Count</td><td>0~50</td><td>2ms</td><td>0</td><td>After restart</td><td></td><td></td></tr>
<tr><td>Pn60E</td><td>Torque Overload Threshold Setting</td><td>0-65535</td><td>%</td><td>0</td><td>After restart</td><td></td><td></td></tr>
<tr><td>Pn60F</td><td>User Torque Overload Time</td><td>0-65535</td><td>10ms</td><td>0</td><td>After restart</td><td></td><td></td></tr>
<tr><td rowspan="2">Pn610</td><td>Position Comparison Output</td><td>0-3</td><td>—</td><td>0</td><td>After restart</td><td>—</td><td>—</td></tr>
<tr><td colspan="7">
<table>
<tr><th colspan="2">Position Comparison Output Function</th><th>Reference</th></tr>
<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>
</table>
</td></tr>
<tr><td>Pn611</td><td>1st Setting Position</td><td>-1073741824 ～ 1073741823</td><td>pluse</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn613</td><td>2nd Setting Position</td><td>-1073741824 ～ 1073741823</td><td>pluse</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn615</td><td>3rd Setting Position</td><td>-1073741824 ～ 1073741823</td><td>pluse</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn617</td><td>4th Setting Position</td><td>-1073741824 ～ 1073741823</td><td>pluse</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn619</td><td>Active Time of the 1st Setting Position Output Signal</td><td>0-65535</td><td>ms</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn61A</td><td>Active Time of the 2nd Setting Position Output Signal</td><td>0-65535</td><td>ms</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn61B</td><td>Active Time of the 3rd Setting Position Output Signal</td><td>0-65535</td><td>ms</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
<tr><td>Pn61C</td><td>Active Time of the 4th Setting Position Output Signal</td><td>0-65535</td><td>ms</td><td>0</td><td>Immediately</td><td>—</td><td>6.2</td></tr>
</table>

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn61F	Selections	0000 ～ FFFF	—	0000	After restart	Setup	—



Torque Overload Selections		Reference
0	Disabled	—
1	Enabled	

Reserved parameter (Do not change.)

Adapter Board Hall Signal Input Selection		Reference
0	Single-ended	—
1	Differential	

Reserved parameter (Do not change.)

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
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. □ □ □ □

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	

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
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. □ □ □ □

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 Convertion Selection 0	0000H-FFFFH	—	0000H	Immediately	—	—

n. □ □ □ □

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 Single-turn Feedback		Reference
0	Disable 2nd encoder single-turn feedback	—
1	Enable 2nd encoder single-turn feedback	

Node Address Function Selection		Reference
0	Controller	—
1	Servo	

Parameter Write into EEPROM Selection		Reference
0	Write into EEPROM	—
1	Do not write into EEPROM	

PRM No.	Name	Setting range	Unit	Default	When enabled	Classification	Reference
Pn791	EtherCAT Function Convertion Selection 1	0000H-FFFFH	—	0000H	After restart	—	—

n. □ □ □ □

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 Convertion Selection 2	0000H-FFFFH	—	0000H	Immediately	—	—
	n.□□□□ Reserved parameter (Do not change.) Reserved parameter (Do not change.) Reserved parameter (Do not change.) Reserved parameter (Do not change.)						
Pn793	EtherCAT Function Convertion Selection 3	0000H-FFFFH	—	0000H	Immediately	—	—
	n.□□□□ Reserved parameter (Do not change.) 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	0.01ms	INT	-1000-1000	0	Set at operation	Immediately
2165h	Pn165	Anti-Resonance Filter Time Constant 2 Correction	0.01ms	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 FunctionRelated 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）	0.01um	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）	0.01ms	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	0.01ms	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 Commmand 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	一	Reserved（Do not change)	1mm/s	UINT	1-10000	20	Set at operation	Immediately
2582h	一	Reserved（Do not change)	1mm/s	UINT	0-100	10	Set at operation	Immediately
2583h	一	Reserved（Do not change)	1mm/s	UINT	0-10000	10	Set at operation	Immediately
2584h	一	Reserved（Do not change)	1mm/s	UINT	0-10000	10000	Set at operation	Immediately
2585h	一	Reserved（Do not change)	1mm/s	UINT	1-10000	50	Set at operation	Immediately
2586h	一	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）	Command 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 Convertion Selection 0	—	UINT	0-65535	0	Set at stop	After restart
2791h	Pn791	EtherCAT Function Convertion Selection 1	—	UINT	0-65535	0	Set at stop	After restart
2792h	Pn792	EtherCAT Function Convertion Selection 2	—	UINT	0-65535	0	Set at stop	Immediately
2793h	Pn793	EtherCAT Function Convertion 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 opeation control mode	
5	Related to opeation control mode	
6	Related to opeation 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 manufactor’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 manufactor’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 positionn 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 positionn 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 6062h and user position feedback 6064h exceeds ±6065h, 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 ±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 ±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 ±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 ±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 $60FF_h$/$60B1_h$×(-1)，speed feedback $606B_h$/$606B_h$×(-1)，and the motor turns in the reverse direction
7	Set the position command $607A_h$/$60B0_h$×(-1)，positiion feedback 6062_h/6064_h×(-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/S^2

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 /S^2

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 /S^2

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/S^2

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：Enalbed
9	Probe 2 rising edge latch 0：Disabled 1：Enalbed
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

Record s 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 positin 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

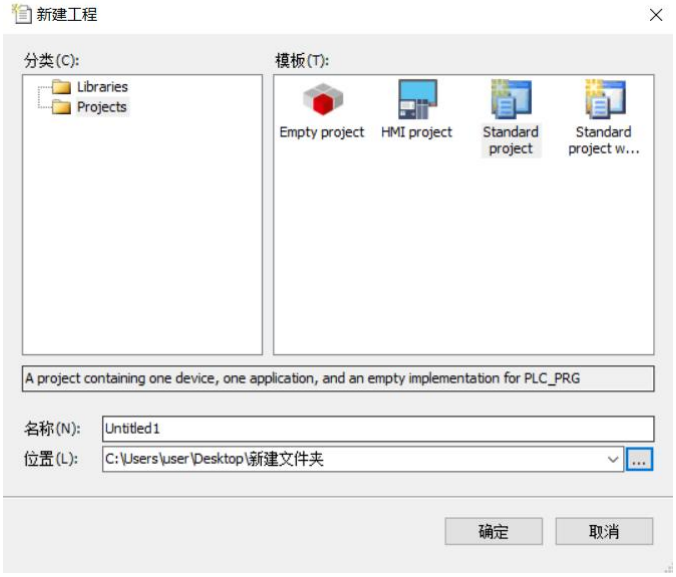
13.1 Application Examples with HCFA Q-series PAC

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



A project containing one device, one application, and an empty implementation for PLC_PRG

名称(N): Untitled1
位置(L): C:\Users\user\Desktop\新建文件夹

Figure 13-2 Project classification

3. Select [HCQI-1300-D], and then select [Structured Text (ST)] in PLC_PRG (P), and click [OK], as shown in Figure 13-3.

即将创建一个新的标准工程. 该向导将在此工程中创建以下对象:

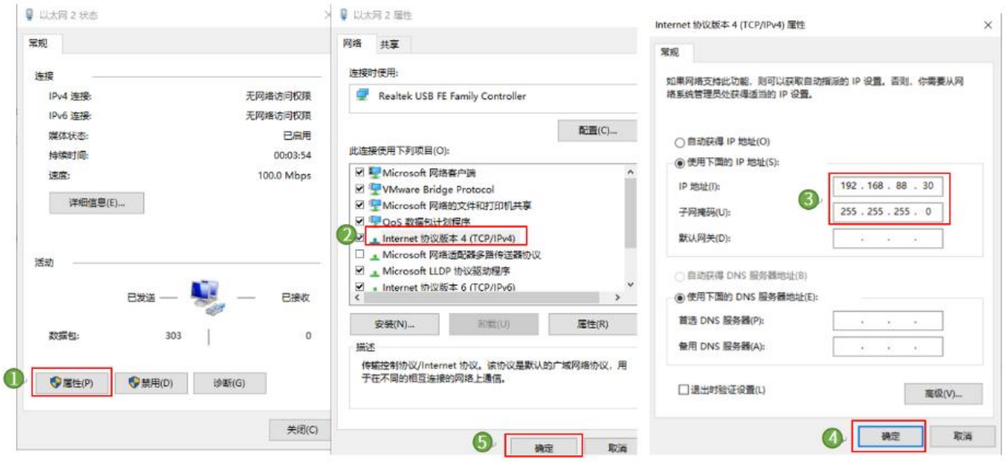
- 一个如下所述的可编程设备
- 使用下面指定语言的程序 PLC_PRG
- 调用 PLC_PRG的循环任务
- 引用当前安装的最新版本的标准库.

设备(D) HCQ1-1300-D (Zhejiang Hechuan Technology)
PLC_PRG在(P) 结构化文本(ST)

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.



以太网 2 状态

IPv4 连接: 无网络访问权限
IPv6 连接: 无网络访问权限
媒体状态: 已启用
持续时间: 00:03:54
速度: 100.0 Mbps
数据包: 已发送 303 已接收 0

以太网 2 属性

连接时使用: Realtek USB FE Family Controller

此连接使用下列项目(O):
☑ Microsoft 网络客户端
☑ VMware Bridge Protocol
☑ Microsoft 网络的文件和打印机共享
☑ QoS 数据包计划程序
☑ Internet 协议版本 4 (TCP/IPv4)
☐ Microsoft 网络适配器多路传送器协议
☑ Microsoft LLDP 协议驱动程序
☑ Internet 协议版本 6 (TCP/IPv6)

描述
传输控制协议/Internet 协议。该协议是默认的广域网络协议，用于在不同的相互连接的网络上通信。

Internet 协议版本 4 (TCP/IPv4) 属性

如果网络支持此功能，则可以获取自动指派的 IP 设置。否则，你需要从网络系统管理员处获得适当的 IP 设置。

○ 自动获得 IP 地址(O)
● 使用下面的 IP 地址(S):
IP 地址(I): 192 . 168 . 88 . 30
子网掩码(U): 255 . 255 . 255 . 0
默认网关(D): . . .
○ 自动获得 DNS 服务器地址(B)
● 使用下面的 DNS 服务器地址(E):
首选 DNS 服务器(P): . . .
备用 DNS 服务器(A): . . .
☐ 退出时验证设置(L)

Figure 13-4 Project description

2. Double-click [Device], as shown in Figure 13-5, and click [Scan Network].

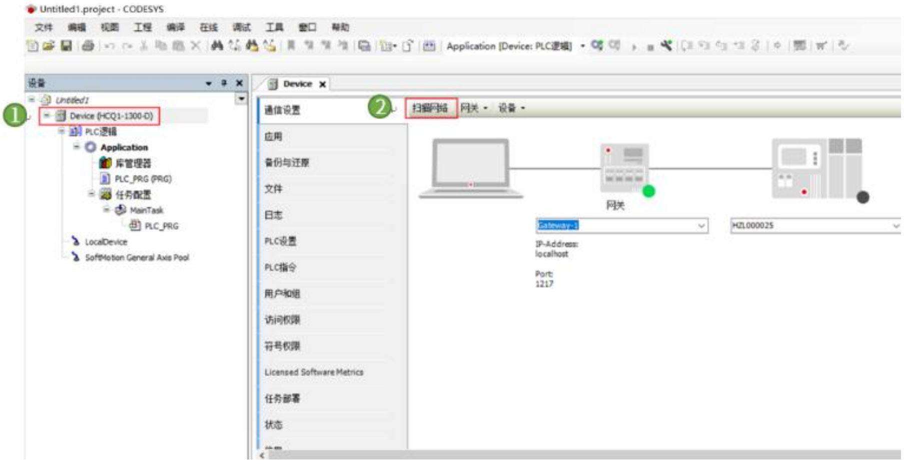
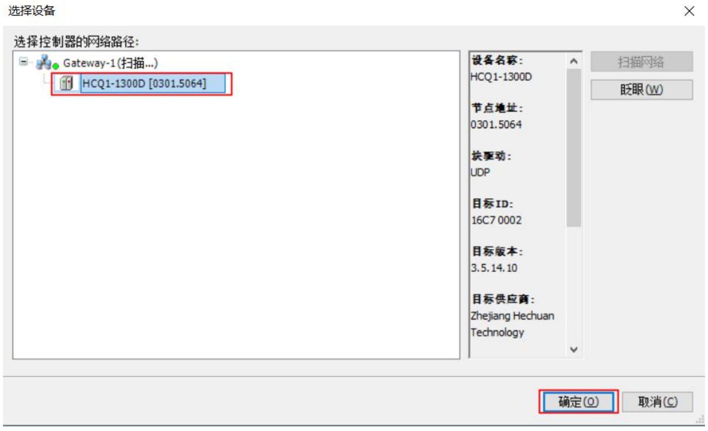


Figure 13-5 Internet connection

3. As shown in Figure 13-6, select the scanned [HCQ1-1300D] and click [OK], and then the computer is connected to the controller.



选择设备

选择控制器的网络路径:

Gateway-1 (扫描...)
HCQ1-1300D [0301.5064]

设备名称:
HCQ1-1300D

节点地址:
0301.5064

块驱动:
UDP

目标ID:
16C7 0002

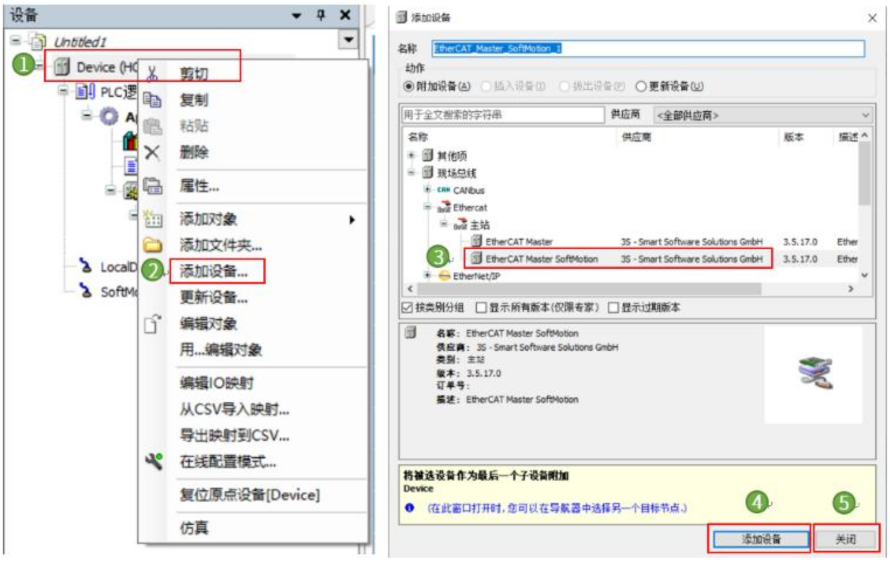
目标版本:
3.5.14.10

目标供应商:
Zhejiang Hechuan Technology

Figure 13-6 Connection

13.1.3 Project Editting

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.



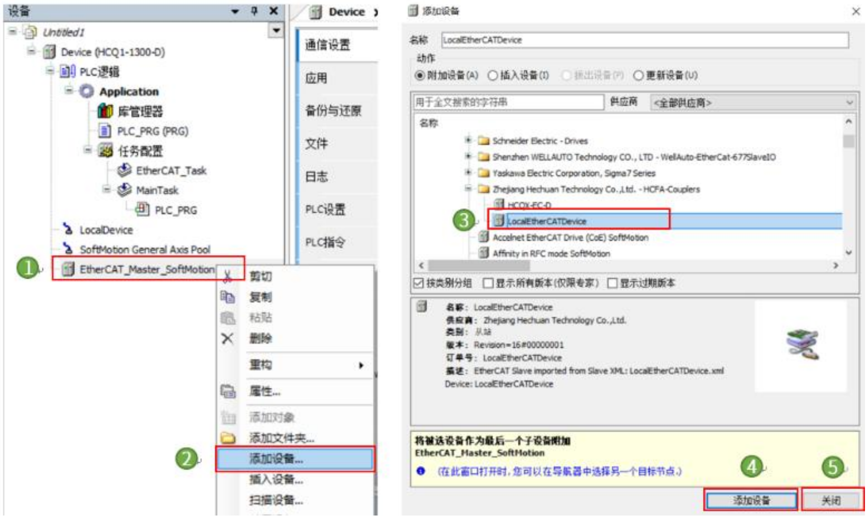
名称 EtherCAT_Master_SoftMotion_1

名称: EtherCAT Master SoftMotion
供应商: 3S - Smart Software Solutions GmbH
类别: 主站
版本: 3.5.17.0
订单号:
描述: EtherCAT Master SoftMotion

将被选设备作为最后一个子设备附加
Device
(在此窗口打开时，您可以在导航器中选择另一个目标节点。)

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.



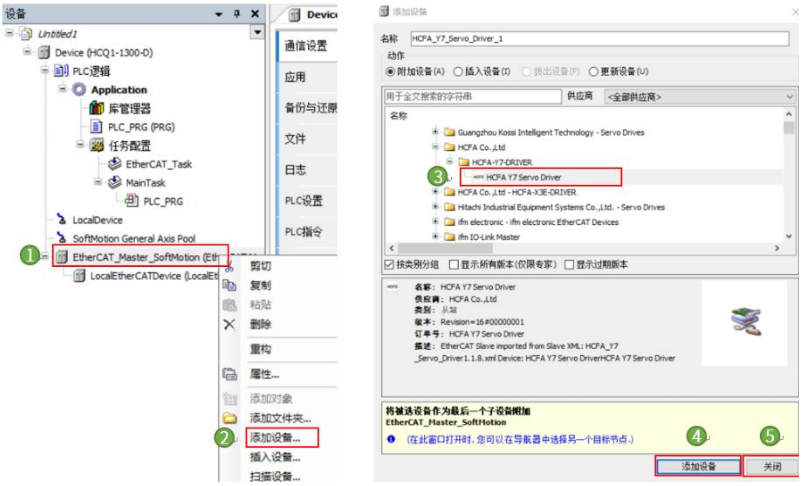
名称 LocalEtherCATDevice

名称: LocalEtherCATDevice
供应商: Zhejiang Hechuan Technology Co.,Ltd.
类别: 从站
版本: Revision=16#00000001
订单号: LocalEtherCATDevice
描述: EtherCAT Slave imported from Slave XML: LocalEtherCATDevice.xml
Device: LocalEtherCATDevice

将被选设备作为最后一个子设备附加
EtherCAT_Master_SoftMotion
(在此窗口打开时，您可以在导航器中选择另一个目标节点。)

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.



添加设备

名称 HCFA_Y7_Servo_Driver_1

动作

◉ 附加设备(A) ○ 插入设备(I) ○ 拔出设备(P) ○ 更新设备(U)

用于全文搜索的字符串　供应商 <全部供应商>

名称
- Guangzhou Kossi Intelligent Technology - Servo Drives
- HCFA Co.,Ltd
  - HCFA-Y7-DRIVER
    - HCFA Y7 Servo Driver
- HCFA Co.,Ltd - HCFA-X3E-DRIVER
- Hitachi Industrial Equipment Systems Co.,Ltd. - Servo Drives
- ifm electronic - ifm electronic EtherCAT Devices
- ifm IO-Link Master

☑ 按类别分组 ☐ 显示所有版本(仅限专家) ☐ 显示过期版本

名称: HCFA Y7 Servo Driver
供应商: HCFA Co.,Ltd
类别: 从站
版本: Revision=16#00000001
订单号: HCFA Y7 Servo Driver
描述: EtherCAT Slave imported from Slave XML: HCFA_Y7_Servo_Driver1.1.8.xml Device: HCFA Y7 Servo DriverHCFA Y7 Servo Driver

将被选设备作为最后一个子设备附加
EtherCAT_Master_SoftMotion
(在此窗口打开时，您可以在导航器中选择另一个目标节点。)

添加设备　关闭

Figure 13-9　　Y7S servo adding

4. Right-click [HCFA Y7 Servo Driver], select [Add SoftMotion CiA402 axis], as shown in Figure 13-10.

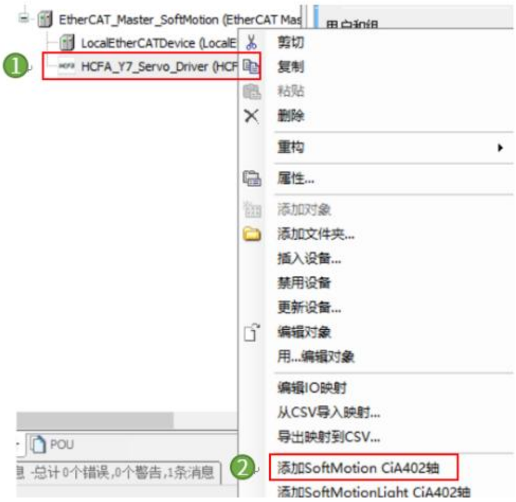
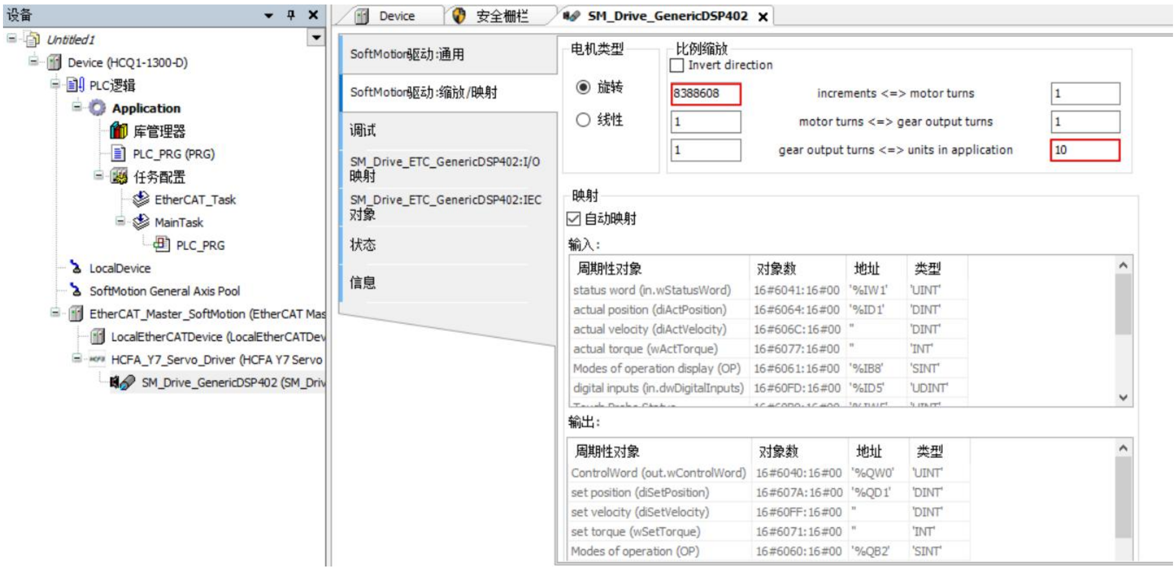


Figure 13-10　　CiA402 axis adding

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.



电机类型

◉ 旋转

○ 线性

比例缩放

☐ Invert direction

8388608	increments <=> motor turns	1
1	motor turns <=> gear output turns	1
1	gear output turns <=> units in application	10

映射

☑ 自动映射

输入：

周期性对象	对象数	地址	类型
status word (in.wStatusWord)	16#6041:16#00	'%IW1'	'UINT'
actual position (diActPosition)	16#6064:16#00	'%ID1'	'DINT'
actual velocity (diActVelocity)	16#606C:16#00	"	'DINT'
actual torque (wActTorque)	16#6077:16#00	"	'INT'
Modes of operation display (OP)	16#6061:16#00	'%IB8'	'SINT'
digital inputs (in.dwDigitalInputs)	16#60FD:16#00	'%ID5'	'UDINT'

输出：

周期性对象	对象数	地址	类型
ControlWord (out.wControlWord)	16#6040:16#00	'%QW0'	'UINT'
set position (diSetPosition)	16#607A:16#00	'%QD1'	'DINT'
set velocity (diSetVelocity)	16#60FF:16#00	"	'DINT'
set torque (wSetTorque)	16#6071:16#00	"	'INT'
Modes of operation (OP)	16#6060:16#00	'%QB2'	'SINT'

Figure 13-11　　DSP402 axis configuration

6. Double-click [EtherCAT_Master_SoftMotionm], as shown in Figure 13-12, and click [Browse]

☑ 自动配置主站/从站

EtherCAT NIC设置

目的地址(MAC) FF-FF-FF-FF-FF-FF ☑ 广播 ☐ 冗余

源地址(MAC) 00-00-00-00-00-00

网络名称

● 按MAC选择网络 ○ 按名称选择网络

分布式时钟

周期 4000 µs

同步偏移 20 %

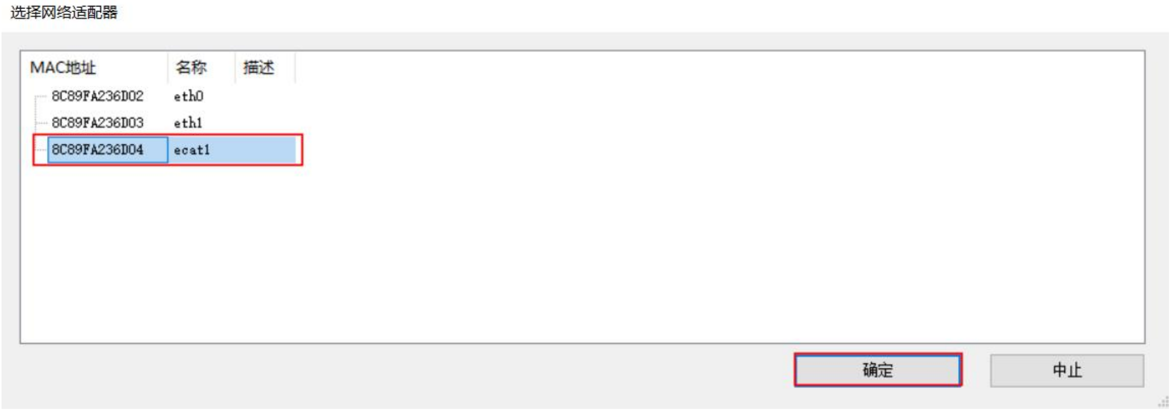
☐ 同步窗口监视

同步窗口 1 µs

选项

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.


选择网络适配器

MAC地址	名称	描述
8C89FA236D02	eth0	
8C89FA236D03	eth1	
8C89FA236D04	ecat1	

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.

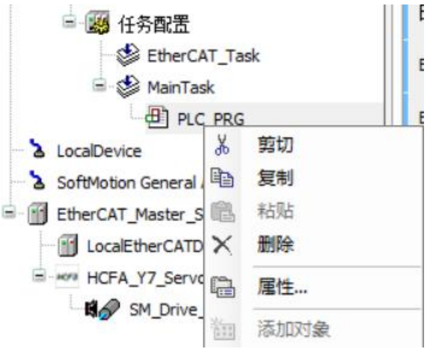


Figure 13-14 Delete POU of the Main Task

9. Put [PLC_PRG] at ① to [EtherCAT_Task] at ②, as shown in Figure 13-15.

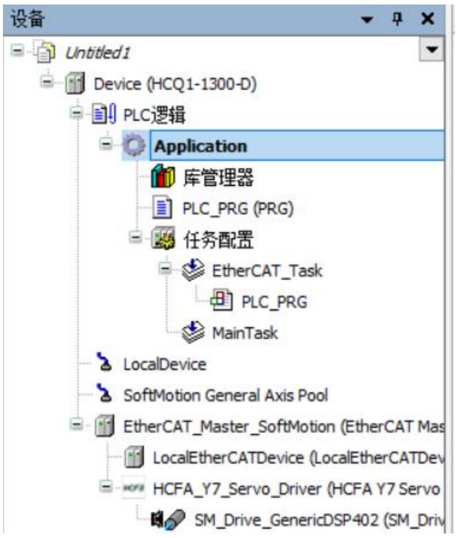
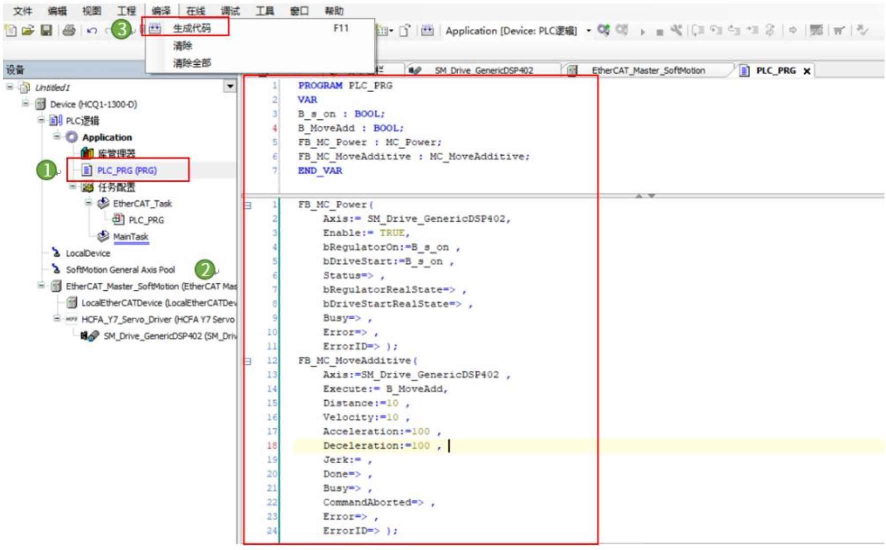


Figure 13-15 Adding EtherCAT POU

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.



```
PROGRAM PLC_PRG
VAR
B_s_on : BOOL;
B_MoveAdd : BOOL;
FB_MC_Power : MC_Power;
FB_MC_MoveAdditive : MC_MoveAdditive;
END_VAR
```

```
FB_MC_Power(
    Axis:= SM_Drive_GenericDSP402,
    Enable:= TRUE,
    bRegulatorOn:=B_s_on ,
    bDriveStart:=B_s_on ,
    Status=> ,
    bRegulatorRealState=> ,
    bDriveStartRealState=> ,
    Busy=> ,
    Error=> ,
    ErrorID=> );
FB_MC_MoveAdditive(
    Axis:=SM_Drive_GenericDSP402 ,
    Execute:= B_MoveAdd,
    Distance:=10 ,
    Velocity:=10 ,
    Acceleration:=100 ,
    Deceleration:=100 ,
    Jerk:= ,
    Done=> ,
    Busy=> ,
    CommandAborted=> ,
    Error=> ,
    ErrorID=> );
```

Figure 13-16 Test code

13.1.4 Controller Login

1. After compiling, click [Online-Login], as shown in Figure 13-17.

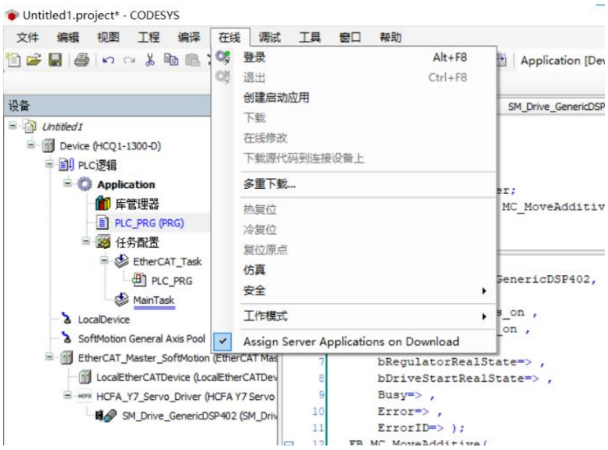
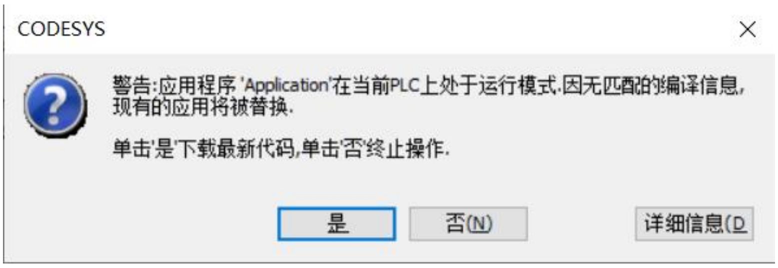


Figure 13-17 Controller login

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.


CODESYS

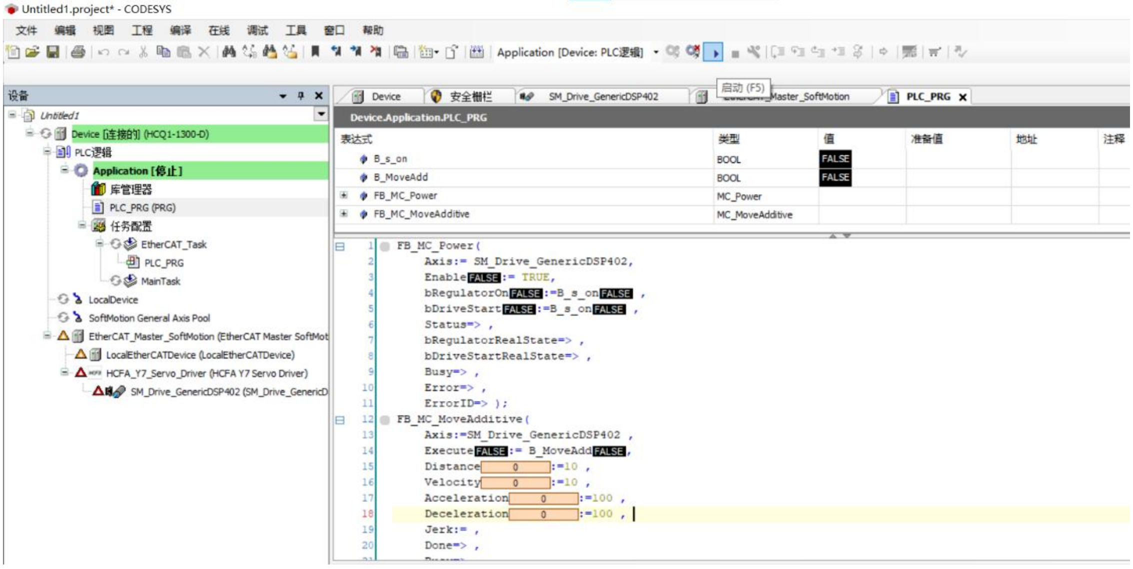
警告:应用程序'Application'在当前PLC上处于运行模式.因无匹配的编译信息,现有的应用将被替换.

单击'是'下载最新代码,单击'否'终止操作.

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.


Device.Application.PLC_PRG

表达式	类型	值	准备值	地址	注释
B_s_on	BOOL	FALSE			
B_MoveAdd	BOOL	FALSE			
FB_MC_Power	MC_Power				
FB_MC_MoveAdditive	MC_MoveAdditive				

```
FB_MC_Power(
    Axis:= SM_Drive_GenericDSP402,
    Enable := TRUE,
    bRegulatorOn :=B_s_on ,
    bDriveStart :=B_s_on ,
    Status=> ,
    bRegulatorRealState=> ,
    bDriveStartRealState=> ,
    Busy=> ,
    Error=> ,
    ErrorID=> );
FB_MC_MoveAdditive(
    Axis:=SM_Drive_GenericDSP402 ,
    Execute := B_MoveAdd ,
    Distance :=10 ,
    Velocity :=10 ,
    Acceleration :=100 ,
    Deceleration :=100 ,
    Jerk:= ,
    Done=> ,
```

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.

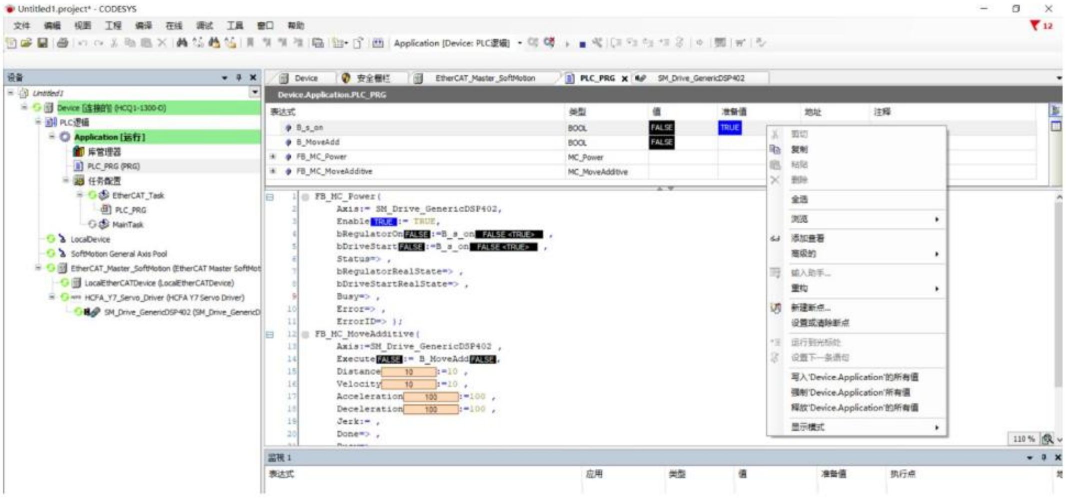
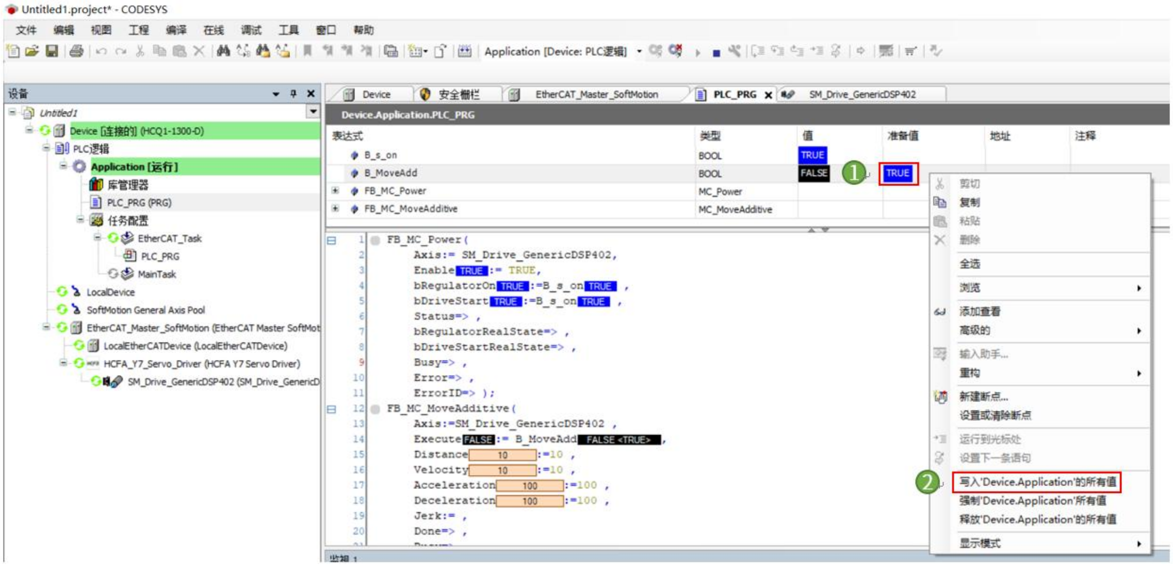


Figure 13-20 Servo motor enabled

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.



表达式	类型	值	准备值	地址	注释
B_s_on	BOOL	TRUE			
B_MoveAdd	BOOL	FALSE	TRUE		
FB_MC_Power	MC_Power				
FB_MC_MoveAdditive	MC_MoveAdditive				

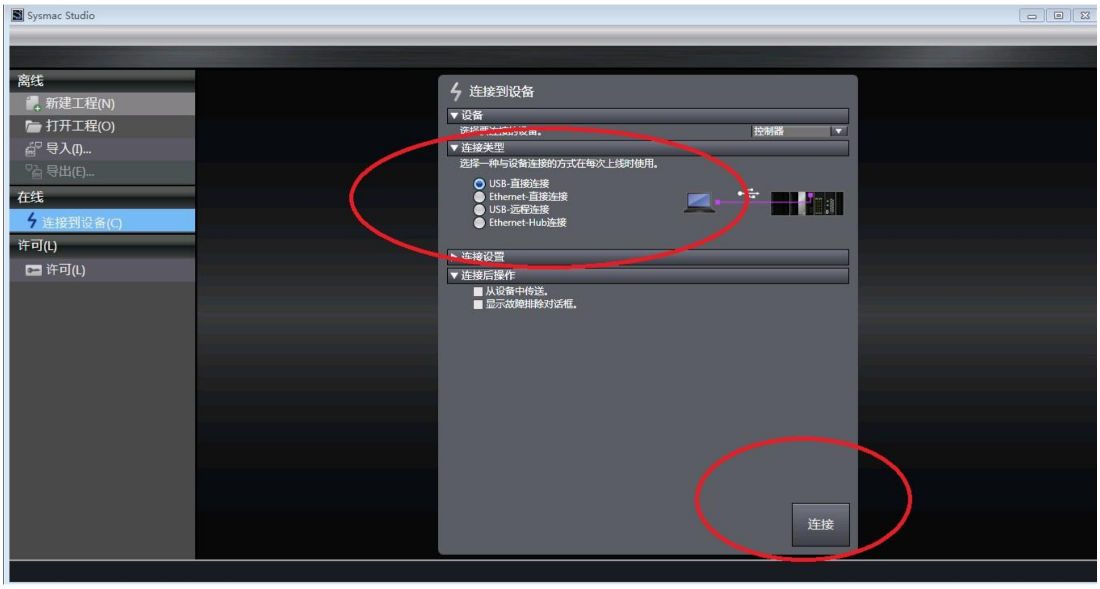
```
FB_MC_Power(
    Axis:= SM_Drive_GenericDSP402,
    Enable TRUE := TRUE,
    bRegulatorOn TRUE :=B_s_on TRUE ,
    bDriveStart TRUE :=B_s_on TRUE ,
    Status=> ,
    bRegulatorRealState=> ,
    bDriveStartRealState=> ,
    Busy=> ,
    Error=> ,
    ErrorID=> );
FB_MC_MoveAdditive(
    Axis:=SM_Drive_GenericDSP402 ,
    Execute FALSE := B_MoveAdd FALSE <TRUE> ,
    Distance 10 :=10 ,
    Velocity 10 :=10 ,
    Acceleration 100 :=100 ,
    Deceleration 100 :=100 ,
    Jerk:= ,
    Done=> ,
```

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.



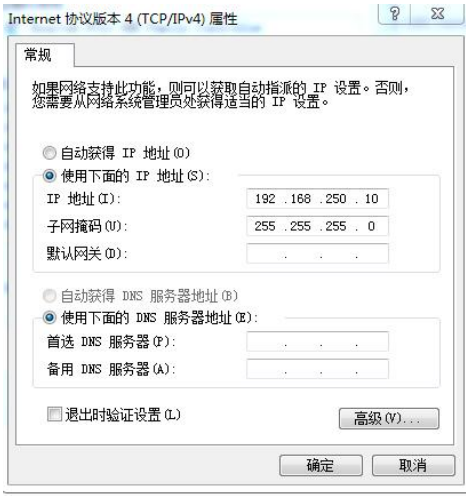
选择一种与设备连接的方式在每次上线时使用。

● USB-直接连接
○ Ethernet-直接连接
○ USB-远程连接
○ Ethernet-Hub连接

☐ 从设备中传送。
☐ 显示故障排除对话框。

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).



Internet 协议版本 4 (TCP/IPv4) 属性

常规

如果网络支持此功能，则可以获取自动指派的 IP 设置。否则，您需要从网络系统管理员处获得适当的 IP 设置。

○ 自动获得 IP 地址(O)
● 使用下面的 IP 地址(S):
IP 地址(I): 192 . 168 . 250 . 10
子网掩码(U): 255 . 255 . 255 . 0
默认网关(D): . . .

○ 自动获得 DNS 服务器地址(B)
● 使用下面的 DNS 服务器地址(E):
首选 DNS 服务器(P): . . .
备用 DNS 服务器(A): . . .

☐ 退出时验证设置(L)

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.

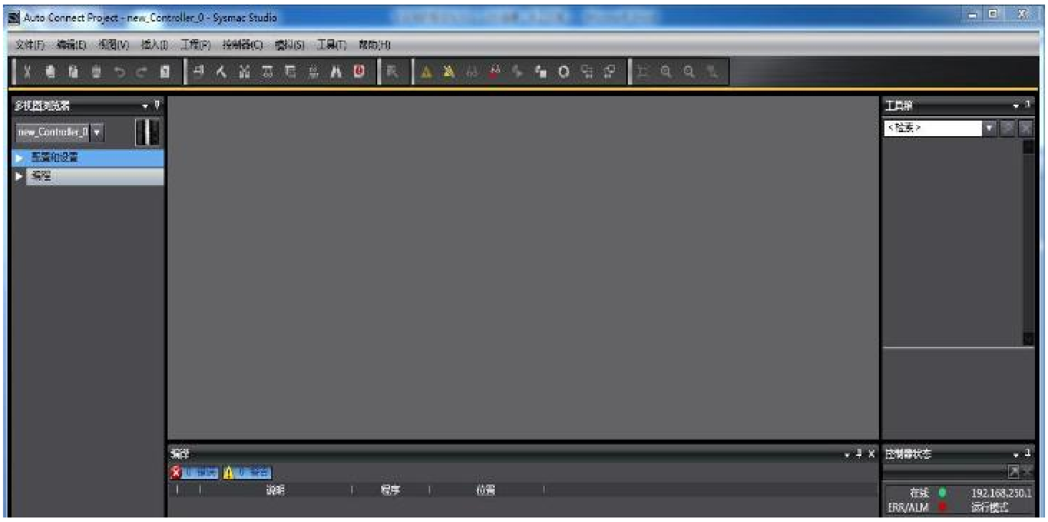
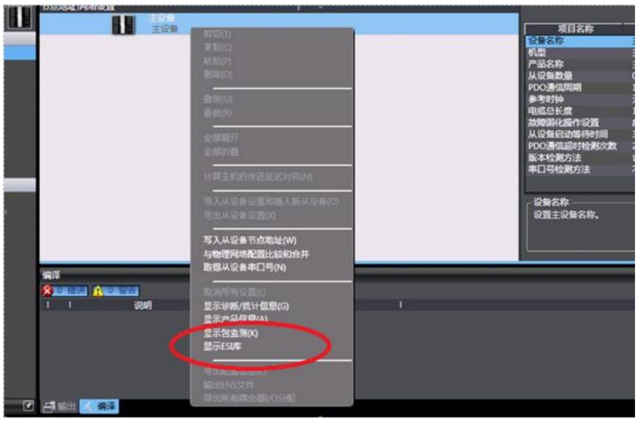


Figure 13-24 PLC connection

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.



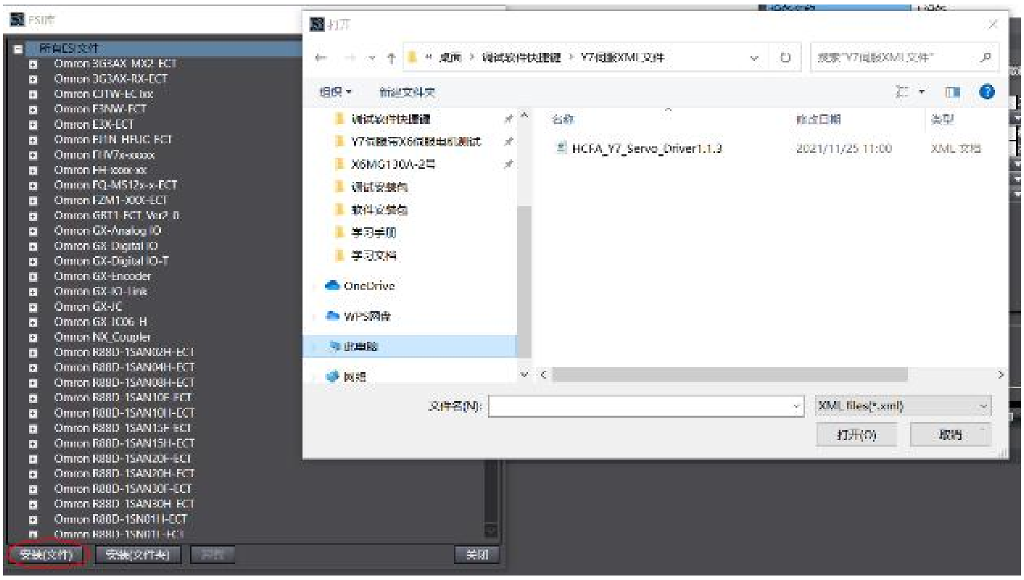
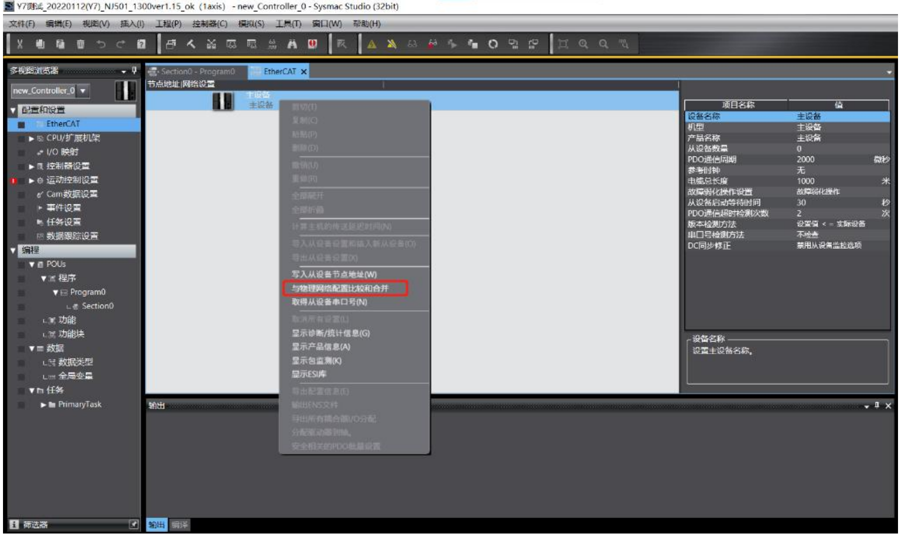


Figure 13-25 Y7 xml file installation

13.2.3 EtherCAT Parameter Setting

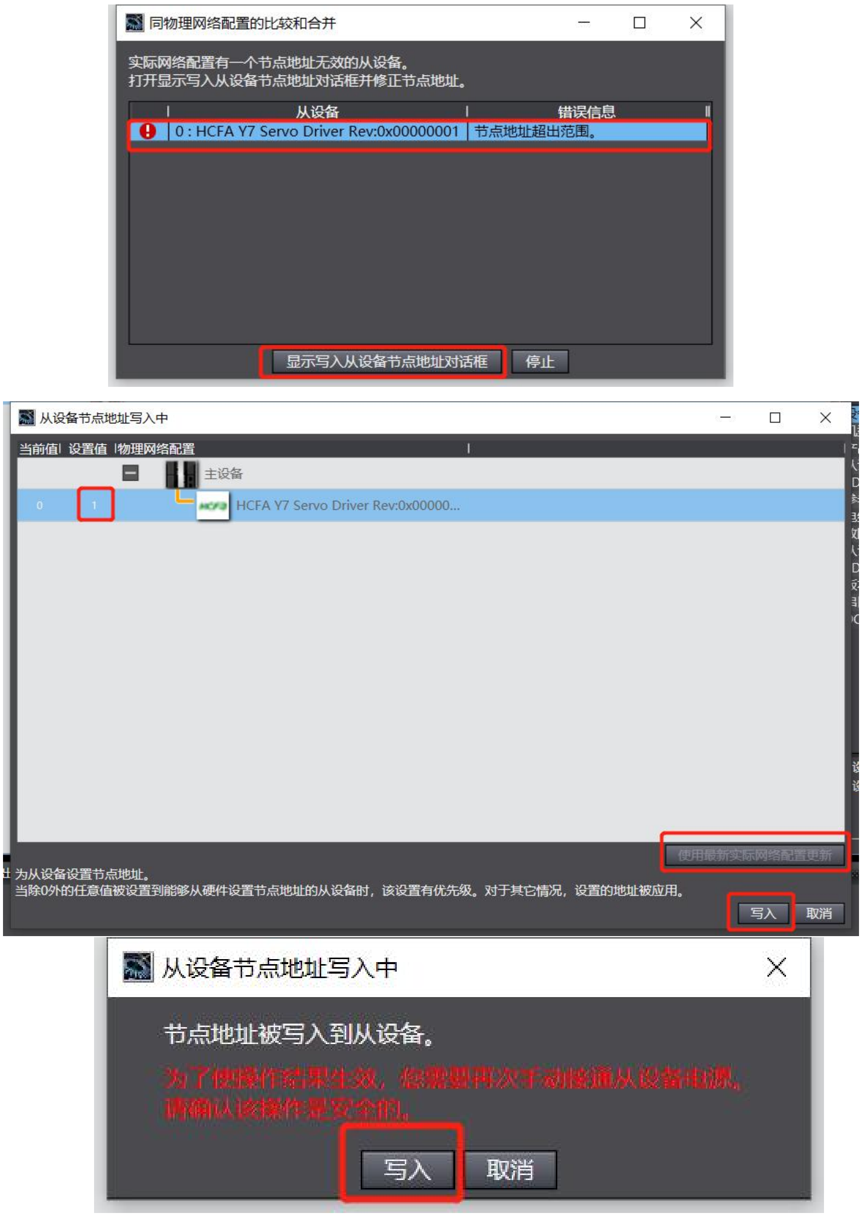
1. Add Y7 slave station (PLC must be online): At this time, both Pn787.0 and Pn787.1 in the parameters need to be set to 1; After reconnecting the PLC, expand "Configuration and Settings" → double-click "EtherCAT" → Right-click to select "Master Device" → Compare and merge with the physical network configuration → 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



项目名称	值	
设备名称	主设备	
机型	主设备	
产品名称	主设备	
从设备数量	0	
PDO通信周期	2000	微秒
参考时钟	无	
电缆总长度	1000	米
故障弱化操作设置	故障弱化操作	
从设备启动等待时间	30	秒
PDO通信超时检测次数	2	次
版本检测方法	设置值 < = 实际设备	
串口号检测方法	不检查	
DC同步修正	禁用从设备监控选项	

设备名称
设置主设备名称。



实际网络配置有一个节点地址无效的从设备。
打开显示写入从设备节点地址对话框并修正节点地址。

从设备	错误信息
0 : HCFA Y7 Servo Driver Rev:0x00000001	节点地址超出范围。

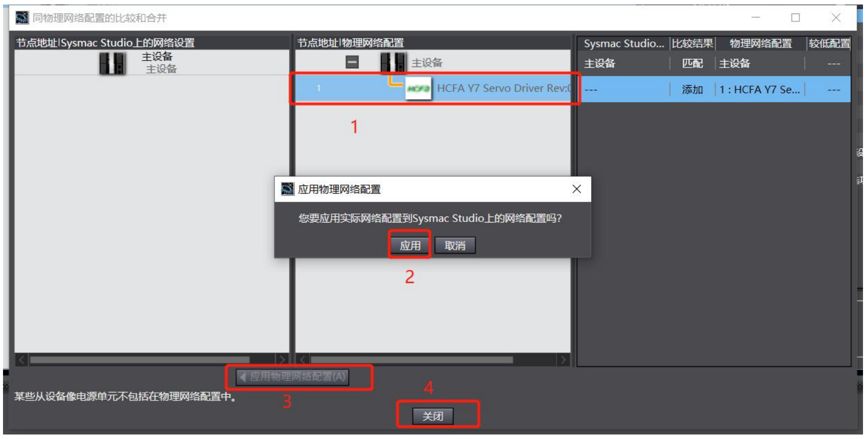
当前值	设置值	物理网络配置
0	1	HCFA Y7 Servo Driver Rev:0x00000...

为从设备设置节点地址。
当除0外的任意值被设置到能够从硬件设置节点地址的从设备时，该设置有优先级。对于其它情况，设置的地址被应用。

节点地址被写入到从设备。
为了使操作结果生效，您需要再次手动接通从设备电源。
请确认该操作是安全的。

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".



Sysmac Studio...	比较结果	物理网络配置	较低配置
主设备	匹配	主设备	---
---	添加	1 : HCFA Y7 Se...	---

您要应用实际网络配置到Sysmac Studio上的网络配置吗?

某些从设备像电源单元不包括在物理网络配置中。

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

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。

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

SiteAddressAlias
值范围: 0-255
出场设定: 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".

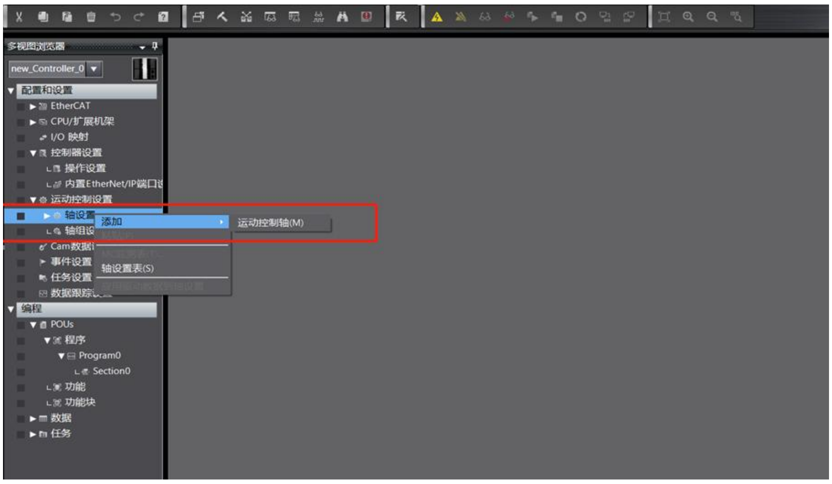


Figure 13-29 Motion control axis adding

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:

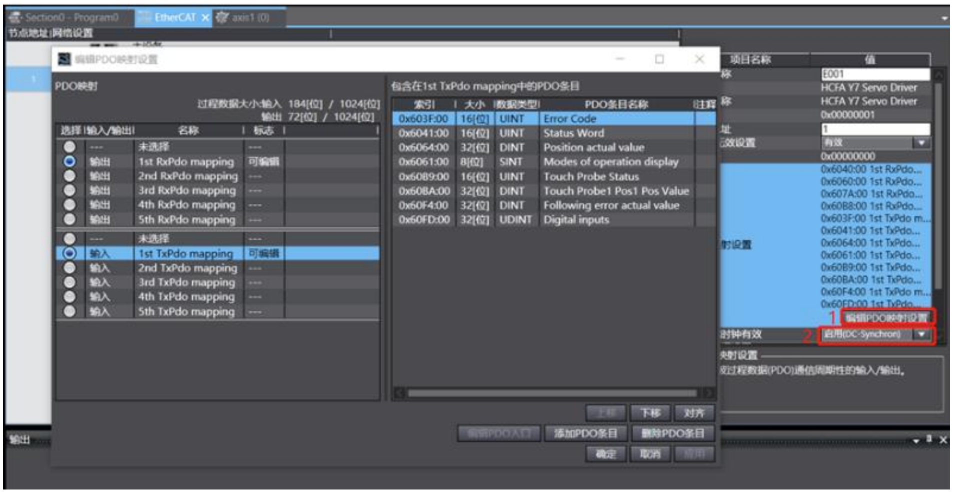
轴基本设置

轴号 0
轴使用 使用的轴
轴类型 伺服器轴
反馈控制 无控制回路
输入设备1 <未分配>
输入设备2 <未分配>
输入设备3 <未分配>
输出设备1 节点:1 HCFA Y7 Servo Driver(E001)
输出设备2 <未分配>
输出设备3 <未分配>

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



过程数据大小输入 184[位] / 1024[位]
输出 72[位] / 1024[位]

选择	输入/输出	名称	标志
○	---	未选择	---
●	输出	1st RxPdo mapping	可编辑
○	输出	2nd RxPdo mapping	---
○	输出	3rd RxPdo mapping	---
○	输出	4th RxPdo mapping	---
○	输出	5th RxPdo mapping	---
○	---	未选择	---
●	输入	1st TxPdo mapping	可编辑
○	输入	2nd TxPdo mapping	---
○	输入	3rd TxPdo mapping	---
○	输入	4th TxPdo mapping	---
○	输入	5th TxPdo mapping	---

包含在1st TxPdo mapping中的PDO条目

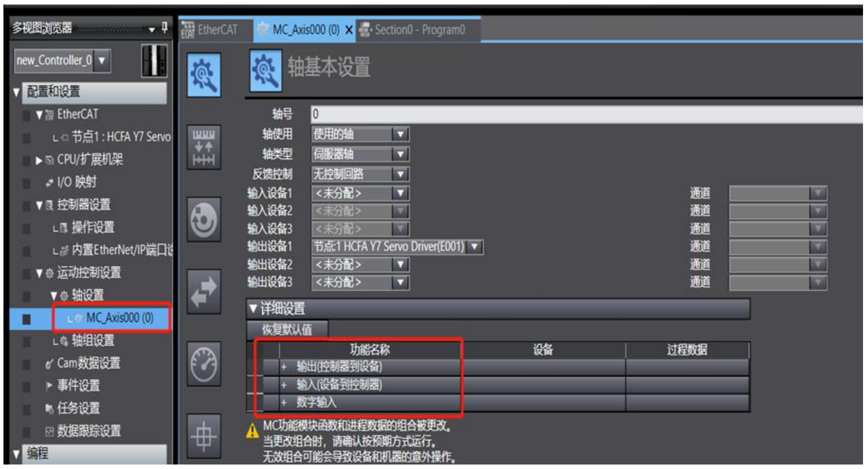
索引	大小	数据类型	PDO条目名称	注释
0x603F:00	16[位]	UINT	Error Code	
0x6041:00	16[位]	UINT	Status Word	
0x6064:00	32[位]	DINT	Position actual value	
0x6061:00	8[位]	SINT	Modes of operation display	
0x60B9:00	16[位]	UINT	Touch Probe Status	
0x60BA:00	32[位]	DINT	Touch Probe1 Pos1 Pos Value	
0x60F4:00	32[位]	DINT	Following error actual value	
0x60FD:00	32[位]	UDINT	Digital inputs	

E001
HCFA Y7 Servo Driver
HCFA Y7 Servo Driver
0x00000001
1
有效
0x00000000
0x6040:00 1st RxPdo...
0x6060:00 1st RxPdo...
0x607A:00 1st RxPdo...
0x60B8:00 1st RxPdo...
0x603F:00 1st TxPdo m...
0x6041:00 1st TxPdo...
0x6064:00 1st TxPdo...
0x6061:00 1st TxPdo...
0x60B9:00 1st TxPdo...
0x60BA:00 1st TxPdo...
0x60F4:00 1st TxPdo m...
0x60FD:00 1st TxPdo...
时钟有效 启用(DC-Synchron)
过程数据(PDO)通信周期性的输入/输出。

Figure 13-31　PDO parameter configuration

3）Mapping motion control axis PDO parameters

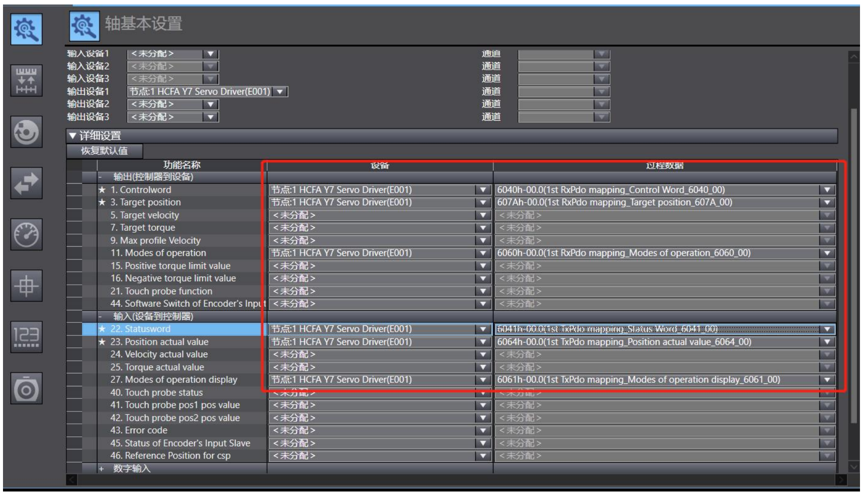
Y7 servo drive must manually configure PDO parameters, double-click MC_Axis000 (0), enter into the axis basic setting → Click detailed settings → Set related parameters about output (controller to device), input (controller to device), digital input, shown as follows.



轴号 0
轴使用 使用的轴
轴类型 伺服器轴
反馈控制 无控制回路
输入设备1 <未分配>　通道
输入设备2 <未分配>　通道
输入设备3 <未分配>　通道
输出设备1 节点:1 HCFA Y7 Servo Driver(E001)　通道
输出设备2 <未分配>　通道
输出设备3 <未分配>　通道

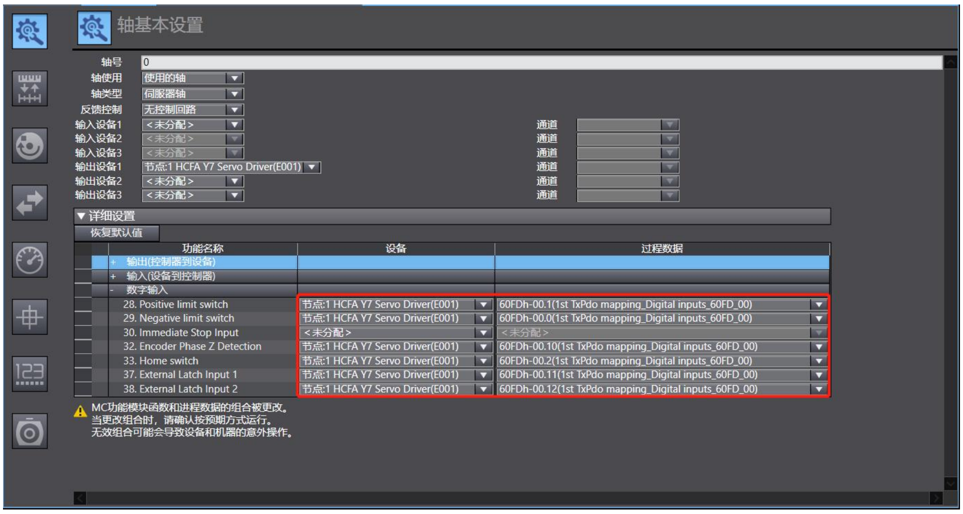
功能名称	设备	过程数据
+ 输出(控制器到设备)		
+ 输入(设备到控制器)		
+ 数字输入		

MC功能模块函数和进程数据的组合被更改。
当更改组合时，请确认按预期方式运行。
无效组合可能会导致设备和机器的意外操作。



输入设备1 <未分配>　通道
输入设备2 <未分配>　通道
输入设备3 <未分配>　通道
输出设备1 节点:1 HCFA Y7 Servo Driver(E001)　通道
输出设备2 <未分配>　通道
输出设备3 <未分配>　通道

功能名称	设备	过程数据
- 输出(控制器到设备)		
★ 1. Controlword	节点:1 HCFA Y7 Servo Driver(E001)	6040h-00.0(1st RxPdo mapping_Control Word_6040_00)
★ 3. Target position	节点:1 HCFA Y7 Servo Driver(E001)	607Ah-00.0(1st RxPdo mapping_Target position_607A_00)
5. Target velocity	<未分配>	<未分配>
7. Target torque	<未分配>	<未分配>
9. Max profile Velocity	<未分配>	<未分配>
11. Modes of operation	节点:1 HCFA Y7 Servo Driver(E001)	6060h-00.0(1st RxPdo mapping_Modes of operation_6060_00)
15. Positive torque limit value	<未分配>	<未分配>
16. Negative torque limit value	<未分配>	<未分配>
21. Touch probe function	<未分配>	<未分配>
44. Software Switch of Encoder's Input	<未分配>	<未分配>
- 输入(设备到控制器)		
★ 22. Statusword	节点:1 HCFA Y7 Servo Driver(E001)	6041h-00.0(1st TxPdo mapping_Status Word_6041_00)
★ 23. Position actual value	节点:1 HCFA Y7 Servo Driver(E001)	6064h-00.0(1st TxPdo mapping_Position actual value_6064_00)
24. Velocity actual value	<未分配>	<未分配>
25. Torque actual value	<未分配>	<未分配>
27. Modes of operation display	节点:1 HCFA Y7 Servo Driver(E001)	6061h-00.0(1st TxPdo mapping_Modes of operation display_6061_00)
40. Touch probe status	<未分配>	<未分配>
41. Touch probe pos1 pos value	<未分配>	<未分配>
42. Touch probe pos2 pos value	<未分配>	<未分配>
43. Error code	<未分配>	<未分配>
45. Status of Encoder's Input Slave	<未分配>	<未分配>
46. Reference Position for csp	<未分配>	<未分配>
+ 数字输入		



轴基本设置

轴号 0
轴使用 使用的轴
轴类型 伺服器轴
反馈控制 无控制回路
输入设备1 <未分配> 通道
输入设备2 <未分配> 通道
输入设备3 <未分配> 通道
输出设备1 节点:1 HCFA Y7 Servo Driver(E001) 通道
输出设备2 <未分配> 通道
输出设备3 <未分配> 通道

▼ 详细设置

恢复默认值

功能名称	设备	过程数据
+ 输出(控制器到设备)		
+ 输入(设备到控制器)		
- 数字输入		
28. Positive limit switch	节点:1 HCFA Y7 Servo Driver(E001)	60FDh-00.1(1st TxPdo mapping_Digital inputs_60FD_00)
29. Negative limit switch	节点:1 HCFA Y7 Servo Driver(E001)	60FDh-00.0(1st TxPdo mapping_Digital inputs_60FD_00)
30. Immediate Stop Input	<未分配>	<未分配>
32. Encoder Phase Z Detection	节点:1 HCFA Y7 Servo Driver(E001)	60FDh-00.10(1st TxPdo mapping_Digital inputs_60FD_00)
33. Home switch	节点:1 HCFA Y7 Servo Driver(E001)	60FDh-00.2(1st TxPdo mapping_Digital inputs_60FD_00)
37. External Latch Input 1	节点:1 HCFA Y7 Servo Driver(E001)	60FDh-00.11(1st TxPdo mapping_Digital inputs_60FD_00)
38. External Latch Input 2	节点:1 HCFA Y7 Servo Driver(E001)	60FDh-00.12(1st TxPdo mapping_Digital inputs_60FD_00)

⚠ MC功能模块函数和进程数据的组合被更改。
当更改组合时，请确认按预期方式运行。
无效组合可能会导致设备和机器的意外操作。

Figure 13-32 Mapping motion axis PDO parameters

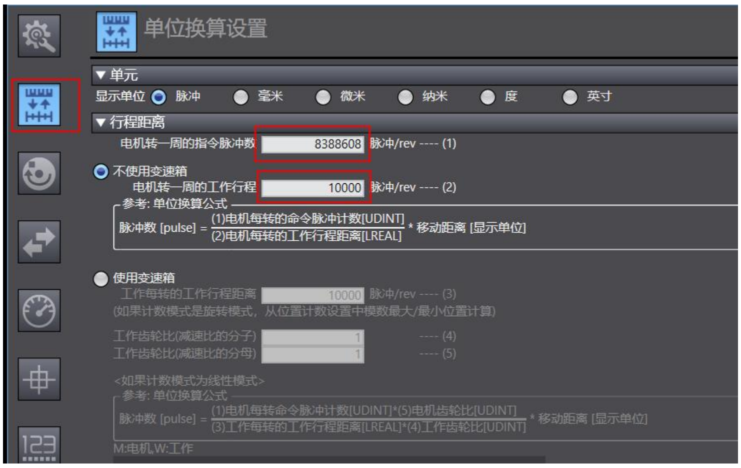
Notes: Due to the limitation of Omron background configuration, all Y7 servo axis settings need to be manually configured.

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.



单位换算设置

▼ 单元
显示单位 ● 脉冲 ○ 毫米 ○ 微米 ○ 纳米 ○ 度 ○ 英寸

▼ 行程距离
电机转一周的指令脉冲数 8388608 脉冲/rev ---- (1)

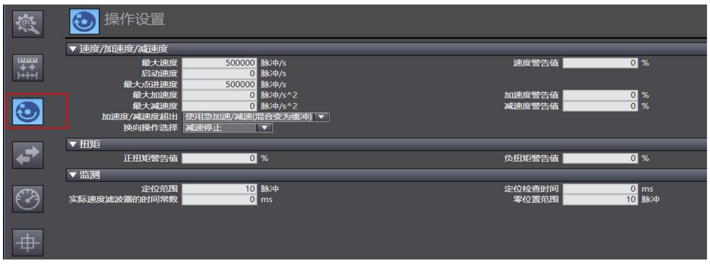
● 不使用变速箱
电机转一周的工作行程 10000 脉冲/rev ---- (2)
参考: 单位换算公式
脉冲数 [pulse] = (1)电机每转的命令脉冲计数[UDINT] / (2)电机每转的工作行程距离[LREAL] * 移动距离 [显示单位]

○ 使用变速箱
工作每转的工作行程距离 10000 脉冲/rev ---- (3)
(如果计数模式是旋转模式，从位置计数设置中模数最大/最小位置计算)
工作齿轮比(减速比的分子) 1 ---- (4)
工作齿轮比(减速比的分母) 1 ---- (5)
<如果计数模式为线性模式>
参考: 单位换算公式
脉冲数 [pulse] = (1)电机每转命令脉冲计数[UDINT]*(5)电机齿轮比[UDINT] / (3)工作每转的工作行程距离[LREAL]*(4)工作齿轮比[UDINT] * 移动距离 [显示单位]
M:电机,W:工作

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.



操作设置

▼ 速度/加速度/减速度
最大速度 500000 脉冲/s
启动速度 0 脉冲/s
最大点进速度 500000 脉冲/s
最大加速度 0 脉冲/s^2
最大减速度 0 脉冲/s^2
加速度/减速度超出 使用急加速/减速(混合变为缓冲)
换向操作选择 减速停止
速度警告值 0 %
加速度警告值 0 %
减速度警告值 0 %

▼ 扭矩
正扭矩警告值 0 %
负扭矩警告值 0 %

▼ 监测
定位范围 10 脉冲
实际速度滤波器的时间常数 0 ms
定位检查时间 0 ms
零位置范围 10 脉冲

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.

限位设置

▼ 软件限位

软件的限位 无效 ▼
正软件限位 2147483647 脉冲
负软件限位 -2147483648 脉冲

▼ 位置偏移

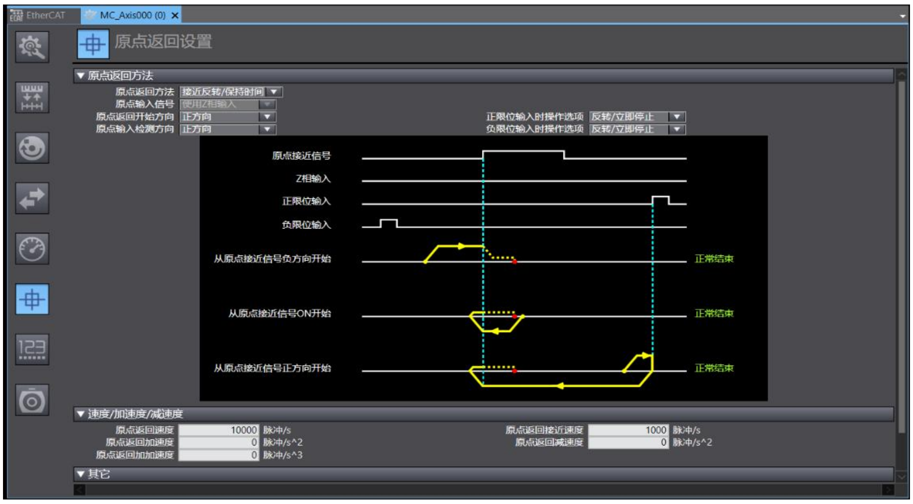
位置偏移超出值 0 脉冲
位置偏移警告值 0 脉冲

Figure 13-35 Limit settiing

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.



原点返回设置

▼ 原点返回方法

原点返回方法 接近反转/保持时间 ▼
原点输入信号 使用Z相输入 ▼
原点返回开始方向 正方向 ▼
原点输入检测方向 正方向 ▼
正限位输入时操作选项 反转/立即停止 ▼
负限位输入时操作选项 反转/立即停止 ▼

▼ 速度/加速度/减速度

原点返回速度 10000 脉冲/s
原点返回加速度 0 脉冲/s^2
原点返回加加速度 0 脉冲/s^3
原点返回接近速度 1000 脉冲/s
原点返回减速度 0 脉冲/s^2

▼ 其它

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	SI0（PIN40）
Positive limit input	P-OT	SI2（PIN42）
Negative limit input	N-OT	SI3（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;

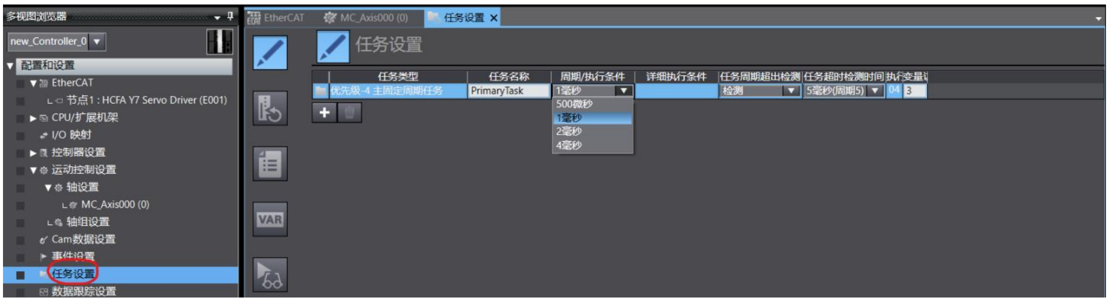
Hold time/contact time: After the upper controller receives the origin signal (such as the edge change of the origin approach signal), it shields the origin signal within the set time, and starts to receive the origin signal after this period of time;

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.



任务设置

任务类型	任务名称	周期/执行条件	详细执行条件	任务周期超出检测	任务超时检测时间	执行	变量
优先级-4 主固定周期任务	PrimaryTask	1毫秒		检测	5毫秒(周期5)	04	3

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.

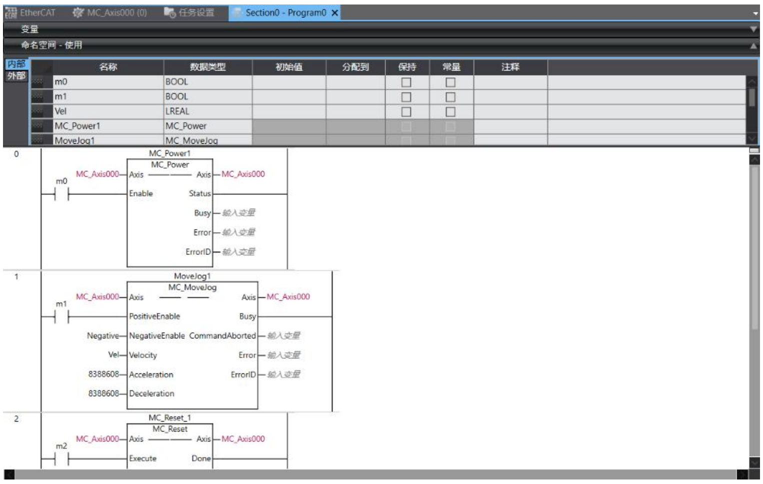


Figure 13-39 Program example

2. Project compiling(offline)

In Main menu, Project (P) → Recompile Controller (R).

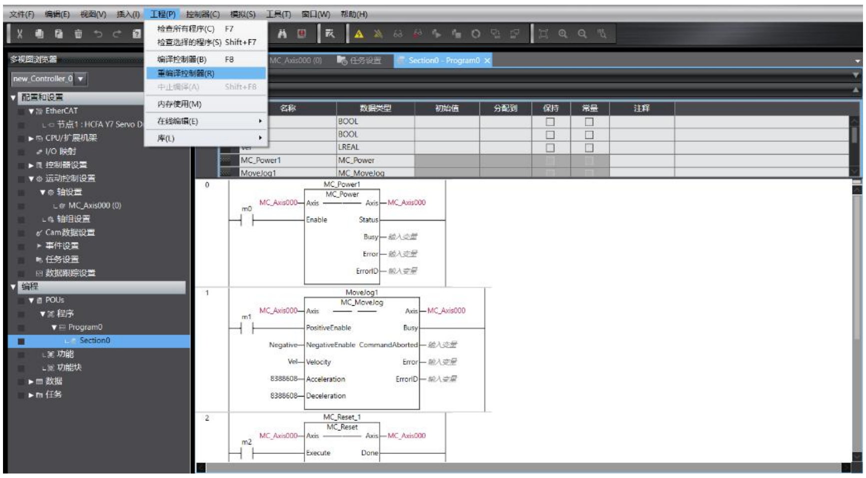


Figure 13-40 Programming compiling

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

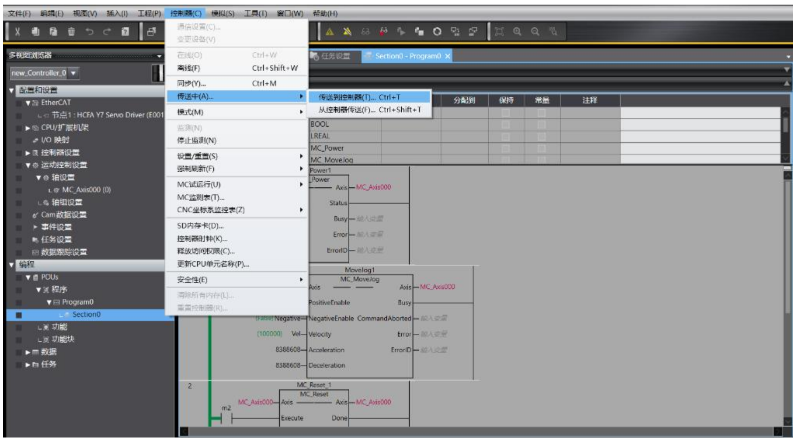


Figure 13-41 Program download

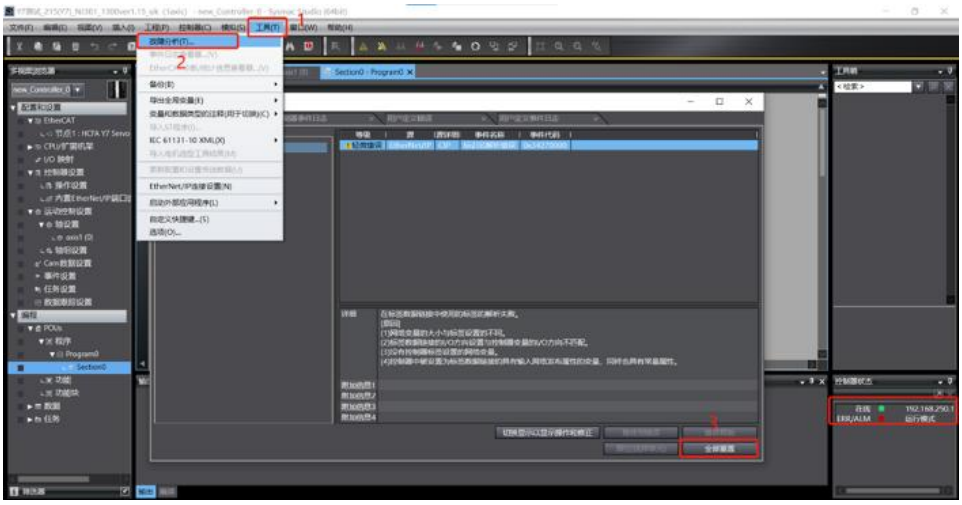


Figure 13-42 Troubleshooting

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".

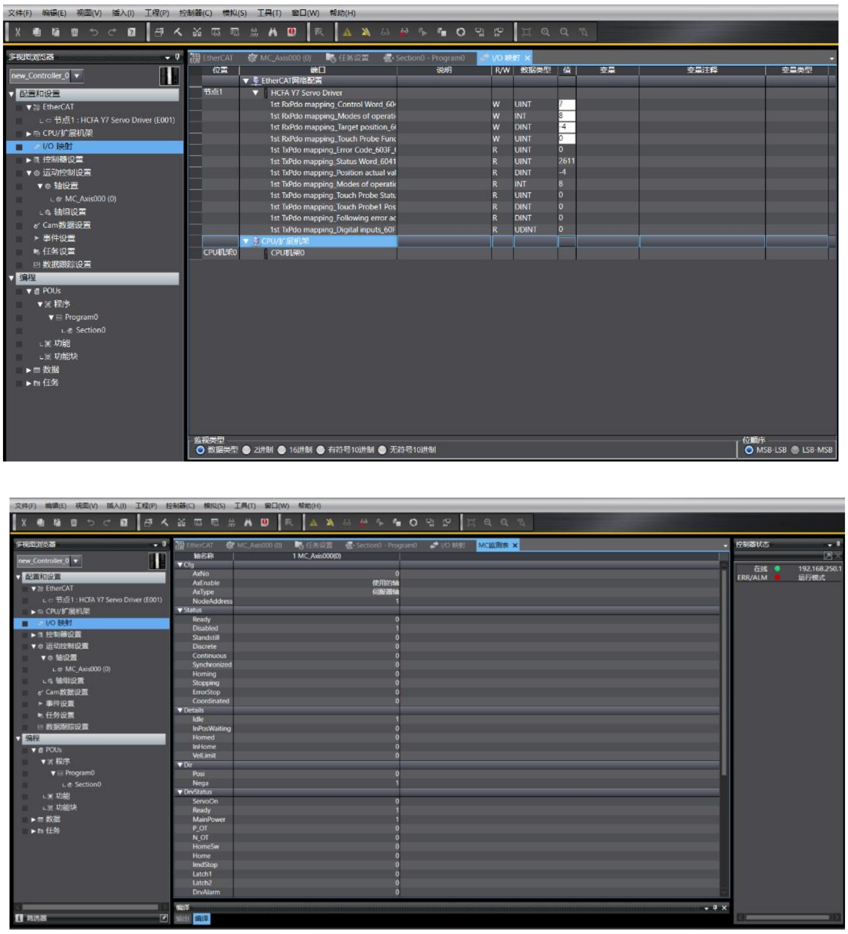
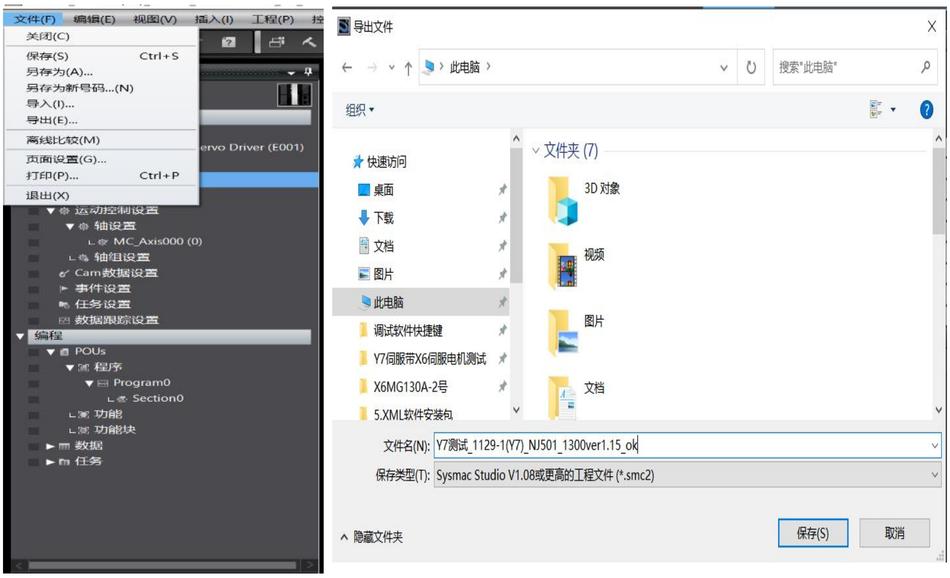


Figure 13-43 Data monitoring

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".



文件名(N): Y7测试_1129-1(Y7)_NJ501_1300ver1.15_ok

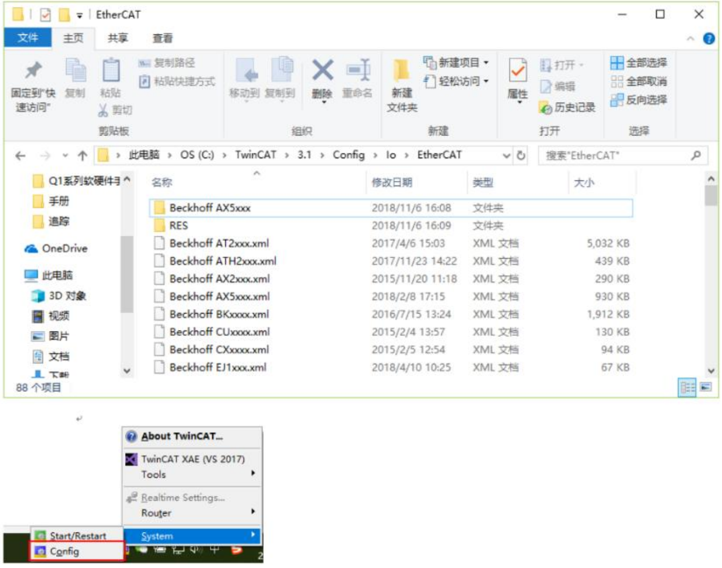
保存类型(T): Sysmac Studio V1.08或更高的工程文件 (*.smc2)

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.

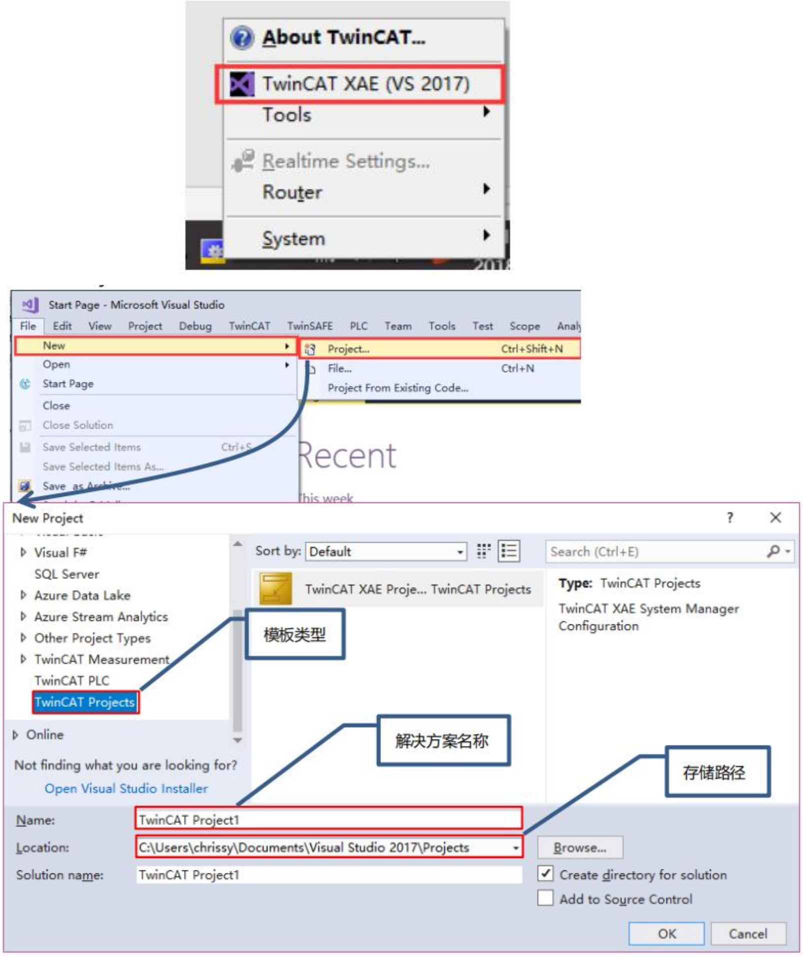


名称	修改日期	类型	大小
Beckhoff AX5xxx	2018/11/6 16:08	文件夹	
RES	2018/11/6 16:09	文件夹	
Beckhoff AT2xxx.xml	2017/4/6 15:03	XML 文档	5,032 KB
Beckhoff ATH2xxx.xml	2017/11/23 14:22	XML 文档	439 KB
Beckhoff AX2xxx.xml	2015/11/20 11:18	XML 文档	290 KB
Beckhoff AX5xxx.xml	2018/2/8 17:15	XML 文档	930 KB
Beckhoff BKxxxx.xml	2016/7/15 13:24	XML 文档	1,912 KB
Beckhoff CUxxxx.xml	2015/2/4 13:57	XML 文档	130 KB
Beckhoff CXxxxx.xml	2015/2/5 12:54	XML 文档	94 KB
Beckhoff EJ1xxx.xml	2018/4/10 10:25	XML 文档	67 KB

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.



Name: TwinCAT Project1

Location: C:\Users\chrissy\Documents\Visual Studio 2017\Projects

Solution name: TwinCAT Project1

Figure 13-46 New project

3. Servo drive scanning

Scan IO after switching TwinCAT3 to configuration mode.

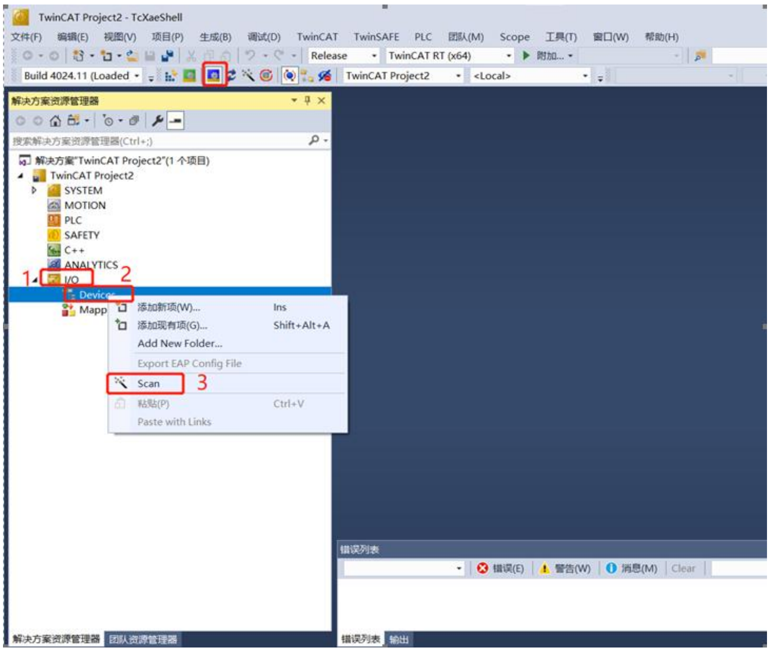
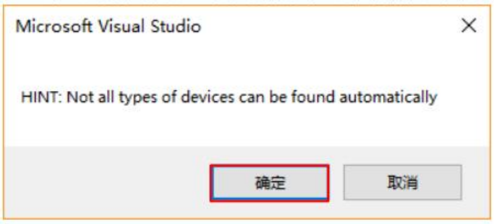


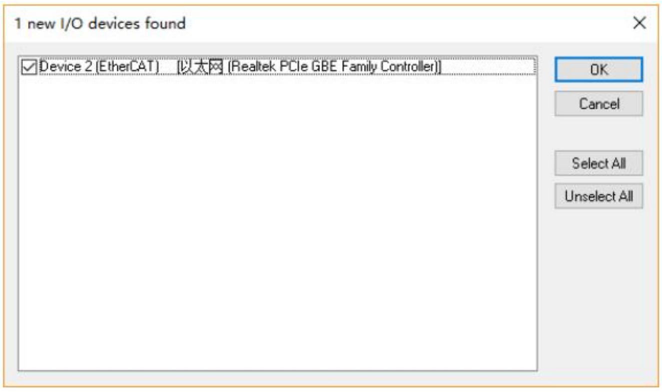
Figure 13-47 Servo screen scanning

A dialog box pops up: Not all types of devices can be found automatically, click "OK"



HINT: Not all types of devices can be found automatically

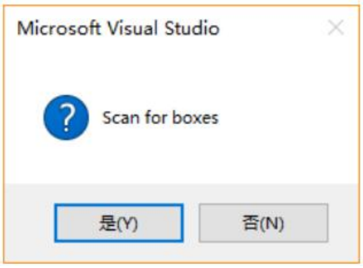
EtherCAT bus found, click "OK"



1 new I/O devices found

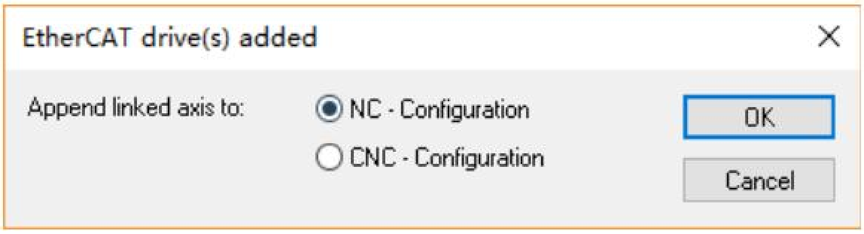
☑ Device 2 (EtherCAT) [以太网 (Realtek PCIe GBE Family Controller)]

Scan for boxes? Click “Yes”.



Scan for boxes

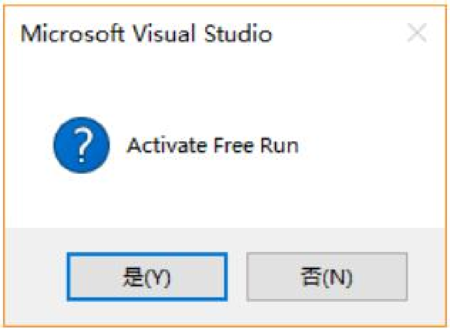
When the motion control device is scanned, the system will ask whether to associate the scanned axis with the NC configuration, click "OK" to complete the mapping.



EtherCAT drive(s) added

Append linked axis to: ● NC - Configuration ○ CNC - Configuration

Click "Yes" to activate the Freerun debugging mode. In the debugging mode, the user can test the IO without a program.



Activate Free Run

After completing the above steps, you can see that the Y7 servo drive has been successfully scanned in menu "I/O" → "Devices".

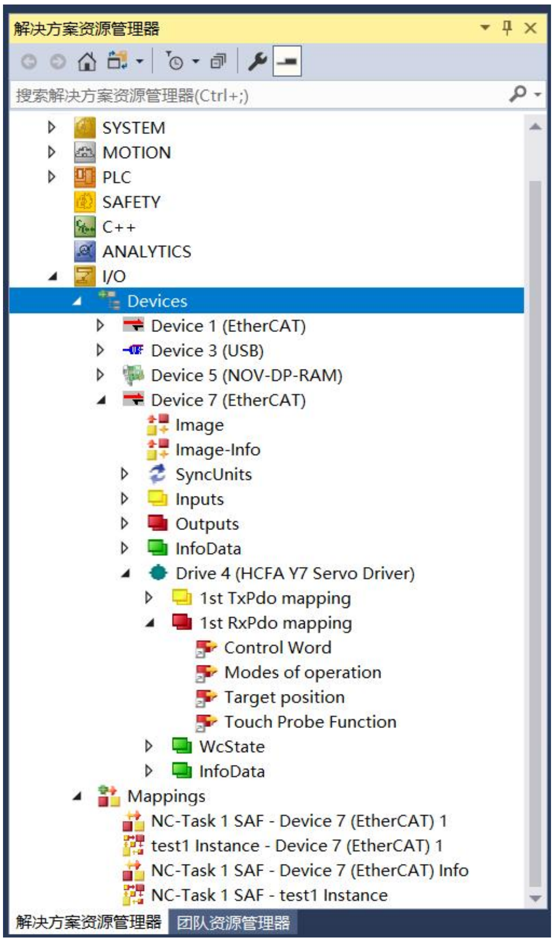
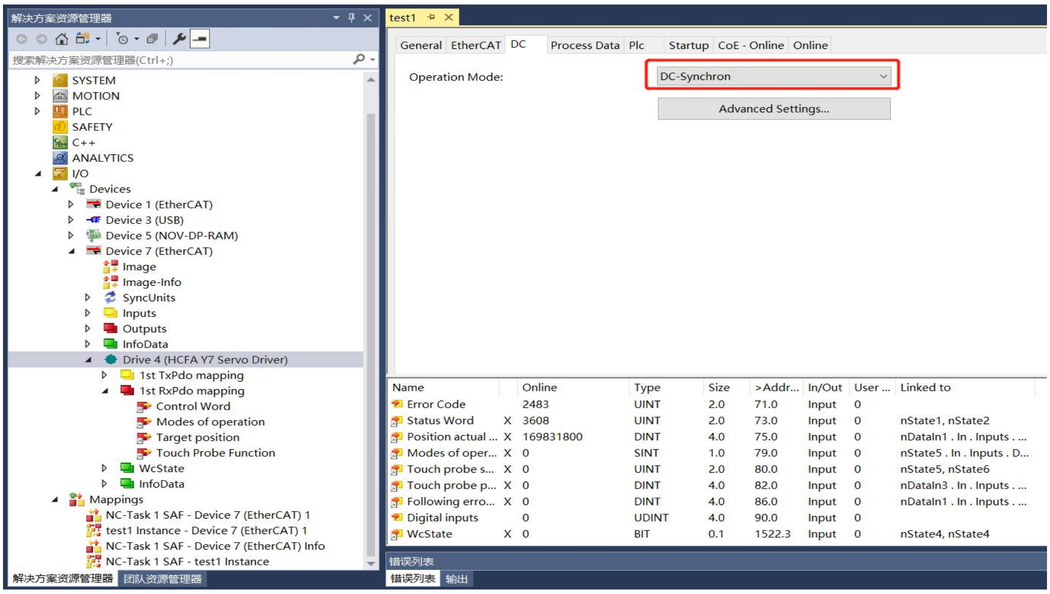


Figure 13-48 Scanning completed

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



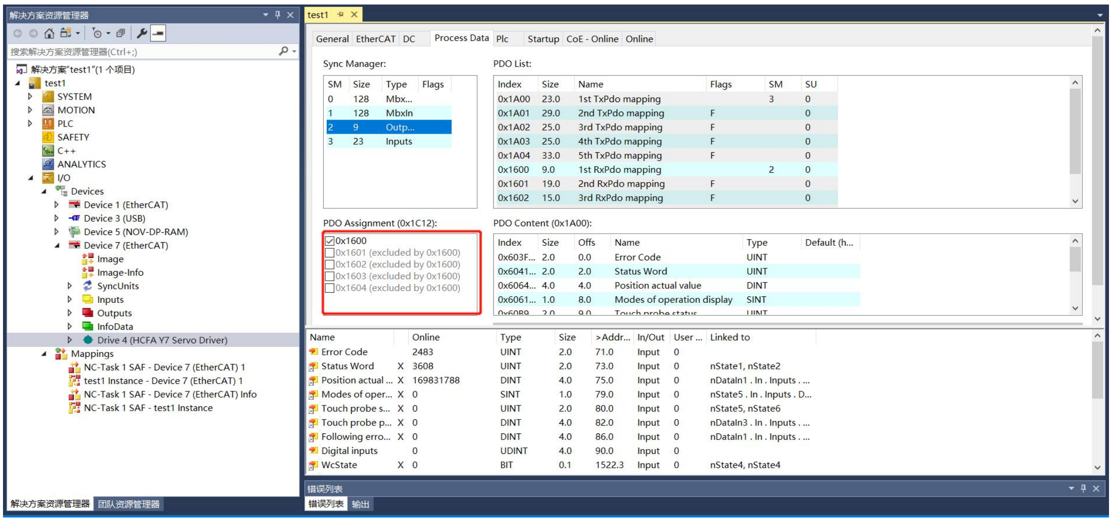
Operation Mode: DC-Synchron

Name		Online	Type	Size	>Addr...	In/Out	User ...	Linked to
Error Code		2483	UINT	2.0	71.0	Input	0	
Status Word	X	3608	UINT	2.0	73.0	Input	0	nState1, nState2
Position actual ...	X	169831800	DINT	4.0	75.0	Input	0	nDataIn1 . In . Inputs . ...
Modes of oper...	X	0	SINT	1.0	79.0	Input	0	nState5 . In . Inputs . D...
Touch probe s...	X	0	UINT	2.0	80.0	Input	0	nState5, nState6
Touch probe p...	X	0	DINT	4.0	82.0	Input	0	nDataIn3 . In . Inputs . ...
Following erro...	X	0	DINT	4.0	86.0	Input	0	nDataIn1 . In . Inputs . ...
Digital inputs		0	UDINT	4.0	90.0	Input	0	
WcState	X	0	BIT	0.1	1522.3	Input	0	nState4, nState4

Figure13-49 Operation mode changing

2. Select the desired PDO mapping

Click the scanned Y7 servo drive, and find "Process Data" in the setting.



Sync Manager:

SM	Size	Type	Flags
0	128	Mbx...	
1	128	MbxIn	
2	9	Outp...	
3	23	Inputs	

PDO List:

Index	Size	Name	Flags	SM	SU
0x1A00	23.0	1st TxPdo mapping		3	0
0x1A01	29.0	2nd TxPdo mapping	F		0
0x1A02	25.0	3rd TxPdo mapping	F		0
0x1A03	25.0	4th TxPdo mapping	F		0
0x1A04	33.0	5th TxPdo mapping	F		0
0x1600	9.0	1st RxPdo mapping		2	0
0x1601	19.0	2nd RxPdo mapping	F		0
0x1602	15.0	3rd RxPdo mapping	F		0

PDO Assignment (0x1C12):

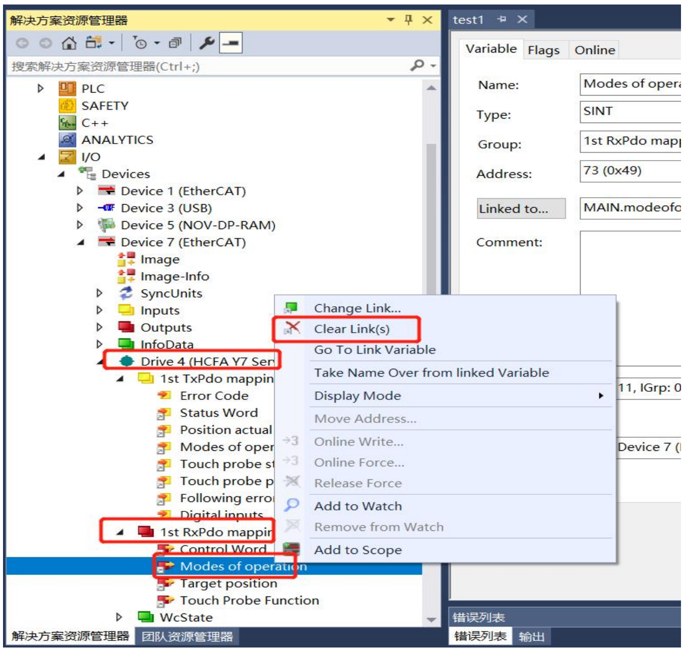
☑ 0x1600
☐ 0x1601 (excluded by 0x1600)
☐ 0x1602 (excluded by 0x1600)
☐ 0x1603 (excluded by 0x1600)
☐ 0x1604 (excluded by 0x1600)

PDO Content (0x1A00):

Index	Size	Offs	Name	Type	Default (h...
0x603F...	2.0	0.0	Error Code	UINT	
0x6041...	2.0	2.0	Status Word	UINT	
0x6064...	4.0	4.0	Position actual value	DINT	
0x6061...	1.0	8.0	Modes of operation display	SINT	
0x60B9	2.0	9.0	Touch probe status	UINT	

Name		Online	Type	Size	>Addr...	In/Out	User ...	Linked to
Error Code		2483	UINT	2.0	71.0	Input	0	
Status Word	X	3608	UINT	2.0	73.0	Input	0	nState1, nState2
Position actual ...	X	169831788	DINT	4.0	75.0	Input	0	nDataIn1 . In . Inputs . ...
Modes of oper...	X	0	SINT	1.0	79.0	Input	0	nState5 . In . Inputs . D...
Touch probe s...	X	0	UINT	2.0	80.0	Input	0	nState5, nState6
Touch probe p...	X	0	DINT	4.0	82.0	Input	0	nDataIn3 . In . Inputs . ...
Following erro...	X	0	DINT	4.0	86.0	Input	0	nDataIn1 . In . Inputs . ...
Digital inputs		0	UDINT	4.0	90.0	Input	0	
WcState	X	0	BIT	0.1	1522.3	Input	0	nState4, nState4

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.

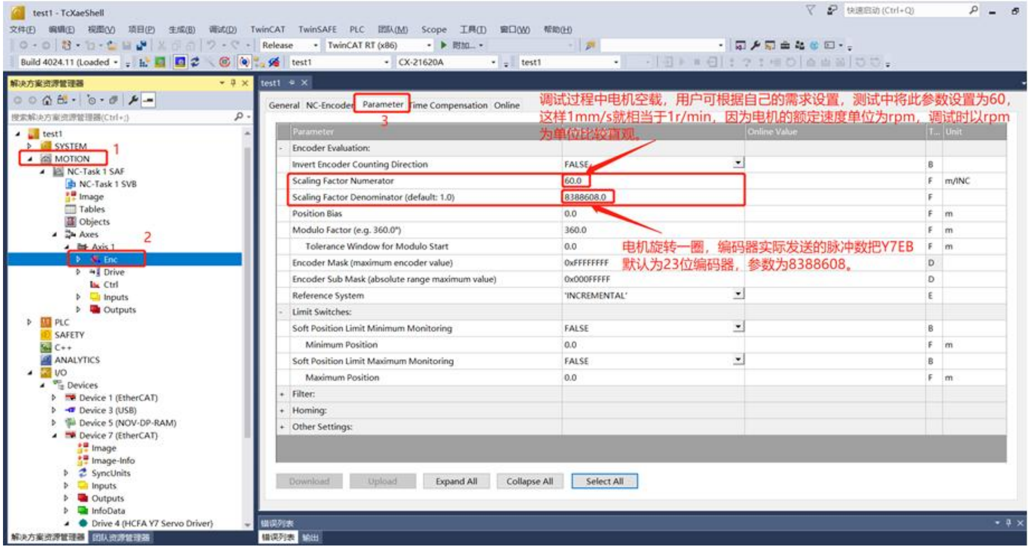


Name: Modes of opera
Type: SINT
Group: 1st RxPdo mapp
Address: 73 (0x49)
Linked to... MAIN.modeofo
Comment:

Figure 13-50 Select PDO mapping

3. Set encoder parameters

Find “Motion” → “Axes” → “Axis1” → “Enc” → “Paramter” to set the encoder parameters.



调试过程中电机空载，用户可根据自己的需求设置，测试中将此参数设置为60，这样1mm/s就相当于1r/min，因为电机的额定速度单位为rpm，调试时以rpm为单位比较直观。

电机旋转一圈，编码器实际发送的脉冲数把Y7EB默认为23位编码器，参数为8388608。

Parameter		Online Value	T...	Unit
- Encoder Evaluation:				
Invert Encoder Counting Direction	FALSE		B	
Scaling Factor Numerator	60.0		F	m/INC
Scaling Factor Denominator (default: 1.0)	8388608.0		F	
Position Bias	0.0		F	m
Modulo Factor (e.g. 360.0°)	360.0		F	m
Tolerance Window for Modulo Start	0.0		F	m
Encoder Mask (maximum encoder value)	0xFFFFFFFF		D	
Encoder Sub Mask (absolute range maximum value)	0x000FFFFF		D	
Reference System	'INCREMENTAL'		E	
- Limit Switches:				
Soft Position Limit Minimum Monitoring	FALSE		B	
Minimum Position	0.0		F	m
Soft Position Limit Maximum Monitoring	FALSE		B	
Maximum Position	0.0		F	m
+ Filter:				
+ Homing:				
+ Other Settings:				

Figure 13-51 Encoder parameter setting

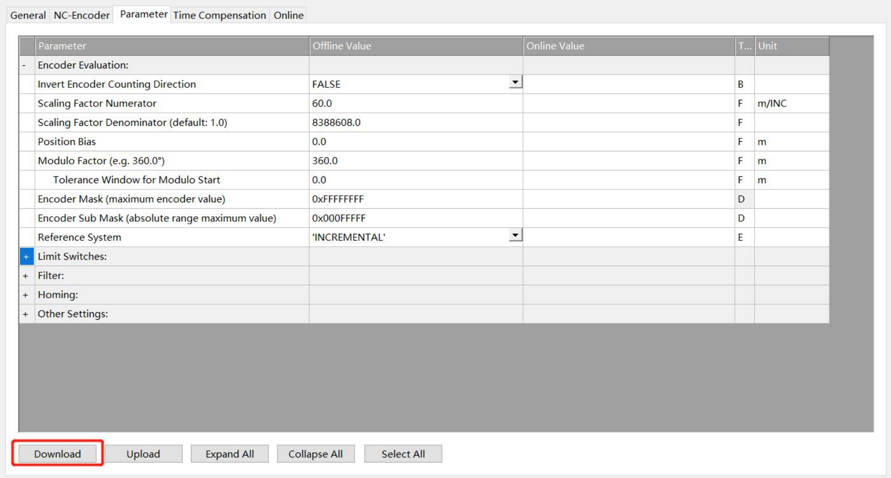
Scaling Factor indicates the distance corresponding to the encoder pulse of each position feedback

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 ；

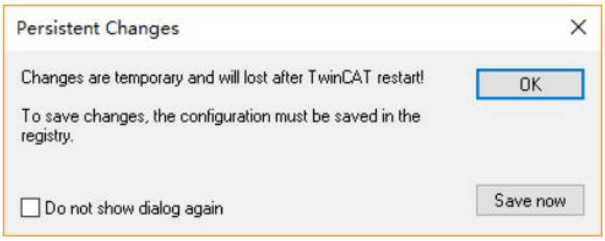
Encoder Sub Mask（absolute range maximum value）: The encoder submask is related to the maximum feedback value. For example, for a 16-bit incremental encoder, it will change to 0 if it exceeds 65535 in the positive direction. At this time, the NC will handle the zero-crossing problem, and the position is increasing steadily, at this time, SubMask should be set to 0x0000FFFF. 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 mistakesat 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” .



Parameter	Offline Value	Online Value	T...	Unit
- Encoder Evaluation:				
Invert Encoder Counting Direction	FALSE		B	
Scaling Factor Numerator	60.0		F	m/INC
Scaling Factor Denominator (default: 1.0)	8388608.0		F	
Position Bias	0.0		F	m
Modulo Factor (e.g. 360.0°)	360.0		F	m
Tolerance Window for Modulo Start	0.0		F	m
Encoder Mask (maximum encoder value)	0xFFFFFFFF		D	
Encoder Sub Mask (absolute range maximum value)	0x000FFFFF		D	
Reference System	'INCREMENTAL'		E	
+ Limit Switches:				
+ Filter:				
+ Homing:				
+ Other Settings:				

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.



Persistent Changes

Changes are temporary and will lost after TwinCAT restart!

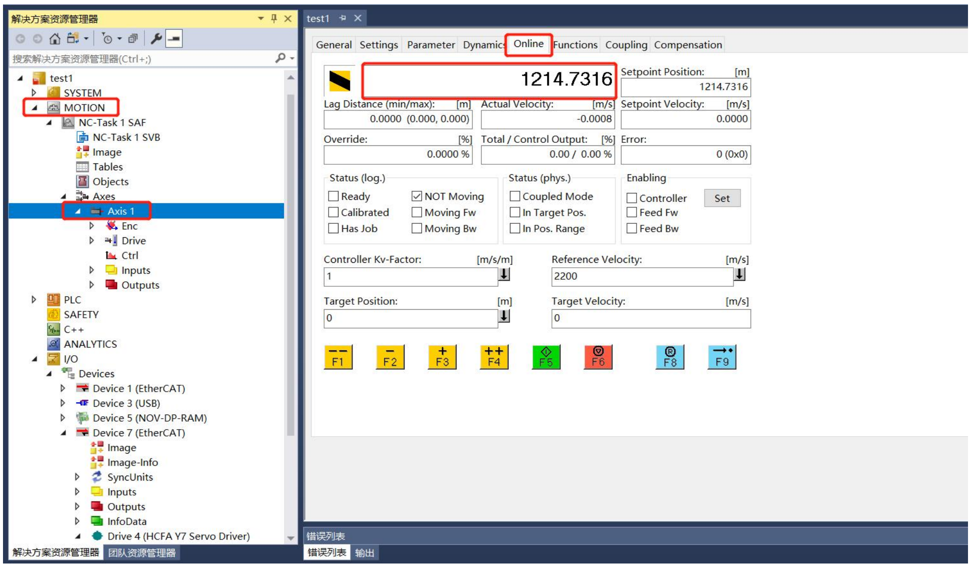
To save changes, the configuration must be saved in the registry.

☐ Do not show dialog again

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.



1214.7316

Setpoint Position: [m] 1214.7316

Lag Distance (min/max): [m] 0.0000 (0.000, 0.000)

Actual Velocity: [m/s] -0.0008

Setpoint Velocity: [m/s] 0.0000

Override: [%] 0.0000 %

Total / Control Output: [%] 0.00 / 0.00 %

Error: 0 (0x0)

Status (log.): ☐ Ready ☐ Calibrated ☐ Has Job ☑ NOT Moving ☐ Moving Fw ☐ Moving Bw

Status (phys.): ☐ Coupled Mode ☐ In Target Pos. ☐ In Pos. Range

Enabling: ☐ Controller ☐ Feed Fw ☐ Feed Bw

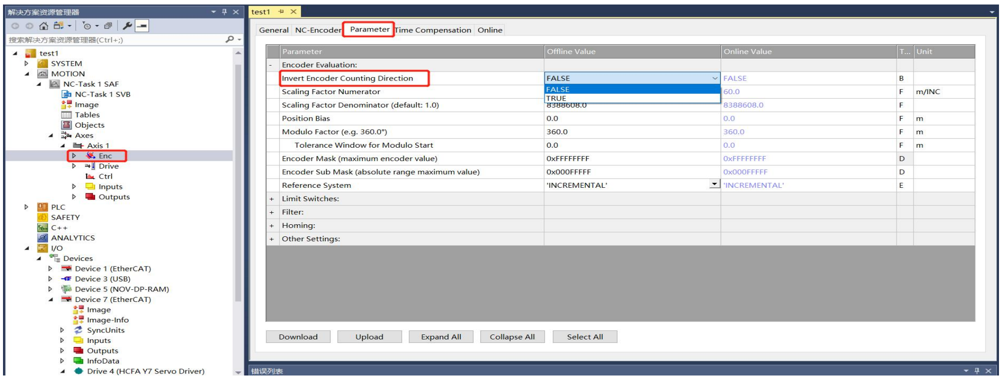
Controller Kv-Factor: [m/s/m] 1

Reference Velocity: [m/s] 2200

Target Position: [m] 0

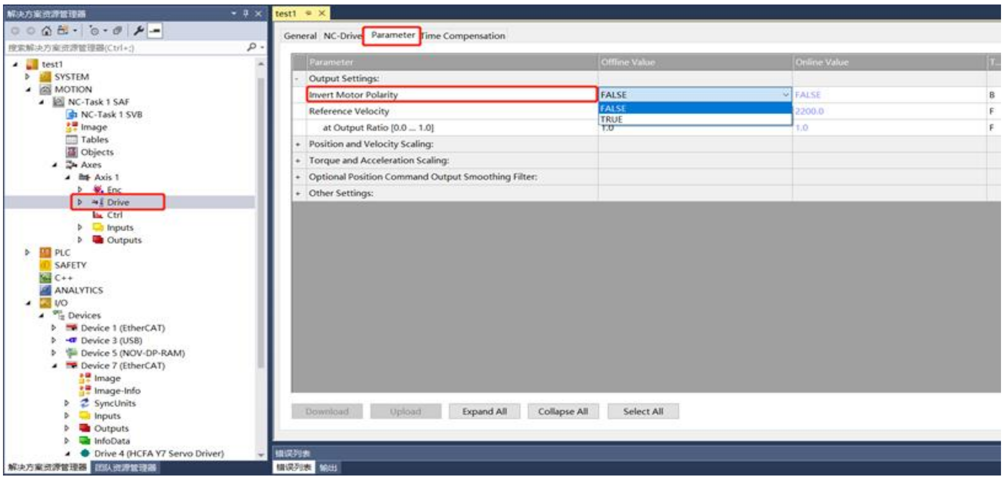
Target Velocity: [m/s] 0

The figure below shows how to adjust the counting direction of the encoder.



	Parameter	Offline Value	Online Value	T...	Unit
-	Encoder Evaluation:				
	Invert Encoder Counting Direction	FALSE	FALSE	B	
	Scaling Factor Numerator	FALSE TRUE	60.0	F	m/INC
	Scaling Factor Denominator (default: 1.0)	8388608.0	8388608.0	F	
	Position Bias	0.0	0.0	F	m
	Modulo Factor (e.g. 360.0°)	360.0	360.0	F	m
	Tolerance Window for Modulo Start	0.0	0.0	F	m
	Encoder Mask (maximum encoder value)	0xFFFFFFFF	0xFFFFFFFF	D	
	Encoder Sub Mask (absolute range maximum value)	0x000FFFFF	0x000FFFFF	D	
	Reference System	'INCREMENTAL'	'INCREMENTAL'	E	
+	Limit Switches:				
+	Filter:				
+	Homing:				
+	Other Settings:				

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

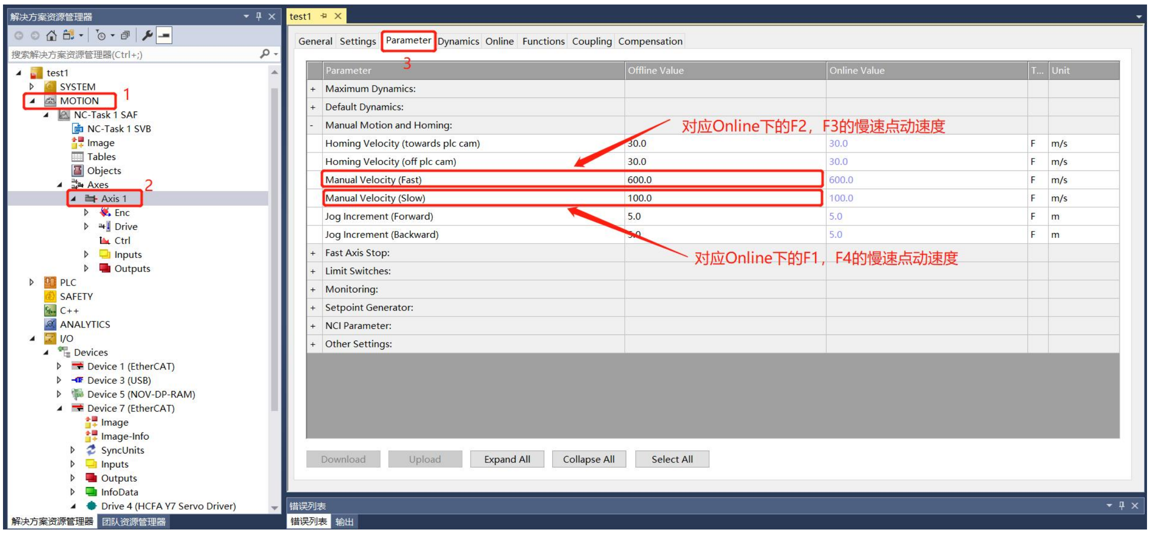


	Parameter	Offline Value	Online Value	T...
-	Output Settings:			
	Invert Motor Polarity	FALSE	FALSE	B
	Reference Velocity		2200.0	F
	at Output Ratio [0.0 ... 1.0]	1.0	1.0	F
+	Position and Velocity Scaling:			
+	Torque and Acceleration Scaling:			
+	Optional Position Command Output Smoothing Filter:			
+	Other Settings:			

Figure 13-53 Check feedback

5. Modify NC manual debugging speed

Take Y7 series 750W servo drive with a rated speed of 3000rmp as the example. Users can modify the speed of manual debugging on the NC-Online in "Motion"→"Axes"→"Axis1"→"Parameter"→"Manual Motion and Homing" .



	Parameter	Offline Value	Online Value	T...	Unit
+	Maximum Dynamics:				
+	Default Dynamics:				
-	Manual Motion and Homing:				
	Homing Velocity (towards plc cam)	30.0	30.0	F	m/s
	Homing Velocity (off plc cam)	30.0	30.0	F	m/s
	Manual Velocity (Fast)	600.0	600.0	F	m/s
	Manual Velocity (Slow)	100.0	100.0	F	m/s
	Jog Increment (Forward)	5.0	5.0	F	m
	Jog Increment (Backward)	5.0	5.0	F	m
+	Fast Axis Stop:				
+	Limit Switches:				
+	Monitoring:				
+	Setpoint Generator:				
+	NCI Parameter:				
+	Other Settings:				

对应Online下的F2，F3的慢速点动速度

对应Online下的F1，F4的慢速点动速度

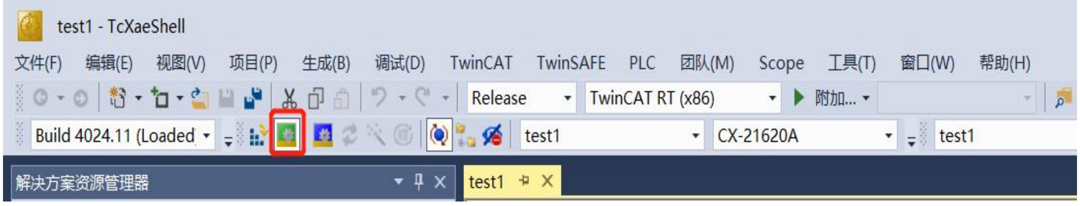
Fi

gure 13-54 Modify NC manual debugging speed

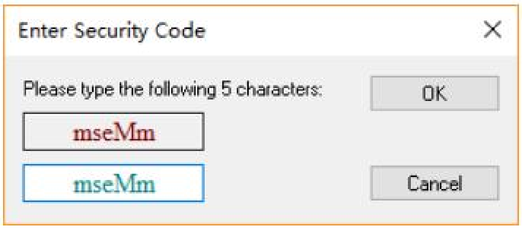
13.3.3 Test Run

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".



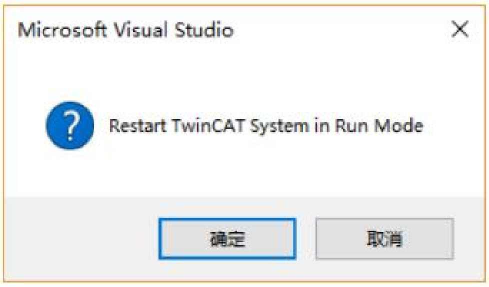
Enter Security Code

Please type the following 5 characters:

mseMm

mseMm

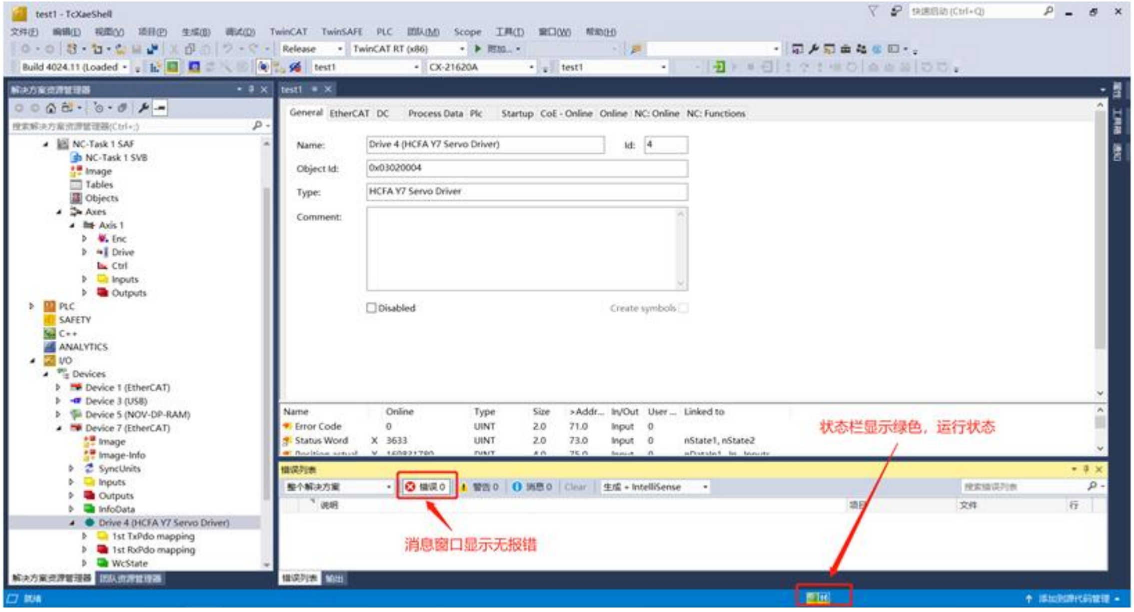
The system prompts whether to switch TwinCAT to the running mode, click OK



Microsoft Visual Studio

Restart TwinCAT System in Run Mode

After switching the running state correctly, the screen is displayed as follows:



Name: Drive 4 (HCFA Y7 Servo Driver) Id: 4

Object Id: 0x03020004

Type: HCFA Y7 Servo Driver

Comment:

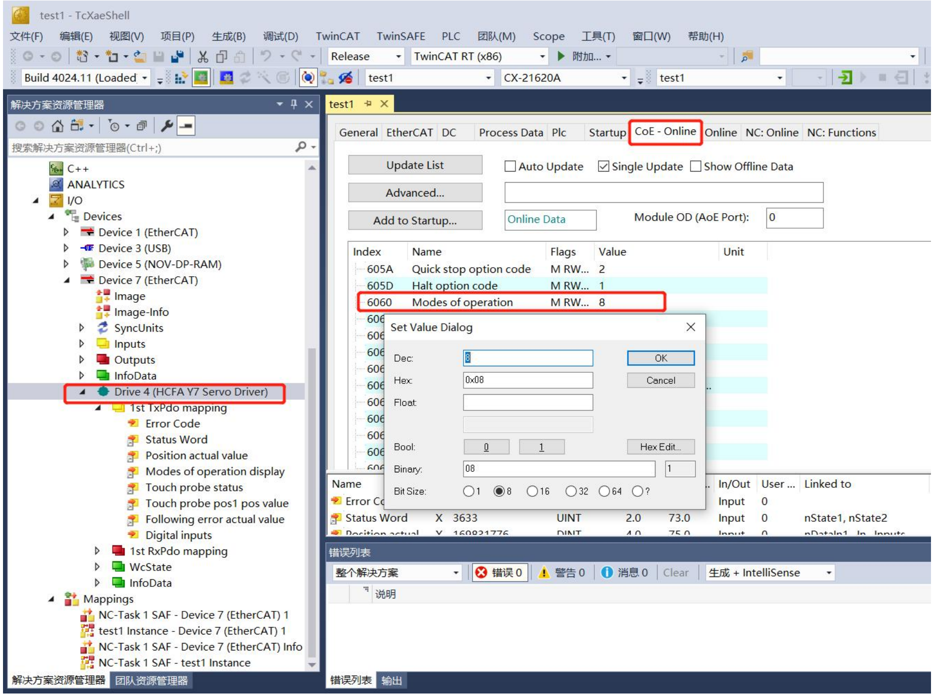
☐ Disabled

Name	Online	Type	Size	>Addr...	In/Out	User ...	Linked to
Error Code	0	UINT	2.0	71.0	Input	0	
Status Word	X 3633	UINT	2.0	73.0	Input	0	nState1, nState2

状态栏显示绿色，运行状态

消息窗口显示无报错

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-Oline 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.



Release · TwinCAT RT (x86) · Build 4024.11 (Loaded · test1 · CX-21620A

☐ Auto Update ☑ Single Update ☐ Show Offline Data

Module OD (AoE Port): 0

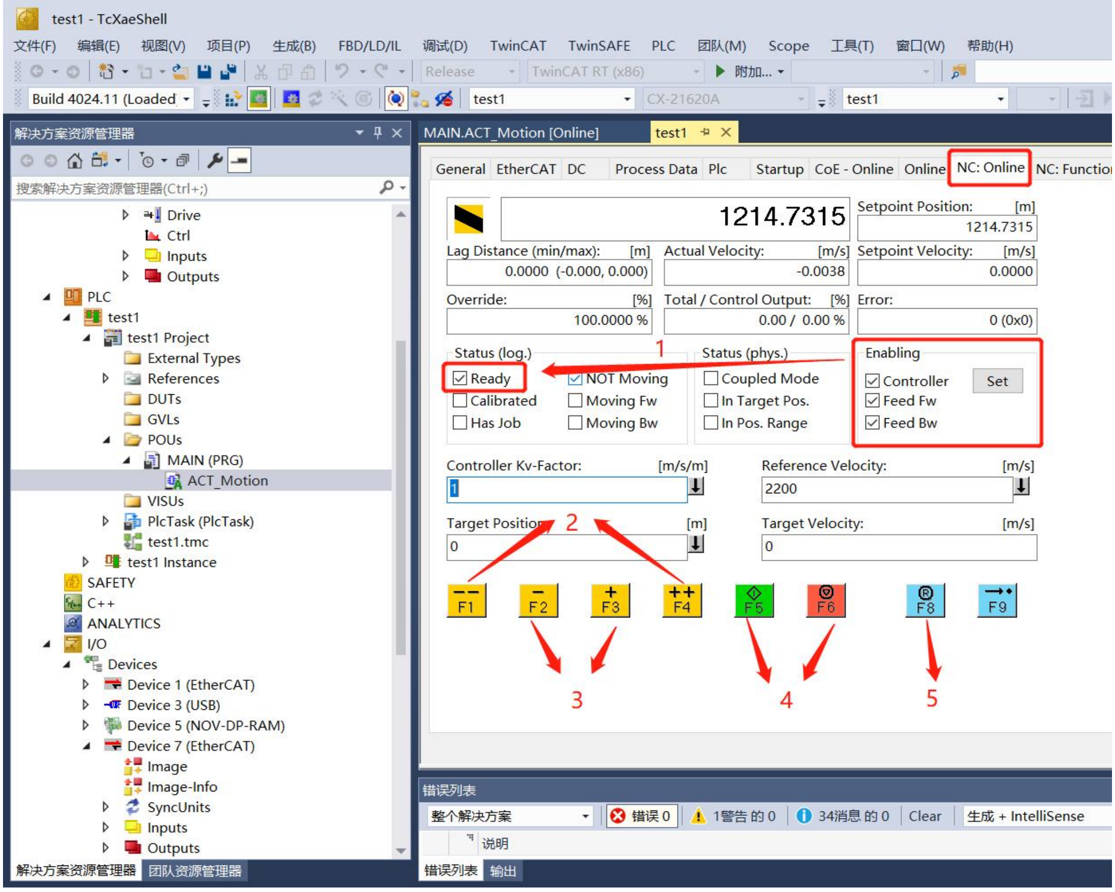
Index	Name	Flags	Value	Unit
605A	Quick stop option code	M RW...	2	
605D	Halt option code	M RW...	1	
6060	Modes of operation	M RW...	8	

Set Value Dialog:
Dec: 8
Hex: 0x08
Float:
Bool: 0 1
Binary: 08 1
Bit Size: ○1 ●8 ○16 ○32 ○64 ○?

Name					In/Out	User ...	Linked to
Error C...					Input	0	
Status Word	X	3633	UINT	2.0	73.0	Input	0	nState1, nState2

错误 0 · 警告 0 · 消息 0 · Clear · 生成 + IntelliSense

After setting the working mode, enter into "Motion" → "Axes" → "Axis1" → "Online" for programless debugging.



1214.7315

Setpoint Position: [m] 1214.7315
Lag Distance (min/max): [m] 0.0000 (-0.000, 0.000)
Actual Velocity: [m/s] -0.0038
Setpoint Velocity: [m/s] 0.0000
Override: [%] 100.0000 %
Total / Control Output: [%] 0.00 / 0.00 %
Error: 0 (0x0)

Status (log.): ☑ Ready ☑ NOT Moving ☐ Calibrated ☐ Moving Fw ☐ Has Job ☐ Moving Bw
Status (phys.): ☐ Coupled Mode ☐ In Target Pos. ☐ In Pos. Range
Enabling: ☑ Controller ☑ Feed Fw ☑ Feed Bw

Controller Kv-Factor: [m/s/m] 1
Reference Velocity: [m/s] 2200
Target Position: [m] 0
Target Velocity: [m/s] 0

错误 0 · 1警告 的 0 · 34消息 的 0 · Clear · 生成 + IntelliSense

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;

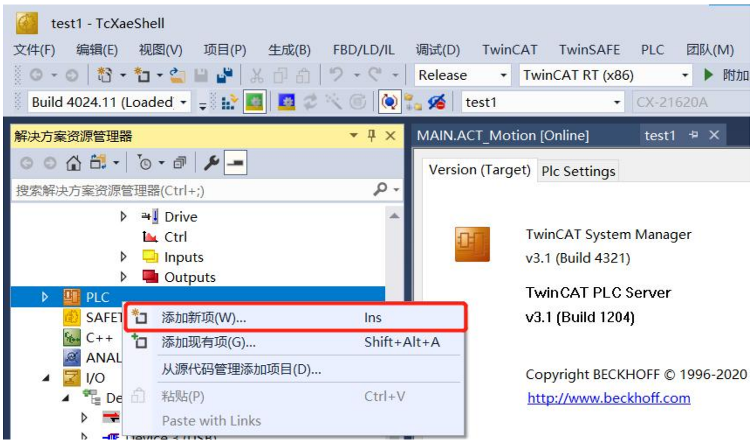
③ F2 means reverse slow jog, F3 means forward slow jog, the speed is set in Parameter;

④ F5 means to start, F6 means to stop;

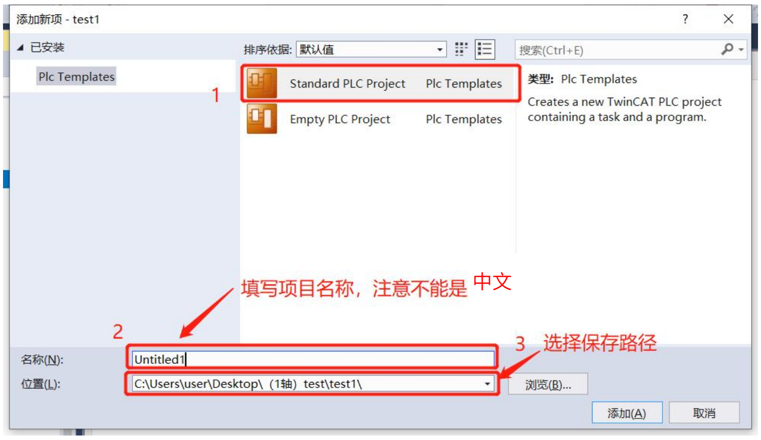
⑤ F8 means reset, when an error occurs, you can reset it by F8.

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"



1

填写项目名称，注意不能是中文

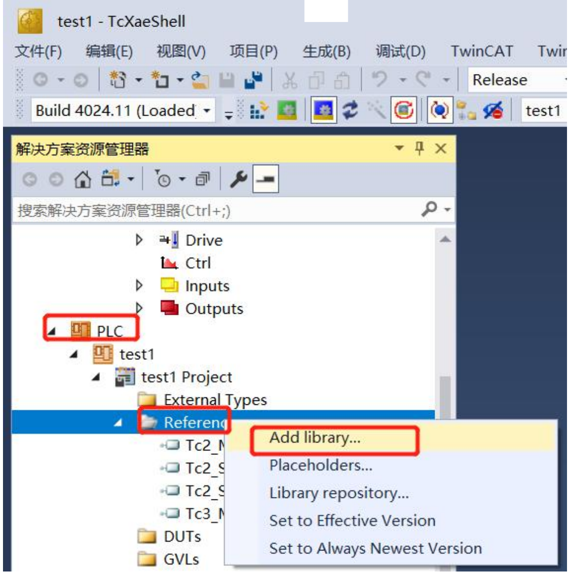
2

3 选择保存路径

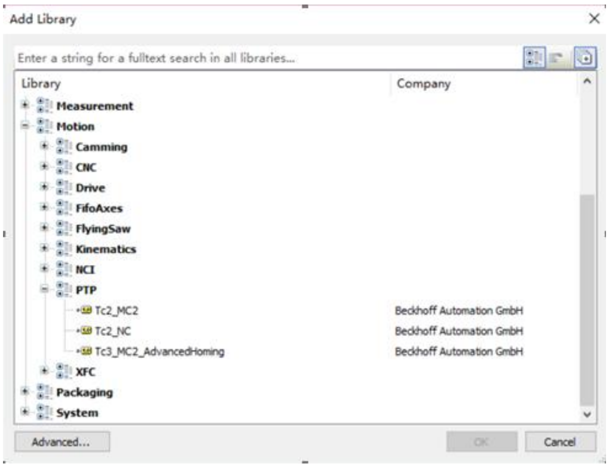
名称(N): Untitled1

位置(L): C:\Users\user\Desktop\（1轴）test\test1\

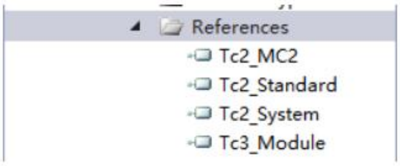
Add motion control library, find “PLC” → “Reference” → “Add Library”



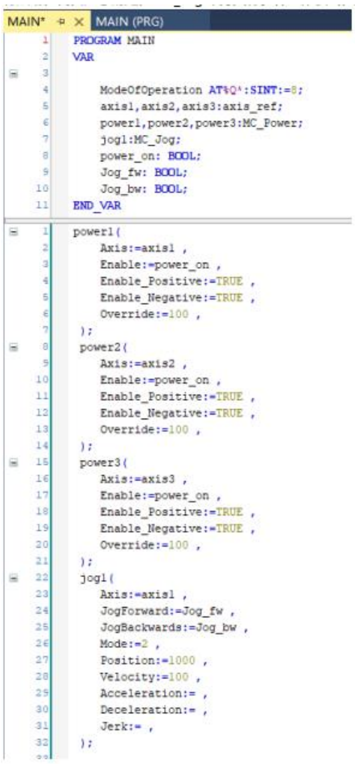
Find Tc2_MC2 on Add library, select "OK" in the lower right corner to add.



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.



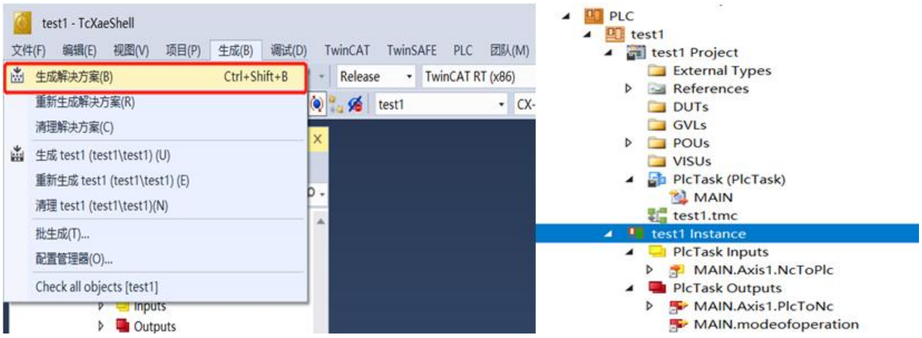
```
PROGRAM MAIN
VAR

    ModeOfOperation AT%Q*:SINT:=8;
    axis1,axis2,axis3:axis_ref;
    power1,power2,power3:MC_Power;
    jog1:MC_Jog;
    power_on: BOOL;
    Jog_fw: BOOL;
    Jog_bw: BOOL;
END_VAR
```

```
power1(
    Axis:=axis1 ,
    Enable:=power_on ,
    Enable_Positive:=TRUE ,
    Enable_Negative:=TRUE ,
    Override:=100 ,
 );
 power2(
    Axis:=axis2 ,
    Enable:=power_on ,
    Enable_Positive:=TRUE ,
    Enable_Negative:=TRUE ,
    Override:=100 ,
 );
 power3(
    Axis:=axis3 ,
    Enable:=power_on ,
    Enable_Positive:=TRUE ,
    Enable_Negative:=TRUE ,
    Override:=100 ,
 );
 jog1(
    Axis:=axis1 ,
    JogForward:=Jog_fw ,
    JogBackwards:=Jog_bw ,
    Mode:=2 ,
    Position:=1000 ,
    Velocity:=100 ,
    Acceleration:= ,
    Deceleration:= ,
    Jerk:= ,
 );
```

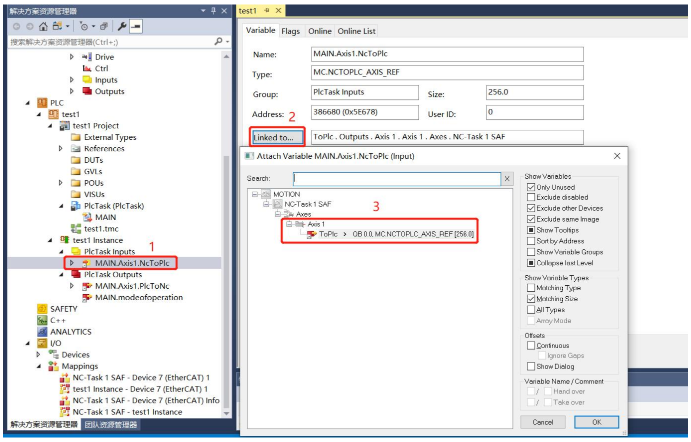
Figure 13-56 Writing test programs

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.



Name: MAIN.Axis1.NcToPlc

Type: MC.NCTOPLC_AXIS_REF

Group: PlcTask Inputs

Size: 256.0

Address: 386680 (0x5E678)

User ID: 0

Linked to... ToPlc . Outputs . Axis 1 . Axis 1 . Axes . NC-Task 1 SAF

Attach Variable MAIN.Axis1.NcToPlc (Input)

MOTION
NC-Task 1 SAF
Axes
Axis 1
ToPlc > QB 0.0, MC.NCTOPLC_AXIS_REF [256.0]

Show Variables
☑ Only Unused
☐ Exclude disabled
☑ Exclude other Devices
☑ Exclude same Image
■ Show Tooltips
☐ Sort by Address
☐ Show Variable Groups
■ Collapse last Level

Show Variable Types
☐ Matching Type
☑ Matching Size
☐ All Types
☐ Array Mode

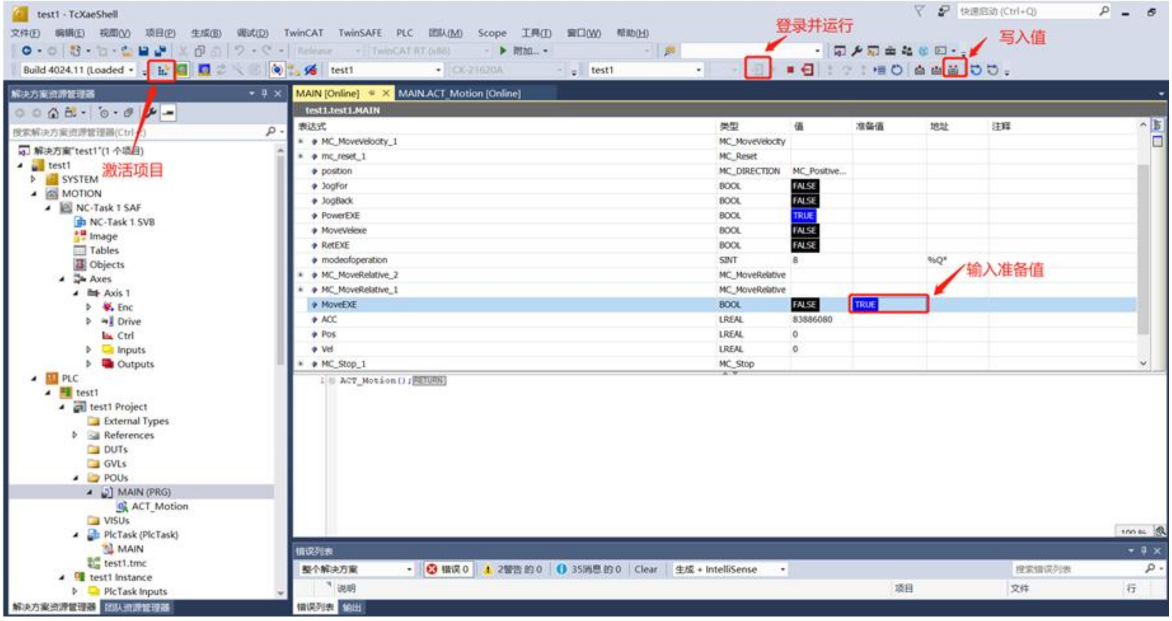
Offsets
☐ Continuous
☐ Ignore Gaps
☐ Show Dialog

Variable Name / Comment
☐ Hand over
☐ Take over

Figure 13-57 Variable mapping.

4. Online debugging

Activate the project and log in.



表达式	类型	值	准备值	地址	注释
MC_MoveVelocity_1	MC_MoveVelocity				
mc_reset_1	MC_Reset				
position	MC_DIRECTION	MC_Positive...			
JogFor	BOOL	FALSE			
JogBack	BOOL	FALSE			
PowerEXE	BOOL	TRUE			
MoveVelexe	BOOL	FALSE			
RetEXE	BOOL	FALSE			
modeofoperation	SINT	8		%Q*	
MC_MoveRelative_2	MC_MoveRelative				
MC_MoveRelative_1	MC_MoveRelative				
MoveEXE	BOOL	FALSE	TRUE		
ACC	LREAL	83886080			
Pos	LREAL	0			
Vel	LREAL	0			
MC_Stop_1	MC_Stop				

```
ACT_Motion();RETURN
```

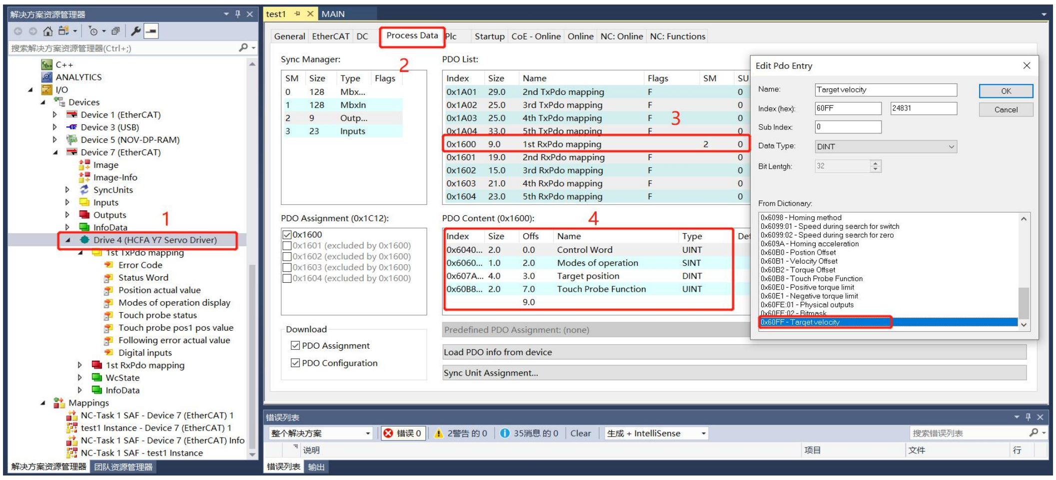
Figure 13-58 Activate and run the project

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.



Sync Manager:

SM	Size	Type	Flags
0	128	Mbx...	
1	128	MbxIn	
2	9	Outp...	
3	23	Inputs	

PDO List:

Index	Size	Name	Flags	SM	SU
0x1A01	29.0	2nd TxPdo mapping	F		0
0x1A02	25.0	3rd TxPdo mapping	F		0
0x1A03	25.0	4th TxPdo mapping	F		0
0x1A04	33.0	5th TxPdo mapping	F		0
0x1600	9.0	1st RxPdo mapping		2	0
0x1601	19.0	2nd RxPdo mapping	F		0
0x1602	15.0	3rd RxPdo mapping	F		0
0x1603	21.0	4th RxPdo mapping	F		0
0x1604	23.0	5th RxPdo mapping	F		0

PDO Assignment (0x1C12):

☑ 0x1600
☐ 0x1601 (excluded by 0x1600)
☐ 0x1602 (excluded by 0x1600)
☐ 0x1603 (excluded by 0x1600)
☐ 0x1604 (excluded by 0x1600)

PDO Content (0x1600):

Index	Size	Offs	Name	Type
0x6040...	2.0	0.0	Control Word	UINT
0x6060...	1.0	2.0	Modes of operation	SINT
0x607A...	4.0	3.0	Target position	DINT
0x60B8...	2.0	7.0	Touch Probe Function	UINT
		9.0		

Download

☑ PDO Assignment
☑ PDO Configuration

Predefined PDO Assignment: (none)

Load PDO info from device

Sync Unit Assignment...

Name: Target velocity
Index (hex): 60FF 24831
Sub Index: 0
Data Type: DINT
Bit Lentgh: 32

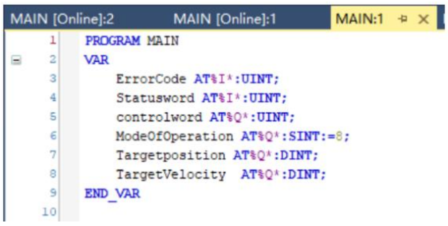
From Dictionary:

0x6098 - Homing method
0x6099:01 - Speed during search for switch
0x6099:02 - Speed during search for zero
0x609A - Homing acceleration
0x60B0 - Postion Offset
0x60B1 - Velocity Offset
0x60B2 - Torque Offset
0x60B8 - Touch Probe Function
0x60E0 - Positive torque limit
0x60E1 - Negative torque limit
0x60FE:01 - Physical outputs
0x60FE:02 - Bitmask
0x60FF - Target velocity

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：



```
PROGRAM MAIN
VAR
    ErrorCode AT%I*:UINT;
    Statusword AT%I*:UINT;
    controlword AT%Q*:UINT;
    ModeOfOperation AT%Q*:SINT:=8;
    Targetposition AT%Q*:DINT;
    TargetVelocity  AT%Q*:DINT;
END_VAR
```

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

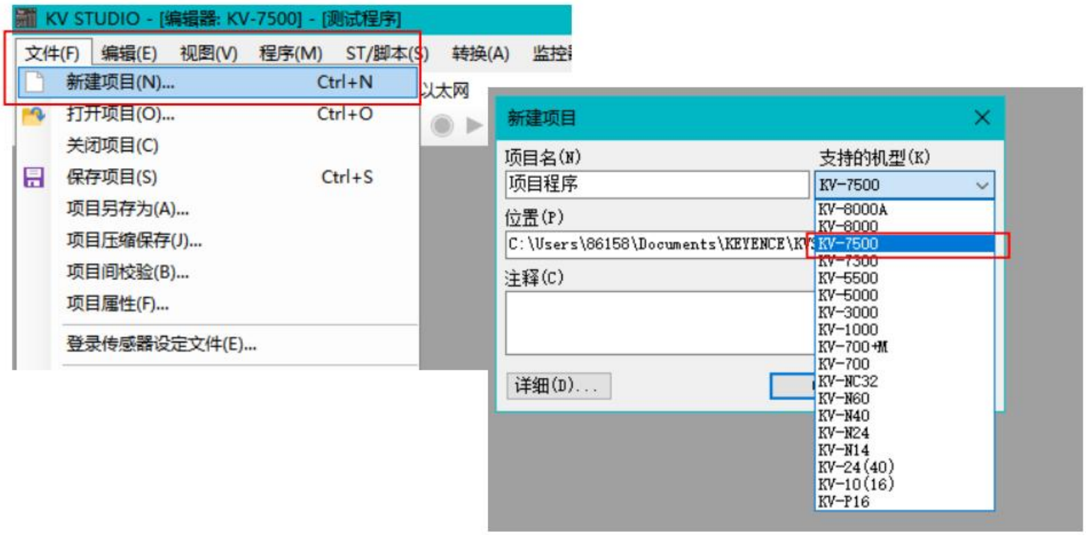
For the parameter setting of Y7_EtherCAT servo drive, if there are multiple servo drives used, the network cables must be inserted in strict accordance with the order of the top-in and bottom-out network ports. The parameter setting of Y7_EtherCAT servo drive is shown in the table below:

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].



项目名(N): 项目程序

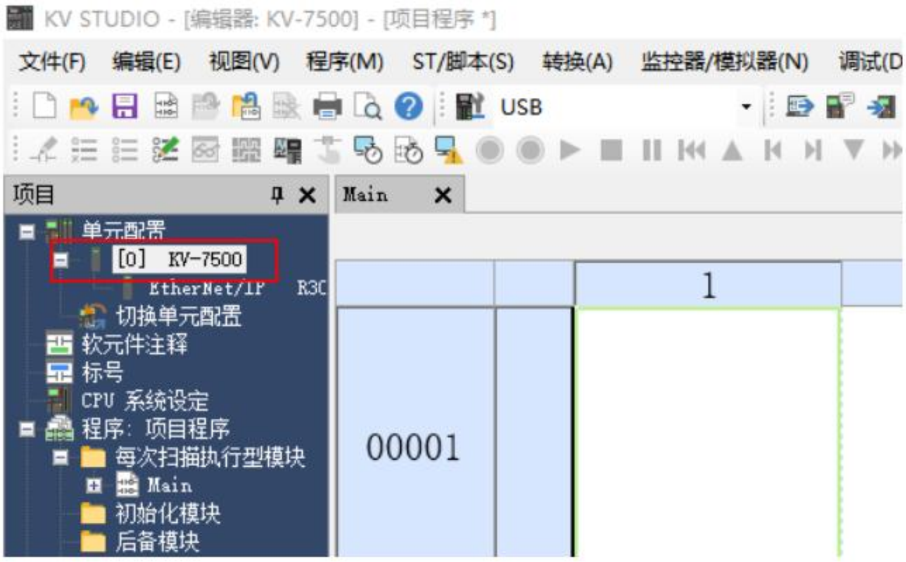
支持的机型(K): KV-7500

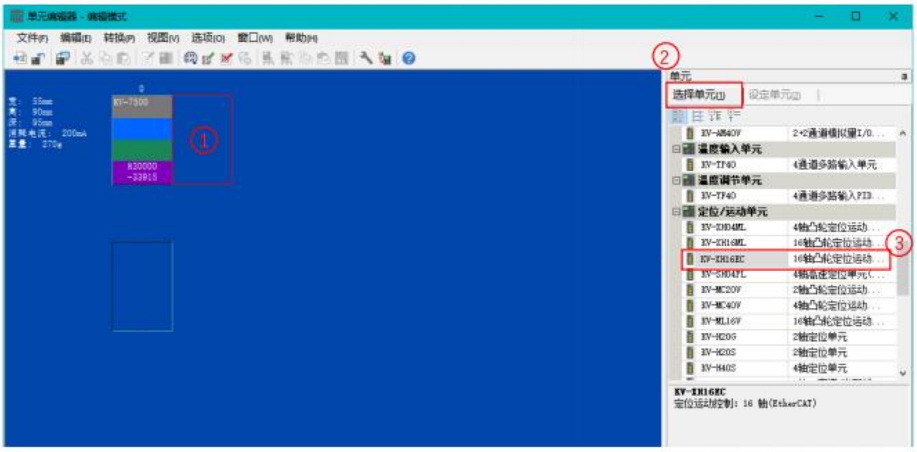
位置(P): C:\Users\86158\Documents\KEYENCE\KV

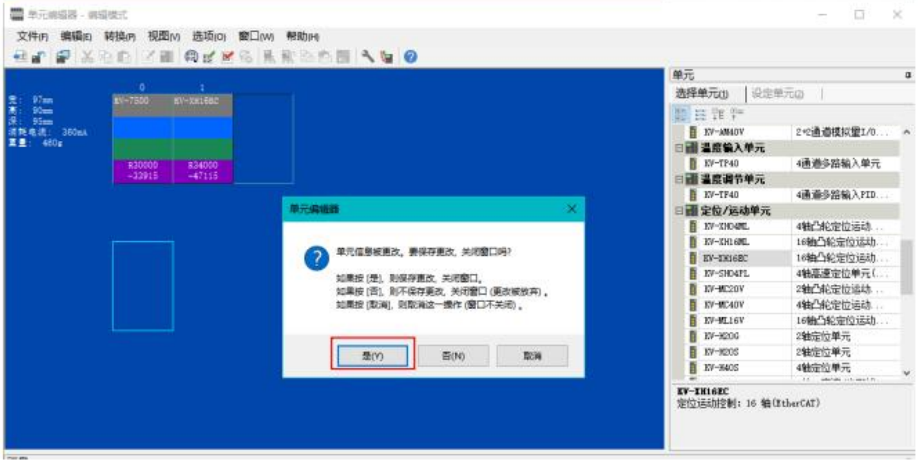
注释(C):

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.





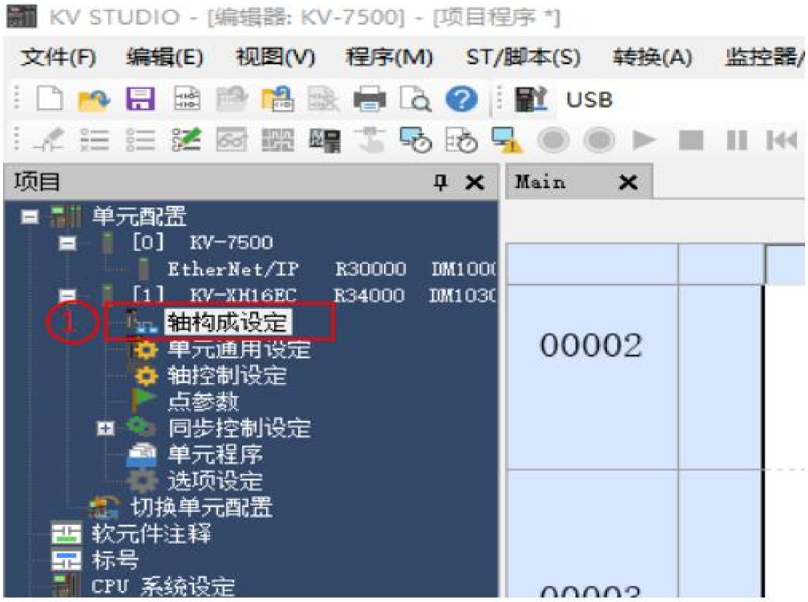


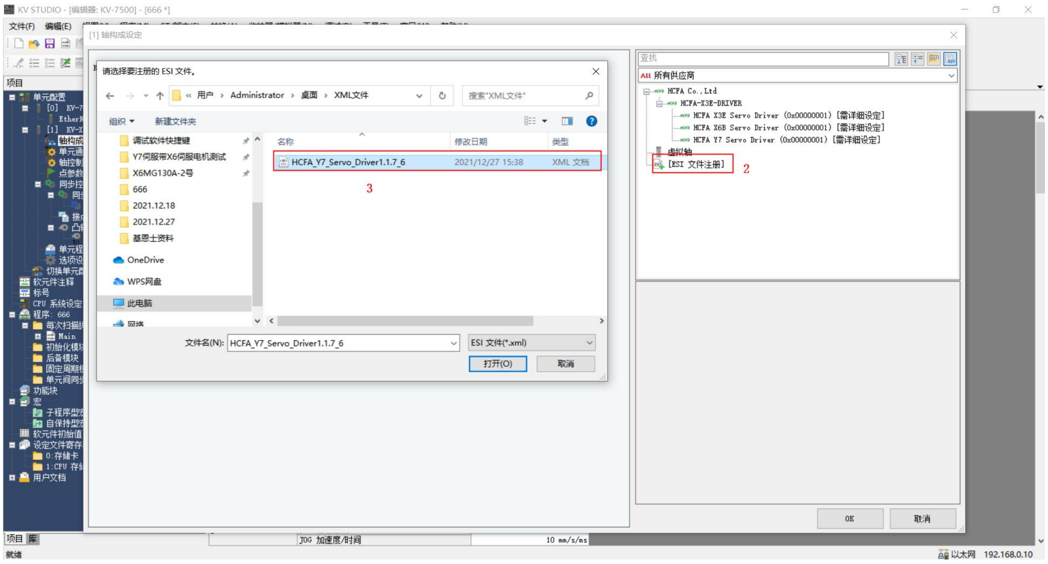
单元信息被更改。要保存更改，关闭窗口吗?

如果按 [是]，则保存更改，关闭窗口。
如果按 [否]，则不保存更改，关闭窗口 (更改被放弃)。
如果按 [取消]，则取消这一操作 (窗口不关闭)。

13.4.4 Description File Adding

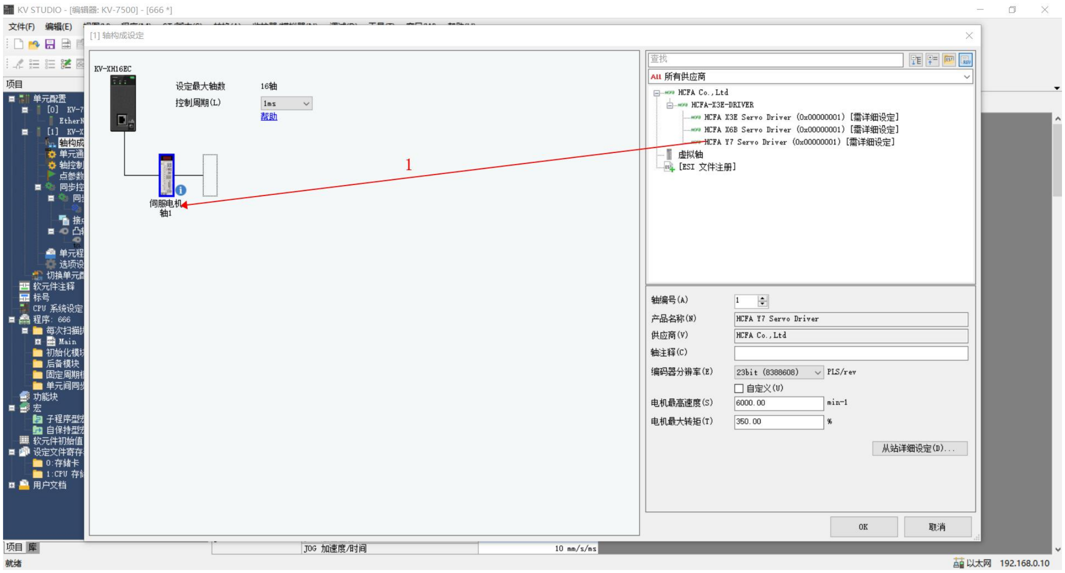
Expand [KV-XH16EC], open [Shaft Structure Setting], click [ESI File Registration] in the pop-up window, find the corresponding description file and install.





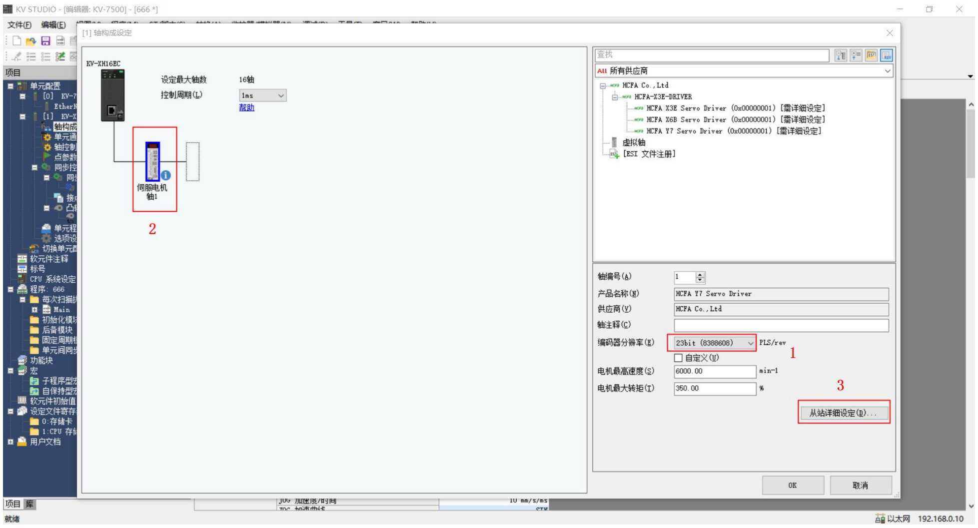
13.4.5 Slave Configuration

According to the actual installation sequence, drag the Y7 servo to the bottom of KV-XH16EC.

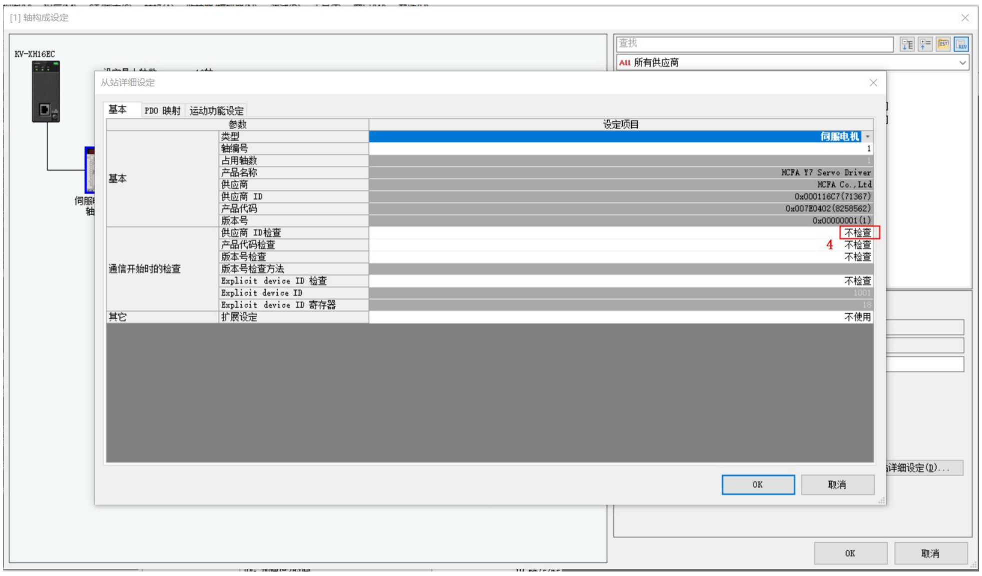


设定最大轴数 16轴
控制周期(L) 1ms
轴编号(A) 1
产品名称(N) HCFA Y7 Servo Driver
供应商(V) HCFA Co.,Ltd
轴注释(C)
编码器分辨率(E) 23bit (8388608) PLS/rev
☐ 自定义(U)
电机最高速度(S) 6000.00 min-1
电机最大转矩(T) 350.00 %

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.

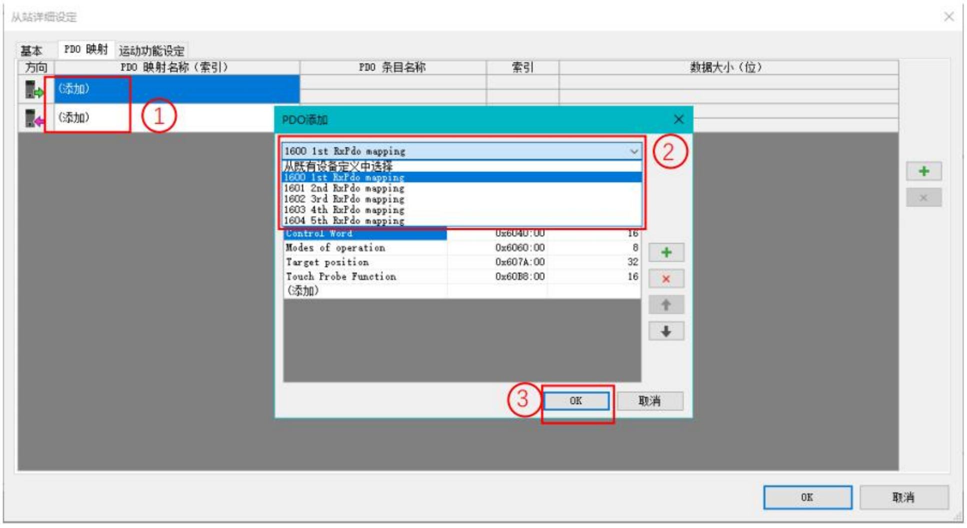


设定最大轴数 16轴
控制周期(L) 1ms
轴编号(A) 1
产品名称(N) HCFA Y7 Servo Driver
供应商(V) HCFA Co.,Ltd
轴注释(C)
编码器分辨率(E) 23bit (8388608) PLS/rev
☐ 自定义(U)
电机最高速度(S) 6000.00 min-1
电机最大转矩(T) 350.00 %



参数		设定项目
基本	类型	伺服电机
	轴编号	1
	占用轴数	1
	产品名称	HCFA Y7 Servo Driver
	供应商	HCFA Co.,Ltd
	供应商 ID	0x000116C7(71367)
	产品代码	0x007E0402(8258562)
	版本号	0x00000001(1)
通信开始时的检查	供应商 ID检查	不检查
	产品代码检查	不检查
	版本号检查	不检查
	版本号检查方法	
	Explicit device ID 检查	不检查
	Explicit device ID	1001
	Explicit device ID 寄存器	18
其它	扩展设定	不使用

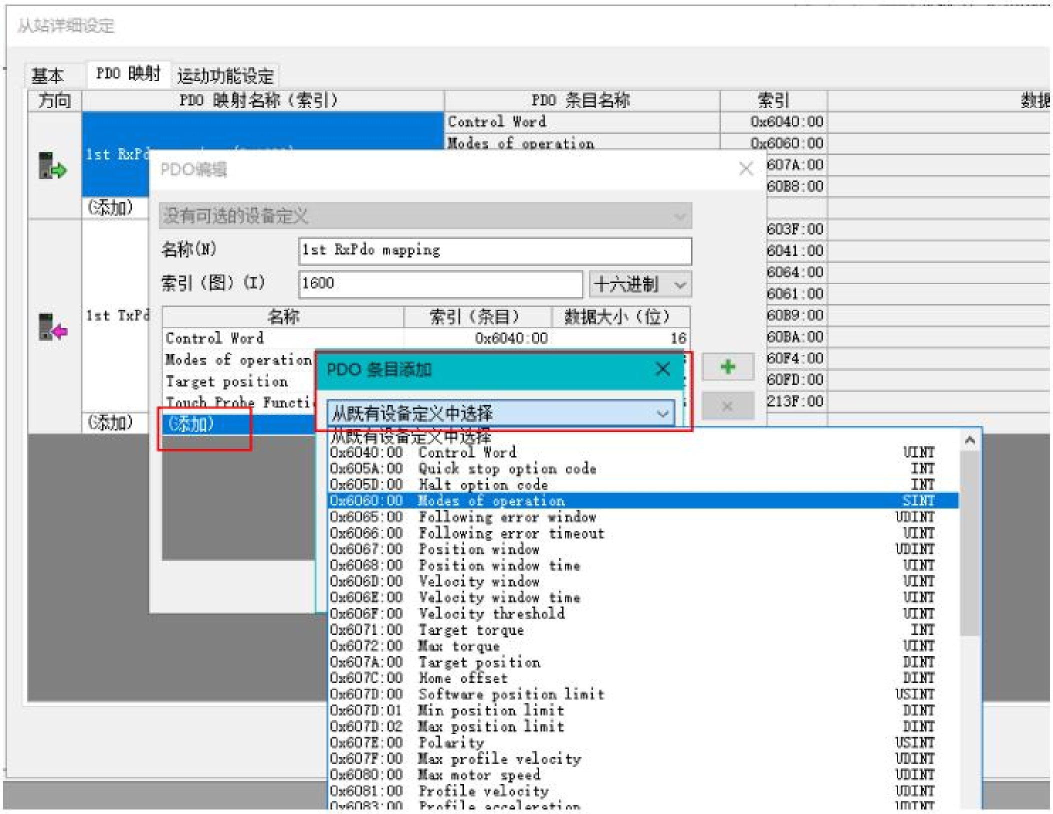
Configure the required PDO parameters in [PDO Mapping], click Add, select the appropriate PDO and add the required object dictionary according to the needs in the pop-up dialog box [PDO] and finally click [OK].



1600 1st RxPdo mapping
从既有设备定义中选择
1600 1st RxPdo mapping
1601 2nd RxPdo mapping
1602 3rd RxPdo mapping
1603 4th RxPdo mapping
1604 5th RxPdo mapping

Control Word	0x6040:00	16
Modes of operation	0x6060:00	8
Target position	0x607A:00	32
Touch Probe Function	0x60B8:00	16
(添加)		

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 [×] on the right side.



名称(N) 1st RxPdo mapping

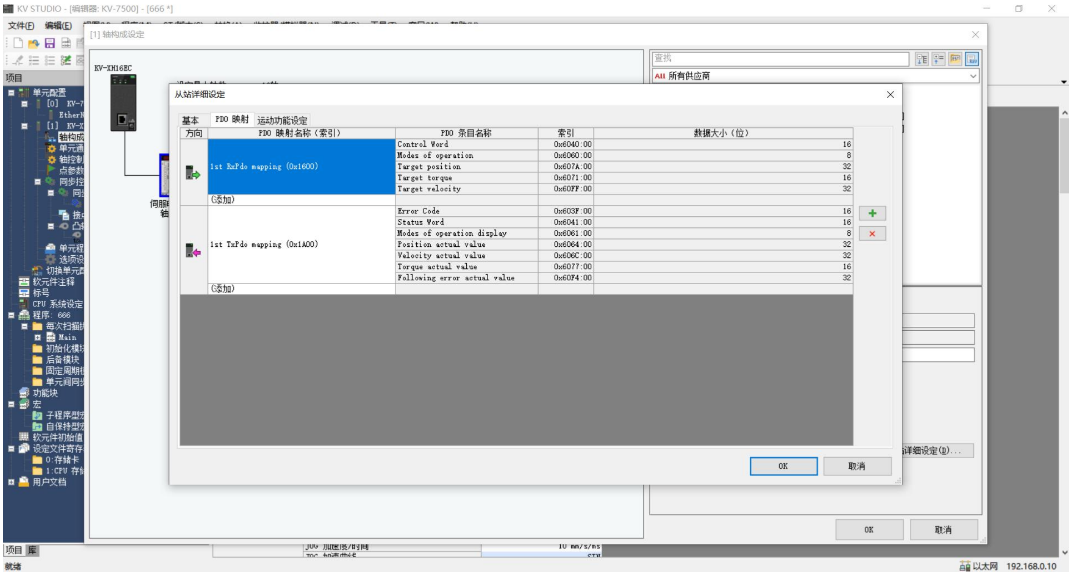
索引（图）(I) 1600

名称	索引（条目）	数据大小（位）
Control Word	0x6040:00	16
Modes of operation		
Target position		
Touch Probe Functi		

从既有设备定义中选择

0x6040:00	Control Word	UINT
0x605A:00	Quick stop option code	INT
0x605D:00	Halt option code	INT
0x6060:00	Modes of operation	SINT
0x6065:00	Following error window	UDINT
0x6066:00	Following error timeout	UINT
0x6067:00	Position window	UDINT
0x6068:00	Position window time	UINT
0x606D:00	Velocity window	UINT
0x606E:00	Velocity window time	UINT
0x606F:00	Velocity threshold	UINT
0x6071:00	Target torque	INT
0x6072:00	Max torque	UINT
0x607A:00	Target position	DINT
0x607C:00	Home offset	DINT
0x607D:00	Software position limit	USINT
0x607D:01	Min position limit	DINT
0x607D:02	Max position limit	DINT
0x607E:00	Polarity	USINT
0x607F:00	Max profile velocity	UDINT
0x6080:00	Max motor speed	UDINT
0x6081:00	Profile velocity	UDINT
0x6083:00	Profile acceleration	UDINT

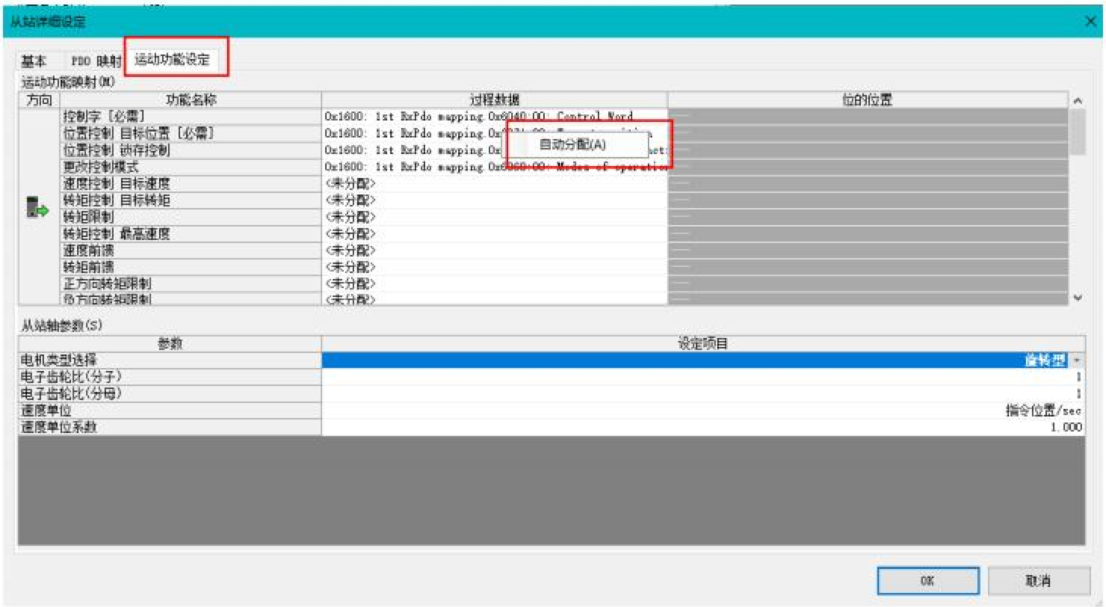
After following the steps above to add PDO parameters, shown as below:


从站详细设定

基本 | PDO 映射 | 运动功能设定

方向	PDO 映射名称（索引）	PDO 条目名称	索引	数据大小（位）
	1st RxPdo mapping (0x1600)	Control Word	0x6040:00	16
		Modes of operation	0x6060:00	8
		Target position	0x607A:00	32
		Target torque	0x6071:00	16
		Target velocity	0x60FF:00	32
	(添加)			
	1st TxPdo mapping (0x1A00)	Error Code	0x603F:00	16
		Status Word	0x6041:00	16
		Modes of operation display	0x6061:00	8
		Position actual value	0x6064:00	32
		Velocity actual value	0x606C:00	32
		Torque actual value	0x6077:00	16
		Following error actual value	0x60F4:00	32
	(添加)			

Finally, clcik [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.


从站详细设定

基本 | PDO 映射 | 运动功能设定

运动功能映射(M)

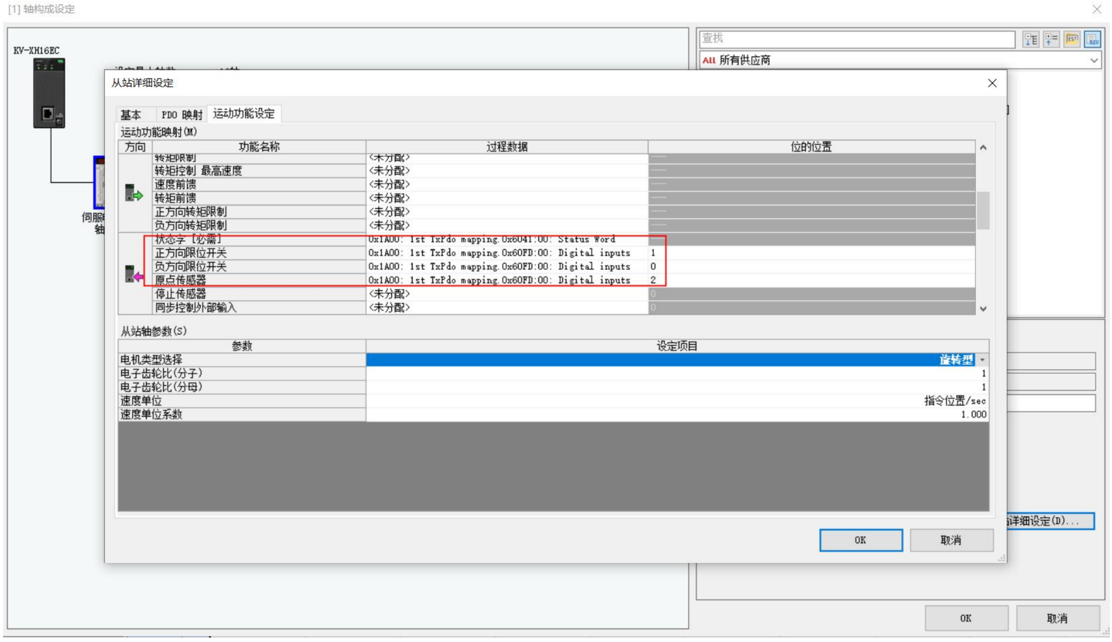
方向	功能名称	过程数据	位的位置
	控制字［必需］	0x1600: 1st RxPdo mapping 0x6040:00: Control Word	—
	位置控制 目标位置［必需］	0x1600: 1st RxPdo mapping 0x	—
	位置控制 锁存控制	0x1600: 1st RxPdo mapping 0x	—
	更改控制模式	0x1600: 1st RxPdo mapping 0x6060:00: Modes of operation	—
	速度控制 目标速度	<未分配>	—
	转矩控制 目标转矩	<未分配>	—
	转矩限制	<未分配>	—
	转矩控制 最高速度	<未分配>	—
	速度前馈	<未分配>	—
	转矩前馈	<未分配>	—
	正方向转矩限制	<未分配>	—
	负方向转矩限制	<未分配>	—

从站轴参数(S)

参数	设定项目
电机类型选择	旋转型
电子齿轮比(分子)	1
电子齿轮比(分母)	1
速度单位	指令位置/sec
速度单位系数	1.000

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.



从站详细设定

基本 | PDO 映射 | 运动功能设定

运动功能映射(M)

方向	功能名称	过程数据	位的位置
	转矩限制	<未分配>	—
	转矩控制 最高速度	<未分配>	—
	速度前馈	<未分配>	—
	转矩前馈	<未分配>	—
	正方向转矩限制	<未分配>	—
	负方向转矩限制	<未分配>	—
	状态字 [必需]	0x1A00: 1st TxPdo mapping.0x6041:00: Status Word	—
	正方向限位开关	0x1A00: 1st TxPdo mapping.0x60FD:00: Digital inputs	1
	负方向限位开关	0x1A00: 1st TxPdo mapping.0x60FD:00: Digital inputs	0
	原点传感器	0x1A00: 1st TxPdo mapping.0x60FD:00: Digital inputs	2
	停止传感器	<未分配>	0
	同步控制外部输入	<未分配>	0

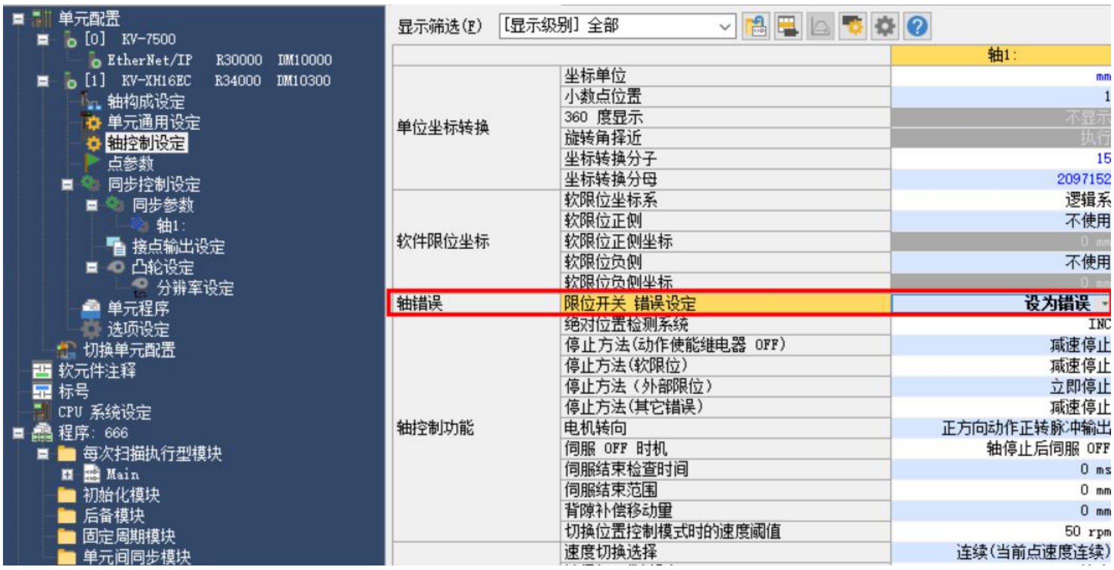
从站轴参数(S)

参数	设定项目
电机类型选择	旋转型
电子齿轮比(分子)	1
电子齿轮比(分母)	1
速度单位	指令位置/sec
速度单位系数	1.000

OK 取消

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]:

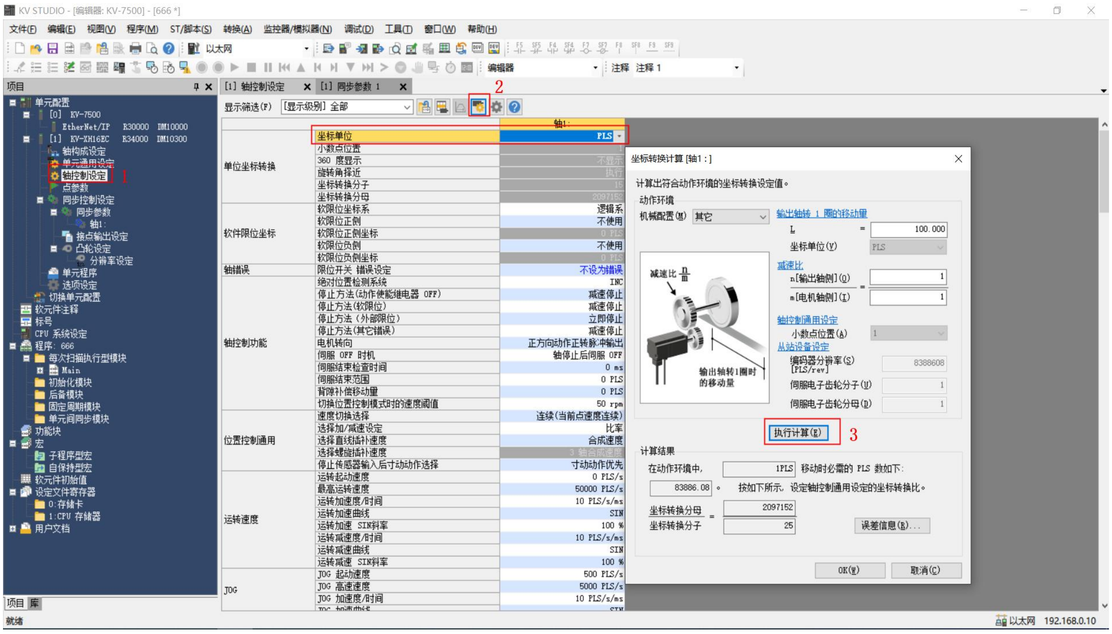


显示筛选(F) [显示级别] 全部

		轴1:
单位坐标转换	坐标单位	mm
	小数点位置	1
	360 度显示	不显示
	旋转角择近	执行
	坐标转换分子	15
	坐标转换分母	2097152
软件限位坐标	软限位坐标系	逻辑系
	软限位正侧	不使用
	软限位正侧坐标	0 mm
	软限位负侧	不使用
	软限位负侧坐标	0 mm
轴错误	限位开关 错误设定	设为错误
轴控制功能	绝对位置检测系统	INC
	停止方法(动作使能继电器 OFF)	减速停止
	停止方法(软限位)	减速停止
	停止方法(外部限位)	立即停止
	停止方法(其它错误)	减速停止
	电机转向	正方向动作正转脉冲输出
	伺服 OFF 时机	轴停止后伺服 OFF
	伺服结束检查时间	0 ms
	伺服结束范围	0 mm
	背隙补偿移动量	0 mm
	切换位置控制模式时的速度阈值	50 rpm
	速度切换选择	连续(当前点速度连续)

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.



坐标转换计算 [轴1 :]

计算出符合动作环境的坐标转换设定值。

动作环境

机械配置(M): 其它

输出轴转 1 圈的移动量

L = 100.000

坐标单位(V): PLS

减速比

n[输出轴侧](O) = 1

m[电机轴侧](I) = 1

轴控制通用设定

小数点位置(A): 1

从站设备设定

编码器分辨率(S) [PLS/rev]: 8388608

伺服电子齿轮分子(U): 1

伺服电子齿轮分母(D): 1

计算结果

在动作环境中, 1PLS 移动时必需的 PLS 数如下:

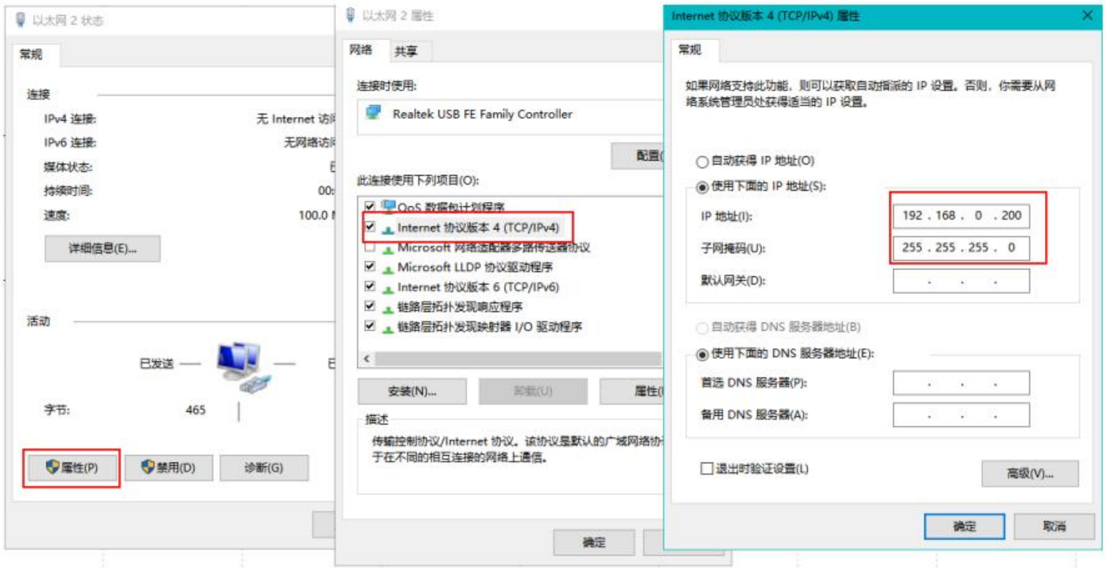
83886.08 。 按如下所示，设定轴控制通用设定的坐标转换比。

坐标转换分母 = 2097152

坐标转换分子 = 25

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.



Internet 协议版本 4 (TCP/IPv4) 属性

○ 自动获得 IP 地址(O)

● 使用下面的 IP 地址(S):

IP 地址(I): 192 . 168 . 0 . 200

子网掩码(U): 255 . 255 . 255 . 0

默认网关(D): . . .

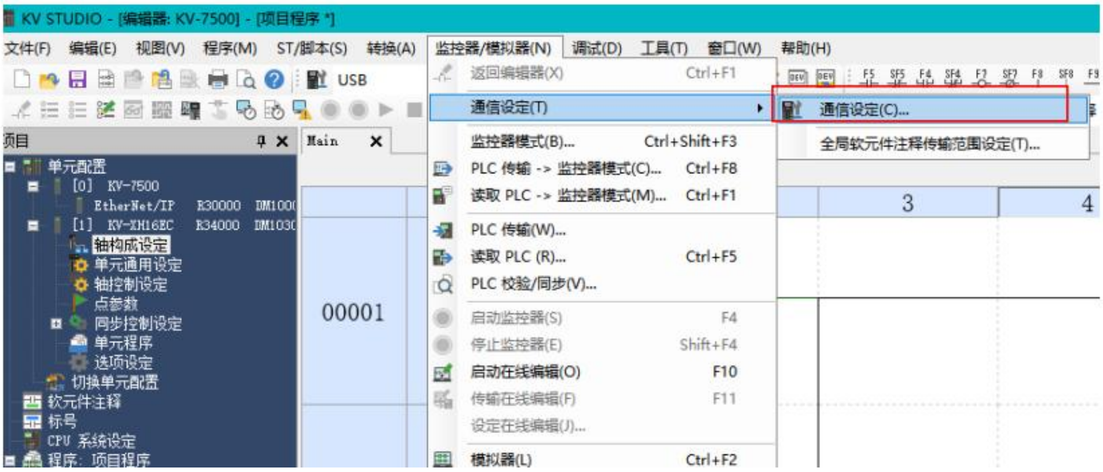
● 使用下面的 DNS 服务器地址(E):

首选 DNS 服务器(P): . . .

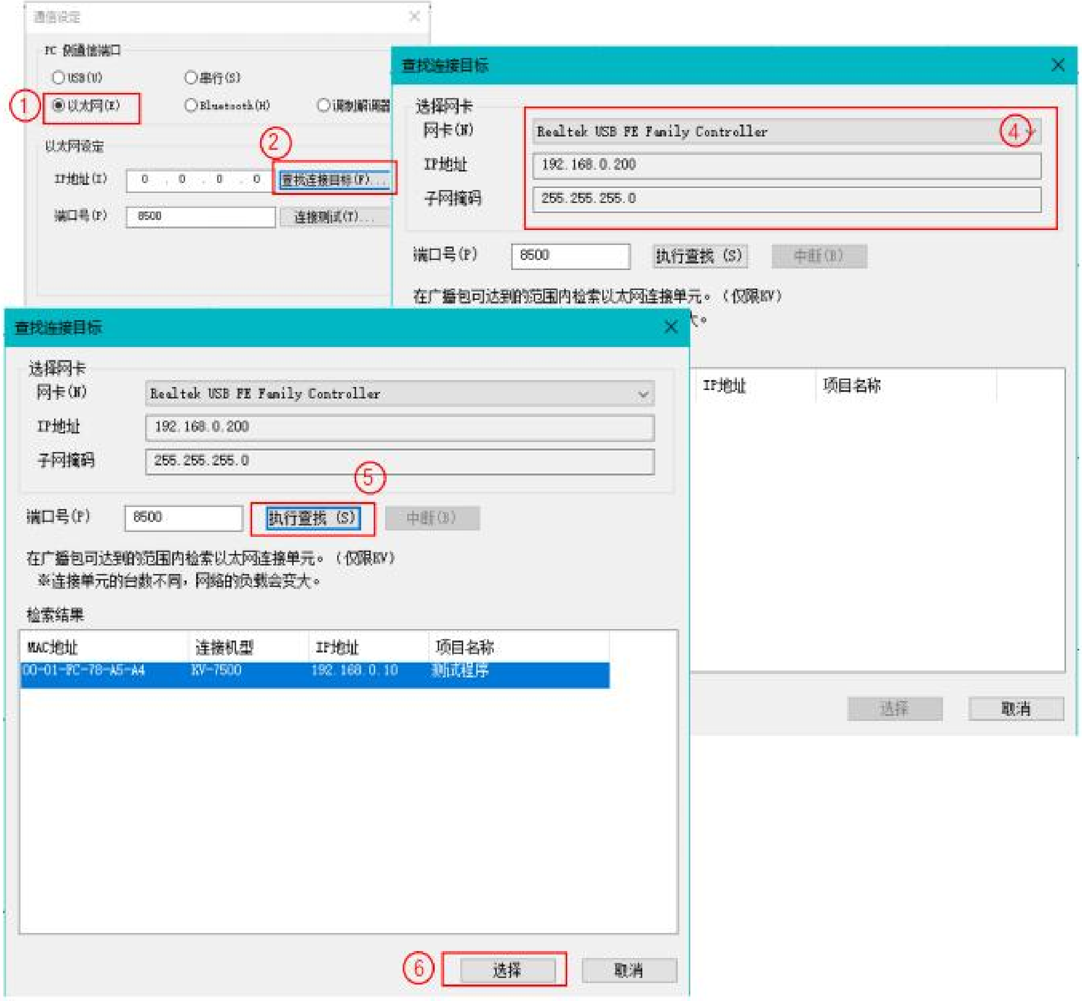
备用 DNS 服务器(A): . . .

☐ 退出时验证设置(L)

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.



IP地址(I) 0 . 0 . 0 . 0

端口号(P) 8500

网卡(N) Realtek USB FE Family Controller

IP地址 192.168.0.200

子网掩码 255.255.255.0

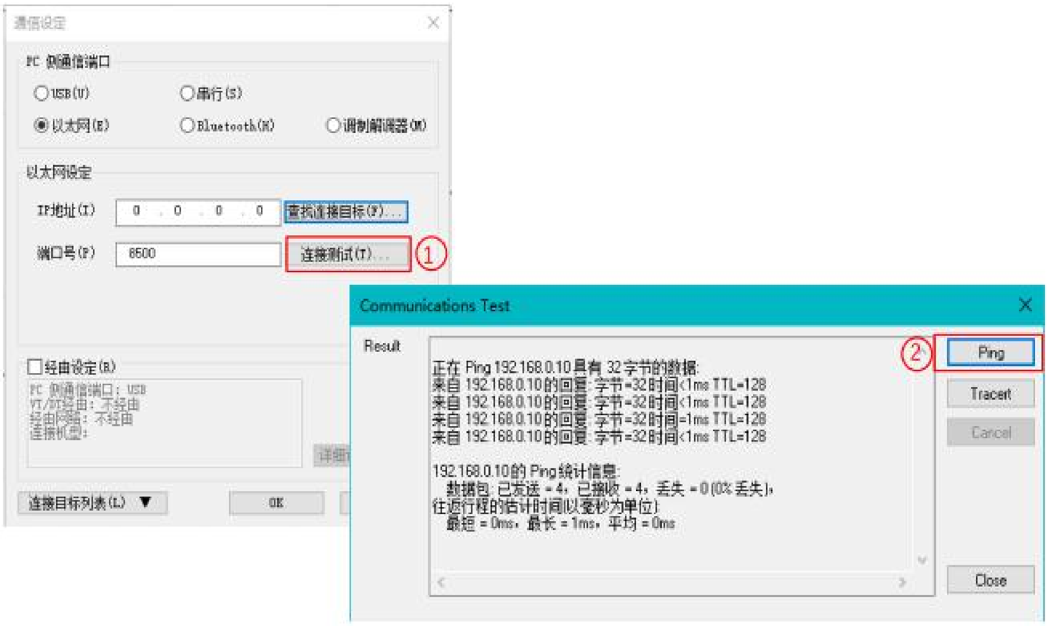
端口号(P) 8500

在广播包可达到的范围内检索以太网连接单元。（仅限KV）
※连接单元的台数不同，网络的负载会变大。

检索结果

MAC地址	连接机型	IP地址	项目名称
00-01-FC-78-A5-A4	KV-7500	192.168.0.10	测试程序

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.



通信设定

PC 侧通信端口

○USB(U) ○串行(S)

● 以太网(E) ○Bluetooth(H) ○调制解调器(M)

以太网设定

IP地址(I) 0 . 0 . 0 . 0

端口号(P) 8500

□经由设定(R)

PC 侧通信端口：USB
VT/DT经由：不经由
经由网络：不经由
连接机型：

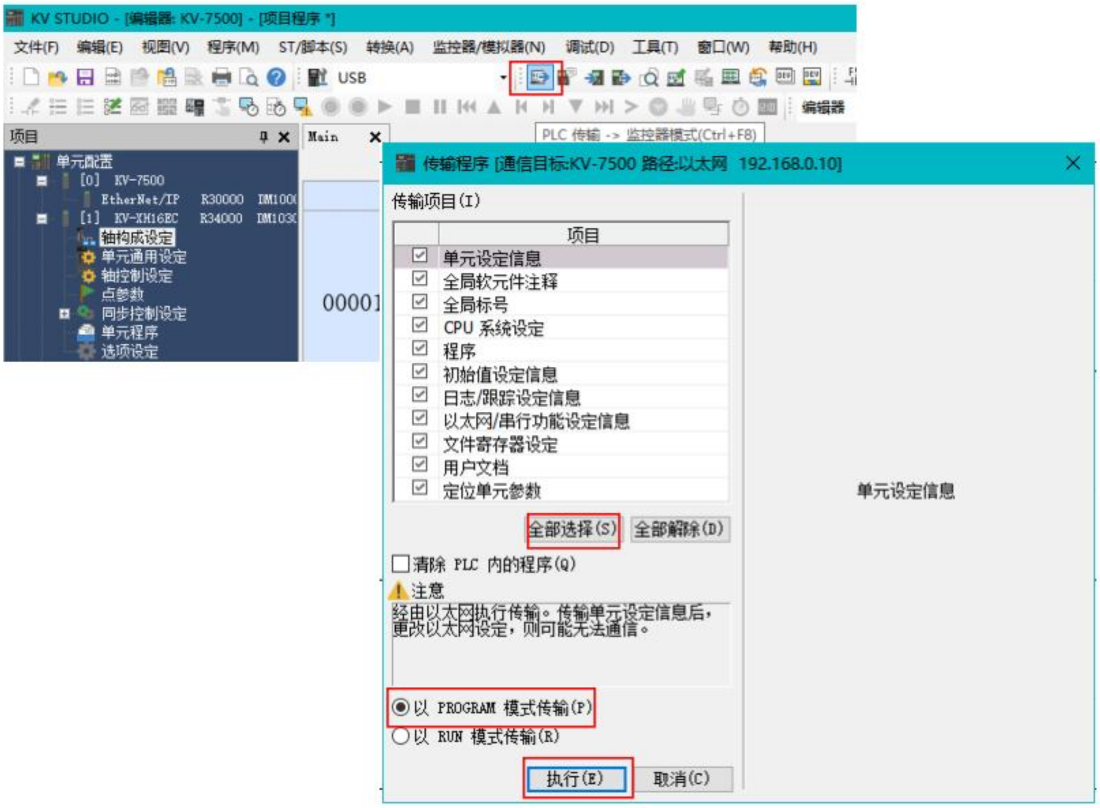
Communications Test

Result

```
正在 Ping 192.168.0.10 具有 32 字节的数据:
来自 192.168.0.10 的回复: 字节=32 时间<1ms TTL=128
来自 192.168.0.10 的回复: 字节=32 时间<1ms TTL=128
来自 192.168.0.10 的回复: 字节=32 时间=1ms TTL=128
来自 192.168.0.10 的回复: 字节=32 时间<1ms TTL=128

192.168.0.10 的 Ping 统计信息:
    数据包: 已发送 = 4，已接收 = 4，丢失 = 0 (0% 丢失)，
往返行程的估计时间(以毫秒为单位):
    最短 = 0ms，最长 = 1ms，平均 = 0ms
```

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 .



KV STUDIO - [编辑器: KV-7500] - [项目程序 *]

传输程序 [通信目标:KV-7500 路径:以太网 192.168.0.10]

传输项目(I)

	项目
☑	单元设定信息
☑	全局软元件注释
☑	全局标号
☑	CPU 系统设定
☑	程序
☑	初始值设定信息
☑	日志/跟踪设定信息
☑	以太网/串行功能设定信息
☑	文件寄存器设定
☑	用户文档
☑	定位单元参数

□清除 PLC 内的程序(Q)

⚠注意

经由以太网执行传输。传输单元设定信息后，更改以太网设定，则可能无法通信。

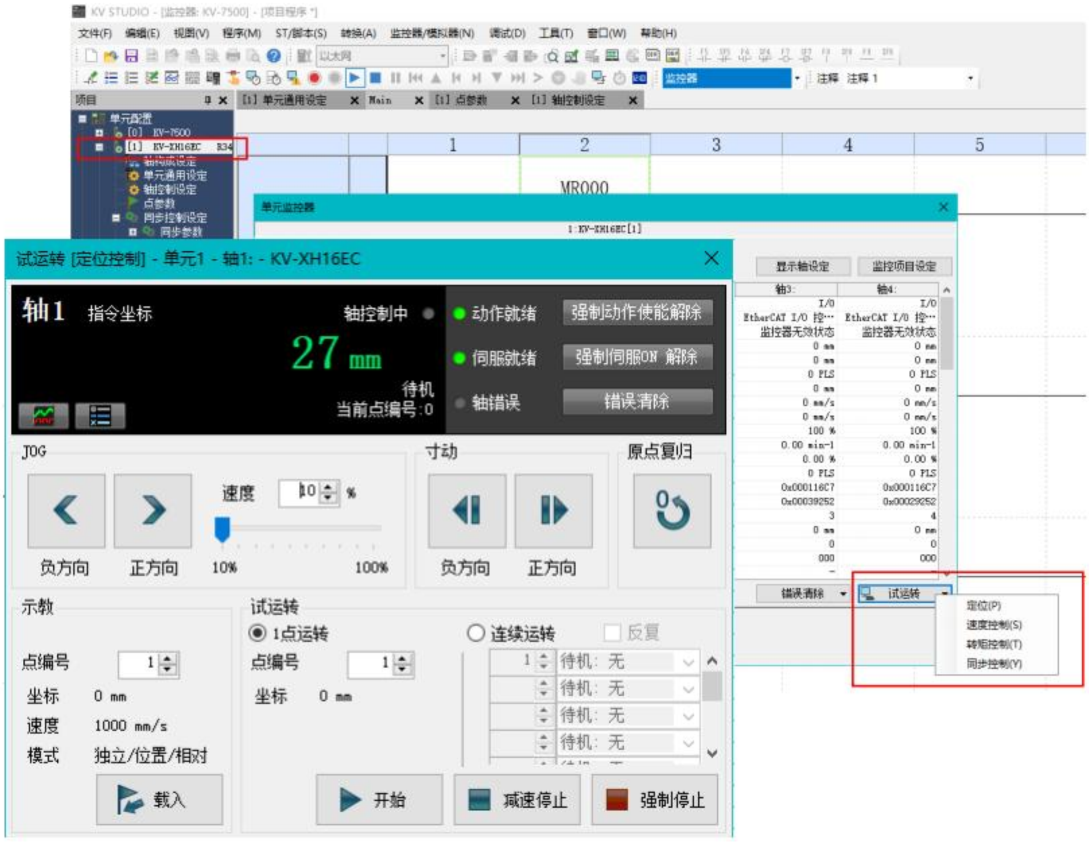
● 以 PROGRAM 模式传输(P)

○以 RUN 模式传输(R)

单元设定信息

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 (HCFA 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.

(Note: Most diagrams in this chapter are in Chinese, which will be updated in the new version. if you need specific details for connection example, please send an email to 400@hcfa.cn)