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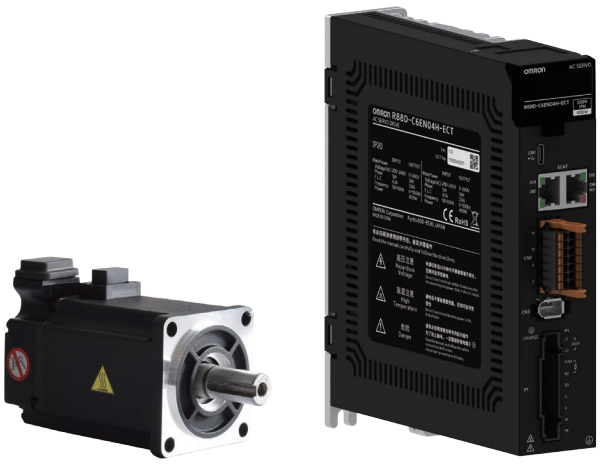
AC Servomotors/Servo Drives

C6E-series with Built-in

EtherCAT® Communications

User's Manual

R88M-C6L□/-C6M□/-C6H□ (AC Servomotors)
R88D-C6EN□-ECT (AC Servo Drives)



I700-E5-01

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Introduction

Thank you for purchasing a C6E-series Servo Drive with Built-in EtherCAT Communications. This User's Manual describes the installation and wiring methods of the C6E-series Servo Drives with Built-in EtherCAT Communications and parameter setting method which is required for the operation, as well as troubleshooting and inspection methods.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of introducing FA devices.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and connecting FA facilites.
- Personnel in charge of site management of FA systems and devices.

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503.

Notice

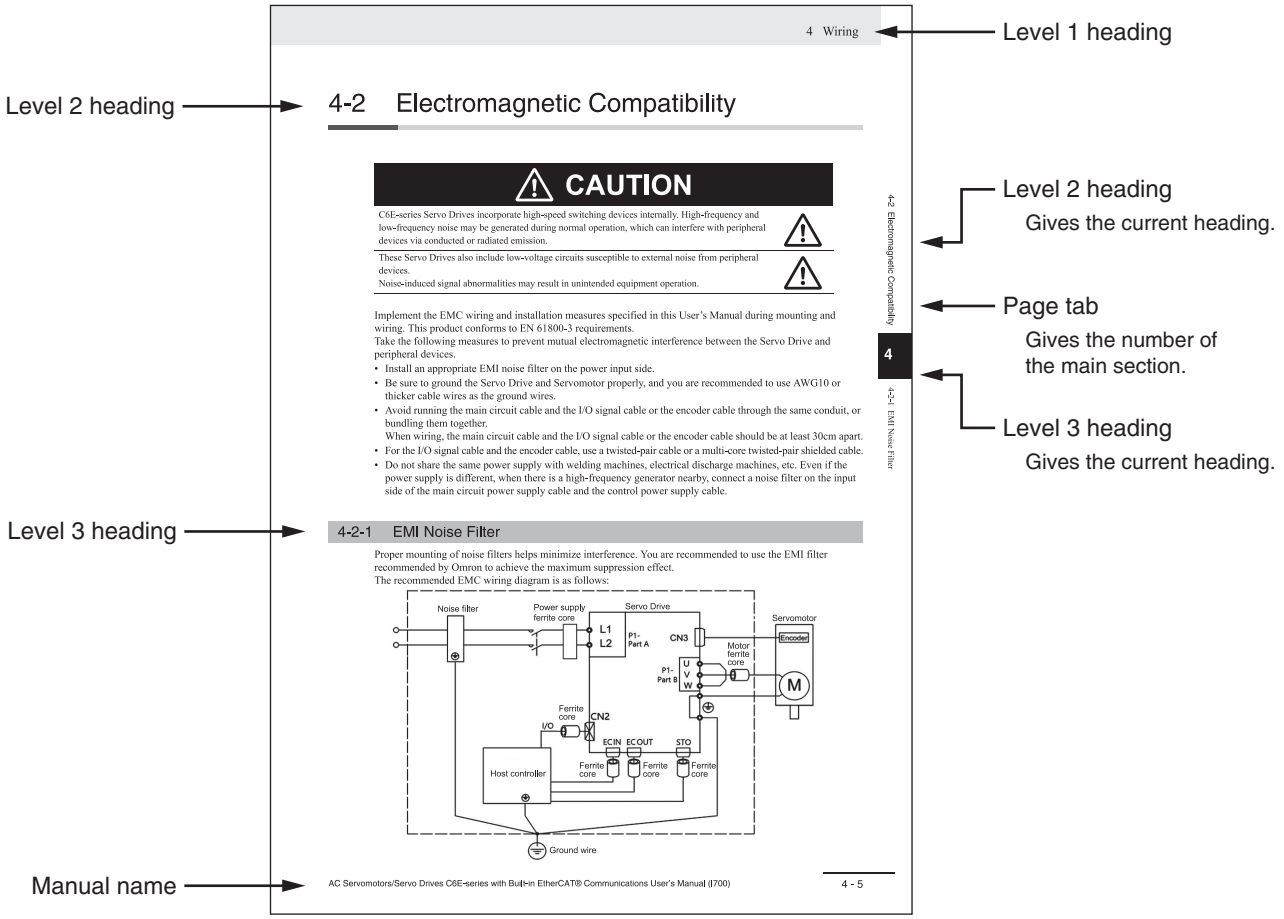
This User's Manual contains information you need to know to correctly use the C6E-series Servo Drives with Built-in EtherCAT Communications and peripheral equipment.
Before using the Servo Drive, read this User's Manual and gain a full understanding of the information provided herein.
After you finished reading this User’s Manual, keep it in a convenient place so that it can be referenced at any time.
Make sure this User’s Manual is delivered to the end user.

Manual Structure

The following section describes the page structure and the meanings of icons.

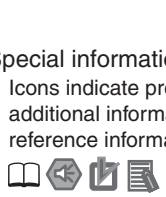
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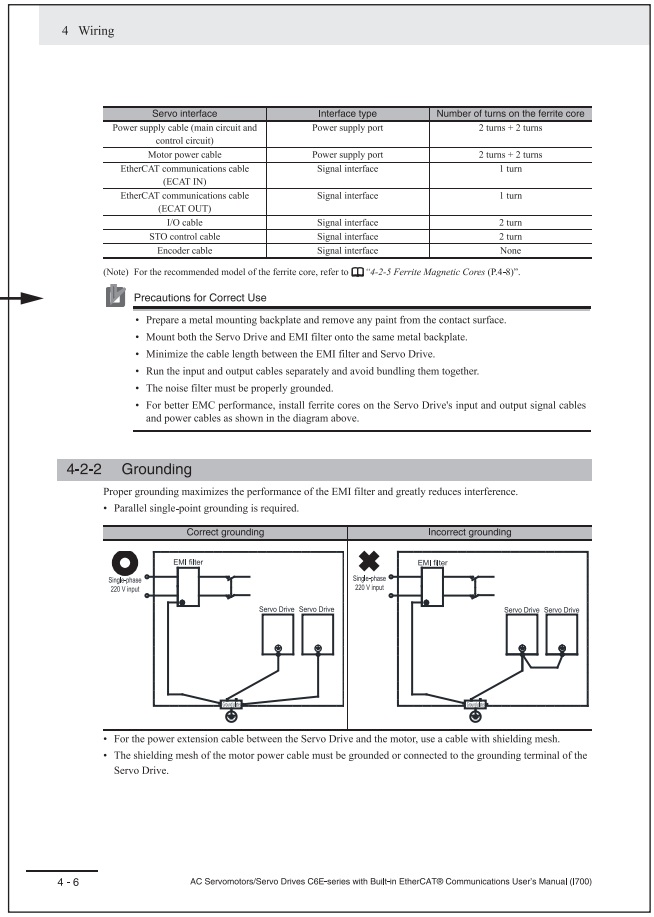
The following page structure is used in this manual.



(Note) This illustration is provided only as a sample. It may not literally appear in this manual.

Special information
Icons indicate precautions, additional information, or reference information.





4 Wiring

Servo interface	Interface type	Number of turns on the ferrite core
Power supply cable (main circuit and control circuit)	Power supply port	2 turns + 2 turns
Motor power cable	Power supply port	2 turns + 2 turns
EtherCAT communications cable (ECAT IN)	Signal interface	1 turn
EtherCAT communications cable (ECAT OUT)	Signal interface	1 turn
I/O cable	Signal interface	2 turn
STO control cable	Signal interface	2 turn
Encoder cable	Signal interface	None

(Note) For the recommended model of the ferrite core, refer to "*4-2-5 Ferrite Magnetic Cores* (P.4-8)".

Precautions for Correct Use

- Prepare a metal mounting backplate and remove any paint from the contact surface.
- Mount both the Servo Drive and EMI filter onto the same metal backplate.
- Minimize the cable length between the EMI filter and Servo Drive.
- Run the input and output cables separately and avoid bundling them together.
- The noise filter must be properly grounded.
- For better EMC performance, install ferrite cores on the Servo Drive's input and output signal cables and power cables as shown in the diagram above.

4-2-2 Grounding

Proper grounding maximizes the performance of the EMI filter and greatly reduces interference.

- Parallel single-point grounding is required.

Correct grounding	Incorrect grounding
EMI filter, Single-phase 220 V input, Servo Drive, Servo Drive	EMI filter, Single-phase 220 V input, Servo Drive, Servo Drive

- For the power extension cable between the Servo Drive and the motor, use a cable with shielding mesh.
- The shielding mesh of the motor power cable must be grounded or connected to the grounding terminal of the Servo Drive.

4 - 6

AC Servomotors/Servo Drives C6E-series with Built-in EtherCAT® Communications User's Manual (I700)

(Note) This illustration is provided only as a sample. It may not literally appear in this manual.

Icons

The meaning of the icons used in this manual is described below.

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.

This icon indicates where detailed and related information is provided.

Manual Configuration

This User's Manual consists of the following sections.
Read the necessary section or sections by reference to the following table.

Section		Outline
Section 1	Features and System Configuration	This section explains the system configuration of the Servo Drive, the name and function of each part, and the applicable standards.
Section 2	Product Outline	This section explains the models and external dimensions of Servo Drives, Servomotors, and peripheral devices.
Section 3	Installation	This section explains the storage conditions, installation conditions, and installation precautions for the Servo Drive and Servomotor.
Section 4	Wiring	This section explains the definitions of various interfaces and connector pins of the Servo Drive and motor, the wiring methods, and the regenerative energy calculation methods, etc.
Section 5	Display Panel Operation	This section explains the names and functions, the display, the function operation modes, the parameter setting modes, and the error alarm display of the Servo Drive display panel.
Section 6	Test Run	This section explains the inspections before test run of the servo system, the test run procedure, and the parameters setting for connecting to the computer.
Section 7	Servo Gain Tuning	This section introduces the servo debugging process and modes, and explains the auto-tuning mode, advanced tuning mode, vibration suppression, etc.
Section 8	EtherCAT Communications	This section provides an outline of EtherCAT, and explains the CANopen over EtherCAT reference model, the EtherCAT frame structure and state machine, the PDO process data, and the SDO mailbox data, etc.
Section 9	Motion Control Modes	This section explains the PDS state control, modes of operation, Profile position mode, Profile velocity mode, Profile torque mode, and Cyclic synchronous position mode, etc. of the Servo Drive.
Section 10	Applied Functions	This section provides the outline and settings of the applied functions such as electronic gear and gain switching.
Section 11	Troubleshooting	This section explains the troubleshooting at startup, the alarm list, the causes of alarms and measures.
Section 12	Maintenance and Inspection	This section explains maintenance and inspection of the Servomotors and Servo Drives.
Section 13	Object Dictionary	This section explains the classification, data types, and object attributes of the object dictionary.
Appendices		The appendices provide the LED Display Character Reference Table and the Object Dictionary and Parameter Code Reference Table.

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1 Features and System Configuration

2 Product Outline

3 Installation

4 Wiring

5 Display Panel Operation

6 Test Run

7 Servo Gain Tuning

8 EtherCAT Communications

9 Motion Control Modes

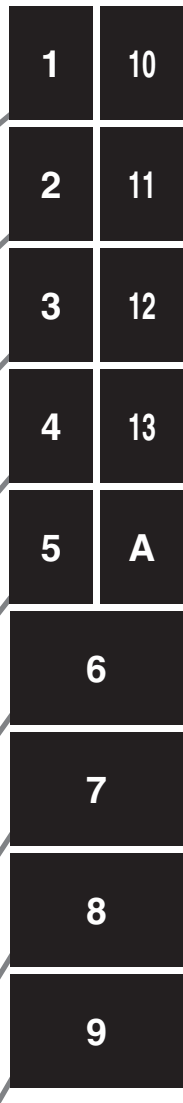
10 Applied Functions

11 Troubleshooting

12 Maintenance and Inspection

13 Object Dictionary

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Safety Precautions

- To ensure that the C6E-series Servo Drive with Built-in EtherCAT Communications/C6E-series Servomotor as well as peripheral equipment are used safely and correctly, be sure to read this *Safety Precautions* section and the main text before using the product. Learn all items you should know before use, regarding the equipment as well as the required safety information and precautions.
- Make sure this User's Manual is delivered to end users.
- After reading, keep this manual in an easily accessible place.

Explanation of Displays

- The precautions indicated here provide important information for safety. Be sure to heed the information provided with the precautions.
- The following signal words are used to indicate and classify precautions in this User's Manual.

⚠ DANGER	Indicates an imminently hazardous situation which, if not avoided, is likely to result in serious injury or may result in death. Additionally there may be severe property damage.
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be severe property damage.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

Even those items denoted by the caution symbol may lead to a serious outcome depending on the situation. Accordingly, be sure to observe all safety precautions.

Explanation of Symbols

This User's Manual uses the following symbols.

	The circle and slash symbol (⃠) indicates operations that you must not do. The specific operation is shown in the circle (⃠) and explained in text. This example indicates prohibiting disassembly.
	The triangle symbol (△) indicates precautions and warnings. The specific operation is shown in the triangle (△) and explained in text. This example indicates a precaution for electric shock.
	The triangle symbol (△) indicates precautions and warnings. The specific operation is shown in the triangle (△) and explained in text. This example indicates a general precaution.
	The filled circle symbol (●) indicates operations that you must do. The specific operation is shown in the circle (●) and explained in text. This example indicates a requirement for the ground.

Precautionary Information

- Illustrations contained in this manual sometimes depict conditions without covers and safety shields for the purpose of showing the details. When you use this product, be sure to install the covers and shields as specified and use the product according to this manual.
- If the product has been stored for an extended period of time, contact your OMRON sales representative.

Handling of Safety Products

If the functions of safety products cannot attain their full potential, it will result in minor or moderate injury, or may result in serious injury or death. When building the system, observe the following warnings and optimize safety product selection for your equipment and devices to ensure the integrity of the safety-related components.

⚠ WARNING

● Setting Up a Risk Assessment System

The process of selecting these products should include the development and execution of a risk assessment system early in the design development stage to help identify potential dangers in your equipment and optimize safety product selection.

The following is an example of related international standards.

- ISO12100 General Principles for Design - Risk Assessment and Risk Reduction

● Protective Measure

When developing a safety system for the equipment and devices that use safety products, make every effort to understand and conform to the entire series of international and industry standards available, such as the examples given below.

The following are examples of related international standards.

- ISO12100 General Principles for Design - Risk Assessment and Risk Reduction
- IEC60204-1 Electrical Equipment of Machines - Part 1: General Requirements
- ISO13849-1, -2 Safety-related Parts of Control Systems
- ISO14119 Interlocking Devices Associated with Guards - Principles for Design and Selection
- IEC/TS 62046 Safety of Machinery – Application of Protective Equipment to Detect the Presence of Persons

● Role of Safety Products

Safety products incorporate standardized safety functions and mechanisms, but the benefits of these functions and mechanisms are designed to attain their full potential only within properly designed safety-related systems. Make sure you fully understand all functions and mechanisms, and use that understanding to develop systems that will ensure optimal usage.

The following are examples of related international standards.

- ISO14119 Interlocking Devices Associated with Guards - Principles for Design and Selection
- ISO13857 Safety Distances to Prevent Hazard Zones being Reached by Upper and Lower Limbs

Installing Safety Products

Qualified engineers must develop your safety-related system and install safety products in devices and equipment. Prior to machine commissioning, verify through testing that the safety products work as expected.

The following are examples of related international standards.

- ISO12100 General Principles for Design - Risk Assessment and Risk Reduction
- IEC60204-1 Electrical Equipment of Machines - Part 1: General Requirements
- ISO13849-1, -2 Safety-related Parts of Control Systems
- ISO14119 Interlocking Devices Associated with Guards - Principles for Design and Selection

Observing Laws and Regulations

Safety products must conform to pertinent laws, regulations, and standards. Make sure that they are installed and used in accordance with the laws, regulations, and standards of the country where the devices and equipment incorporating these products are distributed.

Observing Usage Precautions

Carefully read the specifications and precautions as well as all items in the Instruction Manual and User's Manual for your safety product to learn appropriate usage procedures. Any deviation from instructions will disable the design functions of safety-related parts, and lead to unexpected device or equipment failure not anticipated by the safety-related system, as well as consequent hazards.

Transferring Devices and Equipment

When you transfer devices and equipment, be sure to retain one copy of the Instruction Manual for safety devices and the User's Manual, and supply another copy with the device or equipment so the person receiving it will have no problems with operation and maintenance.

The following are examples of related international standards.

- ISO12100 General Principles for Design - Risk Assessment and Risk Reduction
- IEC60204-1 Electrical Equipment of Machines - Part 1: General Requirements
- ISO13849-1, -2 Safety-related Parts of Control Systems
- IEC62061 Functional Safety of Safety-related Electrical, Electronic and Programmable Electronic Control Systems
- IEC61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Installation, Wiring and Maintenance

⚠ WARNING

Install the Servo Drive, Servomotor, and peripheral equipment before wiring.
Not doing so may cause electric shock.



Be sure to implement Class D grounding or above for the protective grounding terminals of 220V models of the Servo Drives, Servomotors and peripheral equipment according to the wire diameter and wiring instructions in Section 4.
Not doing so may cause electric shock.



Do not remove the front cover, terminal covers, cables, or peripheral equipment while the power is supplied.
Electric shock may result.



Before carrying out wiring or inspection, turn OFF the power supply and wait for 10 minutes.
Not doing so may cause electric shock or burning.



Do not damage, pull, or put excessive stress or heavy objects on the cables, or squeeze the cables.
Electric shock, malfunction, or burning may result.



Use appropriate tools to wire terminals and connectors. Check that there is no short-circuit before use.
Not doing so may cause electric shock.



Connect the frame ground wire in the motor cable securely to the ⏚ or FG of the Servo Drive.
Not doing so may cause electric shock.



Install the Servomotor, Servo Drive, and peripheral equipment on non-flammable materials such as metals.
Not doing so may cause fire.



Keep conductive or flammable foreign objects such as screws, metal pieces, and oil out of the Servo Drive and connectors. Pay particular attention to the connector on the top part of Servo Drive.
Not doing so may cause fire or electric shock.



Operation Check

⚠ WARNING

Use the Servomotor and Servo Drive in a specified combination.
Not doing so may cause fire or equipment damage.



Provide safety measures, such as a circuit breaker, to protect against short circuiting of external wiring and failure of the Servo Drive.
Not doing so may cause fire.



Design the configuration to cut off the main circuit power supply when the ALM signal of the control output function is output.
Not doing so may cause fire.



Before operating the Servo Drive in an actual environment, check if it operates correctly based on the newly set parameters.
Equipment damage may result.



Usage

⚠ WARNING	
Do not enter the operating area during operation. Injury may result.	
Do not touch the Servo Drive radiator, Servomotor and peripheral equipment while the power is supplied or for a while after the power is turned OFF because they may be still hot. Fire or burn injury may result.	
In locations where the power supply is unstable, ensure that the specified power with the rated voltage is supplied. Not doing so may cause failure.	
When the power is restored after a momentary power interruption, the machine may restart suddenly. Do not come close to the machine when restoring power. Take measures to ensure personal safety in case the machine restarts suddenly. Not doing so may cause injury.	
Be sure to observe the radiator plate installation conditions that are specified in the manual. Not doing so may cause the Servo Drive or Servomotor to burn.	
Be aware that if the load that exceeds the allowable range is installed, it may cause a dynamic braking fault. Be sure to use the appropriate load. Not doing so may cause the Servo Drive to be damaged.	
Use an appropriate Dynamic Brake Resistor. Not doing so may cause fire, crash or equipment damage.	
The dynamic brake is intended for the stop at the time of an error and therefore it has a short time rating. If the dynamic brake is activated, provide an interval of 5 minutes or more before the next activation to prevent a circuit failure and burning of the Dynamic Brake Resistor.	
Do not place flammable materials near the Servomotor, Servo Drive, or peripheral equipment. Fire may result.	
If the Servo Drive fails, cut off the power supply to the Servo Drive at the power supply side. Not doing so may cause fire.	
Use an appropriate External Regeneration Resistor. Install an external protective device such as temperature sensor to ensure safety when using the External Regeneration Resistor. Not doing so runs the risk of burnout.	
Even if the 7-segment LED display is not lit, the main circuit power supply may be ON. Always confirm that the charge lamp is not lit before you perform wiring. Not doing so may cause electric shock.	

Security Measures

⚠ WARNING

Anti-virus protection
Install the latest commercial-quality anti-virus software on the computer connected to the control system and maintain to keep the software up-to-date.



Security measures to prevent unauthorized access
Take the following measures to prevent unauthorized access to our products.

- Install physical controls so that only authorized personnel can access control systems and equipment.
- Reduce connections to control systems and equipment via networks to prevent access from untrusted devices.
- Install firewalls to shut down unused communications ports and limit communications hosts and isolate control systems and equipment from the IT network.
- Use a virtual private network (VPN) for remote access to control systems and equipment.
- Adopt multifactor authentication to devices with remote access to control systems and equipment.
- Use complex passwords and change them frequently.
- Scan virus to ensure safety of USB drives or other external storages before connecting them to control systems and equipment.



Data input and output protection
Validate backups and ranges to cope with unintentional modification of input/output data to control systems and equipment.

- Checking the scope of data
- Checking validity of backups and preparing data for restore in case of falsification and abnormalities
- Safety design, such as emergency shutdown and fail-soft operation in case of data tampering and abnormalities



Data recovery
Backup data and keep the data up-to-date periodically to prepare for data loss.



When using an intranet environment through a global address, connecting to an unauthorized terminal such as a SCADA, HMI or to an unauthorized server may result in network security issues such as spoofing and tampering. You must take adequate and effective security measures, such as restricting access to the terminal, using a terminal equipped with a secure function, and locking the panel setting area by yourself.



When constructing an intranet, communication failure may occur due to cable disconnection or the influence of unauthorized network equipment.
Take adequate and effective security measures, such as restricting physical access to network devices by means such as locking the panel setting area.



When using a device equipped with the SD Memory Card function, there is a security risk that a third party may acquire, alter, or replace the files and data in the removable media by removing the removable media or unmounting the removable media.
You must take adequate and effective security measures, such as restricting physical access to the Controller or taking appropriate management measures for removable media, by means of locking the panel setting area, entrance management, etc., by yourself.



Transporting and Unpacking

⚠ CAUTION

When transporting the Servo Drive, do not hold it by the cables, shield clamp, connectors or motor shaft.
Injury or failure may result.



Do not step on the Servo Drive or place heavy articles on it.
Injury or failure may result.



Do not overload the product.
Injury or failure may result.



Be sure to observe the specified amount when piling up products.
Injury or failure may result.

- The allowable number of piled-up products
  Servo Drive, Servomotor, Reactor: Follow the instructions on the individual package.



Wiring

⚠ CAUTION

Be careful about sharp parts such as the corner of the equipment when handling the Servo Drive and Servomotor.
Not doing so may cause injury.



Wire the cables correctly and securely.
Not doing so may cause damage or burnout of Servo Drive.



Wire the cables correctly and securely.
Not doing so may cause runaway motor, unintended operation of a brake, personal injury, or equipment failure.



Do not control or operate the servo system through USB and ECAT connection simultaneously.
Personal injury or equipment failure may result.



Safety Precautions

General Precaution

- Do not store or install the Servo Drive in the following locations. Electric shock, fire, equipment damage, or malfunction may result.
  Locations subject to direct sunlight
  Locations subject to ambient temperatures outside the range specified in the specifications
  Locations subject to relative humidity outside the range specified in the specifications
  Locations subject to condensation as the result of severe changes in temperature
  Locations subject to corrosive or flammable gases
  Locations subject to dust (especially iron dust) or salts
  Locations subject to exposure to water, oil, or chemicals
  Locations subject to shock or vibration
- Medical electronics such as cardiac pacemakers may malfunction or become damaged.
- Provide safety measures, such as a circuit breaker, to protect against short circuiting of external wiring and failure of the Servo Drive. Not doing so may cause fire.
- If an error occurs, remove the cause of the error and ensure safety, and then perform the error reset and restart the operation. Not doing so may cause injury, equipment damage, or burning.

Wiring

- Use a robot cable for the wiring to separately install the Servo Drive and Servomotor to moving and fixed parts of the equipment. Equipment damage may result.
- Connect the Servo Drive to the Servomotor directly without using a connector or similar device. Not doing so may cause malfunction or equipment damage.
- Be sure to comply with the installation conditions. Not doing so may cause burnout or failure.
- Take appropriate and sufficient countermeasures to provide shielding when installing systems in the following locations. Not doing so may cause failure.
  Locations subject to static electricity or other forms of noise
  Locations subject to strong electric or magnetic fields
  Locations subject to possible exposure to radioactivity
  Locations close to power supply cables or power lines
- Be careful when locking the connector buckle, or the buckle may pinch your fingers.

Precautions for Correct Use

General Precaution

- When transporting or installing the products at 20 kg or more, always have at least two people lift the products by grasping a metal part other than the shaft. Do not grasp a plastic part of the product. Injury or failure may result.

Transporting and Unpacking

- Check that the eye bolts are not loose after replacing them. If they are loose, the screws can come off and the Servomotor may fall during the transportation by the use of eye bolts. Do not put the human body under the Servomotor during the transportation.

Installation

- Be sure to observe the mounting direction. Not doing so may cause failure.
- Provide the specified clearance between the Servo Drive and the inner surface of the control panel or other equipment. Not doing so may cause fire or failure.
- Tighten the mounting screws, terminal block screws, and cable screws for the Servo Drive, Servomotor, and peripheral equipment to the specified torque. Not doing so may cause failure.
- Do not apply strong impact on the motor shaft or the Servo Drive. Failure may result.
- Do not hammer or apply any impact on connectors. Failure may result.
- Do not touch the key grooves with bare hands if the Servomotor with shaft-end key grooves is used. Injury may result.
- Use non-magnetic mounting screws. Note also that the depth of any mounted screw does not reach the effective thread length. Equipment damage may result.
- Be sure to observe the allowable axial load for the Servomotor. Equipment damage may result.
- Install equipment to prevent crash and reduce shock. Do not run the Servomotor outside the operable range by the use of the drive prohibition function such as overtravel. Crash against the stroke edge may occur depending on stopping distance and equipment damage may result.
- Do not block the intake or exhaust openings. Do not allow foreign objects to enter the product. Fire may result.
- Be sure to attach a shield clamp by the specified method. Not doing so may cause electric shock.

Wiring

- Use crimp terminals to wire screw type terminal blocks. Do not connect bare stranded wires directly to terminals blocks. Fire may result.
- Always use the power supply voltage specified in this document. Not doing so may cause burning.
- Do not apply a commercial power supply directly to the Servomotor. Fire or failure may result.
- Disconnect all connections to the Servo Drive and Servomotor before attempting a megger test (insulation resistance measurement) on the Servo Drive or Servomotor. Not doing so may result in Servo Drive or Servomotor failure. Do not perform a dielectric strength test on the Servo Drive or Servomotor. Damage of the internal elements may result.
- Carefully perform the wiring and assembling. Not doing so may cause injury.
- Wear the protective equipment when installing or removing the power input terminals, power input connectors, and connectors for motor connection. Do not apply a force after the protrusion of the connector opener reaches the bottom dead center. As a guide, do not apply a force of 100 N or more.
- Do not put excessive stress on terminals or connectors when wiring them. Injury or damage may result.

Adjustment

- Install an immediate stop device externally to the machine so that the operation can be stopped and the power supply is cut off immediately. Not doing so may cause injury.
- Secure a sufficient rigidity when you install a Servomotor into equipment. Not doing so may cause equipment damage or malfunction.
- If a problem occurs in serial communications or the computer during a test operation, you have no means to stop the Servomotor. Connect an externally installed emergency stop switch, etc. to the Error Stop Input of the general-purpose input so that the Servomotor can be stopped without fail.
- When using the Servomotor with key, run the Servomotor in a state in which the key cannot jump out of the shaft. Not doing so may result in hurting people around the equipment due to the jumping key.

- When debugging with the USB function of the Servo Drive, be sure to disconnect the EtherCAT cable. Do not connect the servo system or implement control via EtherCAT. Personal injury or equipment failure may result.
- Be sure to disconnect the USB communication of the servo system before a motor operation command is implemented by the PLC. Not doing so may cause personal injury or equipment failure.
- To prevent the danger caused by not cutting off USB communication, ensure that a motor operation command is implemented after the [Servo On] status is detected by setting in the PLC program. Not doing so may cause personal injury or equipment failure.

Operation Check

- Do not adjust or set parameters to extreme values, because it will make the operation unstable. Injury may result.
- Do not drive the Servomotor by the use of an external drive source. Fire may result.

Usage

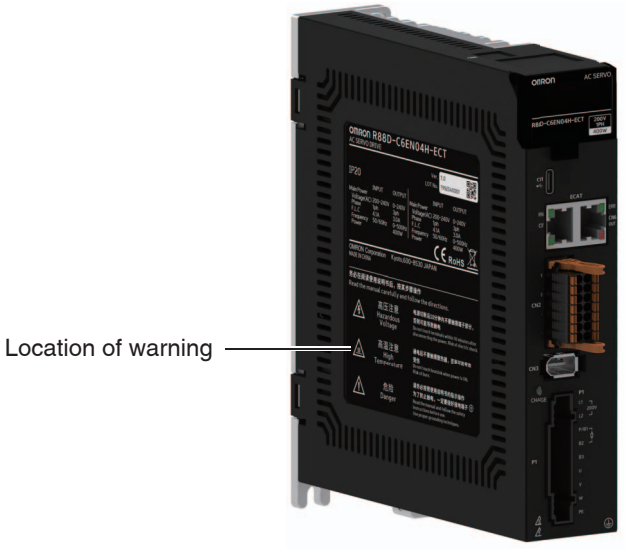
- Install a stopping device on the machine to ensure safety.
  The holding brake is not a stopping device to ensure safety. Not doing so may cause injury.
- Conduct a test operation after confirming that the equipment is not affected. Equipment damage may result.
- Do not use the built-in brake of the Servomotor for normal braking operation. Failure may result.
- After an earthquake, be sure to conduct safety checks. Not doing so may cause electric shock, injury, or fire.
- Connect an emergency stop (immediate stop) relay in series with the brake interlock output. Not doing so may cause injury or failure.
- Do not use the cable when it is laying in oil or water. Electric shock, injury, or fire may result.
- Install safety devices to prevent idling or locking of the electromagnetic brake or the gear head, or leakage of grease from the gear head. Not doing so may cause injury, damage, or taint.
- Be sure to turn OFF the power supply when not using the Servo Drive for a prolonged period of time. Not doing so may result in injury or malfunction.
- If the Servomotor is not controlled, it may not be possible to maintain the stop. To ensure safety, install a stop device. Not doing so may cause equipment damage or injury.
- Periodically run the Servomotor approximately one rotation when the oscillation operation continues at a small angle of 45° or smaller. Not doing so may result in Servomotor failure.
- Immediately stop the operation and cut off the power supply when unusual smell, noise, smoking, abnormal heat generation, or vibration occurs. Not doing so may result in Servo Drive or Servomotor damage or burning.
- When the position displayed on the Servo Drive before power OFF differs by one rotation or more from the position displayed upon Servo Drive startup, confirm that the device is properly positioned.
- Before running the system, ensure that the encoder battery is correctly installed. Replace the battery immediately if a battery under-voltage alarm is displayed during use. When replacing the battery, pay attention to the correct polarity.
- When the ring network is disconnected, check the situation quickly and take appropriate measures. Equipment damage may result.
- When the ring network is disconnected and the EtherCAT communication cable must be reconnected, turn off the power supply to the EtherCAT master and slaves. Connecting a faulty EtherCAT communication cable while the system is operating may cause the entire EtherCAT communication system to shut down.

Maintenance

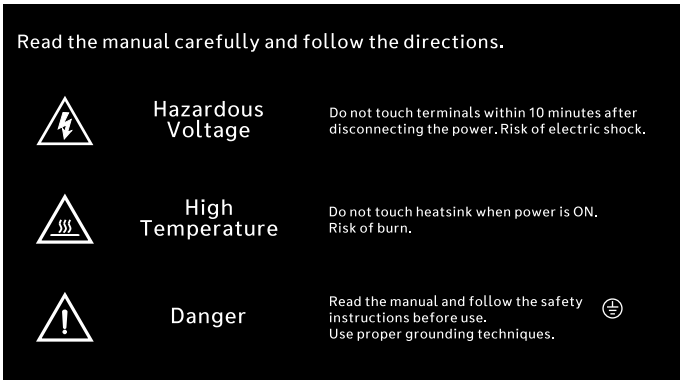
- After replacing the Servo Drive, transfer to the new Servo Drive all data needed to resume operation, before restarting operation. Equipment damage may result.
- Do not repair the Servo Drive by disassembling it. Electric shock or injury may result.

Location of Warning Display

The Servo Drive bears a warning label at the following location to provide handling warnings.
When you handle the Servo Drive, be sure to observe the instructions provided on this label.



Instructions on Warning Display



(Note) The above is an example of warning display.

Disposal

Dispose of the product as industrial waste.

Items to Check After Unpacking

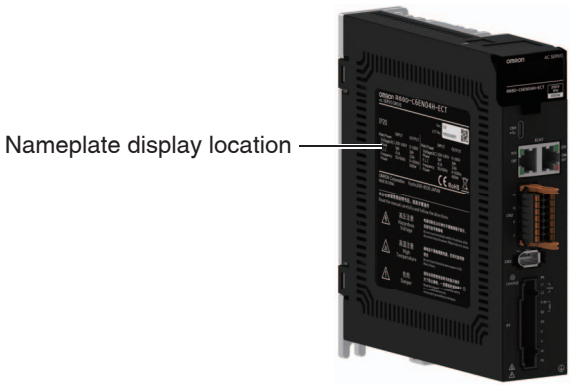
After you unpack the product, check the following items.

- Is this the model you ordered?
- Was there any damage sustained during shipment?

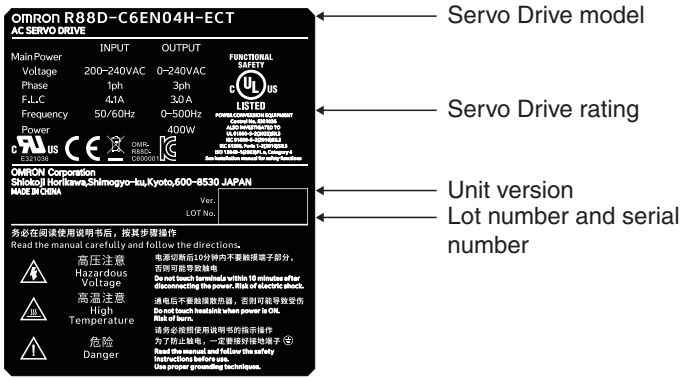
Servo Drive

Nameplate of Servo Drive

The model, rating, and lot number of the C6E-series Servo Drive are given on the product nameplate.



Nameplate example: 200 VAC 400 W Servo Drive



The notifications and their meanings of lot number and serial number are explained below.

Notation: Lot No. DDMYY□××××
DDMYY: Lot number, □: For use by OMRON, ××××: Serial number
DD gives the date.
"M" gives the month. (1 to 9: January to September, X: October, Y: November, Z: December)
YY gives the last two digits of the year.

Unit Versions and Sysmac Studio Versions

The Unit Versions and Sysmac Studio Versions are as follows.

Unit version	Change	Corresponding version of Sysmac Studio
Ver.1.0	—	Ver.1.65
Ver.1.1 or higher	—	Ver.1.67 or higher

(Note) When the Servo Drive Ver.1.0 is used with Sysmac Studio Ver.1.67, the parameters of the Servo Drive Ver1.0 are displayed, and the debugging functions added in Ver.1.1 are not supported. We recommend using the Servo Drive after upgrading its version.

Accessories of Servo Drive

This product comes with the following accessories.

- INSTRUCTION MANUAL × 1 copy
- General Compliance Information and instructions for EU × 1 copy
- Attached connectors (Depends on the model. Refer to the following table.)

Connectors, mounting screws, mounting brackets, and other accessories other than those in the table below are not supplied. They must be prepared by the customer.

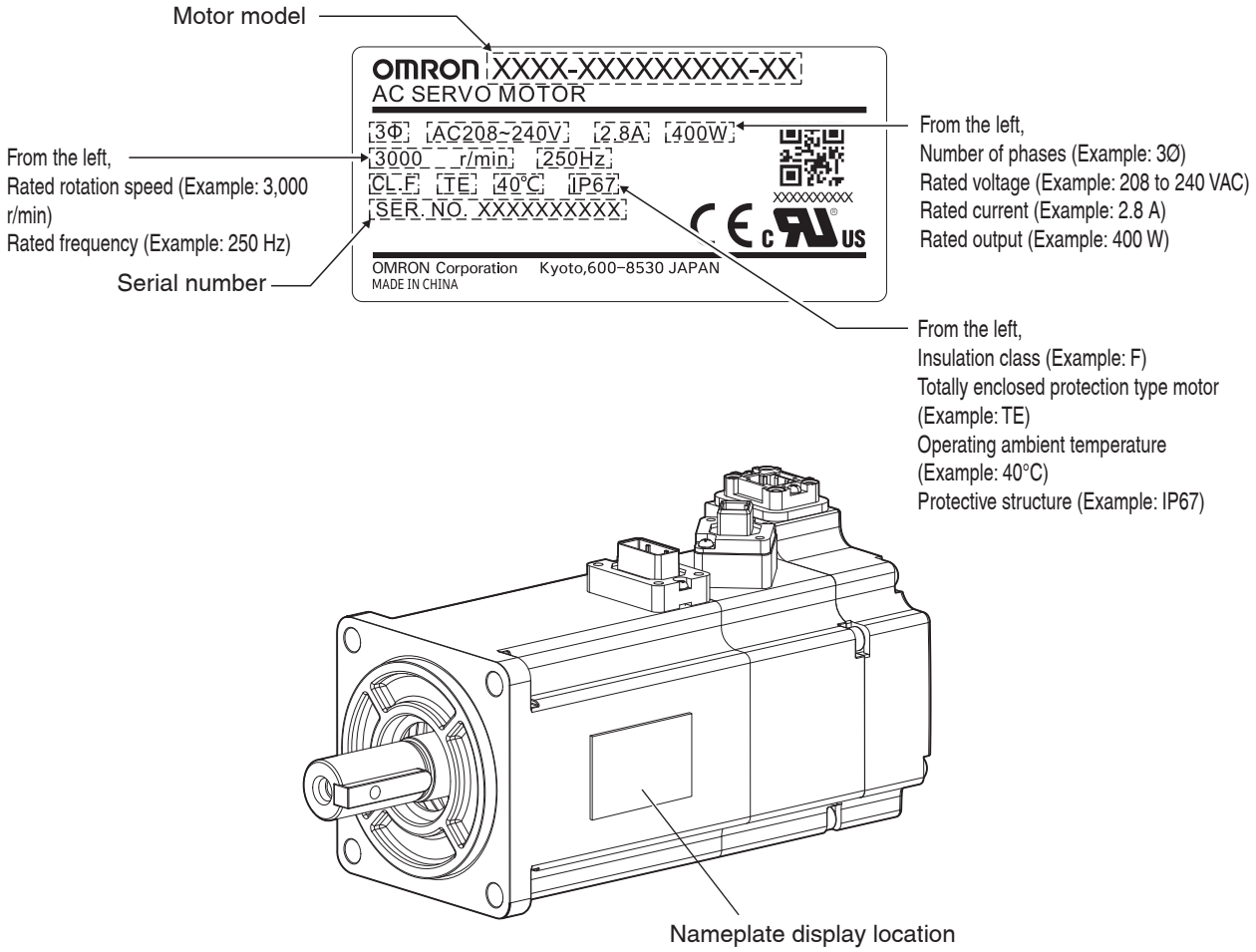
If any item is missing or a problem is found such as Servo Drive damage, contact the OMRON dealer or sales office where you purchased your product.

Specifications		Power input connector (P1)	I/O connector (CN2)	STO function connector (CN5)
Single-phase 200 VAC	400 W	Included	Included	Included
	750 W	Included*1		
	1 kW			

*1. One short-circuit wires are connected.

Servomotor

The model, rating and serial number of the C6E-series Servomotor are given on the product nameplate.



The notation and their meaning of serial number are explained below.

Notation: Lot No. DDMYY□××××

DDMYY: Lot number, □: For use by OMRON, ××××: Serial number

DD gives the date.

"M" gives the month. (1 to 9: January to September, X: October, Y: November, Z: December)

YY gives the last two digits of the year.

Related Manuals

The following are the manuals related to this manual. Use these manuals for reference.

Manual name	Man.No.	Model	Application	Description
NX-series CPU Unit Hardware User's Manual	W535	NX701-□□□□	Learning the basic specifications of the NX701 CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NX701 system is provided along with the following information on the CPU Unit. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NJ-series CPU Unit Hardware User's Manual	W500	NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning the basic specifications of the NJ-series CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NJ-series system is provided along with the following information on the CPU Unit. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NJ/NX-series CPU Unit Software User's Manual	W501	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software information is provided.	The following information is provided on a Controller built with an NJ/NX-series CPU Unit. • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications

Manual name	Man.No.	Model	Application	Description
NJ/NX-series CPU Unit Motion Control User's Manual	W507	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning about motion control settings and programming concepts.	The settings and operation of the CPU Unit and programming concepts for motion control are described.
NX-series Safety Control Unit User's Manual	Z930	NX-SL□□□□ NX-SI□□□□ NX-SO□□□□	Learning how to use NX-series Safety Control Units.	Describes the hardware, setup methods, and functions of the NX-series Safety Control Units.
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC-SE2 □□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
Sysmac Studio Drive Functions Operation Manual	I589	SYSMAC-SE2□□□ SYSMAC-DE□□□L	Learning about the Servo Drive related functions of the Sysmac Studio.	Describes the Servo Drive related operating procedures and functions among those of the Sysmac Studio.
G9SP-series Safety Controller Operation Manual	Z922	G9SP-N10S G9SP-N10D G9SP-N20S	Learning how to use the G9SP-series safety Controllers.	Describes the hardware, setup methods and functions of the G9SP-series safety Controllers.

Terminology

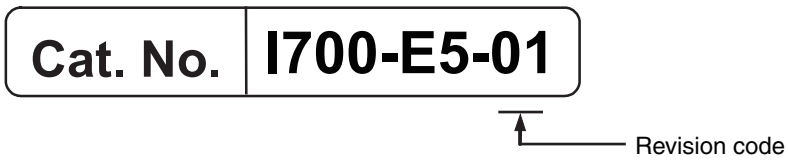
Term	Abbreviation	Description
Object	—	Abstract representation of a particular component within a device, which consists of data, parameters, and methods.
Object Dictionary	OD	Data structure addressed by Index and Subindex that contains description of data type objects, communication objects and application objects.
Service Data Object	SDO	CoE asynchronous mailbox communications where all objects in the object dictionary can be read and written.
Index	—	Address of an object within an application process.
Subindex	SUB	Sub-address of an object within the object dictionary.
standard control	—	A type of control that use devices, functions, and data that are designed for general control purposes. This term is used to differentiate from a safety control.
safe state	—	The status of a device or piece of equipment when the risk of danger to humans has been reduced to an acceptable level.
safety process data communications	—	A type of I/O data communications that is used for safety control purposes.
safety control	—	A type of control that uses devices, functions, and data that are designed with special safety measures.
safety reaction time	—	The time required for the system to enter a safe state in a worst-case scenario after the occurrence of a safety-related input (press of an emergency stop pushbutton switch, interruption of a light curtain, opening of a safety door, etc.) or device failure. The reaction time of the system includes the reaction times of sensors and actuators, just like the reaction time for a Controller or network.
Process Data	—	Collection of application objects designated to be transferred cyclically or acyclically for the purpose of measurement and control.
Process Data Object	PDO	Structure described by mapping parameters that contain one or several process data entities.
Receive PDO	RxPDO	A process data object received by an EtherCAT slave.
Transmit PDO	TxPDO	A process data object sent from an EtherCAT slave.
Sync Manager	SM	Collection of control elements to coordinate access to concurrently used objects.
Distributed Clocks	DC	Method to synchronize slaves and maintain a global time base.
Device Profile	—	Collection of device dependent information and functionality providing consistency between similar devices of the same device type.
Fieldbus Memory Management Unit	FMMU	Single element of the fieldbus memory management unit: one correspondence between a coherent logical address space and a coherent physical memory location.
Physical device internal interface	PDI	A series of elements to access data link services from the application layer.
CAN in Automation	CiA	CiA is the international users' and manufacturers' group that develops and supports higher-layer protocols.
CAN application protocol over EtherCAT	CoE	A CAN application protocol service implemented on EtherCAT.

Term	Abbreviation	Description
EtherCAT Technology Group	ETG	The ETG is a global organization in which OEM, End Users and Technology Providers join forces to support and promote the further technology development.
EtherCAT Slave Controller	ESC	A controller for EtherCAT slave communication.
EtherCAT State Machine	ESM	An EtherCAT communication state machine.
EtherCAT Slave Information	ESI	An XML file that contains setting information for an EtherCAT slave.
Safety over EtherCAT	FSoE	A system to communicate for the functional safety over EtherCAT.
Slave Information Interface	SII	Slave information stored in the nonvolatile memory of each slave.
Power Drive System	PDS	A power drive system consisting of a Servo Drive, an inverter, and other components.

Revision History

The manual revision code is a number appended to the end of the catalog number found in the front and back cover.

Example



Revision code	Revision date	Revised content and pages
01	September 2026	Original production

1

Features and System Configuration

This section explains the system configuration of the Servo Drive, the name and function of each part, and the applicable standards.

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1-1 Outline

C6E-series Servo Drives are designed to deliver optimal functionality and operability when used in combination with machine automation controllers (including the NJ/NX series) and the automation software Sysmac Studio.

1-1-1 EtherCAT

EtherCAT is an open high-speed industrial network system that conforms to Ethernet (IEEE 802.3). Each node achieves a short communications cycle time by transmitting Ethernet frames at high speed. A mechanism that allows sharing clock information enables high-precision synchronization control with low communications jitter.

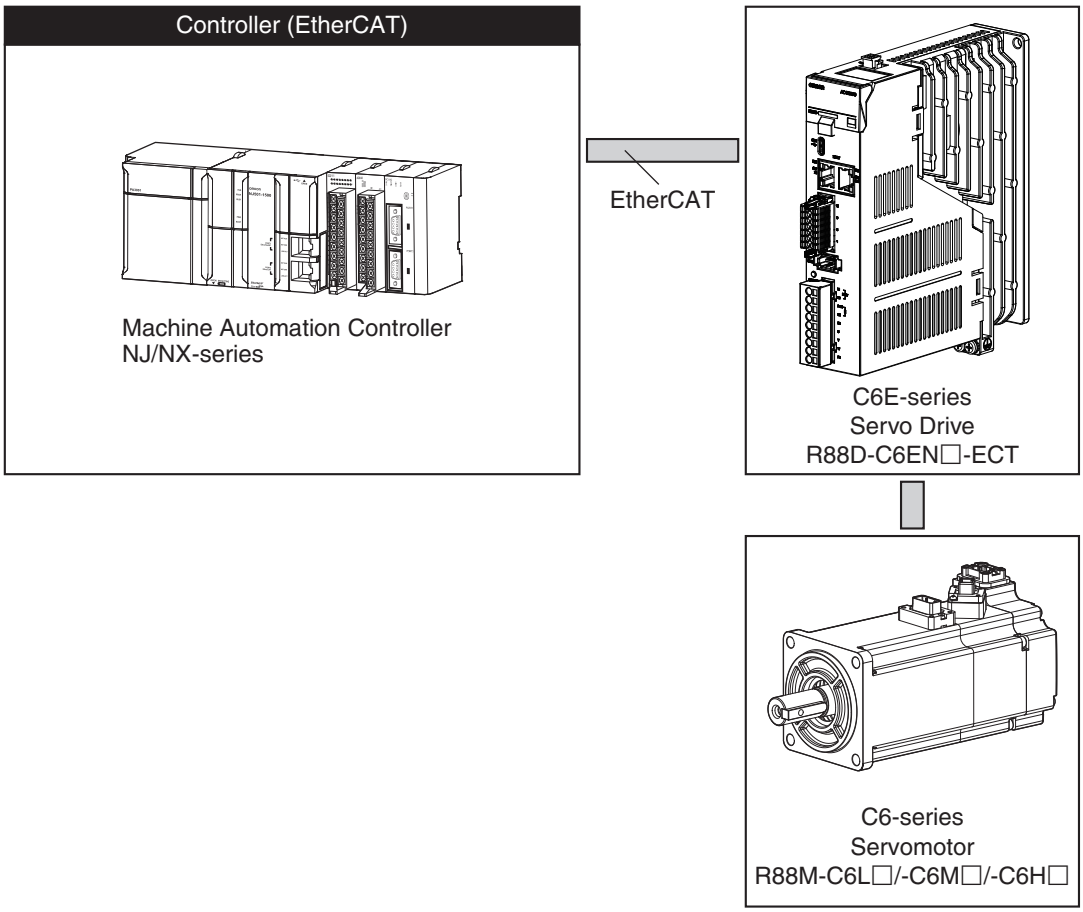
1-1-2 Object Dictionary

C6E-series Servo Drives with Built-in EtherCAT Communications use the object dictionary for CAN application protocol over EtherCAT (CoE) as a base for communications.
An object is an abstract representation of a particular component within a device, which consists of data, parameters, and methods.
An object dictionary is a data structure that contains description of data type objects, communication objects and application objects.
Each object is addressed using a 16-bit index value, and an 8-bit subindex is defined to allow access to individual elements in the data structure.

Index	Object
0x0000	Not used
0x0001 - 0x001F	Static data types (standard data types, such as BOOL, INTEGER16)
0x0020 - 0x003F	Complex data types (predefined structures composed of basic data types, such as PDO CommPar and SDO Parameter)
0x0040 - 0x005F	Manufacturer-defined complex data types
0x0060 - 0x007F	Device subprotocol-defined static data types
0x0080 - 0x009F	Device subprotocol-defined complex data types
0x00A0 - 0x0FFF	Reserved
0x1000 - 0x1FFF	Communication subprotocol area
0x2000 - 0x5FFF	Manufacturer-specific subprotocol area
0x6000 - 0x9FFF	Standard device subprotocol area
0xA000 - 0xFFFF	Reserved

1-2 System Configuration

The system configuration for a C6E-series Servo Drive with Built-in EtherCAT Communications is shown below.



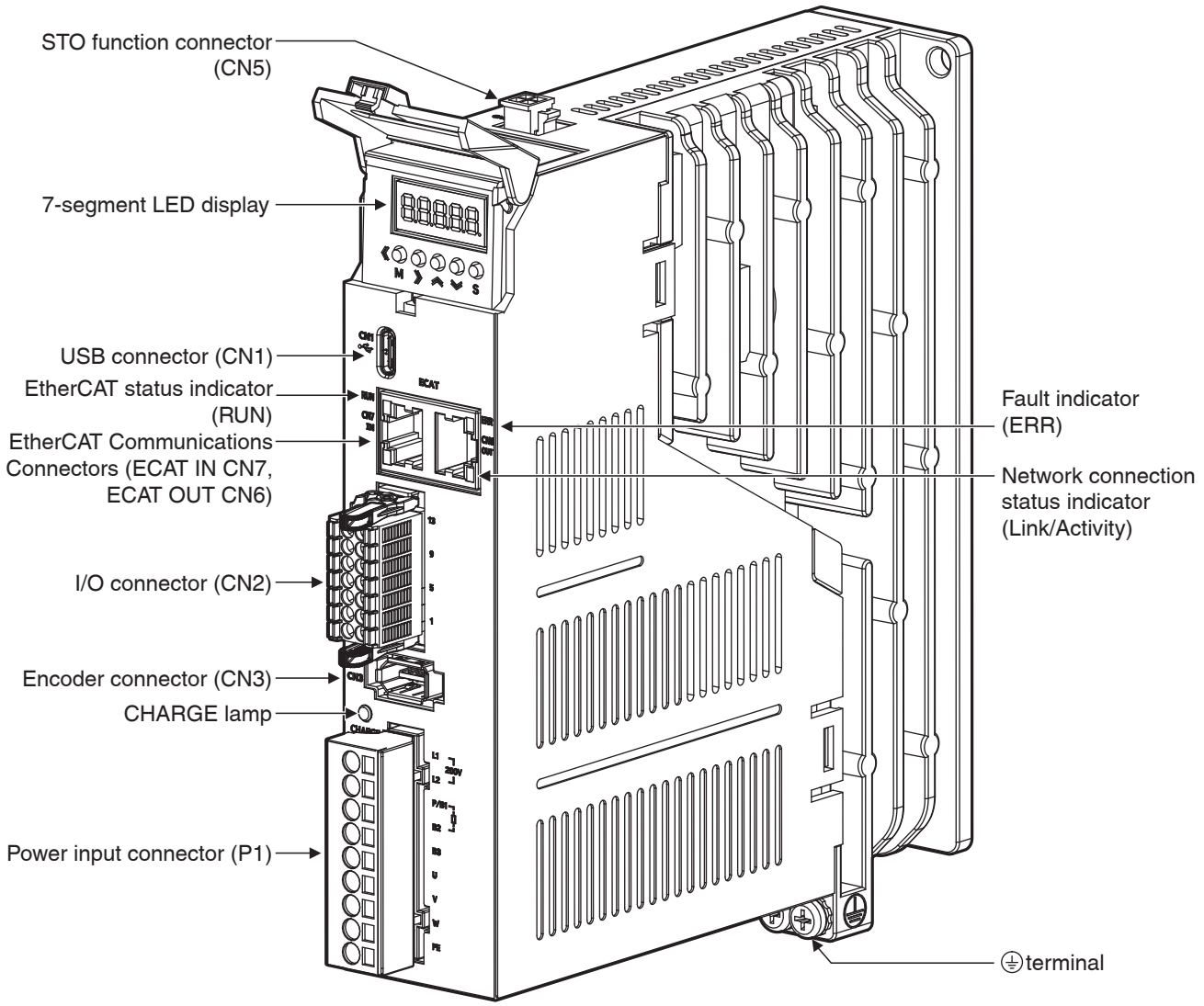
1-3 Names and Functions

This section describes the names and functions of Servo Drive parts.

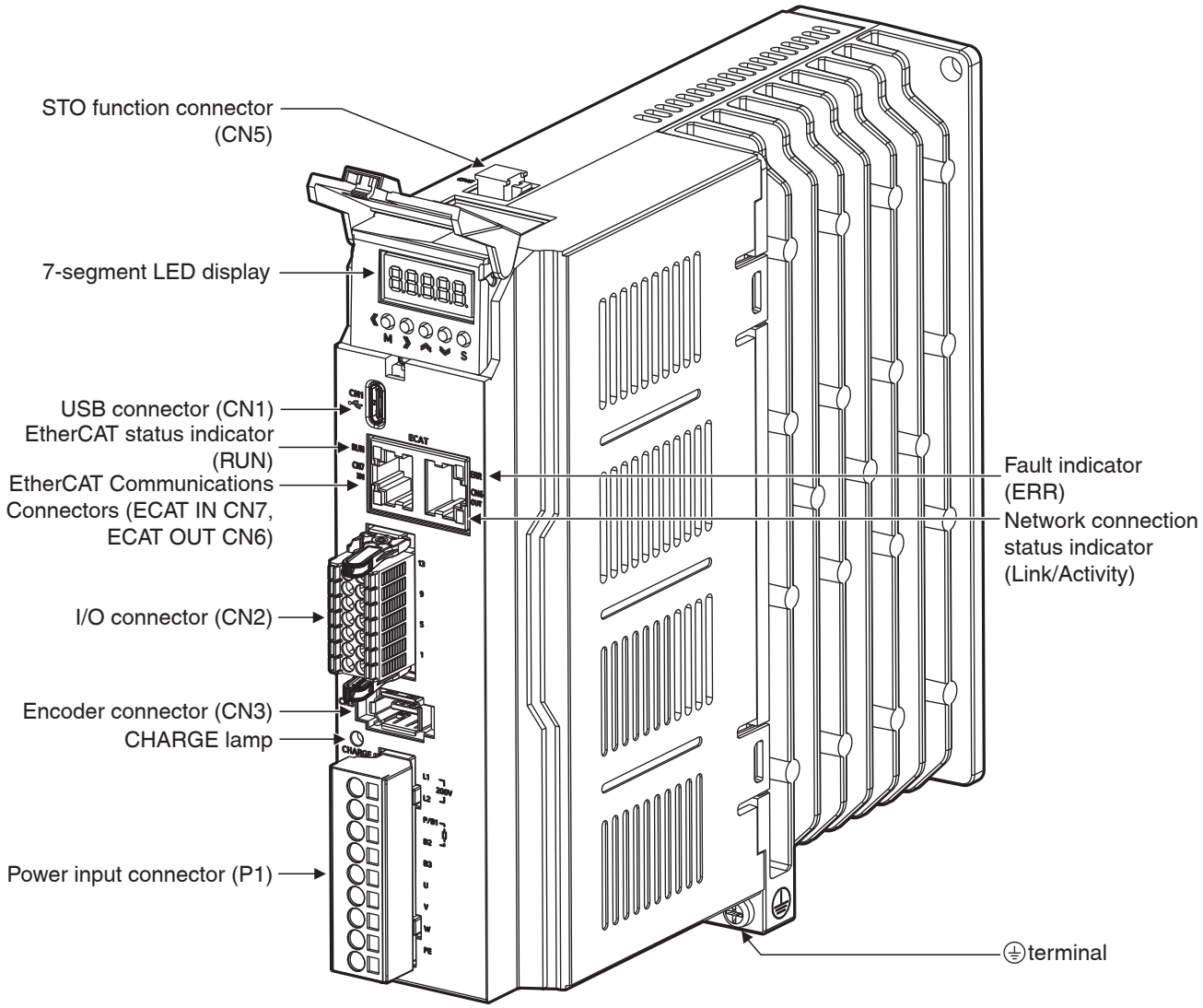
1-3-1 Servo Drive Part Names

The Servo Drive part names are given below.

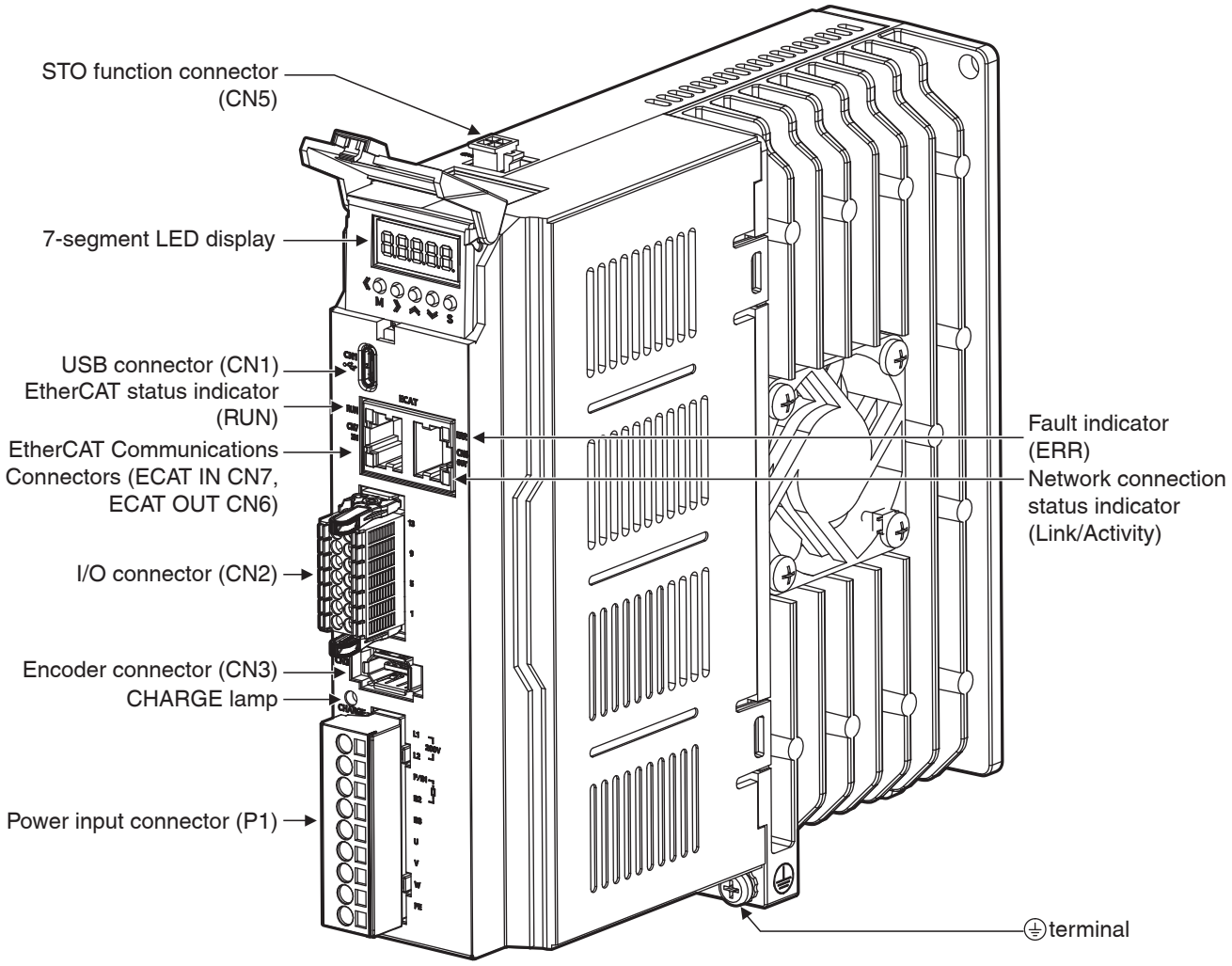
R88D-C6EN04H-ECT (400 W)



R88D-C6EN08H-ECT (750 W)



R88D-C6EN10H-ECT (1.0 kW)



1-3-2 Servo Drive Functions

The functions of each part of the Servo Drive are described below.

Status Indicators

The following four indicators are mounted.

Name	Color	Description
CHARGE	Green	Displays the energized status of Servo Drive.
RUN	Green	Displays the EtherCAT communications status.
ERR	Red	
Link/Activity	Green	Lights or flashes according to the status of a link in the EtherCAT physical layer.

For details on display, refer to 🕮 *"4-1-2 EtherCAT Communications Status Indicators* (P.4-3)".

7-segment LED display

A 5-digit 7-segment LED display shows error numbers, the Servo Drive status, and other information.

CHARGE lamp

Lights when the main circuit power supply carries electric charge.

I/O Connector (CN2)

Connector for command input signals and I/O signals.

Encoder Connector (CN3)

Connector for the encoder installed in the Servomotor.

STO Function Connector (CN5)

Connector for the safety device. The short-circuit wire is installed on the safety signal circuit before shipment.

EtherCAT Communications Connectors (ECAT IN CN7, ECAT OUT CN6)

These connectors are for EtherCAT communications.

USB Connector (CN1)

USB Type-C communications connector for the computer.

Power Input Connector (P1)

Connector for the main power input, the power cable to the phase U, V, and W of the Servomotor and the regeneration resistor.

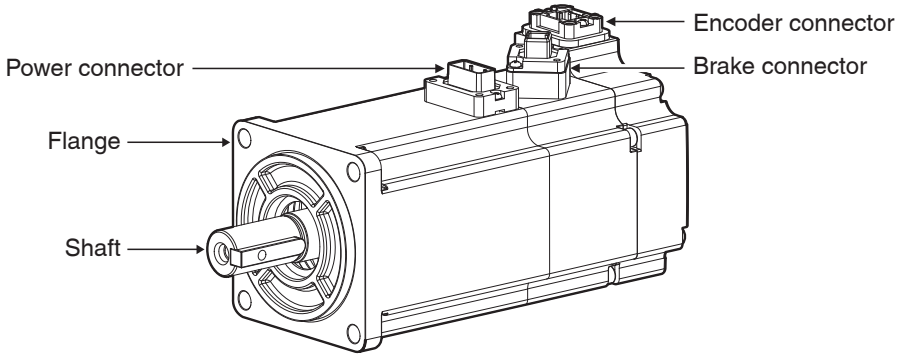
⏚ Terminal

The are two terminals on bottom.
Used for connection to the PE wire of the main circuit power supply cable. Used for connection to the FG wire inside the control panel, and FG wire for the motor cable and shielded wire.

1-3-3 Servomotor Part Names

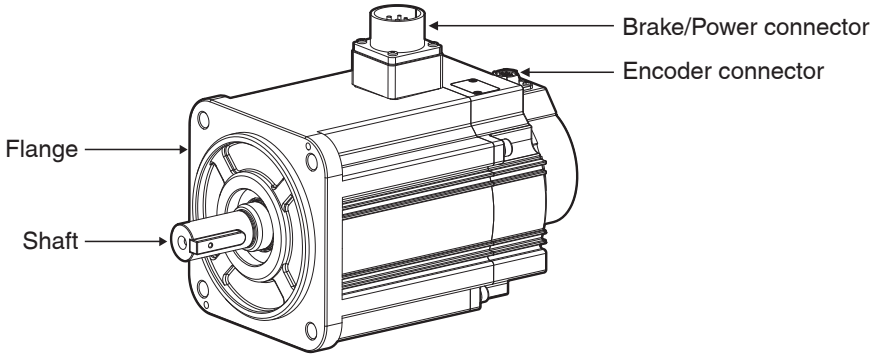
The Servomotor part names are given below.

50 W/100 W/200 W/400 W/750 W



200 VAC 400 W Servomotors (with Brake)

1 kW



200 VAC 1 kW Servomotors (with Brake)

1-3-4 Servomotor Functions

The functions of each part of the Servomotor are described below.

Shaft

The load is mounted on this shaft.
The direction which is in parallel with the shaft is called the thrust direction, and the direction which is perpendicular to the shaft is called the radial direction.

Flange

Used for mounting the Servomotor on the equipment.
Fit the mating part into the equipment and use the mounting holes to screw the Servomotor.

Power Connector

Used for supplying power to the phase U, V, and W of the Servomotor.
For Servomotors with a brake and flange size of 100 mm or more, the pins for power and brake are set on the same connector.

Encoder Connector

Used for supplying power to the encoder of the Servomotor and communicating with the Servo Drive.

Brake Connector

Used for supplying power to the brake coil of the Servomotor.
This part is attached only to the Servomotors with a brake and flange size of 80 mm or less.

1-4 Applicable Standards

C6E-series AC servo products are certified by the following standards.

Drive		Applicable standards
EU	EMC	EN61800-3
	LVD	EN61800-5-1
	Machinery directive*1	EN ISO13849-1, EN61508, EN61800-5-2, EN IEC 62061
UL		UL61800-5-1 FSPC*2 (UL61800-5-2, IEC61800-5-2, IEC61508-1, IEC61508-2, ISO13849-1)
CSA		CSA C22.2 No.274
Korea Radio Regulations (KC)		Applicable

*1 Details of the Machinery Directive are as follows.
The STO function via safety input signals: EN ISO13849-1 (PLe/Cat.4), EN61508, EN61800-5-2 (STO SIL3), and EN IEC 62061 (SIL3)

*2 Details of UL FSPC are as follows.
The STO function via safety input signals: UL61800-5-2 (STO SIL3), IEC61800-5-2 (STO SIL3), IEC61508-1 (SIL3), IEC61508-2 (SIL3), and ISO13849-1 (PLe/Cat.4)

Motor		Applicable standards
EU	EMC	EN61000-6-2, EN61000-6-4
	LVD	EN60034-1, EN60034-5
UL		UL1004-1, UL1004-6
CSA		CSA C22.2 No.100
GB		GB30253

2

Product Outline

This section explains the models and external dimensions of Servo Drives, Servomotors, and peripheral devices.

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2-1 Product Confirmation

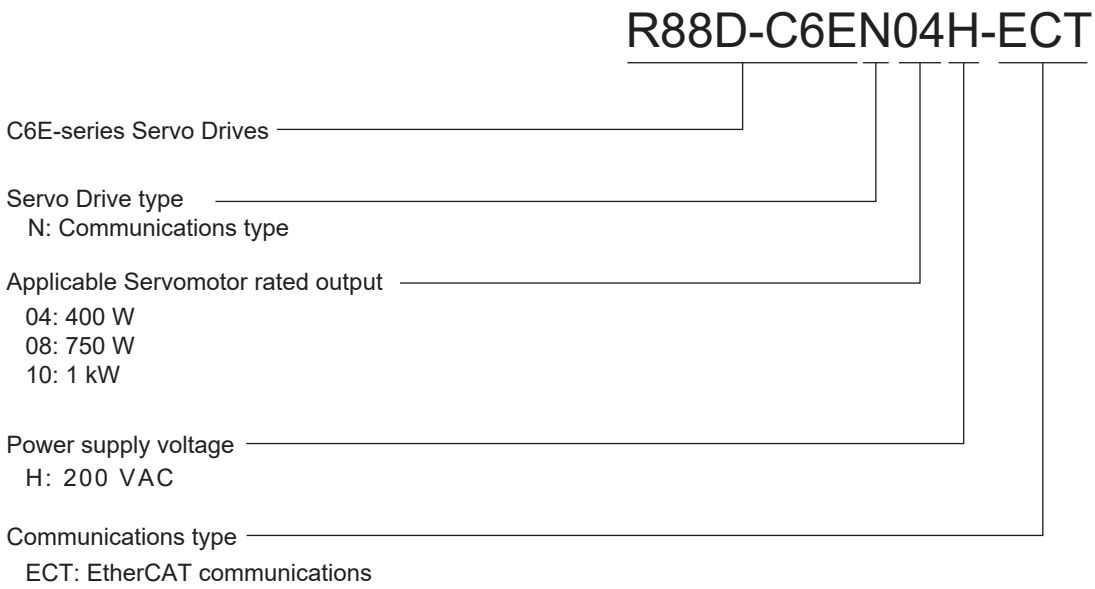
Please confirm the Servo Drive model and the Servomotor model referring to subsequent sections.
A complete and operable servo system should include the following components:

- Power-matched Servo Drive and Servomotor
- Motor power cable for connecting the Servo Drive and the Servomotor (optional)
- Encoder cable for connecting the Servo Drive and the Servomotor (optional)
- USB Type-C communication cable for connecting port CN1 to a PC (optional)
- I/O connector for port CN2 (standard)
- Encoder connector for port CN3 (optional)
- STO connector for port CN5 (suitable for Servo Drives with STO function, standard)
- RJ-45 connectors for ports IN (CN7) and OUT (CN6), used for EtherCAT communications (optional)
- Servo Drive power input, motor power and regeneration resistor connectors for port P1 (standard)

2-2 Servo Drive Model Introduction

2-2-1 Servo Drive Model Description

The Servo Drive model number tells the Servo Drive type, applicable Servomotor, power supply voltage, etc.



2-2-2 Servo Drive Specifications

Electrical Specifications

Servo Drive model	R88D-C6EN04H-ECT	R88D-C6EN08H-ECT	R88D-C6EN10H-ECT
Main circuit power supply	Single-phase, 200 to 240 VAC ± 10%, 50/60 Hz		
Control circuit power supply	Single-phase, 200 to 240 VAC ± 10%, 50/60 Hz		
Input current A (rms)	4.1	6.7	8.6
Continuous output current A (rms)	3	4.5	6
Max output current A (rms)	12	15	21
Insulation voltage	Primary-to-ground: withstand voltage 1,500 VAC, 1 min, (leakage current: 20 mA)		

General Specifications

Item			Specifications
Operating environment	Temperature		• Operating temperature: 0 to 55 ℃ (if the ambient temperature exceeds 45 ℃ , please store it in a well-ventilated place) • Storage temperature: -20 ℃ to 65 ℃
	Humidity		Storage and use: 10% to 85% RH, without condensation
	Altitude		Below 1,000m
	Vibration		10 to 60 Hz at 9.8 m/s^2 or below (continuous operation is not allowed at the resonance point)
Control method			IGBT: PWM control
Motor encoder feedback			26-bit multi-turn absolute photoelectric encoder
I/O	Digital signal	Input	6-channel optocoupler isolated general-purpose inputs, configurable via parameters, 24 VDC, 20 mA
		Output	3-channel optocoupler isolated general-purpose outputs, configurable via parameters, max. 30 VDC, 100 mA
	Analog signal	Input	1-channel analog inputs, -10 V to +10 V, 16-bit resolution
Communications interface	USB		For connection to a PC for software debugging
	EtherCAT		For EtherCAT communications
Operation panel			Five operation buttons (MODE, RIGHT, UP, DOWN, and SET) 5-digit LED display
Regenerative energy absorption resistor			Built-in regenerative resistor for 750 W or more models (all models support external regenerative resistors)
LED indicator			IN/OUT connection display, RUN display, and ERROR display at ports
Modes of operation			CoE (compliant with CiA402 standard); supports PP, PV, TQ, CSP, CSV, CST, and HM modes
Control input signal			Alarm clear, CW/CCW limit, gain switching, zero speed clamp, emergency stop, CW/CCW torque limit, speed limit, homing sensor, general-purpose input, etc.
Control output signal			Fault output (error report), warning output (alarm), Servo-Ready, motor brake control, velocity reached, torque reached, position arrived, Servo-ON status output, dynamic following error output, positioning completed, zero speed signal, velocity match, torque match output, velocity limit output, torque limit output, homing complete, soft limit (CW/CCW), general-purpose output, etc.
Protection function			Over-current, over-voltage, under-voltage, over-temperature, encoder feedback anomaly, overload, velocity limit, position following error, emergency stop, CW/CCW limit, communication error
Dynamic brake			Built-in
STO			Built-in
Weight			R88D-C6EN04H-ECT: 0.92Kg R88D-C6EN08H-ECT: 1.3Kg R88D-C6EN10H-ECT: 1.3Kg

2-2-3 EtherCAT Communications Specifications

Item	Specifications
Communication standard	IEC 61158 Type12, IEC 61800-7 CiA402 Drive Profile
Physical layer	100Base - Tx
Communication port	RJ45×2 (Input: IN, Output: OUT)
Communication rate	2×100 Mbps (full-duplex)
Communication cable	Shielded twisted-pair CAT5e cable (straight-through/crossover)
Transmission distance	Max 100 m (between nodes) / daisy chain
Sync manager	SM0: Output mailbox SM1: Input mailbox SM2: Output process data SM3: Input process data
FMMU	FMMU0: Mapped to process data (RxPDO) receiving area FMMU1: Mapped to process data (TxPDO) transmission area FMMU2: Mapped to mailbox status
Application layer protocol	CoE: CANopen over EtherCAT
Synchronization mode	SM Event*1 DC SYNC Event
Communication object	SDO: Non-periodic data PDO: Periodic Data EMCY: Emergency
LED indicator	EtherCAT RUN×1 EtherCAT ERR×1 EtherCAT Link/Activity×2
Operation mode	Profile Position Mode(PP) Profile Velocity Mode(PV) Profile Torque Mode(TQ) Homing Mode(HM) Cycle Synchronized Postion Mode(CSP) Cycle Synchronized Velocity Mode(CSV) Cycle Synchronized Torque Mode(CST)

*1. SM mode is only available under the PP, PV, TQ, and HM modes.

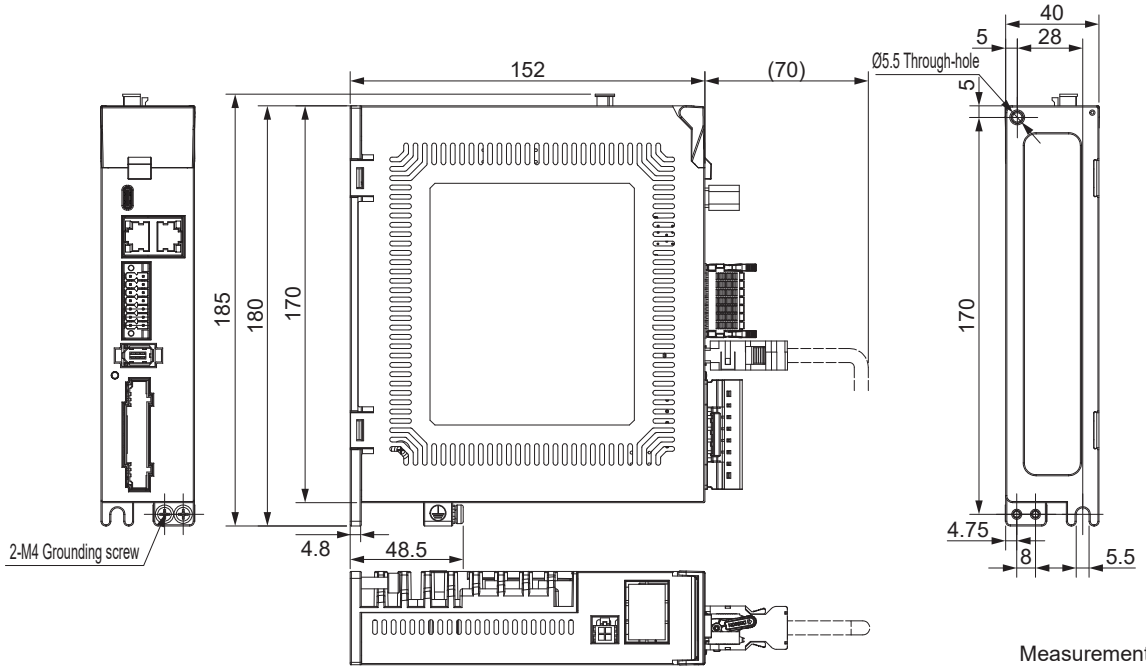
2-2-4 Regeneration Resistor Relevant Specifications

When the output torque of the motor shaft is opposite to the rotation direction, energy is fed back to the bus capacitor of the drive from the motor load side, causing the bus voltage to rise. Once the voltage rises to the braking voltage threshold, the energy can only be consumed through the regeneration resistor; otherwise, the Servo Drive will be damaged. Regenerative resistors can be either built-in or externally connected. The specifications for the built-in regenerative resistors of the C6E-series Servo Drives are listed below:

Servo Drive model	Built-in resistor specifications		External resistor
	Resistance value (Ω)	Power (W)	Minimum allowable resistance value (Ω)
R88D-C6EN04H-ECT	None		40
R88D-C6EN08H-ECT	50	50	20
R88D-C6EN10H-ECT	50	50	20

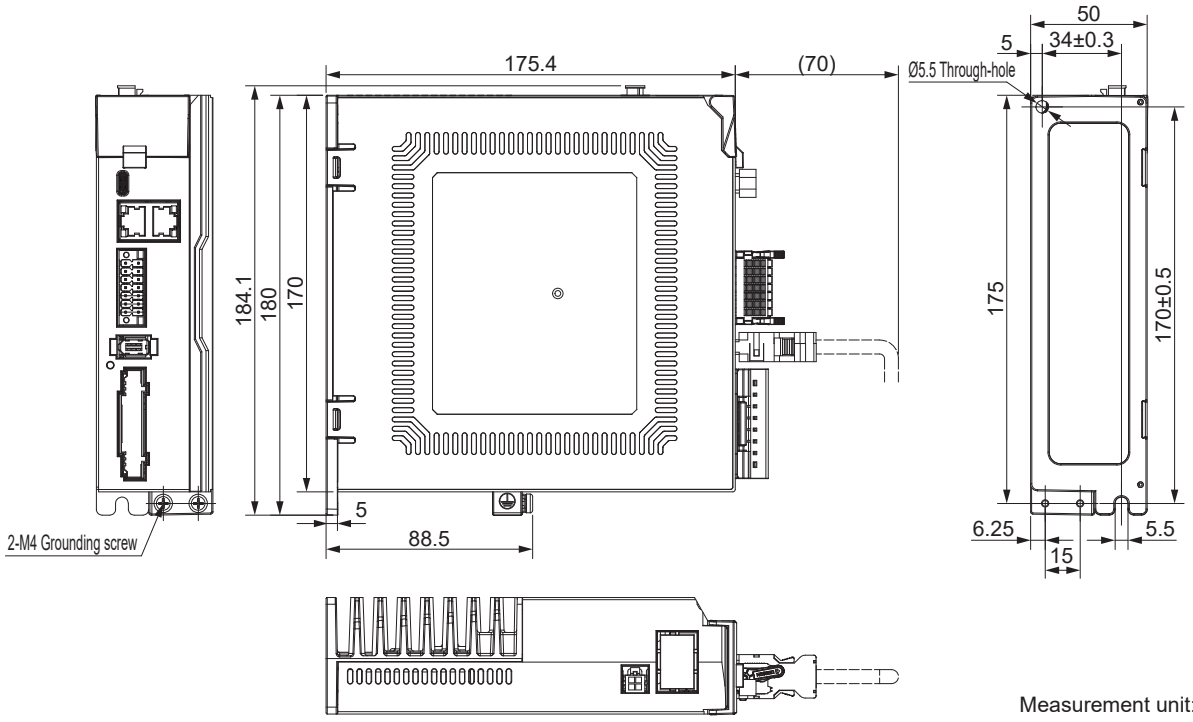
2-2-5 Servo Drive External Dimensions

R88D-C6EN04H-ECT (400 W Model)



Measurement unit: mm

R88D-C6EN08/10H-ECT (750 W/1.0 kW Models)



Measurement unit: mm

2-3 Servomotor Model Introduction

2-3-1 Motor Model Description

The Servomotor model number tells the Servomotor type, rated output, rated rotation speed, voltage, etc.

R88M-C6L1K030T-BOS2-10

C6-series Servomotor

Servomotor type

L	: Low Inertia
M	: Middle Inertia
H	: High Inertia

Rated output

050	: 50 W
100	: 100 W
200	: 200 W
400	: 400 W
750	: 750 W
850	: 850 W
1K0	: 1 kW

Rated rotation speed

15	: 1500 r/min
20	: 2000 r/min
30	: 3000 r/min

Servo Drive main power supply voltage and encoder type

T	: 200 VAC absolute encoder

Options

Brake

None	: Without brake
B	: With 24 VDC brake

Oil seal

None	: Without oil seal
O	: With oil seal

Key and tap

None	: Straight shaft
S2	: With key and tap

Others

08	: C6L1K030T-S2 80 mm flange motor
10	: C6L1K030T-S2 100 mm flange motor

2-3-2 Specifications

3,000 r/min Servomotors (220 VAC)

Model / Item		Unit	R88M-C6H05030T	R88M-C6L10030T	R88M-C6H10030T
Rated voltage		V	AC220	AC220	AC220
Rated output*1		W	50	100	100
Rated torque*1		N·m	0.16	0.32	0.32
Rated rotation speed*1		r/min	3,000	3,000	3,000
Maximum rotation speed*1		r/min	6,000	6,000	6,000
Momentary maximum torque*1		N·m	0.64	1.28	1.28
Rated current*2		A	1.4	1.3	1.3
Momentary maximum current*2		A	6	5.9	5.2
Rotor inertia	Without brake	$kg·m^2$	$0.0383×10^{-4}$	$0.038×10^{-4}$	$0.0702×10^{-4}$
	With brake	$kg·m^2$	$0.0395×10^{-4}$	$0.04×10^{-4}$	$0.0724×10^{-4}$
Recommended load inertia ratio*3		-	⩽ 30	⩽ 30	⩽ 30
Torque constant*2		N·m/A(rms)	0.114	0.267	0.246
Allowable radial load*4		N	60	60	60
Allowable thrust load*4		N	50	50	50
Weight	Without brake	kg	0.32	0.5	0.44
	With brake	kg	0.5	0.75	0.6
Insulation class		-	F	F	F
IP rating (except for the through-shaft part)		-	IP67	IP65	IP67
Radiator plate dimensions (material)		mm	200×200×6 Aluminum	200×200×6 Aluminum	200×200×6 Aluminum
Brake	Moment of inertia	$kg·m^2$	$0.00231×10^{-4}$	$0.0037×10^{-4}$	$0.00231×10^{-4}$
	Excitation voltage	V	DC24	DC24	DC24
	Current consumption	A	0.26	0.29	0.26
	Static friction torque	N·m	⩾ 0.32	⩾ 0.32	⩾ 0.32
	Attraction time	ms	＜ 50	＜ 50	＜ 50
	Release time	ms	＜ 20	＜ 20	＜ 20
Flange		mm	□ 40	□ 40	□ 40

Model / Item		Unit	R88M-C6L20030T	R88M-C6H20030T	R88M-C6L40030T	R88M-C6H40030T
Rated voltage		V	AC220	AC220	AC220	AC220
Rated output*1		W	200	200	400	400
Rated torque*1		N·m	0.64	0.64	1.27	1.27
Rated rotation speed*1		r/min	3,000	3,000	3,000	3,000
Maximum rotation speed*1		r/min	6,000	6,000	6,000	6,000
Momentary maximum torque*1		N·m	1.9	2.24	3.8	4.445
Rated current*2		A	1.7	1.7	2.8	2.8
Momentary maximum current*2		A	5.4	5.9	10	9.8
Rotor inertia	Without brake	$kg \cdot m^2$	0.152×10^{-4}	0.31×10^{-4}	0.237×10^{-4}	0.59×10^{-4}
	With brake	$kg \cdot m^2$	0.169×10^{-4}	0.32×10^{-4}	0.258×10^{-4}	0.61×10^{-4}
Recommended load inertia ratio*3		-	⩽ 30	⩽ 30	⩽ 30	⩽ 30
Torque constant*2		N·m/A(rms)	0.427	0.376	0.453	0.453
Allowable radial load*4		N	200	200	240	240
Allowable thrust load*4		N	70	70	70	70
Weight	Without brake	kg	0.9	0.8	1.2	1.2
	With brake	kg	1.3	1.2	1.7	1.6
Insulation class		-	F	F	F	F
IP rating (except for the through-shaft part)		-	IP65	IP67	IP65	IP67
Radiator plate dimensions (material)		mm	250×250×6 Aluminum	250×250×6 Aluminum	250×250×6 Aluminum	250×250×6 Aluminum
Brake	Moment of inertia	$kg \cdot m^2$	0.018×10^{-4}	0.0112×10^{-4}	0.018×10^{-4}	0.0112×10^{-4}
	Excitation voltage	V	DC24	DC24	DC24	DC24
	Current consumption	A	0.3	0.4	0.3	0.4
	Static friction torque	N·m	⩾ 1.5	⩾ 1.5	⩾ 1.5	⩾ 1.5
	Attraction time	ms	< 50	< 50	< 50	< 50
	Release time	ms	< 20	< 20	< 20	< 20
Flange		mm	□ 60	□ 60	□ 60	□ 60

Model / Item		Unit	R88M-C6L75030T	R88M-C6H75030T	R88M-C6L1K030T-□□-08	R88M-C6H1K030T
Rated voltage		V	AC220	AC220	AC220	AC220
Rated output*1		W	750	750	1,000	1,000
Rated torque*1		N·m	2.4	2.4	3.2	3.2
Rated rotation speed*1		r/min	3,000	3,000	3,000	3,000
Maximum rotation speed*1		r/min	6,000	6,000	6,000	6,000
Momentary maximum torque*1		N·m	6.7	8.4	9.6	11.2
Rated current*2		A	4.5	4.5	5.9	5.9
Momentary maximum current*2		A	14	16.7	19	21.6
Rotor inertia	Without brake	$kg·m^2$	$0.829×10^{-4}$	$1.46×10^{-4}$	$1.01×10^{-4}$	$1.82×10^{-4}$
	With brake	$kg·m^2$	$0.958×10^{-4}$	$1.63×10^{-4}$	$1.08×10^{-4}$	$1.96×10^{-4}$
Recommended load inertia ratio*3		-	⩽ 20	⩽ 20	⩽ 20	⩽ 20
Torque constant*2		N·m/A(rms)	0.533	0.533	0.571	0.542
Allowable radial load*4		N	270	270	270	270
Allowable thrust load*4		N	90	90	90	90
Weight	Without brake	kg	2.3	2.2	2.8	2.6
	With brake	kg	3.1	2.9	3.6	3.3
Insulation class		-	F	F	F	F
IP rating (except for the through-shaft part)		-	IP65	IP67	IP65	IP67
Radiator plate dimensions (material)		mm	250×250×6 Aluminum	250×250×6 Aluminum	300×300×12 Aluminum	300×300×12 Aluminum
Brake	Moment of inertia	$kg·m^2$	$0.0425×10^{-4}$	$0.0935×10^{-4}$	$0.0425×10^{-4}$	$0.0935×10^{-4}$
	Excitation voltage	V	DC24	DC24	DC24	DC24
	Current consumption	A	0.42	0.36	0.36	0.36
	Static friction torque	N·m	⩾ 4	⩾ 3.8	⩾ 4	⩾ 3.8
	Attraction time	ms	< 60	< 60	< 60	< 60
	Release time	ms	< 40	< 40	< 40	< 40
Flange		mm	□ 80	□ 80	□ 80	□ 80

Model / Item		Unit	R88M-C6L1K030T- □□ -10
Rated voltage		V	AC220
Rated output*1		W	1,000
Rated torque*1		N·m	3.2
Rated rotation speed*1		r/min	3,000
Maximum rotation speed*1		r/min	6,000
Momentary maximum torque*1		N·m	9.6
Rated current*2		A	6.6
Momentary maximum current*2		A	24
Rotor inertia	Without brake	$kg·m^2$	$1.79×10^{-4}$
	With brake	$kg·m^2$	$2.67×10^{-4}$
Recommended load inertia ratio*3		-	⩽ 10
Torque constant*2		N·m/A(rms)	0.485
Allowable radial load*4		N	392
Allowable thrust load*4		N	147
Weight	Without brake	kg	3.8
	With brake	kg	5.2
Insulation class		-	F
IP rating (except for the through-shaft part)		-	IP67
Radiator plate dimensions (material)		mm	300×300×12 Aluminum
Brake	Moment of inertia	$kg·m^2$	$0.441×10^{-4}$
	Excitation voltage	V	DC24
	Current consumption	A	0.6
	Static friction torque	N·m	⩾ 8
	Attraction time	ms	＜ 80
	Release time	ms	＜ 40
Flange		mm	□ 100

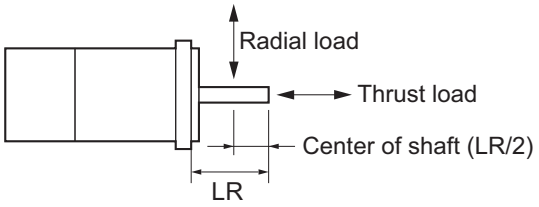
2,000 r/min Servomotors (220 VAC)

Model			R88M-C6M1K020T
Item		Unit	
Rated voltage		V	AC220
Rated output*1		W	1,000
Rated torque*1		N·m	4.77
Rated rotation speed*1		r/min	2,000
Maximum rotation speed*1		r/min	3,000
Momentary maximum torque*1		N·m	14.3
Rated current*2		A	5.4
Momentary maximum current*2		A	16.9
Rotor inertia	Without brake	$kg·m^2$	$13×10^{-4}$
	With brake	$kg·m^2$	$15.2×10^{-4}$
Recommended load inertia ratio*3		-	⩽ 5
Torque constant*2		N·m/A(rms)	0.88
Allowable radial load*4		N	490
Allowable thrust load*4		N	196
Weight	Without brake	kg	5.8
	With brake	kg	7.9
Insulation class		-	F
IP rating (except for the through-shaft part)		-	IP67
Radiator plate dimensions (material)		mm	400×400×20 Iron
Brake	Moment of inertia	$kg·m^2$	$1.105×10^{-4}$
	Excitation voltage	V	DC24
	Current consumption	A	0.8
	Static friction torque	N·m	⩾ 18
	Attraction time	ms	< 100
	Release time	ms	< 40
Flange		mm	□ 130

1,500 r/min Servomotors (220 VAC)

Model			R88M-C6H85015T
Item		Unit	
Rated voltage		V	AC220
Rated output*1		W	850
Rated torque*1		N·m	5.39
Rated rotation speed*1		r/min	1,500
Maximum rotation speed*1		r/min	3,000
Momentary maximum torque*1		N·m	16.2
Rated current*2		A	6
Momentary maximum current*2		A	19
Rotor inertia	Without brake	$kg·m^2$	$13×10^{-4}$
	With brake	$kg·m^2$	$15.2×10^{-4}$
Recommended load inertia ratio*3		-	≤ 5
Torque constant*2		N·m/A(rms)	0.9
Allowable radial load*4		N	490
Allowable thrust load*4		N	196
Weight	Without brake	kg	5.8
	With brake	kg	7.9
Insulation class		-	F
IP rating (except for the through-shaft part)		-	IP67
Radiator plate dimensions (material)		mm	400×400×20 Iron
Brake	Moment of inertia	$kg·m^2$	$1.105×10^{-4}$
	Excitation voltage	V	DC24
	Current consumption	A	0.8
	Static friction torque	N·m	≥ 18
	Attraction time	ms	< 100
	Release time	ms	< 40
Flange		mm	□ 130

*1. Indicates the limit characteristics of a single motor in a cold state. When the motor and the drive are used in combination, the characteristics should be confirmed according to the actual situation.
*2. Typical values of the motor in a cold state
*3. Maximum allowable load inertia = Recommended load inertia ratio × Rotor inertia
*4. The allowable radial and thrust loads are the values determined for a limit of 20,000 hours at normal operating temperatures. The allowable radial loads are applied as shown in the following diagram.



(Note) For models with an oil seal, the following derating is used due to increase in friction torque.

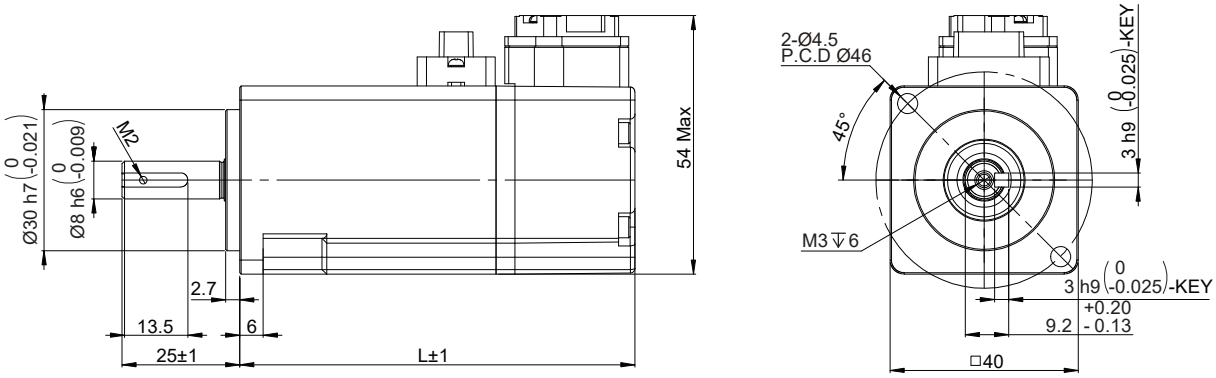
Flange	□ 40 mm (50 W)	□ 40 mm (100 W)	□ 60 mm, □ 80 mm	□ 100 mm	□ 130 mm
Derating	30%	20%	10%	6%	3%

2-3-3 External Dimensions

3,000 r/min Servomotors (220 VAC)

- 100 W (without brake, low inertia)

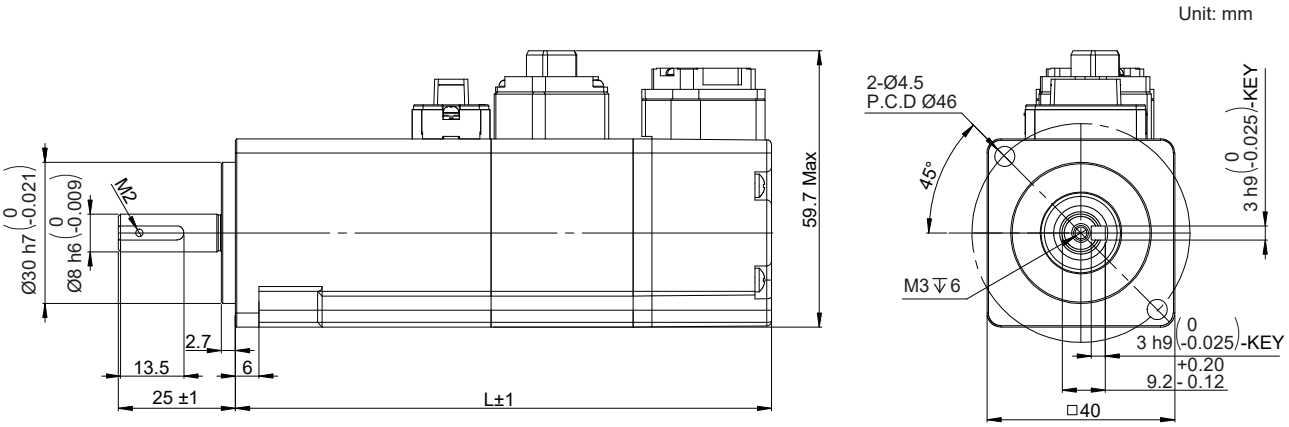
Unit: mm



Model without brake	L
R88M-C6L10030T-S2/OS2	91.5

- 100 W (with brake, low inertia)

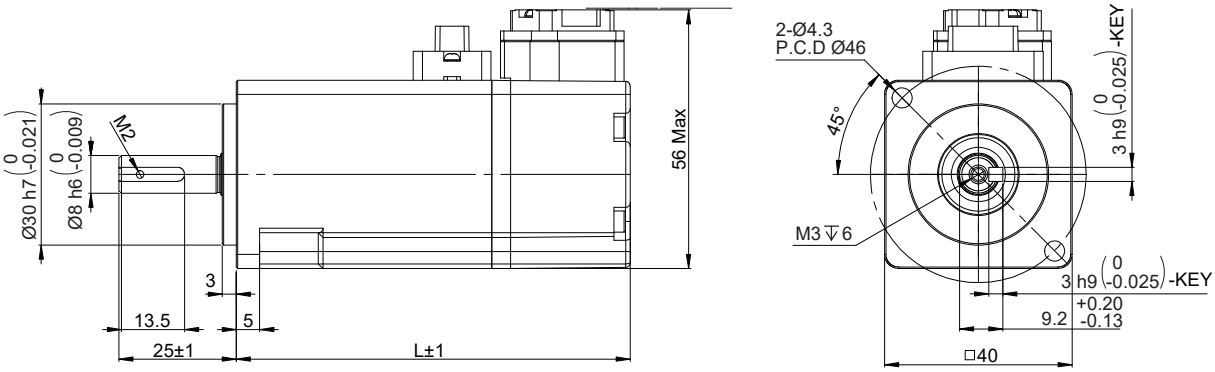
Unit: mm



Model with brake	L
R88M-C6L10030T-BS2/BOS2	134.5

- 50 W, 100 W (without brake, high inertia)

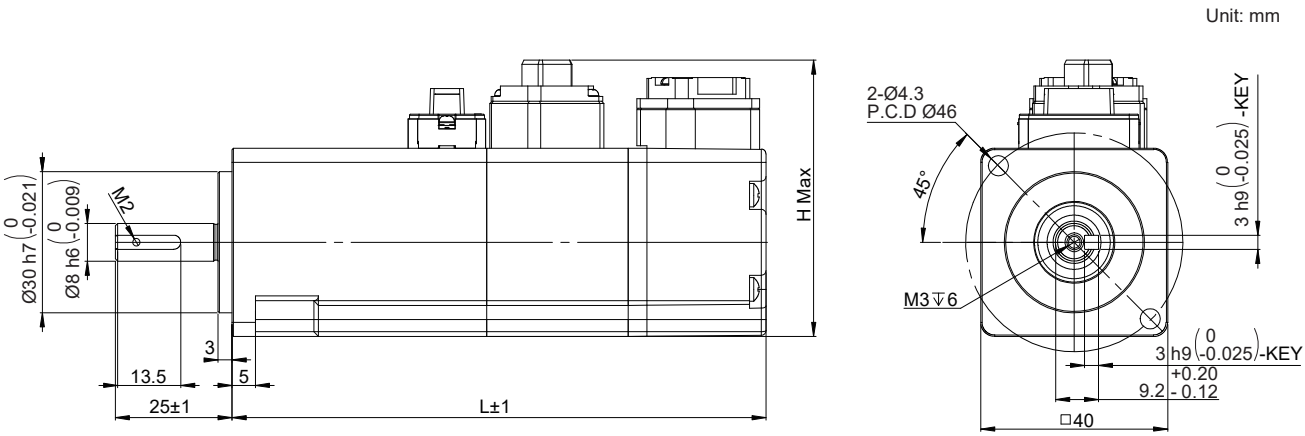
Unit: mm



Model without brake	L
R88M-C6H05030T-S2/OS2	70
R88M-C6H10030T-S2/OS2	84

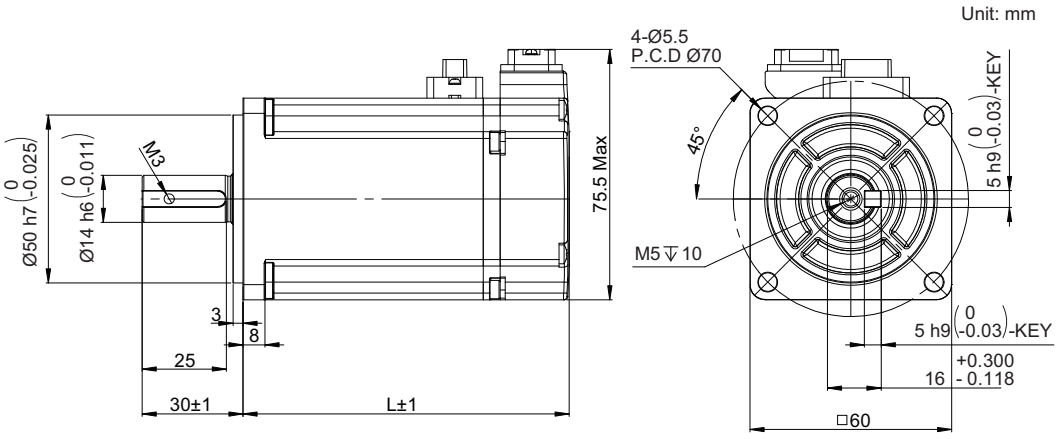
- 50 W, 100 W (with brake, high inertia)

Unit: mm



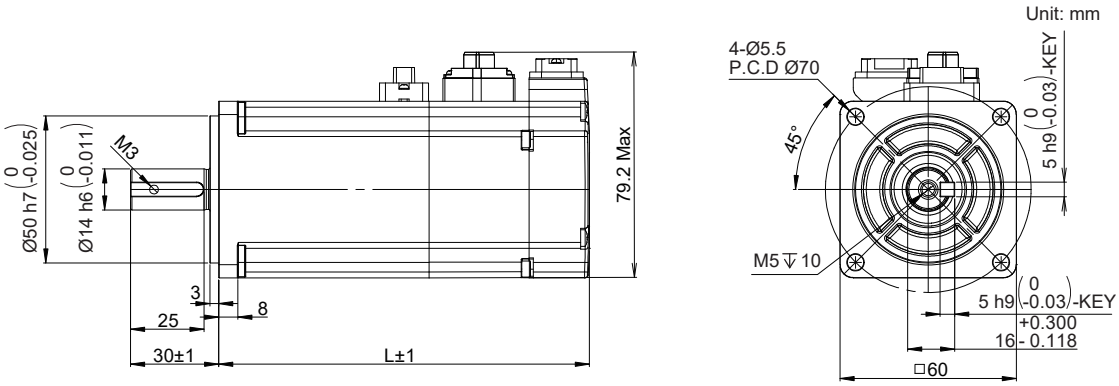
Model with brake	L	H
R88M-C6H05030T-BS2/BOS2	100.3	59.7
R88M-C6H10030T-BS2/BOS2	106.3	57.7

- 200 W, 400 W (without brake, low inertia)



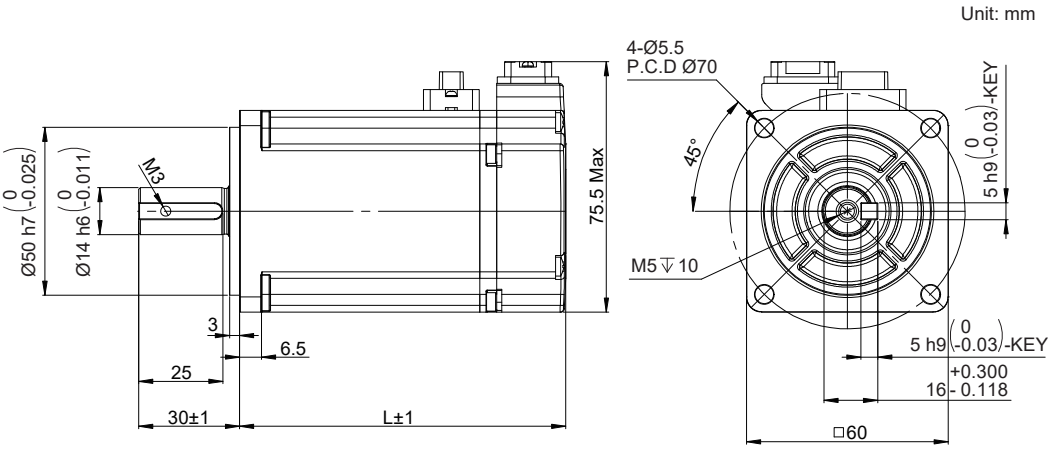
Model without brake	L
R88M-C6L20030T-S2/OS2	84
R88M-C6L40030T-S2/OS2	102.5

- 200 W, 400 W (with brake, low inertia)



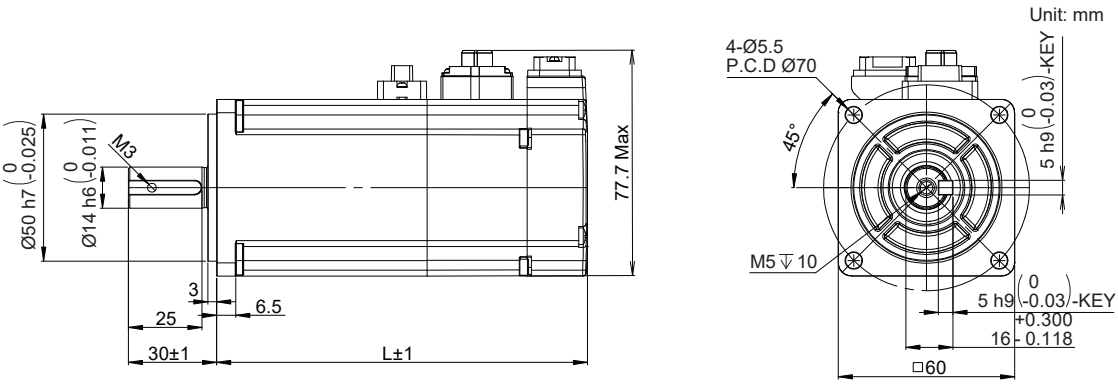
Model with brake	L
R88M-C6L20030T-BS2/BOS2	124.5
R88M-C6L40030T-BS2/BOS2	143

- 200 W, 400 W (without brake, high inertia)



Model without brake	L
R88M-C6H20030T-S2/OS2	77
R88M-C6H40030T-S2/OS2	97

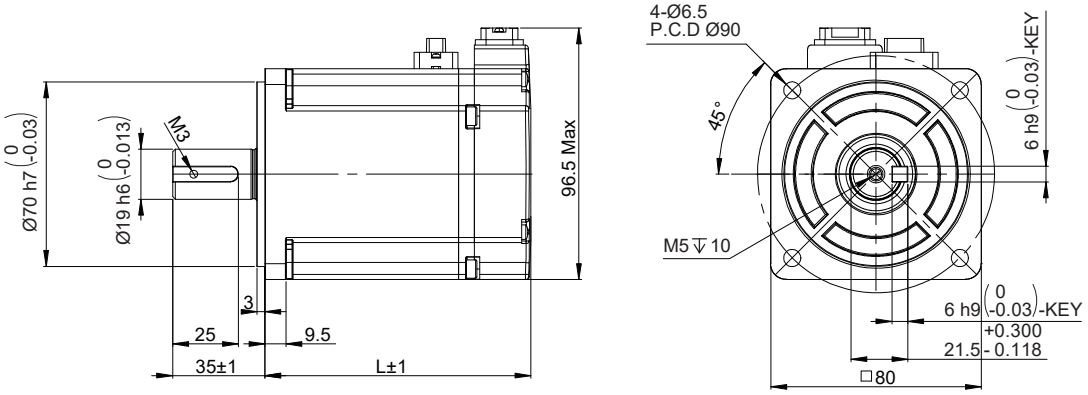
- 200 W, 400 W (with brake, high inertia)



Model with brake	L
R88M-C6H20030T-BS2/BOS2	106
R88M-C6H40030T-BS2/BOS2	126

- 750 W, 1 kW (without brake, low inertia)

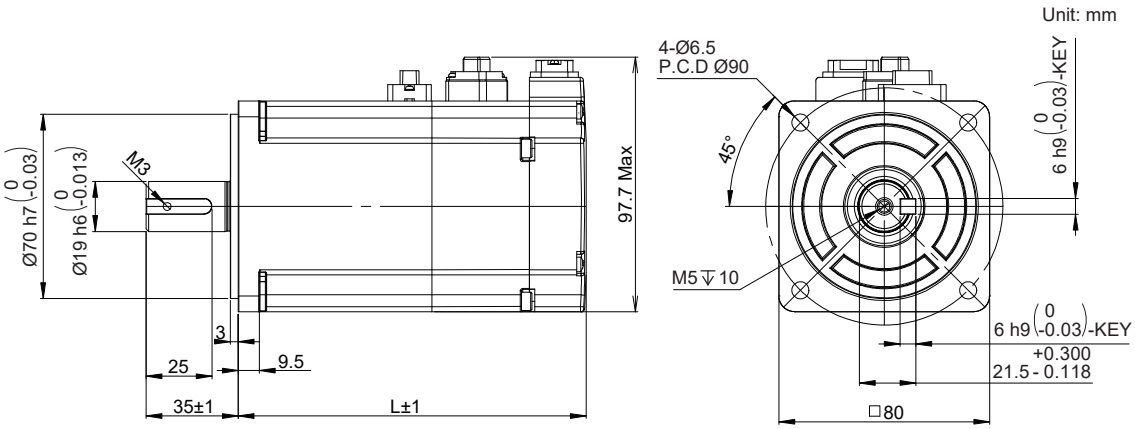
Unit: mm



Model without brake	L
R88M-C6L75030T-S2/OS2	114
R88M-C6L1K030T-S2/OS2-08	128

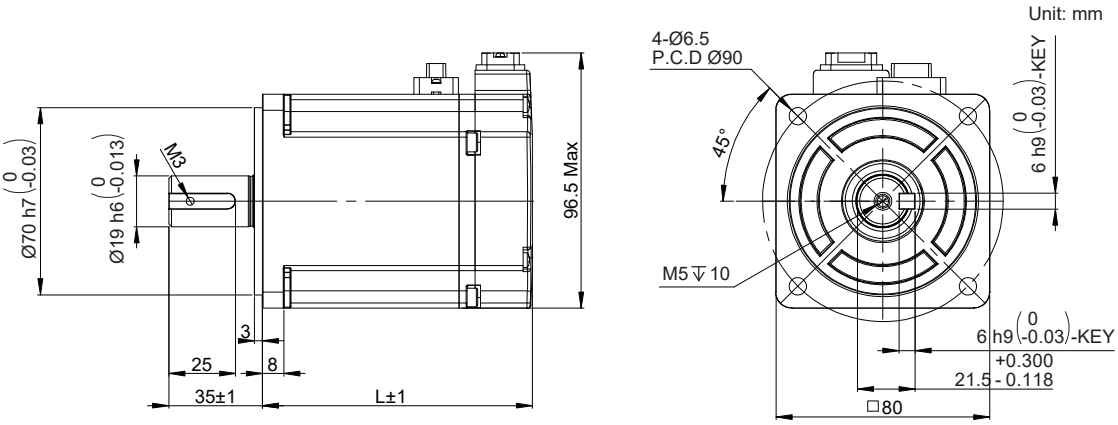
- 750 W, 1 kW (with brake, low inertia)

Unit: mm



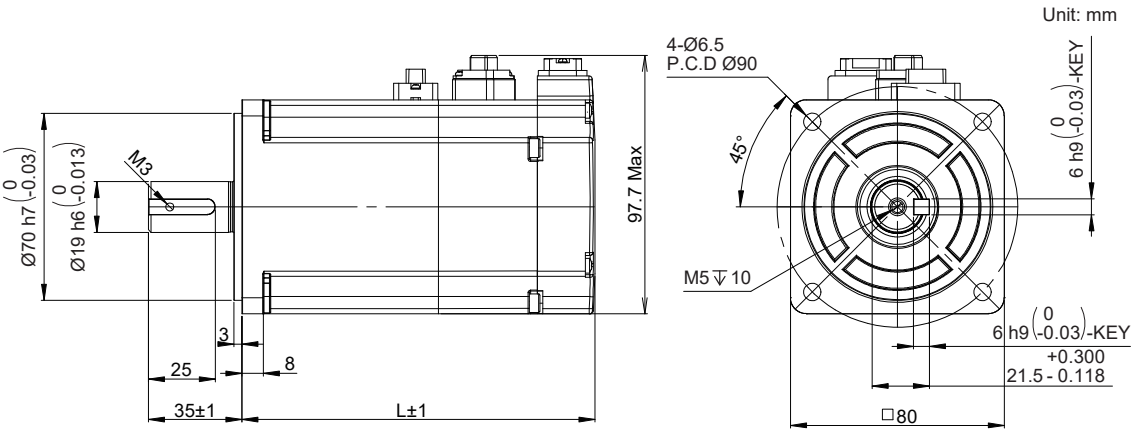
Model with brake	L
R88M-C6L75030T-BS2/BOS2	156.5
R88M-C6L1K030T-BS2/BOS2-08	170.5

- 750 W, 1 kW (without brake, high inertia)



Model without brake	L
R88M-C6H75030T-S2/OS2	101
R88M-C6H1K030T-S2/OS2	114

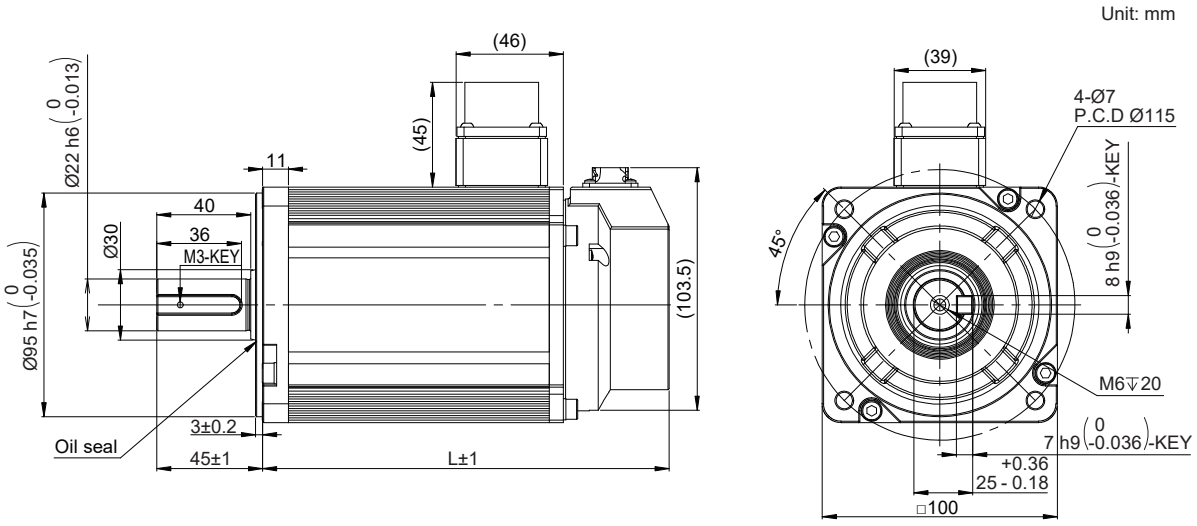
- 750 W, 1 kW (with brake, high inertia)



Model with brake	L
R88M-C6H75030T-BS2/BOS2	132
R88M-C6H1K030T-BS2/BOS2	145

- 1 kW (without brake, low inertia)

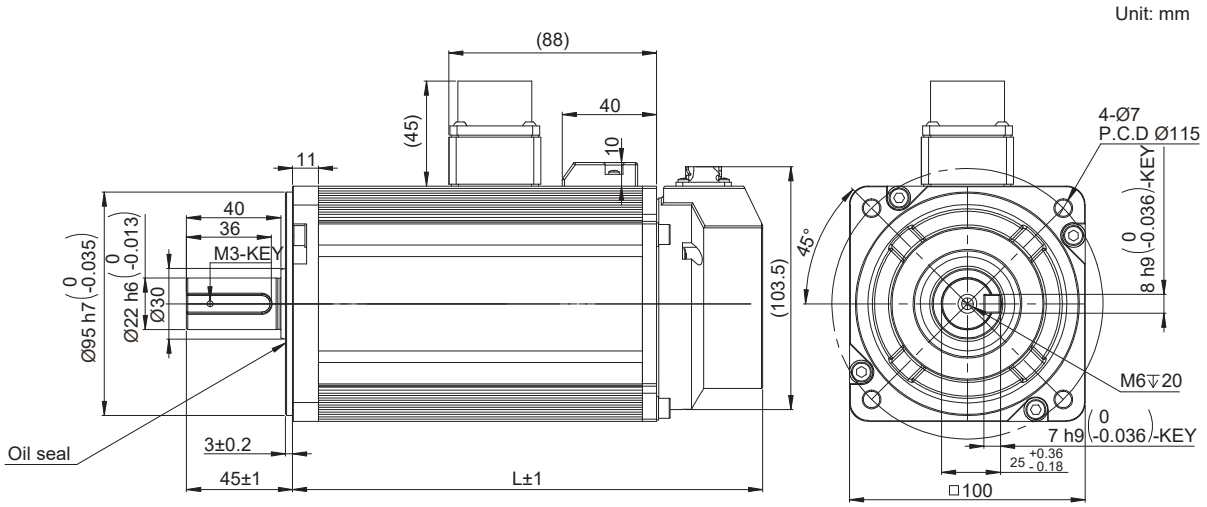
Unit: mm



Model without brake	L
R88M-C6L1K030T-OS2-10	142

- 1 kW (with brake, low inertia)

Unit: mm

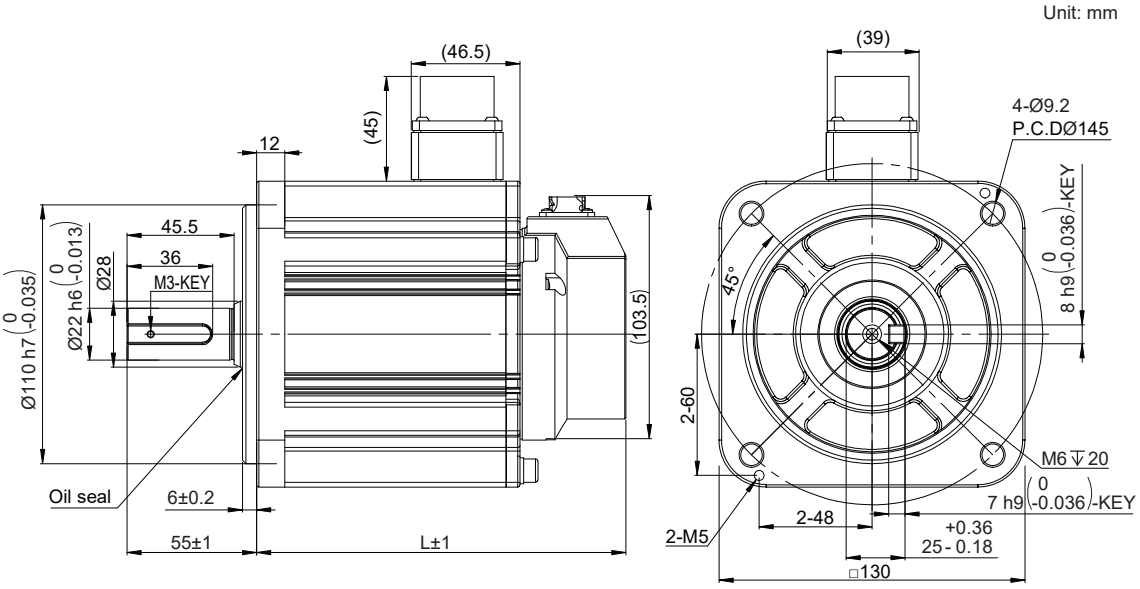


Model with brake	L
R88M-C6L1K030T-BOS2-10	184.4

2,000 r/min Servomotors (220 VAC)

- 1 kW (without brake, medium inertia)

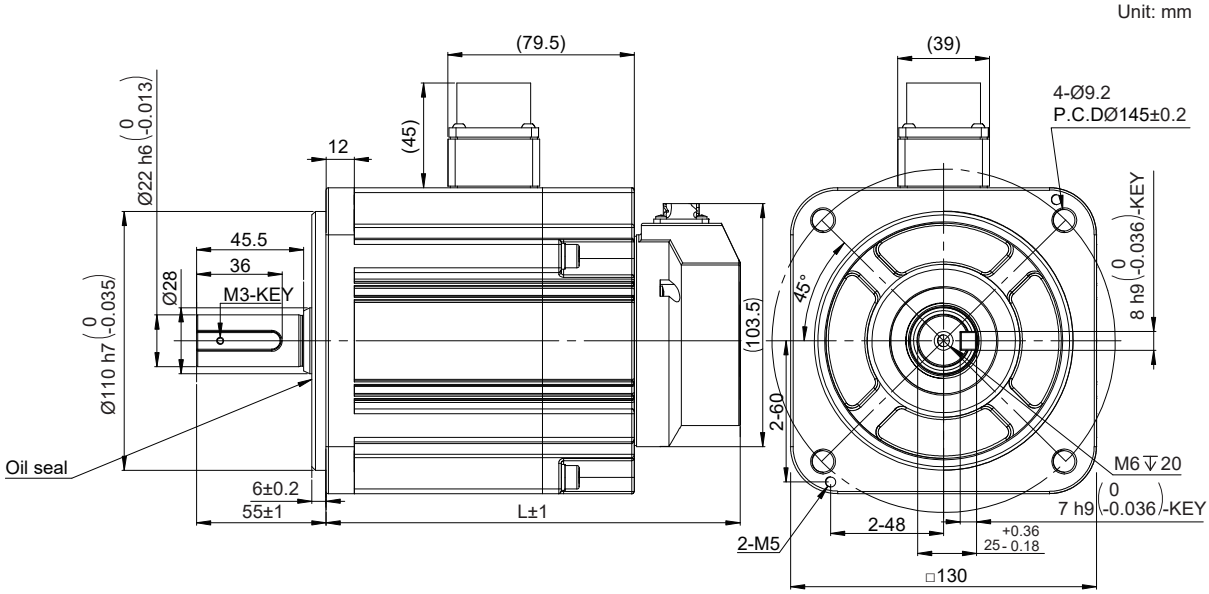
Unit: mm



Model without brake	L
R88M-C6M1K020T-OS2	143

- 1 kW (with brake, medium inertia)

Unit: mm

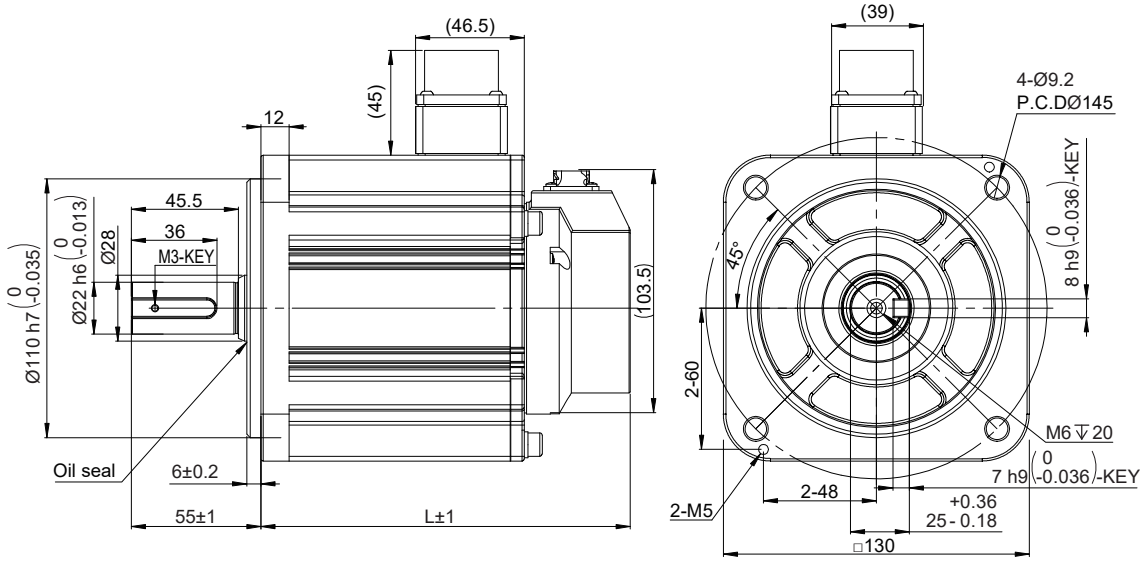


Model with brake	L
R88M-C6M1K020T-BOS2	176

1,500 r/min Servomotors (220 VAC)

- 850 W (without brake, high inertia)

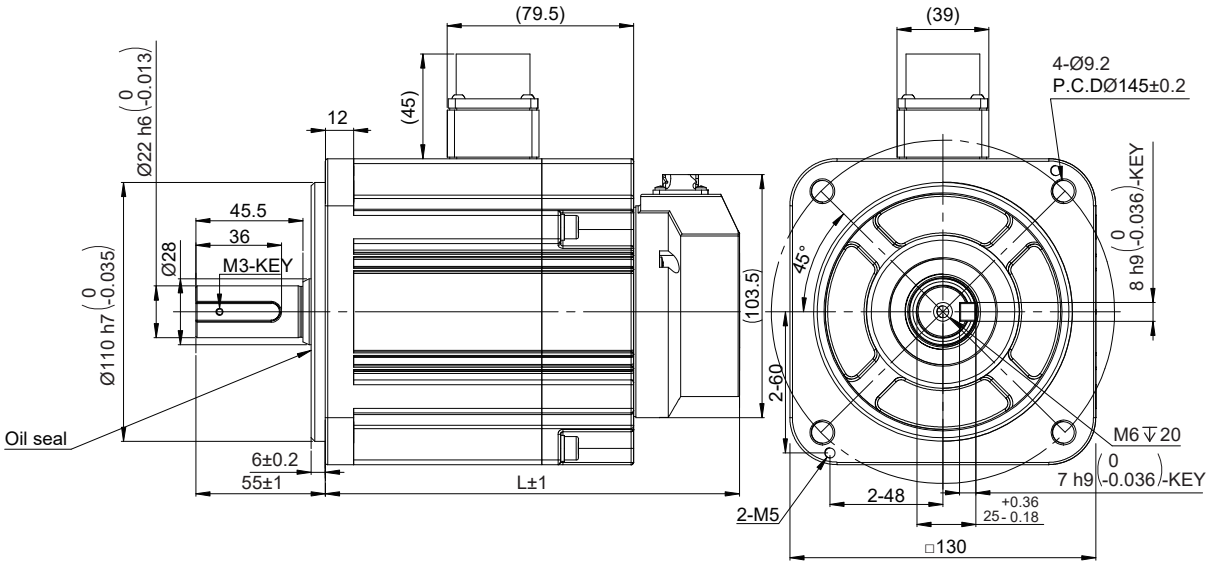
Unit: mm



Model without brake	L
R88M-C6H85015T-OS2	143

- 850 W (with brake, high inertia)

Unit: mm



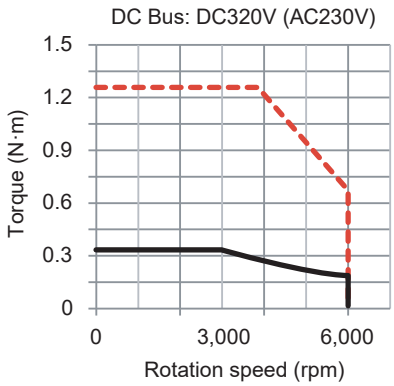
Model with brake	L
R88M-C6H85015T-BOS2	176

2-3-4 Torque-Rotation Speed Characteristics

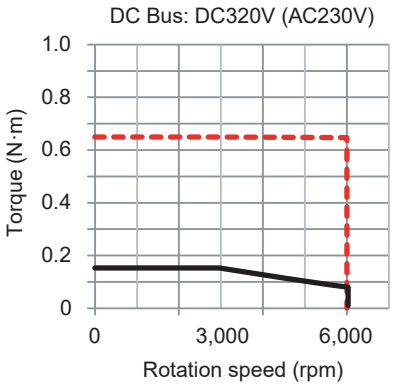
The following graphs show the limit characteristics of the motor in a cold state. When the motor and the drive are used in combination, the characteristics should be confirmed according to the actual situation.

3,000 r/min Servomotors (220 VAC)

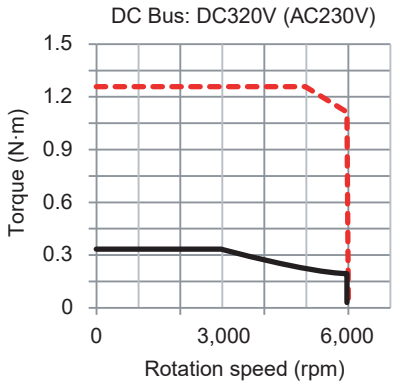
• R88M-C6L10030T (100Watts)



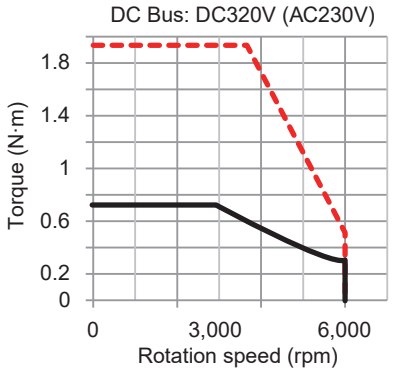
• R88M-C6H05030T (50Watts)



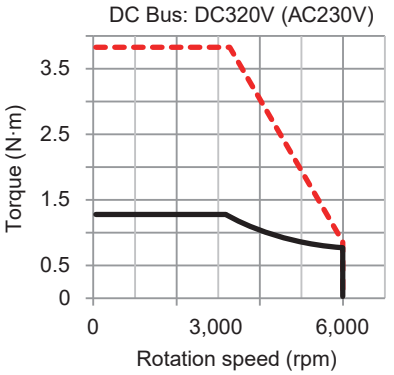
• R88M-C6H10030T (100Watts)



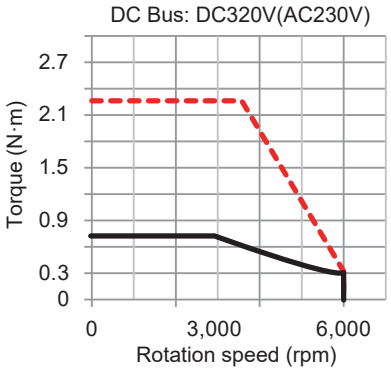
• R88M-C6L20030T (200Watts)



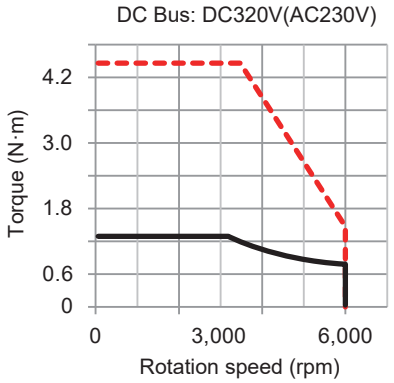
• R88M-C6L40030T (400Watts)



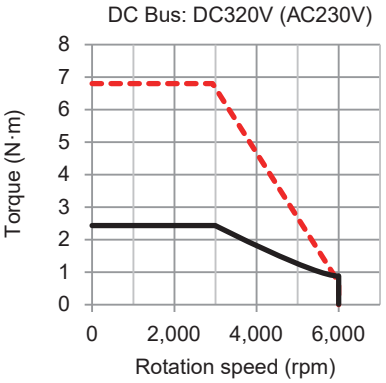
• R88M-C6H20030T (200Watts)



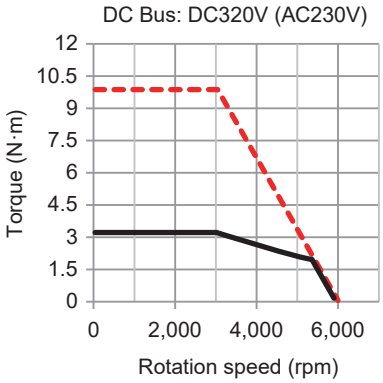
• R88M-C6H40030T (400Watts)



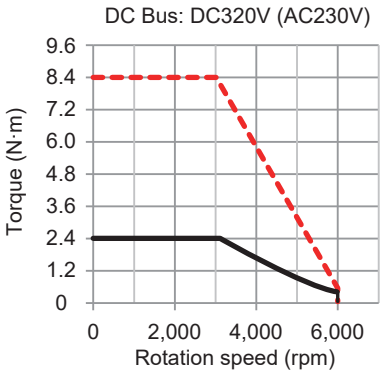
• R88M-C6L75030T (750Watts)



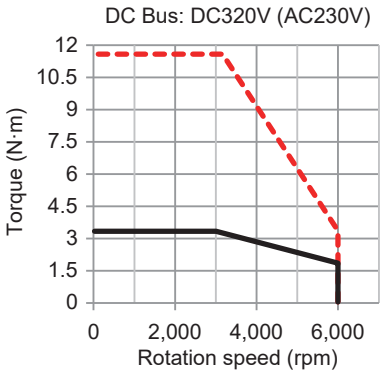
• R88M-C6L1K030T-□□-08 (1,000Watts)



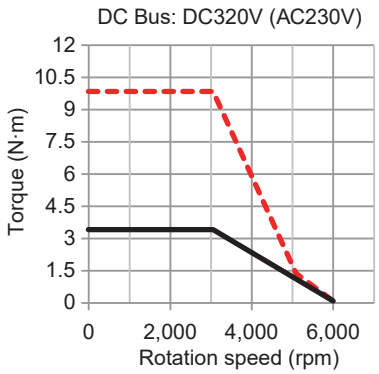
• R88M-C6H75030T (750Watts)

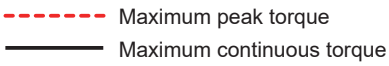


• R88M-C6H1K030T (1,000Watts)



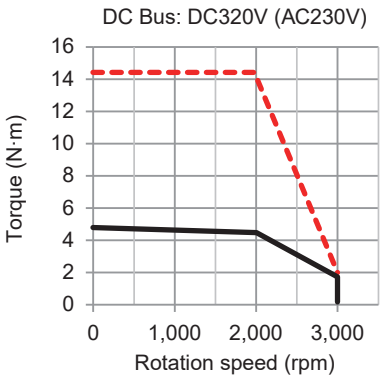
• R88M-C6L1K030T- □□ -10 (1,000Watts)

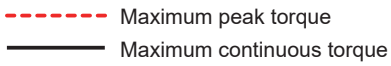




2,000 r/min Servomotors (220 VAC)

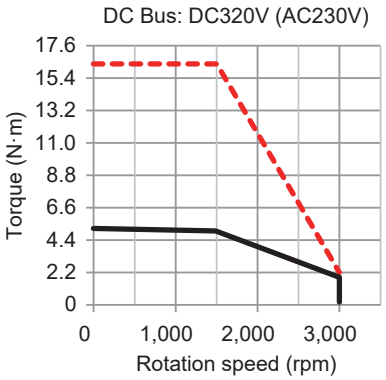
• R88M-C6M1K020T (1,000Watts)

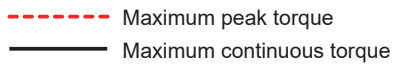




1,500 r/min Servomotors (220 VAC)

• R88M-C6H85015T (850Watts)





2-4 Servomotor General Specifications

Item	Specifications
Encoder type	26-bit multi-turn absolute photoelectric encoder
Insulation class	Class F (155 ℃)
Installation conditions	Indoor installation, avoiding direct sunlight, corrosive and flammable gases
Ambient temperature	Operating temperature: 0 ℃ to 40 ℃ ; storage temperature: -20 ℃ to 60 ℃
Humidity	Storage and operating: 20% to 85% RH (without condensation)
Altitude	Below 1,000m
Vibration resistance	10 to 60 Hz at 49 m/s^2 or below (continuous operation is not allowed at the resonance point)
Dielectric strength	Between winding and housing: 1,500 VAC for 1 min (voltage 220 V) Between winding and housing: 1,800 VAC for 1 min (voltage 400 V) Between brake winding and housing：500 VAC for 1 min

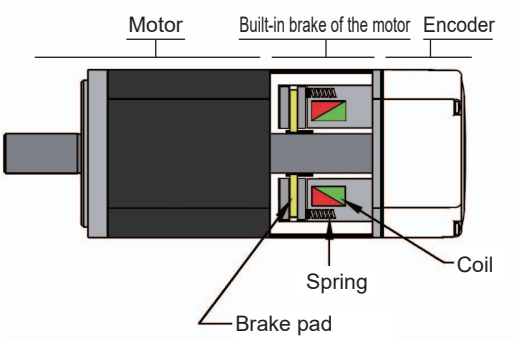
2-4-1 Motor Encoder Specifications

Item	Specifications
Power supply voltage VCC	DC 4.5V to 5.5V (Typ 5V)
External battery voltage	DC 3.3 to 5.5V (Typ 3.6V)
Current consumption at power supply voltage VCC	Typ 160mA
Current consumption of external battery	Typ 15μA
Pulses per revolution	67,108,864 (26-bit)
Multi-turn revolution count	65,535 (16-bit)
Communication method	Half-duplex asynchronous serial communication
Communication rate	4Mbps
Operating temperature	0 to 105 ℃

2-4-2 Motor Brake Specifications

The motor brake is used to prevent the motor from rotating when the brake is de-energized. The most common application: when the motor is used to control a vertical load, Servomotors with brakes are required to prevent the motor driven mechanical mechanism from displacement due to gravity and other factors in the event of servo off or de-energization.

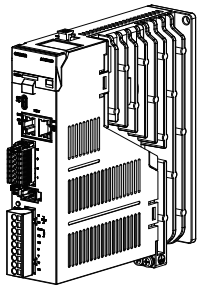
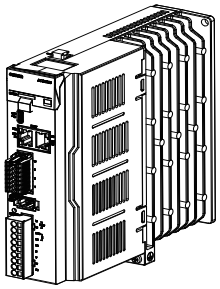
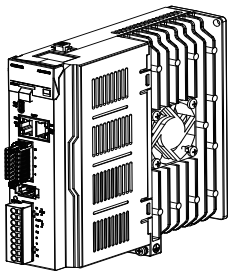
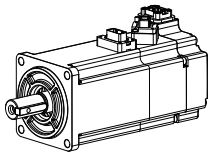
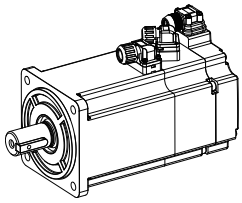
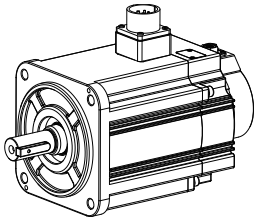
The motor can run normally when the brake is energized (the armature is attracted and the brake pads are released), and the motor cannot rotate normally when the brake is de-energized (the armature is released and the brake pads are locked).



For the brake specifications of different motor models, refer to📖 *"2-3-2 Specifications* (P.2-8)".

(Note) During normal operation, do not use the motor's brake to slow it down, as this will damage the brake.

2-5 Servo Drive and Servomotor Selection Reference Information Table

Servo Drive				
26-pin spring-loaded I/O connector				
EtherCAT		R88D-C6EN04H-ECT	R88D-C6EN08H-ECT	R88D-C6EN10H-ECT
Mating motor				
Motor flange & power				
		40 flange, 50 W, 100 W	-	80 flange, 1,000 W
		60 flange, 200 W, 400 W	-	100 flange, 1,000 W
		-	80 flange, 750 W	130 flange, 850 W, 1,000 W
Low inertia	Without brake	R88M-C6L10030T-S2/OS2 R88M-C6L20030T-S2/OS2 R88M-C6L40030T-S2/OS2	R88M-C6L75030T-S2/OS2	R88M-C6L1K030T-S2/OS2-08 R88M-C6L1K030T-OS2-10
	With brake	R88M-C6L10030T-BS2/BOS2 R88M-C6L20030T-BS2/BOS2 R88M-C6L40030T-BS2/BOS2	R88M-C6L75030T-BS2/BOS2	R88M-C6L1K030T-BS2/BOS2-08 R88M-C6L1K030T-BOS2-10
Medium inertia	Without brake	-	-	R88M-C6M1K020T-OS2
	With brake	-	-	R88M-C6M1K020T-BOS2
High inertia	Without brake	R88M-C6H05030T-S2/OS2 R88M-C6H10030T-S2/OS2 R88M-C6H20030T-S2/OS2 R88M-C6H40030T-S2/OS2	R88M-C6H75030T-S2/OS2	R88M-C6H1K030T-S2/OS2 R88M-C6H85015T-OS2
	With brake	R88M-C6H05030T-BS2/BOS2 R88M-C6H10030T-BS2/BOS2 R88M-C6H20030T-BS2/BOS2 R88M-C6H40030T-BS2/BOS2	R88M-C6H75030T-BS2/BOS2	R88M-C6H1K030T-BS2/BOS2 R88M-C6H85015T-BOS2

2-6 Connectors and Peripheral Accessories

2-6-1 Servo Drive Connector Kit (Wiring Side)

Name	Manufacturer's model	Manufacturer	Description
I/O connector	15EDGKNHG-3.5-14P-13-00A(H)	DEGSON	CN2, 14-pin spring-loaded I/O connector
Motor encoder connector	YS1394-06P11AA001	Yuanshang Electronic Technology	CN3, drive-side motor encoder connector
STO function connector	Connector: 3025HM-2*02-N0HF-00	SESO	CN5, STO connector
	Pin: 3025TF-PSN-B		
Drive connector kit	P1: 0234-20	DINKLE	P1 for 400 W/750 W/1 kW Servo Drives

2-6-2 Servomotor Connector Kit (Wiring Side)

Name	Manufacturer's model	Manufacturer	Description
Motor connector	Power cable connector: DGFA4S-B1-00A(H) Pin: DGFA-00A(H)	DEGSON	Motor connector kits of 40 mm/60 mm/80 mm flanges (without brake connector)
	Encoder connector: DGFA9S-B1-01A(H) Pin: DGFA-02A(H)		
	Power cable connector: DGFA4S-B1-00A(H) Pin: DGFA-00A(H)	DEGSON	Motor connector kits of 40 mm/60 mm/80 mm flanges (with brake connector)
	Encoder connector: DGFA9S-B1-01A(H) Pin: DGFA-02A(H)		
	Brake connector: DGFA2S-B1-00AH		
	Power cable connector: YS-H5015-20-18S-C-001	Yuanshang Electronic Technology	Motor connector kits of 100 mm/130 mm flanges (elbow)
	Encoder connector: YS-DDK-10PHSMSZC-001		

2-6-3 Absolute Encoder Backup Battery

Name	Manufacturer's model	Manufacturer	Description
Battery	ER14505	EVE	For absolute encoder motor with battery
Battery and battery case			

2-6-4 Regenerative Energy Absorption Resistor

Specifications	Description
100 W， 120 Ω	Regenerative energy absorption resistor
200 W， 120 Ω	
300 W， 120 Ω	

2-6-5 EMI Filter

Specifications	Description
250 VAC, 20 A	EMI filter on AC input side of drive (single-phase)

(Note) For wiring and peripheral accessories, please consult the Sales Department of Omron Industrial Automation (China) Co., Ltd.

3

Installation

This section explains the storage conditions, installation conditions, and installation precautions for the Servo Drive and Servomotor.

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3-1-1 Drive Storage Environment Conditions 3-2
3-1-2 Motor Storage Environment Conditions 3-2
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3-1 Storage Conditions

3-1-1 Drive Storage Environment Conditions

- Store this drive in the packaging box and keep it in a dry, dust-free place, away from direct sunlight and vibration.
- The ambient temperature is -20 ℃ to +65 ℃ .
- The ambient humidity is 10% to 85% RH, without condensation.
- Avoid storing in environments with corrosive gases.

3-1-2 Motor Storage Environment Conditions

- Store the motor in the packaging box and keep it in a dry, dust-free place, away from direct sunlight and vibration.
- The ambient temperature is -20 ℃ to +60 ℃ .
- The ambient humidity is 20% to 85% RH, without condensation.
- Avoid storing in environments with corrosive gases.

3-2 Installation Conditions

3-2-1 Drive Operating Environment Conditions

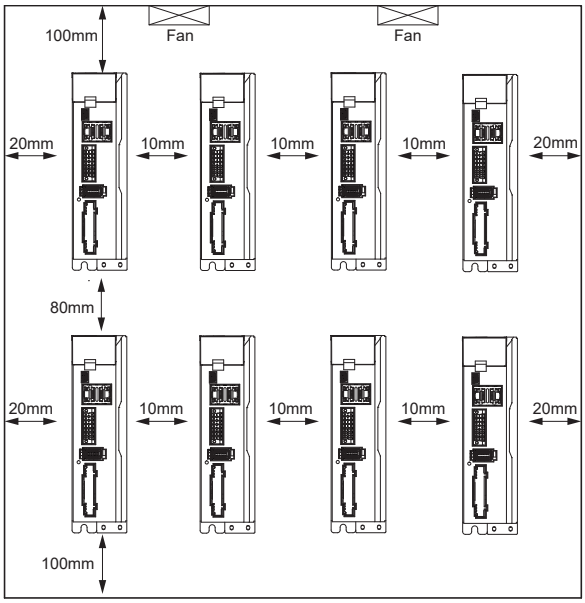
- The ambient temperature is 0 ℃～ 55 ℃ . If the ambient temperature exceeds 45 ℃ , please store it in a well-ventilated place. For extended operation, it is recommended to use the product at an ambient temperature below 45 ℃ to ensure reliable performance.
- If this product is installed in a distribution box, the distribution box must be properly sized and ventilated to ensure that all internal electronic devices are not at risk of overheating.
- The ambient humidity is 10% to 85% RH, without condensation.
- Vibration is 10 to 60 Hz at 9.8 m/s^2 or below (continuous operation is not allowed at the resonance point).
- Do not use this drive near corrosive gases, flammable gases, or combustible materials.
- Install the drive in an indoor electrical control box away from water and direct sunlight.
- Avoid using this drive in dusty environments.

3-2-2 Motor Operating Environment Conditions

- The ambient temperature is 0 ℃ to 40 ℃ .
- The ambient humidity is 20% to 85% RH, without condensation.
- Vibration is 10 to 60 Hz at 49 m/s^2 or below (continuous operation is not allowed at the resonance point).
- Do not use this motor near corrosive gases, flammable gases, or combustible materials.
- Do not use this motor in enclosed environments, as this will cause the motor to overheat and shorten its lifespan.

3-2-3 Drive Installation Space

- When installing the drive, please leave sufficient space above, below, left, and right to ensure good circulating cooling.
- Do not block the drive's ventilation holes.
- To ensure the temperature inside the electrical control box, it is recommended to install a cooling fan inside the electrical control box.
- Ensure the drive is properly grounded during installation.

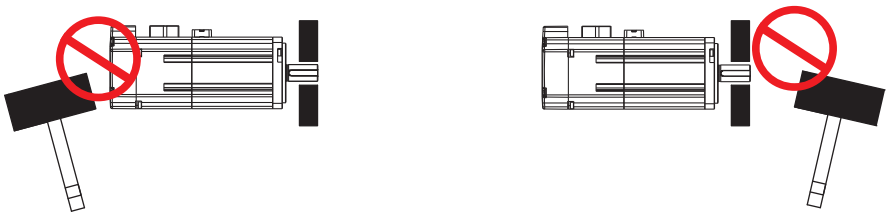


(Note) All dimensions above represent minimum distances.

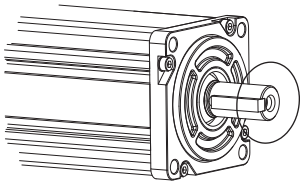
3-3 Precautions for Motor Installation

3-3-1 Encoder and Bearing Protection

- During installation, do not strike the motor body or shaft, etc. in order to prevent damage to the encoder and bearing.



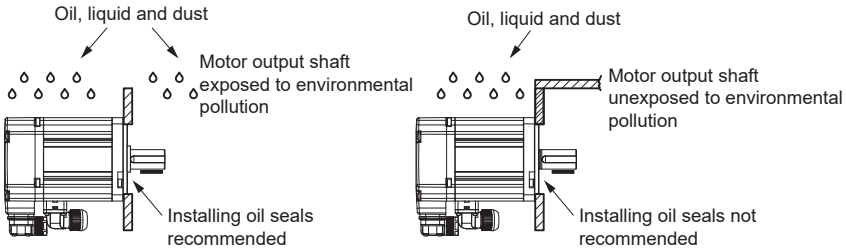
- It is recommended to use a flexible coupling specifically designed for servomotors, which can provide some cushioning during radial or angular misalignment.
- When installing the coupling, wipe the anti-rust oil off the motor output shaft end.
- When using the keyway, use the key that is included in the motor packaging box.
- When installing a pulley on a servomotor with a keyway, press the pulley into the motor shaft with a screw using the threaded hole on the motor shaft.



- When disassembling the pulley, use a specialized tool such as pulley remover to prevent damage to the bearing.
- When connecting the shaft, ensure that the required concentricity is achieved. Poor concentricity can cause vibration damage to the bearing and encoder.
- Do not apply loads to the motor in the axial or radial direction exceeding the range specified in the specifications. Refer to the specification table for each servomotor.
- The servomotor output shaft material is not rust-resistant. Although grease is used for rust prevention at the factory, if the storage time exceeds six months, please check the condition of the motor shaft every three months and add appropriate anti-rust grease as needed to ensure the motor shaft is free from corrosion.

3-3-2 Precautions for Using the Motor in Oil and Water Environments

- Do not allow oil or water to enter the motor.
- Do not immerse the cable in water or oil.
- Since the motor shaft through part is not designed for IP67 protection, please ensure that no water or oil enters from this part.
- An industrial oil seal can extend motor life by blocking contaminants (oils, impurities). However, the oil seal will create some resistance on the motor shaft, so it is recommended to de-rate the motor during use.
- In applications involving liquids, install the motor with the wiring terminals facing downwards.



- When installing the oil seal, ensure that the lip of the oil seal faces outward.

3-3-3 Wiring

- If using carrier cables, use bend-resistant cables and ensure a bend diameter of at least 100mm.
- Do not twist the cable.
- Do not pull on the cable when moving the motor.
- Avoid running the main circuit cable and the I/O signal cable or the encoder cable through the same conduit, or bundling them together. When wiring, the main circuit cable and the I/O signal cable or the encoder cable should be at least 30cm apart.

3-3-4 Motor Temperature Rise

When the motor is combined with a mating drive, its temperature rise is a typical value at the motor armature temperature of 20°C. When the servomotor is installed in a small device, its heat dissipation area is reduced, so the temperature may rise significantly.
The standard heat sink dimensions for the servomotor are as follows:

Motor flange size	Power	Heat sink dimensions
40 mm	50 W, 100 W	200*200*6 Aluminum
60 mm	200 W, 400 W	250*250*6 Aluminum
80 mm	750 W	250*250*6 Aluminum
	1 kW	300*300*12 Aluminum
130 mm	850 W to 1 kW	400*400*20 Iron

If the installation environment makes it difficult to use a large heat sink, or if the motor is operating at an ambient temperature exceeding the specifications, the following requirements must be observed:

- Do not operate at rated power; select a motor with a power rating 1 to 2 times greater than the actual required power.
- Reduce acceleration and deceleration during the operation cycle to reduce motor load.
- Reduce the duty cycle.
- Use a cooling fan or other methods to externally force-cool the servomotor.

(Note) Do not place any heat insulation material between the servomotor and the metal heat sink, as this may prevent the motor from dissipating heat, causing the motor temperature to rise and potentially leading to motor failure.

4

Wiring

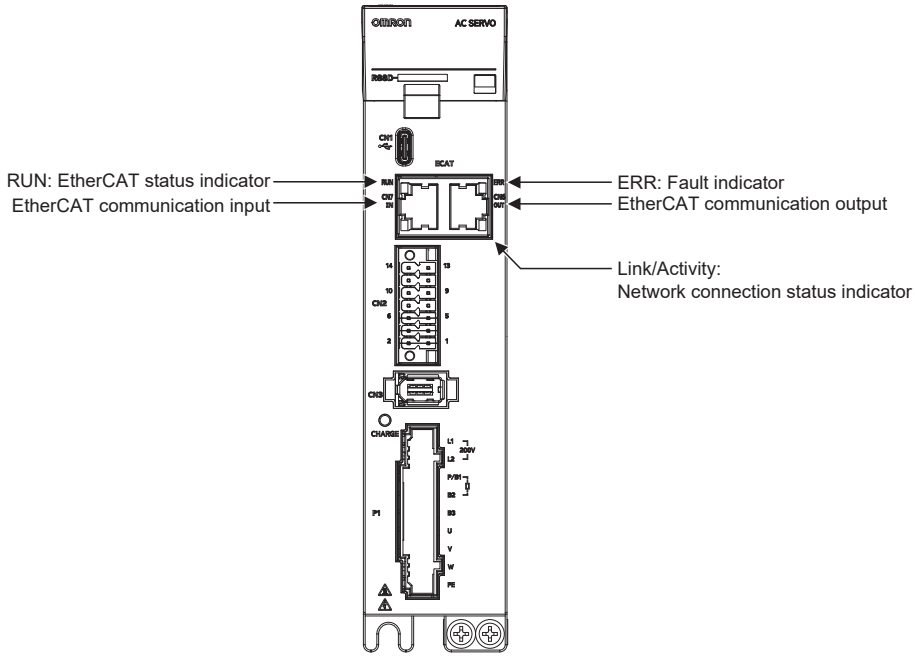
This section explains the definitions of various interfaces and connector pins of the Servo Drive and motor, the wiring methods, and the regenerative energy calculation methods, etc.

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4-1 EtherCAT Communications Interface

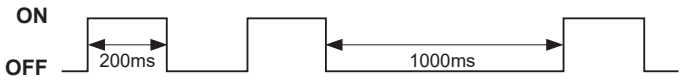
4-1-1 Description of Communications Interface



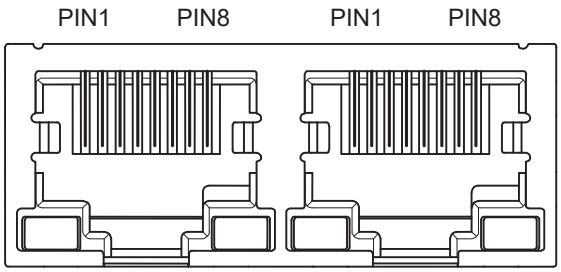
4-1-2 EtherCAT Communications Status Indicators

LED	Color	Status	Description
Link/Activity	Green	OFF	Connection not established
		Always ON	Connection established, no data transmission
		Flickering	Connection established, data in transmission
RUN	Green	OFF	Init state
		Always ON	Operational state
		Blinking	Pre-Operational state
		Single flashing	Safe-Operational state
ERR	Red	OFF	No error
		Blinking	Communications error
		Single flashing	Synchronization error
		Double flashing	Watchdog timeout
		Flickering	Initialization error

See the following diagram for the status of the indicators.

Flickering	
Blinking	
Single flashing	
Double flashing	

4-1-3 RJ45 (8p8c) Pin Definitions



PIN No.	Signal name	Function
1	TX+	Send data +
2	TX-	Send data -
3	RX+	Receive data +
4	-	-
5	-	-
6	RX-	Receive data -
7	-	-
8	-	-

4-2 Electromagnetic Compatibility

⚠ CAUTION

C6E-series Servo Drives incorporate high-speed switching devices internally. High-frequency and low-frequency noise may be generated during normal operation, which can interfere with peripheral devices via conducted or radiated emission.

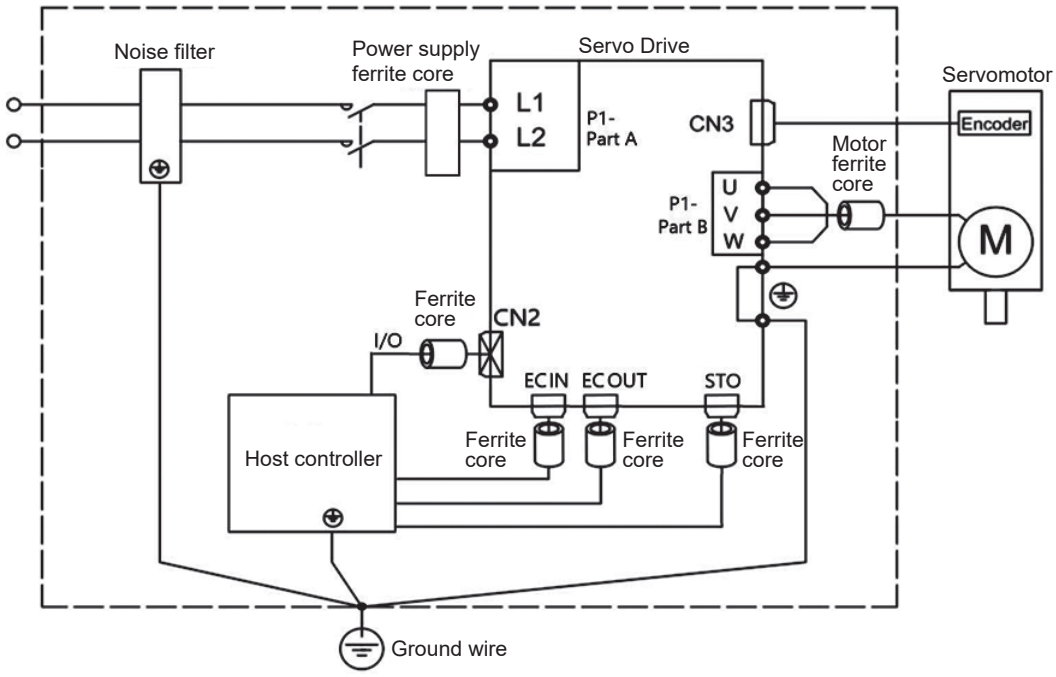
These Servo Drives also include low-voltage circuits susceptible to external noise from peripheral devices.
Noise-induced signal abnormalities may result in unintended equipment operation.

Implement the EMC wiring and installation measures specified in this User's Manual during mounting and wiring. This product conforms to EN 61800-3 requirements.
Take the following measures to prevent mutual electromagnetic interference between the Servo Drive and peripheral devices.

- Install an appropriate EMI noise filter on the power input side.
- Be sure to ground the Servo Drive and Servomotor properly, and you are recommended to use AWG10 or thicker cable wires as the ground wires.
- Avoid running the main circuit cable and the I/O signal cable or the encoder cable through the same conduit, or bundling them together.
  When wiring, the main circuit cable and the I/O signal cable or the encoder cable should be at least 30cm apart.
- For the I/O signal cable and the encoder cable, use a twisted-pair cable or a multi-core twisted-pair shielded cable.
- Do not share the same power supply with welding machines, electrical discharge machines, etc. Even if the power supply is different, when there is a high-frequency generator nearby, connect a noise filter on the input side of the main circuit power supply cable and the control power supply cable.

4-2-1 EMI Noise Filter

Proper mounting of noise filters helps minimize interference. You are recommended to use the EMI filter recommended by Omron to achieve the maximum suppression effect.
The recommended EMC wiring diagram is as follows:



Servo interface	Interface type	Number of turns on the ferrite core
Power supply cable (main circuit and control circuit)	Power supply port	2 turns + 2 turns
Motor power cable	Power supply port	2 turns + 2 turns
EtherCAT communications cable (ECAT IN)	Signal interface	1 turn
EtherCAT communications cable (ECAT OUT)	Signal interface	1 turn
I/O cable	Signal interface	2 turn
STO control cable	Signal interface	2 turn
Encoder cable	Signal interface	None

(Note) For the recommended model of the ferrite core, refer to "*4-2-5 Ferrite Magnetic Cores* (P.4-8)".

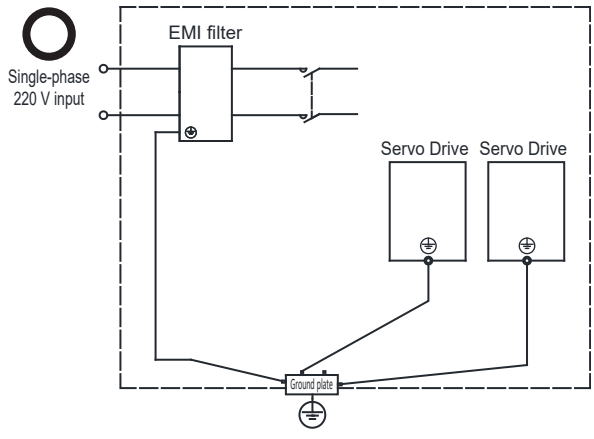
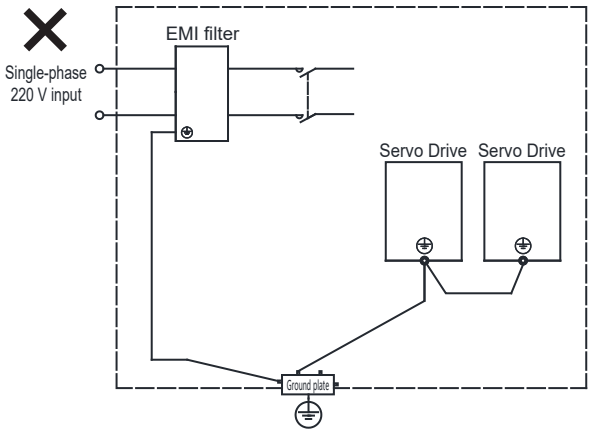
Precautions for Correct Use

- Prepare a metal mounting backplate and remove any paint from the contact surface.
- Mount both the Servo Drive and EMI filter onto the same metal backplate.
- Minimize the cable length between the EMI filter and Servo Drive.
- Run the input and output cables separately and avoid bundling them together.
- The noise filter must be properly grounded.
- For better EMC performance, install ferrite cores on the Servo Drive's input and output signal cables and power cables as shown in the diagram above.

4-2-2 Grounding

Proper grounding maximizes the performance of the EMI filter and greatly reduces interference.

- Parallel single-point grounding is required.

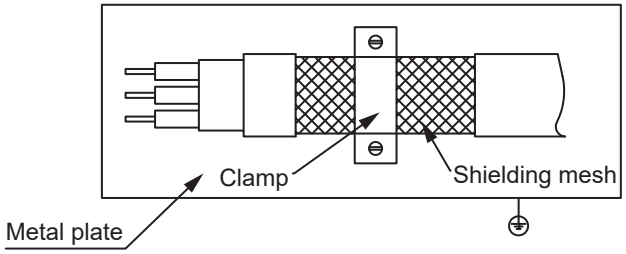
Correct grounding	Incorrect grounding
	

- For the power extension cable between the Servo Drive and the motor, use a cable with shielding mesh.
- The shielding mesh of the motor power cable must be grounded or connected to the grounding terminal of the Servo Drive.

4-2-3 Handling of Motor Cable Shielding Mesh

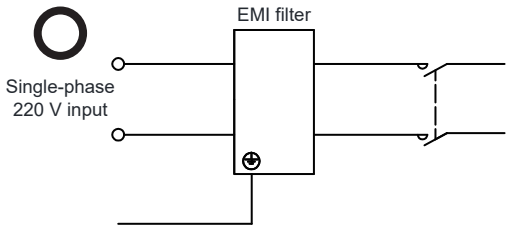
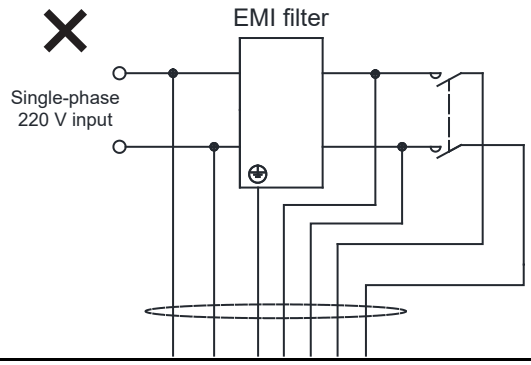
Using a motor cable with shielding mesh and properly installing the shielding mesh can result in better EMC performance and interference suppression. Observe the following precautions:

- Use a cable with shielding mesh (cable with double-layered insulation is even better).
- The shielding mesh at both ends of the motor cable must be grounded with the shortest distance and the largest contact area, using clamps to fix the shielding mesh at both ends of the motor cable to the metal surface, as shown in the diagram below.
- The protective paint must be removed from the area where the clamp is fixed to the metal surface to ensure good contact.



4-2-4 Recommended EMI Noise Filter Models

The Servo Drives generate electromagnetic interference during normal operation. To prevent interference with sensitive external devices, selecting a suitable EMI noise filter may minimize interference.

Correct wiring	Incorrect wiring
	

You can select the following noise filters:

Optional model	Specifications	Manufacturer	Description
1100-314	250 VAC, 20 A	LCR	EMI noise filter (single-phase)

(Note) Run the power supply input and output cables separately. Do not bundle the input and output cables together and place them in the same cable tray.

4-2-5 Ferrite Magnetic Cores

Ferrite magnetic cores, also known simply as ferrite cores, can effectively absorb radiation interference from wire harnesses.

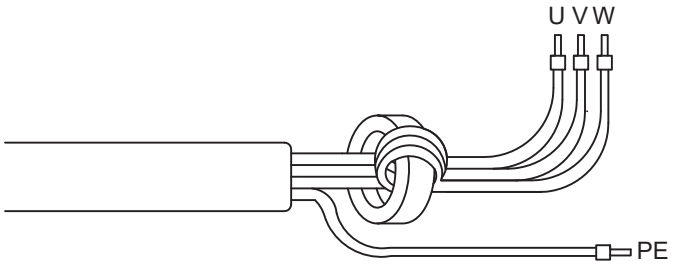
The ferrite core provides a frequency-dependent impedance. Generally, the impedance is very small at low frequencies. As the signal frequency increases, the impedance increases sharply, allowing normal and useful signals to pass through easily while effectively suppressing the passage of high-frequency interference signals. This solves the problem of high-frequency interference in power supply lines, signal lines, and connectors.

When suppressing common-mode interference, the ferrite core converts high-frequency components into heat loss through the eddy current loss of the high-frequency signal. This forms a low-pass filter, which greatly attenuates high-frequency noise while ignoring the impedance of useful low-frequency signals, without affecting the normal operation of the circuit.

The inductance can be increased by repeatedly winding the wires through the ferrite core, thereby enhancing the performance of the ferrite core. However, too many turns will result in excessive losses and cause the ferrite core to overheat.

The recommended winding method and number of turns are shown in the table below:

Type	Winding method
Signal cable	Wind the required number of turns (2 to 3 turns) around the ferrite core.
Motor cable	Wind the motor's U/V/W phases 2 to 3 turns around the ferrite core. The ground wire and shielding mesh must not be wound into the ferrite core.
Encoder cable	Wind the required number of turns (2 to 3 turns) around the ferrite core.

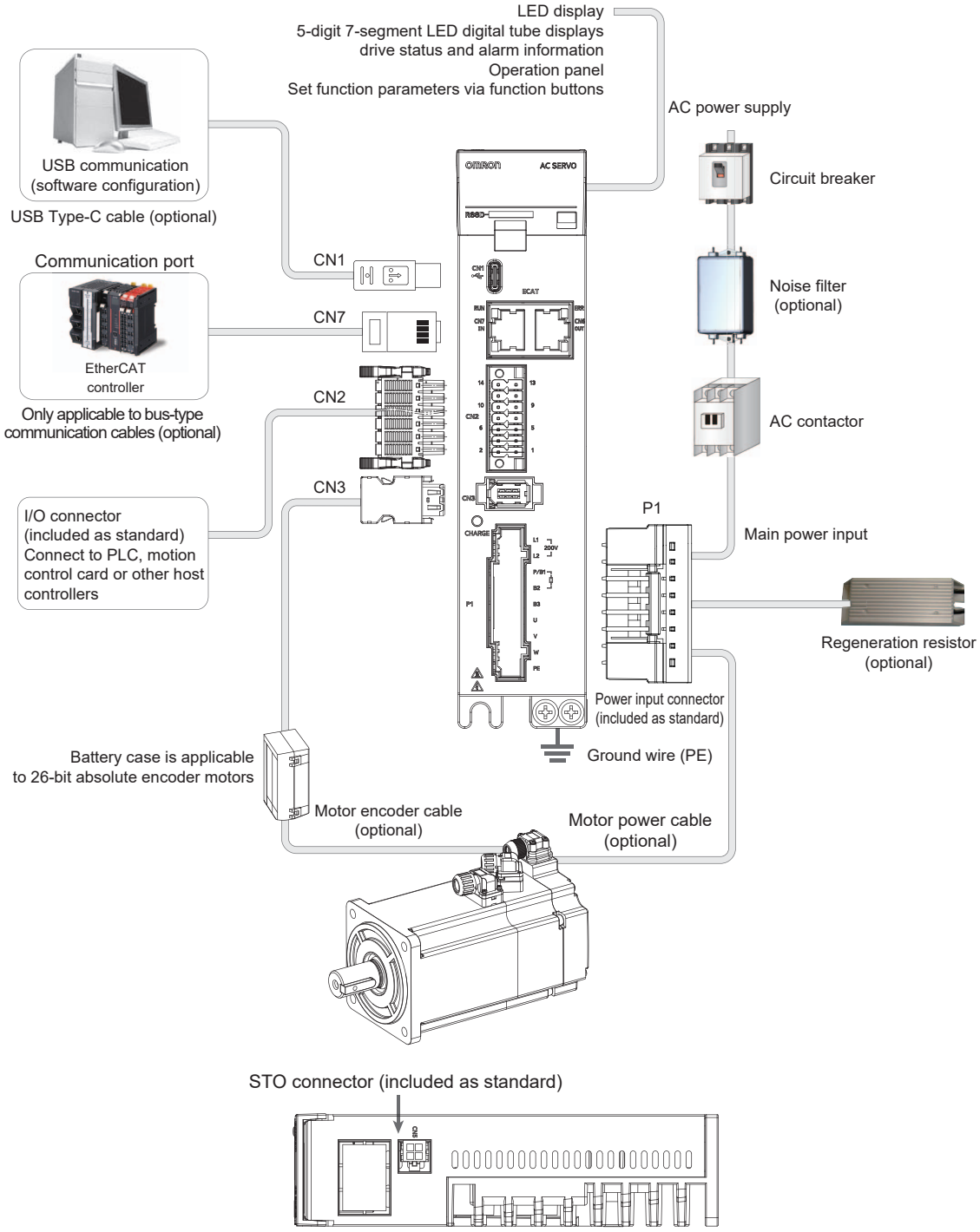


Recommended ferrite core models:

Name	Manufacturer	Model and description	Compatible Servo Drive model
Power supply ferrite core	ACME TDK	A05 T38*19*13 C ZCAT3035-1330	R88D-C6EN04H-ECT
			R88D-C6EN08H-ECT
		A05 T50*30*20 C ZCAT3035-1330	R88D-C6EN10H-ECT
Motor ferrite core	ACME TDK	A05 T38*19*13 C ZCAT3035-1330	R88D-C6EN04H-ECT
			R88D-C6EN08H-ECT
		A05 T50*30*20 C ZCAT3035-1330	R88D-C6EN10H-ECT
Ferrite core	TDK	ZCAT3035-1330	All applicable

4-3 External Main Circuit Wiring

4-3-1 Main Circuit Wiring Diagram



4-3-2 Description of Servo Drive Terminals

<table>
<tr><th>Type</th><th>Name</th><th colspan="3">Description</th></tr>
<tr><td>P1</td><td>L1, L2</td><td colspan="3">Supplies power to the power circuit, connected to a single-phase AC power supply.</td></tr>
<tr><td rowspan="5"></td><td rowspan="4">U, V, W</td><td colspan="3">Connector for motor connection</td></tr>
<tr><td>Terminal symbol</td><td>Wire color</td><td>Description</td></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">3-phase power supply for motor</td></tr>
<tr><td>V</td><td>Yellow</td></tr>
<tr><td>W</td><td>Blue</td></tr>
<tr><td rowspan="2">P/B1, B2, B3</td><td>The Internal Regeneration Resistor is used*1</td><td colspan="2">Short-circuit B2 and B3.
Open between P/B1 and B3.</td></tr>
<tr><td>The External Regeneration Resistor is used</td><td colspan="2">Open between B2 and B3.
Connect the Resistor between P/B1 and B2.</td></tr>
<tr><td>CN1</td><td>USB Type-C interface</td><td colspan="3">Connected to PC</td></tr>
<tr><td>CN2</td><td>I/O interface</td><td colspan="3">I/O signal interface</td></tr>
<tr><td>CN3</td><td>Encoder interface</td><td colspan="3">Motor encoder connection port</td></tr>
<tr><td>CN5</td><td>STO interface</td><td colspan="3">Safe Torque Off function interface</td></tr>
<tr><td>CN6(OUT)</td><td>EtherCAT OUT interface</td><td colspan="3">EtherCAT communications output</td></tr>
<tr><td>CN7(IN)</td><td>EtherCAT IN interface</td><td colspan="3">EtherCAT communications input</td></tr>
</table>

*1. R88D-C6EN04H-ECT Servo Drive is not equipped with an internal regeneration resistor. When a large amount of regenerative energy is generated, connect the required regeneration resistor between B1 and B2.

4-3-3 Precautions for Wiring

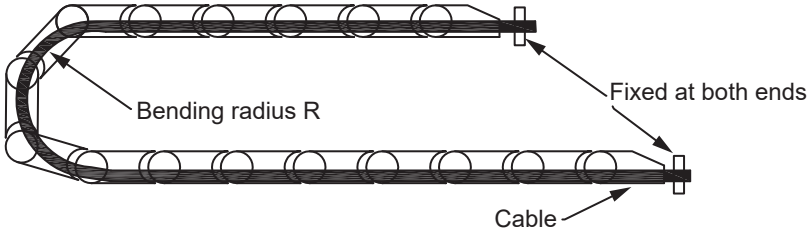
- Be sure to ground the Servo Drive and Servomotor properly, and it is preferable to use AWG10 or thicker cable wires as the ground wires.
- Do not turn the power supply ON if the terminal block screws or the cable wires are loose, as this may cause a fire.
- Wear protective equipment when installing or removing the connectors. Do not apply force after the protrusion of the connector opener (lever included with the Servo Drive) reaches the bottom dead center. As a guide, do not apply a force of 100 N or more.
- Grounding must be a single-point grounding.
- Check that the wiring for L1 and L2 is properly done and that the correct voltage is applied.
- Ensure that the wires U, V and W are in the correct order: red, yellow, blue. An incorrect order will cause the motor to not run or to run erratically.
- It is recommended that the Servo Drive power supply use an isolation transformer and filter to ensure safety and interference immunity.
- An emergency stop circuit must be installed to ensure that the power supply can be immediately cut off in the event of a fault.
- The Servo Drive incorporates a large-capacity capacitor, which will maintain a high voltage even after the power is turned OFF. Do not touch any exposed parts of the Servo Drive and motor terminals within 10 minutes after the power is turned OFF.
- Do not use the same conduit for the main circuit cable and the I/O signal cable or the encoder cable, and do not bundle them together. When wiring, the main circuit cable and the I/O signal cable or the encoder cable should be at least 30cm apart; too close a distance may result in malfunction.
- For the I/O signal cable and the encoder cable, use a twisted-pair cable or a multi-core twisted-pair shielded cable.
- The maximum wiring length for the I/O signal cable is 3m, and the maximum wiring length for the encoder cable is 20m.
- When connecting a cable to the Servomotor, fully insert and tighten the screws.
- The Servomotor will generate high temperatures after operation. When wiring, ensure that the cable is not in contact with the Servomotor.

4-3-4 Precautions for Using Carrier Cables

In applications where motor cables need to be moved or when cables need to be installed in a carrier, use special flexible bend-resistant cables. Common cables are prone to damage from repeated bending, which will cause the servomotor to malfunction.

When using carrier cables, the following requirements must be met:

- Select cables with bending cycle resistance that satisfy the specified requirements.
- The bending radius of cables shall generally be at least 10 times the cable outer diameter. If used under a smaller bending radius, equipment damage, ground faults and other accidents may occur due to insulation breakdown.
- Do not pull the cables forcibly. When wiring inside a carrier, do not fix or bind the cables, otherwise insufficient bending radius will strain and damage the cables.
- Bind the cables at both ends of the carrier where they are fixed to mechanical components.



- Do not overcrowd wiring inside the carrier, ensuring that the cables occupy less than 60% of the internal space of the carrier.
- Avoid laying cables with vastly different outer diameters together. If mixed wiring is unavoidable, install partition baffles for separation.

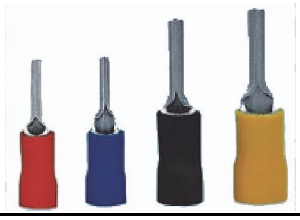
4-3-5 Recommended Wires

- For the main circuit, insulated wires with a rated voltage of 600 V and heat resistance of at least 75 °C are recommended.
- Be sure to use cables with matching allowable current to prevent overheating.
- The table below lists the recommended wires for each part of the drive.

Drive and mating servomotor		Rated power (W)	Wire diameter (AWG)					
			Connector P1			Connector CN3	--	
			L1/L2	U/V/W	P/B1, B2	Encoder	Brake	Ground wire
R88D-C6EN04H-ECT	R88M-C6H05030T	50	2.0 mm^2 AWG14	0.75 to 2.0 mm^2 AWG14 to 18	1.25 to 2.0 mm^2 AWG14 to 16	0.2 mm^2 AWG24	0.5 mm^2 AWG20	2.0 to 5.3mm^2 AWG10 to 14
	R88M-C6L10030T	100						
	R88M-C6H10030T							
	R88M-C6L20030T	200						
	R88M-C6H20030T							
	R88M-C6L40030T	400						
	R88M-C6H40030T							
R88D-C6EN08H-ECT	R88M-C6L75030T	750						
	R88M-C6H75030T							
R88D-C6EN10H-ECT	R88M-C6H85015T	850		2.0 mm^2 AWG14	2.0 to 3.5 mm^2 AWG12 to 14			
	R88M-C6L1K030T	1,000						
	R88M-C6M1K020T							
	R88M-C6H1K030T							

(Note) The above wire sizes correspond to currents under full-load output conditions. Select appropriate cables according to actual operating conditions.

- Use insulated pin terminals for power connectors P1.

Pin terminals	Sleeve terminals	Parallel splice terminals (for connecting two wires into a single terminal)
		

- Select pin terminals of suitable size based on the recommended wires.
  Applicable wire size for connectors: AWG12 to AWG18
  Applicable wire outer diameter for connectors: ø2.1 to 4.2mm

4-3-6 Ground Terminals

- For optimal EMC performance, use dedicated 5.3mm^2/AWG10 copper conductor cables.
- Use O-type cold-pressed terminals.
- Tightening torque of ground terminal

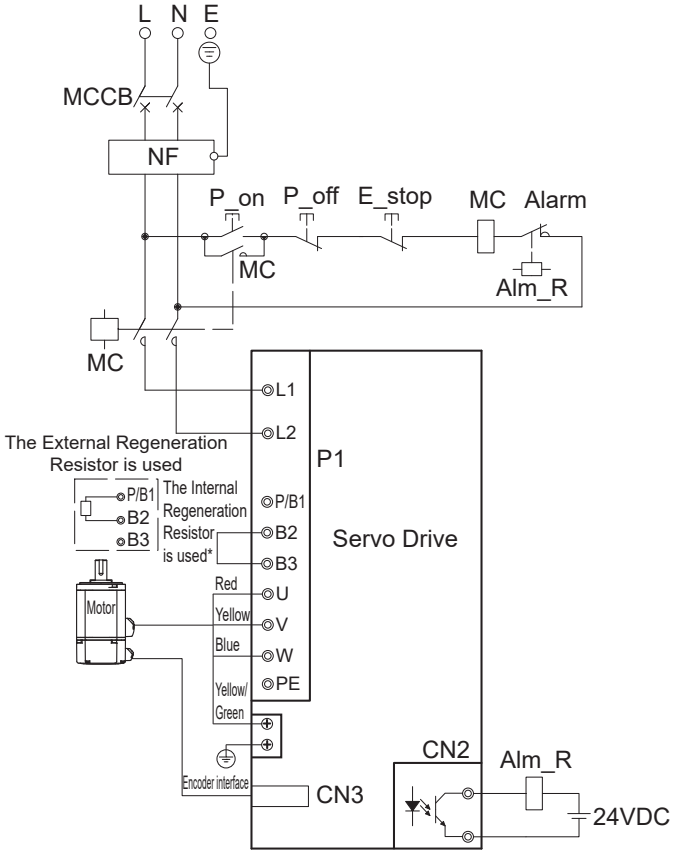
Servo Drive model	Ground screw	
	Size	Tightening torque
R88D-C6EN04H-ECT R88D-C6EN08H-ECT R88D-C6EN10H-ECT	M4	1.4 N·m

(Note) 1. Exceeding the maximum tightening torque will cause damage to the screw holes.
2. Do not install the ground screws while power is on, as electrical sparks may occur.
3. Regularly check whether the ground screws are loose.

4-4 Drive Power Supply Interface

C6E-series AC Servo Drives support single-phase 220 V power input.

4-4-1 Wiring Method for 220 VAC Single-phase Input



Symbol explanation

Name	Description	Name	Description
MCCB	Circuit breaker	E_stop	Emergency stop switch
NF	EMI filter	MC	AC contactor
P_on	Power On switch	Alm_R	Drive alarm relay
P_off	Power Off switch	Alarm	Drive alarm relay NC contact

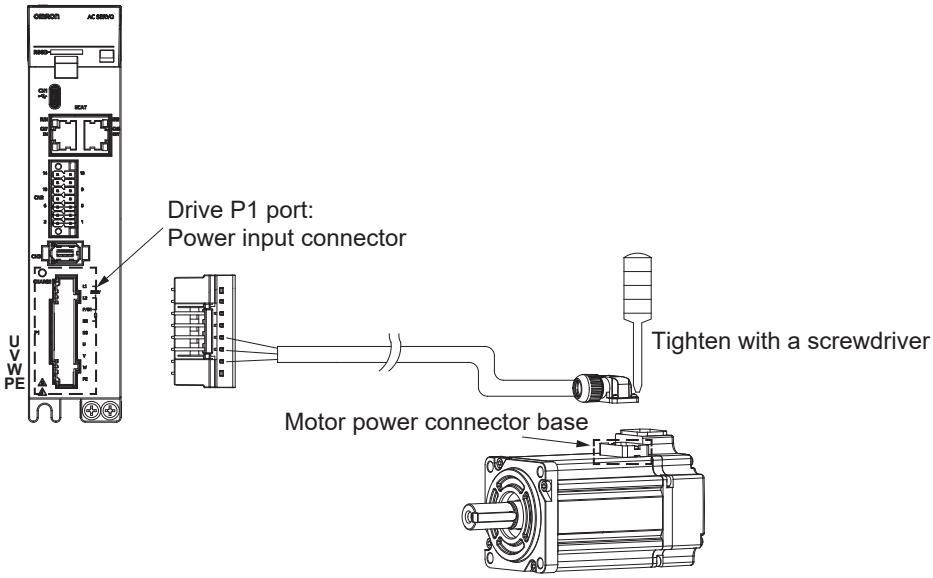
*R88D-C6EN04H-ECT Servo Drive is not equipped with an internal regeneration resistor. When a large amount of regenerative energy is generated, connect the required regeneration resistor between B1 and B2.

Wiring peripheral equipment capacity

Drive	Voltage specification (VAC)	Rated output power of the motor (W)	Drive power supply capacity kVA (at rated load)	Circuit breaker rated current (A)	Contactor rated current (A)
R88D-C6EN04H-ECT	Single-phase 220	50	0.3	6	9A (3P+1a)
		100	0.4		
		200	0.5		
		400	0.9	10	
R88D-C6EN08H-ECT		750	1.3	16	
R88D-C6EN10H-ECT		1,000	1.5	20	

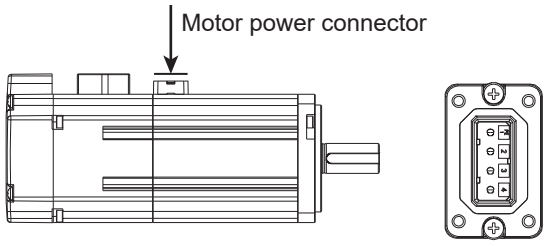
4-5 Drive and Motor Power Cable Connection Port

4-5-1 Drive and Motor Power Cable Connection Diagram

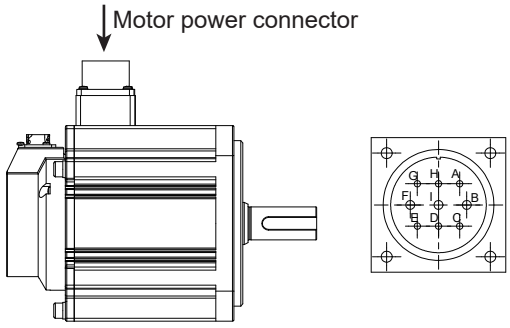


4-5-2 Motor Power Cable Connector Definition

40mm/60mm/80mm Flange Motor Power Connector Pin Definition

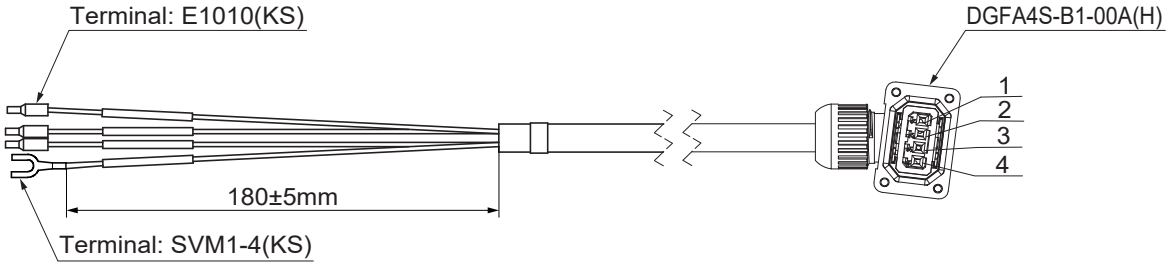
Motor model	PIN No.	Name	Definition	Interface diagram
R88M-C6L10030T R88M-C6L20030T R88M-C6L40030T R88M-C6L75030T R88M-C6L1K030T- □□ -08 R88M-C6H05030T R88M-C6H10030T R88M-C6H20030T R88M-C6H40030T R88M-C6H75030T R88M-C6H1K030T	1	PE	Motor ground wire	
	2	U	Phase U	
	3	V	Phase V	
	4	W	Phase W	

100mm/130mm Flange Motor Power Connector Pin Definition

Motor model	PIN No.	Name	Definition	Interface diagram
R88M-C6L1K030T- □□ -10 R88M-C6M1K020T R88M-C6H85015T	A	PE	Motor ground wire	
	F	U	Phase U	
	I	V	Phase V	
	B	W	Phase W	
	C	Brake 1	Motor brake 1	
	D	Brake 2	Motor brake 2	

4-5-3 Motor Power Cable Wiring Definition

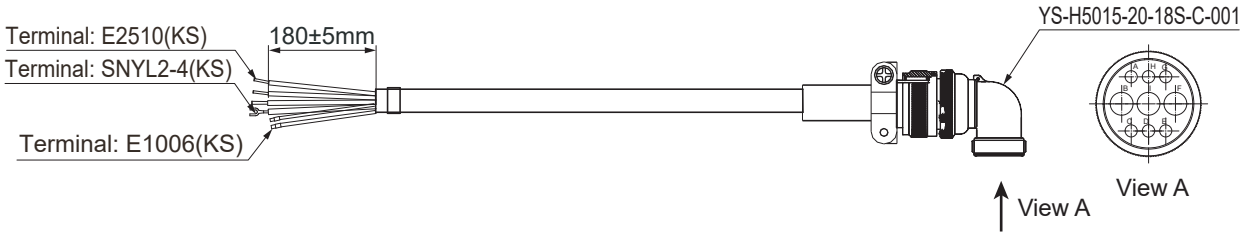
Example of 40mm/60mm/80mm Flange Motor Power Cable and Connector Pin Definition



Motor model	Drive side	Signal	Color	Motor side mating connector
R88M-C6L10030T R88M-C6L20030T R88M-C6L40030T R88M-C6L75030T R88M-C6L1K030T- ☐☐ -08 R88M-C6H05030T R88M-C6H10030T R88M-C6H20030T R88M-C6H40030T R88M-C6H75030T R88M-C6H1K030T	Ground screw	PE	Yellow/Green	1
	3	U	Red	2
	2	V	Yellow	3
	1	W	Blue	4

(Note) Ensure that the wires U, V and W are in the correct order: red, yellow, blue. An incorrect order will cause the motor to not run or to run erratically.

Example of 100mm/130mm Flange Motor Power Cable and Connector Pin Definition

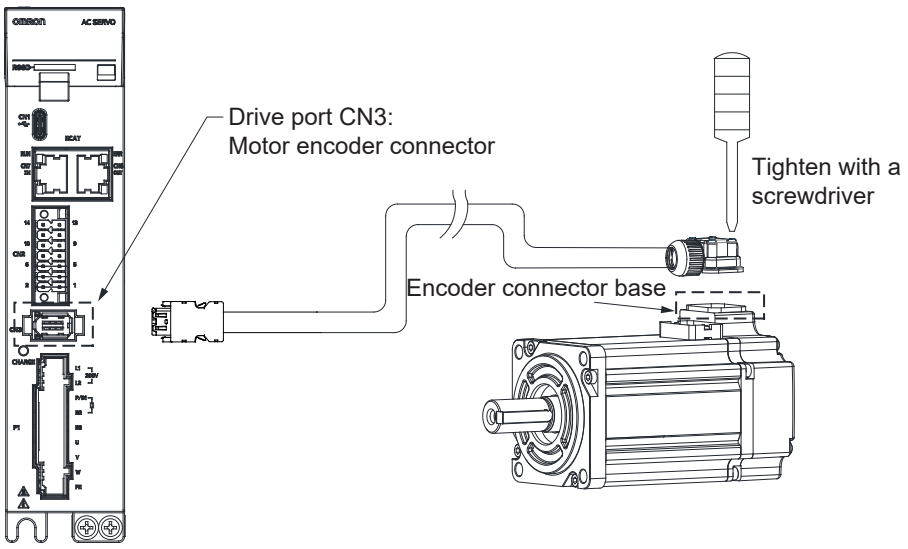


Motor model	Drive side	Signal	Color	Motor side mating connector
R88M-C6L1K030T- ☐☐ -10 R88M-C6M1K020T R88M-C6H85015T	U	U	Red	F
	V	V	Yellow	I
	W	W	Blue	B
	Ground screw	FG	Yellow/Green	A
	-	Brake 1	Red	C
	-	Brake 2	Black	D

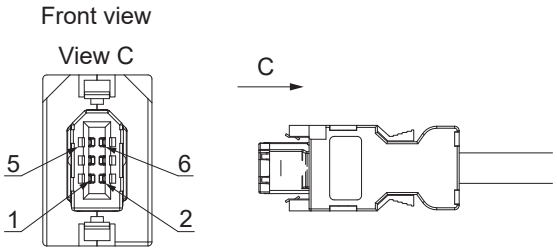
(Note) Ensure that the wires U, V and W are in the correct order: red, yellow, blue. An incorrect order will cause the motor to not run or to run erratically.

4-6 Drive and Motor Encoder Connection Port

4-6-1 Drive and Motor Encoder Cable Connection Diagram



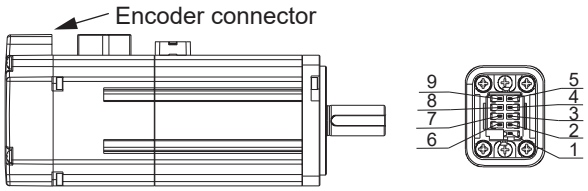
4-6-2 Drive Side Encoder Connector Specifications



PIN No.	Name	Definition
1	5 V	Encoder power supply +5V
2	GND	Encoder power supply ground
3	NC	Reserved
4	NC	Reserved
5	SD+	Encoder communication data +
6	SD-	Encoder communication data -

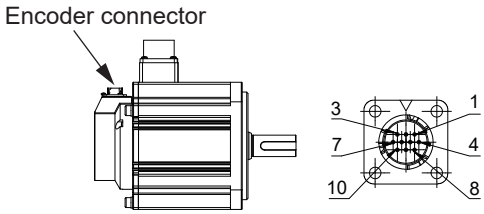
4-6-3 Motor Side Encoder Connector Specifications

40mm/60mm/80mm Flange Motor Encoder Connector Pin Definition



Motor model	PIN No.	Name	Definition
R88M-C6L10030T R88M-C6L20030T R88M-C6L40030T R88M-C6L75030T R88M-C6L1K030T- ☐☐ -08 R88M-C6H05030T R88M-C6H10030T R88M-C6H20030T R88M-C6H40030T R88M-C6H75030T R88M-C6H1K030T	1	Shield	Shield ground
	2	--	--
	3	5 V	Encoder power supply 5V
	4	VBAT+	Absolute encoder battery positive terminal
	5	SD+	Encoder communication data +
	6	--	--
	7	GND	Encoder power supply ground
	8	VBAT_GND	Absolute encoder battery negative terminal
	9	SD-	Encoder communication data -

100mm/130mm Flange Motor Encoder Connector Pin Definition

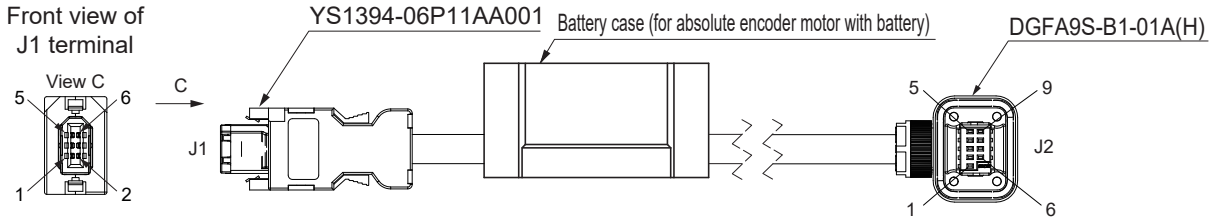


Motor model	PIN No.	Name	Definition
R88M-C6L1K030T- ☐☐ -10 R88M-C6M1K020T R88M-C6H85015T	1	5 V	Encoder power supply 5V
	2	GND	Encoder power supply ground
	3	SD-	Encoder communication data -
	4	SD+	Encoder communication data +
	5	VBAT+	Absolute encoder battery positive terminal
	6	VBAT_GND	Absolute encoder battery negative terminal
	7,8,9	NC	--
	10	Shield	Shield ground

(Note) Do not make any connections to undefined pins.

4-6-4 Motor Encoder Cable Wiring Definition

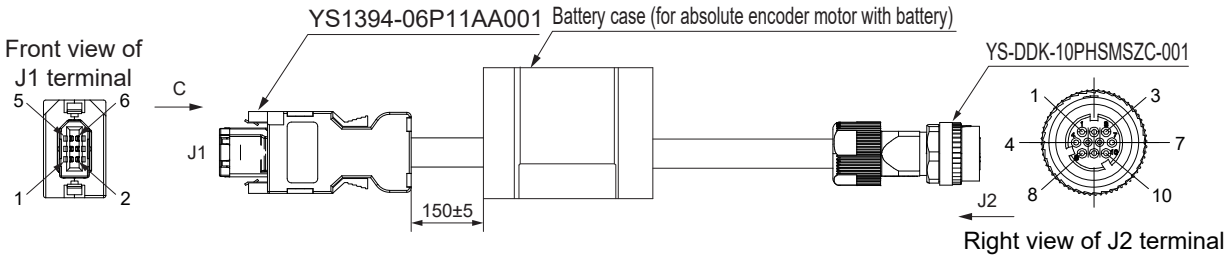
Example of 40mm/60mm/80mm Flange Motor Encoder Cable and Connector Pin Definition



Applicable motor encoder type	Drive side J1 terminal	Battery	Signal	Color	Motor side J2 terminal
R88M-C6L10030T R88M-C6L20030T R88M-C6L40030T R88M-C6L75030T R88M-C6L1K030T- ☐☐ -08 R88M-C6H05030T R88M-C6H10030T R88M-C6H20030T R88M-C6H40030T R88M-C6H75030T R88M-C6H1K030T	1	--	5 V	Red	3
	2	--	GND	Black	7
	--	Battery positive	VBAT+	Green	4
	--	Battery negative	VBAT_GND	Orange	8
	6	--	SD-	Blue/black	9
	5	--	SD+	Blue	5
	--	--	Shield	--	1

(Note) Do not make any connections to undefined pins.

Example of 100mm/130mm Flange Motor Encoder Cable and Connector Pin Definition



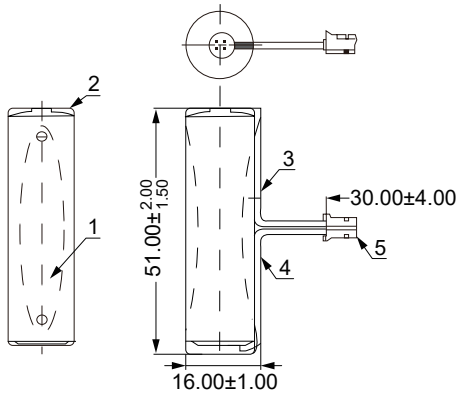
Applicable motor encoder type	Drive side J1 terminal	Battery	Signal	Color	Motor side J2 terminal
R88M-C6L1K030T- ☐☐ -10 R88M-C6M1K020T R88M-C6H85015T	1	--	5 V	Red	1
	2	--	GND	Black	2
	--	Battery positive	VBAT+	Green	5
	--	Battery negative	VBAT_GND	Orange	6
	6	--	SD-	Blue/black	3
	5	--	SD+	Blue	4
	--	--	Shield	--	10

(Note) Do not make any connections to undefined pins.

4-6-5 Absolute Encoder Battery

When C6E-series absolute encoder motors are used in a multi-turn absolute system, battery power supply is required to record multi-turn data in the event of a power failure to the drive. After power-on, the drive calculates the absolute position of the mechanical load based on the absolute position of the encoder, eliminating the need for repeated mechanical homing operations.

Battery Outline Dimensions Diagram



Battery Replacement

A battery that has been used for extended periods of time may leak electrolyte, so it is recommended to replace them every two years. It is recommended to replace the battery when the drive is powered on. Otherwise, removing the battery will cut off power to the motor encoder and cause loss of absolute position data. If the battery is removed when the drive is powered on, the drive will trigger an absolute encoder battery undervoltage warning. The alarm will be automatically cleared once the battery is reconnected.

Battery Selection

Select a battery of the appropriate specification referring to the table below.

Battery selection specification	Item and unit	Rated value			Description
		Minimum value	Typical value	Maximum value	
Output specification 3.6 V， 2.7 Ah	External battery voltage (V)	3.3	3.6	5	During standby operation
	Battery fault voltage (V)	--	2.8	--	
	Battery alarm voltage (V)	--	3.2	--	
	Circuit current consumption (μA)	--	2	--	During normal operation
		--	10	--	During standby operation, the shaft is stationary
		--	30	--	During standby operation, the shaft is rotating
	Operating temperature (°C)	0	--	40	Consistent with the ambient temperature requirements for the motor
	Storage temperature (°C)	-20	--	60	

Precautions for Using Batteries

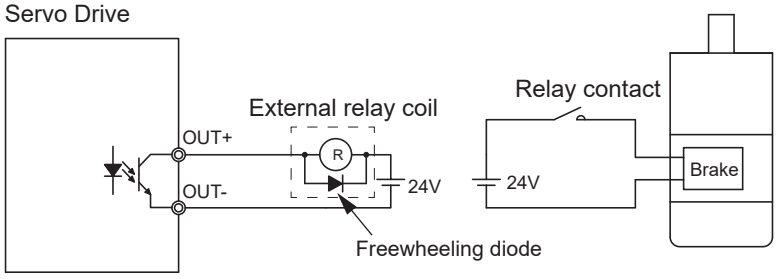
- Connect the positive and negative electrodes correctly.
- Installing long-used or unusable batteries in the machine may cause liquid leakage, etc. This will corrode surrounding components and pose risks such as short circuits. It is recommended to replace the batteries regularly (reference cycle: replace every two years).
- Do not disassemble batteries. This may cause electrolyte splashing that endangers personal safety.
- Do not throw batteries into fire. This may cause explosion.
- Do not short-circuit the positive and negative electrodes of the battery.
- Do not charge batteries.
- Do not solder directly onto the battery surface. Use batteries pre-fitted with tabs or leads.
- Dispose of replaced batteries in accordance with local regulations.

4-7 Wiring Method for Motors with Electromagnetic Brakes

For vertical axis and similar applications, Servomotors equipped with electromagnetic brakes are required to prevent the motor driven mechanical mechanism from dropping due to gravity and other factors in the event of servo off or de-energization.

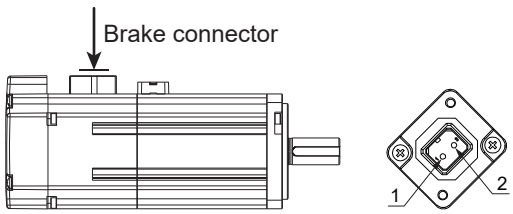
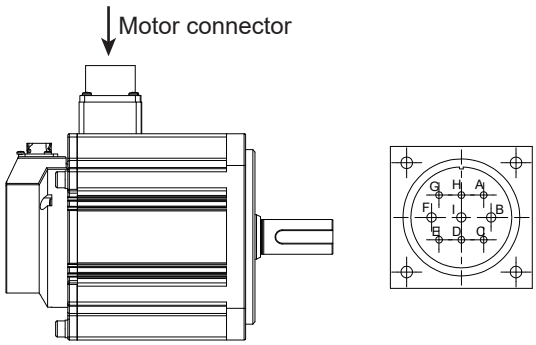
(Note) The brake of the Servomotor can only be used to maintain the position of the mechanism in the event of servo off or de-energization. Do not use it for braking during deceleration, otherwise the motor will be damaged.

4-7-1 Connection Diagram



(Note) 1. Make sure that the freewheeling diode is installed.
2. Pay attention to the polarity of the freewheeling diode.

PIN Definition

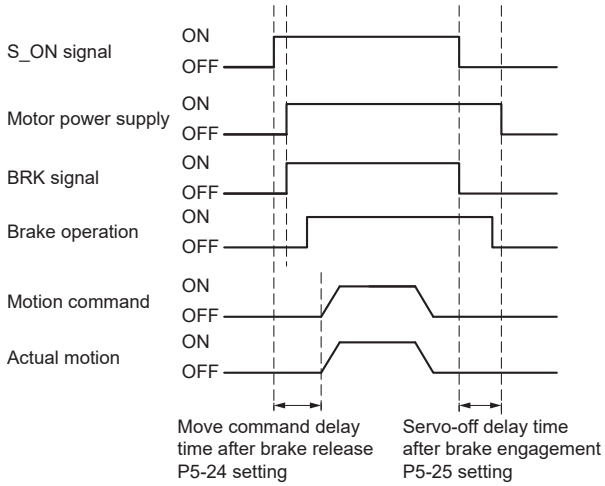
Motor model	PIN No.	Name	Definition	
R88M-C6L10030T R88M-C6L20030T R88M-C6L40030T R88M-C6L75030T R88M-C6L1K030T- ☐☐ -08 R88M-C6H05030T R88M-C6H10030T R88M-C6H20030T R88M-C6H40030T R88M-C6H75030T R88M-C6H1K030T	1	24 V	Brake power supply +	
	2	0 V	Brake power supply -	
R88M-C6L1K030T- ☐☐ -10 R88M-C6M1K020T R88M-C6H85015T	C	24 V	Brake power supply +	
	D	0 V	Brake power supply -	

4-7-2 Precautions for Using Motors with Brakes

- The brake control signal from the drive cannot directly drive the motor brake. An external 24 V power supply and external relay must be used. It is recommended not to share the 24 V power supply with other external equipment to avoid power abnormalities caused by other devices, which may result in unintended operation of the motor brake.
- The digital output signals of the drive are optocoupler outputs with a maximum rating of 30 VDC, 30 mA. To control inductive loads such as relays, a freewheeling diode must be installed; otherwise, the output pin circuit of the drive will be damaged, resulting in abnormal signal output.
- The electromagnetic brake is normally closed, and the motor shaft cannot rotate when the brake is powered off.
- The electromagnetic brake coil has no polarity.
- It is recommended to use cables of 0.5 mm^2(AWG20) or larger size to prevent excessive voltage drop caused by thin cables, which may hinder normal brake operation.
- For the brake specifications of different motor models, refer to 📖 *"2-3-2 Specifications* (P.2-8)".

4-7-3 Brake Operation Sequence

To avoid brake damage due to operation delay of the brake, pay attention to the timing during use. When the drive works in the CSP, CST, or CSV operation mode, the P5-24 parameter settings are invalid. When designing the control program, sufficient time must be reserved to ensure that the brake is released before controlling the motor operation; otherwise, the motor brake will be damaged.



The motion command delay time and servo-off delay time can be set using Sysmac Studio, or by modifying parameters P5-24 and P5-25 on the panel.

4-8 Wiring Method for Regenerative Energy Absorption Resistor

When the output torque of the motor shaft is opposite to the rotation direction, energy is fed back to the bus capacitor of the drive from the motor load side, causing the bus voltage to rise. Once the voltage rises to the braking voltage threshold, the energy can only be consumed through the regeneration resistor; otherwise, the Servo Drive will be damaged. 750 W or more models of C6E-series Servo Drives have built-in regenerative resistors. All models support external regenerative resistors. The specifications for the built-in regenerative resistors are listed below:

Servo Drive model	Built-in resistor specifications		External resistor
	Resistance value (Ω)	Power (W)	Minimum allowable resistance value (Ω)
R88D-C6EN04H-ECT	None		40
R88D-C6EN08H-ECT	50	50	20
R88D-C6EN10H-ECT	50	50	20

4-8-1 Method for Calculating the Regenerative Energy

Reciprocating Motion

During motor deceleration, the kinetic energy is converted into electric energy and fed back to the bus capacitor. The energy generated during deceleration consists of:

A) Energy generated during motor deceleration

B) Energy generated during external load deceleration

Below is a simple calculation method for judging whether a regenerative energy absorption resistor is required.

1) Calculate the energy E_M generated during motor deceleration

The table below shows the energy generated by C6-series Servomotors during deceleration from 3,000 rpm to 0 rpm with no external load applied.

Inertia type	Motor power (W)	Servomotor model	Rotor inertia $J_M(10^{-4}Kg{\cdot}m^2)$	Energy generated when decelerating from rated speed to 0 rpm $E_M(J)$	Maximum energy absorbed by the drive capacitor $E_C(J)$
Low inertia	100	R88M-C6L10030T	0.043	0.21	8.7
	200	R88M-C6L20030T	0.182	0.90	8.7
	400	R88M-C6L40030T	0.268	1.32	13
	750	R88M-C6L75030T	0.961	4.74	26.6
	1,000	R88M-C6L1K030T-□□-08	1.12	5.52	40.6
	1,000	R88M-C6L1K030T-□□-10 R88M-C6L1K030C	2.67	13.16	40.6
Medium inertia	1,000	R88M-C6M1K020T	15.2	33.30	40.6

Inertia type	Motor power (W)	Servomotor model	Rotor inertia $J_M(10^{-4}Kg{\cdot}m^2)$	Energy generated when decelerating from rated speed to 0 rpm E_M(J)	Maximum energy absorbed by the drive capacitor E_C(J)
High inertia	50	R88M-C6H05030T	0.0395	0.19	8.7
	100	R88M-C6H10030T	0.0724	0.36	8.7
	200	R88M-C6H20030T	0.32	1.58	8.7
	400	R88M-C6H40030T	0.62	3.06	13
	750	R88M-C6H75030T	1.63	8.04	26.6
	850	R88M-C6H85015T	15.2	18.73	40.6
	1,000	R88M-C6H1K030T	1.96	9.66	40.6

2) Calculate the energy E_L generated by the driven load during deceleration.

Assuming that the load inertia is N times the motor inertia, the energy generated by the driven load during deceleration from the rated speed to 0 rpm is:

$$E_L=N\times E_M$$

If $E_M+E_L < E_C$, i.e. the energy generated by the motor and the driven load during deceleration is less than the energy that can be absorbed by the drive capacitor, there is no need to worry about the regenerative energy absorption.

3) Calculate the average power P_{AV} required for the regenerative energy absorption resistor.

$$P_{AV}=\frac{E_M+E_L-E_C}{t_{dec}}$$

Where: t_{dec}= deceleration time + interval between two decelerations

4) Judgment

When $P_{AV} < P_R$, i.e. the total power generated during deceleration is less than the power of the built-in regenerative energy absorption resistor of the drive, no external absorption resistor is required.

When $P_{AV} > P_R$, i.e. the total power generated during deceleration is greater than the power of the built-in regenerative energy absorption resistor of the drive, an external absorption resistor is required. To properly control the temperature rise of the external absorption resistor, the minimum power of the resistor shall be P_{AV} / 0.5.

Calculation example:

Select a 750 W R88M-C6L75030T Servo Drive with a load inertia 5 times the motor inertia. Assuming that t_{dec} (deceleration time + interval time between two consecutive decelerations) is 1 s and each motion cycle involves deceleration from 3,000 rpm to 0 rpm, the required power of the absorption resistor is calculated as follows:

E_M = 4.74J, E_C = 32.4J

$E_L = N \times E_M = 5 \times 4.74 = 23.7J$

$E_M+E_L-E_C$=4.74+23.7-32.4= -3.96W

Since E_M+E_L is less than E_C, it is unnecessary to connect an external absorption resistor.

(Note) R88D-C6EN04H-ECT Servo Drive is not equipped with an internal regeneration resistor. When a large amount of regenerative energy is generated, connect the required regeneration resistor between B1 and B2.

The motor is driven by external load torque and continuously outputs negative power.

In most applications, the motor performs positive work, which means that the direction of motor torque output direction matches the rotation direction. In some special applications, the motor torque output direction is opposite to the rotation direction, causing external energy to flow back into the drive. For example, when a heavy load moves downward vertically, the servomotor generates a force in the opposite direction to offset the gravitational force of the external load so as to meet the position and speed requirements. During prolonged operation, the bus capacitor becomes fully charged and can no longer absorb regenerative energy. In this case, a regenerative resistor is required to absorb this energy. The power calculation formula is given below:

$$P_T = 2\pi T_M N_M$$

Where:

T_M is the motor output torque, unit: Nm (Newton meter)

N_M is the motor output speed, unit: rps (revolutions per second)

Calculation example:

If the motor torque output direction is opposite to the rotation direction, when the motor output torque is 0.6 Nm and the speed is 2,400 rpm, the power is:

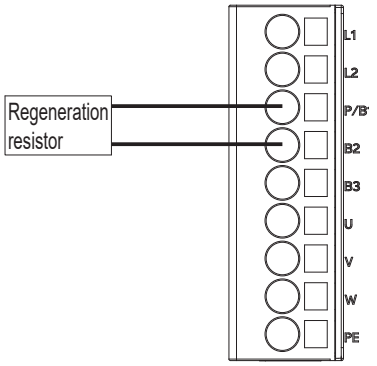
P_T=2 x 3.14 x 0.6 x 2400 / 60= 150.72

In this case, an external absorption resistor is required, and the minimum power shall be 150.72 W. To properly control the temperature rise of the external absorption resistor, the minimum power shall be 300 W.

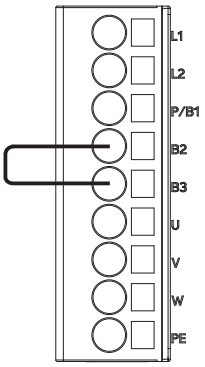
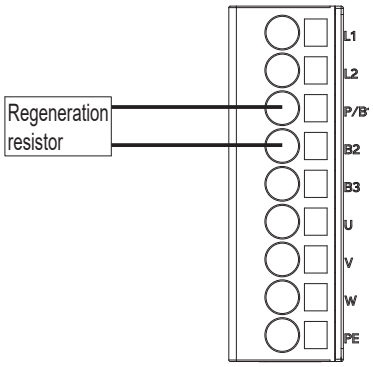
4-8-2 Wiring Method

In some applications, when the built-in absorption resistor cannot fully absorb the regenerative electromotive force, an external absorption resistor with higher power must be connected to prevent the drive from triggering an overvoltage alarm.

The wiring method for regenerative resistors of 400 W is as follows.

When using an external regenerative resistor
Connect the regenerative resistors to P/B1 and B2, and keep B2 disconnected from B3.


The wiring method for regenerative resistors of 750 W/1 kW is as follows.

When using a built-in regenerative resistor of the drive	When using an external regenerative resistor
Short-circuit ports B2 and B3 of connector P2 on the drive side. (Note) A jumper wire has been installed before shipment.	Connect the regenerative resistors to P/B1 and B2, and keep B2 disconnected from B3.
	

(Note) R88D-C6EN04H-ECT Servo Drive is not equipped with an internal regeneration resistor. No jumper wire has been installed between B2 and B3 before shipment. When a large amount of regenerative energy is generated, connect the required regeneration resistor between B1 and B2.

4-8-3 Drive Parameters Setting

The relevant parameters are as follows:

Parameter	Name	Unit	Description
P1-19	Regeneration resistor value	O hm	Sets the resistance of the regeneration resistor
P1-20	Regeneration resistor continuous wattage	Watt	Sets the power of the regeneration resistor
P1-21	Regeneration resistor time constant	ms	Sets the continuous absorption time of the regeneration resistor

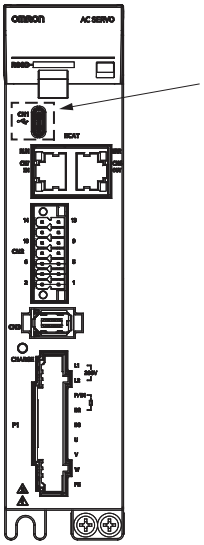
Precautions for Correct Use

Correctly set the resistance value, power, and absorption time of the absorption resistor; otherwise, the use of this function will be affected and the drive may trigger alarms such as overvoltage or regenerative energy absorption failure.
When using an external absorption resistor, make sure that the total resistance is not less than the minimum allowable resistance of the drive. If multiple resistors are connected in series or parallel, calculate the total resistance and total power correctly.

Example of parameters setting:

External specifications	Parameters setting
External: 100Ω, 200W resistor	P1-19 = 100 P1-20 = 200
External: Two 50Ω, 200W resistors, connected in series	P1-19 = 100 P1-20 = 400
External: Two 100Ω, 200W resistors, connected in parallel	P1-19 = 50 P1-20 = 400

4-9 USB Type-C Host Configuration Interface

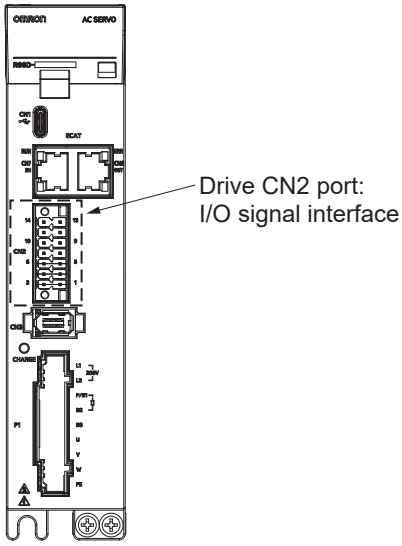


The CN1 connector is used for communication between the drive and the PC. The configuration software Sysmac Studio enables control mode setting, parameter modification, online auto-tuning, etc.

Pin	ID
A1, B12	USB_DGND
A4, B9	USB_5V
A5, B5	Servo internal pull-down resistor (as device side)
A6, B6	D+
A7, B7	D-
A9, B4	USB_5V
A12, B1	USB_DGND
Other pins	NC (No signal connection)

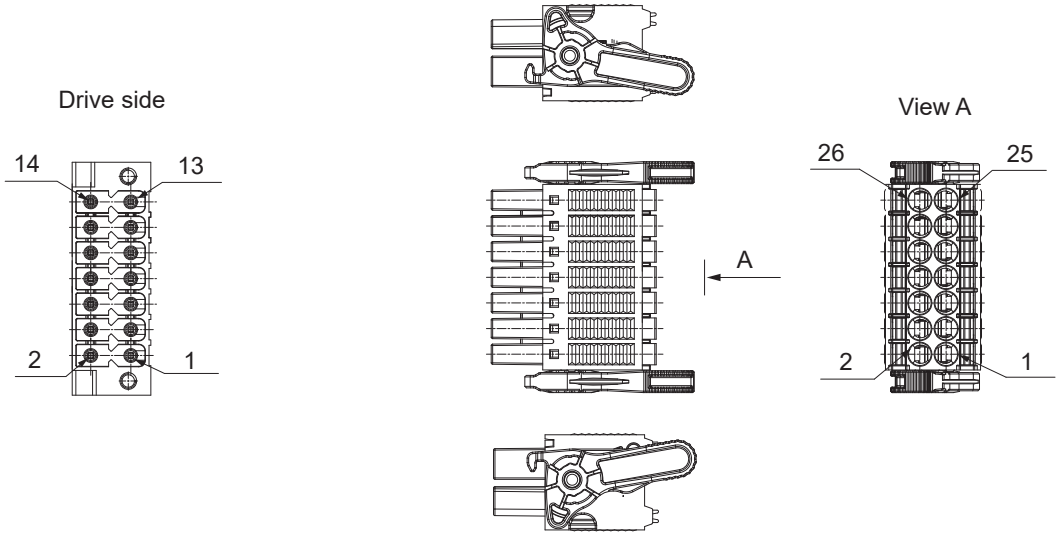
(Note) Use USB Type-C connector for the drive side

4-10 I/O Signal Interface



4-10-1 I/O Signal Specifications

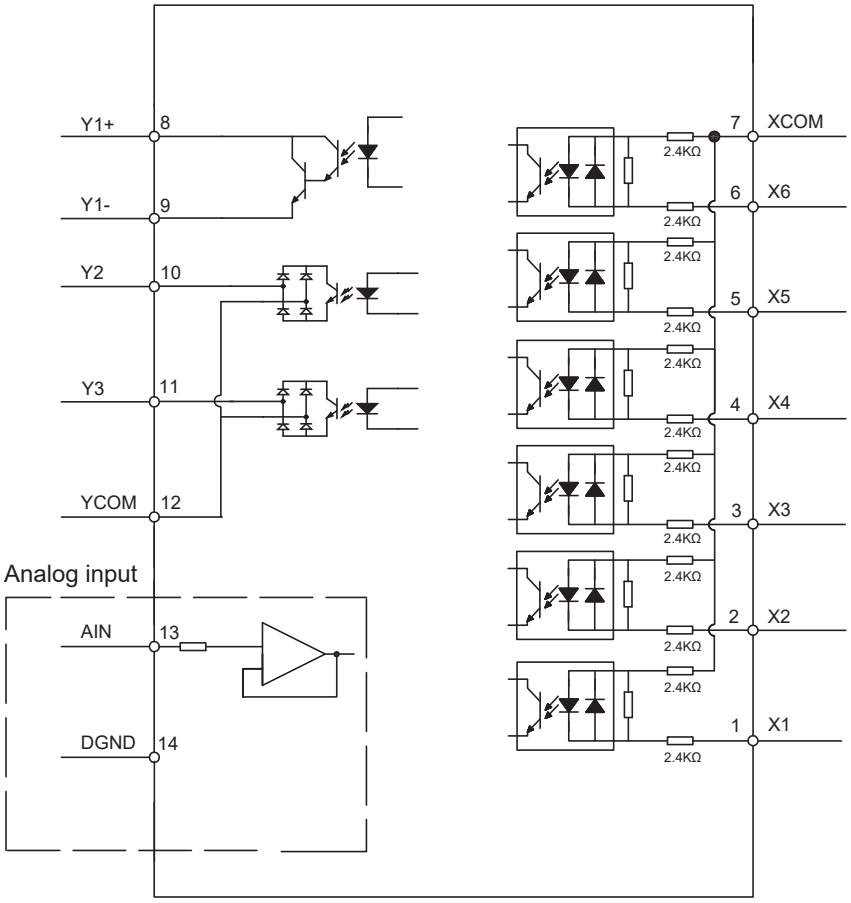
The CN2 connector of the C6E-series AC Servo Drives is used for connecting I/O signals. The pin definitions are listed below:



The specifications of I/O signals are shown in the table below:

I/O signal		Specifications
Digital signal	Input	6-channel optocoupler isolated general-purpose inputs, configurable via parameters, 24 VDC, 20 mA
	Output	3-channel optocoupler isolated general-purpose outputs, configurable via parameters, max. 30 VDC, 100 mA
Analog signal	Input	1-channel analog inputs, -10V to +10V, 16-bit resolution

4-10-2 I/O Signal Pin Block Diagram



I/O pin definition

Pin No.	Signal symbol	Description
14	DGND	Digital ground
12	YCOM	Digital output common terminal
10	Y2	Analog output 2
8	Y1+	Digital output 1+
6	X6	Digital input 6
4	X4	Digital input 4
2	X2	Digital input 2

Pin No.	Signal symbol	Description
13	AIN	Analog input
11	Y3	Digital output 3
9	Y1-	Digital output 1-
7	XCOM	Common terminal for digital inputs
5	X5	Digital input 5
3	X3	Digital input 3
1	X1	Digital input 1

(Note) Do not make any connections to undefined pins.

4-10-3 Digital Input Signal

C6E-series AC Servo Drives have 6 channels of digital input signals, each configurable via parameters to achieve specific functions and set the input level logic. In the C6E-series AC Servo Drives, each pin has the following functions:

- Specific function signals, such as alarm clearing, limit switch, and Touch Probe signal input
- General-purpose input signals, which have no specific function

Function Inputs That Can Be Allocated

Function name	Symbol	Function code	
		Closed	Open
General-purpose input	GPIN	0	--
Clear alarm	A-CLR	3	4
CW limit	CW-LMT	5	6
CCW limit	CCW-LMT	7	8
Gain select	GAIN-SEL	11	12
Emergency stop	E-STOP	13	14
Torque limit	TQ-LMT	19	20
Zero speed clamp	ZCLAMP	21	22
Velocity limit	V-LMT	37	38
Homing switch	HOM-SW	39	40
Virtual CW limit	Virtual-CW-LMT	41	42
Virtual CCW limit	Virtual-CCW-LMT	43	44

The input pin level logic is as follows:
Closed: The digital input circuit of the drive forms a loop, with current flowing into or out of the input pin.
Open: The digital input circuit of the drive does not form a loop, with no current flowing into or out of the input pin.

Signal name	Signal symbol	CN2-Pin No.	Default setting	
			Function name	Input logic
X1	X1	1	CCW limit	Closed
X2	X2	2	CW limit	Closed
X3	X3	3	Clear alarm	Closed
X4	X4	4	Emergency stop	Closed
X5	X5	5	Touch probe signal 1	Closed
X6	X6	6	Home switch	Closed
XCOM	XCOM	7	Input signal common terminal	--

4-10-4 Digital Output Signal

C6E-series AC Servo Drives have 3 channels of digital output signals. Each output channel can be configured via parameters to achieve specific functions and set the output level logic.

Function Outputs That Can Be Allocated

Function name	Symbol	Function code	
		Closed	Open
General-purpose output	GPOUT	0	--
Alarm output	ALM	1	2
Warning output	WARN	3	4
Brake release output	BRK	5	6
Servo on status	SON-ST	7	8
Positioning completed	COIN	9	10
Dynamic following error output	DYM-LMT	11	12
Torque reached	TQ-REACH	13	14
Torque limit output	T-LMT	15	16
Velocity match output	V-COIN	17	18
Velocity reach output	AT-SPD	19	20
Velocity limit output	V-LMT	21	22
Servo Ready	S-RDY	23	24
Homing complete	HOMED	25	26
Soft limit CW	SLCW	27	28
Soft limit CCW	SLCCW	29	30
Position arrived output	IN-POS	31	32
Zero-speed detected output	Z-SPD	33	34
Torque match output	T-COIN	35	36

The output pin level logic is as follows:

Closed: The digital output circuit of the drive forms a loop, and the drive has output signals

Open: The digital output circuit of the drive does not form a loop, and the drive has no output signals.

Signal name	Signal symbol	CN2-Pin No.	Default setting	
			Function name	Input logic
Y1	Y1+	8	General-purpose output	Open
	Y1-	9		
Y2	Y2	10	Servo Ready	Closed
Y3	Y3	11	Alarm output	Open
YCOM-	YCOM-	12	Y2 to Y3 output signal common terminal	--

4-10-5 Input Signal Wiring Instructions

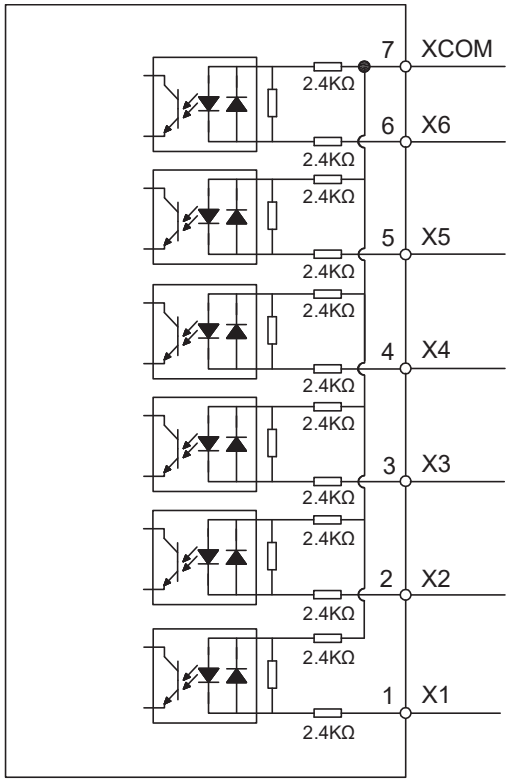
Standard input X1 to X6

C6E-series AC Servo Drives have 6-channel optocoupler-isolated single-ended input ports with shared COM terminals, a rated voltage of 24 VDC, and a maximum input current of 20 mA. These ports can serve as general-purpose inputs for connecting sensor signals, Touch Probe 1 (X5) signals, Touch Probe 2 (X6) signals, and output signals from PLCs or other controllers.

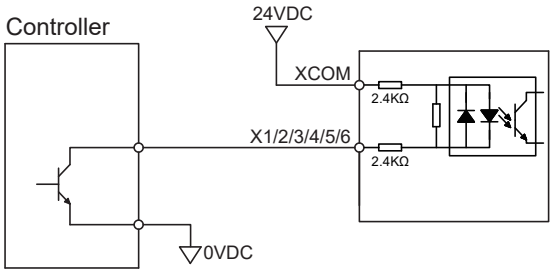
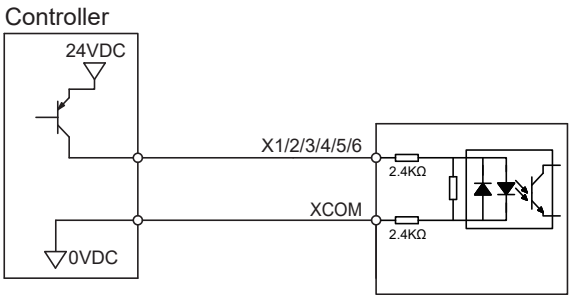
These input circuits require a power supply because they are optically isolated. If connected to a PLC, power supply from the PLC can be used. If connected to a relay or mechanical switch, a 24 VDC power supply is required.

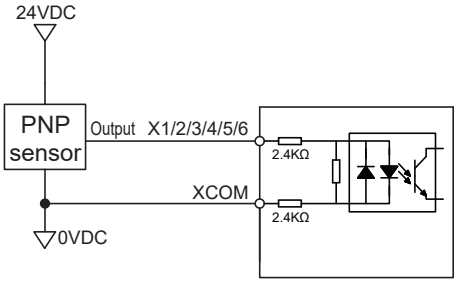
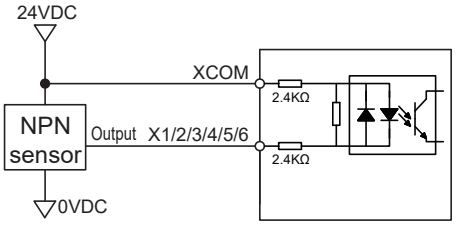
"Common" refers to the common terminal at an equal potential. If source current (PNP) signals are used, the COM terminal should be grounded (connected to the negative terminal of the power supply); if sink current (NPN) signals are used, the COM terminal should be connected to the positive terminal of the power supply.

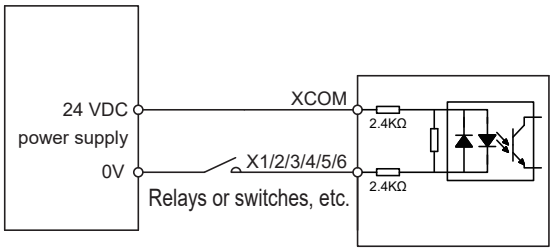
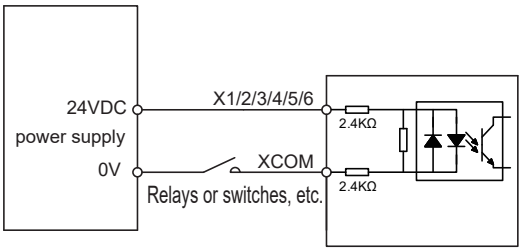
- Internal Circuit Block Diagram



● Wiring Example

A. Controller SINK mode (sink current)	B. Controller SOURCING mode (source current)
	

C. Connection to PNP sensor	D. Connection to NPN sensor
	

E. Connection to relay contact or switch (XCOM connected to 24 VDC)	F. Connection to relay contact or switch (XCOM connected to 0 V)
	

Precautions for Correct Use

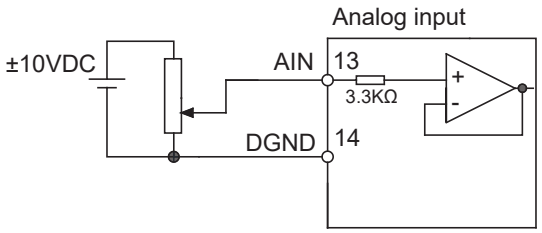
Voltage limit for valid digital input signals: > 16V
Voltage limit for invalid digital input signals: < 8V
Fuzzy zone: 8V ≤ Voltage ≤ 16V
The input signal voltage should be kept away from the fuzzy zone to prevent abnormal input signals.

4-10-6 Analog Signal Input

C6E-series AC Servo Drives have 1-channel single-ended analog inputs with a voltage range of -10V to +10V and 16-bit resolution. The torque limit and the speed limit in torque mode can be configured via these analog inputs.

Signal name		CN2-Pin No.	Description
AIN1	Analog signal input	13	The torque limit or the speed limit in torque mode can be set via analog input The setting range can be modified via parameters
DGND		14	Reference ground for analog input signals

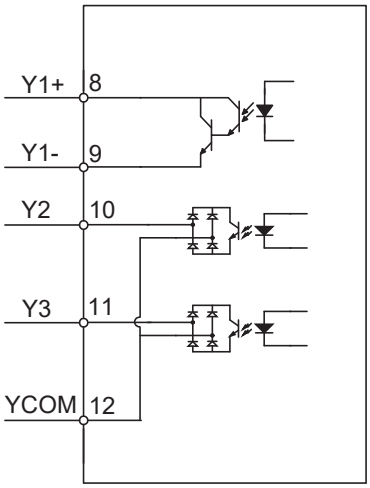
Analog Input Wiring Example



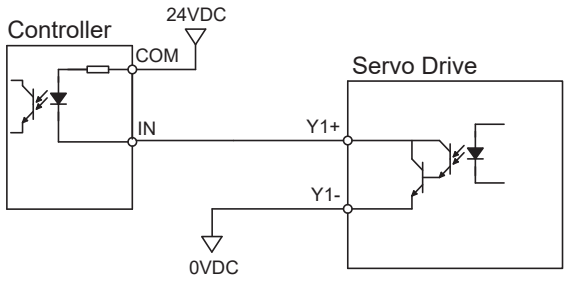
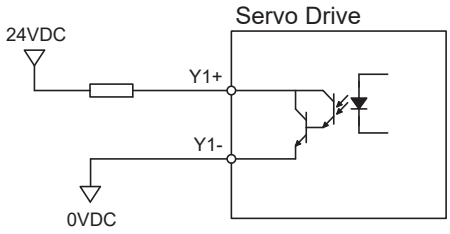
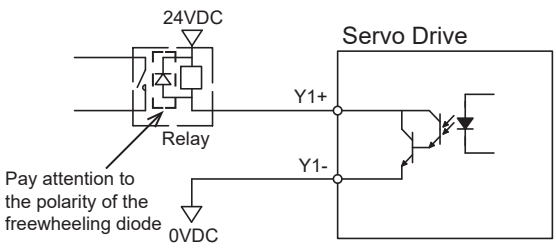
4-10-7 Output Signal Wiring Instructions

C6E-series AC Servo Drives have 1-channel optocoupler-isolated differential output port and 2-channel optocoupler-isolated output ports with shared COM terminals. The functions of these ports can be configured via parameters, and both SINK and SOURCING wiring methods are supported.

Internal Circuit Block Diagram



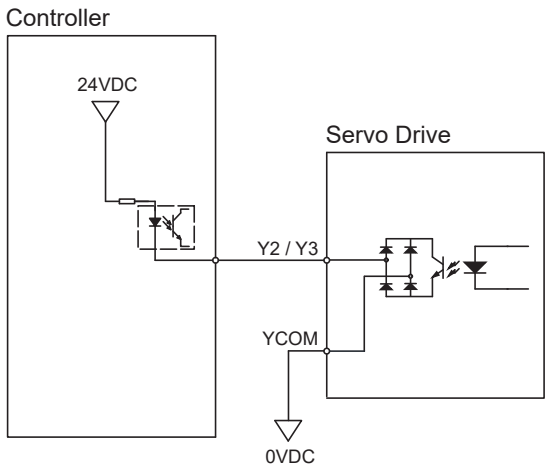
Y1 Output Wiring Example

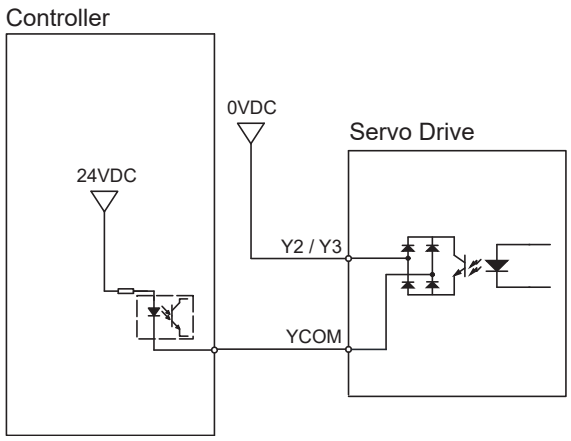
A. Connection to control optocoupler	B. Connection to impedance load
	
C. Connection to inductive loads such as relays	
	

(Note) Output capacity is max. 30 VDC, 100 mA

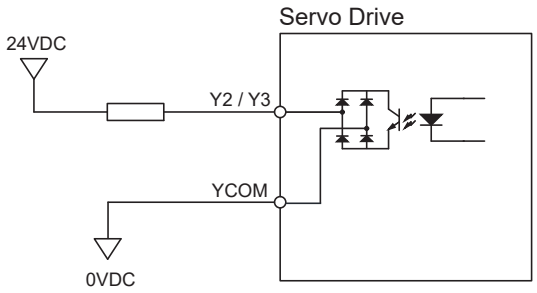
Y2/Y3 Output Wiring Example

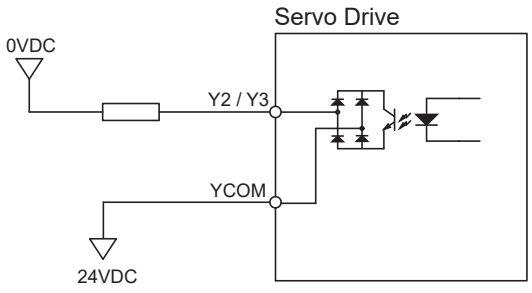
A. Connection to control optocoupler



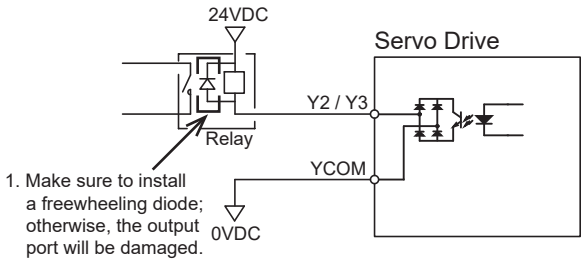


B. Connection to impedance load



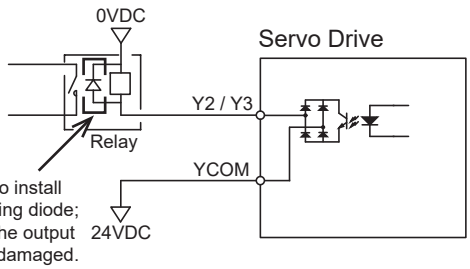


C. Connection to inductive loads such as relays



1. Make sure to install a freewheeling diode; otherwise, the output port will be damaged.

2. Pay attention to the polarity of the freewheeling diode.



1. Make sure to install a freewheeling diode; otherwise, the output port will be damaged.

2. Pay attention to the polarity of the freewheeling diode.

(Note) Output capacity is max. 30 VDC, 100 mA

4-11 Safe Torque OFF (STO) Function Interface

C6E-series AC Servo Drives support the STO function, whose connection port is the CN5 connector of the drive. STO is a hardware-level safety protection function. When the STO function is activated, the hardware circuit of the drive will be triggered to forcibly shut down the internal power transistors, preventing motor operation and disabling the drive. This can protect the safety of personnel and equipment in emergency situations.
When the STO function is triggered, the Servo Ready signal of the drive will be cleared, the motor will be disabled and enter an alarm state. The LED on the drive panel will display the alarm code " r20to ".

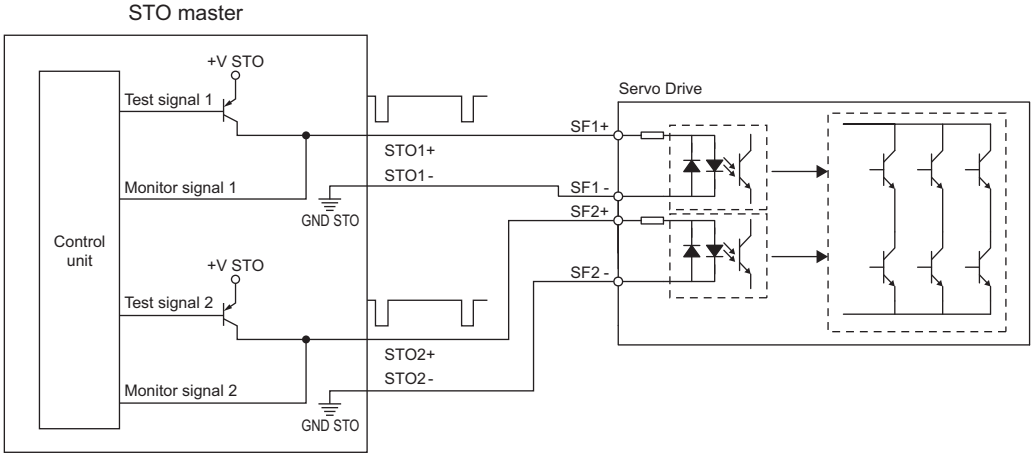
4-11-1 Precautions for STO Function

- If the STO function is not required, make sure that the factory-mounted STO plug-in terminal is correctly inserted into the CN5 port.
- Before using the STO function, be sure to understand its working principle and safety precautions.
- When the STO function works, the motor will rotate due to external force (such as vertical axis load). In this case, make sure to use a servomotor with brake and connect the brake control circuit correctly.
- When the STO function works, the motor will stop freely, so be aware that the stopping distance will increase due to inertia.
- Note that when the STO function works, the output of the internal power transistors of the drive will be cut off, but the power supply of the drive will not be cut off. Make sure that the drive is disconnected from the power supply before troubleshooting and maintenance.
- After the STO function is activated, the drive will enter the alarm state and the motor will be disabled.
- When the STO input signal returns to normal, the drive will not automatically clear the alarm, and the drive will remain in a disabled state

Precautions for Correct Use

L pulses for self-diagnosis of safety equipment

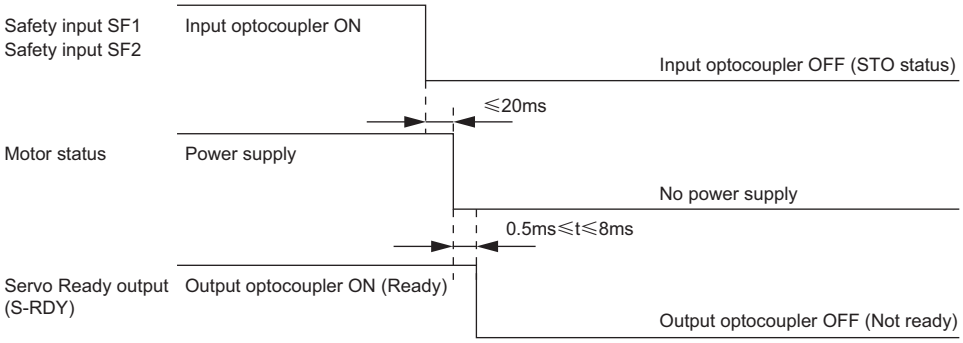
When you connect a safety device, such as a safety controller or a safety sensor, the safety output signal of the device may include L pulses for self-diagnosis. To avoid malfunction due to the L pulses for self-diagnosis, a filter that removes the L pulses is built into the safety input circuit. If the OFF time of the safety input signal is 1 ms or less, and the pulse frequency is 20Hz or less, the safety input circuit does not recognize it as OFF.



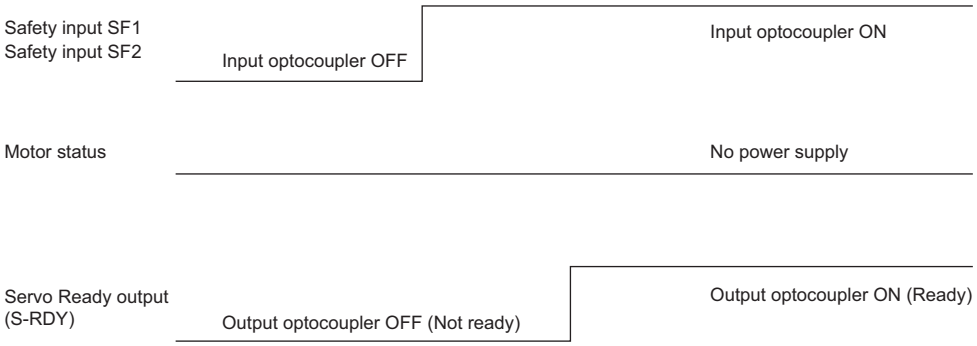
4-11-2 Operation Example

This section gives the timing charts to show the operation timing to a safe state as well as the timing of return from safe state.

Operation Timing to a Safe State

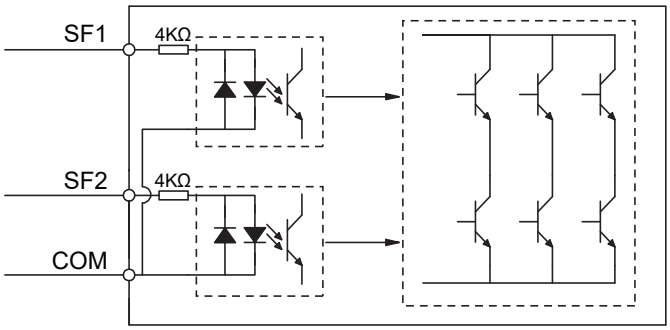


Timing of Return from Safe State

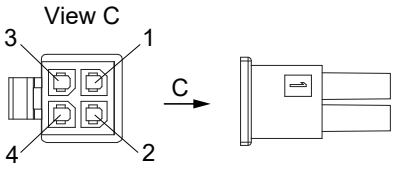


4-11-3 STO Function I/O Signal

I/O Internal Block Diagram



- I/O Pin Marking



The connector and terminal models are as follows:

Name	Model	Manufacturer
Plastic shell	3025HM-2*02-N0HF-00	SESO
Pin	3025TF-PSN-B	

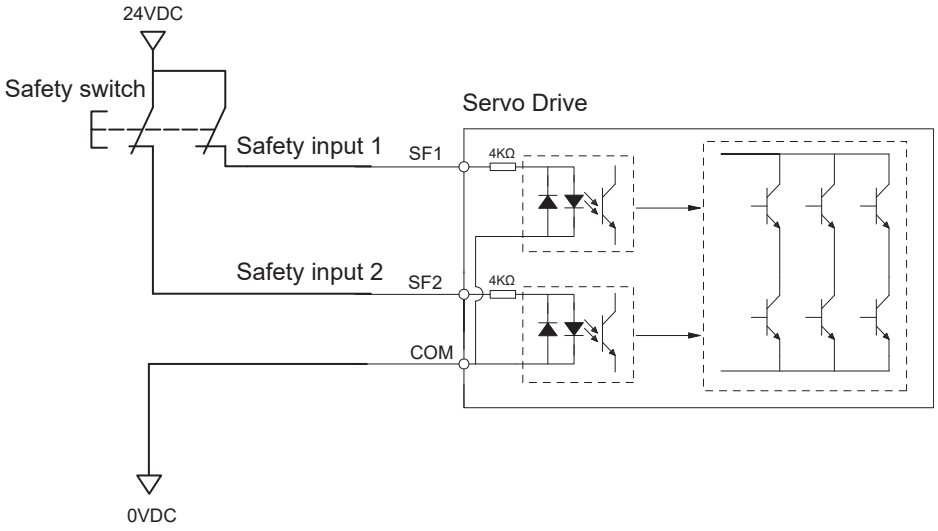
- STO Function I/O Pin Definition

Signal name	ID	Pin	Description	Applicable mode
Digital ground	COM	1	STO reference ground	All modes of operation
Power supply	24 V	2	Internal 24 VDC power supply output	
Safety signal input 1	SF1	3	When STO1 has no input signal, i.e. SF1 is disconnected, the optocoupler inside SF1 is in the OFF state; the drive signals for the internal power transistors of the drive will be cut off.	
Safety signal input 2	SF2	4	When STO2 has no input signal, i.e. SF2 is disconnected, the optocoupler inside SF2 is in the OFF state; the drive signals for the internal power transistors of the drive will be cut off.	

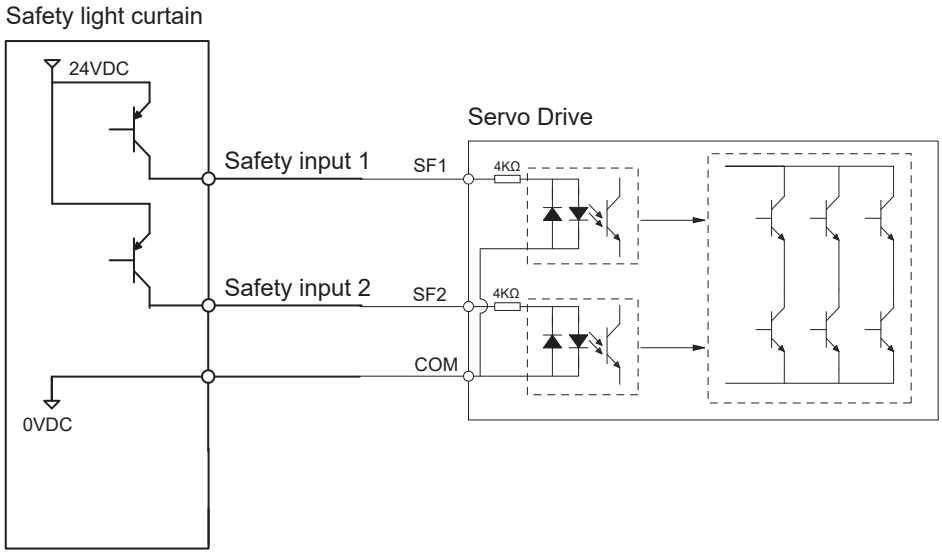
(Note) The STO function will be activated if either safety input SF1 or SF2 is in the OFF state.

STO Connection Example

- Connection with Safety Switch



- Connection with Safety Light Curtain



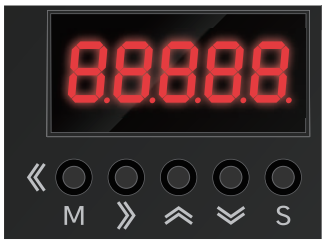
5

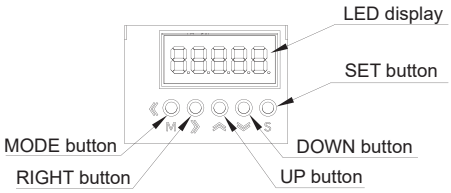
Display Panel Operation

This section explains the names and functions, the display, the function operation modes, the parameter setting modes, and the error alarm display of the Servo Drive display panel.

5-1 Display Panel Name and Function 5-2
5-2 Mode Switching 5-3
5-3 Display 5-5
5-3-1 Meaning of Decimal Points 5-5
5-3-2 Data Display 5-5
5-3-3 Other Display 5-6
5-3-4 Point-to-Point Motion Mode 5-7
5-3-5 JOG Mode 5-7
5-3-6 Locking and Unlocking of Buttons 5-7
5-4 Status Display Selection Mode 5-8
5-5 Function Operation Mode 5-10
5-5-1 Function Comparison Table for Function Operation Mode 5-10
5-5-2 Operation Flowchart 5-11
5-6 Parameter Setting Mode 5-12
5-6-1 Parameter Setting Method 5-12
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5-1 Display Panel Name and Function





ID	Name	Function
	LED display	5-digit 7-segment LED digital tube displays the drive status, alarm information, parameter values, and set values.
M	MODE button	Press and hold this button to switch between LED display modes a) Monitoring selection mode b) Function selection mode c) Parameter setting mode When editing parameters, press the MODE button briefly to move the digit currently being edited to the left.
«	LEFT button	Press the LEFT button briefly to move the digit currently being edited to the left.
»	RIGHT button	Press the RIGHT button briefly to move the digit currently being edited to the right.
^ v	UP/DOWN buttons	Press the UP/DOWN buttons to briefly scroll through the display content/functions and modify parameters/settings.
S	SET button	Press this button briefly to enter the selected parameter, and press and hold this button to save the modified parameter.

5-2 Mode Switching

1 Press the MODE and SET buttons to switch between different modes, such as status display, parameter setting, and function operation.

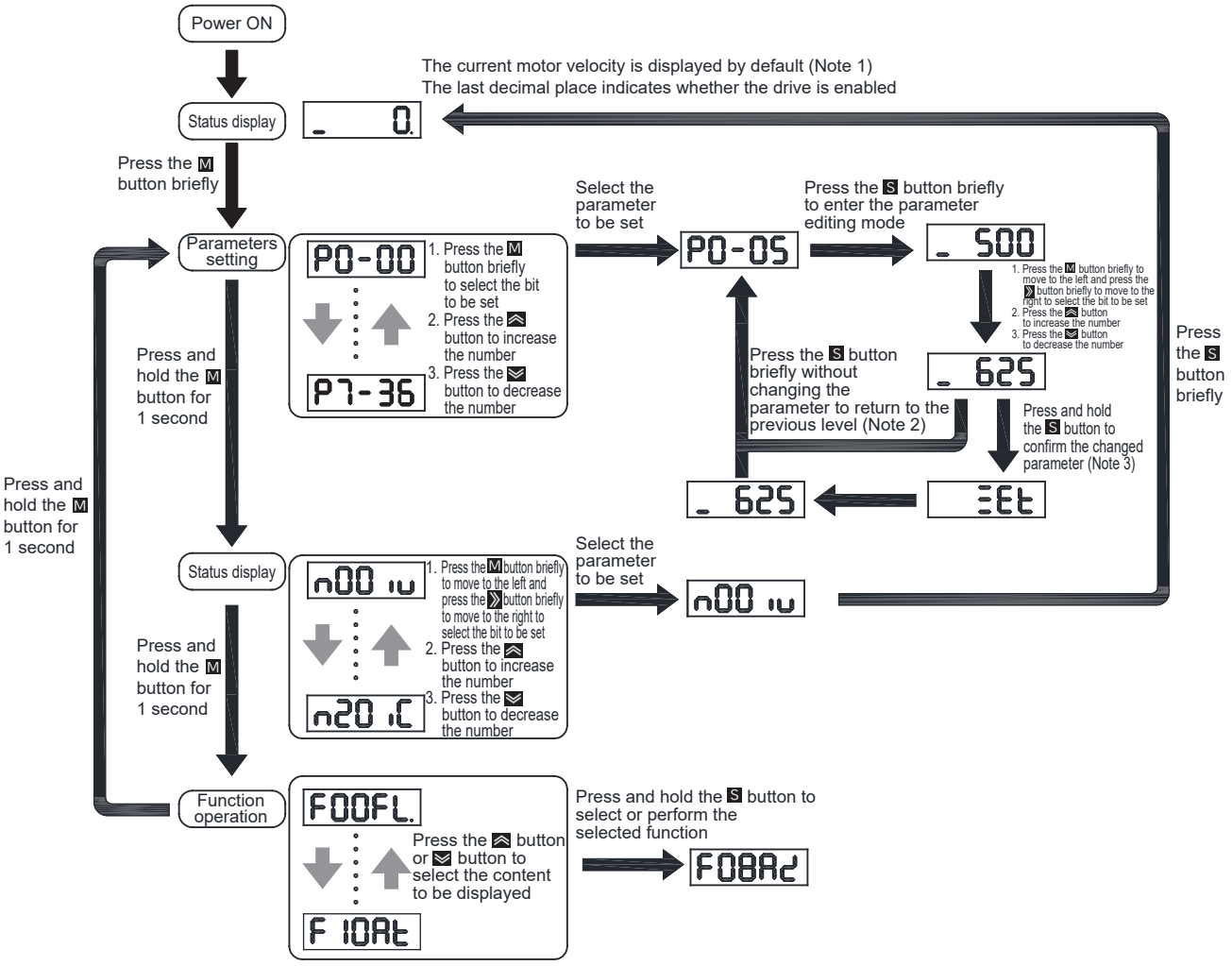
2 The error alarm mode will not be displayed if no error alarm occurs.

3 When an error alarm occurs, the system will immediately switch to the error alarm mode and display the current alarm code, regardless of the current mode. Press the MODE and SET buttons to return to the mode before the alarm occurs, and press the UP and DOWN buttons to view other alarm information.

4 In the status display selection mode, parameter setting mode, and function operation mode, press the MODE button briefly to switch between digits to increase or decrease, and the selected digit will flash.

5 In the status display mode, press and hold the SET button to lock the operation panel. To unlock the panel, press and hold the SET button again.

Refer to the diagram below for instructions on switching between modes.



(Note) 1. After power-on, the status display selected by the customer will be displayed, and the current velocity of the motor will be displayed by default.

2. In the parameter setting mode, press the SET button briefly to exit the parameter editing mode and return to the parameter setting selection interface without saving the settings.
3. In the parameter setting mode, press and hold the SET button to confirm the modified parameter, which will take effect immediately but will not be saved to the drive's Flash memory. If you want this parameter to be retained after a power outage, select the parameter saving function in the function operation interface and press and hold the SET button to save the parameter.

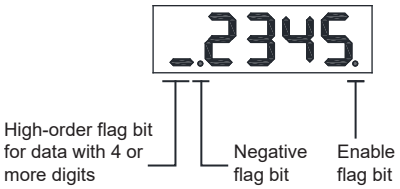


Precautions for Correct Use

Do not save parameters while the motor is running.

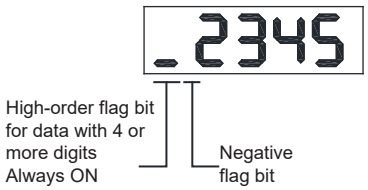
5-3 Display

5-3-1 Meaning of Decimal Points

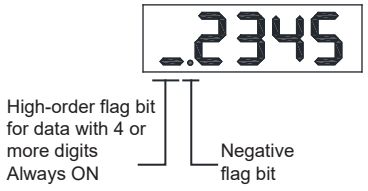
Display	Description
	• Enable flag: The decimal point in the lower right corner of the LED panel acts as a flag indicating whether the drive is enabled Always ON: Indicates that the drive is enabled and the motor is energized and excited OFF: Indicates that the drive is disabled and the motor is not energized • Negative number flag: Indicates whether the currently displayed number is positive or negative Always ON: Indicates that the displayed number is negative OFF: Indicates that the displayed number is positive • High-order flag for data with more than 4 digits: Data with more than 4 digits will be displayed on multiple pages, and this flag indicates the current digit position. For details, refer to "*5-3-2 Data Display* (P.5-5)".

5-3-2 Data Display

Display of Positive Number with 4 or Less Digits

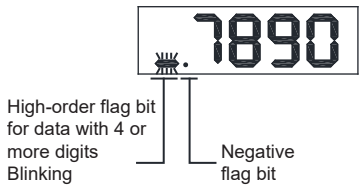
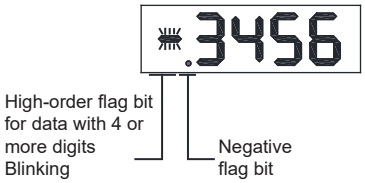
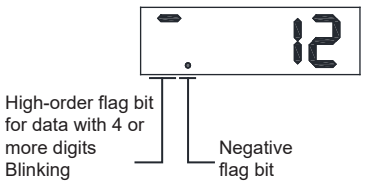
Display	Description
	• The first digit from the left acts as the flag for data with more than 4 digits. When the flag is at the bottom of the 7-segment LED display, it indicates that the last 4 digits of the data are being displayed. Always ON: Indicates that the last 4 digits of the data are being displayed, and there are no higher-order digits Blinking: Indicates that the last 4 digits of the data are being displayed, and the data contains more than 4 digits • When the decimal point of the negative number flag is OFF, it indicates that the displayed data is a positive number. As shown in the figure, the displayed number is 2345.

Display of Negative Number with 4 or Less Digits

Display	Description
	• The first digit from the left acts as the flag for data with more than 4 digits. When the flag is at the bottom of the 7-segment LED display, it indicates that the last 4 digits of the data are being displayed. Always ON: Indicates that the last 4 digits of the data are being displayed, and there are no higher-order digits Blinking: Indicates that the last 4 digits of the data are being displayed, and the data contains more than 4 digits • When the decimal point of the negative number flag is Always ON, it indicates that the displayed data is a negative number. As shown in the figure, the displayed number is -2345.

Display of Number with 5 or More Digits

Since the LED display panel of C6E-series AC servo products only has 5 digits, the following method is adopted to display data with more than 5 digits.
Example: Displaying -1234567890

	Display	Description
Display of the last 4 digits "7890"		• The first digit from the left acts as the flag for data with more than 4 digits. When the flag is at the bottom of the 7-segment LED display, it indicates that the last 4 digits of the data are being displayed. Blinking: Indicates that the last 4 digits of the data are being displayed, and the data contains more than 4 digits • When the decimal point of the negative number flag is Always ON, it indicates that the displayed data is a negative number.
Display of the middle 4 digits "3456"		• When the first digit from the left lights up in the middle of the 7-segment LED display, it indicates that the middle 4 digits of the data are being displayed. Always ON: Indicates that the middle 4 digits of the data are being displayed, and there are no higher-order digits Blinking: Indicates that the middle 4 digits of the data are being displayed, and the data contains higher-order digits
Display of the first two digits "12"		• When the first digit from the left lights up at the top of the 7-segment LED display, it indicates that the first 4 digits of the data are being displayed. Always ON: Indicates that the first 4 digits of the data are being displayed, and there are no higher-order digits

(Note) When the high-order flag blinks, it indicates that there are still higher-order digits. Press the "" or "" button briefly to switch the displayed page.

5-3-3 Other Display

Display	Description
	Indicates "SET". To modify a parameter, press and hold the "S" button for 1 second. The parameter will then be modified and take effect immediately. However, the modification will not be saved in the event of a power outage.
	Indicates "SAVED". Select the parameter to be saved, such as P0-05, press and hold the "S" button for 1 second, and "Saved" will be displayed, indicating that the parameter has been saved to a non-volatile register and will be retained even after a power outage.
	In the parameter modification mode, while the motor is rotating, press and hold the "S" button, and then "Busy" will be displayed, indicating that the current parameter cannot be saved temporarily. Wait until the motor has stopped rotating before saving the parameters.

5-3-4 Point-to-Point Motion Mode

Display	Description
	P--CW indicates that the motor is rotating clockwise in the point-to-point mode.
	P-CCW indicates that the motor is rotating counterclockwise in the point-to-point mode.

5-3-5 JOG Mode

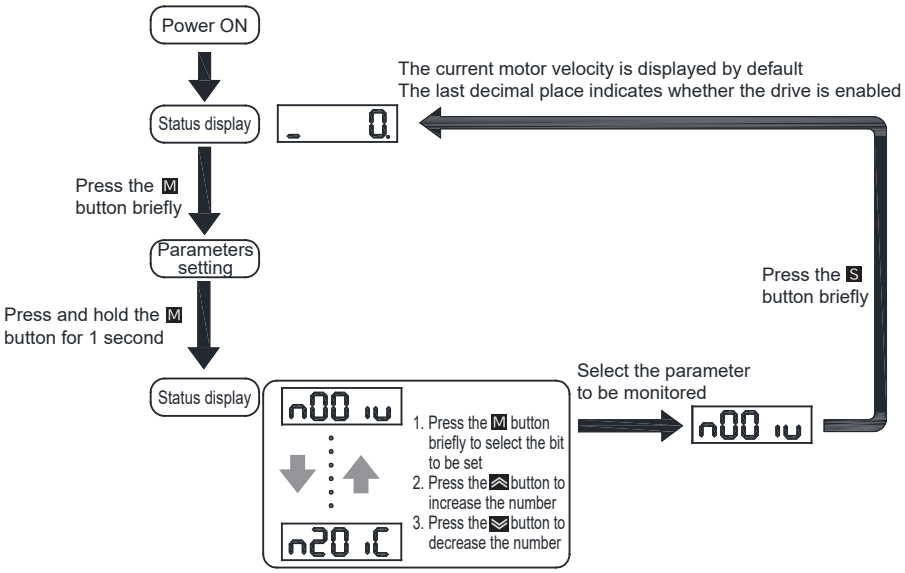
Display	Description
	J--CW indicates that the motor is rotating clockwise in the JOG mode.
	J-CCW indicates that the motor is rotating counterclockwise in the JOG mode.

5-3-6 Locking and Unlocking of Buttons

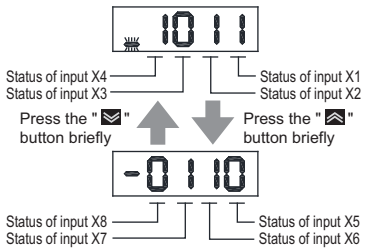
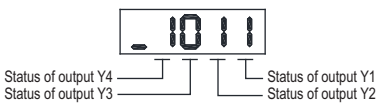
Display	Description
	Indicates that the buttons are locked. In the status display mode, press and hold the "S" button for 1 second to lock the buttons.
	When the buttons are locked, press and hold the "S" button for 1 second to unlock them.

5-4 Status Display Selection Mode

To change the content displayed in the status display mode, first press the M button to switch to the status display selection mode, then use the ⩓ ⩔ buttons to select the desired content, and finally press the S button briefly to confirm. The process is as shown in the diagram below.



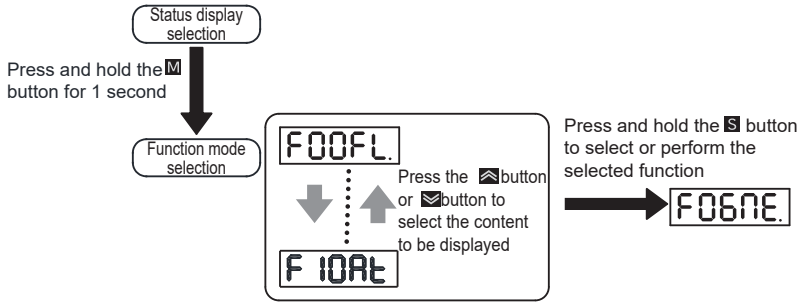
n-Set value of status display selection mode	Display symbol	Description	Unit	Display example
n-00	n00 iu	Motor actual velocity	RPM Revolutions per Minute	• When "3000" rpm is displayed _3000. • When "-3000" rpm is displayed -3000.
n-01	n01 i4	Motor real-time position error	Pulses	• When "-1234567890" is displayed -7890 Press the button briefly / Press the button briefly -3456 Press the button briefly / Press the button briefly -12
n-02	n02L E	Command pulse input count	Pulses	
n-03	n03 iE	Motor encoder position	Pulses	
n-04	n04 iP	Command position	Pulses	
n-05	n05 it	Drive PCB temperature	0.1 ℃	• When "62.5" ℃ is displayed _625
n-06	n06 iU	DC bus voltage	0.1 V	• When "315.7" VDC is displayed _3157
n-07	n07dA	EtherCAT communication node ID		• When the displayed address is "1" _1001
n-08	n08AH	Alarm history 0		• When alarm code "r07" is displayed _7

n-Set value of status display selection mode	Display symbol	Description	Unit	Display example
n-09	n09AH	Alarm history 1		• When alarm code "r07" is displayed _ 7
n-10	n 10AH	Alarm history 2		• When alarm code "r07" is displayed _ 7
n-11	n 11AH	Alarm history 3		• When alarm code "r07" is displayed _ 7
n-12	n 12AH	Alarm history 4		• When alarm code "r07" is displayed _ 7
n-13	n 13AH	Alarm history 5		• When alarm code "r07" is displayed _ 7
n-14	n 14AH	Alarm history 6		• When alarm code "r07" is displayed _ 7
n-15	n 15AH	Alarm history 7		• When alarm code "r07" is displayed _ 7
n-16	n 16 iA	Analog input 1 sampling voltage	mV	• When "8.211" V is displayed _8211
n-17	n 17 iA	Analog input 2 sampling voltage	mV	• When "8.707" V is displayed _8707
n-18	n 18 in	Digital input status		• Each 7-segment display represents the status of a digital input: 1: Closed status 0: Open status 
n-19	n 19oU	Digital output status		• Each 7-segment display represents the status of a digital output: 1: Closed status 0: Open status 
n-20	n20 iC	Command current percentage	0.1%	• When the displayed current command is 72.5% _725

(Note) Closed: The digital input/output circuit of the drive forms a loop, and the drive has input/output signals.
Open: The digital input/output circuit of the drive does not form a loop, and the drive has no input/output signals.

5-5 Function Operation Mode

In this mode, users can select the function to be performed, which is displayed in the form of "F + parameter number". In the status display selection mode, press and hold the M button for 1 second to enter the function operation mode, use the ▲ and ▼ buttons to select the required function, and finally press and hold the S button to confirm or perform the selected function (Note: Except for F00FL and F01CJ).

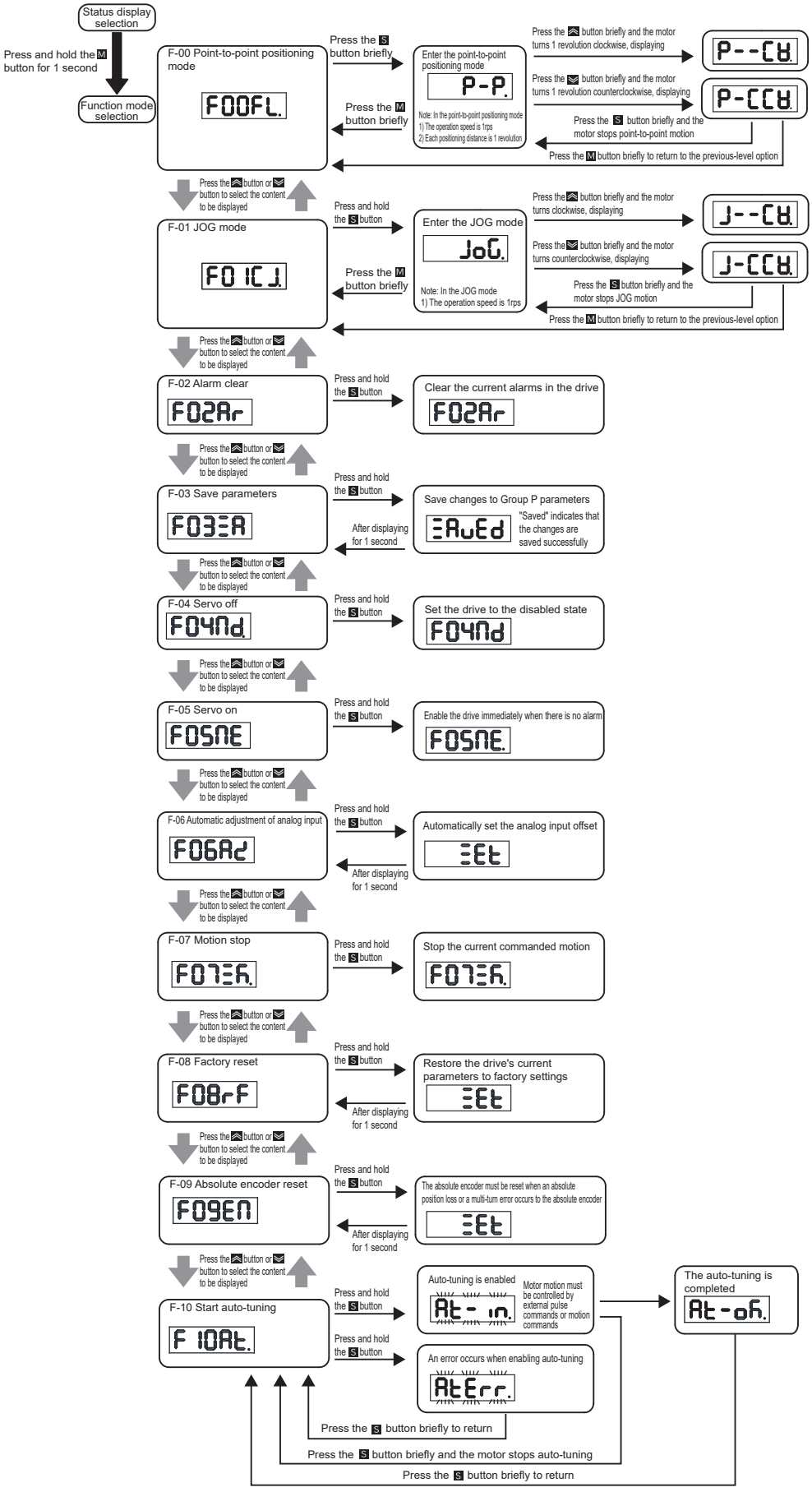


5-5-1 Function Comparison Table for Function Operation Mode

Details of the function operation mode are given in the table below.

F-Function operation mode	Display symbol	Description
F00	F00FL	(F00FL) ---- Point-to-point position mode • The operation speed is 1 rps • The operating distance is 1 revolution
F01	F01CJ	(F01CJ) ---- Rotate at the speed of 1 rps in the Jog mode
F02	F02Ar	(F02AR) ---- Clear the current alarms in the drive
F03	F03SA	(F03SA) ---- Save changes to Group P parameters
F04	F04Md	(F04MD) ---- Disable drive
F05	F05nE	(F05ME) ---- Enable drive
F06	F06Az	(F06AZ) ---- Auto-set analog offset
F07	F07SK	(F07SK) ---- Stop motion
F08	F08rF	(F08RF) ---- Restore the drive parameters to default factory settings
F09	F09EM	(F09EM) ---- Reset absolute encoder
F10	F 10At	(F10AT) ---- Start auto-tuning

5-5-2 Operation Flowchart



5-6 Parameter Setting Mode

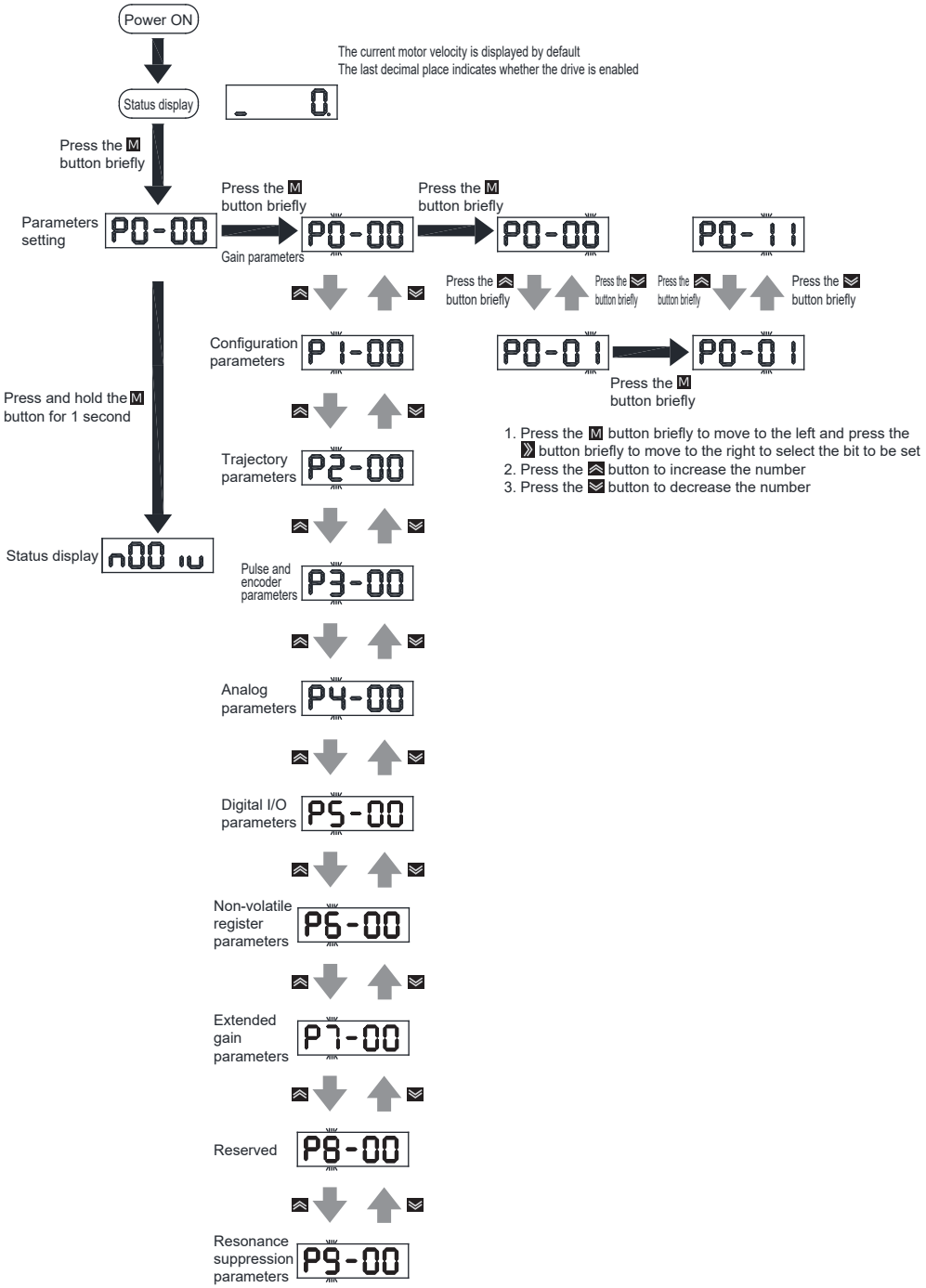
5-6-1 Parameter Setting Method

In this mode, users can modify the parameter to be set, which is displayed in the form of "P + parameter number".

1 Press the M button briefly to select the digit to be set.

2 Press the ▲ button briefly to increase the number.

3 Press the ▼ button briefly to decrease the number.

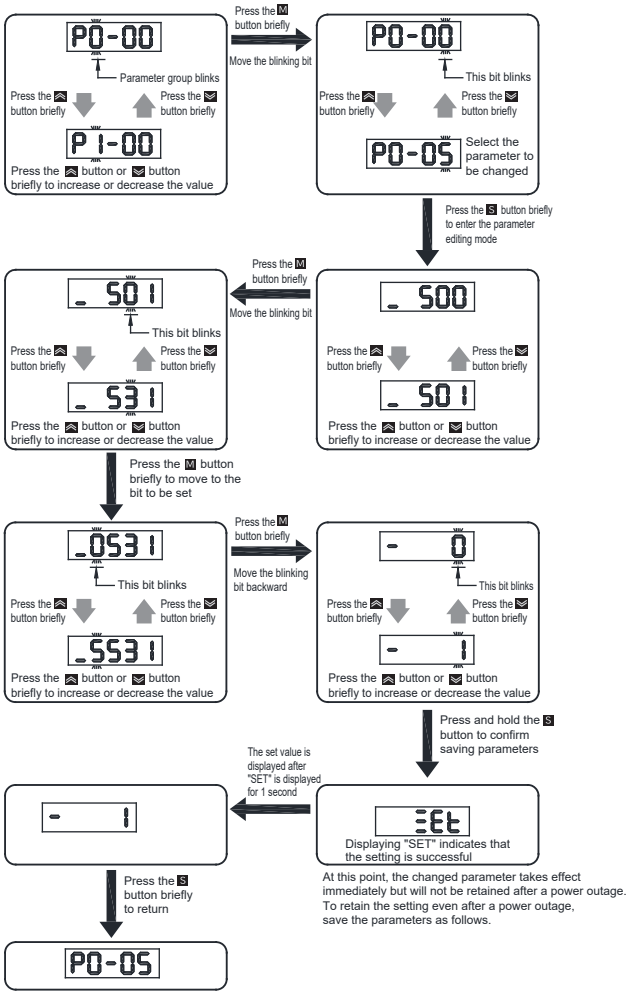


5-6-2 Examples of Modifying and Saving Parameters

Modifying Parameters

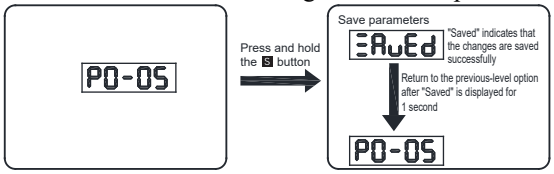
1. Press the M button briefly to move up and select the digit to be set.
2. Press the ≫ button to move down and select the digit to be set.
3. Press the ∧ button briefly to increase the number.
4. Press the ∨ button briefly to increase the number.
5. Press and hold the S button to confirm the modified parameter.

Example of setting: Modify the parameter P0-05 to 15531.



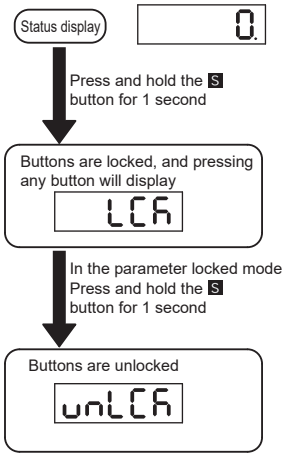
Saving Parameters

Once a parameter is successfully modified, the modification takes effect immediately (except for certain parameters that require a power outage to take effect). However, the modified parameter is not retained after a power outage; that is, the parameter will be restored to its previously saved value the next time the device is powered on. To retain the setting even after a power outage, follow the steps below.



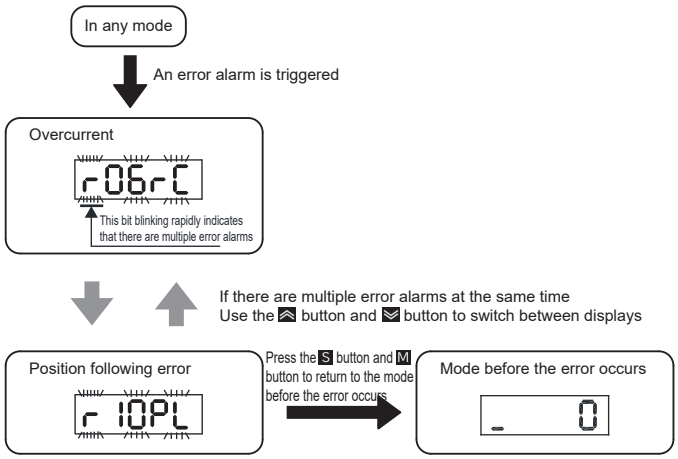
5-7 Locking of Buttons

To prevent misoperation by personnel unfamiliar with this Servo Drive, C6E-series AC Servo Drives provide the button locking function. Once the buttons are locked, the parameters will no longer be operable or modifiable.



5-8 Error Alarm Display

Under any circumstances, the drive will enter the error alarm display mode once it triggers the following alarms. If multiple error alarms are triggered simultaneously, press the ▲▲ and ▼▼ buttons to view the pages. Press the M and S buttons briefly to return to the mode before the error alarm is triggered.



Alarm Display Code

Display	Description	Alarm type	Drive status after alarm occurs
r01ot	Drive power module over temperature	Fault	Servo off
r02ur	Drive internal voltage error	Fault	Servo off
r03uH	Drive over voltage	Fault	Servo off
r04HC	Drive over current	Fault	Servo off
r05LC		Fault	Servo off
r06rC		Fault	Servo off
r07Fb	FPGA error	Fault	Servo off
r09Eb	Motor encoder disconnected	Fault	Servo off
r 10PL	Position following error	Fault	Servo off
r 11Lu	Drive low voltage	Fault	Servo off
r 12ou	Over speed	Fault	Servo off
r 13Lt	CW and CCW limit switch is triggered	Warning	The present status remains, and the motor cannot continue CW/CCW rotation.
r 14cL	CCW limit is triggered	Warning	The present status remains, and the motor cannot continue CCW rotation.
r 15JL	CW limit is triggered	Warning	The present status remains, and the motor cannot continue CW rotation.
r 16CL	Current limit exceed	Warning	The present status remains

Display	Description	Alarm type	Drive status after alarm occurs
r17CE	USB communication error	Warning	The present status remains
r18EF	Save failed	Fault	Servo off
r19LP	Drive main circuit power supply phase loss	Fault	Servo off
r20to	Safe torque off	Fault	Servo off
r21rF	Regenerate failed	Warning	Servo off
r22uV	Drive under-voltage	Warning	The present status remains
r24dd	Motion command received while motor disable	Warning	The present status remains
r25ur	Drive internal voltage error	Fault	Servo off
r26ur		Fault	Servo off
r27E3	Emergency stop	Fault	The status depends on the setting value of 0x605E.
r28FP	Full closed-loop hybrid deviation excess error	Fault	Servo off
r29FE	Second encoder signal error	Fault	Servo off
r30nE	Parameter read failed	Fault	Servo off
r31bt	Absolute encoder battery under-voltage	Warning	The present status remains
r32AP	Absolute position lost	Warning	The present status remains
r33oP	Absolute position overflow	Warning	The present status remains
r34Ot	Motor over temperature	Fault	Servo off
r35Ct	Drive processor over temperature	Fault	Servo off
r36Or	Absolute encoder multi-turn error	Fault	Servo off
r37Et	Motor stall	Fault	Servo off
r38CE	EtherCAT communication error	Fault	Servo off
r39Hr	Homing parameter configuration error	Warning	The present status remains
r40H1	Motor collision alarm	Fault	Servo off
r41Er	Encoder communication error	Fault	Servo off
r42io	IO function multiplexing	Warning	The present status remains
r44CU	CSP command exceeds limits within DC cycle	Fault	Servo off
r45ro	Motor runaway detected	Fault	Servo off
r66d3	Drive mismatch with motor	Fault	Servo off

6

Test Run

This section explains the inspections before test run of the servo system, the test run procedure, and the parameters setting for connecting to the computer.

6-1 Inspections Before Test Run 6-2
6-2 Test Run Procedure 6-3
6-3 JOG Operation 6-4
6-4 Test Run via USB Communications from the Sysmac Studio 6-5

6-1 Inspections Before Test Run

Wiring

- Make sure that there are no wiring errors (especially for the power supply input and motor output).
- Make sure that there are no short circuits. (Check the ground for short circuits as well.)
- Make sure that there are no loose connections.
- Make sure that the EtherCAT cable is not connected simultaneously during the panel and USB test run.

Power Supply and Voltage

- Make sure that the power voltage is within the specified range.
- Make sure that there is no voltage fluctuation.

Servomotor Installation

Make sure that the Servomotor is securely installed.

Disconnection from Mechanical Systems

If necessary, make sure that the load is disconnected from mechanical systems.

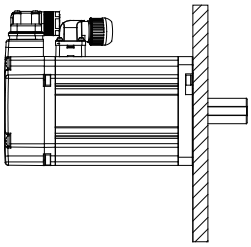
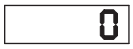
Brake Released

Make sure that the brake is released.

Connection to Mechanical Systems

- Make sure that the load and Servomotor shaft are properly aligned.
- Make sure that the load on the Servomotor shaft is within specifications.

6-2 Test Run Procedure

Step	Details	Description
1	Make sure that the Servomotor is securely installed. 	1) The Servomotor can be installed on the mechanical system. 2) Do not connect a load to the Servomotor.
2	Verify that the wiring between the motor and the drive is correct.	1) The motor phases U, V, and W must correspond to the red, yellow, and blue terminals of the lead wires, and the PE terminal must correspond to the yellow-green terminal. If connected incorrectly, the motor will not run properly. 2) Verify that the motor encoder cable is correctly connected to CN3.
3	Verify that that the drive power supply circuit wiring is correct.	Refer to 🕮 *"4-3 External Main Circuit Wiring* (P.4-9)" to check whether the power supply input circuit is correct.
4	When using a motor equipped with an electromagnetic brake, the electromagnetic brake control circuit must be set before use.	Refer to 🕮 *"4-7 Wiring Method for Motors with Electromagnetic Brakes* (P.4-21)"
5	Turn on the power supply.	Connect to a power supply with matching voltage.
6	Under normal circumstances, ### will be displayed.  In the event of an alarm, ### will be displayed: 	1) Under normal circumstances, the drive does not display any alarms and is in an disabled state. 2) If alarm r-09 occurs, it indicates an abnormal encoder cable connection. Please turn off the power and check whether the wiring is correct. 3) For other alarms, refer to 🕮 *"5-8 Error Alarm Display* (P.5-15)".
7	Operate in the JOG mode.	If there are no problems in the above steps, proceed with the test run in the JOG mode.

⚠ CAUTION

Before running the motor, make sure to set the motor parameters according to the following procedure.

6-3 JOG Operation

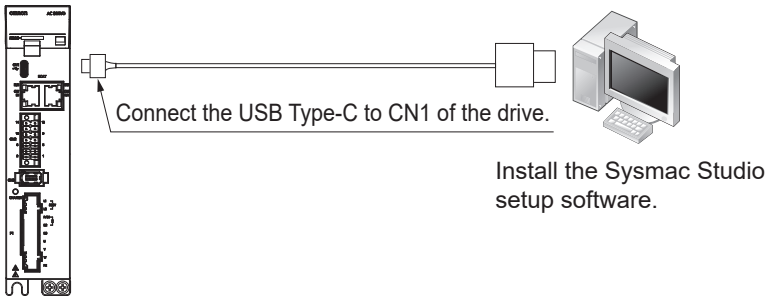
Step	Display	Description
1	F00FL	Press and hold the M button to enter the functional operation mode.
2	F05nE	Use the ⌃ and ⌄ buttons to select the F05ME servo enable function.
3	F05nE.	Press and hold the S button until the last decimal point lights up, indicating that the servo is enabled.
4	F01CJ.	Use the ⌃ and ⌄ buttons to select the F01CJ JOG function.
5	JoG.	Press the S button briefly to enter the JOG mode.
6	J--CW.	Press the ⌃ button briefly to run the motor in CW direction at 1 revolution per second.
7	or J-CCW.	Or press the ⌄ button briefly to run the motor in CCW direction at 1 revolution per second.
8	JoG.	Press the S button briefly to stop the motor.
9	F01CJ.	Press the M button briefly to return to the functional operation mode.
10	F04nd	Select F04MD, press and hold the S button for 1 second to disable the motor.

6-4 Test Run via USB Communications from the Sysmac Studio

1. Connect a sensor or other device to the control I/O connector.
2. Turn ON the Servo Drive power supply.
3. Connect a USB cable to the USB connector.
4. Start the Sysmac Studio and go online with the Servo Drive via USB communications.
5. In the Sysmac Studio, right-click the target Servo Drive under **Configurations and Setup**, and select **Test Run**.
6. Click the **Servo ON** button to apply the servo lock to the Servomotor
7. Click the  or  button to start the Servomotor.

For how to use the Sysmac Studio, refer to the please refer to the 🕮"Sysmac Studio Driver Function Operation Manual (SBCE-CN5-401)".

Connection Method



Precautions for Correct Use

When you perform a test run via USB communications, pull out the EtherCAT cable before you turn ON the power supply to the Servo Drive.

Additional Information

When you use an NJ/NX-series CPU Unit, you can perform a test run from the Sysmac Studio via EtherCAT.

7

Servo Gain Tuning

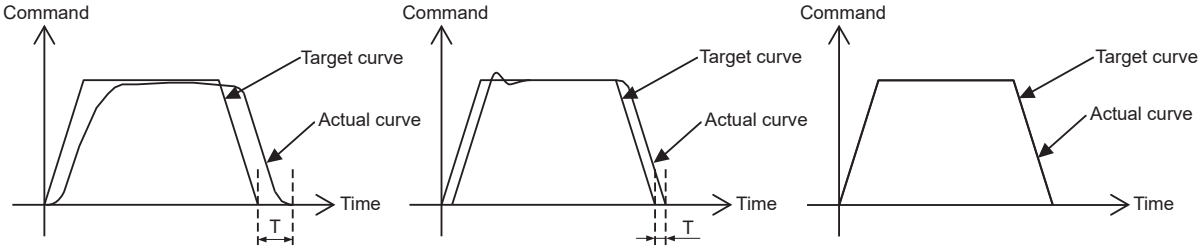
This section introduces the servo debugging process and modes, and explains the auto-tuning mode, advanced tuning mode, vibration suppression, etc.

7-1 Introduction to Servo Debugging Process and Modes 7-2
7-1-1 Outline of Servo Gain Tuning 7-2
7-1-2 Servo Debugging Flowchart 7-3
7-1-3 Introduction to Parameter Tuning Modes 7-4
7-2 No Tuning Mode 7-5
7-3 Auto-Tuning Mode 7-6
7-3-1 Auto-tuning Flowchart 7-7
7-3-2 Motion Trajectory Conditions for Auto-tuning 7-8
7-3-3 Start Auto-tuning -- From the Operation Panel 7-9
7-3-4 Start Auto-tuning -- From the Software Operation 7-10
7-4 Advanced Tuning 7-11
7-4-1 PID Parameter Switching Settings 7-12
7-4-2 FFT 7-12
7-4-3 Data Trace Function 7-12

7-1 Introduction to Servo Debugging Process and Modes

7-1-1 Outline of Servo Gain Tuning

Servo gain tuning is a function that optimizes the responsiveness of a servo unit.
The Servo Drive must drive the Servomotor as precisely and without time delay as possible in response to the commands from the host system. Gain adjustment is required to make the motor operation follow commands more closely and maximize the performance of the machine.



The target curve is inconsistent with the actual curve.

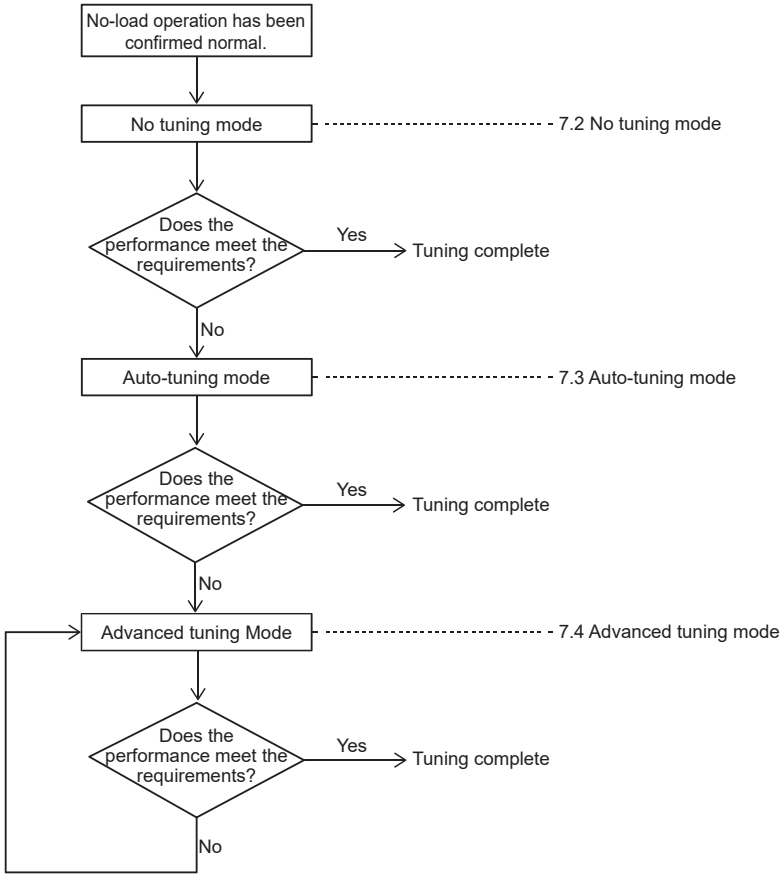
Adjust the gain parameters so that the target curve gradually approximates the actual curve.

Optimize the gain parameters so that the target curve basically coincides with the actual curve.

Servo gain setting depends on the coordinated configuration of multiple parameters including position loop gain, velocity loop gain, filter, friction compensation, and load inertia ratio. These parameters affect each another. Therefore, when adjusting the servo gain, you need to comprehensively consider the coordination and balance between the setting values of various parameters in order to optimize the overall system performance.

7-1-2 Servo Debugging Flowchart

The servo debugging flowchart is as follows. Before starting the servo debugging, make sure that the servo system can run normally according to the test run procedure described in Section 6.



Precautions for Safe Use

When you perform the debugging, be sure to follow these guidelines:

- Check the mechanical connections to ensure that all mechanical connection components, such as couplings, lead screws, belts, and gears, are secure and reliable, without any looseness or damage.
- Check and minimize backlash and structural deformation of the transmission mechanism.
- Install a stopping device on the machine to ensure safety.
- In order to avoid accidental overtravel, use software or mechanical limits to keep the motion range of the Servomotor within a safe area.
- Do not touch the rotating parts of the motor when the servo is enabled and the motor is rotating.
- When the Servomotor is running, keep it running in a state where an emergency stop can be executed at any time.
- Make adjustments after verifying that the test run has completed properly.

7-1-3 Introduction to Parameter Tuning Modes

Multiple modes are available for servo parameter tuning, which are set by the parameter P0-00.

Servo debugging process		Parameter P0-00 setting value	Introduction	Reference
1	No tuning	0	The servo system is in a relatively stable but less rigid state. At this time, the inertia ratio P0-02 is locked at the default value of 2.5 and cannot be modified. You can try to select an initial rigidity that allows the servo system to run normally, and gradually increase the rigidity level so that the servo rigidity meets the application requirements.	7.2 No tuning mode
2	Auto-tuning	1	The Servo Drive controls motor operation, and performs the following adjustments during the operation: 1. Gain (position loop, velocity loop) 2. Filter (torque command filter) 3. Velocity and acceleration feedforward gain 4. Vibration suppression and other parameters 5. Two-degree-of-freedom control related parameters (model tracing control, external disturbance compensation)	7.3 Auto-tuning mode
3	Advanced tuning	2	The user may manually set all gain parameters for each servo control loop as required.	7.4 Advanced tuning mode

7-2 No Tuning Mode

In "No tuning mode", the servo system is in a relatively stable but less rigid state, which meets most application requirements. You can try to select an initial rigidity that allows the servo system to run normally, and gradually increase the rigidity level so that the servo rigidity meets the application requirements.



Precautions for Correct Use

In this mode:

- The inertia ratio P0-02 is locked at 2.5 and cannot be modified.
- All gain parameters except feedforward gain will not take effect when modified individually.
- The 2nd rigidity level P0-04 is valid during gain switching.

7-3 Auto-Tuning Mode

"Auto-tuning mode" is the default mode of the Servo Drive before shipment.
In the "Auto-tuning mode", the user sets the motion trajectory and response requirements parameters using the wizard, and the servo system will run automatically and identify mechanical characteristics based on real-time feedback data to generate a set of optimal servo gain parameters.
Details of the auto-tuning optimization are as follows.

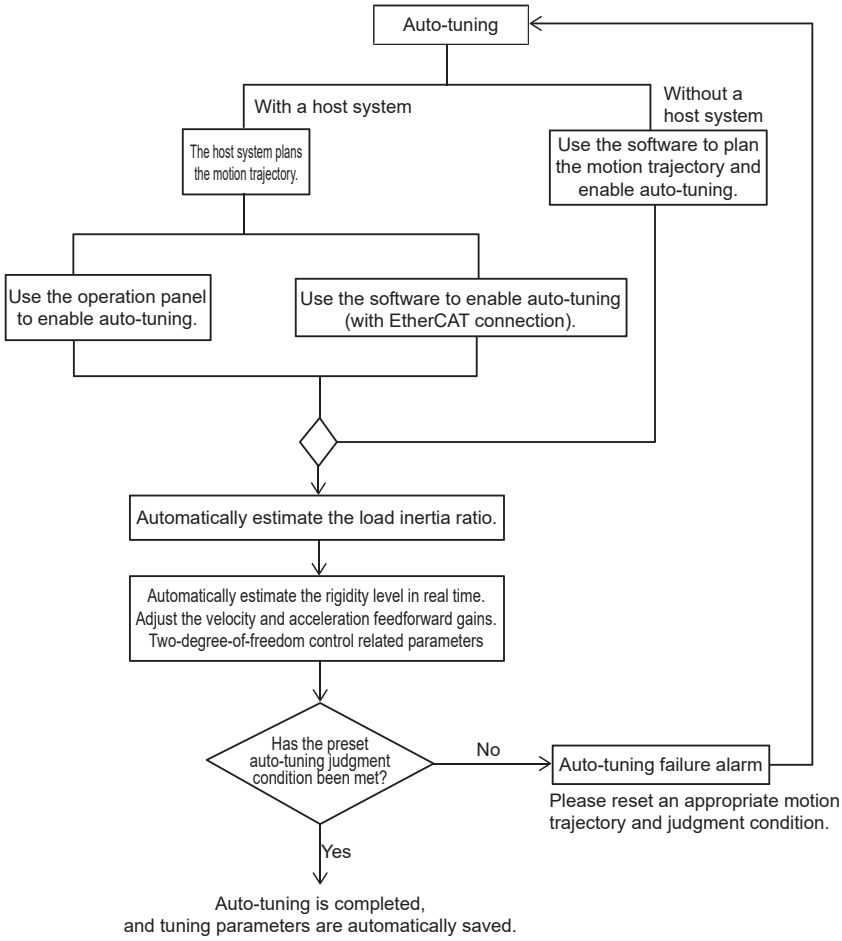
- Gain (position loop, velocity loop)
- Filter (torque filter)
- Velocity and acceleration gain
- Vibration suppression parameters
- Two-degree-of-freedom control parameters (model tracing control, external disturbance compensation)

During the auto-tuning, the parameters in the table below will change automatically. After the auto-tuning is completed, the parameters are automatically saved to the drive.

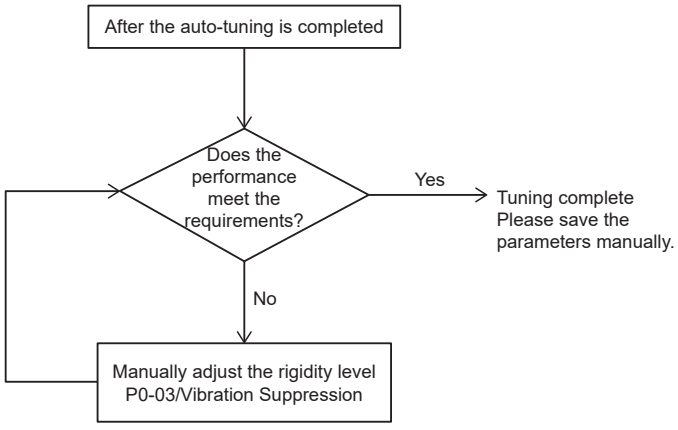
Parameter	Name	Is manual modification effective in the Auto-tuning mode?
P0-02	Load inertia ratio	Yes
P0-03	1st rigidity level	Yes
P0-05	1st position loop gain	No
P0-09	Velocity feedforward gain	Yes
P0-10	Velocity feedforward filter	Yes
P0-12	1st velocity loop gain	No
P0-13	1st velocity loop integral time constant	No
P0-14	Acceleration feedforward gain	Yes
P0-15	Acceleration feedforward filter	Yes
P0-16	1st torque command filter	No
P2-28	Jerk filter	Yes
P2-29	Interpolation filter	Yes
P7-01	Model control function	Yes
P7-02	Model gain	Yes
P7-20	Extended function	Yes
P7-23	Disturbance torque gain	Yes
P7-30	Resonance frequency	Yes
P7-31	Anti-Resonance gain1	Yes

7-3-1 Auto-tuning Flowchart

There are two auto-tuning methods.
With a host system: The Servo Drive performs adjustment by receiving external motion commands (Not supported when the Sysmac Studio is configured for USB connection).
Without a host system: Adjustment is performed with a custom motion trajectory created internally in the Servo Drive.
The user can perform auto-tuning and debugging of parameters from the Sysmac Studio or the operation panel on the drive.



After the auto-tuning is completed, you can continue to use the parameter P0-03 to adjust the rigidity and response of the servo system.



7-3-2 Motion Trajectory Conditions for Auto-tuning

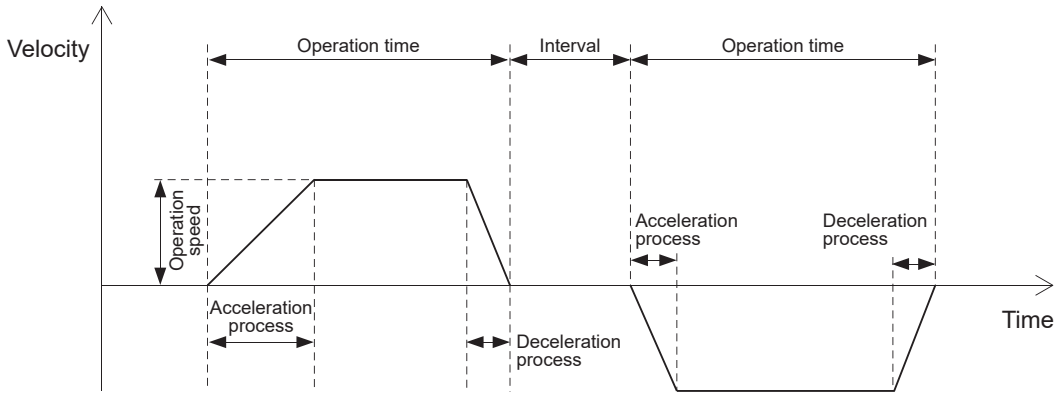
To accurately complete automatic parameter tuning, it is necessary to set a reasonable motion trajectory, including sufficient stroke, operation speed, running time, acceleration/deceleration, and the interval between two motions.

Operation time: > 0.5 s

Operation speed: > 3 rps

Acceleration/deceleration: > 30 rps/s

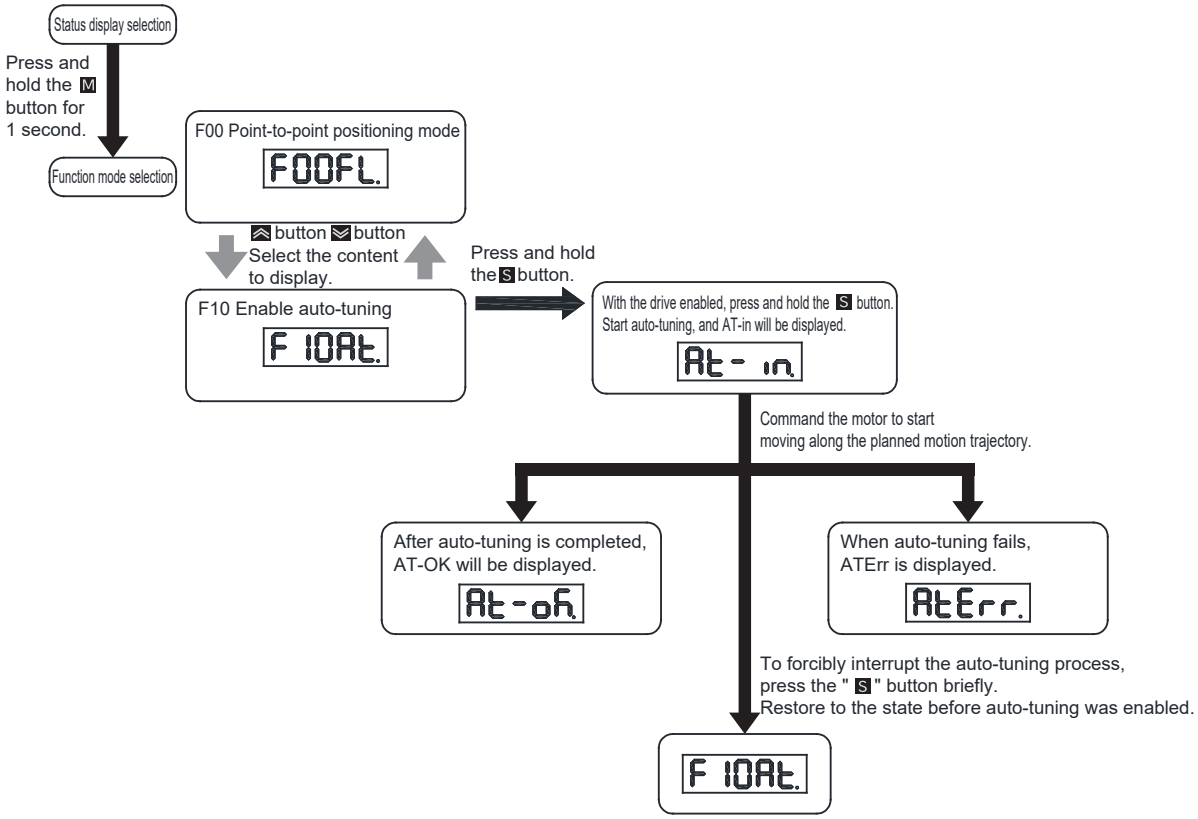
Interval: > 1.5 s



7-3-3 Start Auto-tuning -- From the Operation Panel

When using the operation panel for automatic parameter tuning, the adjustment can only be performed by the Servo Drive receiving external motion commands. The auto-tuning procedure can be activated via the buttons on the operation panel as follows:

1. Press and hold the "M" button to switch to the "Function Mode", and "F00FL." will be displayed.
2. Press the "▲▲" or "▼▼" button, and "F 10AT." will be displayed.
3. Press and hold the "S" button to activate the auto-tuning function and enter the display interface, and "AT- in." will be displayed.
4. Command the motor to start moving along the planned motion trajectory.
5. If an error occurs, "ATErr." will be displayed. Press the "M" button briefly to eliminate the error message.
6. After the auto-tuning process is completed (including if it is forcibly interrupted), "AT-oK." will be displayed.
7. To forcibly interrupt the auto-tuning process, press the "S" button briefly to restore to the state before auto-tuning was enabled.



Precautions for Correct Use

- The parameter tuning mode must be set to "Auto-tuning mode".
- Auto-tuning must be enabled only when the motion trajectory conditions for auto-tuning are satisfied; otherwise, an AtErr alarm will be triggered.
- Before starting the auto-tuning, the Servo Drive must be enabled; otherwise, an AtErr alarm will be triggered.

7-3-4 Start Auto-tuning -- From the Software Operation

Whether or not a host system is available, you can use the Sysmac Studio software to start automatic parameter tuning, which is a recommended method.
The procedure for enabling auto-tuning using the Sysmac Studio is as follows:

1. Configure the encoder operation mode.
2. Set the I/O signal functions of the drive.
3. In the Sysmac Studio, right-click the target Servo Drive under **Configurations and Setup**, and select a suitable tuning method from **Setup and Tuning**.



Precautions for Correct Use

- Easy tuning is performed by the use of the automatic adjustment function of the Servo Drive (Load Characteristic Estimation).
- If each function does not operate properly, the automatic adjustment by the easy tuning also may not operate properly.
- Do not connect the EtherCAT cable when performing automatic adjustment via USB connection.

● Related Settings Description

1) Auto-tuning mode

There are two auto-tuning modes available: standard and fast positioning.

- Standard: Automatically sets the rigidity levels, feedforward gain parameters, and vibration suppression parameters.
- Fast positioning: Based on the Standard mode, the model control function is enabled to automatically set the jerk filter, which is suitable for fast positioning applications.

2) Perform inertia identification

You can choose whether to enable inertia identification; it is enabled by default.
If inertia identification is not performed, please set the correct inertia ratio and enter it into the parameter Load Inertia Ratio (P0-02).
If you do not know the present load inertia ratio, you do not need to enter it. Just check "Perform Inertia Identification" and the system will automatically identify the load inertia ratio.

3) Optimal response mode

When "Optimal Response Mode" is selected, the system will adjust the responsiveness to a relatively optimal state while ensuring stability.
When "Optimal Response Mode" is not selected, the tuning target is determined by two groups of parameters: positioning error range and positioning completion time. Its default value is based on the default setting of the number of pulses required per motor revolution (P3-05). If the setting value of P3-05 is modified, the tuning target related parameters must be modified accordingly.

4) Vibration energy level

Sets the maximum allowable torque vibration value for the servo system after auto-tuning is completed. A higher setting results in a higher system rigidity after auto-tuning.

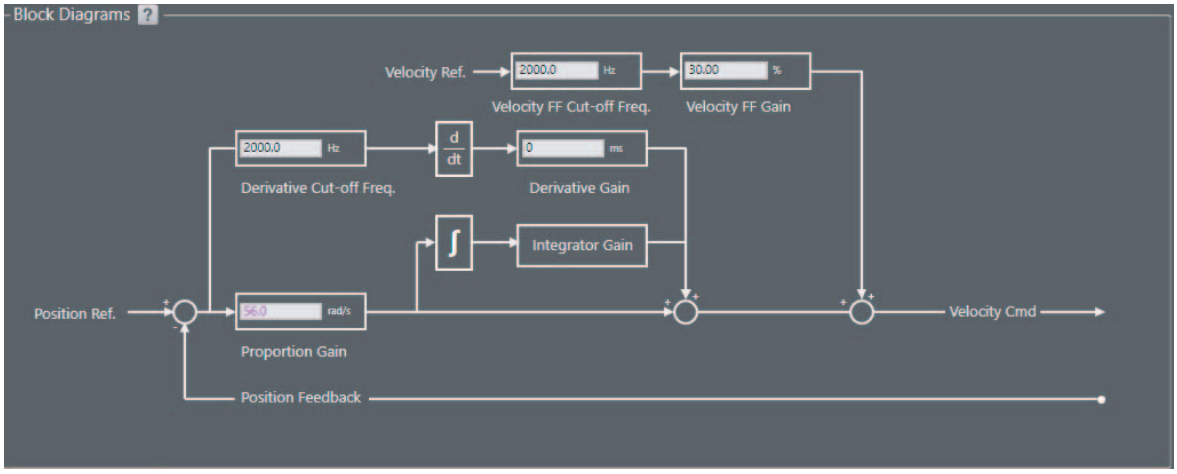
7-4 Advanced Tuning

For advanced users familiar with PID control and requiring relatively high tuning performance, advanced tuning can be selected. In the advanced tuning mode, all PID parameters can be adjusted.
After setting the advanced tuning mode, click [Download to Servo Drive] button to download it to the Servo Drive. Then, control the motor motion through test run and adjust the corresponding PID parameters according to the actual running performance.

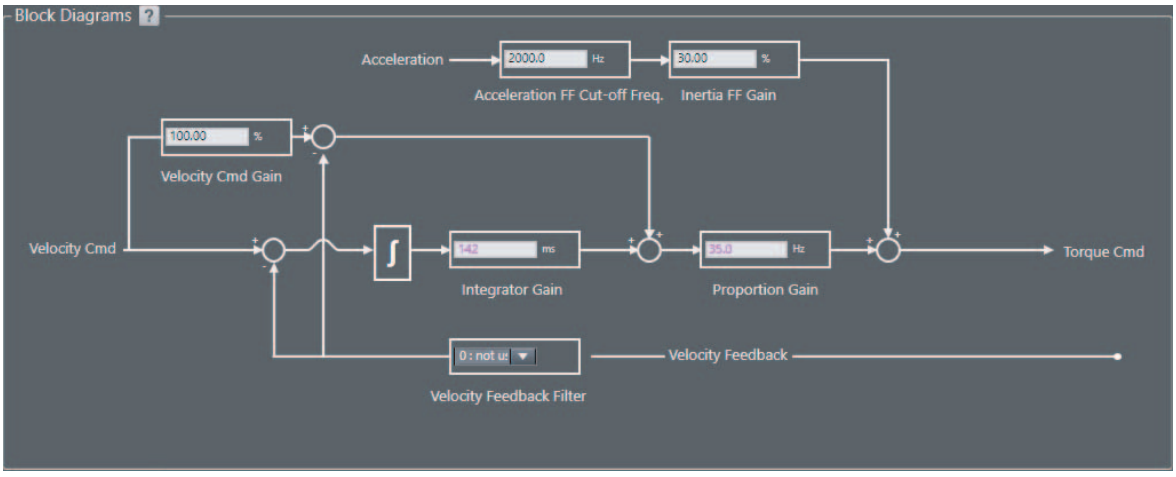
Additional Information

- After switching to "Advanced Tuning Mode", the parameter values will be inherited after the auto-tuning is completed. You need to save manually after the adjustment is completed.
- It allows direct switching from "No Tuning Mode" to "Advanced Tuning Mode". The parameter values of the No Tuning Mode will be inherited, and you need to manually adjust the inertia ratio to an appropriate value.

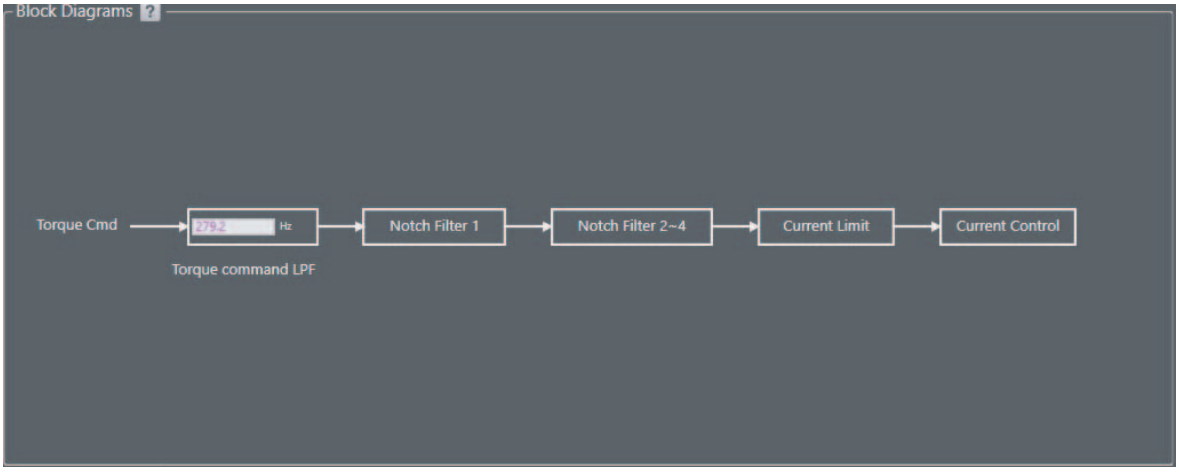
Position Loop Control Block Diagram



Velocity Loop Control Block Diagram



● Current Loop Control Block Diagram



7-4-1 PID Parameter Switching Settings

C6E-series Servo Drives allow you to define two different groups of PID parameters and set certain switching conditions (P0-33, please refer to 🕮 *"10-7 Gain Switching Function* (P.10-18)"). When the operational state meets the switching conditions, the drive will automatically switch to the second group of PID parameters. Once the set switching conditions are no longer met, the drive will automatically switch back to the first group of PID parameters. When switching PID parameters, a certain switching time can also be set, in milliseconds.

7-4-2 FFT

Sysmac Studio allows you to test the load characteristics and the frequency characteristics of the velocity control loop.

(Note) This function is only supported when connected via USB. Do not connect the EtherCAT cable when using this function.

For how to use, refer to the 🕮"Sysmac Studio Drive Functions Operation Manual (SBCE-CN5-401)".

There are four types of analysis under FFT:

- Load characteristic analysis: Used to analyze the torque-velocity response characteristics of the load, excluding the effects of torque and notch filter. This type of analysis requires the motor to be disabled.
- Closed-loop velocity characteristic analysis: Used to analyze the closed-loop velocity characteristics.
- Open-loop velocity characteristic analysis: Used to analyze the open-loop velocity characteristics.
- Open-loop velocity characteristic (vertical axis) analysis: Used to analyze the open-loop velocity characteristics of a vertically mounted axis.

7-4-3 Data Trace Function

This is a function that uses the Sysmac Studio to sample and display the commands sent to the motor or the motor's actions (position, velocity, torque) at regular intervals.

In the C6E-series Servo Drives, it is possible to monitor four 16-bit data or one 32-bit data (in place of two 16-bit data) simultaneously.

(Note) Set the sampling time appropriately. If it is too fast, data loss will occur due to the caching of the C6E-series Servo Drives. The default sampling period is 125 μs for USB connection and 1 ms for EtherCAT connection. A pop-up message will appear when data loss occurs. In this case, increase the sampling time appropriately and perform data tracing again.

For how to use, refer to the 🕮"Sysmac Studio Drive Functions Operation Manual (SBCE-CN5-401)".

8

EtherCAT Communications

This section provides an outline of EtherCAT, and explains the CANopen over EtherCAT reference model, the EtherCAT frame structure and state machine, the Process Data Object (PDO), and the SDO mailbox data, etc.

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8-1 Introduction to EtherCAT

8-1-1 Outline of EtherCAT

EtherCAT (Ethernet for Control Automation Technology) is a high-speed, real-time industrial Ethernet technology developed by Beckhoff in Germany. Using the standard Fast Ethernet physical layer, EtherCAT features high speed, high efficiency, excellent synchronization performance, and low hardware cost. EtherCAT adopts a bus topology that improves wiring efficiency and supports linear topology, tree topology, star topology, or any combination of them, supporting up to 65535 connected devices.
EtherCAT® is a registered trademark and patented technology licensed by Beckhoff Automation GmbH.

8-1-2 Introduction to EtherCAT Communication Protocol

EtherCAT is a protocol optimized for process data and embeds its payload directly in standard Ethernet frames for transmission. During startup, the master device configures and maps the process data on the slave devices. An EtherCAT frame consists of an EtherCAT frame header and one or more EtherCAT datagrams. The EtherCAT frame header indicates the data type to be accessed by the master device:

- Read, write, or read/write
- Access to a specific slave device through direct addressing, or access to multiple slave devices through logical addressing

8-1-3 Terminology of EtherCAT

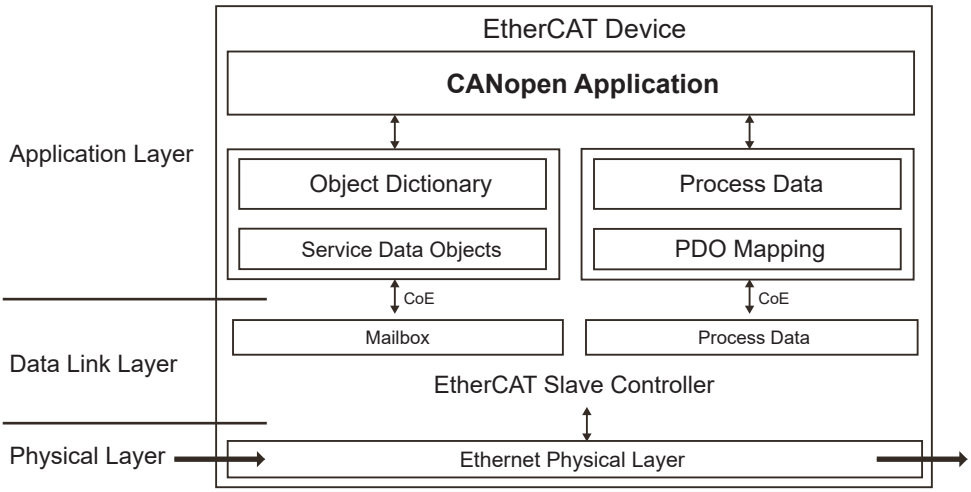
The following are the terms used in EtherCAT.

Abbreviation	Description
100Base-Tx	100 Mbit/s Twisted-Pair Ethernet
AL	Application Layer
CAN	Controller Area Network
CANopen	CAN Bus Application Layer Protocol
CoE	CANopen over EtherCAT
CiA	CAN in Automation
DC	Distributed Clock, synchronize EtherCAT master and slaves
DL	Data Link Layer
EMCY	Emergency Object
ESC	EtherCAT Slave Controller
ESI	EtherCAT Slave Information
ESM	EtherCAT State Machine
ETG	EtherCAT Technology Group
INIT	EtherCAT State Machine: Initialization State
OP	EtherCAT State Machine: Operational State
OD	Object Dictionary
PDO	Process Data Object
PDS	Power Drive Systems
PREOP	EtherCAT State Machine: Pre-Operational State
RxPDO	Receive PDO
SAFEOP	EtherCAT State Machine: Safe-Operational State
SDO	Service Data Object
TxPDO	Transmit PDO
XML	Extensible Markup Language - for ESI files

8-2 Basics of EtherCAT Communications

8-2-1 CANopen over EtherCAT Reference Model

The CANopen over EtherCAT (CoE) network reference model mainly consists of the data link layer and the application layer. The data link layer is mainly responsible for the EtherCAT communication protocol, and the application layer is embedded with the CiA402 motion control protocol. The CoE network reference model of EtherCAT device is Shown below:



The application layer object dictionary contains parameters, application data, process data interfaces, and PDO mapping information for the drive applications. The process data object (PDO) consists of the object dictionary that can be used for PDO mapping. The contents of the process data are defined by the PDO mapping. Process data communications cyclically read and write the PDO. Mailbox communications (SDO) are asynchronous message communications where all objects in the object dictionary can be read and written.

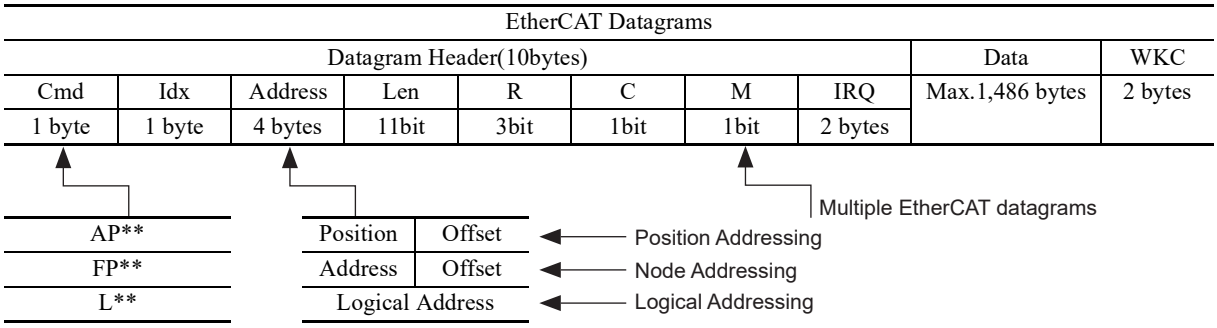
8-2-2 EtherCAT Frame Structure

In an EtherCAT network, the data used for communication between the master and slave devices is directly embedded within standard Ethernet frames for transmission. Since the EtherType of the Ethernet Header is 0x88A4, the subsequent Ethernet Data is processed as an EtherCAT frame. An EtherCAT frame consists of an EtherCAT frame header and one or more EtherCAT datagrams. Only EtherCAT frames with Type=1 in the EtherCAT frame header are processed by the ESC.

Ethernet Header(14bytes)			EtherCAT Data				FSC
Destination	Source	EtherType(88A4h)	EtherCAT Header			EtherCAT Datagrams	FSC
			Length	Res.	Type		
6 bytes	6 bytes	2 bytes	11bit	1bit	4bit	44 to 1,498 bytes	4 bytes

1

EtherCAT Datagrams			
1st EtherCAT Datagram	2nd EtherCAT Datagram	. . .	nth EtherCAT Datagram

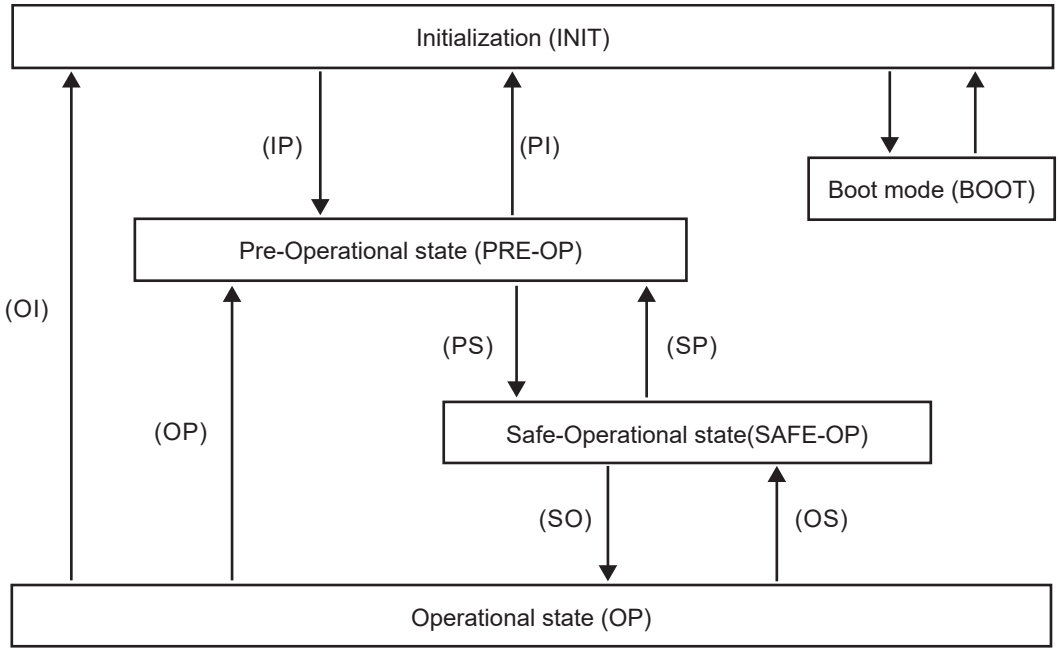


● Cmd Details

Addressing mode	Cmd	Abbreviation	Name	Description
---	00h	NOP	No operation	No operation is performed.
Position Addressing	01h	APRD	Auto increment physical read	Each slave increments the Address, and performs a read operation when receiving a frame with an Address value of 0.
	02h	APWR	Auto increment physical write	Each slave increments the Address, and performs a write operation when receiving a frame with an Address value of 0.
	03h	APRW	Auto increment physical read write	Each slave increments the Address, and performs read and write operations when receiving a frame with an Address value of 0.
Node Addressing	04h	FPRD	configured address physical read	Each slave performs a read operation when its Address value matches the Station Address.
	05h	FPWR	configured address physical write	Each slave performs a write operation when its Address value matches the Station Address.
	06h	FPRW	configured address physical read write	Each slave performs read and write operations when its Address value matches the Station Address.
---	07h	BRD	Broadcast read	All slaves perform read operations.
	08h	BWR	Broadcast write	All slaves perform write operations.
	09h	BRW	Broadcast read write	All slaves perform read and write operations.
Logical Addressing	0Ah	LRD	Logical read	Each slave performs a read operation when its Logical Address value matches the logical memory area specified by FMMU request.
	0Bh	LWR	Logical write	Each slave performs a write operation when its Logical Address value matches the logical memory area specified by FMMU request.
	0Ch	LRW	Logical read write	Each slave performs read and write operations when its Logical Address value matches the logical memory area specified by FMMU request.
Position Addressing	0Dh	ARMW	Positional physical read/multiple write	Each slave increments the Address. Slaves that have received a frame with an Address value of 0 perform read operations, while all other slaves perform write operations.
Node Addressing	0Eh	FRMW	Configured address physical read/multiple write	Each slave compares its Address value with the Station Address. Slaves with matching values perform read operations, while all other slaves perform write operations.
---	0Fh to FFh	---	Reserved	---

8-2-3 EtherCAT State Machine

The EtherCAT State Machine (ESM) is used to describe the states of slave applications and the state switching. The state machine of an EtherCAT slave application is controlled by the EtherCAT master. To switch from the Initialization state to the Operational state, the device goes through the states in the order of Pre-Op → Safe-Op → Op. From the Operational state, the device can directly switch to other states.

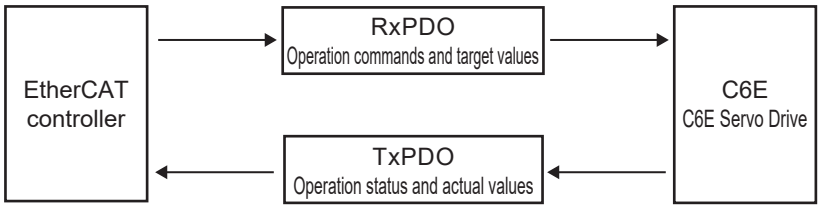


EtherCAT State Machine

ESM status	Communication action			Description
	SDO(Mailbox)	Transmit PDO	Receive PDO	
	Transmit and receive	Slave to Master	Master to Slave	
Initialization	Not supported	Not supported	Not supported	Communication module is initializing, rendering communication impossible
Pre-Operational	Supported	Not supported	Not supported	Only SDO communication is possible. After communication initialization is complete, the slave enters this state, and network initialization settings are implemented.
Safe-Operational	Supported	Supported	Not supported	SDO and PDO transmit communications are possible, and PDOs are used to send feedback on Servo Drive status.
Operational	Supported	Supported	Supported	Normal operating state, enabling all communications
Boot mode	Not supported	Not supported	Not supported	Not used

8-2-4 Process Data Object (PDO)

Process Data Object (PDO) is used for cyclic data exchange between the master and slave devices. PDOs consist of RxPDO that enables a drive to receive data from the controller and TxPDO that allows a drive to send data to the controller. The content of process data is recorded in PDO mapping objects and PDO assignment objects. The Servo Drive uses the Sync Manager SM2 (0x1C12) to map RxPDO data, and uses the Sync Manager SM3 (0x1C13) to map TxPDO data.



(Note) Do not use SDO to update objects that are updated through PDO.

PDO Mapping Object

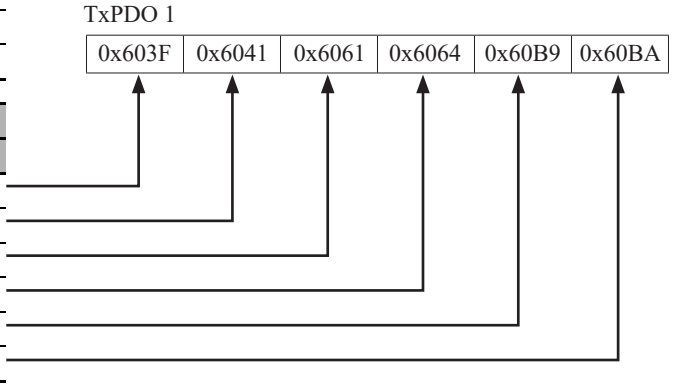
PDO mapping refers to the mapping of application objects from the object dictionary to the PDO. Mapping objects 0x1600 to 0x1603 and 0x1A00 to 0x1A03 store the mapping tables for RxPDO and TxPDO, respectively. The maximum number of application objects that can be mapped by a mapping object is shown in the table below:

Maximum PDO data length	1 RxPDO: 12 application objects; 4 RxPDOs: 68 bytes
	1 TxPDO: 12 application objects; 4 TxPDOs: 68 bytes

Example of PDO mapping: Assign application objects 0x603F, 0x6041, 0x6061, 0x6064, 0x60B9, and 0x60BA to mapping object 0x1A00 (TxPDO 1)

Mapping object		Object description		
Index	Subindex	Index	Subindex	Data length
0x1A00	0	0x06		
	1	0x603F	0x00	0x10
	2	0x6041	0x00	0x10
	3	0x6061	0x00	0x08
	4	0x6064	0x00	0x20
	5	0x60B9	0x00	0x10
	6	0x60BA	0x00	0x20

Application objects		
Index	Subindex	Name
0x603F	0x00	Error code
0x6041	0x00	Statusword
0x6061	0x00	Modes of operation display
0x6064	0x00	Position feedback
0x60B9	0x00	Touch probe status
0x60BA	0x00	Touch probe pos1 pos feedback



(Note) 1. PDO mapping objects can be changed only when the EtherCAT communications state is Pre-Operational.
2. Since changed content cannot be saved in non-volatile memory, be sure to reconfigure the mapping objects after each power-on of the drive. Otherwise, the mapping objects will be the drive's default parameters.

PDO Assignment Object

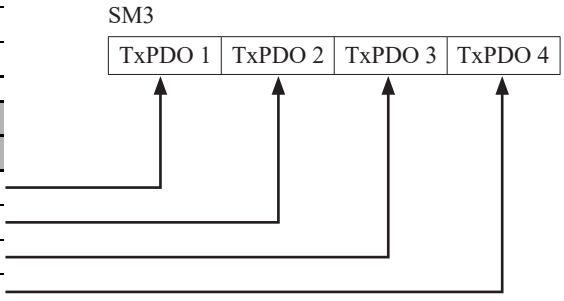
The Sync Manager can consist of multiple PDOs, and Sync-Manager PDO assignment object describes the relationship between the PDO and the Sync Manager. C6E-series Servo Drives use the Sync Manager SM2 (0x1C12) to map RxPDO data, and use the Sync Manager SM3 (0x1C13) to map TxPDO data.
The maximum number of mapping objects that can be assigned by an assignment object is shown in the table below:

Maximum number of PDO assignments	RxPDO: 4
	TxPDO: 4

Example on how to set a PDO assignment object of Sync Manager: Assign mapping objects 0x1A00, 0x1A01, 0x1A02, and 0x1A03 to assignment object 0x1C13 (SM3)

Assignment object		Object description
Index	Subindex	
0x1C13	0	0x04
	1	0x1A00
	2	0x1A01
	3	0x1A02
	4	0x1A03

Mapping object	
Index	Name
0x1A00	TxPDO 1
0x1A01	TxPDO 2
0x1A02	TxPDO 3
0x1A03	TxPDO 4



(Note) 1. PDO mapping objects can be changed only when the EtherCAT communications state is Pre-Operational.
2. Since changed content cannot be saved in non-volatile memory, be sure to reconfigure the mapping objects after each power-on of the drive. Otherwise, the mapping objects will be the drive's default parameters.

Steps for PDO Mapping

To configure PDO mapping using SDO mailbox data, follow the steps below:

1 Switch the ESM state to the Pre-Operational state

2 Disable the PDO assignment function
Set the subindex 0 of 0x1C12 and 0x1C13 to 0

3 Disable the PDO mapping function
Set the subindex 0 of 0x1600 to 0x1603 and 0x1A00 to 0x1A03 to 0

4 Configure the mapping entries for PDO mapping objects 0x1600 to 0x1603 and 0x1A00 to 0x1A03

5 Set the values of the mapping entries (subindex 0) for PDO mapping objects 0x1600 to 0x1603 and 0x1A00 to 0x1A03

6 Configure the mapping entries for PDO assignment objects 0x1C12 and 0x1C13

7 Enable the PDO assignment function
Set the values of the mapping entries (subindex 0) for 0x1C12 and 0x1C13

8-2-5 SDO Mailbox Data

SDO data is non-periodic communication data. The master uses the SM channels for reading and writing mailbox data to achieve non-periodic data exchange. The master can configure objects or monitor their status by reading and writing data in the records in the object dictionary.
The table below lists the abort codes for SDO communication failures:

Value (Hex)	Description	Value (Hex)	Description
05030000	Toggle bit not changed	06070010	Data type does not match, length of service parameter does not match
05040000	SDO protocol timeout	06070012	Data type does not match, length of service parameter too high
05040001	Client/Server command specifier not valid or unknown	06070013	Data type does not match, length of service parameter too low
05040005	Out of memory	06090011	Subindex does not exist
06010000	Unsupported access to an object	06090030	Value range of parameter exceeded (only for write access)
06010001	Attempt to read from a write only object	06090031	Value of parameter written too high
06010002	Attempt to write to a read only object	06090032	Value of parameter written too low
06010003	Subindex cannot be written, SI0 must be 0 for write access	06090036	Maximum value is less than minimum value
06020000	The object does not exist in the object directory	08000000	General error
06040041	The object can not be mapped into the PDO	08000020	Data cannot be transferred or stored to the application
06040042	The number and length of the objects to be mapped would exceed the PDO length	08000021	Data cannot be transferred or stored to the application because of local control
06040043	General parameter incompatibility reason	08000022	Data cannot be transferred or stored to the application because of the present device state
06040047	General internal incompatibility in the device	08000023	Object dictionary dynamic generation fails or no object dictionary is present
06060000	Access failed due to a hardware error		

8-2-6 Emergency Message

Emergency message is sent from the slave to the master via the Mailbox communication when an error alarm occurs in the slave.
The structure of an emergency message is as follows:

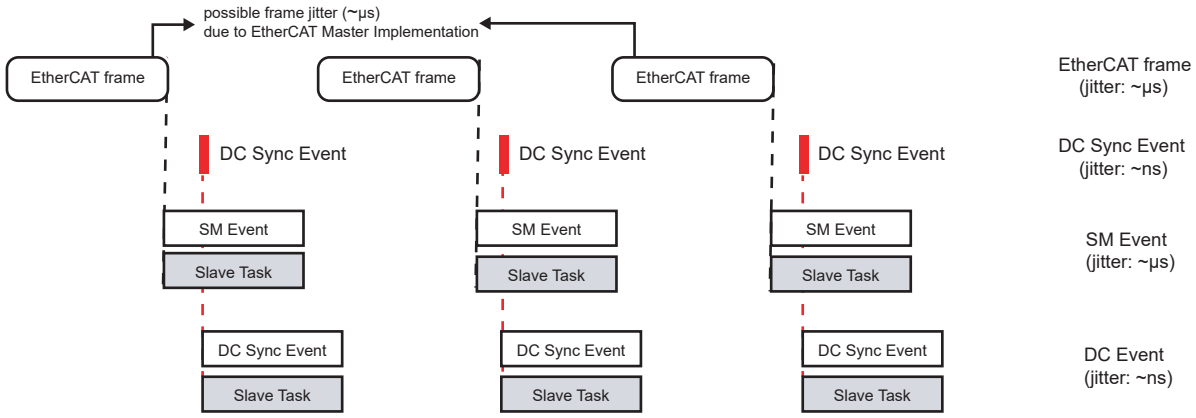
Standard data frame header		Standard CANopen emergency message		
Mailbox Header	CoE Header	ErrorCode	Error Register	Data
6 bytes	2 bytes	2 bytes	1 byte	5 bytes

Byte	0	1	2	3	4	5	6	7
Data	Emergency ErrorCode		Error Register	Reserved	Manufacturer Specific Error Field			
			0x1001		Fault/Warning Code		Reserved	

8-2-7 Distributed Clock

In an EtherCAT network, the clock of the first node serves as the reference clock for the entire network. The reference clock provides system time to the network, and the distributed clocks of the slave devices are all synchronized with it. Distributed clocks enable the synchronization of the local applications of slaves with the synchronization events of the reference clock.
The C6E-series supports the following synchronization modes

Synchronization mode	Details	Synchronization method	Characteristics
SM	SM2 event synchronization	Synchronization based on RxPDO reception time	Low accuracy, no transmission delay compensation; transmission time must be maintained on the drive side
DC	SYNC0 time event synchronization	Time of the first node serves as the reference to synchronize the time information of other nodes	High accuracy Compensation must be performed on the master side



● SM Event Synchronization Mode (SM)

The slave synchronizes with the SM2 event. The SM event will be triggered once an EtherCAT data frame is received.
(Note) The SM mode of C6E-series only supports PP, PV, TQ, and HM operation modes.

● DC Synchronization Mode (SYNC0 Synchronization)

The master synchronizes its time with all slaves, and the slaves receive data transmitted by the master in the same time interval.
The setting range of synchronization cycle is as follows:
3 kW or less Servo Drives: 125 µs, 250 µs, 500 µs, 1 to 20 ms (an interval of 500 µs)
3 kW or more Servo Drives: 500 µs, 1 to 20 ms (an interval of 500 µs)

8-2-8 EtherCAT Slave Address Settings

In an EtherCAT network, the node address of C6E-series Servo Drives can be configured in two ways: automatic assignment by the controller and manual configuration. Duplicate node addresses are not permitted within the same network.

Automatic Assignment by Master (Default)

For controllers that automatically assign slave node addresses, the assignment of drive-side node IDs must be set to "Automatic Assignment by Master". Set the value of parameter P1-18 to 1 via the Servo Drive configuration software Sysmac Studio or the operation panel.
Follow the steps below to use Sysmac Studio to configure the node address to be automatically assigned by the master:

1. Establish communication with the drive using Sysmac Studio
2. Open the parameter list
3. Set P1-18 to 1: automatic assignment by master
4. Click "Transfer to Drive Option" to download the parameters to the drive
5. Power off and restart the drive
6. Assign ECT addresses in the master's ECT configuration window

Manual configuration

For controllers that cannot assign slave node addresses, manual configuration is required on the drive side, which can be done by modifying parameters P1-17 and P1-18 via the Servo Drive configuration software Sysmac Studio or the operation panel.
Follow the steps below to use Sysmac Studio to configure the node address:

1. Establish communication with the drive using Sysmac Studio
2. Open the parameter list
3. Set P1-18 to 0: Use the Servo Drive configuration software Sysmac Studio to set P1-17 to the desired node address value
4. Click "Transfer to Drive Option" to download the parameters to the drive
5. Power off and restart the drive

- Instructions for setting node addresses using operation panel:

  Modify the value of parameter P1-17 to the desired node address value, and modify the value of parameter P1-18 to 0. After completing and saving the parameter settings, power off and restart the drive.

8-2-9 ESI Files

ESI files are XML files that record information about EtherCAT slave devices. The master identifies slave devices on the network based on the ESI file, so the ESI file must be saved in the folder specified by the master before use. ESI files for Omron's EtherCAT drives can be downloaded from the Omron website or requested from relevant technical personnel.

9

Motion Control Modes

This section explains the PDS state control, modes of operation, Profile position mode, Profile velocity mode, Profile torque mode, and Cyclic synchronous position mode, etc. of the Servo Drive.

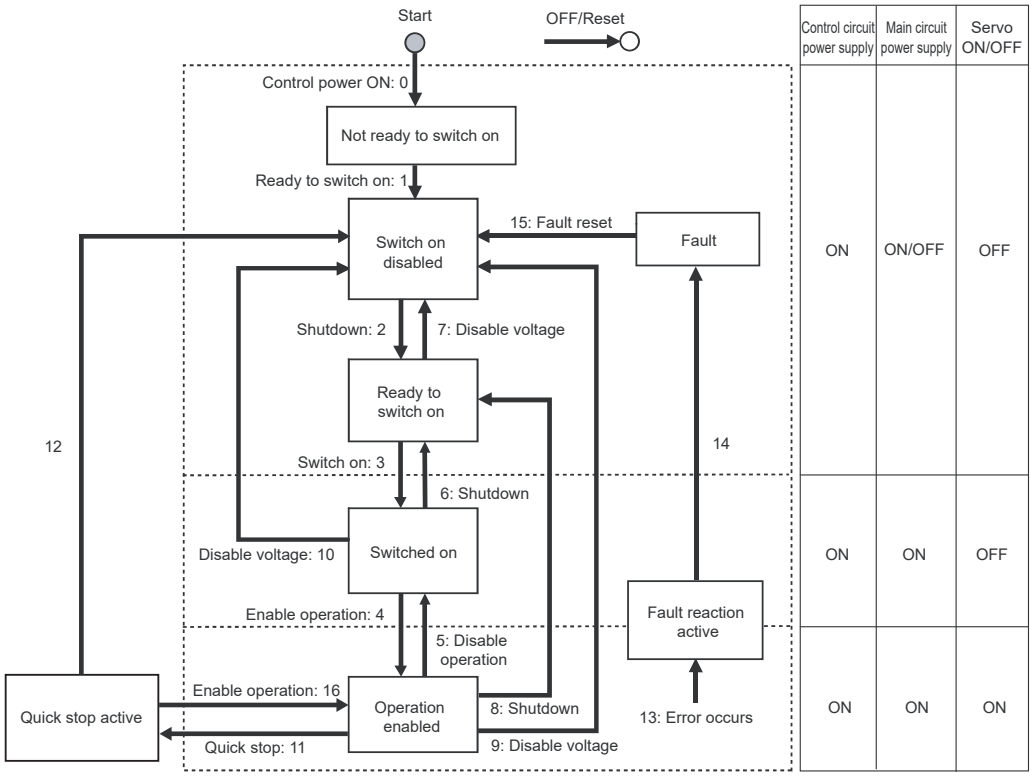
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9-1 PDS State Control of Servo Drive

In the C6E-series Servo Drives, PDS state refers to the state of Power Drive Systems. The PDS state can be modified via Controlword 0x6040 and displayed via Statusword 0x6041. The state of C6E-series Servo Drives shall perform state transitions according to the procedures specified in the CiA402 standard protocol, i.e. the command for switching to the next state shall only be transmitted after completion of the previous state change confirmed via 0x6041.

9-1-1 State Transition Sequence



PDS State Descriptions

State	Description
Not ready to switch on	Initialization is in progress after the control circuit power supply is turned on. Drive parameters cannot be set.
Switch on disabled	It is possible to set the Servo Drive parameters. Drive parameters can be set.
Ready to switch on	The main circuit power supply can be turned on at any time. Drive parameters can be set.
Switched on	Main circuit power supply is turned on. Drive parameters can be set.
Operation enabled	Servo is turned on. Drive parameters can be set.
Quick stop active	The quick stop function is activated, and quick stop is in progress. Drive parameters can be set.
Fault reaction active	An error occurs in the Servo Drive, and error stop is in progress.

State	Description
Fault	Error stop is completed. Drive parameters can be set.

9-1-2 State Control Commands

The PDS state is controlled by the combination of bits of Controlword 0x6040 in the table below.

CiA402 state transition		Controlword 0x6040	Bit 0 to 9 of Statusword 0x6041
0	Power on → Not ready to switch on	Natural transition, no control commands required.	0x0000
1	Not ready to switch on → Switch on disabled	Natural transition, no control commands required. If an initialization error occurs, the drive proceed directly to step 13.	0x0250
2	Switch on disabled → Ready to switch on	0x0006	0x0231
3	Ready to switch on → Switched on	0x0007	0x0233
4	Switched on → Operation enabled	0x000F	0x0237
5	Operation enabled → Switched on	0x0007	0x0233
6	Switched on → Ready to switch on	0x0006	0x0231
7	Ready to switch on → Switch on disabled	0x0000	0x0250
8	Operation enabled → Ready to switch on	0x0006	0x0231
9	Operation enabled → Switch on disabled	0x0000	0x0250
10	Switched on → Switch on disabled	0x0000	0x0250
11	Operation enabled → Quick stop active	0x0002	0x0217
12	Quick stop active → Switch on disabled	When the Quickstop option code 0x605A is set to 0 to 2, the state transitions naturally and no control commands are required.	0x0250
13	→ Fault reaction active	In any state other than the "Fault" state, if the Servo Drive reports an error, it will automatically transition to the fault handling state, and no control commands are required.	0x020F
14	Fault reaction active → Fault	After the fault handling is completed, the state transitions automatically and no control commands are required.	0x0208
15	Fault → Switch on disabled	0x80, bit7: 0 → 1	0x0250
16	Quick stop active → Operation enabled	Select 5 to 7 for the Quickstop option code 0x605A, and send 0x000F after the stop is completed.	0x0237

(Note) Bit 10 to 15 of Statusword 0x6041 are related to servo control modes and are all represented by "0" in the table above. For the specific status of each bit, refer to the corresponding servo control mode.

Bit Combination of PDS State Change Command 0x6040

Command	Controlword 0x6040					State transition
	Bit 7 (fr)	Bit 3 (eo)	Bit 2 (qs)	Bit 1 (ev)	Bit 0 (so)	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3+4
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	0 → 1	X	X	X	X	15

Symbol explanation:

X: Indicates that this bit does not affect the PDS state transition at this time. Normally, just write "0".

so: switch on qs: quick stop fr: fault reset

ev: enable voltage eo: enable operation

Bit Combination of PDS State Display 0x6041

State	Statusword 0x6041						
	Bit 6 (sod)	Bit 5 (qs)	Bit 4 (ve)	Bit 3 (f)	Bit 2 (oe)	Bit 1 (so)	Bit 0 (rtso)
Not ready to switch on	0	X	X	0	0	0	0
Switch on disabled	1	X	X	0	0	0	0
Ready to switch on	0	1	X	0	0	0	1
Switched on	0	1	X	0	0	1	1
Operation enabled	0	1	X	0	1	1	1
Quick stop active	0	0	X	0	1	1	1
Fault reaction active	0	X	X	1	1	1	1
Fault	0	X	X	1	0	0	0

Symbol explanation:

X: Indicates that this bit does not affect the PDO state.

rtso: ready to switch on ve: voltage enabled

so: switched on qs: quick stop

oe: operation enabled sod: switch on disabled

f: fault

9-2 Modes of Operation

The modes of operation supported by C6E-series Servo Drives are shown in the table below.

Modes of operation	Abbreviation
Profile Position Mode	PP
Profile Velocity Mode	PV
Profile Torque Mode	TQ
Cyclic Synchronous Position Mode	CSP
Cyclic Synchronous Velocity Mode	CSV
Cyclic Synchronous Torque Mode	CST
Homing Mode	HM

9-2-1 Modes of Operation Writing

The modes of operation of the Servo Drive are set by 0x6060. The correspondence between the modes of operation and the parameters of 0x6060 is shown in the table below.

0x6060	
Modes of operation	Value
PP	1
PV	3
TQ	4
CSP	8
CSV	9
CST	10
HM	6

(Note) The default value of 0x6060 is 0. After the drive control power supply is turned ON, make sure to set the value for the mode of operation to be used.

9-2-2 Modes of Operation Reading

The modes of operation of the Servo Drive are confirmed by reading the value of 0x6061. The correspondence between the modes of operation and the parameters of 0x6061 is shown in the table below.

0x6061	
Modes of operation	Value
PP	1
PV	3
TQ	4
CSP	8
CSV	9
CST	10
HM	6

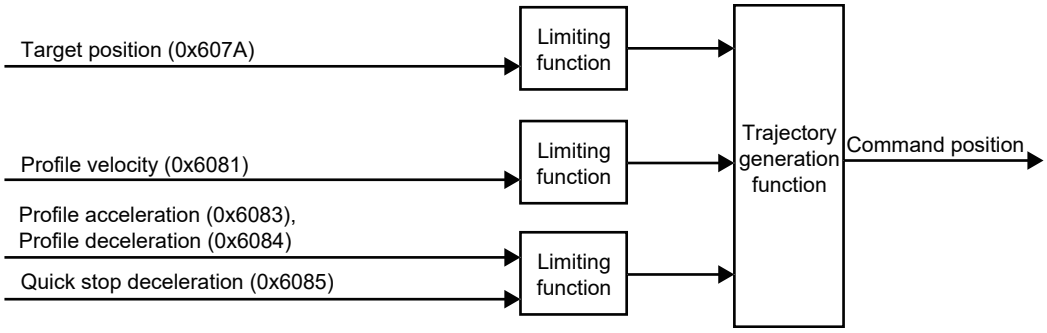
9-2-3 Precautions for Switching Modes of Operation

- Switching the modes of operation is prohibited while the motor is running.
- When switching the modes of operation, first update the objects in the RxPDO related to the Modes of operation (0x6060).
- It takes a certain amount of time to complete switching between the modes of operation. During this process, the values of 0x6061 and objects within TxPDOs related to the modes of operation are undefined.
- In a changed mode of operation, the values of unsupported objects are undefined.
- An error will occur when setting a mode of operation unsupported by the drive.

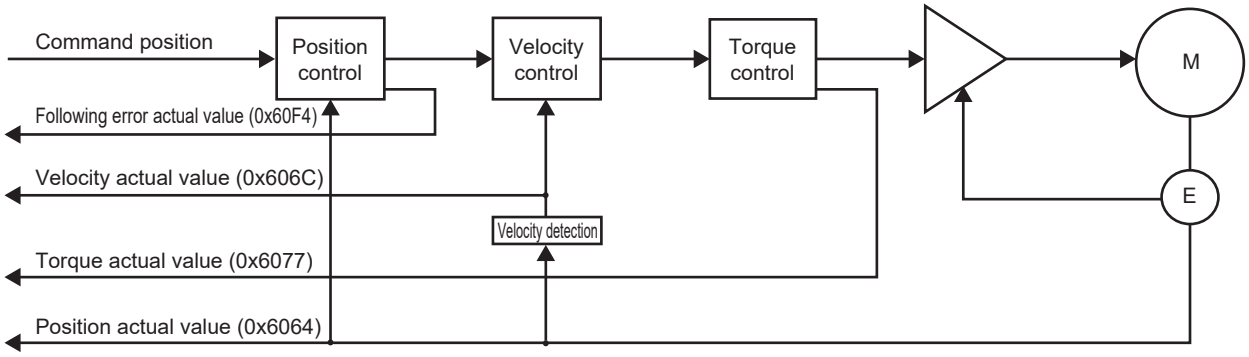
9-3 Profile Position Mode

In the Profile Position mode, the servo drive generates a motion trajectory based on the acceleration, deceleration, velocity and target position set by the host controller, and controls the motor to perform relative or absolute point-to-point motion along this trajectory. To enable the Profile Position mode, set object 0x6060 to 1.

Structure of Motion Trajectory Generation Function



Configuration of Profile Position Mode



9-3-1 Profile Position Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605D		Halt option code	RW	INTEGER16	---	1 to 3	1	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x607A		Target position	RW	INTEGER32	Pulses	-(2^{31}-1) to 2^{31}-1	0	RxPDO
0x6081		Profile velocity	RW	UNSIGNED32	Pulses/s	0 to 135*OD 0x2A90	5*OD 0x2A90	RxPDO
0x6083		Profile acceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)*OD 0x2A90	100*OD 0x2A90	RxPDO
0x6084		Profile deceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)*OD 0x2A90	100*OD 0x2A90	RxPDO
0x6085		Quick stop deceleration	RW	UNSIGNED32	100 Pulses/s^2	(0.00167 to 54.61)* OD 0x2A90	30*OD 0x2A90	NO
0x60F4		Following error actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x2AB1	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

9-3-2 Controlword Settings

In the Profile Position mode, the meaning of each bit of Controlword 0x6040 is shown in the table below, where the dark-marked bits of the Controlword are to be used in this mode.

15 ··· 10	9	8	7	6	5	4	3	2	1	0
Reserved	Change of set point	Halt	Fault reset	Abs/rel	Change set immediately	New set point	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick stop	0	Enabled
		1	Disabled
3	Enable operation	0	Disabled
		1	Enabled
4	New set point	0 → 1	1. Start the positioning 2. Activate the change of set point (0x607A, 0x6081, 0x6083, 0x6084)
5	Change set immediately	0	Perform the next positioning operation after completing the current positioning operation.
		1	Interrupt the current positioning operation, and start the next positioning operation immediately.
6	Abs/rel	0	Perform the positioning with 0x607A as an absolute position
		1	Perform the positioning with 0x607A as a relative position
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Disabled
		1	Perform the stop operation according to the Halt option code set by 0x605D.
9	Change of set point	0	Disabled
		1	Set point changed
10 to 15	Reserved	0	Reserved, keep as "0"

9-3-3 Statusword Definition

In the Profile position mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Reserved	Set point acknowledge	Internal limit active	Target reached	Remote	Reserved

Bit	Name		Value	Description
0	Ready to Switch on		0	Disabled
			1	Enabled
1	Switched on	Switched on	0	Disabled
			1	Enabled
2	Operation enabled	Operation enabled	0	Disabled
			1	Enabled
3	Fault		0	No fault
			1	Fault
4	Voltage enabled		0	Disabled
			1	Enabled
5	Quick stop		0	Quick stop enabled
			1	Quick stop disabled
6	Switch on disabled		0	Disabled
			1	Enabled
7	Warning		0	No warning
			1	Warning
8	Reserved		0	Reserved, keep as "0"
9	Remote		0	Disabled
			1	Controlword control enabled
10	Target reached		0	Controlword bit8=0, positioning not completed; Controlword bit8=1, decelerating
			1	Controlword bit8=0, positioning completed; Controlword bit8=1, velocity is 0
11	Internal limit active		0	Digital input limit not activated
			1	Digital input limit activated
12	Set point acknowledge		0	New set-point change enabled
			1	New set point changed
13	Reserved		0	Reserved, keep as "0"
14	Reserved		0	Reserved, keep as "0"
15	Reserved		0	Reserved, keep as "0"

9-3-4 Function Parameters Setting

See the table below for the settings of conditions for position reached, dynamic following error, target reached, etc. and the following error thresholds.

Index	Subindex	Name	Description
0x2A14	---	Reached position	When the absolute value of the difference between the position actual value and the set value does not exceed 100 pulses, the position reached signal is valid.
0x2A15	0x01	Dynamic following error threshold	When the absolute value of the position deviation is within the set value, the dynamic error following signal is valid.
	0x02	Time constant of motion output condition	When the absolute value of the position deviation is within the in-position output threshold and the duration reaches the time set by subindex 2 of 0x2A15, the target reached signal is valid and bit 10 of Statusword 0x6041 is 1.
	0x03	In-position output threshold	
0x2AA8	---	Following error threshold	When the absolute value of the position deviation exceeds the set value, the drive will trigger the position following error fault; When the set value is 0, the position following error detection is disabled.

9-3-5 Function Examples

● Enable the Profile Position Mode

The controller writes 1 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Profile Position mode.

● Enable the Motor

The controller sequentially writes 0x06, 0x07 and 0x0F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

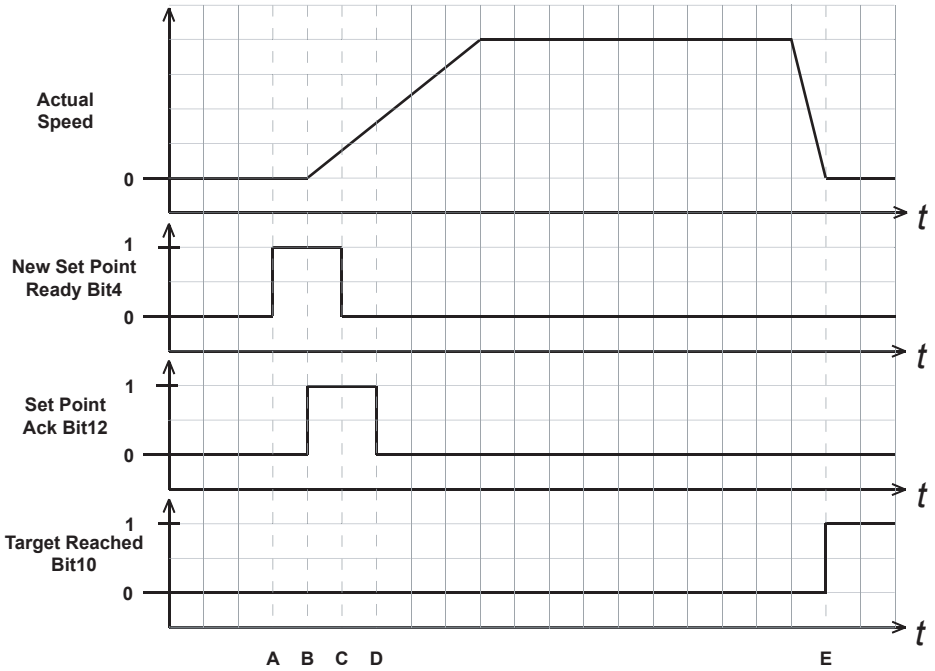
● Set the Operation Parameters

Depending on the application, the controller writes parameters such as target position, velocity, acceleration, and deceleration to 0x607A, 0x6081, 0x6083 and 0x6084 respectively.

● Start/Stop Operation

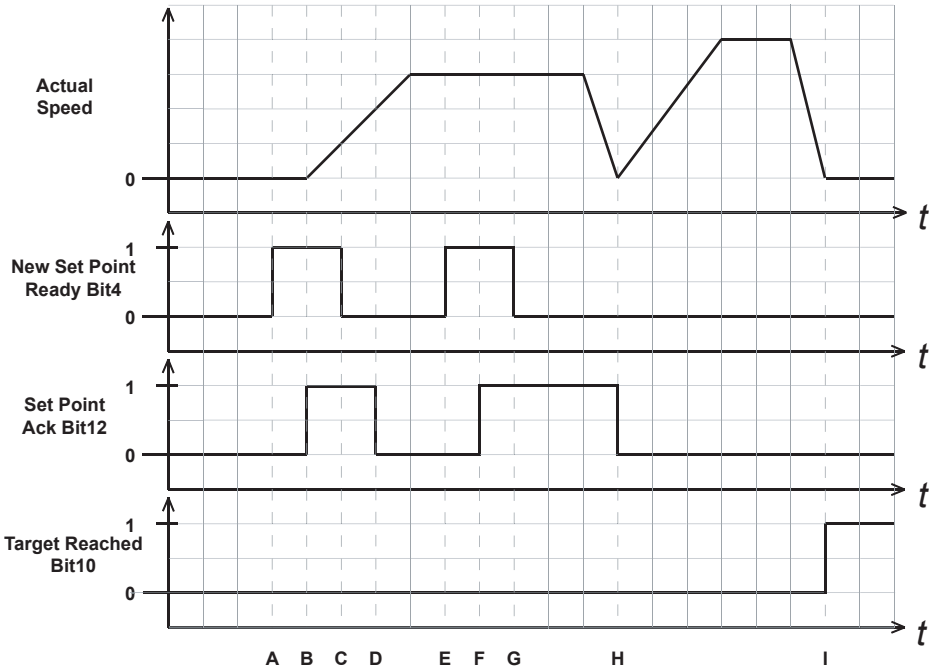
Depending on the application, select either relative or absolute positioning. Set bit 6 of 0x6040 to 0 for absolute positioning and to 1 for relative positioning. Send corresponding commands based on different operation types. For specific commands, refer to the following Sections.

Single-step Motion



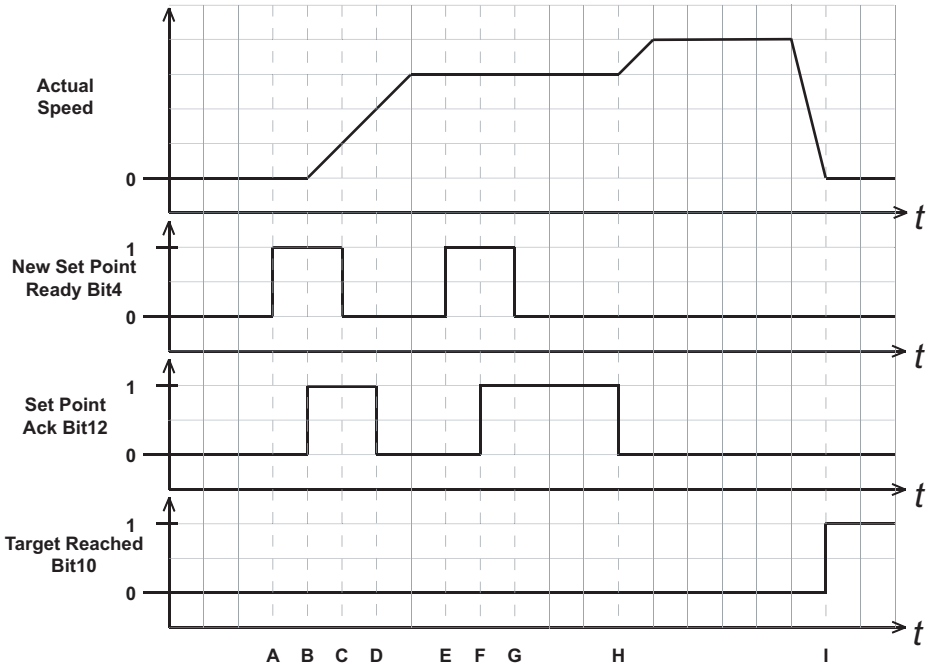
Graph point	Controlword (0x6040)			Statusword (0x6041)		Description
	New set point (bit4)	Change set immediately (bit5)	Change of set point (bit9)	Set point acknowledge (bit12)	Target reached (bit10)	
Start	0	0	0	0	0	Wait for trigger signal to execute action
A	0 → 1	0	0	0	0	Trigger the generation of motion trajectory
B	1	0	0	0 → 1	0	Motion trajectory has been generated, starting to execute action
C	1 → 0	0	0	1	0	Reset the motion trajectory generation trigger bit
D	0	0	0	1 → 0	0	The motion trajectory generation trigger bit has been reset, and a new motion trajectory can be generated.
E	0	0	0	0	1	Positioning completed

Multi-step Motion with Intermediate Stops



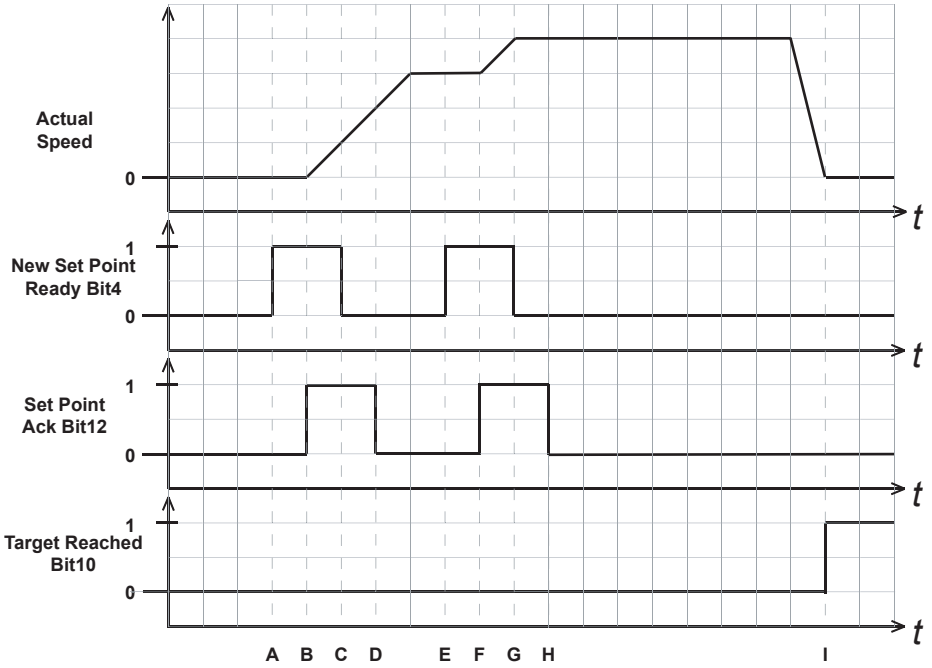
Graph point	Controlword (0x6040)			Statusword (0x6041)		Description
	New set point (bit4)	Change set immediately (bit5)	Change of set point (bit9)	Set point acknowledge (bit12)	Target reached (bit10)	
Start	0	0	0	0	0	Wait for trigger signal to execute action
A	0 → 1	0	0	0	0	Trigger the generation of motion trajectory
B	1	0	0	0 → 1	0	Motion trajectory has been generated, starting to execute action
C	1 → 0	0	0	1	0	Reset the motion trajectory generation trigger bit
D	0	0	0	1 → 0	0	The motion trajectory generation trigger bit has been reset, and a new motion trajectory can be generated.
E	0 → 1	0	0	0	0	Trigger the generation of a new motion trajectory
F	1	0	0	0 → 1	0	A new motion trajectory has been generated and buffered, waiting for execution after the current motion trajectory is executed.
G	1 → 0	0	0	1	0	Reset the motion trajectory generation trigger bit
H	0	0	0	1 → 0	0	The current motion trajectory has been executed. The motor will first decelerate to 0, and then start executing the buffered motion trajectory.
I	0	0	0	0	1	The cached motion trajectory has been executed, and the target is reached.

Multi-step Motion with Continuous Intermediate Motion



Graph point	Controlword (0x6040)			Statusword (0x6041)		Description
	New set point (bit4)	Change set immediately (bit5)	Change of set point (bit9)	Set point acknowledge (bit12)	Target reached (bit10)	
Start	0	0	1	0	0	Wait for trigger signal to execute action
A	0 → 1	0	1	0	0	Trigger the generation of motion trajectory
B	1	0	1	0 → 1	0	Motion trajectory has been generated, starting to execute action
C	1 → 0	0	1	1	0	Reset the motion trajectory generation trigger bit
D	0	0	1	1 → 0	0	The motion trajectory generation trigger bit has been reset, and a new motion trajectory can be generated.
E	0 → 1	0	1	0	0	Trigger the generation of a new motion trajectory
F	1	0	1	0 → 1	0	A new motion trajectory has been generated and buffered, waiting for execution after the current motion trajectory is executed.
G	1 → 0	0	1	1	0	Reset the motion trajectory generation trigger bit
H	0	0	1	1 → 0	0	The current motion trajectory has been executed, and the motor will continue executing the buffered motion trajectory without stopping.
I	0	0	1	0	1	The cached motion trajectory has been executed, and the target is reached.

Continuous Operation with Immediate Change of Motion Trajectory

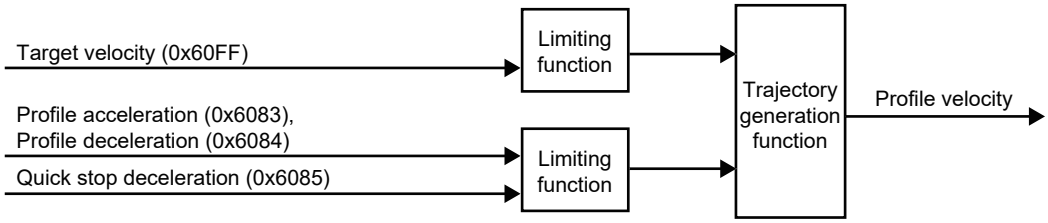


Graph point	Controlword (0x6040)			Statusword (0x6041)		Description
	New set point (bit4)	Change set immediately (bit5)	Change of set point (bit9)	Set point acknowledge (bit12)	Target reached (bit10)	
Start	0	1	X	0	0	Wait for trigger signal to execute action
A	0 → 1	1	X	0	0	Trigger the generation of motion trajectory
B	1	1	X	0 → 1	0	Motion trajectory has been generated, starting to execute action
C	1 → 0	1	X	1	0	Reset the motion trajectory generation trigger bit
D	0	1	X	1 → 0	0	The motion trajectory generation trigger bit has been reset, and a new motion trajectory can be generated.
E	0 → 1	1	X	0	0	Trigger the generation of a new motion trajectory
F	1	1	X	0 → 1	0	A new motion trajectory has been generated. The ongoing operation is interrupted, and the motor immediately starts executing the new motion trajectory without stopping.
G	1 → 0	1	X	1	0	Reset the motion trajectory generation trigger bit
H	0	1	X	1 → 0	0	The motion trajectory generation trigger bit has been reset, and a new motion trajectory can be generated.
I	0	1	X	0	1	Positioning completed

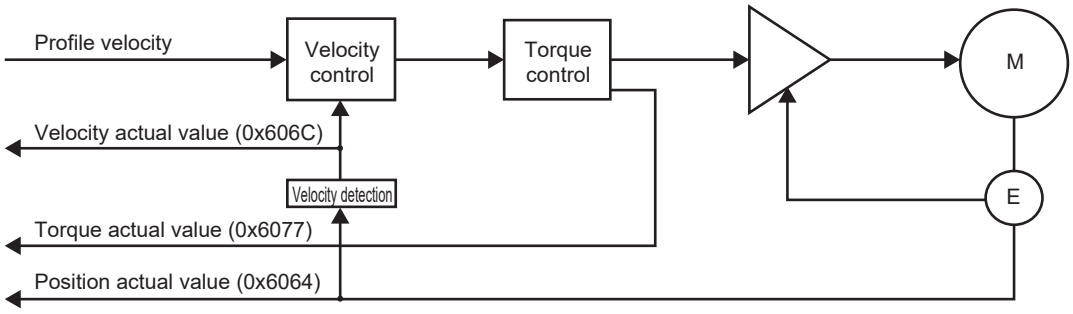
9-4 Profile Velocity Mode

In the Profile velocity mode, the Servo Drive generates a motion trajectory according to the acceleration, deceleration and velocity set by the host controller, and commands the motor to follow this trajectory. Set object 0x6060 = 3 to enable Profile Velocity Mode.

Structure of Motion Trajectory Generation Function



Configuration of Profile Velocity Mode



9-4-1 Profile Velocity Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605D		Halt option code	RW	INTEGER16	---	1 to 3	1	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6083		Profile acceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)*OD 0x2A90	100*OD 0x2A90	RxPDO
0x6084		Profile deceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)*OD 0x2A90	100*OD 0x2A90	RxPDO
0x6085		Quick stop deceleration	RW	UNSIGNED32	100 Pulses/s^2	(0.00167 to 54.61)* OD 0x2A90	30*OD 0x2A90	NO
0x60FF		Target velocity	RW	INTEGER32	Pulses/s	-2^{31} to 2^{31}-1	0	RxPDO
0x2AB1	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to "*A-4 List of Maximum Torque Parameters* (P.A-14)".

9-4-2 Controlword Settings

In the Profile velocity mode, the meaning of each bit of Controlword 0x6040 is shown in the table below, where the dark-marked bits of the Controlword are to be used in this mode.

15 … 10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Halt	Fault reset	Reserved	Reserved	Reserved	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick Stop	0	Enabled
		1	Disabled
3	Enable Operation	0	Disabled
		1	Enabled
4	Reserved	0	Reserved, keep as "0"
5	Reserved	0	Reserved, keep as "0"
6	Reserved	0	Reserved, keep as "0"
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Start or continue velocity control
		1	Perform the stop operation according to the Halt option code set by 0x605D.
9	Reserved	0	Reserved, keep as "0"
10 to 15	Reserved	0	Reserved, keep as "0"

9-4-3 Statusword Definition

In the Profile velocity mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Reserved	Speed	Internal limit active	Target reached	Remote	Reserved

Bit	Name	Value	Description
0	Ready to Switch on	0	Disabled
		1	Enabled
1	Switched on	0	Disabled
		1	Enabled
2	Operation enabled	0	Disabled
		1	Enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	Disabled
		1	Enabled
5	Quick stop	0	Quick stop enabled
		1	Quick stop disabled
6	Switch on disabled	0	Disabled
		1	Enabled
7	Warning	0	No warning
		1	Warning
8	Reserved	0	Reserved, keep as "0"
9	Remote	0	Disabled
		1	Controlword control enabled
10	Target reached	0	Controlword bit8=0, Target velocity not reached; Controlword bit8=1, decelerating
		1	Controlword bit8=0, Target velocity reached; Controlword bit8=1, velocity is 0
11	Internal limit active	0	Digital input limit not activated
		1	Digital input limit activated
12	Speed	0	Zero speed range not reached
		1	Zero speed range reached
13	Reserved	0	Reserved, keep as "0"
14	Reserved	0	Reserved, keep as "0"
15	Reserved	0	Reserved, keep as "0"

9-4-4 Function Parameters Setting

See the table below for the settings of conditions for velocity reached, zero-speed detected, and velocity match.

Index	Subindex	Name	Description
0x2A15	0x02	Time constant of motion output condition	When the command velocity is 0 and the absolute value of the actual velocity is within the zero velocity width, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the motor has become nearly stationary and the zero-speed detected signal is valid.
0x2A16	0x01	Zero velocity width	
	0x02	Target value of AT-speed output	When the absolute value of actual velocity exceeds the set value and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor velocity has reached the expected value and the velocity reached signal is valid.
	0x03	Velocity coincidence width	When the absolute value of the difference between the actual velocity and the target velocity (0x60FF) is within the set value, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor velocity has reached the expected value, the velocity match signal is valid and Statusword 0x6041 bit10=1.

9-4-5 Function Examples

● Enable the Profile Velocity Mode

The controller writes 3 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Profile velocity mode.

● Enable the Motor

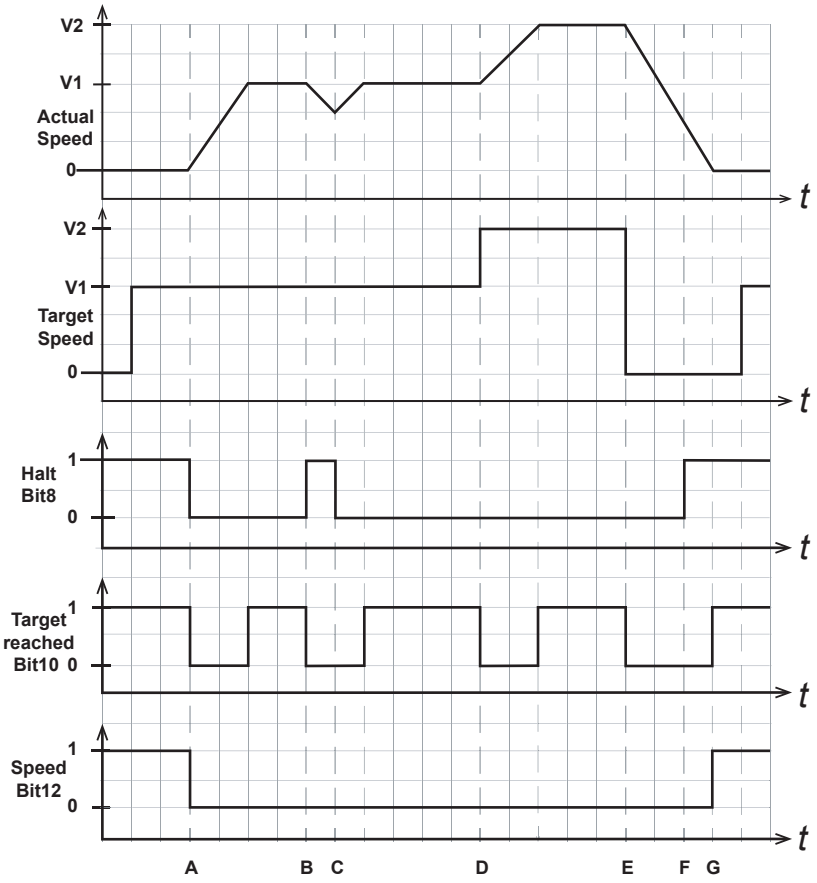
The controller sequentially writes 0x06, 0x07 and 0x10F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

● Set the Operation Parameters

Depending on the application, the controller writes parameters such as target velocity, acceleration and deceleration to 0x60FF, 0x6083 and 0x6084 respectively.

● Start/Stop Operation

The controller can control the start/stop of the motor by controlling the status of bit 8 of 0x6040. When bit8=0, the motor starts or continues running; when bit8=1, the motor starts performing deceleration stop.

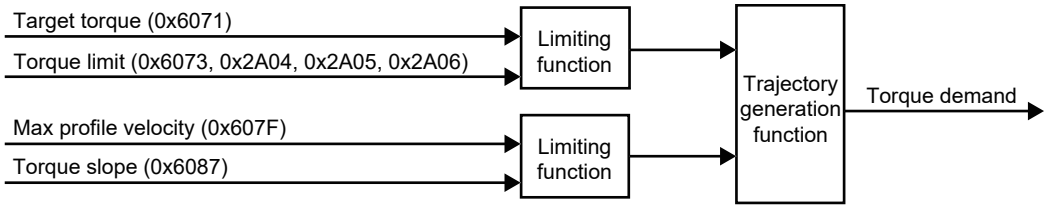


Graph point	Controlword (0x6040)	Statusword (0x6041)		Target velocity (0x60FF)	Description
	Halt (bit8)	Speed (bit12)	Target reached (bit10)		
Start	1	1	1	0	Motor is stopped
A	1 → 0	1 → 0	1 → 0	V1	The Halt bit is reset, and the motor performs acceleration start.
B	0 → 1	0	1 → 0	V1	The Halt bit is set, and the motor starts decelerating.
C	1 → 0	0	0	V1	The Halt bit is reset, and the motor starts accelerating.
D	0	0	1 → 0	V1 → V2	Increase the target velocity, and the motor starts accelerating.
E	0	0	1 → 0	V2 → 0	The target velocity is set to 0, and the motor starts decelerating.
F	0 → 1	0	0	0	The Halt bit is set, and the motor performs deceleration stop.
G	1	0 → 1	0 → 1	0	Motion is stopped

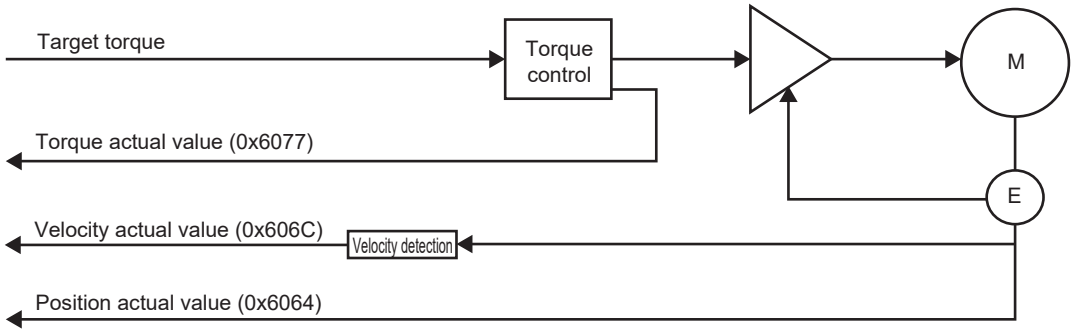
9-5 Profile Torque Mode

In the Profile torque mode, the Servo Drive generates a motion trajectory based on the target torque and torque demand change rate (Torque slope) set by the host controller, and controls the motor to perform motion according to the generated motion trajectory. To enable the Profile torque mode, 0x6060 must be set to 4.

Structure of Motion Trajectory Generation Function



Configuration of Profile Torque Mode



9-5-1 Profile Torque Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605D		Halt option code	RW	INTEGER16	---	1 to 3	1	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6071		Target torque	RW	INTEGER16	0.1%	-4,000 to 4,000	0	RxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6074		Torque demand	RO	INTEGER16	0.1%	---	0	TxPDO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x607F		Max profile velocity	RW	UNSIGNED32	Pulses/s	0 to 135*OD 0x2A90	80*OD 0x2A90	RxPDO
0x6087		Torque slope	RW	UNSIGNED32	0.1%/s	0 to 2^{32}-1	0	RxPDO
0x2A04		2nd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2A05		3rd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2A06		4th torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2AB1	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

9-5-2 Controlword Settings

In the Profile torque mode, the meaning of each bit of Controlword 0x6040 is shown in the table below, where the dark-marked bits of the Controlword are to be used in this mode.

15 … 10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Halt	Fault reset	Reserved	Reserved	Reserved	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick Stop	0	Enabled
		1	Disabled
3	Enable Operation	0	Disabled
		1	Enabled
4	Reserved	0	Reserved, keep as "0"
5	Reserved	0	Reserved, keep as "0"
6	Reserved	0	Reserved, keep as "0"
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Start or continue torque control
		1	Perform the stop operation according to the Halt option code set by 0x605D.
9	Reserved	0	Reserved, keep as "0"
10 to 15	Reserved	0	Reserved, keep as "0"

9-5-3 Statusword Definition

In the Profile torque mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Reserved	Reserved	Internal limit active	Target reached	Remote	Reserved

Bit	Name	Value	Description
0	Ready to Switch on	0	Disabled
		1	Enabled
1	Switched on	0	Disabled
		1	Enabled
2	Operation enabled	0	Disabled
		1	Enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	Disabled
		1	Enabled
5	Quick stop	0	Quick stop enabled
		1	Quick stop disabled
6	Switch on disabled	0	Disabled
		1	Enabled
7	Warning	0	No warning
		1	Warning
8	Reserved	0	Reserved, keep as "0"
9	Remote	0	Disabled
		1	Controlword control enabled
10	Target reached	0	Controlword bit8=0, target torque not reached by torque demand 0x6074 Controlword bit8=1, decelerating
		1	Controlword bit8=0, target torque reached by torque demand 0x6074 Controlword bit8=1, velocity is 0
11	Internal limit active	0	Digital input limit not activated
		1	Digital input limit activated
12	Reserved	0	Reserved, keep as "0"
13	Reserved	0	Reserved, keep as "0"
14	Reserved	0	Reserved, keep as "0"
15	Reserved	0	Reserved, keep as "0"

9-5-4 Function Parameters Setting

See the table below for the settings of conditions for torque reached and torque match.

Index	Subindex	Name	Description
0x2A15	0x02	Time constant of motion output condition	When the absolute value of the difference between the torque demand and the target torque (0x6071) falls within the torque match width, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor torque has reached the expected value, the torque match signal is valid and Statusword 0x6041 bit10=1.
0x2A17	---	Torque ripple range when arrival	
0x2A18		Target torque value when torque value reached	When the absolute value of the difference between the absolute value of torque demand and the set value falls within the torque match width (0x2A17), and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor torque has reached the expected value and the torque reached signal is valid.

9-5-5 Function Examples

● Enable the Profile Torque Mode

The controller writes 4 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Profile torque mode.

● Enable the Motor

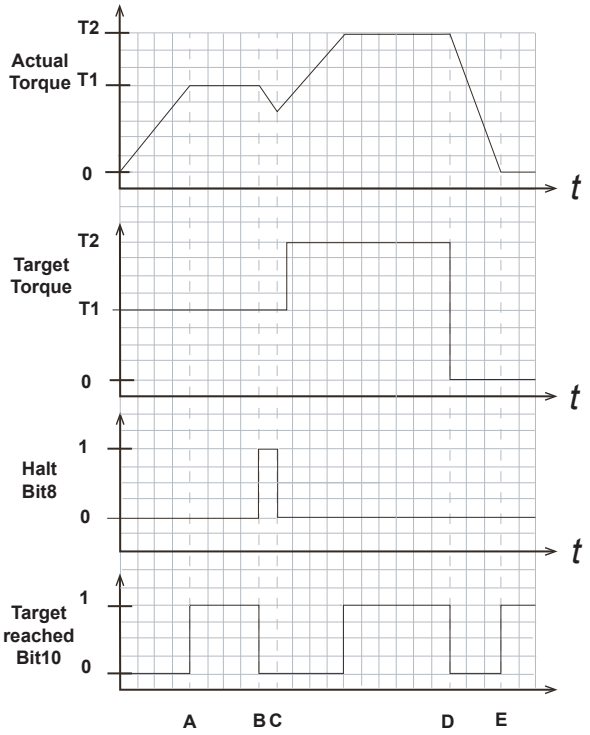
The controller sequentially writes 0x06, 0x07 and 0x10F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

● Set the Operation Parameters

Depending on the application, the controller writes parameters such as target torque, maximum velocity and Torque slope to 0x6071, 0x607F and 0x6087 respectively.

● Start/Stop Operation

The controller can control the start/stop of the motor by controlling the status of bit 8 of 0x6040. When bit8=0, the motor starts or continues running; when bit8=1, the motor starts performing deceleration stop.

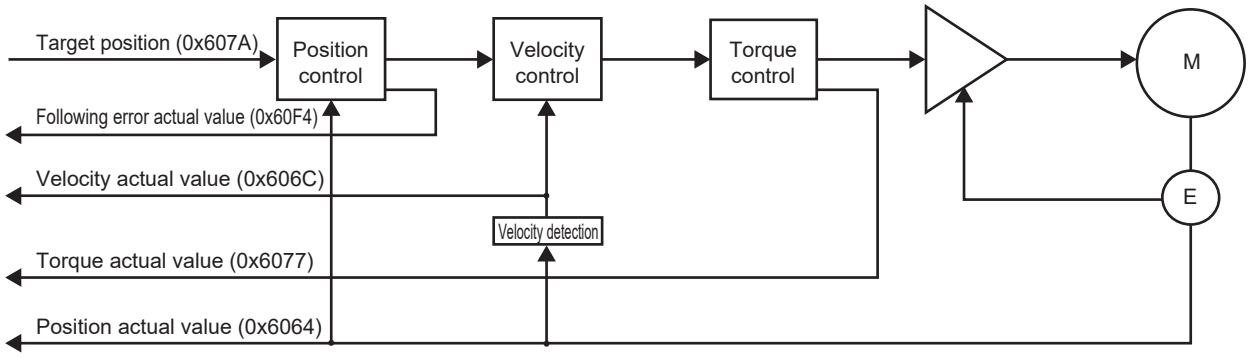


Graph point	Controlword (0x6040)	Statusword (0x6041)	Target torque (0x6071)	Description
	Halt (bit8)	Target reached (bit10)		
Start	0	1	T1	The Halt bit is reset, and the motor starts increasing the output torque to T1.
A	0	0 → 1	T1	The motor maintains the output torque T1.
B	0 → 1	1 → 0	0	The Halt bit is set, and the motor starts decreasing the output torque.
C	1 → 0	0	0 → T2	The Halt bit is reset, the target torque is increased, and the motor starts increasing the output torque to T2.
D	0	1 → 0	T2 → 0	The target torque is set to 0, and the motor starts decreasing the output torque.
E	0	0 → 1	0	The motor maintains an output torque of 0.

9-6 Cyclic Synchronous Position Mode

In the Cyclic synchronous position mode, the host controller generates a motion trajectory and sends the target position to the Servo Drive in each synchronization cycle, and the Servo Drive then operates following the target position. To enable the Cyclic synchronous position mode, 0x6060 must be set to 8.

Configuration of Cyclic Synchronous Position Mode



9-6-1 Cyclic Synchronous Position Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x607A		Target position	RW	INTEGER32	Pulses	-(2^{31}-1) to 2^{31}-1	0	RxPDO
0x60F4		Following error actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x2AB1	0x03	operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

9-6-2 Controlword Settings

In the Cyclic synchronous position mode, the meaning of each bit of Controlword 0x6040 is shown in the table below.

15 … 10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Halt	Fault reset	Reserved	Reserved	Reserved	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick Stop	0	Enabled
		1	Disabled
3	Enable Operation	0	Disabled
		1	Enabled
4	Reserved	0	Reserved, keep as "0"
5	Reserved	0	Reserved, keep as "0"
6	Reserved	0	Reserved, keep as "0"
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Reserved, keep as "0"
9	Reserved	0	Reserved, keep as "0"
10 to 15	Reserved	0	Reserved, keep as "0"

9-6-3 Statusword Definition

In the Cyclic synchronous position mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Reserved	Drive follows the command value	Internal limit	Status toggle	Remote	Reserved

Bit	Name	Value	Description
0	Ready to Switch on	0	Disabled
		1	Enabled
1	Switched on	0	Disabled
		1	Enabled
2	Operation enabled	0	Disabled
		1	Enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	Disabled
		1	Enabled
5	Quick stop	0	Quick stop enabled
		1	Quick stop disabled
6	Switch on disabled	0	Disabled
		1	Enabled
7	Warning	0	No warning
		1	Warning
8	Reserved	0	Reserved, keep as "0"
9	Remote	0	Disabled
		1	Controlword control enabled
10	Status toggle	0	Target position changed for the master
		1	Target position not changed for the master
11	Interanl limit active	0	Digital limit input not activated
		1	Digital limit input activated
12	Drive follows the command value	0	Drive not following the command value
		1	Drive following the command value
13	Reserved	0	Reserved, keep as "0"
14	Reserved	0	Reserved, keep as "0"
15	Reserved	0	Reserved, keep as "0"

9-6-4 Function Parameters Setting

See the table below for the settings of conditions for position reached, dynamic following error, target reached, etc. and the following error thresholds.

Index	Subindex	Name	Description
0x2A14	---	Reached position	When the absolute value of the difference between the position actual value and the set value does not exceed 100 pulses, the position reached signal is valid.
0x2A15	0x01	Dynamic following error threshold	When the absolute value of the position deviation is within the set value, the dynamic error following signal is valid.
	0x02	Time constant of motion output condition	When the absolute value of the position deviation is within the in-position output threshold and the duration reaches the time set by subindex 2 of 0x2A15, the target reached signal is valid and bit 10 of Statusword 0x6041 is 1.
	0x03	In-position output threshold	
0x2AA8	---	Following error threshold	When the absolute value of the position deviation exceeds the set value, the drive will trigger the position following error fault; When the set value is 0, the position following error detection is disabled.

9-6-5 Function Examples

● Enable the Cyclic Synchronous Position Mode

The controller writes 8 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Cyclic synchronous position mode.

● Enable the Motor

The controller sequentially writes 0x06, 0x07 and 0x0F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

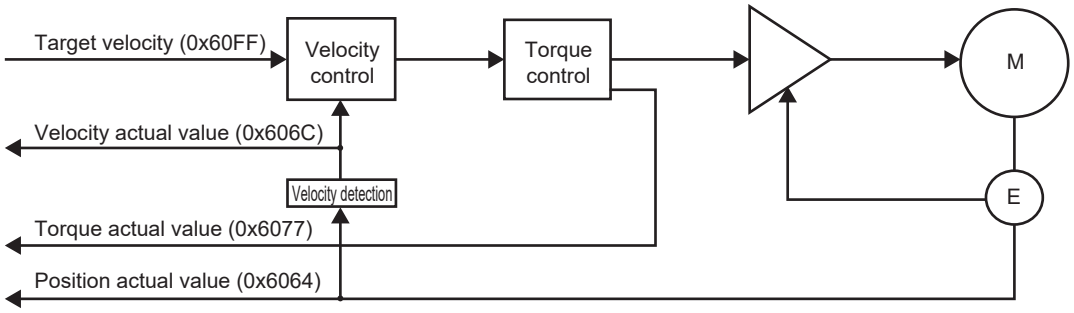
● Set the Operation Parameters and Control the Start/Stop

The controller generates a motion trajectory based on the set operation parameters and cyclically writes the target position to 0x607A to control the motor operation.

9-7 Cyclic Synchronous Velocity Mode

In the Cyclic synchronous velocity mode, the host controller generates a motion trajectory and sends the target velocity to the Servo Drive in each synchronization cycle, and the Servo Drive then follows the target velocity. To enable the Cyclic synchronous velocity mode, 0x6060 must be set to 9.

Configuration of Cyclic Synchronous Velocity Mode



9-7-1 Cyclic Synchronous Velocity Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6085		Quick stop deceleration	RW	UNSIGNED32	100 Pulses/s^2	(0.00167 to 54.61)* OD 0x2A90	30*OD 0x2A90	NO
0x60FF		Target velocity	RW	INTEGER32	Pulses/s	-2^{31} to 2^{31}-1	0	RxPDO
0x2AB1	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to "*A-4 List of Maximum Torque Parameters* (P.A-14)".

9-7-2 Controlword Settings

In the Cyclic synchronous velocity mode, the meaning of each bit of Controlword 0x6040 is shown in the table below.

15 … 10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Halt	Fault reset	Reserved	Reserved	Reserved	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick Stop	0	Enabled
		1	Disabled
3	Enable Operation	0	Disabled
		1	Enabled
4	Reserved	0	Reserved, keep as "0"
5	Reserved	0	Reserved, keep as "0"
6	Reserved	0	Reserved, keep as "0"
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Reserved, keep as "0"
9	Reserved	0	Reserved, keep as "0"
10 to 15	Reserved	0	Reserved, keep as "0"

9-7-3 Statusword Definition

In the Cyclic synchronous velocity mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Reserved	Drive follows the command value	Internal limit	Status toggle	Remote	Reserved

Bit	Name	Value	Description
0	Ready to Switch on	0	Disabled
		1	Enabled
1	Switched on	0	Disabled
		1	Enabled
2	Operation enabled	0	Disabled
		1	Enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	Disabled
		1	Enabled
5	Quick stop	0	Quick stop enabled
		1	Quick stop disabled
6	Switch on disabled	0	Disabled
		1	Enabled
7	Warning	0	No warning
		1	Warning
8	Reserved	0	Reserved, keep as "0"
9	Remote	0	Disabled
		1	Controlword control enabled
10	Status toggle	0	Target velocity changed for the master
		1	Target velocity not changed for the master
11	Interanl limit active	0	Digital limit input not activated
		1	Digital limit input activated
12	Drive follows the command value	0	Drive not following the command value
		1	Drive following the command value
13	Reserved	0	Reserved, keep as "0"
14	Reserved	0	Reserved, keep as "0"
15	Reserved	0	Reserved, keep as "0"

9-7-4 Function Parameters Setting

See the table below for the settings of conditions for velocity reached, zero-speed detected, and velocity match.

Index	Subindex	Name	Description
0x2A15	0x02	Time constant of motion output condition	When the command velocity is 0 and the absolute value of the actual velocity is within the zero velocity width, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the motor has become nearly stationary and the zero-speed detected signal is valid.
0x2A16	0x01	Zero velocity width	
	0x02	Target value of AT-speed output	When the absolute value of actual velocity exceeds the set value and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor velocity has reached the expected value and the velocity reached signal is valid.
	0x03	Velocity coincidence width	When the absolute value of the difference between the actual velocity and the target velocity (0x60FF) is within the set value, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor velocity has reached the expected value, the velocity match signal is valid and Statusword 0x6041 bit10=1.

9-7-5 Function Examples

● Enable the Cyclic Synchronous Velocity Mode

The controller writes 9 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Cyclic synchronous velocity mode.

● Enable the Motor

The controller sequentially writes 0x06, 0x07 and 0x0F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

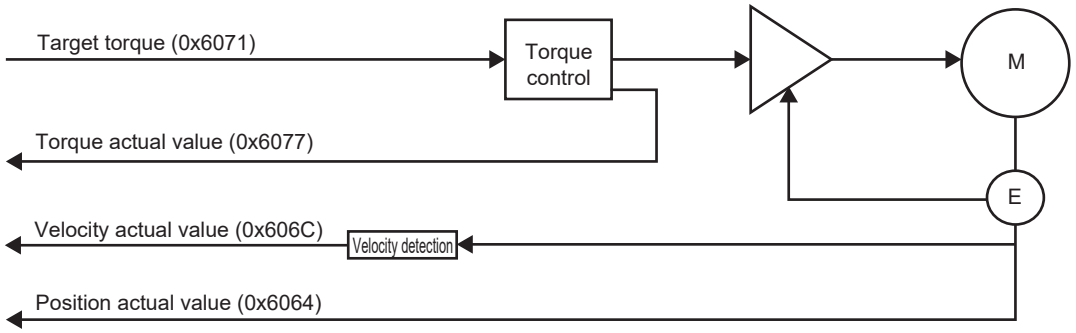
● Set the Operation Parameters and Control the Start/Stop

The controller generates a motion trajectory based on the set operation parameters and cyclically writes the target velocity to 0x60FF to control the motor operation.

9-8 Cyclic Synchronous Torque Mode

In the Cyclic synchronous torque mode, the host controller generates a motion trajectory and sends the target torque to the Servo Drive in each synchronization cycle, and the Servo Drive then operates following the target torque. To enable the Cyclic synchronous torque mode, 0x6060 must be set to 10.

Configuration of Cyclic Synchronous Torque Mode



9-8-1 Cyclic Synchronous Torque Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6071		Target torque	RW	INTEGER16	0.1%	-4,000 to 4,000	0	RxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6074		Torque demand	RO	INTEGER16	0.1%	---	0	TxPDO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x607F		Max profile velocity	RW	UNSIGNED32	Pulses/s	0 to 135*OD 0x2A90	80*OD 0x2A90	RxPDO
0x2A04		2nd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2A05		3rd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2A06		4th torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2AB1	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to “*A-4 List of Maximum Torque Parameters* (P.A-14)”.

9-8-2 Controlword Settings

In the Cyclic synchronous torque mode, the meaning of each bit of Controlword 0x6040 is shown in the table below.

15 … 10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Halt	Fault reset	Reserved	Reserved	Reserved	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick Stop	0	Enabled
		1	Disabled
3	Enable Operation	0	Disabled
		1	Enabled
4	Reserved	0	Reserved, keep as "0"
5	Reserved	0	Reserved, keep as "0"
6	Reserved	0	Reserved, keep as "0"
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Reserved, keep as "0"
9	Reserved	0	Reserved, keep as "0"
10 to 15	Reserved	0	Reserved, keep as "0"

9-8-3 Statusword Definition

In the Cyclic synchronous torque mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Reserved	Drive follows the command value	Internal limit	Status toggle	Remote	Reserved

Bit	Name	Value	Description
0	Ready to Switch on	0	Disabled
		1	Enabled
1	Switched on	0	Disabled
		1	Enabled
2	Operation enabled	0	Disabled
		1	Enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	Disabled
		1	Enabled
5	Quick stop	0	Quick stop enabled
		1	Quick stop disabled
6	Switch on disabled	0	Disabled
		1	Enabled
7	Warning	0	No warning
		1	Warning
8	Reserved	0	Reserved, keep as "0"
9	Remote	0	Disabled
		1	Controlword control enabled
10	Status toggle	0	Target torque changed for the master
		1	Target torque not changed for the master
11	Interanl limit active	0	Digital limit input not activated
		1	Digital limit input activated
12	Drive follows the command value	0	Drive not following the command value
		1	Drive following the command value
13	Reserved	0	Reserved, keep as "0"
14	Reserved	0	Reserved, keep as "0"
15	Reserved	0	Reserved, keep as "0"

9-8-4 Function Parameters Setting

See the table below for the settings of conditions for torque reached and torque match.

Index	Subindex	Name	Description
0x2A15	0x02	Time constant of motion output condition	When the absolute value of the difference between the actual torque and the target torque (0x6071) falls within the torque match width, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor torque has reached the expected value, the torque match signal is valid and Statusword 0x6041 bit10=1.
0x2A17	---	Torque match width	
0x2A18	---	Target torque value when torque value reached	When the absolute value of the difference between the absolute value of actual torque and the set value is within the torque match width (0x2A17), and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor torque has reached the expected value and the torque reached signal is valid.

9-8-5 Function Examples

● Enable the Cyclic Synchronous Torque Mode

The controller writes 10 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Cyclic synchronous torque mode.

● Enable the Motor

The controller sequentially writes 0x06, 0x07 and 0x0F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

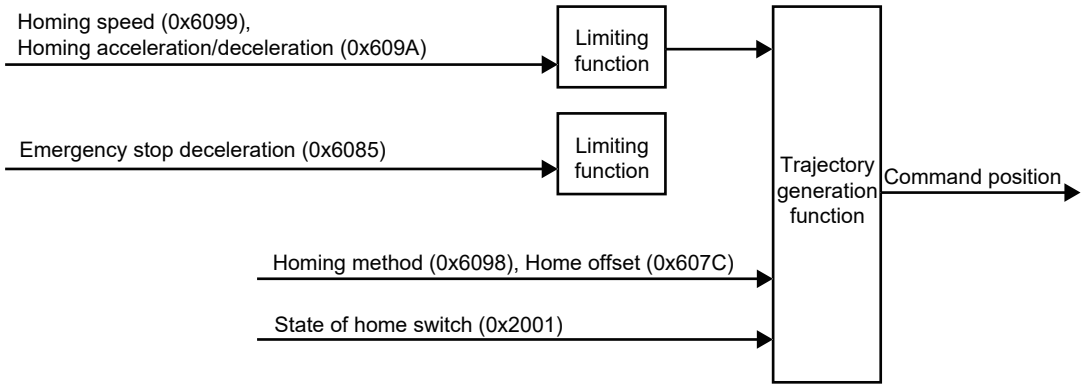
● Set the Operation Parameters and Control the Start/Stop

The controller generates a motion trajectory based on the set operation parameters, writes the maximum velocity to 0x607F and cyclically writes the target torque to 0x6071 to control the motor operation.

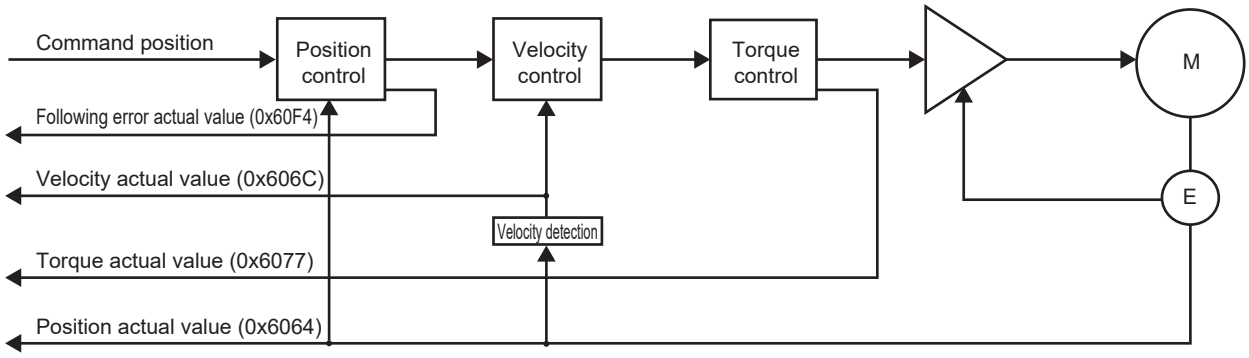
9-9 Homing Mode

In the Homing mode, the Servo Drive generates a motion trajectory based on parameters such as homing acceleration/deceleration, velocity, home offset, homing method, and home sensor signal set by the host controller, and controls the motor to perform motion according to the generated motion trajectory. To enable the Homing mode, 0x6060 must be set to 6. C6E-series AC Servo Drives support 39 homing methods.

Structure of Motion Trajectory Generation Function



Configuration of Homing Mode



9-9-1 Homing Mode Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO
0x6040		Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x6041		Statusword	RO	UNSIGNED16	---	---	592	TxPDO
0x605A		Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO
0x605B		Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605C		Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO
0x605D		Halt option code	RW	INTEGER16	---	1 to 3	1	NO
0x6060		Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO
0x6061		Modes of operation display	RO	INTEGER8	---	---	0	TxPDO
0x6064		Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x606C		Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO
0x6073		Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x6077		Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x6078		Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO
0x607C		Home offset	RW	INTEGER32	Pulses	-(2^{31}-1) to 2^{31}-1	0	RxPDO
0x6085		Emergency stop deceleration	RW	UNSIGNED32	100 Pulses/s^2	(0.00167 to 54.61)* OD 0x2A90	30*OD0x 2A90	NO
0x6098		Homing method	RW	INTEGER8	---	-4 to 35	1	RxPDO
0x6099	0x01	Speed during search for switch	RW	UNSIGNED32	Pulses/s	0 to 135*OD 0x2A90	10*OD0x 2A90	RxPDO
	0x02	Speed during search for zero	RW	UNSIGNED32	Pulses/s	0 to 135*OD 0x2A90	1*OD0x 2A90	RxPDO
0x609A	---	Homing acceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)*OD 0x2A90	100*OD0x 2A90	RxPDO
0x60F4		Following error actual value	RO	INTEGER32	Pulses	---	0	TxPDO
0x2A08		Torque limit for homing on hard limit	RW	UNSIGNED32	0.1%	0 to 4,000	1,000	NO
0x2AB1	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

*1 The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

9-9-2 Controlword Settings

In the Homing mode, the meaning of each bit of Controlword 0x6040 is shown in the table below, where the dark-marked bits of the Controlword are to be used in this mode.

15 … 10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Halt	Fault reset	Reserved	Reserved	Homing operation start	Enable operation	Quick stop	Enable voltage	Switch on

Bit	Name	Value	Description
0	Switch on	0	Disabled
		1	Enabled
1	Enable voltage	0	Disabled
		1	Enabled
2	Quick Stop	0	Enabled
		1	Disabled
3	Enable Operation	0	Disabled
		1	Enabled
4	Homing operation start	0	Homing operation not started
		0 → 1	Homing operation started
		1	Homing operation in progress
		1 → 0	Homing operation terminated
5	Reserved	0	Reserved, keep as "0"
6	Reserved	0	Reserved, keep as "0"
7	Fault reset	0 → 1	Perform the fault reset once
8	Halt	0	Disabled
		1	Perform the stop operation according to the Halt option code set by 0x605D.
9	Reserved	0	Reserved, keep as "0"
10 to 15	Reserved	0	Reserved, keep as "0"

9-9-3 Statusword Definition

In the Homing mode, the meaning of each bit of Statusword 0x6041 is shown in the table below, where the dark-marked bits of the Statusword are to be used in this mode.

7	6	5	4	3	2	1	0
Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to switch on

15	14	13	12	11	10	9	8
Reserved	Reserved	Homing error	Homing attained	Internal limit active	Target reached	Remote	Reserved

Bit	Name	Value	Description
0	Ready to Switch on	0	Disabled
		1	Enabled
1	Switched on	0	Disabled
		1	Enabled
2	Operation enabled	0	Disabled
		1	Enabled
3	Fault	0	No fault
		1	Fault
4	Voltage enabled	0	Disabled
		1	Enabled
5	Quick stop	0	Quick stop enabled
		1	Quick stop disabled
6	Switch on disabled	0	Disabled
		1	Enabled
7	Warning	0	No warning
		1	Warning
8	Reserved	0	Reserved, keep as "0"
9	Remote	0	Disabled
		1	Controlword control enabled
10	Target reached	0	Controlword bit8=0, home not reached; Controlword bit8=1, decelerating
		1	Controlword bit8=0, home reached; Controlword bit8=1, velocity is 0
11	Interanl limit active	0	Digital limit input not activated
		1	Digital limit input activated
12	Homing attained	0	Homing not attained
		1	Homing attained
13	Homing error	0	No homing abnormality
		1	Homing abnormality
14	Reserved	0	Reserved, keep as "0"
15	Homing complete	0	Homing operation not completed
		1	Homing operation completed

9-9-4 Function Examples

- **Enable the Homing Mode**

  The controller writes 6 to 0x6060 and checks the value of 0x6061 to confirm whether the current mode is the Homing mode.

- **Enable the Motor**

  The controller sequentially writes 0x06, 0x07 and 0x0F to 0x6040 to enable the motor. The motor enabled state is confirmed by checking whether bit 0, bit 1 and bit 2 of 0x6041 are all set to 1.

- **Set the Operation Parameters**

  Depending on the application, the controller writes parameters such as homing method, velocity, acceleration and home offset to 0x6098, 0x6099, 0x609A and 0x607C respectively.

- **Start/Stop Operation**

  The controller can control the start/stop of the motor by controlling the status of bit 4 of 0x6040. When bit 4 changes from 0 to 1, the motor starts homing operation.

9-9-5 Introduction to Homing Methods

Homing is used to find the mechanical home and determine the positional relationship between the mechanical home and the mechanical zero point.

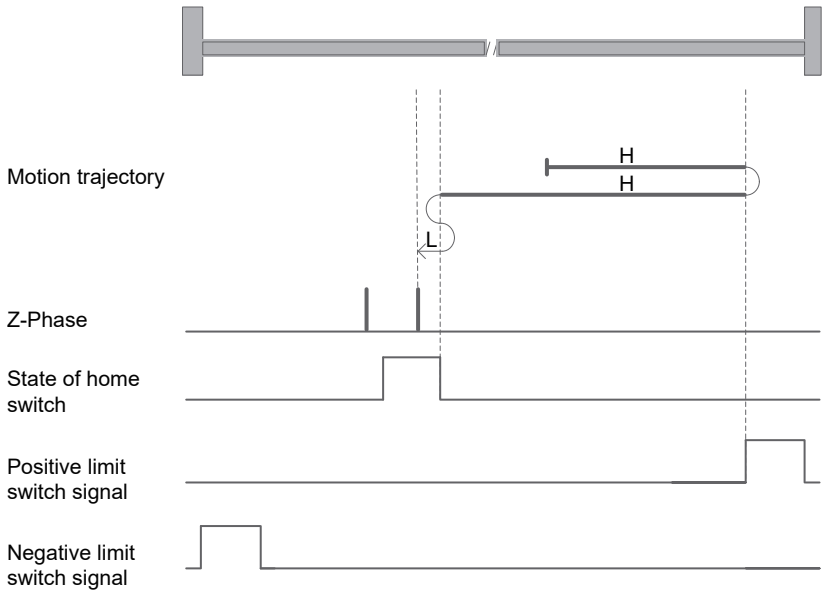
Mechanical home: A fixed position on a machine, which can be either a specific sensor or Z-Phase signal of a motor.

Mechanical zero point: The absolute zero position on a machine.

After the homing operation, the motor stops at the mechanical home. The relationship between the mechanical home and the mechanical zero point can be determined by setting the Home offset (0x607C).

Mechanical home = Mechanical zero point + 0x607C

When 0x607C=0, the mechanical home coincides with the mechanical zero point.



H: Subindex 1 of Speed during search for switch (0x6099)

L: Subindex 2 of Speed during search for zero (0x6099)

Home switch signal: HOM-SW=0 indicates that the home signal is invalid, while HOM-SW=1 indicates that the home signal is valid.

Positive limit switch signal: POT=0 indicates that the positive limit signal is invalid, while POT=1 indicates that the positive limit signal is valid.

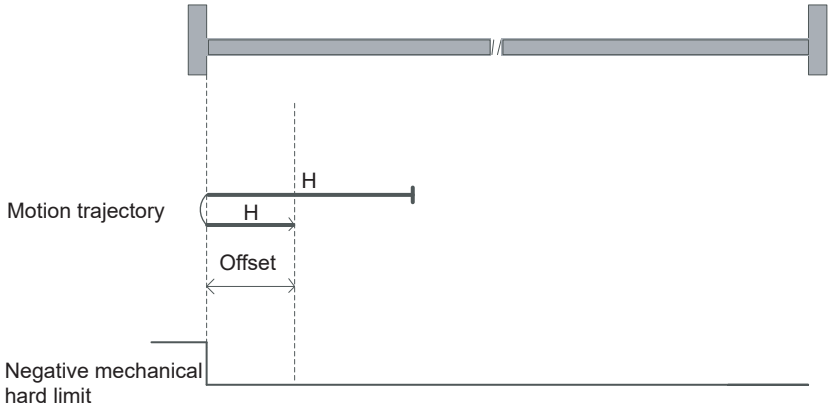
Negative limit switch signal: NOT=0 indicates that the negative limit signal is invalid, while NOT=1 indicates that the negative limit signal is valid.

Homing methods -4 to -1 are specific to the manufacturer. For these methods, the Servo Drive does not require external switch signals as auxiliary homing signals. Instead, the motor torque during homing is limited by a mechanical hard stop. When the load driven by the motor contacts the mechanical hard stop and is blocked, the motor thrust will balance the blocking force and the motor will stand still at a position. This position is defined as the mechanical home. The motor torque limit during homing is set via 0x2A08, where 100% corresponds to 1 times the rated torque of the motor. Set the value of this object according to actual application conditions. An excessively small setting may result in inaccurate homing position, while an excessively large setting may cause damage to mechanical equipment.

Precautions for Correct Use

When using homing methods -4 to -1, it is necessary to set an appropriate Home offset (0x607C) so that the motor will move in the opposite direction by a distance specified by Home offset (0x607C) after the mechanical home is found during homing. When the load moves away from the mechanical hard stop and the motor stops, the Position actual value (0x6064) is set to the value of Home offset (0x607C).

Homing Method -4: Homing on negative mechanical hard stop



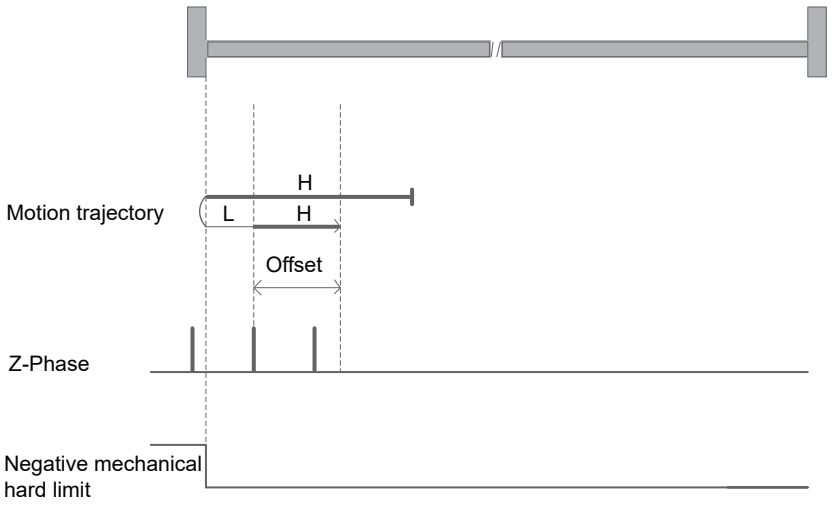
The motor starts homing at high speed in a negative direction. When the load encounters the mechanical hard stop and the blocking force equals the motor limited torque, the motor performs deceleration stop and moves the distance specified by Home offset (0x607C) at high speed. After stopping, the motor's position is set to the value of 0x607C.

Homing Method -3: Homing on positive mechanical hard stop



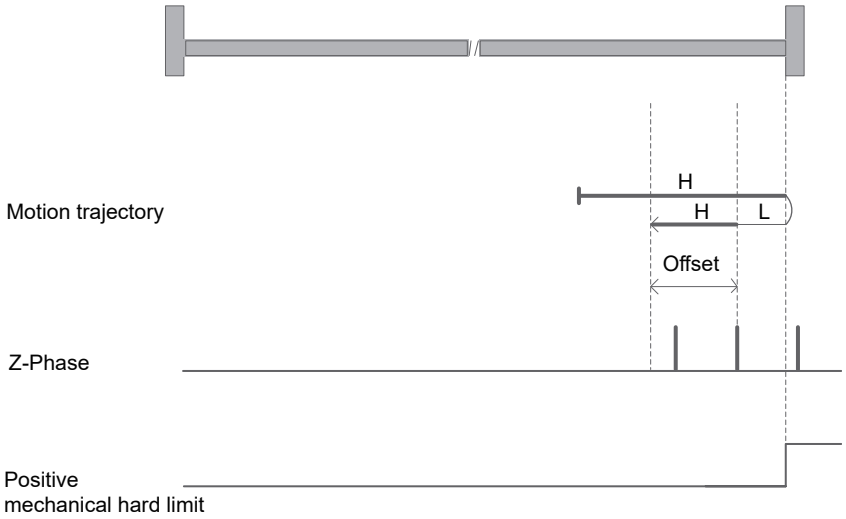
The motor starts homing at high speed in a positive direction. When the load encounters the mechanical hard stop and the blocking force equals the motor limited torque, the motor performs deceleration stop and moves the distance specified by Home offset (0x607C) at high speed. After stopping, the motor's position is the value of 0x607C.

Homing Method -2: Homing on negative mechanical hard stop and Z-Phase



The motor starts homing at high speed in a negative direction. When the load encounters the mechanical hard stop and the blocking force equals the motor limited torque, the motor performs deceleration stop, runs at low speed in a positive direction, and stops after detecting the first Z-Phase. Then, the motor moves the distance specified by Home offset (0x607C) at high speed. After stopping, the motor's position is the value of 0x607C.

Homing Method -1: Homing on positive mechanical hard stop and Z-Phase



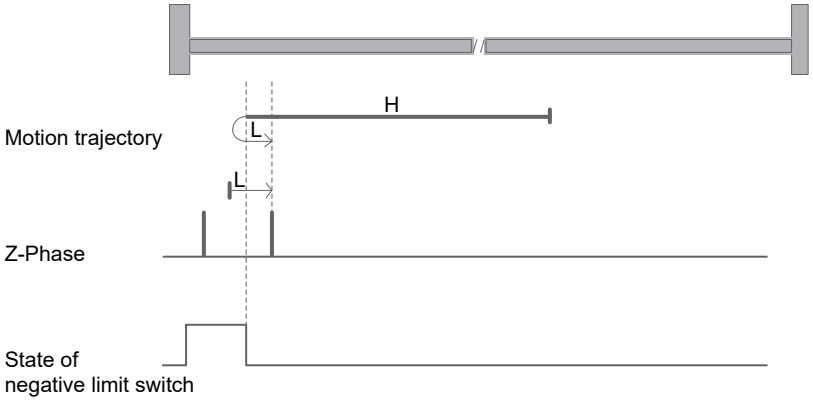
The motor starts homing at high speed in a positive direction. When the load encounters the mechanical hard stop and the blocking force equals the motor torque limit, the motor performs deceleration stop, runs at low speed in a negative direction, and stops after detecting the first Z-Phase. Then, the motor moves the distance specified by Home offset (0x607C) at high speed. After stopping, the motor's position is the value of 0x607C.

Homing methods 1 to 35 are defined according to the CiA402 motion control protocol.

Precautions for Correct Use

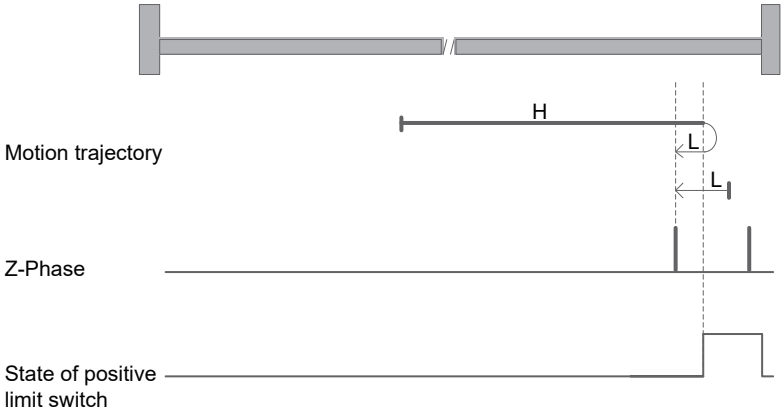
- When using homing methods 1 to 35, the motor's Position actual value (0x6064) is set to the value of Home offset (0x607C) after the motor finishes homing.
- Homing methods 15, 16, 31, and 32 are reserved.

Homing Method 1: Homing on a negative limit switch and Z-Phase



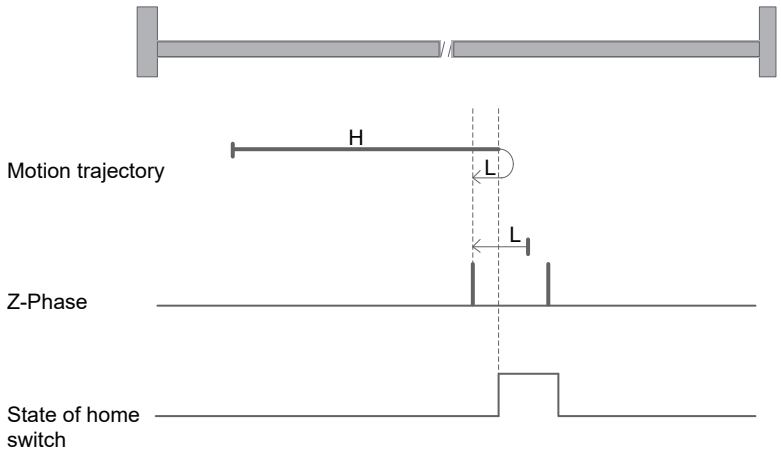
- When homing starts, NOT=0. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the falling edge of NOT.
- When homing starts, NOT=1. The motor starts homing at low speed in a positive direction, and stops at the first Z-Phase after detecting the falling edge of NOT.

Homing Method 2: Homing on a positive limit switch and Z-Phase



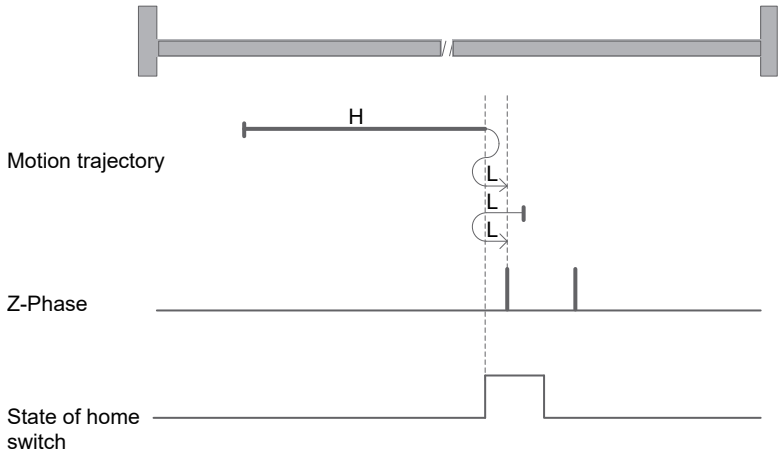
- When homing starts, POT=0. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the falling edge of POT.
- When homing starts, POT=1. The motor starts homing at low speed in a negative direction, and stops at the first Z-Phase after detecting the falling edge of POT.

Homing Method 3: Homing on a positive limit switch falling edge and Z-Phase pulse



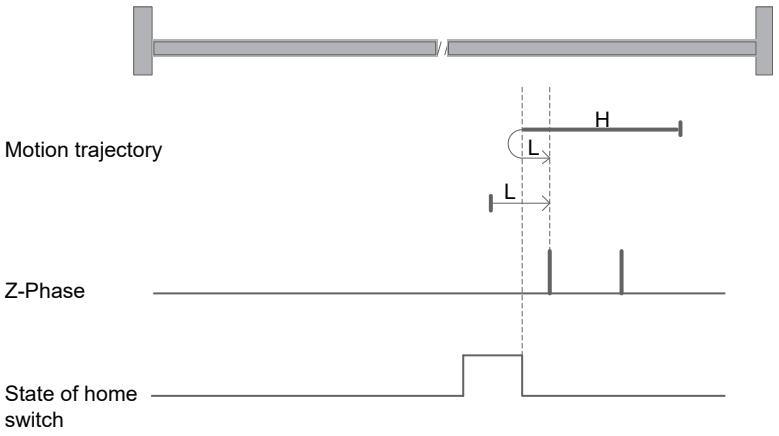
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.

Homing Method 4: Homing on a positive home switch rising edge and Z-Phase pulse



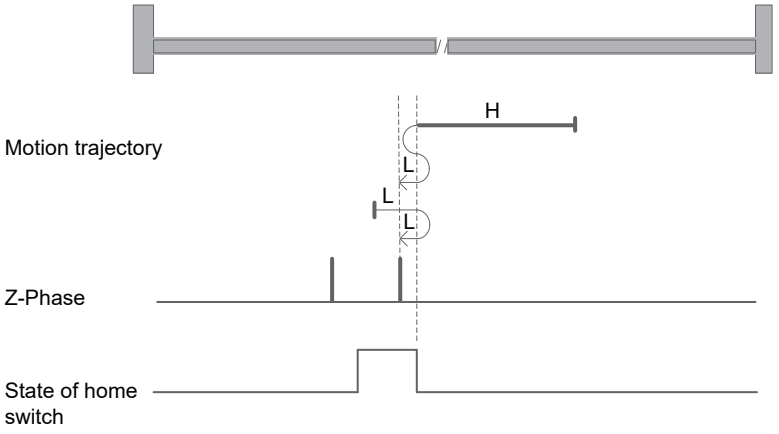
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops at the first Z-Phase after detecting the rising edge of HW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.

Homing Method 5: Homing on a negative home switch falling edge and Z-Phase pulse



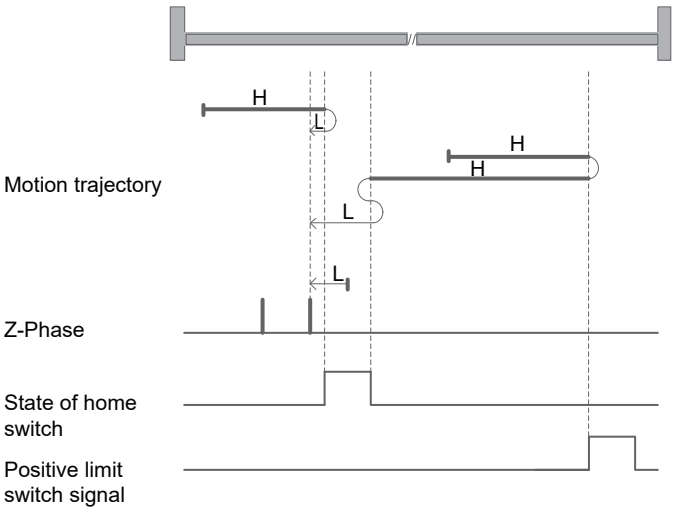
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.

Homing Method 6: Homing on a negative home switch rising edge and Z-Phase pulse



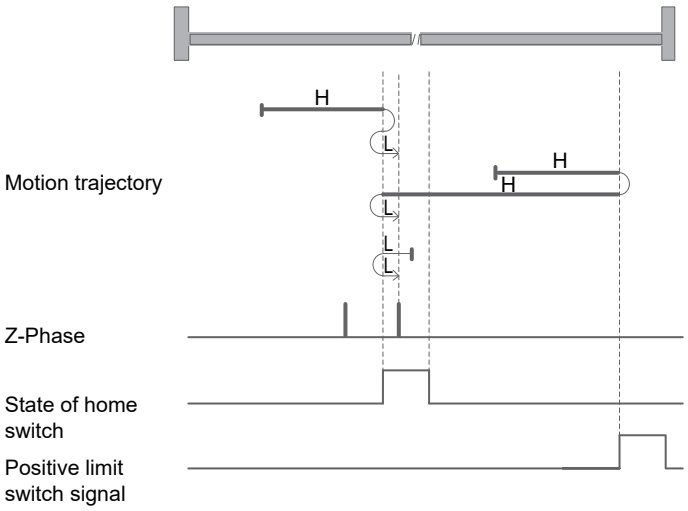
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops at the first Z-Phase after detecting the rising edge of HW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.

Homing Method 7: Homing on a positive home switch falling edge and Z-Phase pulse, and reversing upon detecting a positive limit



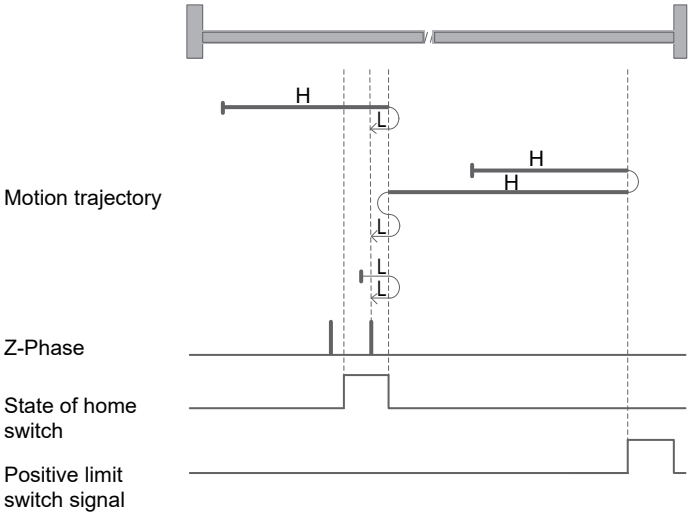
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.

Homing Method 8: Homing on a positive home switch rising edge and Z-Phase pulse, and reversing upon detecting a positive limit



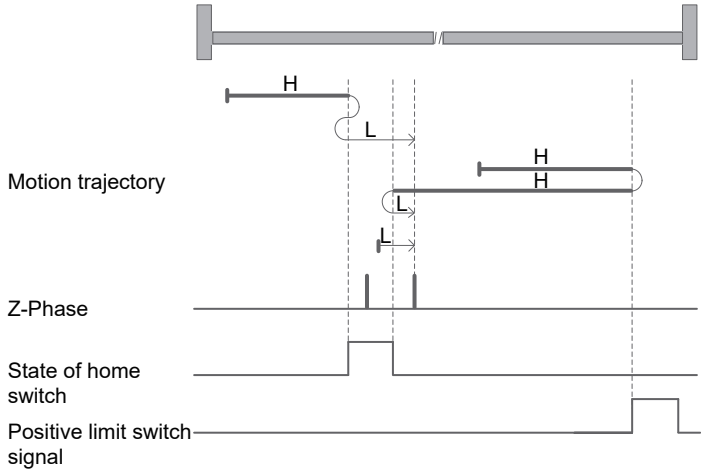
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a positive direction, and stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.

Homing Method 9: Homing on a positive home switch rising edge and Z-Phase pulse, and reversing upon detecting a positive limit



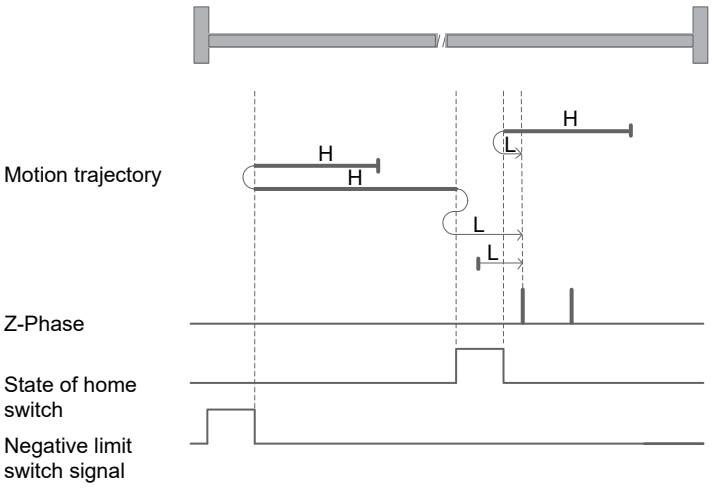
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.

Homing Method 10: Homing on a positive home switch falling edge and Z-Phase pulse, and reversing upon detecting a positive limit



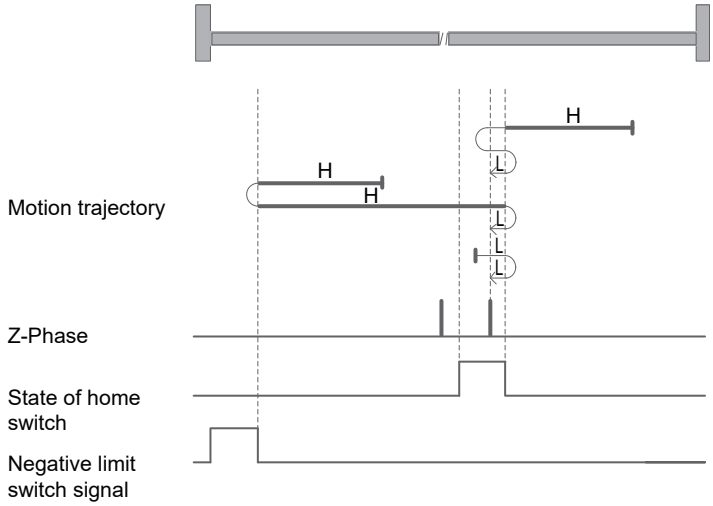
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a positive direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.

Homing Method 11: Homing on a negative home switch falling edge and Z-Phase pulse, and reversing upon detecting a negative limit



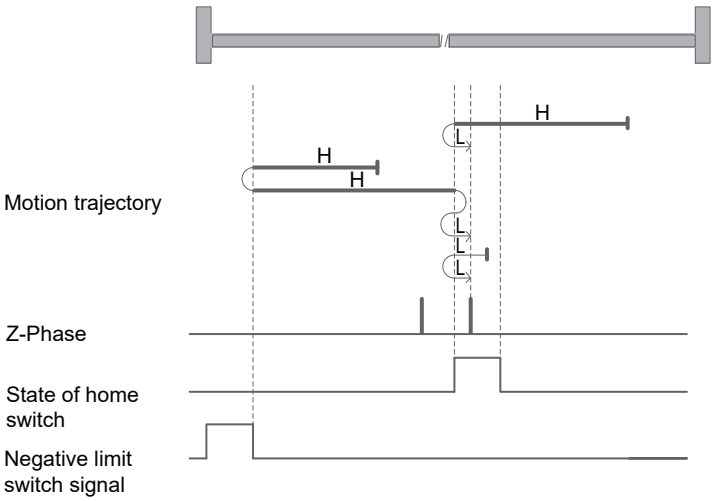
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.

Homing Method 12: Homing on a negative home switch rising edge and Z-Phase pulse, and reversing upon detecting a negative limit



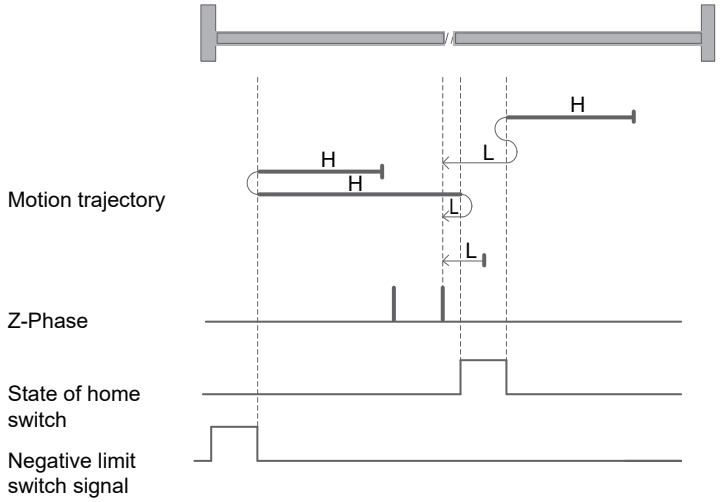
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a negative direction, and stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.

Homing Method 13: Homing on a negative home switch rising edge and Z-Phase pulse, and reversing upon detecting a negative limit



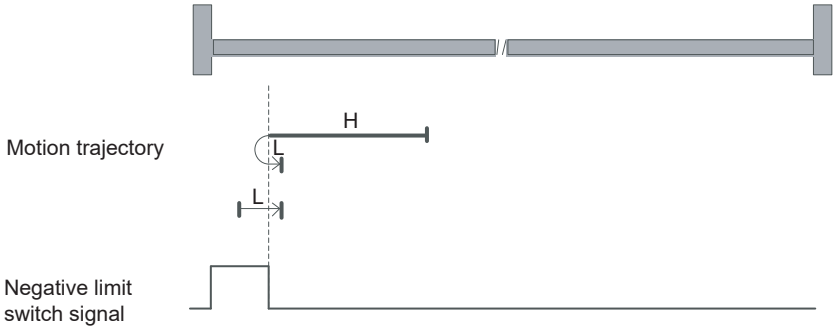
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops at the first Z-Phase after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops at the first Z-Phase after detecting the rising edge of HOM-SW.

Homing Method 14: Homing on a negative home switch falling edge and Z-Phase pulse, and reversing upon detecting a negative limit



- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a negative direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction, and stops at the first Z-Phase after detecting the falling edge of HOM-SW.

Homing Method 17: Homing on a negative limit switch



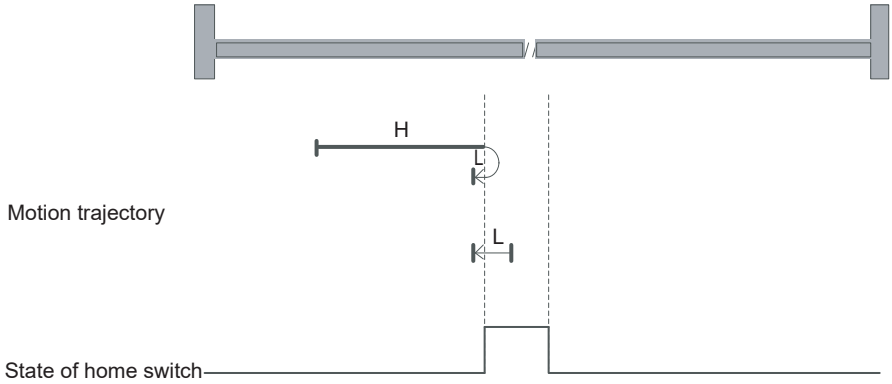
- When homing starts, NOT=0. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the falling edge of NOT.
- When homing starts, NOT=1. The motor starts homing at low speed in a positive direction, and stops after detecting the falling edge of NOT.

Homing Method 18: Homing on a positive limit switch



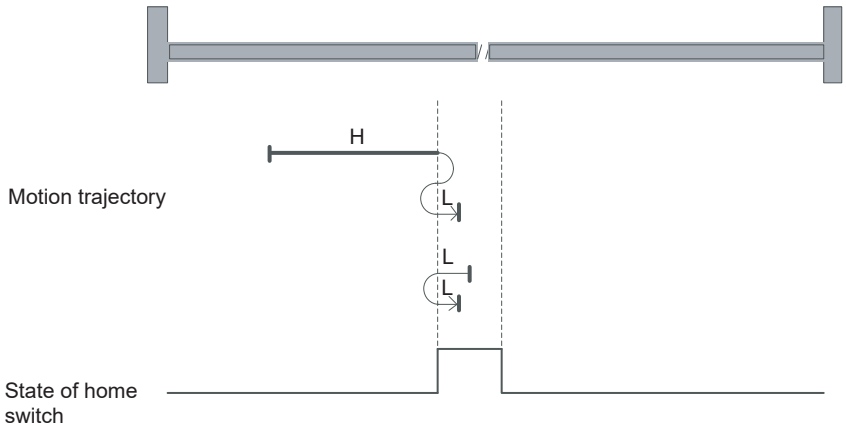
- When homing starts, POT=0. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the falling edge of POT.
- When homing starts, POT=1. The motor starts homing at low speed in a negative direction, and stops after detecting the falling edge of POT.

Homing Method 19: Homing on a positive home switch falling edge



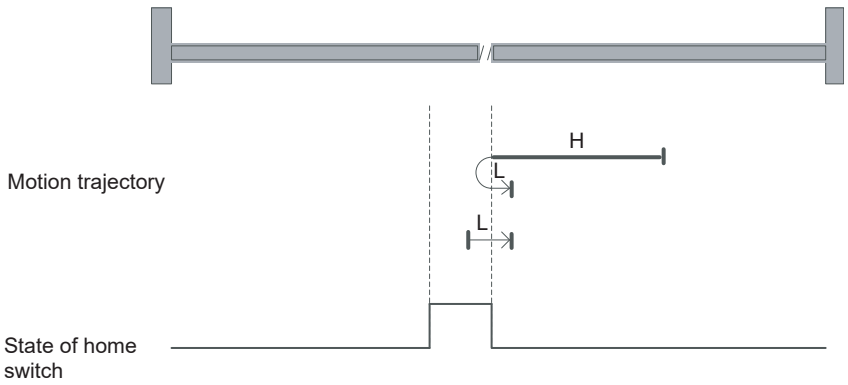
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction, and stops after detecting the falling edge of HOM-SW.

Homing Method 20: Homing on a positive home switch rising edge



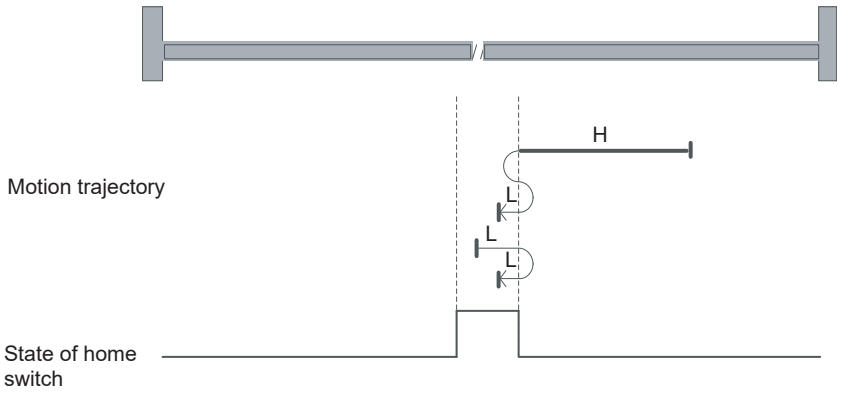
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the rising edge of HOM-SW.

Homing Method 21: Homing on a negative home switch falling edge



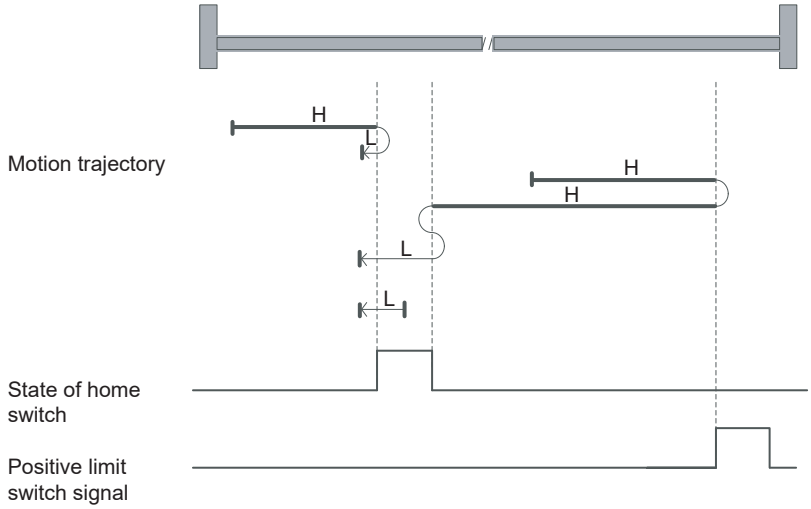
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction, and stops after detecting the falling edge of HOM-SW.

Homing Method 22: Homing on a negative home switch rising edge



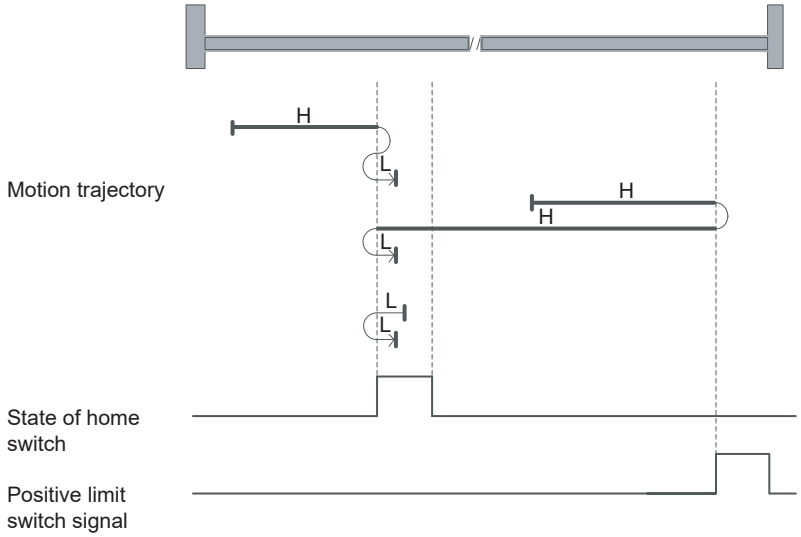
- When homing starts, HOM-SW=0. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the rising edge of HOM-SW.

Homing Method 23: Homing on a positive home switch falling edge, and reversing upon detecting a positive limit



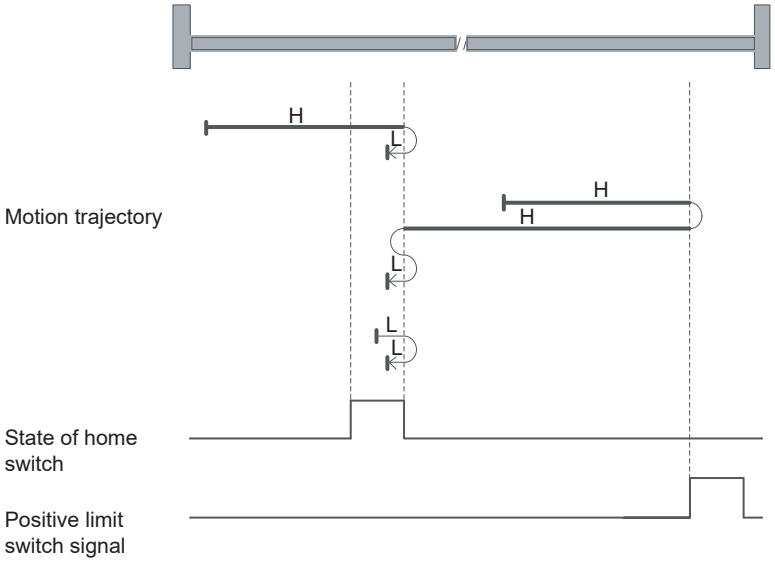
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction, and stops after detecting the falling edge of HOM-SW.

Homing Method 24: Homing on a positive home switch rising edge, and reversing upon detecting a positive limit



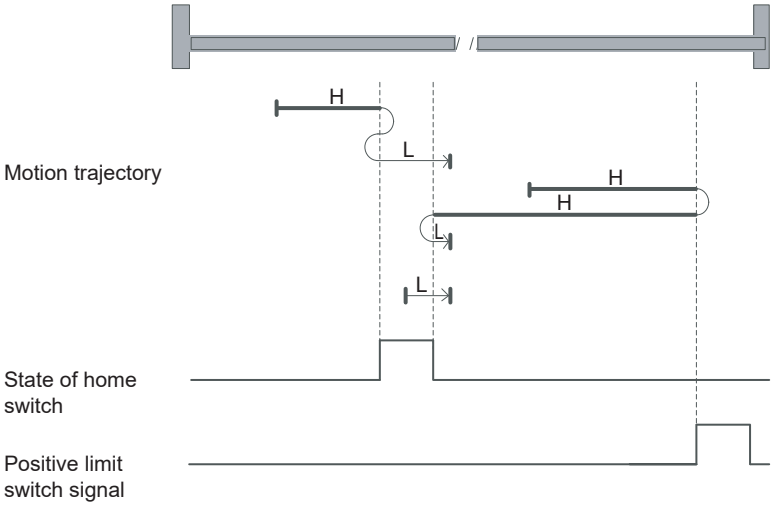
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a positive direction, and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the rising edge of HOM-SW.

Homing Method 25: Homing on a positive home switch rising edge, and reversing upon detecting a positive limit



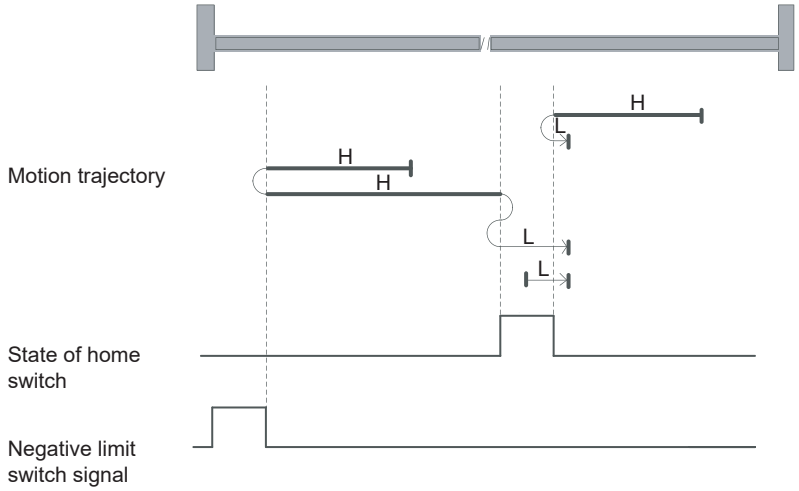
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the rising edge of HOM-SW.

Homing Method 26: Homing on a positive home switch falling edge, and reversing upon detecting a positive limit



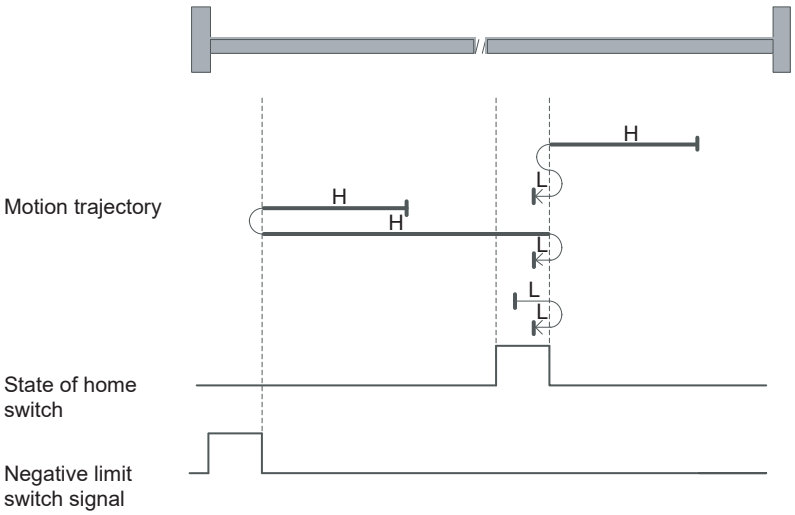
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a positive direction. After detecting the rising edge of POT, the motor decelerates, reverses, and runs at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a positive direction, and stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction, and stops after detecting the falling edge of HOM-SW.

Homing Method 27: Homing on a negative home switch falling edge, and reversing upon detecting a negative limit



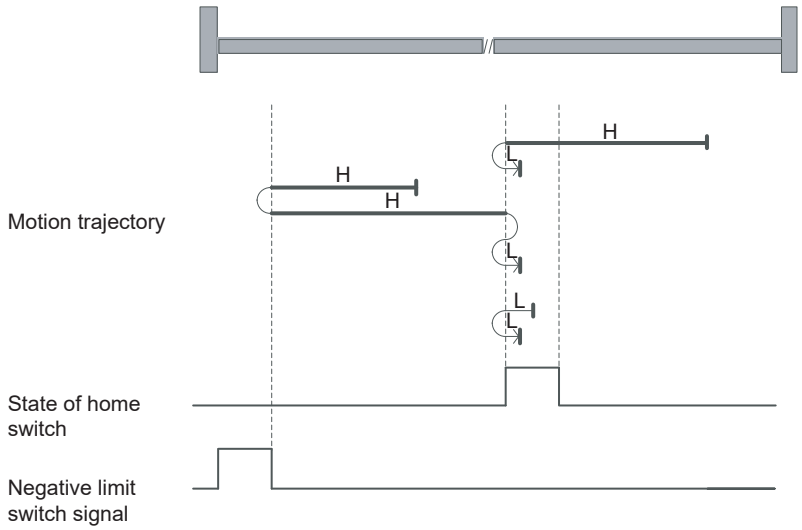
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction, and stops after detecting the falling edge of HOM-SW.

Homing Method 28: Homing on a negative home switch rising edge, and reversing upon detecting a negative limit



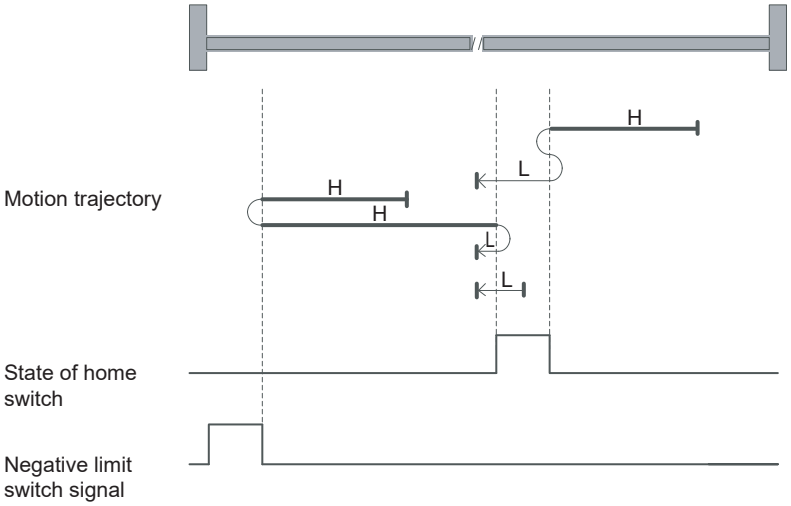
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a negative direction, and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a positive direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction. The motor stops after detecting the rising edge of HOM-SW.

Homing Method 29: Homing on a negative home switch rising edge, and reversing upon detecting a negative limit



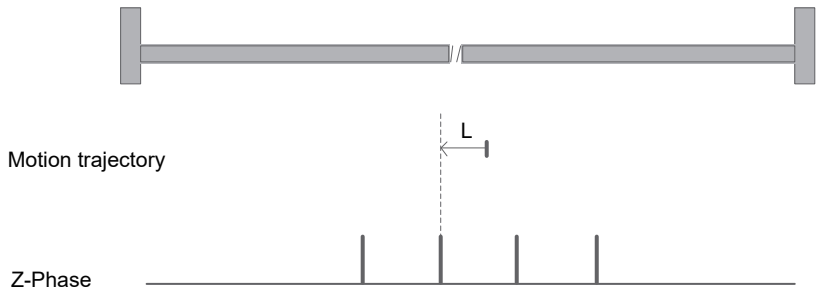
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a negative direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a positive direction and stops after detecting the rising edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction. After detecting the falling edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction. The motor stops after detecting the rising edge of HOM-SW.

Homing Method 30: Homing on a negative home switch falling edge, and reversing upon detecting a negative limit



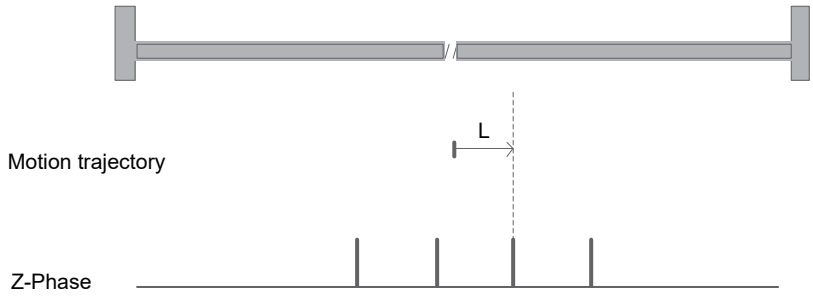
- When homing starts, HOM-SW=0 and the motor is on the positive side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, and runs at low speed in a positive direction until it reaches the position where HOM-SW is inactive, then the motor performs deceleration stop. Afterward, the motor runs at low speed in a negative direction and stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=0 and the motor is on the negative side of the home switch. The motor starts homing at high speed in a negative direction. After detecting the rising edge of NOT, the motor decelerates, reverses, and runs at high speed in a positive direction. After detecting the rising edge of HOM-SW, the motor decelerates, reverses, runs at low speed in a negative direction, and stops after detecting the falling edge of HOM-SW.
- When homing starts, HOM-SW=1. The motor starts homing at low speed in a negative direction, and stops after detecting the falling edge of HOM-SW.

Homing Method 33: Homing on negative first Z-Phase pulse



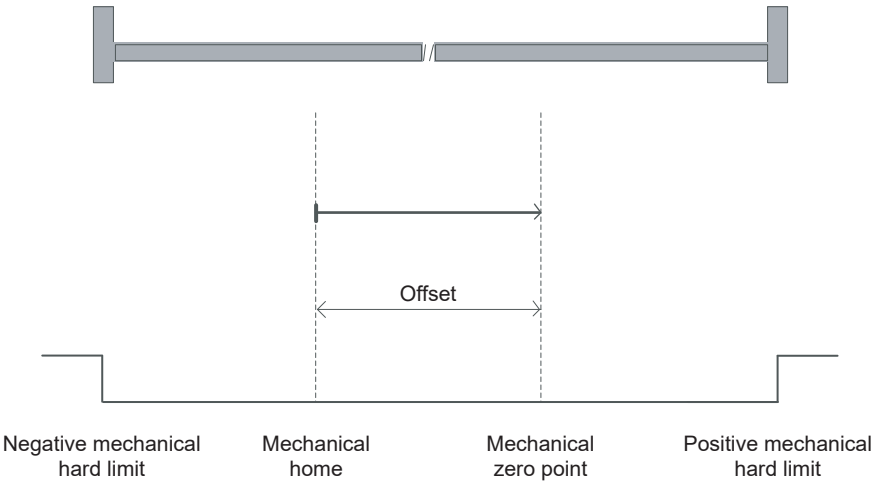
The motor starts homing at low speed in a negative direction and stops after detecting the first Z-Phase.

Homing Method 34: Homing on positive first Z-Phase pulse



The motor starts homing at low speed in a positive direction and stops after detecting the first Z-Phase.

Homing Method 35: Homing on current position as mechanical home



10

Applied Functions

This section provides the outline and settings of the applied functions such as electronic gear and gain switching.

10-1 Digital I/O Functions 10-2
10-1-1 Input Functions 10-2
10-1-2 Output Functions 10-4
10-2 Virtual Digital Input Function 10-9
10-3 Limit Function 10-11
10-4 Touch Probe Function 10-12
10-5 Torque Limit Function 10-16
10-6 Electronic Gear Function 10-17
10-7 Gain Switching Function 10-18
10-8 Dynamic Brake 10-20
10-9 Operation of Absolute System 10-22

10-1 Digital I/O Functions

C6E-series AC Servo Drives provide 6 general-purpose input ports and 3 general-purpose output ports to which you can allocate specific functions in the I/O Connector CN2. You can also set the logic for signals that can be allocated. Note that you cannot allocate more than one function to the same general-purpose input or output port, and that you cannot allocate the same function to different general-purpose input or output ports at the same time.

10-1-1 Input Functions

Function Inputs That Can Be Allocated

Function name	Symbol	Function code	
		Closed	Open
General-purpose input	GPIN	0	
Clear alarm	A-CLR	3	4
CW limit	CW-LMT	5	6
CCW limit	CCW-LMT	7	8
Gain select	GAIN-SEL	11	12
Emergency stop	E-STOP	13	14
Torque limit	TQ-LMT	19	20
Zero speed clamp	ZCLAMP	21	22
Velocity limit	V-LMT	37	38
Home switch	HOM-SW	39	40
Virtual CW limit	Virtual-CW-LMT	41	42
Virtual CCW limit	Virtual-CCW-LMT	43	44

Closed: Digital input optocoupler is closed Open: Digital input optocoupler is open

● General-purpose input

This is a general-purpose digital input, which does not affect motor operation, and the status of the input port can be monitored by the controller.

● Clear alarm

This function clears the drive alarm status via an external digital signal, but some alarm statuses cannot be cleared using this function.

● CW limit

This input disables movement in the positive direction. When this input is active, the motor performs deceleration stop at the quick stop deceleration 0x6085, bit1 (positive limit) of digital input 0x60FD is set to 1, and bit11 (Internal limit active) of statusword 0x6041 is set to 1.

An external positive limit signal used in the Homing mode.

● CCW limit

This input disables movement in the negative direction. When this input is active, the motor performs deceleration stop at the quick stop deceleration 0x6085, bit0 (negative limit) of digital input 0x60FD is set to 1, and bit11 (Internal limit active) of statusword 0x6041 is set to 1.

An external negative limit signal used in the Homing mode.

- **Gain select**

  This input selects the 1st or 2nd group of gain parameters via an external digital signal. When this input is active, the 2nd group of gain parameters is used; when this input is inactive, the 1st group of gain parameters is used.

- **Emergency stop**

  This input controls the motor's deceleration stop via an external digital signal. When this input is active, the motor performs deceleration stop according to the stop method set by 0x605E.

- **Torque limit**

  This input switches the torque limit value via an external digital signal. When this input is active, the motor limits its torque according to the I/O control method in the torque limit method set by 0x2A02.

- **Zero speed clamp**

  This input forcibly sets the command velocity to 0 via an external digital signal. When this input is active, if the absolute value of the motor's command velocity falls within the zero velocity width (subindex 1 of 0x2A16) and the duration reaches the time set by subindex 2 of 0x2A15, the servo system enters the zero position lock state. At this time, the internal position loop control of the drive enables the motor to return to the clamped position even if it rotates under external force.

- **Velocity limit**

  This input limits the motor velocity in the torque mode via an external digital signal. When this input is active, the velocity limit function is enabled, and the velocity limit value is set by 0x6081.

- **Home switch**

  This is the deceleration signal or home signal during the homing process in the Homing mode. When this input is active, bit2 (home switch) of digital input 0x60FD is set to 1.

- **Virtual CW limit**

  When this input is active, the motor operation will not be affected, and bit1 (positive limit) of digital input 0x60FD is set to 1.

  An external positive limit signal used in the Homing mode.

- **Virtual CCW limit**

  When this input is active, the motor operation will not be affected, and bit0 (negative limit) of digital input 0x60FD is set to 1.

  An external negative limit signal used in the Homing mode.

Input Port Related Parameters

Index	Subindex	Code	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A20	0x01	P5-00	Digital input 1 function	RW	UNSIGNED16	---	0 to 46	44	NO
	0x02	P5-01	Digital input 2 function	RW	UNSIGNED16	---	0 to 46	42	NO
	0x03	P5-02	Digital input 3 function	RW	UNSIGNED16	---	0 to 46	3	NO
	0x04	P5-03	Digital input 4 function	RW	UNSIGNED16	---	0 to 46	13	NO
	0x05	P5-04	Digital input 5 function	RW	UNSIGNED16	---	0 to 46	0	NO
	0x06	P5-05	Digital input 6 function	RW	UNSIGNED16	---	0 to 46	39	NO
0x2A21	0x01	P5-28	Digital input 1 filter	RW	UNSIGNED16	ms	0 to 8,000	0	NO
	0x02	P5-29	Digital input 2 filter	RW	UNSIGNED16	ms	0 to 8,000	0	NO
	0x03	P5-30	Digital input 3 filter	RW	UNSIGNED16	ms	0 to 8,000	0	NO
	0x04	P5-31	Digital input 4 filter	RW	UNSIGNED16	ms	0 to 8,000	0	NO
	0x05	P5-32	Digital input 5 filter	RW	UNSIGNED16	ms	0 to 8,000	0	NO
	0x06	P5-33	Digital input 6 filter	RW	UNSIGNED16	ms	0 to 8,000	0	NO

(Note) Do not set the parameters of 0x2A20 to values other than the function codes.

10-1-2 Output Functions

Function Outputs That Can Be Allocated

Function name	Symbol	Function code	
		Closed	Open
General-purpose output	GPOUT	0	
Alarm output	ALM	1	2
Warning output	WARN	3	4
Brake release output	BRK	5	6
Servo on status	SON-ST	7	8
Positioning completed	COIN	9	10
Dynamic following error output	DYM-LMT	11	12
Torque reached	TQ-REACH	13	14
Torque limit output	T-LMT	15	16
Velocity match output	V-COIN	17	18
Velocity reach output	AT-SPD	19	20
Velocity limit output	V-LMT	21	22
Servo Ready	S-RDY	23	24
Homing complete	HOMED	25	26
Soft limit CW	SLCW	27	28
Soft limit CCW	SLCCW	29	30
Position arrived output	IN-POS	31	32
Zero-speed detected output	Z-SPD	33	34
Torque match output	T-COIN	35	36

Closed: Digital output optocoupler is closed Open: Digital output optocoupler is open

● General-purpose output

This is a general-purpose digital output, and the output signal status can be forcibly controlled by the controller.

Alarm output

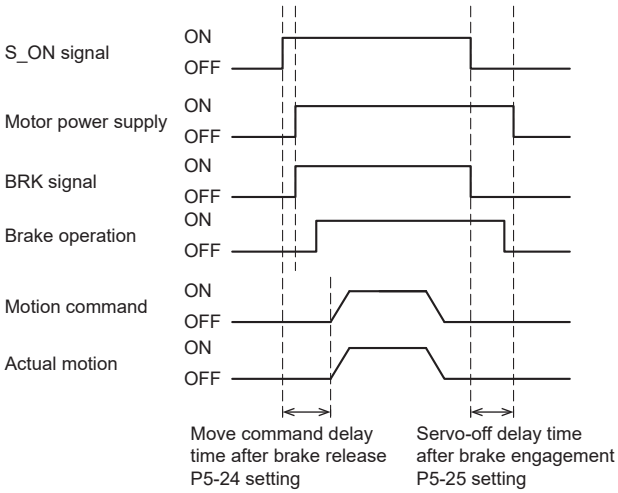
This output is active when the drive triggers an alarm of type "Fault".

Warning output

This output is active when the drive triggers an alarm of type "Warning".

Brake release output

This output is used to control the electromagnetic brake operation of the motor. To avoid brake damage due to operation delay of the brake, pay attention to the timing during use. When the drive works in the CSP, CSV, or CST operation mode, the P5-24 parameter settings are invalid. When designing the control program, sufficient time must be reserved to ensure that the brake is released before controlling the motor operation; otherwise, the motor brake will be damaged.

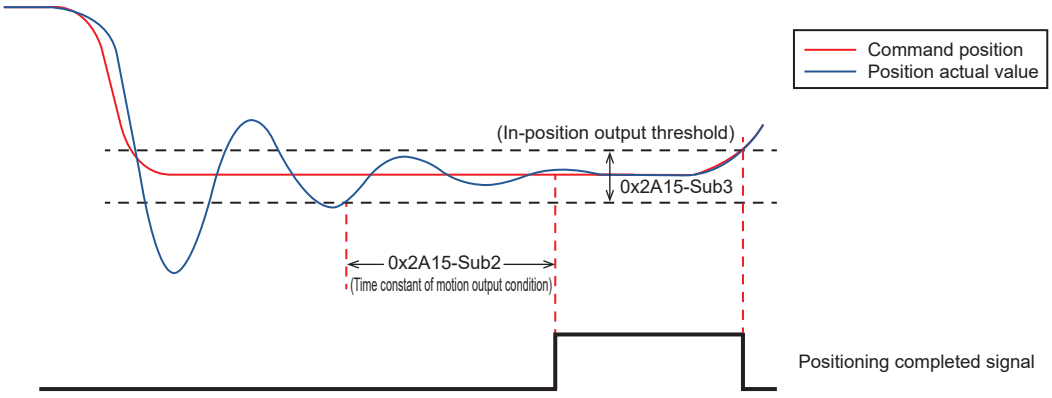


Servo On status

This output is active when Servo On is enabled.

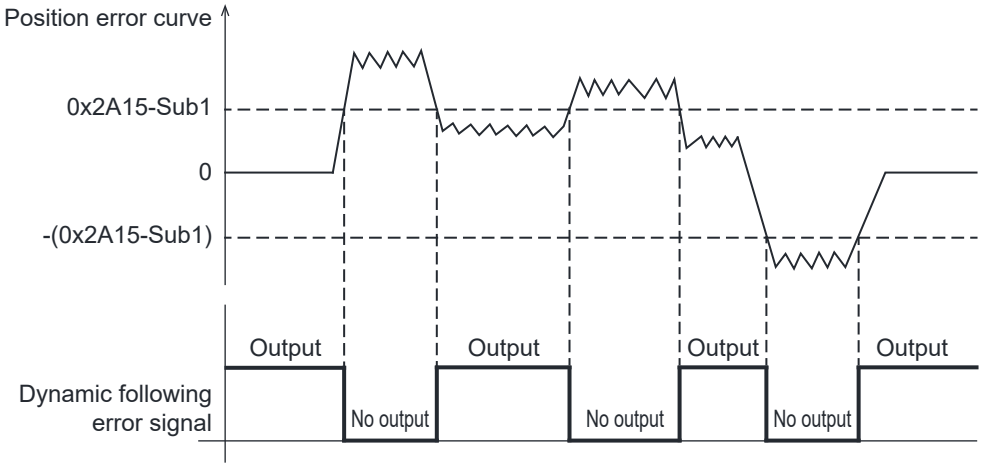
Positioning completed

This output is active when no new position command is received internally, the absolute value of the position deviation is within the in-position output threshold (subindex 3 of 0x2A15), and the duration reaches the time set by subindex 2 of 0x2A15.



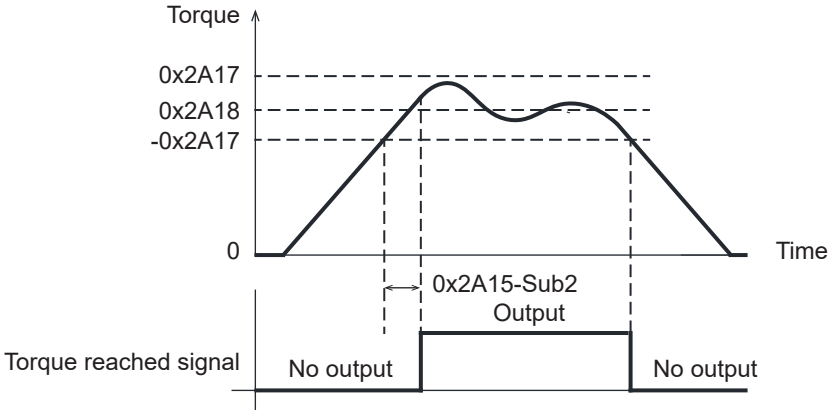
Dynamic following error output

This output is active when the absolute value of the position deviation is within the dynamic following error threshold (subindex 1 of 0x2A15).



Torque reached

This output is active when the absolute value of the difference between the absolute value of command torque and the target torque value when torque value reached (0x2A18) falls within the torque match width (0x2A17), and the duration reaches the time set by subindex 2 of 0x2A15.

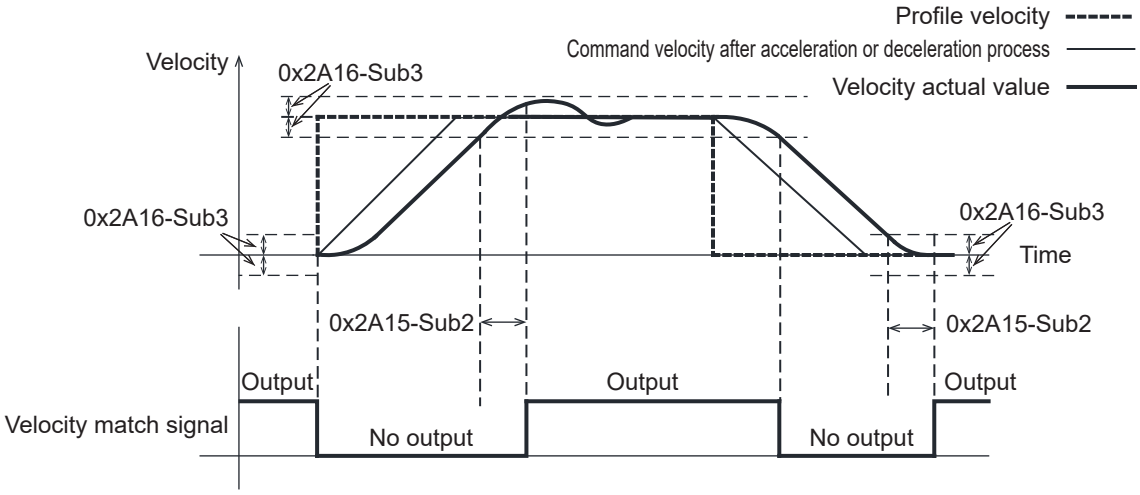


Torque limit output

This output is active when the output torque reaches the torque limit setting value in the corresponding torque limit method.

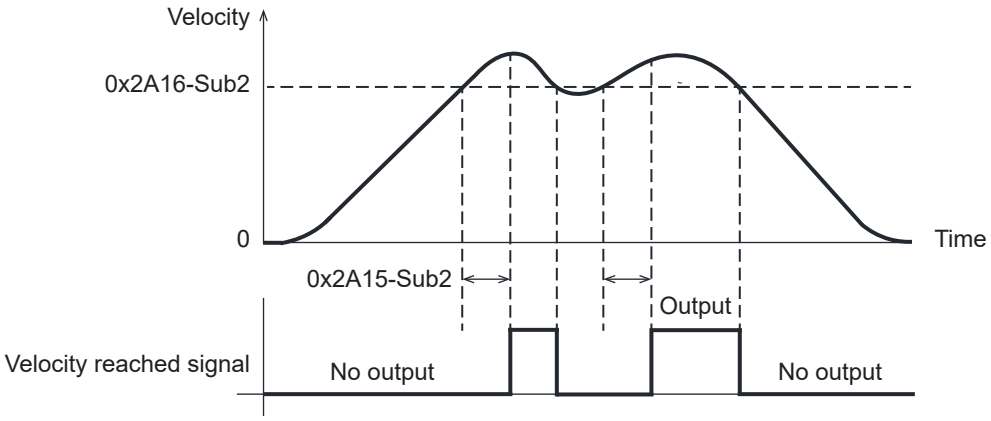
Velocity match output

This output is active when the absolute value of the velocity deviation falls within the velocity coincidence width (subindex 3 of 0x2A16), and the duration reaches the time set by subindex 2 of 0x2A15.



Velocity reach output

This output is active when the absolute value of the actual velocity exceeds the setting value of the target value of AT-speed output (subindex 2 of 0x2A16), and the duration reaches the time set by subindex 2 of 0x2A15.



Velocity limit output

This output is active when the actual velocity reaches the maximum velocity of the motor or the velocity limit in the torque mode.

Servo Ready

This output is active if no fault alarm occurs in the drive after the main circuit and the control circuit are powered on.

Homing complete

This output is active when the homing operation is completed normally.

Soft limit CW

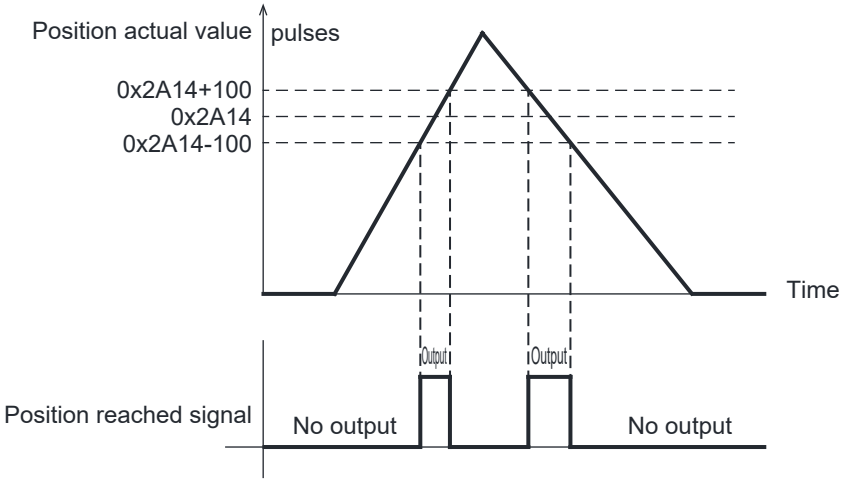
This output is active when the actual position exceeds the software position limit in the positive direction.

Soft limit CCW

This output is active when the actual position exceeds the software position limit in the negative direction.

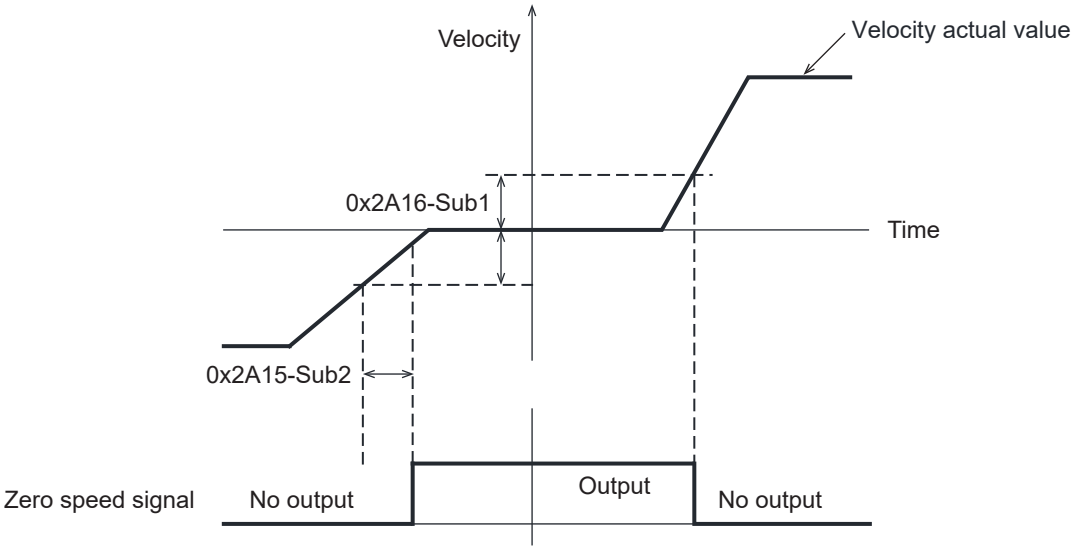
- **Position arrived output**

This output is active when the absolute value of the difference between the actual motor position and the reached position (0x2A14) does not exceed subindex 3 of 0x2A15.



- **Zero-speed detected output**

This output is active when the absolute value of the actual velocity falls within the zero velocity width (subindex 1 of 0x2A16), and the duration reaches 10 ms.



- **Torque match output**

This output is active when the absolute value of the difference between the command torque and the target torque (0x2A18) falls within the torque match width (0x2A17), and the duration reaches the time set by subindex 2 of 0x2A15.

Output port related parameters

Index	Subindex	Code	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A10	0x01	P5-12	Digital output 1 function	RW	UNSIGNED16	---	0 to 44	0	NO
	0x02	P5-13	Digital output 2 function	RW	UNSIGNED16	---	0 to 44	23	NO
	0x03	P5-14	Digital output 3 function	RW	UNSIGNED16	---	0 to 44	1	NO

(Note) Do not set the parameters of 0x2A10 to values other than the function codes.

10-2 Virtual Digital Input Function

The virtual digital input function forcibly controls the internal status of input signals via commands without being affected by the hardware circuit of the external digital input. The virtual digital input function enables all functions of external digital input signals without the drive receiving these signals, including gain select, torque limit, zero speed clamp, CW/CCW limit, and other functions controlled via digital input signals.

Virtual Digital Input Function Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AB0	0x01	Input status setting	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
	0x02	Input status enable	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO

Enabling Virtual Digital Input Function

Users can enable the virtual digital input function by setting the parameters for subindex 2 of 0x2AB0. Refer to the table below for the definition of each bit of subindex 2 of 0x2AB0.

Bit	Function	Description
0	Digital input 1	0: Virtual input disabled 1: Virtual input enabled
1	Digital input 2	
2	Digital input 3	
3	Digital input 4	
4	Digital input 5	
5	Digital input 6	
15 to 6	Reserved	Reserved, keep as "0"

Virtual Digital Input Signal Status Setting

Users can control the input signal status by setting the parameters for subindex 1 of 0x2AB0. Refer to the table below for the definition of each bit of subindex 1 of 0x2AB0.

Bit	Function	Description
0	Digital input 1	0: Virtual input open 1: Virtual input closed
1	Digital input 2	
2	Digital input 3	
3	Digital input 4	
4	Digital input 5	
5	Digital input 6	
15 to 6	Reserved	Reserved, keep as "0"

Function Examples

Use the virtual input function to close the optocouplers for digital inputs 1 to 5, while the signal status of digital input 6 is controlled by the external hardware circuit. The specific operation steps are as follows:

1 Enable the virtual input function for digital inputs 1 to 5, 0x2AB0-Sub2=0x001F

2 Close the optocouplers for virtual inputs 1 to 5, 0x2AB0-Sub1=0x001F



Precautions for Correct Use

- Each time the drive is powered on, be sure to re-enable the virtual digital input function; otherwise, the forced virtual input is inactive.
- Virtual digital input signals do not support the input signal filter function.

10-3 Limit Function

The limit function utilizes the limit signal sent by a switch connected to the drive I/O connector CN2, and disables motor rotation when the drive receives a valid limit signal.

Limit Function Related Parameters

Function name	Symbol	Function code		Operation type
		Closed	Open	
CW limit	CW-LMT	5	6	Deceleration stop
CCW limit	CCW-LMT	7	8	
Virtual CW limit	Virtual-CW-LMT	41	42	Normal operation
Virtual CCW limit	Virtual-CCW-LMT	43	44	

The limit function is enabled when the digital input of the drive is configured with the above function codes. The motor operates according to the set operation method when the drive detects a valid limit input signal.
Closed: Digital input optocoupler is closed Open: Digital input optocoupler is open

Operation description

Logic type	Function code	Operation description
Closed	5	When a valid limit input signal is detected: 1. The motor performs deceleration stop at the deceleration set by 0x6085. 2. bit0 and bit1 of the digital input 0x60FD are set to 1 according to the corresponding valid negative/positive limit signal. 3. bit11 (Internal limit active) of statusword 0x6041 is set to 1 4. The drive gives the corresponding limit alarm message.
	7	
Open	6	
	8	
Closed	41	When a valid limit input signal is detected: bit0 and bit1 of the digital input 0x60FD are set to 1 according to the corresponding valid negative/positive limit signal.
	43	
Open	42	
	44	

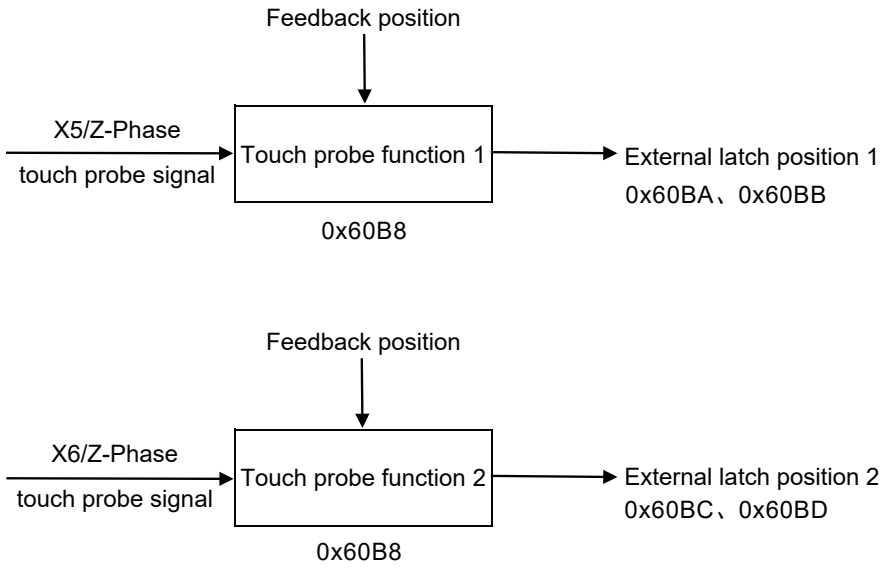
Precautions for Correct Use

- By factory default, the digital inputs 1 and 2, which serve as the limit signal input ports, are configured with the function codes 44 and 42, respectively.
- When the motor operation range is limited using the limit signal on the controller side and the limit input signal is connected to the drive, it is recommended to configure the limit function on the drive side with the limit function code of the type "Normal Operation", and control the motor to stop rotating after the controller detects the valid limit signal.
- When the operation type of the limit function is configured with the limit function code of deceleration stop, if only the CW limit is active, the motor cannot be driven in the positive direction, but can move normally in the negative direction; on the contrary, if only the CCW limit is active, the motor cannot be driven in the negative direction, but can move normally in the positive direction.

10-4 Touch Probe Function

The touch probe function is a position latching function, which can use interrupts to latch the position at the moment the external touch probe input signal or motor encoder Z-Phase signal changes. C6E-series products support simultaneous use of 2 touch probes. It can record positions corresponding to the rising edge and falling edge of each touch probe signal at the same time, enabling latching of 4 positions simultaneously. For the touch probe 1, either the digital input X5 or the motor encoder Z-Phase signal can be selected as the touch probe input signal. For the touch probe 2, either the digital input X6 or the motor encoder Z-Phase signal can be selected as the touch probe input signal. When X5 or X6 is used as the touch probe signal, the logic settings of this signal must be consistent with the settings of 0x60B8. This function is commonly used in applications such as high-speed measurement and packaging.

Composition of Touch Probe Function



Touch Probe Function Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60B8	---	Touch probe function control	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
0x60B9		Touch probe function status	RO	UNSIGNED16	---	---	0	TxPDO
0x60BA		Touch probe pos1 pos value	RO	INTEGER32	Pulses	---	0	TxPDO
0x60BB		Touch probe pos1 neg value	RO	INTEGER32	Pulses	---	0	TxPDO
0x60BC		Touch probe pos2 pos value	RO	INTEGER32	Pulses	---	0	TxPDO
0x60BD		Touch probe pos2 neg value	RO	INTEGER32	Pulses	---	0	TxPDO

● Touch Probe Function Controlword Setting

Users can set up the touch probe function via 0x60B8. Refer to the table below for the definition of each bit of 0x60B8.

Bit	Function	Value	Description
0	Touch probe 1 enable	0	Disable touch probe 1
		1	Enable touch probe 1
1	Touch probe 1 trigger type	0	Single trigger
		1	Continuous trigger
2	Touch probe 1 trigger source select	0	X5 signal
		1	Z-Phase signal
3	Reserved	0	Reserved, keep as "0"
		1	
4	Enable sample at touch probe 1 rising edge	0	Not use sample at touch probe 1 rising edge
		1	Use sample at touch probe 1 rising edge
5	Enable sample at touch probe 1 falling edge	0	Not use sample at touch probe 1 falling edge
		1	Use sample at touch probe 1 falling edge
6	Reserved	0	Reserved, keep as "0"
		1	
7	Reserved	0	Reserved, keep as "0"
		1	
8	Touch probe 2 enable	0	Disable touch probe 2
		1	Enable touch probe 2
9	Touch probe 2 trigger type	0	Single trigger
		1	Continuous trigger
10	Touch probe 2 trigger source select	0	X6 signal
		1	Z-Phase signal
11	Reserved	0	Reserved, keep as "0"
		1	
12	Enable sample at touch probe 2 rising edge	0	Not use sample at touch probe 2 rising edge
		1	Use sample at touch probe 2 rising edge
13	Enable sample at touch probe 2 falling edge	0	Not use sample at touch probe 2 falling edge
		1	Use sample at touch probe 2 falling edge
14	Reserved	0	Reserved, keep as "0"
		1	
15	Reserved	0	Reserved, keep as "0"
		1	

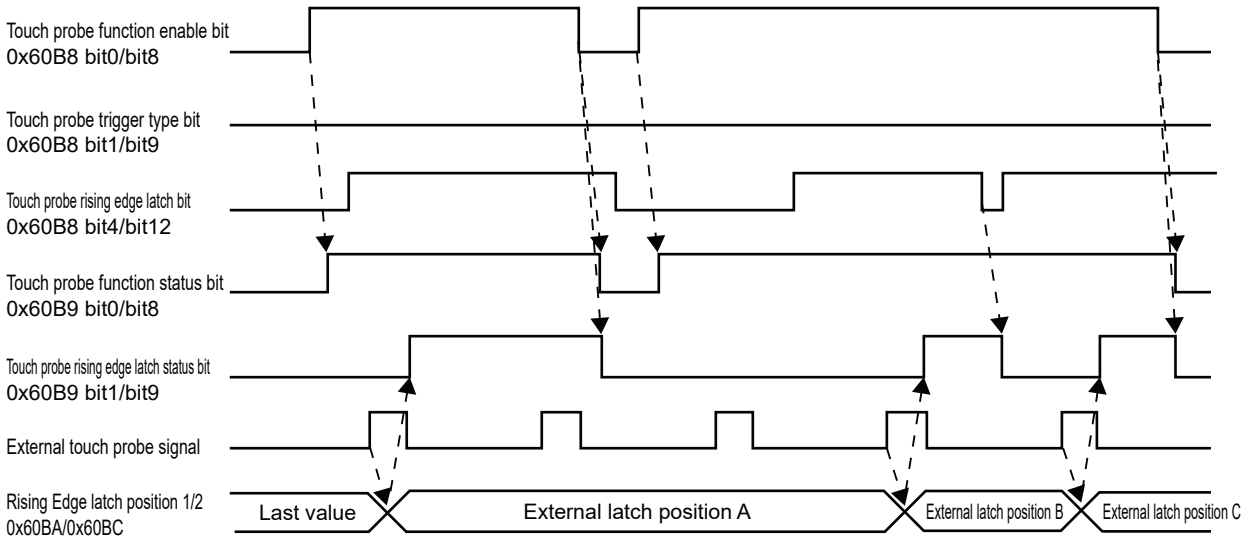
- Touch probe function status

Users can read the status of the touch probe function via 0x60B9. Refer to the table below for the definition of each bit of 0x60B9.

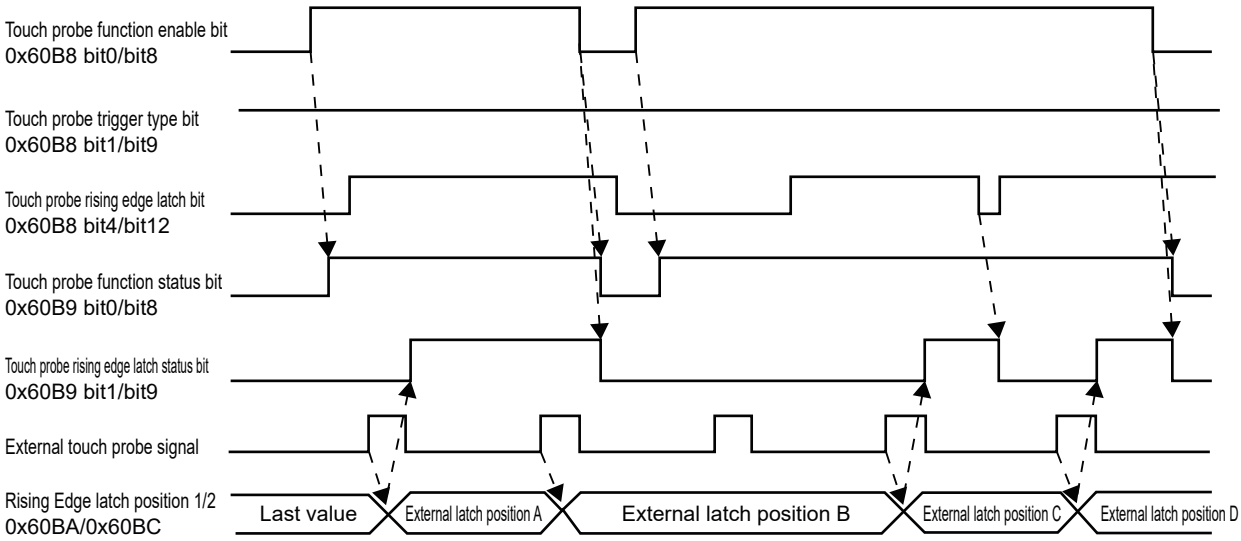
Bit	Function	Value	Description
0	Touch probe 1 status	0	Touch probe 1 disabled
		1	Touch probe 1 enable
1	Touch probe 1 rising edge value stored	0	Touch probe 1 no rising edge value stored
		1	Touch probe 1 rising edge value stored
2	Touch probe 1 falling edge value stored	0	Touch probe 1 no falling edge value stored
		1	Touch probe 1 falling edge value stored
3 to 7	Reserved	0	Reserved, keep as "0"
		1	
8	Touch probe 2 status	0	Touch probe 2 disabled
		1	Touch probe 2 enable
9	Touch probe 2 rising edge value stored	0	Touch probe 2 no rising edge value stored
		1	Touch probe 2 rising edge value stored
10	Touch probe 2 falling edge value stored	0	Touch probe 2 no falling edge value stored
		1	Touch probe 2 falling edge value stored
11 to 15	Reserved	0	Reserved, keep as "0"
		1	

Operation Sequence Diagram of Touch Probe Function

- Single trigger 0x60B8 bit1/bit9=0



- Continuous trigger 0x60B8 bit1/bit9=1



10-5 Torque Limit Function

The torque limit function controls the motor output torque by limiting the drive output current. C6E-series products switch the torque limit value according to the operation direction, the torque limit input signal, and the torque limit input commands from EtherCAT communications. This function is normally used when pressing is performed or when the torque at startup and during deceleration is suppressed to protect mechanical systems, etc.

Torque Limit Related Parameters

Index	Subindex	Code	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A02	---	P1-10	Torque limit method	RW	UNSIGNED16	---	0 to 6	1	NO
0x6073		P1-06	Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*1	NO
0x2A04		P1-25	2nd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2A05		P1-26	3rd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x2A06		P1-27	4th torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*1	NO
0x60E0	---	---	Positive torque limit value	RW	UNSIGNED16	0.1%	0 to 4,000	0	RxPDO
0x60E1	---	---	Negative torque limit value	RW	UNSIGNED16	0.1%	0 to 4,000	0	RxPDO

*1. The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to *"A-4 List of Maximum Torque Parameters* (P.A-14)".

(Note) 100.0% corresponds to 1 times the rated torque of the motor.

● Torque limit method

Based on the settings of the torque limit method (0x2A02), the following operations can be performed.

Torque limit method (0x2A02)	Positive torque limit value	Negative torque limit value
0	0x60E0	0x60E1
1	0x6073	
2	0x6073	0x2A04
3	TQ-LMT active: 0x6073	
	TQ-LMT inactive: 0x2A04	
4	Analog input torque limit	
5	TQ-LMT active: 0x6073	TQ-LMT active: 0x2A04
	TQ-LMT inactive: 0x2A05	TQ-LMT inactive: 0x2A06
6	Reserved	Reserved

(Note) 1. TQ-LMT indicates the digital torque limit input signal.
2. Torque limits are limited by the maximum torque limit value.
3. Changes to the torque limit value take effect immediately when the torque limit method is set to 0.

10-6 Electronic Gear Function

The electronic gear function obtains a value by multiplying the input position command received by the drive by the specified electronic gear ratio, and uses this value as the internal position command for position control. Users can set the actual distance the motor rotates or moves when the input position command is 1 command unit by using the function of frequency division (electronic gear ratio < 1) or frequency multiplication (electronic gear ratio > 1) of electronic gear ratio.

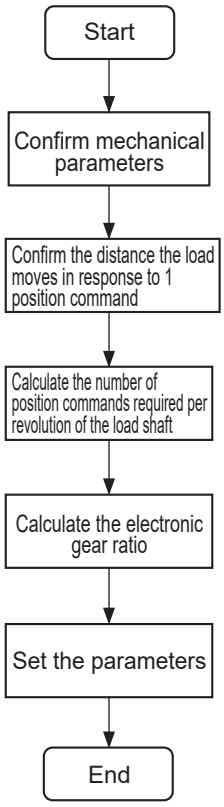
Electronic Gear Function Related Parameters

Index	Subindex	Code	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A90	0x00	P3-05	Command pulses per revolution	RW	UNSIGNED32	Pulses	1 to 2^{26}	8,388,608	NO
0x2A93	0x01	P3-00	Electronic gear ratio - numerator	RW	UNSIGNED32	---	1 to 2^{31}-1	67,108,864	NO
	0x02	P3-01	Electronic gear ratio - denominator	RW	UNSIGNED32	---	1 to 2^{31}-1	8,388,608	NO
	0x03	P3-16	Electronic gear function enable	RW	UNSIGHED16	---	0 to 1	0	---

$$\text{Internal position command} = \text{Position command} \times \text{Electronic gear ratio} = \frac{\text{Position command} \times \text{0x2A93-Sub1}}{\text{0x2A93-Sub2}}$$

Electronic Gear Ratio Setting Procedure

The electronic gear ratio varies depending on the mechanical structure. Follow the procedure below to set the ratio.



Confirm the reduction ratio of the decelerator, the gear pitch diameter in gear transmission, the pulley pitch diameter in pulley transmission, and the screw lead, etc.

Confirm the distance the load moves in response to 1 position command

Calculate the number of position commands required per revolution of the load shaft using the mechanical parameters and the distance the load moves in response to 1 position command

$$\text{Electronic gear ratio} = \frac{67108864}{\text{Number of position commands required per revolution of the load shaft}} \times \text{Reduction ratio}$$

(Reduction ratio refers to the ratio of input shaft speed to output shaft speed of the decelerator)

Set the electronic gear ratio when servo off according to the calculation results

Precautions for Correct Use

Do not change the electronic gear parameters when the motor is running.

10-7 Gain Switching Function

The gain switching function switches the position loop gain, velocity loop gain, and current loop command torque filter during the motion control of the drive. Users can optimize the response performance of the motor when it is stationary or running or when the load inertia changes by using gain switching.
The gain switching function of C6E-series AC servo products is only effective in the Profile position mode and the Profile velocity mode. It can be controlled by the servo internal status, the gain switching input signals, and the gain switching commands from EtherCAT communications.

Gain Switching Function Related Parameters

Index	Subindex	Code	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A69	0x01	P0-33	Automatic gain swiching method	RW	UNSIGNED32	---	0 to 4	0	NO
	0x02	P0-34	Gain switch with position error condition change	RW	UNSIGNED32	Pulses	0 to 2^{31}-1	0	NO
	0x03	P0-35	Gain switch with actual velocity condition change	RW	UNSIGNED32	Pulses/s	0 to 135*OD 0x2A90	0	NO
	0x04	P0-36	Gain switch with actual torque condition change	RW	UNSIGNED32	0.1%	0 to 4,000	10	NO
	0x05	P0-37	Gain switching time 1	RW	UNSIGNED32	ms	0 to 10,000	10	NO
	0x06	P0-38	Gain switching time 2	RW	UNSIGNED32	ms	0 to 10,000	10	NO

Gain Switching Mode Selection

There are two modes available for controlling the switching between the 1st and 2nd groups of gains of the servo drive. Refer to the table below for details:

Mode	Selection condition	Description
Mode 1	Digital inputs are configured with the gain switching function	Gain switching is performed according to the digital input status
Mode 2	Mode 1 is not selected	Gain switching is performed according to the conditions set by subindex 1 of 0x2A69

Priority: Mode 1 > Mode 2

Gain Switching Condition Setting

Value	Gain switching condition	Description
0	Fixed at 1st group of gains	Fixed at 1st group of gains
1	Large position deviation	Effective only in the Profile position mode
		In the 1st group of gains, when the absolute value of the actual position deviation exceeds the set value of subindex 2 of 0x2A69 and the duration reaches the time set by subindex 6 of 0x2A69, the gain switches to the 2nd group of gains. In the 2nd group of gains, when the absolute value of the actual position deviation is lower than the set value of subindex 2 of 0x2A69, and the duration reaches the time set by subindex 5 of 0x2A69, the gain returns to the 1st group of gains.
2	Large actual velocity	In the 1st group of gains, when the absolute value of the actual velocity exceeds the set value of subindex 3 of 0x2A69 and the duration reaches the time set by subindex 6 of 0x2A69, the gain switches to the 2nd group of gains. In the 2nd group of gains, when the absolute value of the actual velocity is lower than the set value of subindex 3 of 0x2A69, and the duration reaches the time set by subindex 5 of 0x2A69, the gain returns to the 1st group of gains.
3	Large actual torque	In the 1st group of gains, when the percentage of the absolute value of the actual torque relative to the rated torque of the motor exceeds the set value of subindex 4 of 0x2A69, and the duration reaches the time set by subindex 6 of 0x2A69, the gain switches to the 2nd group of gains. In the 2nd group of gains, when the percentage of the absolute value of the actual torque relative to the rated torque of the motor is lower than the set value of subindex 4 of 0x2A69, and the duration reaches the time set by subindex 5 of 0x2A69, the gain returns to the 1st group of gains.
4	Positioning completed	Effective only in the Profile position mode
		In the 1st group of gains, if positioning is not completed, the gain switches to the 2nd group of gains. In the 2nd group of gains, if positioning is completed and the duration reaches the time set by subindex 5 of 0x2A69, the gain returns to the 1st group of gains.

10-8 Dynamic Brake

The dynamic brake can be used to stop the Servomotor in the events such as Servo OFF or occurrence of an error. When the dynamic brake is working, the U/V/W phases of the motor are short-circuited, enabling the motor to stop quickly, thereby ensuring the safety of both equipment and personnel.

Dynamic Brake Related Parameters

Index	Subindex	Code	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A16	0x01	P5-42	Zero velocity width	RW	UNSIGNED32	Pulses/s	(0.1 to 2)*OD 0x2A90	0.5*OD 0x2A90	NO
0x2AB1	0x01	P1-29	Operation when servo off	RW	UNSIGNED32	---	0 to 5	0	NO
	0x02	P1-31	Mechanical brake action time during deceleration when servo off	RW	UNSIGNED32	ms	0 to 30,000	500	NO
	0x03	P1-30	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	P1-32	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO
0x606C	---	---	Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO

Description of Dynamic Brake Action When Servo Off

The dynamic brake action when servo off is set by subindex 1 of 0x2AB1.

Value	Description	
	Deceleration process	Stopped
0	Stop on max brake deceleration (set by 0x6085)	Keep in freerun state
1	Stop on max brake deceleration (set by 0x6085)	Dynamic brake action
2	Freerun state	Keep in freerun state
3	Freerun state	Dynamic brake action
4	Dynamic brake action	Keep in freerun state
5	Dynamic brake action	Dynamic brake action

Description of Dynamic Brake Action When Servo Reports Error

The dynamic brake action when the servo reports an error is set by subindex 3 of 0x2AB1.

Value	Description		
	During the deceleration process		Stopped
	Non-critical fault	Critical fault	
0	Freerun state		Keep in freerun state
1	Freerun state		Dynamic brake action
2	Dynamic brake action		Keep in freerun state
3	Dynamic brake action		Dynamic brake action
4	Stop on max brake deceleration (set by 0x6085)	Freerun state	Keep in freerun state
5	Stop on max brake deceleration (set by 0x6085)	Freerun state	Dynamic brake action
6	Stop on max brake deceleration (set by 0x6085)	Dynamic brake action	Keep in freerun state
7	Stop on max brake deceleration (set by 0x6085)	Dynamic brake action	Dynamic brake action

`Non-critical faults`: including position following error, over-temperature, power supply voltage out of range, drive main circuit power supply phase loss, EtherCAT communication error, and emergency stop alarm.
`Critical faults`: Among the fault alarms, apart from non-critical fault alarms, all others are critical fault alarms.

Precautions for Correct Use

- The dynamic brake is a stop function used in the event of servo abnormality. Do not use it to stop normal operation.
- The dynamic brake keeps acting even when the drive control power supply input is disconnected.
- Do not drive the motor to rotate by external force when the dynamic brake is activated; otherwise, the dynamic brake circuit may be damaged, even resulting in the servo smoking or catching fire.

10-9 Operation of Absolute System

The absolute encoder detects the motor position within one revolution and performs the motor revolution count. After power-on, the drive calculates the absolute position of the mechanical load based on the absolute position of the encoder, making repeated mechanical homing operations unnecessary.
C6E-series AC servo products are equipped with a 26-bit battery backup multi-turn absolute encoder. Refer to the table below for encoder specifications.

Item	Specifications
Motor model	R88M-C6*
Power supply voltage VCC	DC 4.5V to 5.5V(Typ 5V)
External battery voltage	DC 3.3 to 5.5V(Typ 3.6V)
Current consumption at power supply voltage VCC	Typ 160mA
Current consumption of external battery	Typ 15μA
Pulses per revolution	67,108,864 (26-bit)
Multi-turn revolution count	65,535(16-bit)
Communication method	Half-duplex asynchronous serial communication
Communication rate	4Mbps
Operating temperature	0 to 105 ℃

Absolute System Related Parameters

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x200C	---	Zero position	RW	UNSIGNED8	---	0 to 1	0	NO
0x2A90		Command pulses per revolution	RW	UNSIGNED32	Pulses	1 to 2^{26}	8,388,608	NO
0x2A9C	0x04	Absolute encoder usage	RW	UNSIGNED16	---	0 to 4	0	NO
	0x05	Absolute encoder reset	RW	UNSIGNED16	---	1 to 2	—	NO
	0x06	Absolute encoder multi-turn counter overflow value	RW	INTEGER16	Rve	0 to 32,767	0	NO
0x6064	---	Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO

Absolute Encoder Mode Selection

The operation mode of the absolute encoder can be set by subindex 4 of 0x2A9C. The default encoder mode before shipment is incremental mode. Refer to the table below for the setting and description of each mode.

Value	Mode	Description
0	Use as incremental mode	Used as the incremental encoder, not equipped with the function of memorizing position after power loss
1	Use as single-turn Abs. encoder	Used as the absolute encoder, requiring no battery power supply, equipped with the function of memorizing single-turn position after power loss
2	Use as multi-turn Abs. encoder	Used as the absolute encoder, equipped with the function of memorizing position after power loss. When the absolute position count is out of range, the drive will give an absolute position overflow warning, with the alarm code of ###. 
3	Use as multi-turn Abs. encoder without overflow	Used as the absolute encoder, equipped with the function of memorizing position after power loss. When the absolute position count is out of range, the drive gives no alarm.
4	Use as multi-turn Abs. encoder with overflow value configurable	Used as the absolute encoder, with configurable multi-turn overflow threshold. When the count value reaches the set threshold, the encoder position will be automatically reset to zero.

Absolute Encoder Zero Resetting

Used as the absolute encoder, which must be reset to zero when the machine is initially started to set the origin position, when the value of the command pulses per revolution (0x2A90) is changed, or when the drive experiences an absolute position loss or gives an absolute encoder multi-turn error alarm.
The absolute encoder alarms or multi-turn data can be cleared by setting the parameter values of subindex 5 of 0x2A9C. Refer to the table below.

Value	Function
0	No operation
1	Reset fault
2	Clear multi-turn data

The procedure of absolute encoder zero resetting using EtherCAT communication is as follows:

1 Control the motor to enter the Servo OFF state

2 Write 2 to subindex 5 of 0x2A9C to clear the multi-turn data of the encoder

3 Write 1 to subindex 5 of 0x2A9C to clear the encoder alarm

4 Write 1 to 0x200C to reset the position actual value (0x6064) to zero

5 The drive is powered off and then restarted

Position Data of Absolute Encoder

Assuming that the value of the command pulses per revolution (0x2A90) is M, and that the value of the position actual value (0x6064) is N, the count range of N when the absolute encoder operates in different modes is as follows:

- **Use as incremental mode**

  $-2^{31} \leqslant N \leqslant 2^{31}-1$

  After the drive is powered off and then restarted, the multi-turn count is automatically reset to zero, and the position actual value (0x6064) is 0.

- **Use as single-turn Abs. encoder**

  $\mathrm{Max}\{-2^{15}M, -2^{31}\} \leqslant N \leqslant \mathrm{Min}\{2^{15}M-1, 2^{31}-1\}$

  After the drive is powered off and then restarted, the multi-turn count is automatically reset to zero, and only the single-turn position value is recorded. The count range of single-turn position is as follows:
  0 to M-1 when the value of rotational direction setup (0x2A0A) is 0
  -(M-1) to 0 when the value of rotational direction setup (0x2A0A) is 1

- **Use as multi-turn Abs. encoder**

  $\mathrm{Max}\{-2^{15}M, -2^{31}\} \leqslant N \leqslant \mathrm{Min}\{2^{15}M-1, 2^{31}-1\}$

  After the drive is powered off and then restarted, the position actual value (0x6064) remains the value before the power loss.

11

Troubleshooting

This section explains the troubleshooting at startup, the alarm list, the causes of alarms and measures.

11-1 Troubleshooting at Startup 11-2
11-2 Alarm List 11-3
11-3 Causes of Alarms and Measures 11-5

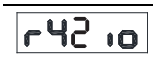
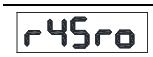
11-1 Troubleshooting at Startup

Refer to the table below for the fault symptoms that occur at startup of the servo drive and the countermeasures.

Startup process	Symptom	Cause	Measures
Power supply (L1, L2)	The digital tube is not lit	Control power supply voltage error	Measure the AC voltage between L1 and L2
		Servo drive failure	Return to factory for repair
	Digital tube displays 	No firmware was downloaded to the drive	Return to factory for repair
	Digital tube displays 	Refer to 🕮 *"11-3 Causes of Alarms and Measures* (P.11-5)"	

11-2 Alarm List

Display	Description	Alarm type	Drive status after alarm occurs	Resettable	Error code (0x603F)	DSP alarm code (0x200F)
r01ot	Drive power module over temperature	Fault	Servo off	Yes	0xFF03	0x00000008
r02ur	Drive internal voltage error	Fault	Servo off	Yes	0xFF05	0x00000010
r03uH	Drive over voltage	Fault	Servo off	Yes	0xFF02	0x00000020
r04HC	Drive over current	Fault	Servo off	No	0xFF01	—
r05LC		Fault	Servo off	No		
r06rC		Fault	Servo off	No		
r07Fb	FPGA error	Fault	Servo off	No	0xFF0D	0x00000010
r09Eb	Motor encoder disconnected	Fault	Servo off	No	0xFF07	0x00000200
r10PL	Position following error	Fault	Servo off	Yes	0xFF06	0x00000001
r11Lu	Drive low voltage	Fault	Servo off	Yes	0xFF36	0x00000020
r12ou	Over speed	Fault	Servo off	Yes	0xFF38	0x00080000
r13Lt	CW and CCW limit switch is triggered	Warning	The present status remains, and the motor cannot continue CW/CCW rotation.	Yes	0xFF33	0x00000006
r14cL	CCW limit is triggered	Warning	The present status remains, and the motor cannot continue CCW rotation.	Yes	0xFF32	0x00000002
r15cL	CW limit is triggered	Warning	The present status remains, and the motor cannot continue CW rotation.	Yes	0xFF31	0x00000004
r16CL	Current limit exceed	Fault	Servo off	Yes	0xFF34	0x00002000
r18EF	Save failed	Fault	Servo off	Yes	0xFF41	0x00000010
r20to	Safe torque off	Fault	Servo off	Yes	0xFF0B	0x00020000
r21rF	Regenerate failed	Warning	The present status remains	Yes	0xFF0A	0x00001000
r22uV	Drive under-voltage	Warning	The present status remains	Yes	0xFF3F	0x00100000
r24dd	Motion command received while motor disable	Warning	The present status remains	Yes	0xFF35	0x00008000
r25ur	Drive internal voltage alarm	Fault	Servo off	Yes	0xFF05	0x00000010
r26ur		Fault	Servo off	Yes		
r27E=	Digital input emergency stop	Fault	The status depends on the setting value of 0x605E.	Yes	0xFF3A	0x00200000
r30nE	Parameter read failed	Fault	Servo off	Yes	0xFF0E	0x00000010
r31bt	Absolute encoder battery under-voltage	Warning	The present status remains	Yes	0xFF3B	0x01000000
r32AP	Absolute position lost	Warning	The present status remains	No	0xFF3C	0x02000000

Display	Description	Alarm type	Drive status after alarm occurs	Resettable	Error code (0x603F)	DSP alarm code (0x200F)
	Absolute position overflow	Warning	The present status remains	No	0xFF3D	0x04000000
	Motor over temperature	Fault	Servo off	Yes	0xFF3E	0x00000008
	Drive processor over temperature	Fault	Servo off	Yes	0xFF03	
	Absolute encoder multi-turn error	Fault	Servo off	No	0xFF0F	0x10000000
	Motor stall	Fault	Servo off	Yes	0xFF10	0x20000000
	EtherCAT communication error	Fault	Servo off	Yes	0xFFC0 to 0xFFDA	0x40000000
	Homing parameter configuration error	Warning	The present status remains	Yes	0xFF45	0x80000000
	Motor collision alarm	Fault	Servo off	Yes	0xFF46	0x20000000
	Motor encoder communication error	Fault	Servo off	No	0xFF12	0x00000010
	IO function multiplexing	Warning	The present status remains	Yes	0xFF42	0x00008000
	CSP command exceeds limits within DC cycle	Fault	Servo off	Yes	0xFF13	0x00040000
	Motor runaway detected	Fault	Servo off	No	0xFF50	0x00000040
	Drive mismatch with motor	Fault	Servo off	No	—	—
	Control authority release fault	Fault	Servo off	Yes	0xFF67	0x00000010

11-3 Causes of Alarms and Measures

Display	Description	Cause	Measures	Solution
r01ot	Drive power module over temperature	Temperature of the heat sink and power component of the drive exceeds the over temperature protection threshold. 1. Ambient temperature is too high. 2. Drive operating temperature exceeds the specified value. 3. Overload, continue to use while the drive has exceed the rated load. 4. Drive cooling fan failure.	1. Reduce the drive operating temperature and improve the cooling conditions. 2. Increase the capacity of the drive and motor, increase acceleration/deceleration time, and reduce the load. 3. Replace the fan or return the servo drive for repairing.	Clear the alarm.
r02ur	Drive internal voltage error	The internal voltage is lower than the normal value.	Check the power supply voltage. If the alarm still exists, replace the drive.	Repower on to clear the alarm.
r03uH	Drive over voltage	Drive DC bus voltage is too high. 220VAC specification: Bus voltage higher than 420VDC 400VAC specification: Bus voltage higher than 800VDC 1. Power supply voltage exceeds the allowable input voltage range. 2. The Regeneration Resistor wiring is broken. 3.Built-in regenerative resistor is too small to absorb the regenerative energy. 4. External regenerative resistor is mismatched and cannot absorb the regenerative energy. 5. Drive failure (circuit failure).	1. Check and input correct voltage. 2. Ensure internal or external regenerative resistor parameters are properly configured. 3. Detect the resistance of the external resistor. Replace the external resistor if the value is ∞ . 4. Use an external regeneration resistor with a higher resistance value. 5. If the problem is not resolved as described above, replace the drive.	Clear the alarm.
r04HC r05LC r06rC	Drive over current	1. Drive fault. 2. Short circuit between motor phase wires (U, V, W). 3. Motor failure due to overheating or insulation damage. 4. Poor contact in motor wiring. 5. Excessive acceleration or deceleration settings applied to the motor. 6. Load was heavy and actual torque has exceeded the rated torque and kept running for a long time. 7. Electromagnetic brake remains engaged during operation. 8. The mechanical system experiences a collision or a sudden increase in load. 9. The electromagnetic brake is operating 10. In multi-axis systems, motor cables are incorrectly wired to the wrong axis, resulting in improper operation.	1. Disconnect the motor cables and servo on. If the fault persists, replace the servo drive. 2. Check for short circuits between the U, V, or W motor cable. Inspect connector terminals for burrs or deformation. 3. Check if the motor wires U, V and W are in the correct order, U-red, V-yellow, W-blue. 4. Measure the insulation resistance between motor phases U, V, W and the motor's ground wire. If insulation is poor, replace the motor. 5. Increase the capacity of the drive and motor, increase acceleration/deceleration time, and reduce the load. 6. Inspect the motor power connectors (U, V, W) for looseness or disconnection. Reinsert and tighten if necessary. 7. Verify if the gain parameters are properly tuned for the application. 8. Measure the voltage at the brake terminals to ensure proper brake release. 9. Ensure that the motor and encoder cables are correctly connected to the respective axis.	Repower on to clear the alarm.
r07Fb	FPGA error	Failed to read parameters during startup	If the alarm still exists after the drive is powered on again, please replace the drive or contact the manufacturer.	Repower on to clear the alarm.
r09Eb	Motor encoder disconnected	Failure to read valid encoder data for 8 consecutive control cycles.	1. Verify that the encoder cable is correctly connected to the motor. 2. Verify that the encoder cable is correctly connected to the drive. 3. Replace the encoder cable. 4. If the alarm persists after the drive is powered on again, replace the motor.	Repower on to clear the alarm.

Display	Description	Cause	Measures	Solution
r 10PL	Position following error	Position following error value exceeds the set value of the parameter P3-04(0x2AA8) (Position Error Alarm Threshold).	1. Verify whether parameter P3-04 (Position Error Alarm Threshold) is set too small for the application requirements. 2. Verify if the gain parameters are properly tuned for the application. 3. Check if the selected motor matches with the actual load, or if the acceleration/deceleration is too large. 4. Check whether torque limit parameters are set within a reasonable range to avoid restricting normal motion. 5. Ensure that the electronic gear ratio is configured correctly. 6. Check whether the mechanical part driven by the motor is stuck. 7. Check if the electromagnetic brake is released. 8. Ensure that the motor and encoder cables are correctly connected to the respective axis.	Clear the alarm.
r 11Lu	Drive low voltage	Drive DC bus voltage is too low. 220VAC specification: Bus voltage below 200VDC 400VAC specification: Bus voltage below 380VDC 1. Power supply voltage is low. 2. Lack of power capacity resulting in voltage drop due to inrush current during main power startup. 3. Drive failure (circuit failure).	Measure input voltage 1. Increase the power capacity, change the power supply. 2. Ensure correct power wiring and connections. 3. Check the drive's L1/L2/L3 terminals and verify the input voltage. 4. If the problem is not resolved as described above, replace the drive.	Clear the alarm.
r 12ou	Overspeed	Motor rotary velocity exceeds parameter P2-00 (0x2AA9) setting value.	Check if the command speed is within a reasonable range. 1. Avoid high command speed. 2. Make a gain adjustment when an overshoot has occurred due to a poor gain adjustment. 3. Check if the motor wires U, V and W are in the correct order, U-red, V-yellow, W-blue.	Clear the alarm.
r 13Lt	CW and CCW limit switch is triggered	1. Digital input negative & positive limit switch is activated. 2. The actual motor position has exceeded the software limit range.	1. Verify whether any external limit switches have been activated. 2. Confirm that the limit input function parameters are correctly configured. 3. Inspect the switches, wiring, and connections related to the limit inputs for any faults or abnormalities. 4. Ensure that the software limit settings are properly set and appropriate for the application.	Clear the alarm.
r 14cL	CCW limit is triggered	1. Digital input negative limit is activated. 2. The actual motor position exceeds the software negative limit range.		The alarm is automatically cleared after the abnormal condition disappears.
r 15JL	CW limit is triggered	1. Digital input positive limit is activated. 2. The actual motor position has exceeded the software positive limit range.		
r 16CL	Current limit exceed	Drive's output current reaches setting value 1. Acceleration or deceleration parameters are set too large. 2. Load was heavy and actual torque has exceeded the rated torque and kept running for a long time. 3. Electromagnetic brake remains engaged during operation. 4. The mechanical system experiences a collision or a sudden increase in load. 5. The electromagnetic brake is operating 6. In multi-axis systems, motor cables are incorrectly wired to the wrong axis, resulting in improper operation. 7. The motor power cable is disconnected or has an open circuit.	1. Verify if the gain parameters are properly tuned for the application. 2. Check if the selected motor matches with the actual load, or if the acceleration/deceleration is too large. 3. Check if the motor wires U, V and W are in the correct order, U-red, V-yellow, W-blue. 4. Increase the capacity of the drive and motor, increase acceleration/deceleration time, and reduce the load. 5. Measure the voltage at the brake terminals to ensure proper brake release.	Clear the alarm.
r 18EF	Save failed	Saving parameter failed.	Try saving again. If problems is not solved, please contact vendor.	Clear the alarm.
r20to	Safe torque off	Safe torque off function is activated. The input photocoupler of either or both safety input 1 or 2 is Open.	Check whether the safety input 1 and 2 wiring configuration or safety sensor settings, etc. are triggered.	Clear the alarm.

Display	Description	Cause	Measures	Solution
r21rF	Regenerate failed	1. The Regeneration Resistor wiring is broken. 2.Built-in regenerative resistor is too small to absorb the regenerative energy. 3. External regenerative resistor is mismatched and cannot absorb the regenerative energy. 4. Power supply voltage exceeds rated specifications. 5. Servo drive failure.	1. Verify correct wiring of the external regenerative resistor. 2. Ensure internal or external regenerative resistor parameters are properly configured. 3. Measure the resistance of the external regenerative resistor. If the measured value is ∞ (infinite), the resistor is either disconnected or damaged. Replace it if necessary. 4. Use an external regeneration resistor with a higher resistance value. 5. Confirm that the input power supply voltage is within the specified range 6. Reduce equipment operating speed and increase acceleration/deceleration time.	Clear the alarm.
r22uV	Drive under-voltage	Drive DC bus voltage is low. 220VAC specification: Bus voltage below 240VDC 400VAC specification: Bus voltage below 450VDC 1. Power supply voltage is low, instantaneous power failure has occurred. 2. Lack of power capacity resulting in voltage drop due to inrush current during main power startup. 3. Drive main power is not powered. 4. Drive failure (circuit failure).	Check the input voltage 1. Increase the power capacity or change the power supply. 2. Ensure correct power wiring and connections. 3. Check the drive's L1/L2/L3 terminals and verify the input voltage. 4. If the problem is not resolved as described above, replace the drive.	Clear the alarm. It is automatically cleared when voltage becomes normal.
r24dd	Motion command received while motor disable	Motion command is received while motor is disabled.	Please enable the motor, and then send the motion command.	Clear the alarm. The alarm is automatically cleared.
r25ur	Drive internal voltage error	The internal voltage is lower than the normal value.	Check the voltage of the power supply and contact the manufacturer if there is still a problem.	Repower on to clear the alarm.
r26ur				
r27E=	Emergency stop	Digital input emergency stop function is triggered.	1. Confirm whether the emergency stop input switch has been mistakenly triggered. 2. Verify that the emergency stop input logic configuration is set correctly.	The alarm is cleared after emergency stop input is released.
r30nE	Parameter read failed	Drive internal memory unit is in exceptional situation.	Repower on, if there is still a problem, contact vendor.	Repower on to clear the alarm.
r31bt	Absolute encoder battery under-voltage	The battery voltage of the absolute encoder is lower than the specified value of 3.2V.	Remind the user to replace the battery. To prevent loss of absolute position, replace the battery while the drive is powered on.	Repower on to clear the alarm.
r32AP	Absolute position lost	When the drive powers on, the absolute encoder operates in multi-turn mode. If the battery voltage drops below 2.8 V or if the battery power supply is interrupted, the internal multi-turn absolute position data may be lost. 1. The encoder is configured as absolute type, but no battery is installed. 2. Absolute encoder is being used for the first time since factory shipment. 3. Battery voltage is critically low and replacement was not performed promptly. 4. Battery was replaced while the drive power was off. 5. Poor connection or disconnection in the battery power supply wiring.	1. Check if the battery voltage is below 2.8 V; if so, replace the battery promptly. 2. Replace the battery when the drive is power-on. 3. Inspect the wiring between the battery holder (both internal and external) and the encoder to ensure proper power supply from the battery.	After replacing the battery, you need to perform the multi-turn zero clearing operation for the absolute encoder.

Display	Description	Cause	Measures	Solution
r33oP	Absolute position overflow	1. The number of turns of absolute multi-turn encoder exceeds the maximum allowable range: from -32,768 to 32,767. 2. Absolute position exceeds the maximum allowable range: from -2^{31} to 2^{31} -1.	1. Check whether the motor actual position exceeds the maximum range. 2. If the position is out of range, perform a multi-turn reset of the absolute encoder. 3. For unidirectional operation, set parameter P3-15 to 3 (multi-turn encoder does not count overflow).	The alarm is automatically cleared after performing the multi-turn zero clearing operation for the absolute encoder.
r34Ot	Motor over temperature	Motor temperature exceeds the specified threshold of 105 ℃ .	1. Check if the ambient temperature of the motor is too high. 2. Reduce the ambient temperature of the motor and improve the cooling conditions. 3. Increase the capacity of the drive and motor, increase the acceleration/deceleration time, and reduce the load. 4. Whether the motor is rubbed by the load. 5. When using a motor with an oil seal, please derate it. The output torque of the motor should be 70% of the rated torque of the motor. 6. The temperature rise and the motor torque are measured when the motor is mounted on a standard heat sink. When the motor mounting plate is small, in order to prevent the motor from overheating, please use it with derating. 7. If the temperature of the motor is normal and cannot be cleared by powering on again, please replace the motor.	Clear the alarm.
r35Ct	Drive processor over temperature	Drive processor temperature exceeds the specified threshold of 100 ℃ .	1. Check if the ambient temperature of the drive is too high. 2. Reduce the ambient temperature of the drive and improve the cooling conditions. 3. The drive needs to be installed on a metal backplane with good heat dissipation. 4. Increase the capacity of the drive and motor, increase acceleration/deceleration time, and reduce the load. 5. Inspect cooling fans for proper operation 6. If the temperature of the drive heatsink is normal and the alarm still exists after powering on again, please replace the drive.	Clear the alarm.
r36Nr	Absolute encoder multi-turn error	Absolute encoder multi-turn error 1. The encoder is configured as absolute type, but no battery is installed. 2. Absolute encoder is being used for the first time since factory shipment.	Need to perform the multi-turn zero clearing operation for the absolute encoder.	The alarm is automatically cleared after performing the multi-turn zero clearing operation for the absolute encoder.
r37Et	Motor stall protection	When operating in non-torque mode, the duration time that motor has been stalled exceeds the value set by P1-28(0x2A09).	1. Check whether the mechanical part driven by the motor is stuck. 2. Check if the electromagnetic brake is released.	Clear the alarm.
r38CE	EtherCAT communication error	EtherCAT communication error 1. EtherCAT communication configuration error. 2. EtherCAT communication interrupted.	1. Check the PDO mapping parameters for EtherCAT communication. 2. Check the DC synchronization settings. 3. Check whether the EtherCAT network topology is correct. 4. Check whehter the EtherCAT communication cable is securely connected. 5. Check for electromagnetic interference.	The alarm is cleared after communication becomes normal.

Display	Description	Cause	Measures	Solution
r39Hr	Homing parameter configuration error	Homing parameter configuration error 1. Use the homing method with limit signal, the limit switch is not configured. 2. Using the homing method with home switch, the home switch is not configured.	Check if the homing parameter is configured properly.	Clear the alarm.
r40HC	Motor collision protection	The instantaneous change of current exceeded the set value of P1-34 (0x2AC1). 1. The load driven by the motor collided with a fixed object. 2. The servo gain settings are improper, stiffness gain is too high. 3. The motor lost control due to incorrect U, V, and W phase sequence.	1. Check whether the motor has collided with any mechanical structure. 2. Check whether the value of parameter P1-34 is set too low. 3. Check whether the gain parameters are configured properly. 4. Check whether the U/V/W phase sequence of the motor is correct.	Clear the alarm.
r41Er	Motor encoder communication error	The servo drive detected abnormality in the communication with the encoder.	1. Check whether the encoder wiring is in accordance with the correct definition. 2. Check the connection between the encoder cable and the drive and motor. 3. Make sure the motor and drive are well grounded. 4. Use twisted pair shielded wire with good anti-interference ability for encoder wire. 5. Swap the motor and encoder wiring harness respectively to confirm whether the motor is abnormal. 6. Replaced by a new motor if there is still a problem.	Repower on to clear the alarm.
r42 io	IO function multiplexing	The functions of I/O signals used in the SCL commands are non general-purpose functions.	1. Configure the function of the relevant I/O signal as a general-purpose function. 2. Use the I/O signals whose functions are general-purpose functions.	Clear the alarm.
r44CU	CSP command exceeds limits within DC cycle	The position command variation within a single DC synchronization cycle exceeds the set value of P1-43 (0x2AC5).	1. Check whether OD 0x2AC5 value is set too low, and adjust the set value to over 120% of maximum trajectory velocity. 2. If possible, reduce position command delta per DC sync cycle. 3. Set a reasonable value for OD 0x2AC5 based on the DC synchronization cycle.	Clear the alarm.
r45ro	Motor runaway detected	1. Drive fault. 2. Incorrect wiring sequence of motor phases U, V, and W. 3. Poor contact in motor wiring. 4. Encoder initial angle error. 5. Motor operating in regenerative mode while runaway detection is enabled. 6. Improper gain tuning.	1. Disconnect motor cables and servo- enable. If the alarm persists, replace the drive device. 2. Check if the motor wires U, V and W are in the correct order, U-red, V-yellow, W-blue. 3. Inspect the motor power connectors (U, V, W) for looseness or disconnection. Reinsert and tighten if necessary. 4. Reconnect motor power cables and encoder cables to their designated ports on both drive and motor. 5. Optimize servo gains. 6. It is recommended to disable the runaway protection function for the vertical loads. 7. If the problem is not resolved as described above, replace the motor.	Clear the alarm.
r66d=	Drive mismatch with motor	Drive voltage is incompatible to motor voltage.	Replace drive or motor to a matching voltage level.	The alarm is cleared after matching correctly.
r68cr	Control authority release fault	1. Cable disconnection 2. Excessive disturbance in communication 3. The computer is busy and the Servo Drive failed to receive commands from the software	1. Ensure proper cable connection 2. Reduce environmental disturbance 3. Reduce the computer processing load and shut down other applications	Clear the alarm

12

Maintenance and Inspection

This section explains maintenance and inspection of the Servomotors and Servo Drives.

12-1 Periodic Maintenance 12-2
12-1-1 Inspection Items and Cycles 12-2
12-2 Servo Drive Lifetime 12-3
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12-4 Replacing the Servomotor or Servo Drive 12-5

12-1 Periodic Maintenance

⚠ CAUTION

After replacing the Servo Drive, transfer to the new Servo Drive all data needed to resume operation, before restarting operation.
Equipment damage may result.



Do not repair the Servo Drive by disassembling it.
Electric shock or injury may result.



Servomotors and Servo Drives contain many components and will operate properly only when each of the individual components is operating properly.
Some of the electrical and mechanical components require maintenance depending on application conditions. Periodic inspection and replacement are necessary to ensure proper long-term operation of Servomotors and Servo Drives. (Quoted from *The Recommendation for Periodic Maintenance of a General-purpose Inverter* published by JEMA.)

The periodic maintenance cycle depends on the installation environment and application conditions of the Servomotors and Servo Drives.
Recommended maintenance times are given below for Servomotors and Servo Drives. Use these for reference in periodic maintenance.

12-1-1 Inspection Items and Cycles

The normal operating conditions for servos are as follows:
Average annual ambient temperature: 30 ℃
Average load factor: below 80 %
Daily operating time: less than 20 hours
The routine inspection items are listed below:

Type	Inspection cycle	Inspection item
Routine inspection	Routine	• Check the ambient temperature, humidity, dust, and foreign objects, and check whether condensation occurs
		• Check for abnormal vibration or noise
		• Power supply voltage
		• Unusual odor
		• Check that fans are operating normally and that the vents are free of foreign objects
		• Check connectors for looseness
		• Check for foreign objects between cables and connectors, and check for exposed cable conductors
		• Check fasteners for looseness

12-2 Servo Drive Lifetime

- The lifetime of Servo Drive depends on application conditions. Under an ambient temperature of 30 ºC, the rated input voltage of the drive, an average output power of 80 % of the rated value, and a 20-hour duty cycle, the design life expectancy is 5 years.
- The use of the Servo Drive in a hot environment shortens its lifetime. We recommend that the ambient temperature and the power supply ON time be reduced as much as possible to lengthen the lifetime of the Servo Drive.
- The lifetimes for the different parts of Servo Drive are given below.

Name	Standard replacement cycle	Remarks
Cooling fan	2-3 years (10,000-30,000 hours)	The standard replacement cycle is for reference only. Replacement is still required if an abnormality occurs, even if the standard replacement cycle has not yet expired.
Power-on buffer relay	Approximately 10,000 operations (depending on operating conditions)	
Buffer resistor	Approximately 20,000 operations (depending on operating conditions)	
Dynamic brake relay	Approximately 1,000 operations (depending on operating conditions)	
Dynamic brake resistor		

12-3 Servomotor Lifetime

The lifetimes for the different motor parts are listed below.

Name	Lifetime
Bearing	14,000 hours
Oil seal	5,000 hours (models with oil seal)
Encoder	30,000 hours
Brake	ON/OFF 1,000,000 times

The operating conditions are determined as follows.

- Operating ambient temperature: 40 °C
- Within the range of allowable axial load
- Rated operation (rated torque and rated rotation speed)
- Installation as specified in this manual
- Operation is not repeated with the motor shaft rotation at an angle of 45° or less, which causes the fretting.

The servomotor output shaft material is not rust-resistant. Although grease is used for rust prevention at the factory, if the storage time exceeds six months, please check the condition of the motor shaft every three months and add appropriate anti-rust grease as needed to ensure the motor shaft is free from corrosion.

Oil seal can be replaced for repair.

When the Servomotor is used for a belt hook such as timing pulley, the radial load during motor operation is generally two or more times the static load. Consult with the belt and pulley manufacturers to adjust designs and system settings so that the motor allowable axial load is not exceeded even during operation. If the Servomotor is used under a shaft load that exceeds the allowable limit, the motor shaft can be broken and the bearings can be damaged.

12-4 Replacing the Servomotor or Servo Drive

Use the following procedure to replace the Servomotor or Servo Drive.

Replacing the Servomotor

1 Replace the Servomotor.

2 Perform the Motor Setup.

- The Servo Drive performs a motor detection when it is powered on. If the voltage level is different, the error code r66de will be displayed. Replace the motor with the correct one in time. When the voltage is the same but the power is different, pay attention to the motor's maximum torque limits P1-06, P1-25, P1-26, and P1-27.

3 In the position control, perform origin adjustment.

- When you replace the motor, the motor's origin position (phase Z) may deviate, so you must perform origin adjustment.
- Refer to the position controller's manual for details on performing origin adjustment.



Additional Information

With the Sysmac Studio, you can clear the relevant error codes of the Servo Drive.

Replacing the Servo Drive

1 Take a record of all object settings.

Use the Sysmac Studio to read all of the servo parameters in the Parameters tab page and save them in a file.

2 Replace the Servo Drive.

3 Set the objects.

Use the Sysmac Studio to write all of the servo parameters in the Parameters tab page.

4 Power off and restart the Servo Drive.

Power off and restart the Servo Drive according to the requirements of actual parameter settings.

Clearing Motor Error Message

1 Start the Sysmac Studio and go online with the Servo Drive via EtherCAT or USB communications.

2 In the Sysmac Studio, right-click the target Servo Drive under **Configurations and Setup**, and select **Motor and Encoder**.

3 Click the **Reset Error** button in the **Encoder Properties** panel.

13

Object Dictionary

This section explains the classification, data types, and object attributes of the object dictionary.

13-1 Object Dictionary Description 13-2
13-1-1 Object Dictionary Classification 13-2
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13-1 Object Dictionary Description

The object dictionary is the most important part of the device specification. It consists of an ordered set of parameters and variables that contain device descriptions and device network status. Each object is addressed using a 16-bit index value, and an 8-bit subindex is defined to allow access to individual elements in the data structure.

13-1-1 Object Dictionary Classification

Refer to the table below for the object dictionary structure diagram.

Index	Object
0x0000	Not used
0x0001 - 0x001F	Static data types (standard data types, such as BOOL, INTEGER16)
0x0020 - 0x003F	Complex data types (predefined structures composed of basic data types, such as PDO CommPar and SDO Parameter)
0x0040 - 0x005F	Manufacturer-defined complex data types
0x0060 - 0x007F	Device subprotocol-defined static data types
0x0080 - 0x009F	Device subprotocol-defined complex data types
0x00A0 - 0x0FFF	Reserved
0x1000 - 0x1FFF	Communication subprotocol area
0x2000 - 0x5FFF	Manufacturer-specific subprotocol area
0x6000 - 0x9FFF	Standard device subprotocol area
0xA000 - 0xFFFF	Reserved

13-1-2 Data Types

Refer to the table below for the data types used in this document.

Data type	Size	Range
BOOL	---	0 to 1
UNSIGNED8	1 byte	0 to 2^8-1
UNSIGNED16	2 bytes	0 to 2^{16}-1
UNSIGNED32	4 bytes	0 to 2^{32}-1
INTEGER8	1 byte	-2^7 to 2^7-1
INTEGER16	2 bytes	-2^{15} to 2^{15}-1
INTEGER32	4 bytes	-2^{31} to 2^{31}-1
Visible string	---	---

13-1-3 Object Property Description

Refer to the table for the attributes contained in objects in C6E EtherCAT.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO

Item	Description
Index	Object index given by a four-digit hexadecimal number
Subindex	Object subindex given by a two-digit hexadecimal number
Name	Object name/subindex name
Access type	RO: Read only RW: Read and write
Data type	Refer to “*13-1-2 Data Types* (P.13-2)”.
Unit	Physical units
Setting range	The range of data that can be set
Default setting	Default value set before shipment
PDO	RxPDO: Reception PDOs can be mapped TxPDO: Transmission PDOs can be mapped NO: PDOs cannot be mapped

13-2 1000H Group Common Object Dictionary

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1000	---	Device Type	RO	UNSIGNED32	---	---	0x00020192	NO

This object indicates the device subprotocol type.

Bit	Name	Description
0 to 15	Device subprotocol	0x0192: CiA402
16 to 23	Type	0x02: Servo Drive
24 to 31	Mode	Reserved

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1001	---	Error Register	RO	UNSIGNED8	---	---	0	NO

This object indicates the error type that occurs in the Servo Drive. When a bit is set to 1, it indicates that an error defined by that bit has occurred.

Bit	Description	Bit	Description
0	Generic error	4	Communications error
1	Current error	5	Device subprotocol-specific error
2	Voltage error	6	Reserved
3	Temperature error	7	Reserved

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1008	---	Manufacturer Device Name	RO	Visible string	---	---	---	NO

This object indicates the Servo Drive name.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1009	---	Manufacturer Hardware Version	RO	Visible string	---	---	Depends on the hardware version	NO

This object indicates the version of the Servo Drive hardware.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x100A	---	Manufacturer Software Version	RO	Visible string	---	---	Depends on the software version	NO

This object indicates the version of the Servo Drive software.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1010	---	Store Parameters	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	1	NO
	0x01	Store Parameters	RW	UNSIGNED32	---	0 to 2^{32}-1	0	NO

Specific servo parameters are saved in the Servo Drive non-volatile memory.

Storing is executed when "65766173h" (ASCII code: save) is written to subindex 0x01. Upon completion, the value of this object is automatically restored to 0, whether the operation succeeds or not.

MSB			LSB
e	v	a	s
65h	76h	61h	73h

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1011	---	Restore Default Parameters	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	1	NO
	0x01	Restore Default Parameters	RW	UNSIGNED32	---	0 to 2^{32}-1	1	NO

Specific servo parameters are restored to default settings, but cannot be saved automatically. If you want to save the parameters, save them to the Servo Drive non-volatile memory according to the method described in 0x1010. Restoring to default settings is executed when "64616F6Ch" (ASCII code: load) is written to subindex 0x01. Upon completion, the value of this object is automatically restored to 1, whether the operation succeeds or not.

MSB			LSB
d	a	o	l
64h	61h	6Fh	6Ch

(Note) Restart the Servo Drive to apply the parameter settings.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1018	---	Identity Object	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Vendor ID	RO	UNSIGNED32	---	---	0x00000083	NO
	0x02	Product Code	RO	UNSIGNED32	---	---	Depends on the product model	NO
	0x03	Revision Number	RO	UNSIGNED32	---	---	Depends on the product version	NO
	0x04	Serial number	RO	UNSIGNED32	---	---	Depends on the firmware version	NO

This object indicates the drive information.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2104	---	EtherCAT Communication Configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	3	NO
	0x01	Communication Configuration 1	RW	UNSIGNED32	---	0 to 3	0	NO
	0x03	RPDO Receive Event Timeout	RW	UNSIGNED16	ms	0 to 65,535	500	NO

This object sets the EtherCAT communication detection configuration.

- Subindex 0x01 defines the EtherCAT communication detection function.

Value	Description
0	Link detection of ESC
1	SM and Sync0 timing sequence detection
2 to 3	Reserved

- Subindex 0x03 defines the software timer for RPDO receive event timeout. If the interval between two consecutive RPDO events exceeds this set value, an EtherCAT communications error will occur in the drive.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1600	---	Receive PDO mapping parameter 1	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	5	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60400010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60600008	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x607A0020	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60B80010	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FE0120	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the RxPDO1 mapping parameters.
Subindexes 0x01 to 0x0C give the information on the mapped application objects. The mapping structure of application objects is shown in the table below:

MSB			LSB
Bit	31 ··· 16	15 ··· 8	7 ··· 0
Description	Index	Subindex	Bit length

(Note) PDO mapping objects can be changed only when the EtherCAT communications state is Pre-Operational.
After each power-on of the drive, be sure to reconfigure the mapping objects. Otherwise, the mapping objects will be the drive's default parameters.
If the same object is mapped more than once, the value of the last object is used.
You can map up to 12 application objects to one RxPDO, and the maximum size of the application objects that can be mapped to four RxPDOs is 68 bytes.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1601	---	Receive PDO mapping parameter 2	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	5	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60400010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60600008	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FF0020	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60B80010	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FE0120	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the RxPDO2 mapping parameters.
Subindexes 0x01 to 0x0C give the information on the mapped application objects. For the mapping structure and precautions of the application objects, refer to 0x1600.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1602	---	Receive PDO mapping parameter 3	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	5	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60400010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60600008	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x607A0020	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60810020	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FE0120	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the RxPDO3 mapping parameters.

Subindexes 0x01 to 0x0C give the information on the mapped application objects. For the mapping structure and precautions of the application objects, refer to 0x1600.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1603	---	Receive PDO mapping parameter 4	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60400010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60600008	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FF0020	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FE0120	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the RxPDO4 mapping parameters.

Subindexes 0x01 to 0x0C give the information on the mapped application objects. For the mapping structure and precautions of the application objects, refer to 0x1600.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1A00	---	Transmit PDO mapping parameter 1	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	11	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x603F0010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60410010	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60610008	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60640020	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60F40020	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60B90010	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BA0020	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BB0020	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BC0020	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BD0020	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FD0020	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the TxPDO1 mapping parameters.

Subindexes 0x01 to 0x0C give the information on the mapped application objects. The mapping structure of application objects is shown in the table below:

MSB			LSB
Bit	31 ··· 16	15 ··· 8	7 ··· 0
Description	Index	Subindex	Bit length

(Note) PDO mapping objects can be changed only when the EtherCAT communications state is Pre-Operational.

After each power-on of the drive, be sure to reconfigure the mapping objects. Otherwise, the mapping objects will be the drive's default parameters.

If the same object is mapped more than once, the value of the last object is used.

You can map up to 12 application objects to one TxPDO, and the maximum size of the application objects that can be mapped to four TxPDOs is 68 bytes.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1A01	---	Transmit PDO mapping parameter 2	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	12	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x603F0010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60410010	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60610008	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60640020	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x606C0020	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60F40020	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60B90010	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BA0020	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BB0020	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BC0020	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60BD0020	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FD0020	NO

This object indicates the TxPDO2 mapping parameters.

Subindexes 0x01 to 0x0C give the information on the mapped application objects. For the mapping structure and precautions of the application objects, refer to 0x1A00.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1A02	---	Transmit PDO mapping parameter 3	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	7	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x603F0010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60410010	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60610008	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60640020	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x606C0020	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60F40020	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FD0020	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the TxPDO3 mapping parameters.

Subindexes 0x01 to 0x0C give the information on the mapped application objects. For the mapping structure and precautions of the application objects, refer to 0x1A00.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1A03	---	Transmit PDO mapping parameter 4	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	7	NO
	0x01	Mapping entry 1	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x603F0010	NO
	0x02	Mapping entry 2	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60410010	NO
	0x03	Mapping entry 3	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60610008	NO
	0x04	Mapping entry 4	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60640020	NO
	0x05	Mapping entry 5	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x606C0020	NO
	0x06	Mapping entry 6	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60F40020	NO
	0x07	Mapping entry 7	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	0x60FD0020	NO
	0x08	Mapping entry 8	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x09	Mapping entry 9	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0A	Mapping entry 10	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0B	Mapping entry 11	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO
	0x0C	Mapping entry 12	RW	UNSIGNED32	---	0 to 0xFFFFFFFF	---	NO

This object indicates the TxPDO4 mapping parameters.

Subindexes 0x01 to 0x0C give the information on the mapped application objects. For the mapping structure and precautions of the application objects, refer to 0x1A00.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1C00	---	Sync Manager Communication Type	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Communication Type Sync Manager 0	RO	UNSIGNED8	---	---	1	NO
	0x02	Communication Type Sync Manager 1	RO	UNSIGNED8	---	---	2	NO
	0x03	Communication Type Sync Manager 2	RO	UNSIGNED8	---	---	3	NO
	0x04	Communication Type Sync Manager 3	RO	UNSIGNED8	---	---	4	NO

This object indicates the communication type of each Syn manager.

Refer to the table below for the correspondence between setting value and communication type:

Value	Description
1	Mailbox receive (Master → Slave)
2	Mailbox send (Slave → Master)
3	RxPDO (Master → Slave)
4	TxPDO (Slave → Master)

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1C12	---	Sync Manager 2 RxPDO Assignment	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	1	NO
	0x01	Index of the object assigned by RxPDO1	RW	UNSIGNED16	---	0x1600 to 0x1603	0x1600	NO
	0x02	Index of the object assigned by RxPDO2	RW	UNSIGNED16	---	0x1600 to 0x1603	---	NO
	0x03	Index of the object assigned by RxPDO3	RW	UNSIGNED16	---	0x1600 to 0x1603	---	NO
	0x04	Index of the object assigned by RxPDO4	RW	UNSIGNED16	---	0x1600 to 0x1603	---	NO

This object indicates the index of the object assigned by RxPDO.

(Note) Assigned PDO objects can be changed only when the EtherCAT communications state is Pre-Operational.

After each power-on of the drive, be sure to reconfigure the assigned objects. Otherwise, the assigned objects will be the drive's default parameters.

You can map up to 4 objects.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1C13	---	Sync Manager 3 TxPDO Assignment	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	1	NO
	0x01	Index of the object assigned by TxPDO1	RW	UNSIGNED16	---	0x1A00 to 0x1A03	0x1A00	NO
	0x02	Index of the object assigned by TxPDO2	RW	UNSIGNED16	---	0x1A00 to 0x1A03	---	NO
	0x03	Index of the object assigned by TxPDO3	RW	UNSIGNED16	---	0x1A00 to 0x1A03	---	NO
	0x04	Index of the object assigned by TxPDO4	RW	UNSIGNED16	---	0x1A00 to 0x1A03	---	NO

This object indicates the index of the object assigned by TxPDO.

(Note) Assigned PDO objects can be changed only when the EtherCAT communications state is Pre-Operational.

After each power-on of the drive, be sure to reconfigure the assigned objects. Otherwise, the assigned objects will be the drive's default parameters.

You can map up to 4 assigned objects.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1C32	---	Sync manager 2 output parameters	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	32	NO
	0x01	Synchronization type	RW	UNSIGNED16	---	0 to 2	2	NO
	0x02	Cycle time	RO	UNSIGNED32	ns	---	2,000,000	NO
	0x04	Synchronization types supported	RO	UNSIGNED16	---	---	7	NO
	0x0A	Sync cycle time	RW	UNSIGNED32	ns	0 to 2^{32}-1	2,000,000	NO

This object indicates the synchronization-related parameters for Sync Manager 2.

- Subindex 0x01 defines the synchronization type of Sync Manager 2.

Value	Description
1	SM2
2	DC Sync0

- Subindex 0x02 indicates the cycle time for the corresponding synchronization type.
- Subindex 0x04 indicates the synchronization types supported.

Bit	Function	Value	Description
0	FreeRun mode	0	Not supported
1	SM synchronization mode	0	Not supported
		1	SM2 synchronization supported
4 to 2	DC Sync0 Synchronization mode	000b	Not supported
		001b	DC Sync0 synchronization supported
6 to 5	Output offset	00b	Not supported
		01b	Local clock offset supported
15 to 7	Reserved	---	Reserved

- Subindex 0x0A defines the synchronization cycle time for DC Sync0. C6E-series EtherCAT Servo Drives support synchronization cycle times of 125 us, 250 us, 500 us, and 1 to 20 ms (in 500 us increments).

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x1C33	---	Sync manager 3 output parameters	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	32	NO
	0x01	Synchronization type	RW	UNSIGNED16	---	0 to 2	2	NO
	0x02	Cycle time	RO	UNSIGNED32	ns	---	2,000,000	NO
	0x04	Synchronization types supported	RO	UNSIGNED16	---	---	7	NO
	0x0A	Sync cycle time	RW	UNSIGNED32	ns	0 to 2^{32}-1	2,000,000	NO

This object indicates the synchronization-related parameters for Sync Manager 3.

- Subindex 0x01 defines the synchronization type of Sync Manager 3.

Value	Description
1	SM2
2	DC Sync0

- Subindex 0x02 indicates the cycle time for the corresponding synchronization type.
- Subindex 0x04 indicates the synchronization types supported.

Bit	Function	Value	Description
0	FreeRun mode	0	Not supported
1	SM synchronization mode	0	Not supported
		1	SM2 synchronization supported
4 to 2	DC Sync0 Synchronization mode	000b	Not supported
		001b	DC Sync0 synchronization supported
6 to 5	Input offset	00b	Not supported
		01b	Local clock offset supported
15 to 7	Reserved		Reserved

- Subindex 0x0A indicates the DC Sync0 synchronization cycle time. C6E-series EtherCAT Servo Drives support synchronization cycle times of 125 us, 250 us, 500 us, and 1 to 20 ms (in 500 us increments).

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Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2001	---	Home switch	RO	UNSIGNED8	---	---	6	NO

This object indicates the input port for configuring the origin sensor signals in Homing mode. 1 represents a digital input X1, and so on.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2002	---	Digital output status	RO	UNSIGNED32	---	---	0x000A0000	NO

This object indicates the status of the Servo Drive's digital output port.

Bit	31 ⋯ 19	18	17	16	15 ⋯ 0
Description	Reserved	Y3	Y2	Y1	Reserved

0: Digital output optocoupler is open 1: Digital output optocoupler is closed

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2006	---	Clear alarm	RW	UNSIGNED8	---	0x55, 0xAA	0	RxPDO

This object indicates the function for clearing the drive alarm of type "Warning".
After the fault that caused the drive alarm is cleared, write 0x55 and 0xAA to this object in sequence. When the value of this object changes from 0x55 to 0xAA, the action to clear the drive alarm is executed.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x200B	---	Status code	RO	UNSIGNED32	---	---	0x00068000	TxPDO

This object indicates the present status code of the drive. When a bit is set to 1, it indicates that the drive is in the state defined by that bit.

Bit	Description	Bit	Description
0	Servo on	16	CSP following
1	Sampling	17	Velocity match output
2	Drive fault	18	Zero-speed
3	In position	19	Torque reached
4	Moving	20	Torque match output
5	Jogging	21	Second group of gains active
6	During deceleration	22	Second mode of operation active
7	Wait input	23	Velocity reach output
8	Saving	24	Homing complete
9	Alarm	25	Main Power Off
10	Homing	26 to 27	Reserved, keep as "0"
11	Delay	28	ESM OP
12	Internal used	29 to 31	Reserved, keep as "0"
13	Checking encoder		
14	Reserved, keep as "0"		
15	Ready to switch on		

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x200C	---	Zero position	RW	UNSIGNED8	---	0 to 1	0	NO

This object indicates the function to reset the motor's actual position (0x6064) to zero.
When the value of this object is changed from 0 to 1, the actual position will be 0. Afterward, the value of this object will automatically reset to 0.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x200F	---	Alarm code	RO	UNSIGNED32	---	---	0	TxPDO

This object indicates the present status code of the drive. When a bit is set to 1, it indicates that the drive is in the state defined by that bit.

Bit	Description	Bit	Description
0	Position following error	16	Drive main circuit power supply phase loss
1	CCW limit is triggered	17	Safe torque off
2	CW limit is triggered	18	CSP command exceeds limits within DC cycle
3	Drive over temperature	19	Over Speed
4	Internal error	20	Drive under-voltage
5	Power supply voltage out of range	21	Emergency stop
6	Motor runaway detected	22	Reserved, keep as "0"
7	Drive over current	23	Reserved, keep as "0"
8	Reserved, keep as "0"	24	Absolute encoder battery under-voltage
9	Motor encoder disconnected	25	Absolute position lost
10	USB communication error	26	Absolute position overflow
11	Reserved, keep as "0"	27	Reserved, keep as "0"
12	Regenerate failed	28	Absolute encoder multi-turn error
13	Current limit exceed	29	Abnormal motion protection
14	Reserved, keep as "0"	30	EtherCAT communication error
15	Abnormal start warning	31	Homing parameter configuration error

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2019	---	Device temperature	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Drive temperature	RO	INTEGER16	0.1 ℃	---	0	NO
	0x02	DSP temperature	RO	INTEGER16	0.1 ℃	---	0	NO
	0x03	Reserved	RO	INTEGER16	---	---	0	NO
	0x04	Reserved	RO	INTEGER16	---	---	0	NO

This object indicates the temperature of the drive's internal modules.

- Subindex 0x01 gives the temperature value of the drive PCB board.
- Subindex 0x02 gives the temperature value of the drive processor chip.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2020	---	Physical address	RO	UNSIGNED16	---	---	0	NO

This object indicates the slave address set through the drive's configuration software Sysmac Studio or the operator panel for the master that cannot automatically assign slave addresses.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2021	---	EtherCAT address	RO	UNSIGNED16	---	---	---	NO

This object indicates the slave address assigned to the slave when using EtherCAT communication with a master that automatically assigns slave addresses.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2022	---	Address source	RO	UNSIGNED16	---	---	1	NO

This object shall indicate the address of the drive is either assigned by the master or set through configuration software or the operator panel in EtherCAT communication.
0: Set through the drive configuration software Sysmac Studio or the operation panel. 1: Automatically assigned by the master.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2030	---	DC BUS voltage	RO	UNSIGNED16	0.1 V	---	---	NO

This object indicates the DC bus voltage of the drive after rectification of the main circuit input voltage.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2031	---	DSP version	RO	Visible string	---	---	---	NO

This object indicates the DSP firmware version of the drive.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2032	---	FPGA version	RO	Visible string	---	---	---	NO

This object indicates the FPGA firmware version of the drive.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2033	---	Encoder version	RO	Visible string	---	---	---	NO

This object indicates the encoder firmware version of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2100	---	User registers	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	26	NO
	0x01	Accumulator	RO	INTEGER32	---	---	0	NO
	0x02	User register 1	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x03	User register 2	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x04	User register 3	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x05	User register 4	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x06	User register 5	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x07	User register 6	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x08	User register 7	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x09	User register 8	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x0A	User register 9	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x0B	User register 10	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x0C	User register 11	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x0D	User register 12	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x0E	User register 13	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x0F	User register 14	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x10	User register 15	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x11	User register 16	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x12	User register 17	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x13	User register 18	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x14	User register 19	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x15	User register 20	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x16	User register 21	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x17	User register 22	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x18	User register 23	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x19	User register 24	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO
	0x1A	User register 25	RW	INTEGER32	---	-2^{31} to $2^{31}-1$	0	Tx/RxPDO

This object indicates the volatile memory of the drive that is provided to the user.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x10F1	---	EtherCAT communication error settings	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	2	NO
	0x02	Sync error counter limit	RW	UNSIGNED16	---	0 to 65,535	9	NO

This object sets the EtherCAT communication detection configuration.
Subindex 0x02 defines the EtherCAT synchronization detection count limit.
If the Internal Sync Error Counter exceeds the Sync Error Counter Limit, a multiple error is detected and the Slave changes its EtherCAT state to SAFEOP with AL Status Code 0x1A.
If the Sync Error Counter Limit is set to 0, the device does not change its EtherCAT State to SAFEOP in case of a Sync Error.
This function is disabled by default. If you want to use this function, please set OD0x2104 subindex 1 Bit1 to 1.
The SM Event Missed Error Counter increments every time by 3 when an SM Event was missed. Every time a SM Event is received the Internal Sync Error Counter shall be decremented by 1.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A01	---	Current overload continuous time	RW	UNSIGNED32	ms	0 to 2,000	2,000	NO

This object sets the maximum continuous duration for the motor operation at maximum overload torque.
When the value of this object is set to 0, the motor is allowed to operate at maximum overload torque for up to 2 s. After 2s, the output torque automatically decreases to the rated torque, and an overload alarm occurs in the drive.
When the value of this object is set to other value, the motor is allowed to operate at maximum overload torque for the specified duration. After this duration elapses, the output torque automatically decreases to the rated torque, and an overload alarm occurs in the drive.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A02	---	Torque limit method	RW	UNSIGNED32	---	0 to 6	1	NO

This object sets the torque limit method of the motor.

Value	Description	
	Positive torque limit value	Negative torque limit value
0	0x60E0	0x60E1
1	0x6073	
2	0x6073	0x2A04
3	TQ-LMT active: 0x6073	
	TQ-LMT inactive: 0x2A04	
4	Analog input torque limit	
5	TQ-LMT active: 0x6073	TQ-LMT active: 0x2A04
	TQ-LMT inactive: 0x2A05	TQ-LMT inactive: 0x2A06
6	Reserved	Reserved

(Note) TQ-LMT indicates the digital torque limit input. For the torque limit function, refer to 📖 *"10-5 Torque Limit Function* (P.10-16)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A04	---	2nd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*	NO

This object sets the 2nd torque limit value of the motor. 100.0% corresponds to 1 times the rated torque of the motor.

* The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A05	---	3rd torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*	NO

This object sets the 3rd torque limit value of the motor. 100.0% corresponds to 1 times the rated torque of the motor.

* The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to "*A-4 List of Maximum Torque Parameters* (P.A-14)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A06	---	4th torque limit	RW	UNSIGNED32	0.1%	0 to 4,000	4,000*	NO

This object sets the 4th torque limit value of the motor. 100.0% corresponds to 1 times the rated torque of the motor.

* The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to "*A-4 List of Maximum Torque Parameters* (P.A-14)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A08	---	Torque limit for hard stop homing	RW	UNSIGNED32	0.1%	0 to 4,000	1,000	NO

This object sets the motor torque limit value for the manufacturer specific homing methods -1 to -4. 100.0% corresponds to 1 times the rated torque of the motor.

(Note) The value of this object is set according to the application requirement. If the set value is too small, it may lead to inaccurate homing. If the set value is too large, the mechanical equipment may be damaged.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A09	---	Motor stall protection time	RW	UNSIGNED32	ms	0 to 30,000	5,000	NO

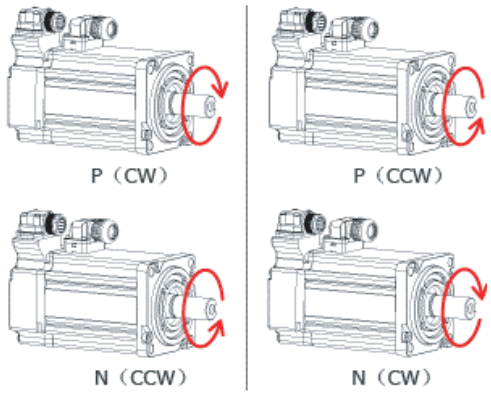
This object sets the motor stall protection time.

In non-torque modes, when the drive detects a motor stall and the duration exceeds this set value, the drive will trigger motor stalled fault with the alarm code  . The value of 0 shall disable the motor stall protection.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A0A	---	Rotational direction setup	RW	UNSIGNED8	---	0 to 1	1	NO

This object sets the positive direction of motor motion when viewed from the motor shaft.

Value	Positive rotation direction	Description
0	CW is positive	During positive motion, when viewed from the motor shaft side, the motor rotates clockwise.
1	CCW is positive	During positive motion, when viewed from the motor shaft side, the motor rotates counter-clockwise.



Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A0B	---	Encoder resolution	RO	UNSIGNED32	pulses/rev	---	67,108,864	NO

This object indicates the motor encoder resolution.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A10	---	Digital output function configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Digital output 1 function	RW	UNSIGNED16	---	0 to 44	0	NO
	0x02	Digital output 2 function	RW	UNSIGNED16	---	0 to 44	23	NO
	0x03	Digital output 3 function	RW	UNSIGNED16	---	0 to 44	2	NO

This object sets the digital output function of the drive. Refer to the table below for the parameter value settings. Do not set values other than those listed in the table below.

Function name	Symbol	Function name	
		Closed	Open
General-purpose output	GPOUT	0	
Alarm output	ALM	1	2
Warning output	WARN	3	4
Brake release output	BRK	5	6
Servo on status	SON-ST	7	8
Positioning completed	COIN	9	10
Dynamic following error output	DYM-LMT	11	12
Torque reached	TQ-REACH	13	14
Torque limit output	T-LMT	15	16
Velocity match output	V-COIN	17	18
Velocity reach output	AT-SPD	19	20
Velocity limit output	V-LMT	21	22
Servo Ready	S-RDY	23	24
Homing complete	HOMED	25	26
Soft limit CW	SLCW	27	28
Soft limit CCW	SLCCW	29	30
Position arrived output	IN-POS	31	32
Zero-speed detected output	Z-SPD	33	34
Torque match output	T-COIN	35	36

Closed: Digital output optocoupler is closed Open: Digital output optocoupler is open

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A13	---	Brake output configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	2	NO
	0x01	Move command delay time after brake release	RW	UNSIGNED32	ms	0 to 32,000	200	NO
	0x02	Servo-off delay time after brake engagement	RW	UNSIGNED32	ms	0 to 32,000	200	NO

This object sets the parameters when the digital output of the drive is configured as the brake release function.

- Subindex 0x01 defines the delay time from when the brake output is ON (brake released) to when the motion command is executed.
- Subindex 0x02 defines the delay time from brake output OFF (brake engaged) to servo-off.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A14	---	Reached position	RW	INTEGER32	Pulses	-2^{31} to $2^{31}-1$	8,388,608	NO

This object sets the target position when the digital output of the drive is configured as the position arrived function. The position arrived signal is valid when the absolute value of the difference between the actual motor position and the specified target position does not exceed 100 pulses.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A15	---	Position status configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Dynamic following error threshold	RW	UNSIGNED32	Pulses	0 to $2^{31}-1$	8,388	NO
	0x02	Time constant of motion output condition	RW	UNSIGNED32	ms	0 to 30,000	40	NO
	0x03	In-position output threshold	RW	UNSIGNED32	Pulses	0 to $2^{31}-1$	33,554	NO

This object sets the motor position related status parameters.

- Subindex 0x01 defines the dynamic following error threshold. When the absolute value of the position deviation is within this set value, the dynamic error following signal is valid.
- Subindex 0x02 defines the valid time window for positioning completed, velocity reached, velocity match, zero-speed detected, torque reached and torque match signals.
- Subindex 0x03 defines the position error threshold of the positioning completed signal. When the absolute value of the position deviation is within this set value, and the duration reaches the time set by subindex 2 of 0x2A15, the positioning completed signal is valid.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A16	---	Speed status configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	3	NO
	0x01	Zero velocity width	RW	UNSIGNED32	Pulses/s	(0.1 to 2) * 0x2A90	0.5 * 0x2A90	NO
	0x02	Target value of AT-speed output	RW	UNSIGNED32	Pulses/s	(0 to 135) * 0x2A90	10 * 0x2A90	NO
	0x03	Velocity coincidence width	RW	UNSIGNED32	Pulses/s	(0.1 to 135) * 0x2A90	0.2 * 0x2A90	NO

This object sets the motor velocity related status parameters.

- Subindex 0x01 defines the zero-speed judgment threshold. When the command velocity is 0 and the absolute value of the actual velocity is within this set value, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the motor has become nearly stationary and the zero-speed detected signal is valid.
- Subindex 0x02 defines the target value for judging the velocity reached. When the absolute value of actual velocity exceeds this set value, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor velocity has reached the expected value and the velocity reached signal is valid.
- Subindex 0x03 defines the fluctuation range for velocity match to be achieved. When the absolute value of the difference between the actual velocity and the target velocity (0x60FF) is within this set value, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor velocity has reached the expected value and the velocity match signal is valid.

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times \text{Setting value}}{\text{0x2A90}}$$

When the set velocity is less than 0.25 rpm, the velocity setting value is 0.
You can set the velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A17	---	Torque match width	RW	UNSIGNED32	0.1%	0 to 4,000	10	NO

This object sets the fluctuation range for the motor torque match to be achieved.
When the absolute value of the difference between the actual torque and the target torque (0x6071) is within this set value, and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor torque has reached the expected value and the torque match signal is valid.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A18	---	Target torque value when torque value reached	RW	UNSIGNED32	0.1%	0 to 4,000	0	NO

This object sets the target torque value when torque value reached.
When the absolute value of the difference between the absolute value of actual torque and this set value is within the torque match width (0x2A17), and the duration reaches the time set by subindex 2 of 0x2A15, it is considered that the actual motor torque has reached the expected value and the torque reached signal is valid.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A20	---	Digital input function configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	6	NO
	0x01	Digital input 1 function	RW	UNSIGNED16	---	0 to 46	44	NO
	0x02	Digital input 2 function	RW	UNSIGNED16	---	0 to 46	42	NO
	0x03	Digital input 3 function	RW	UNSIGNED16	---	0 to 46	3	NO
	0x04	Digital input 4 function	RW	UNSIGNED16	---	0 to 46	13	NO
	0x05	Digital input 5 function	RW	UNSIGNED16	---	0 to 46	0	NO
	0x06	Digital input 6 function	RW	UNSIGNED16	---	0 to 46	39	NO

This object sets the digital input port function of the drive. Refer to the table below for the parameter value settings. Do not set values other than those listed in the table below.

Function name	Symbol	Value	
		Closed	Open
General purpose input	GPIN	0	
Clear alarm	A-CLR	3	4
CW limit	CW-LMT	5	6
CCW limit	CCW-LMT	7	8
Gain select	GAIN-SEL	11	12
Emergency stop	E-STOP	13	14
Torque limit	TQ-LMT	19	20
Zero speed clamp	ZCLAMP	21	22
Velocity limit	V-LMT	37	38
Homing switch	HOM-SW	39	40
Virtual CW limit	Virtual-CW-LMT	41	42
Virtual CCW limit	Virtual-CCW-LMT	43	44

Closed: Digital input optocoupler is closed Open: Digital input optocoupler is open

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A21	---	Digital input filter	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	6	NO
	0x01	Digital input 1 filter	RW	UNSIGNED16	ms	0 to 8,000	1	NO
	0x02	Digital input 2 filter	RW	UNSIGNED16	ms	0 to 8,000	1	NO
	0x03	Digital input 3 filter	RW	UNSIGNED16	ms	0 to 8,000	1	NO
	0x04	Digital input 4 filter	RW	UNSIGNED16	ms	0 to 8,000	1	NO
	0x05	Digital input 5 filter	RW	UNSIGNED16	ms	0 to 8,000	1	NO
	0x06	Digital input 6 filter	RW	UNSIGNED16	ms	0 to 8,000	1	NO

This object sets the filter time of the low-pass filter of the digital input port of the drive. The input filter supports up to 4 valid inputs at once.

(Note) Setting a proper filter time helps eliminate external interference signals. However, if the filter time is too long, it will cause a delay in the input signal.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A22	---	Analog input1 configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	5	NO
	0x01	Dead-band	RW	UNSIGNED32	mV	0 to 255	0	NO
	0x02	Offset	RW	INTEGER32	mV	-10,000 to 10,000	0	NO
	0x03	Low-pass filter	RW	UNSIGNED32	0.1 Hz	1 to 20,000	1,000	NO
	0x04	Threshold	RW	INTEGER32	mV	-10,000 to 10,000	5,000	NO
	0x05	Reserved	---	---	---	---	0	NO

This object sets the analog input 1 parameters.

- Subindex 0x01 defines the range of analog input 1 input voltage when the drive sampling voltage value is 0.
- Subindex 0x02 defines the actual input voltage value of analog input 1 when the drive sampling voltage value is 0.
- Subindex 0x03 defines the drive's low-pass filter frequency for the input voltage signal.
- Subindex 0x04 defines the voltage threshold for digital level state transition when the drive's analog input is configured for digital switch function.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A25	---	Analog input reading	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	3	NO
	0x01	Analog input1 value	RO	INTEGER32	mV	---	0	TxPDO
	0x02	Reserved	---	---	---	---	0	TxPDO
	0x03	Reserved	---	---	---	---	0	TxPDO

This object indicates the analog input actual sampling voltage value.

- Subindex 0x01 indicates the analog input 1 actual sampling voltage value.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A26	---	Analog input auto zero	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	0 to 3	3	NO
	0x01	Analog input auto zero	RW	UNSIGNED16	---	0 to 1	0	NO
	0x02	Reserved	---	---	---	---	0	NO
	0x03	Reserved	---	---	---	---	0	NO

This object sets the analog input sampling voltage automatic zero adjustment.

- Subindex 0x01 defines the analog input sampling voltage automatic zero adjustment. When this parameter is set to 1, automatic zero adjustment is executed, and then the value of this object automatically returns to 0.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A27	---	Analog input function	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	6	NO
	0x01	Analog input 1 function	RW	UNSIGNED32	---	0 to 1	0	NO
	0x02	Reserved	---	UNSIGNED32	---	---	0	NO
	0x03	Reserved	---	UNSIGNED32	---	---	0	NO
	0x04	Reserved	---	UNSIGNED32	---	---	0	NO
	0x05	Analog input velocity gain	RW	INTEGER32	Pulses/s	0 to 135*OD0x2A90	50*OD0x2A90	NO
	0x06	Reserved	---	UNSIGNED32	---	---	0	NO

This object sets the analog input function.

- Subindex 0x01 defines the analog input 1 function.

Value	Description
0	General analog input function
1	Analog velocity control

- Subindex 0x02 is reserved.
- Subindex 0x03 is reserved.
- Subindex 0x04 is reserved.
- Subindex 0x05 defines the command velocity value of the motor that is controlled by the drive when the analog input 1 function is limit velocity and the analog sampling voltage value is +10 V.

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times \text{Setting value}}{0 \times 2A90}$$

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A32	---	Operation mode when power-up	RO	UNSIGNED32	---	---	10	NO

This object indicates the operation mode when power-up.

Value	Description
10	Modbus mode, power-on disabled

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A33	---	Velocity control clamp mode	RW	UNSIGNED32	---	1 to 2	2	NO

This object indicates the drive's control type in the Profile velocity mode (PV) and Cyclic synchronous velocity mode (CSV).

Value	Description
1	Position errors are detected in real time. When the absolute value of the position error is greater than the position error alarm threshold 0x2AA8, the drive will trigger the position error overrun fault.
2	Velocity control only, no position error detected.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A34	---	Regeneration configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	3	NO
	0x01	Regeneration resistor value	RW	UNSIGNED32	Ω	0 to 32,767	50	NO
	0x02	Regeneration resistor continuous wattage	RW	UNSIGNED32	W	0 to 32,767	50	NO
	0x03	Regeneration resistor time constant	RW	UNSIGNED32	ms	0 to 8,000	1,000	NO

This object sets the parameters for the built-in or external regenerative energy absorption resistor.

- Subindex 0x01 defines the resistance of the built-in or external regenerative energy absorption resistor.
- Subindex 0x02 defines the power of the built-in or external regenerative energy absorption resistor.
- Subindex 0x03 defines the absorption time of the built-in or external regenerative energy absorption resistor.

(Note) 1. C6E-series Servo Drives have no built-in regeneration resistors for 400 W models, and have built-in 50 Ω regeneration resistors for 800 W and 1,000 W models.

2. Please define the parameters for the absorption resistor according to the specifications of the actual external resistor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A35	---	Keypad setting lock	RW	UNSIGNED32	---	0 to 1	0	NO

This object indicates the operation panel parameters setting lock function for the drive.

Value	Description
0	Enable the operation panel parameters setting
1	Disable the operation panel parameters setting

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A36	---	Default display	RW	UNSIGNED32	---	0 to 20	0	NO

This object sets the default monitor item of the panel LED on the drive.

Value	Description	Value	Description
0	Motor actual velocity Unit: rpm	11	Alarm history 3
1	Motor real-time position deviation Unit: Pulses	12	Alarm history 4
2	Command pulse input count Unit: Pulses	13	Alarm history 5
3	Motor encoder position Unit: Pulses	14	Alarm history 6
4	Command position Unit: Pulses	15	Alarm history 7
5	Drive temperature Unit: 0.1 ℃	16	Analog input 1 sampling voltage Unit: mV
6	DC bus voltage value Unit: 0.1 V	17	Reserved
7	EtherCAT communication node ID	18	Digital input status 0: Optocoupler is open, 1: Optocoupler is closed
8	Alarm history 0	19	Digital output status 0: Optocoupler is open, 1: Optocoupler is closed
9	Alarm history 1	20	Command torque percentage, unit: 0.1%
10	Alarm history 2		

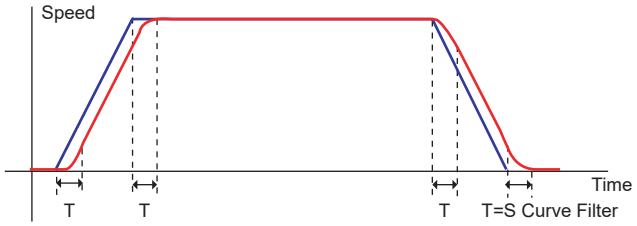
Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A37	---	Alarm mask	RW	UNSIGNED32	---	0 to 2^{32}-1	2^{32}-1	NO

This object sets the masking of warning messages displayed on the drive LED. When a bit is set to 0, the warning message associated with that bit will be suppressed.

Bit	Description	Bit	Description
0	Reserved	16	Reserved, keep as "1"
1	CCW limit	17	Reserved, keep as "1"
2	CW limit	18	Reserved, keep as "1"
3	Reserved, keep as "1"	19	Reserved, keep as "1"
4	Reserved, keep as "1"	20	Reserved, keep as "1"
5	Reserved, keep as "1"	21	Emergency stop
6	Reserved, keep as "1"	22	Reserved, keep as "1"
7	Reserved, keep as "1"	23	Reserved, keep as "1"
8	Reserved, keep as "1"	24	Absolute encoder batter under-voltage
9	Reserved, keep as "1"	25	Absolute position lost
10	USB communication alarm	26	Absolute position overflow
11	Save failed	27	Reserved, keep as "1"
12	Reserved, keep as "1"	28	Reserved, keep as "1"
13	Current limit exceed	29	Reserved, keep as "1"
14	Reserved, keep as "1"	30	Reserved, keep as "1"
15	Motion command received while motor disable	31	Homing parameter configuration error

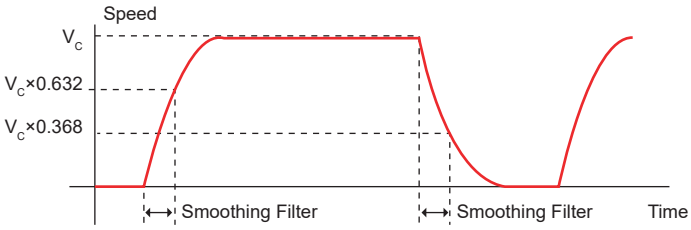
Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A4C	---	Jerk time	RW	UNSIGNED32	ms	0 to 250	10	NO

This object sets the FIR filter time for the drive when using internal trajectory planning. This parameter can reduce the motion transients of the motor and mechanical system, making the motor operation smoother.
The effect of jerk time on input commands is shown in the figure below.



Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A4D	---	Jerk filter	RW	UNSIGNED32	ms	0 to 1,000	10	NO

This object sets the smoothing filter time for the drive to the command. This parameter can reduce the motion transients of the motor and mechanical system, making the motor operation smoother.
The effect of command smoothing filter time on input commands is shown in the figure below.



Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A4E	---	Interpolation filter	RW	UNSIGNED32	ms	0 to 250	10	NO

This object sets the FIR filter time of the drive to the external position command. This parameter can reduce the motion transients of the motor and mechanical system, making the motor operation smoother.
For the effect of interpolation filter time on input commands, refer to the effect diagram of parameter 0x2A4C.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A50	---	Parameter tuning mode	RW	UNSIGNED32	---	0 to 3	1	NO

This object sets the drive parameter tuning mode.

Value	Tuning mode	Description
0	No tuning	The user only needs to set the system rigidity level.
1	Auto-tuning	The user needs to set the system rigidity level, load type, and inertia ratio parameters.
2	Advanced tuning	The user needs to manually set the inertia ratio and gain parameters.
3	Reserved	Reserved

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A52	---	Load inertia ratio	RW	UNSIGNED32	0.01	0 to 10,000	250	NO

This object sets the ratio of mechanical load inertia to the motor rotor inertia.

$$\text{Load inertia ratio} = \frac{\text{Mechanical load inertia + Motor rotor inertia}}{\text{Motor rotor inertia}}$$

When the 0x2A50 parameter tuning type is set to 1 or 2 (auto-tuning or advanced tuning), the load inertia ratio can be set manually or detected automatically.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A53	---	1st rigidity level	RW	UNSIGNED32	---	1 to 42	14	NO

This object sets the rigidity of the servo system. In both No tuning and auto-tuning modes, higher rigidity levels result in stronger gains and faster responses. Excessive rigidity will cause vibration and noise.
Level 1 represents the lowest rigidity, and level 42 represents the highest.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A54	---	2nd rigidity level	RW	UNSIGNED32	---	1 to 42	14	NO

This object sets the rigidity of the servo system. When the gain switch is turned on, the second rigidity level is valid under the corresponding conditions.
In both No tuning and auto-tuning modes, higher rigidity levels result in stronger gains and faster responses. Excessive rigidity will cause vibration and noise.
Level 1 represents the lowest rigidity, and level 42 represents the highest.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A55	---	1st position loop gain	RW	UNSIGNED32	0.1 rad/s	0 to 125,664	480	NO

This object sets the proportional gain of the 1st position control loop.
This parameter determines the responsiveness of the position loop. Increasing the position loop gain can reduce the system's following error and shorten the positioning time. Setting too large may cause vibration and noise.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A57	---	1st position loop derivative time constant	RW	UNSIGNED32	ms	0 to 30,000	0	NO

This object sets the differential time of the 1st position loop. Decreasing this constant significantly improves the system's vibration suppression and allows it to stabilize more rapidly.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A58	---	1st position loop derivative filter	RW	UNSIGNED32	0.1 Hz	0 to 40,000	40,000	NO

This object sets the differential cut-off frequency of the 1st position loop. Decreasing the differential filter frequency can prevent vibration and reduce the noise caused by the differential time.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A59	---	Velocity feedforward gain	RW	INTEGER32	0.01%	-30,000 to 30,000	3,000	NO

This object sets the velocity feedforward gain. Increasing this gain enhances the position loop's responsiveness and can reduce positioning time. However, excessive gain may lead to overshoot or vibration, and may not further shorten the positioning time.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A5A	---	Velocity feedforward filter	RW	UNSIGNED32	0.1 Hz	0 to 40,000	20,000	NO

This object sets the velocity feedforward cut-off frequency. Decreasing the velocity feedforward filter frequency can suppress the speed overshooting or vibration, but the position deviation will increase when the speed changes.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A5B	---	1st velocity command gain	RW	INTEGER32	0.01%	-30,000 to 30,000	10,000	NO

This object sets the 1st velocity loop command velocity reference gain. Increasing the command velocity gain can improve the responsiveness of the velocity loop control.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A5C	---	1st velocity loop gain	RW	UNSIGNED32	0.1 Hz	0 to 30,000	300	NO

This object sets the 1st velocity loop gain.
This parameter determines the responsiveness of the velocity loop. A higher gain results in a faster response. However, excessive gain may cause vibration and noise. In the position mode, increasing the position loop gain requires a corresponding increase in the velocity loop gain.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A5D	---	1st velocity loop integral time constant	RW	UNSIGNED32	ms	0 to 30,000	166	NO

This object sets the 1st velocity loop integral time constant.
This parameter determines the effectiveness of the integral action in the velocity loop. A smaller value strengthens the integral action and reduces steady-state error. However, setting it too low may induce vibration and noise in the servo system.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A5E	---	Acceleration feedforward gain	RW	UNSIGNED32	0.01%	0 to 20,000	3,000	NO

This object sets the acceleration feedforward gain. By supplying an open-loop control current corresponding to a given load at a specified acceleration, this parameter significantly improves system tracing and helps suppress overshoot at the end of acceleration or deceleration.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A5F	---	Acceleration feedforward filter	RW	UNSIGNED32	0.1 Hz	0 to 40,000	20,000	NO

This object sets the acceleration feedforward cut-off frequency.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A60	---	1st torque command filter	RW	UNSIGNED32	0.1 Hz	0 to 80,000	2,411	NO

This object sets the filter of the 1st command torque of current loop.
The filter is a single-output low-pass filter applied to the PID controller (the reference current). Using this filter smooths the command torque and helps reduce vibrations.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A61	---	2nd position loop gain	RW	UNSIGNED32	0.1 rad/s	0 to 125,664	480	NO

This object sets the proportional gain of the 1st position control loop.
This parameter determines the responsiveness of the position loop. Increasing the position loop gain can reduce the system's following error and shorten the positioning time. Setting too large may cause vibration and noise.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A63	---	2nd position loop derivative time constant	RW	UNSIGNED32	ms	0 to 30,000	0	NO

This object sets the differential time of the 1st position loop. Decreasing this constant significantly improves the system's vibration suppression and allows it to stabilize more rapidly.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A64	---	2nd position loop derivative filter	RW	UNSIGNED32	0.1 Hz	0 to 40,000	20,000	NO

This object sets the differential cut-off frequency of the 1st position loop. Decreasing the differential filter frequency can prevent vibration and reduce the noise caused by the differential time.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A65	---	2nd velocity command gain	RW	INTEGER32	0.01%	-30,000 to 30,000	10,000	NO

This object sets the 1st velocity loop command velocity reference gain. Increasing the command velocity gain can improve the responsiveness of the velocity loop control.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A66	---	2nd velocity loop gain	RW	UNSIGNED32	0.1 Hz	0 to 30,000	300	NO

This object sets the 1st velocity loop gain.
This parameter determines the responsiveness of the velocity loop. A higher gain results in a faster response. However, excessive gain may cause vibration and noise. In the position mode, increasing the position loop gain requires a corresponding increase in the velocity loop gain.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A67	---	2nd velocity loop integral time constant	RW	UNSIGNED32	ms	0 to 30,000	166	NO

This object sets the 1st velocity loop integral time constant.

This parameter determines the effectiveness of the integral action in the velocity loop. A smaller value strengthens the integral action and reduces steady-state error. However, setting it too low may induce vibration and noise in the servo system.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A68	---	2nd torque command filter	RW	UNSIGNED32	0.1 Hz	0 to 30,000	2,411	NO

This object sets the filter of the 1st command torque of current loop.

The filter is a single-output low-pass filter applied to the PID controller (the reference current). Using this filter smooths the command torque and helps reduce vibrations.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A69	---	Automatic gain swiching configuration	---	---	---	---	---	NO
	0x00	Number of entries	RO	UNSIGNED8	---	---	6	NO
	0x01	Automatic gain swiching method	RW	UNSIGNED32	---	0 to 4	0	NO
	0x02	Position deviation	RW	UNSIGNED32	Pulses	0 to 2^{31}-1	0	NO
	0x03	Velocity actual value	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	0	NO
	0x04	Torque actual value	RW	UNSIGNED32	0.1%	0 to 4,000	10	NO
	0x05	Gain switching time 1	RW	UNSIGNED32	ms	0 to 10,000	10	NO
	0x06	Gain switching time 2	RW	UNSIGNED32	ms	0 to 10,000	10	NO

This object sets the gain switching parameters.

- Subindex 0x01 defines the gain switching condition.

Value	Gain switching condition	Description
0	Fixed at 1st group of gains	Fixed at 1st group of gains
1	Large position deviation	Effective only in the Profile position mode and full closed-loop function
		In the 1st group of gains, when the absolute value of the actual position deviation exceeds the set value of subindex 2 of 0x2A69 and the duration reaches the time set by subindex 5 of 0x2A69, the gain switches to the 2nd group of gains. In the 2nd group of gains, when the absolute value of the actual position deviation is lower than the set value of subindex 2 of 0x2A69, and the duration reaches the time set by subindex 6 of 0x2A69, the gain returns to the 1st group of gains.
2	Large actual velocity	In the 1st group of gains, when the absolute value of the actual velocity exceeds the set value of subindex 3 of 0x2A69 and the duration reaches the time set by subindex 5 of 0x2A69, the gain switches to the 2nd group of gains. In the 2nd group of gains, when the absolute value of the actual velocity is lower than the set value of subindex 3 of 0x2A69, and the duration reaches the time set by subindex 6 of 0x2A69, the gain returns to the 1st group of gains.
3	Large actual torque	In the 1st group of gains, when the percentage of the absolute value of the actual torque relative to the rated torque of the motor exceeds the set value of subindex 4 of 0x2A69, and the duration reaches the time set by subindex 5 of 0x2A69, the gain switches to the 2nd group of gains. In the 2nd group of gains, when the percentage of the absolute value of the actual torque relative to the rated torque of the motor is lower than the set value of subindex 4 of 0x2A69, and the duration reaches the time set by subindex 6 of 0x2A69, the gain returns to the 1st group of gains.
4	Positioning completed	Effective only in the position mode and full closed-loop function
		In the 1st group of gains, if positioning is not completed, the gain switches to the 2nd group of gains. In the 2nd group of gains, if positioning is completed and the duration reaches the time set by subindex 6 of 0x2A69, the gain returns to the 1st group of gains.

- Subindex 0x02 defines the position error value that triggers a gain switch when the gain switching condition is set to position error.
- Subindex 0x03 defines the actual velocity value that triggers a gain switch when the gain switching condition is set to actual velocity.
- Subindex 0x04 defines the percentage of the absolute value of the actual torque relative to the rated torque of the motor that triggers a gain switch when the gain switching condition is set to actual torque.
- Subindex 0x05 defines the duration for which the switching condition must be met to transition from the 2nd group of gains to the 1st group of gains.
- Subindex 0x06 defines the duration for which the switching condition must be met to transition from the first group of gains to the 2nd group of gains.

(Note) For the gain switching function, refer to 📖 *"10-7 Gain Switching Function* (P.10-18)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A85	---	Resonance suppression filter 1 configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Filter switch	RW	UNSIGNED16	---	0 to 1	0	NO
	0x02	Resonance frequency	RW	UNSIGNED16	0.1 Hz	0 to 40,000	30,000	NO
	0x03	Bandwidth level	RW	UNSIGNED16	---	0 to 20	0	NO
	0x04	Depth Level	RW	UNSIGNED16	---	0 to 100	1	NO

This object sets the parameters for resonance suppression filter 1.

- Subindex 0x01 defines enable or disable resonance suppression filter 1. 0: Disabled 1: Enabled
- Subindex 0x02 defines the center frequency of resonance suppression filter 1, which corresponds to the resonance frequency. The resonance frequency can be obtained through mechanical analysis and can be manually selected for use.
- Subindex 0x03 defines the bandwidth level of resonance suppression filter 1, which represents the ratio of notch width to center frequency. A larger value increases the notch width.
- Subindex 0x04 defines the depth level of the center frequency for resonance suppression filter 1. A smaller value results in a greater notch depth, enhancing vibration suppression. However, if set too low, it may increase vibration instead.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A86	---	Vibration suppression filter 2 configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Filter switch	RW	UNSIGNED16	---	0 to 1	0	NO
	0x02	Resonance frequency	RW	UNSIGNED16	0.1 Hz	0 to 40,000	30,000	NO
	0x03	Bandwidth level	RW	UNSIGNED16	---	0 to 20	0	NO
	0x04	Depth Level	RW	UNSIGNED16	---	0 to 100	1	NO

This object sets the parameters for resonance suppression filter 2.

- Subindex 0x01 defines enable or disable resonance suppression filter 2. 0: Disabled 1: Enabled
- Subindex 0x02 defines the center frequency of resonance suppression filter 2, which corresponds to the resonance frequency. The resonance frequency can be obtained through mechanical analysis and can be manually selected for use.
- Subindex 0x03 defines the bandwidth level of resonance suppression filter 2, which represents the ratio of notch width to center frequency. A larger value increases the notch width.
- Subindex 0x04 defines the depth level of the center frequency for resonance suppression filter 2. A smaller value results in a greater notch depth, enhancing vibration suppression. However, if set too low, it may increase vibration instead.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A87	---	Vibration suppression filter 3 configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Filter switch	RW	UNSIGNED16	---	0 to 2	0	NO
	0x02	Resonance frequency	RW	UNSIGNED16	0.1 Hz	0 to 40,000	30,000	NO
	0x03	Bandwidth level	RW	UNSIGNED16	---	0 to 20	0	NO
	0x04	Depth Level	RW	UNSIGNED16	---	0 to 100	1	NO

This object sets the parameters for resonance suppression filter 3.

- Subindex 0x01 defines enable or disable resonance suppression filter 3. 0: Disabled, 1: Manually set, 2: Adaptive.
- Subindex 0x02 defines the center frequency of resonance suppression filter 3, which corresponds to the resonance frequency.
- Subindex 0x03 defines the bandwidth level of resonance suppression filter 3, which represents the ratio of notch width to center frequency. A larger value increases the notch width.
- Subindex 0x04 defines the depth level of the center frequency for resonance suppression filter 3. A smaller value results in a greater notch depth, enhancing vibration suppression. However, if set too low, it may increase vibration instead.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A88	---	Vibration suppression filter 4 configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Filter switch	RW	UNSIGNED16	---	0 to 2	0	NO
	0x02	Resonance frequency	RW	UNSIGNED16	0.1 Hz	0 to 40,000	30,000	NO
	0x03	Bandwidth level	RW	UNSIGNED16	---	0 to 20	0	NO
	0x04	Depth Level	RW	UNSIGNED16	---	0 to 100	1	NO

This object sets the parameters for resonance suppression filter 4.

- Subindex 0x01 defines enable or disable resonance suppression filter 4. 0: Disabled, 1: Manually set, 2: Adaptive.
- Subindex 0x02 defines the center frequency of resonance suppression filter 4, which corresponds to the resonance frequency.
- Subindex 0x03 defines the bandwidth level of resonance suppression filter 4, which represents the ratio of notch width to center frequency. A larger value increases the notch width.
- Subindex 0x04 defines the depth level of the center frequency for resonance suppression filter 4. A smaller value results in a greater notch depth, enhancing vibration suppression. However, if set too low, it may increase vibration instead.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A90	---	Command pulses per revolution	RW	UNSIGNED32	Pulses/rev	1 to 2^{26}	8,388,608	NO

This object sets the number of pulses required for one full rotation of the Servomotor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A93	---	Electronic gear ratio configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	3	NO
	0x01	Electronic gear ratio - numerator	RW	UNSIGNED32	---	1 to 2^{31}-1	2^{26}	NO
	0x02	Electronic gear ratio - denominator	RW	UNSIGNED32	---	1 to 2^{31}-1	8,388,608	NO
	0x03	Electronic gear ratio enabled	RW	UNSIGNED16	---	0 to 1	0	NO

This object sets the electronic gear ratio parameters for the servo system.

$$\text{Internal position command} = \text{Position command} \times \text{Electronic gear ratio} = \frac{\text{Position command} \times 0 \times \text{2A93-Sub1}}{0 \times \text{2A93-Sub2}}$$

- Subindex 0x01 defines the numerator of electronic gear ratio.
- Subindex 0x02 defines the denominator of electronic gear ratio.
- Subindex 0x03 defines whether the electronic gear ratio function is enabled, 0: Disabled, 1: Enabled.

(Note) 1. The setting range of the electronic gear ratio is 1/8,192 to 8,192. If the set electronic gear ratio exceeds 8,192, the system automatically calculates using an electronic gear ratio of 8,192. If the set electronic gear ratio is less than 1/8,192, the system automatically calculates using an electronic gear ratio of 1/8,192.

2. Do not change the electronic gear parameters when the motor is running.

3. For the electronic gear function, refer to 📖 *"10-6 Electronic Gear Function* (P.10-17)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A9A	---	Absolute encoder motor	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	8	NO
	0x01	Connection status	RO	UNSIGNED16	---	---	0	NO
	0x02	Motor model	RO	Visible string	---	---	0	NO
	0x03	Motor serial number	RO	Visible string	---	---	0	NO
	0x04	Motor rated current	RO	UNSIGNED32	0.01A	---	0	NO
	0x05	Motor rated torque	RO	UNSIGNED32	mN·m	---	0	NO
	0x06	Motor rated speed	RO	UNSIGNED32	rpm	---	0	NO
	0x07	Motor rotor inertia	RO	UNSIGNED32	$g.mm^2$	---	0	NO
	0x08	Drive serial number	RO	Visible string	---	---	0	NO

This object indicates the parameters of the absolute encoder motor connected to the drive.

- Subindex 0x01 indicates whether the drive is connected to the motor. 0: Motor disconnected, 1: Motor connected
- Subindex 0x02 indicates the model of the motor connected to the drive.
- Subindex 0x03 indicates the serial number of the motor connected to the drive.
- Subindex 0x04 indicates the rated current of the motor connected to the drive.
- Subindex 0x05 indicates the rated torque of the motor connected to the drive.
- Subindex 0x06 indicates the rated speed of the motor connected to the drive.
- Subindex 0x07 indicates the rotor inertia of the motor connected to the drive.
- Subindex 0x08 indicates the drive serial number.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A9B	---	Increment encoder motor	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	7	NO
	0x01	Connection status	RO	UNSIGNED16	---	---	0	NO
	0x02	Motor model	RO	Visible string	---	---	0	NO
	0x03	Motor serial number	RO	Visible string	---	---	0	NO
	0x04	Motor rated current	RO	UNSIGNED32	0.01A	---	0	NO
	0x05	Motor rated torque	RO	UNSIGNED32	mN·m	---	0	NO
	0x06	Motor rated speed	RO	UNSIGNED32	rpm	---	0	NO
	0x07	Motor rotor inertia	RO	UNSIGNED32	$g.mm^2$	---	0	NO

This object indicates the parameters of the incremental encoder motor connected to the drive.

- Subindex 0x01 indicates whether the drive is connected to the motor. 0: Motor disconnected, 1: Motor connected
- Subindex 0x02 indicates the model of the motor connected to the drive.
- Subindex 0x03 indicates the serial number of the motor connected to the drive.
- Subindex 0x04 indicates the rated current of the motor connected to the drive.
- Subindex 0x05 indicates the rated torque of the motor connected to the drive.
- Subindex 0x06 indicates the rated speed of the motor connected to the drive.
- Subindex 0x07 indicates the inertia of the motor connected to the drive.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2A9C	---	Encoder information	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	6	NO
	0x01	Encoder type	RO	UNSIGNED16	---	---	9	NO
	0x02	Encoder error code	RO	UNSIGNED32	---	---	0	NO
	0x03	Encoder temperature	RO	Visible string	0.1 ℃	---	0	NO
	0x04	Absolute encoder usage	RW	UNSIGNED16	---	0 to 4	0	NO
	0x05	Absolute encoder reset	RW	UNSIGNED16	---	0 to 2	0	NO
	0x06	Absolute encoder multi-turn counter overflow value	RW	INTEGER16	rev	0 to 32,767	0	NO

This object indicates the encoder information of the motor connected to the drive.

- Subindex 0x01 indicates the motor encoder type.

Value	Description
9	26-bit absolute photoelectric encoder

- Subindex 0x02 indicates the motor encoder error code.

Bit	Description
0	The battery voltage is below 3.2 V
1	The battery is not connected or the voltage is below 2.8 V
17 to 2	Internal used
18	Encoder disconnected
22 to 19	Internal used
23	The encoder needs to perform a multi-turn reset.
31 to 21	Internal used

- Subindex 0x03 indicates the motor encoder temperature.
- Subindex 0x04 defines the operating mode of the absolute encoder.

Value	Mode
0	Use as incremental mode
1	Use as single-turn Abs. encoder
2	Use as multi-turn Abs. encoder
3	Use as multi-turn Abs. encoder without overflow
4	Use as multi-turn Abs. encoder with overflow value configurable

- Subindex 0x05 defines setting to clear the alarm of absolute encoder or clear multi-turn data.
- Subindex 0x06 defines the absolute encoder multi-turn counter overflow value.

(Note) For operation of the absolute system, refer to 📖 *"10-9 Operation of Absolute System* (P.10-22)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AA0	---	Actual output current	RO	UNSIGNED32	0.1%	---	0	NO

This object indicates the actual output current of the drive as a percentage of the rated current.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AA1	---	Motor torque constant	RO	UNSIGNED32	mN·m/A	---	430	NO

This object indicates the torque constant of the motor connected to the drive.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AA8	---	Following error threshold	RW	UNSIGNED32	Pulses	0 to 2^{31}-1	83,886,080	NO

This object sets the following error threshold.
When the absolute value of the actual position deviation exceeds the set value, the drive will trigger the position following error fault, with the alarm code of r 10PL.
When the set value is 0, the position following error detection is disabled.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AA9	---	Max velocity limit	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	100*OD0x2A90	NO

This object sets the maximum velocity limit of the Servomotor.

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 2AA9}{0 \times 2A90}$$

When the motor actual velocity exceeds the set value, the drive will trigger the motor over speed fault, with the alarm code of r 12ou.
The velocity resolution is 0.25 rpm. When the set velocity limit is less than 0.25 rpm, the velocity limit setting value is equivalent to 0, and the motor over speed fault function is disabled at this time.
You can set the velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AB0	---	Virtual digital inputs	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	2	NO
	0x01	Input status setting	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO
	0x02	Input status enable	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO

This object sets the virtual digital input status of the drive.

- Subindex 0x01 defines the input status of the virtual digital input signal.

Bit	Function	Description
0	Digital input 1	0: Virtual input open 1: Virtual input closed
1	Digital input 2	
2	Digital input 3	
3	Digital input 4	
4	Digital input 5	
5	Digital input 6	
15 to 6	Reserved	Reserved, keep as "0"

- Subindex 0x02 defines whether the virtual digital input function is enabled.

Bit	Function	Description
0	Digital input 1	0: Virtual input disabled 1: Virtual input enabled
1	Digital input 2	
2	Digital input 3	
3	Digital input 4	
4	Digital input 5	
5	Digital input 6	
15 to 6	Reserved	Reserved, keep as "0"

(Note) For the virtual digital input function, refer to "*10-2 Virtual Digital Input Function* (P.10-9)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AB1	---	Dynamic brake configuration	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	4	NO
	0x01	Operation when servo off	RW	UNSIGNED32	---	0 to 5	0	NO
	0x02	Mechanical brake action time during deceleration when servo off	RW	UNSIGNED32	ms	0 to 30,000	500	NO
	0x03	Operation when fault occurs	RW	UNSIGNED32	---	0 to 7	6	NO
	0x04	Mechanical brake action time during deceleration when fault occurs	RW	UNSIGNED32	ms	0 to 30,000	0	NO

This object sets the dynamic brake action controlled by the drive.

- Subindex 0x01 defines the dynamic brake action when servo off.

Value	Description	
	Deceleration process	Stopped
0	Stop on max brake deceleration (set by 0x6085)	Keep in freerun state
1	Stop on max brake deceleration (set by 0x6085)	Dynamic brake action
2	Freerun state	Keep in freerun state
3	Freerun state	Dynamic brake action
4	Dynamic brake action	Keep in freerun state
5	Dynamic brake action	Dynamic brake action

- Subindex 0x02 defines the longest action time in the deceleration process when servo off.
- Subindex 0x03 defines the dynamic brake action when the servo reports an error.

Value	Description		
	During the deceleration process		Stopped
	Non-critical fault	Critical fault	
0	Freerun state		Keep in freerun state
1	Freerun state		Dynamic brake action
2	Dynamic brake action		Keep in freerun state
3	Dynamic brake action		Dynamic brake action
4	Stop on max brake deceleration (set by 0x6085)	Freerun state	Keep in freerun state
5	Stop on max brake deceleration (set by 0x6085)	Freerun state	Dynamic brake action
6	Stop on max brake deceleration (set by 0x6085)	Dynamic brake action	Keep in freerun state
7	Stop on max brake deceleration (set by 0x6085)	Dynamic brake action	Dynamic brake action

`Non-critical faults:` including position following error, over-temperature, power supply voltage out of range, drive main circuit power supply phase loss, EtherCAT communication error, over speed, and emergency stop alarm.

`Critical faults:` Among the fault alarms, apart from non-critical fault alarms, all others are critical fault alarms.

- Subindex 0x04 defines the longest action time during the deceleration process when the servo reports an error.

(Note) For the dynamic brake function, refer to 📖 *"10-8 Dynamic Brake* (P.10-20)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC0	---	Alarm auxiliary code	RO	UNSIGNED32	---	---	0	NO

This object indicates the present status code of the drive. When a bit is set to 1, it indicates that the drive is in the state defined by that bit.

Bit	Description	Bit	Description
0	Reserved, keep as "0"	16	Drive low voltage
1	Reserved, keep as "0"	17	Reserved, keep as "0"
2	Over current lowside	18	Motion command received while motor disable
3	Over current highside	19	IO function multiplexing
4	Over current (reading)	20	EC target position abnormal
5	Drive processor over temperature	21	Reserved, keep as "0"
6	Drive power module over temperature	22	Reserved, keep as "0"
7	Motor over temperature	23	Control authority release fault
8	Parameter read failed	24	Motor stall alarm
9	Internal 5 V error	25	Motor collision alarm
10	Internal 12 V error	26	STO SF1 signal invalid
11	Reserved, keep as "0"	27	STO SF2 signal invalid
12	FPGA error	28	Reserved, keep as "0"
13	Save failed	29	Reserved, keep as "0"
14	Motor encoder communication error	30	Reserved, keep as "0"
15	Drive over voltage	31	Reserved, keep as "0"

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC1	---	Current ramp limit	RW	INTEGER32	0.1%	0 to 4,000	0	NO

This object sets the current threshold for motor collision detection. If the commanded current increases beyond the specified threshold within 125 us, the drive will trigger a motor collision fault, with the alarm code of  .

100.0 % corresponds to 1 times the rated torque of the motor, and setting the value to 0 disables the function.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC3	---	Velocity feedback filter	RW	INTEGER32	---	0 to 3	0	NO

This object sets the cut-off frequency of the first-order low-pass filter applied to the velocity feedback signal.

0: Disabled, 1: 8kHz, 2: 2kHz, 3: 1kHz

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC4	---	Self-adapting filter switch	RW	INTEGER32	---	0 to 1	0	NO

This object sets whether the mechanical resonance frequency detection function is activated.

When the detection of mechanical resonance frequency is enabled, the resonance frequency can be detected in real time.

0: Disabled, 1: Enabled

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC5	---	Single DC synchronous cycle command position increment threshold in CSP mode	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	120*OD0x2A90	NO

This object sets the threshold for the commanded position increment within DC cycle in CSP control mode.
If the absolute value of the position change between two consecutive commands, divided by the EtherCAT communication synchronization period, equals or exceeds this threshold, the drive will trigger a CSP command position increment out of range fault, with the alarm code of r44CU.

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 2AC5}{0 \times 2A90}$$

The velocity resolution is 0.25 rpm. When the set velocity is less than 0.25 rpm, the velocity setting value is 0. You can set the velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC6	---	Absolute encoder counter overflow value	RW	INTEGER32	Pulses	0 to 2^{31}-1	0	NO

This object sets the encoder position overflow value when the absolute encoder is configured in multi-turn mode with configurable counter overflow.
When the encoder position reaches this value, the position counter automatically resets to 0 and continues counting.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC7	---	EtherCAT sync deviation threshold	RW	UNSIGNED32	10ns	10 to 400	400	NO

This object sets the allowable jitter range of the synchronization signal when the servo drive is operating in DC synchronization mode.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2AC9	---	Extended Setting	RW	UNSIGNED32	---	0 to 2^{31}-1	768	NO

This object sets the extended functions of the servo drive. Setting a specific bit to 1 enables the corresponding function. After changing the set values, you need to restart the drive for the changes to take effect.

Bit	Description
0	Servomotor field weakening control enable
1	Servomotor excitation noise reduction enable
2	Reserved, keep as "0"
3	
4	Servo action selection when main is power off upon servo on 0: "Drive Under-voltage" or "Drive Low Voltage" alarm occurs when main power OFF; 1: Servo OFF when main power OFF;
5	Reserved, keep as "0"
6	
7	
8	Servomotor runaway protection instantaneous detection enable
9	Servomotor runaway protection continuous detection enable
10	Reserved, keep as "0"
11	
12	
13	
14	
15	

(Note) When the motor load is in a vertical or dragged application, it is recommended to disable the Servomotor runaway protection continuous detection function.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2ACA	---	Runaway current judgment threshold	RW	UNSIGNED32	0.1%	0 to 4,000	50	NO

This object sets the current threshold for runaway protection detection of the Servomotor. 100.0 % corresponds to 1 times the rated torque of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2ACB	---	RunOff Time	RW	UNSIGNED32	ms	1 to 2,000	2	NO

This object sets the detection duration for runaway protection of the Servomotor. If the motor current exceeds the threshold set by 0x2ACA and remains above this threshold for the specified duration, the drive will trigger a runaway protection fault, with the alarm code of  .

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x01	Model control function	RW	INTEGER16	---	-32,768 to 32,767	0	NO

This object sets the servo model tracing control function, which is only effective in position control mode.
Bit0 to Bit7: Selects the model control and low-frequency vibration suppression functions.
0x00: Model control disabled
0x01: Model control enabled
0x11: Model-based low-frequency vibration suppression enabled
0x20: Model control disabled, second low-frequency vibration suppression enabled
0x21: Model-based low-frequency vibration suppression enabled, second low-frequency vibration suppression also enabled

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x02	Model gain	RW	UNSIGNED16	0.1 rad/s	10 to 20,000	800	NO

This object sets the gain for the servo model tracing control function.
Increasing the gain improves the servo system's responsiveness, reduces position following error, and shortens positioning time. However, setting the gain too high may cause position overshoot or vibration.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x03	Model damping	RW	UNSIGNED16	0.1%	500 to 2,000	1,000	NO

This object sets the damping for the servo model tracing control function.
Increasing the damping reduces position overshoot during positioning but may result in a longer positioning time.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x04	Model Anti-Resonance frequency 1	RW	UNSIGNED16	0.1 Hz	10 to 2,500	1,000	NO

This object sets the 1st low-frequency resonance frequency used in model-based control.
When the model control function is enabled and low-frequency vibrations between 1 and 100 Hz are present, the low-frequency vibration suppression function can be activated. Both model anti-resonance frequency 1 and model anti-resonance frequency 2 should be configured. When the system has only one low-frequency resonance frequency, the parameters of model anti-resonance frequency 1 and model anti-resonance frequency 2 should be set to the same value to achieve the best vibration suppression effect.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x05	Model Anti-Resonance frequency 2	RW	UNSIGNED16	0.1 Hz	10 to 2,500	1,000	NO

This object sets the 2nd low-frequency resonance frequency used in model-based control.
When the model control function is enabled and low-frequency vibrations between 1 and 100 Hz are present, the low-frequency vibration suppression function can be activated. Both model anti-resonance frequency 1 and model anti-resonance frequency 2 should be configured. When the system has only one low-frequency resonance frequency, the parameters of model anti-resonance frequency 1 and model anti-resonance frequency 2 should be set to the same value to achieve the best vibration suppression effect.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x0B	Vibration suppression frequency	RW	UNSIGNED16	0.1 Hz	10 to 2,000	1,000	NO

This object sets the frequency used for low-frequency vibration suppression in the servo system.
The frequency should be set according to the actual resonance frequency of the system, the valid suppression range is 1 to 200 Hz.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x0C	Vibration suppression gain	RW	UNSIGNED16	1%	10 to 1,000	100	NO

This object sets the gain of the servo system's low-frequency vibration suppression.
This parameter adjusts the vibration attenuation effect. A higher gain increases the attenuation of vibrations at the target frequency. However, excessively high gain may introduce phase lag or excite new resonances.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x14	Extended function	RW	INTEGER16	---	-32,768 to 32,767	0	NO

This object sets the extended functions of the servo drive. Setting a specific Bit to 1 enables the corresponding function immediately.

Bit	Description	Bit	Description
0	Disturbance observer enable	8	New resonance suppression enable
1	Use observer output as disturbance observer speed input (velocity observer must be enabled)	9	Use velocity observer output as input for new resonance suppression (Velocity observer must be enabled)
2	High-bandwidth disturbance compensation	10	Reserved, keep as "0"
3	Reserved, keep as "0"	11	Reserved, keep as "0"
4	Velocity observer enable	12	Reserved, keep as "0"
5	Use velocity observer as speed controller input	13	Reserved, keep as "0"
6	Reserved, keep as "0"	14	Reserved, keep as "0"
7	Reserved, keep as "0"	15	Reserved, keep as "0"

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x15	Disturbance compensation gain1	RW	UNSIGNED16	1%	10 to 1,000	100	NO

This object sets the gain of the servo system's low-frequency vibration suppression.
It adjusts the delay caused by vibration suppression. Increasing the gain shortens the delay caused by low-frequency vibration suppression.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x17	Disturbance torque gain	RW	UNSIGNED16	1%	0 to 100	0	NO

This object sets the magnitude of torque compensation applied to counteract external disturbances in the servo system.
Increasing the value increases the compensated torque, reducing position error during positioning. Excessively high values may cause vibrations. The recommended setting is approximately 85%, and it should not exceed 95%.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x18	Disturbance delay compensation	RW	INTEGER16	0.1 Hz	-10,000 to 10,000	0	NO

This object sets the magnitude of delay compensation applied by the servo disturbance compensator.
In most cases, no adjustment is necessary, the default value can be used.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x19	Disturbance response compensation	RW	UNSIGNED16	1%	1 to 1,000	100	NO

This object sets the magnitude of inertia compensation applied by the servo disturbance compensator.
After completing the inertia identification, no adjustment is necessary, the default value can be used.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x1A	Velocity observer bandwidth	RW	UNSIGNED16	Hz	100 to 500	300	NO

This object sets the cut-off frequency of the servo velocity observer.
If the value is set too high, it may cause resonance. If excessive noise occurs in the velocity feedback, the value can be reduced accordingly. It is recommended to set the velocity observer bandwidth to 1.5 to 3 times the speed loop bandwidth.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x1B	Velocity observer response compensation	RW	UNSIGNED16	1%	1 to 1,000	100	NO

This object sets the servo velocity observer response compensation.
The velocity observer response compensation corrects the dynamic characteristics of the observer output, such as delay and overshoot, ensuring faster and smoother tracing of the actual speed signal.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x1C	Velocity observer delay compensation	RW	INTEGER16	0.1 Hz	-10,000 to 10,000	0	NO

This object sets the servo velocity observer frequency compensation.
A phase correction loop is added in the observer to suppress resonance and enhance robustness against disturbances at specific frequencies.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x1E	Resonance frequency	RW	UNSIGNED16	Hz	100 to 1,000	1,000	NO

This object sets the low-frequency resonance frequency within the range of 100 to 1,000 Hz.
The new resonance suppression function effectively reduces vibrations caused by resonance within this range.
When the system's resonance points are close to the velocity loop bandwidth and significant lag is present, this new suppression function offers better applicability than a traditional notch filter.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x1F	Anti-Resonance gain1	RW	UNSIGNED16	1%	0 to 300	0	NO

This object sets the resonance suppression gain of the servo system.
With the new resonance suppression function, this parameter adjusts the vibration attenuation effect. A higher gain provides stronger attenuation at the target frequency, but excessive gain may introduce phase lag or excite new resonances.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x20	Anti-Resonance gain2	RW	UNSIGNED16	1%	0 to 300	0	NO

This object sets the 2nd resonance suppression gain of the servo system.
With the new resonance suppression function, if increasing the resonance suppression gain or enhancing system rigidity induces higher-frequency vibrations (typically 3 to 4 times the original vibration frequency), the 2nd resonance suppression gain can be increased. Adjust gradually in steps until the optimal vibration suppression effect is achieved.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x21	Anti-Resonance compensation gain	RW	UNSIGNED16	1%	1 to 1,000	100	NO

This object sets the resonance suppression response compensation of the servo system.
When using the new resonance suppression function, if the load-to-motor inertia ratio is uncertain and vibration suppression is inadequate, adjusting this compensation parameter can improve the suppression effect.
Note that adjusting this parameter may affect the servo system's dynamic response. It should be changed gradually, either increased or decreased until a near-optimal vibration suppression is achieved.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x22	Anti-Resonance compensation frequency1	RW	INTEGER16	Hz	-1,000 to 1,000	0	NO

This object sets the resonance suppression frequency compensation of the servo system.
When using the new resonance suppression function, if increasing the resonance suppression gain does not reduce vibration amplitude and the vibration frequency does not increase significantly, the resonance suppression frequency compensation can be fine-tuned. Typically, only one of the 1st or 2nd resonance suppression frequency compensation parameters is adjusted. When vibration frequency measurement is reliable, it is recommended to first adjust the 1st resonance suppression frequency compensation and observe its effect on vibration suppression.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x23	Anti-Resonance compensation frequency2	RW	INTEGER16	Hz	-1,000 to 1,000	0	NO

This object sets the resonance suppression frequency compensation of the servo system.
When using the new resonance suppression function, if increasing the resonance suppression gain does not reduce vibration amplitude and the vibration frequency does not increase significantly, the resonance suppression frequency compensation can be fine-tuned. Typically, only one of the 1st or 2nd resonance suppression frequency compensation parameters is adjusted. When vibration frequency measurement is reliable, it is recommended to first adjust the 1st resonance suppression frequency compensation and observe its effect on vibration suppression.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x24	Anti-Resonance compensation frequency3	RW	UNSIGNED16	Hz	300 to 6,000	2,000	NO

This object sets the resonance suppression frequency compensation of the servo system.
When using the new resonance suppression function, if increasing the resonance suppression gain does not reduce vibration amplitude and the vibration frequency does not increase significantly, the resonance suppression frequency compensation can be fine-tuned. In most cases, the 3rd resonance suppression frequency compensation remains at its default value.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x25	Gravity compensation selection	RW	INTEGER16	---	0, 1	0	NO

This object sets whether the servo system gravity compensation function is activated.
0: Disabled, 1: Enabled

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x2B00	0x26	Torque gravity	RW	INTEGER16	0.1%	-1,000 to 1,000	0	NO

This object sets the gravity compensation value of the servo system.
When gravity compensation is enabled, assigning an appropriate value for vertical-axis applications helps reduce load drop at startup.

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Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x603F	---	Error code	RO	UNSIGNED16	---	---	0	TxPDO

This object indicates the alarm code occurring in the drive.

The error codes and their descriptions are as follows:

Error code	Description	Error code	Description
0xFFC0 to 0xFFDA	EtherCAT communication error	0xFF32	CCW limit is triggered
0xFF01	Drive over current	0xFF33	CW and CCW limit switch is triggered
0xFF02	Drive over voltage	0xFF34	Current limit exceed
0xFF03	Drive processor over temperature	0xFF35	Motion command received while motor disable
0xFF04	Reserved	0xFF36	Drive low voltage
0xFF05	Drive internal voltage error	0xFF38	Over speed
0xFF06	Position following error	0xFF39	Reserved
0xFF07	Motor encoder disconnected	0xFF3A	Digital input emergency stop
0xFF08	Reserved	0xFF3B	Absolute encoder under-voltage
0xFF09	Reserved	0xFF3C	Absolute position lost
0xFF0A	Regenerate failed	0xFF3D	Absolute position overflow
0xFF0B	Safe Torque Off (STO)	0xFF3E	Motor over temperature
0xFF0C	Reserved	0xFF3F	Drive under-voltage
0xFF0D	FPGA error	0xFF40	USB communication error
0xFF0E	Parameter read failed	0xFF41	Save failed
0xFF0F	Absolute encoder multi-turn error	0xFF42	IO function multiplexing
0xFF10	Motor stall	0xFF45	Homing parameter configuration error
0xFF11	Drive power module over temperature	0xFF46	Motor collision alarm
0xFF12	Encoder communication error	0xFF50	Motor runaway detected
0xFF13	CSP command exceeds limits within DC cycle	0xFF65	Drive and motor voltage mismatch
0xFF31	CW limit is triggered	0xFF67	Control authority release fault

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6040	---	Controlword	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO

This object controls the PDS (Power Drive System) state transition of the servo drive.
The corresponding functions and their descriptions for each bit are as follows:

Bit	Name		Description
0	Switch on		1: Valid 0: Invalid
1	Enable voltage		1: Valid 0: Invalid
2	Quick stop		0: Valid 1: Invalid
3	Enable operation		1: Valid 0: Invalid
6 to 4	Operation mode specific		These bits are specific to the operation mode
7	Fault reset		Clear drive faults, rising edge active
8	Halt		These bits are specific to the operation mode
9	Operation mode specific		These bits are specific to the operation mode
15 to 10	Reserved		Reserved, keep as "0"

Description of bits specific to operation mode is as follows:

Modes of operation	Controlword				
	Bit 9	Bit 8	Bit 6	Bit 5	Bit 4
Profile position mode (PP)	Change of set point	Halt	Absolute/relative (Abs/rel)	Change set immediately	New set point
Profile velocity mode (PV)	---	Halt	---	---	---
Profile torque mode (TQ)	---	Halt	---	---	---
Cyclic synchronous position mode (CSP)	---	---	---	---	---
Cyclic synchronous velocity mode (CSV)	---	---	---	---	---
Cyclic synchronous torque mode (CST)	---	---	---	---	---
Homing mode (HM)	---	Halt	---	---	Homing operation start

(Note) 1. Each bit of a controlword is meaningless when assigned a value on its own, and must be combined with related bits to form a control command.
2. bit0 to bit3 and bit7 have the same meaning in all modes of operation. Control commands must be sent in sequence for the drive to enter the expected state according to the CiA402 status machine toggle process. Each command corresponds to a unique state.
3. bit10 to bit15 are reserved, keep as "0".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6041	---	Statusword	RO	UNSIGNED16	---	---	592	TxPDO

This object indicates the present PDS status of the servo drive.

The corresponding functions and their descriptions for each bit are as follows:

Bit	Name	Description	
0	Ready to switch on		1: Valid 0: Invalid
1	Switched on		1: Valid 0: Invalid
2	Operation enabled		1: Valid 0: Invalid
3	Fault		1: Valid 0: Invalid
4	Voltage enabled		1: Valid 0: Invalid
5	Quick stop		0: Valid 1: Invalid
6	Switch on disabled		1: Valid 0: Invalid
7	Warning		1: Warning 0: No warning
8	Reserved		Reserved, keep as "0"
9	Remote		This bit indicates that the Servo Drive is currently controlled with Controlword 1: Valid 0: Invalid
10	Operation mode specific		These bits are specific to the operation mode
11	Internal limit active		This bit indicates that the limit function is in effect* 1: Valid 0: Invalid
12	Operation mode specific		These bits are specific to the operation mode
15 to 13	Manufacturer specific		Specific to the manufacturer

*The limit function includes digital input limit.

Description of bits specific to operation mode is as follows:

Modes of operation	Controlword			
	Bit 15	Bit 13	Bit 12	Bit 10
Profile position mode (PP)	---	---	Set point acknowledge	Target reached
Profile velocity mode (PV)	---	---	Speed	Target reached
Profile torque mode (TQ)	---	---	---	Target reached
Cyclic synchronous position mode (CSP)	---	---	Drive follows the command value	Status toggle
Cyclic synchronous velocity mode (CSV)	---	---	Drive follows the command value	Status toggle
Cyclic synchronous torque mode (CST)	---	---	Drive follows the command value	Status toggle
Homing mode (HM)	Home find	Homing error	Homing attained	Target reached

(Note) 1. bit0 to bit6 and bit9 have the same meaning in all modes of operation.

2. In the Homing mode, bit13 and bit15 are defined as special functions.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x605A	---	Quickstop option code	RW	INTEGER16	---	0 to 7	2	NO

This object sets what action is performed when the quick stop function is executed.
Different settings based on different operation modes.
PP/PV/CSP/CSV mode:

Value	Description	
	Deceleration process	Stopped
0	Stop based on 0x2AB1 subindex 01h setting	
1	Stop on max brake deceleration (set by 0x6084)	Freerun state
2	Stop on max brake deceleration (set by 0x6085)	Freerun state
3	Stop on max brake deceleration (set by 0x60C6)	Freerun state
4	Reserved	
5	Stop on max brake deceleration (set by 0x6084)	Keep enabled
6	Stop on max brake deceleration (set by 0x6085)	Keep enabled
7	Stop on max brake deceleration (set by 0x60C6)	Keep enabled

TQ/CST mode:

Value	Description	
	Deceleration process	Stopped
0	Stop based on 0x2AB1 subindex 01h setting	
1	Stop on max brake deceleration (set by 0x6087)	Freerun state
2	Stop on max brake deceleration (set by 0x6087)	Freerun state
3	Zero command torque	Freerun state
4	Reserved	
5	Stop on max brake deceleration (set by 0x6087)	Keep enabled
6	Stop on max brake deceleration (set by 0x6087)	Keep enabled
7	Zero command torque	Keep enabled

HM mode:

Value	Description	
	Deceleration process	Stopped
0	Stop based on 0x2AB1 subindex 01h setting	
1	Stop on max brake deceleration (set by 0x609A)	Freerun state
2	Stop on max brake deceleration (set by 0x6085)	Freerun state
3	Stop on max brake deceleration (set by 0x60C6)	Freerun state
4	Reserved	
5	Stop on max brake deceleration (set by 0x609A)	Keep enabled
6	Stop on max brake deceleration (set by 0x6085)	Keep enabled
7	Stop on max brake deceleration (set by 0x60C6)	Keep enabled

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x605B	---	Shutdown option code	RW	INTEGER16	---	-1 to 1	0	NO

Different settings based on different operation modes. Refer to the settings of 0x605C.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x605C	---	Disable operation option code	RW	INTEGER16	---	-1 to 1	0	NO

Different settings based on different operation modes.

PP/PV/CSP/CSV mode:

Value	Description	
	Deceleration process	Stopped
-1	Stop on max brake deceleration (set by 0x6084)	Dynamic brake
0	Stop based on 0x2AB1 subindex 01h setting	
1	Stop on max brake deceleration (set by 0x6084)	Freerun state

TQ/CST mode:

Value	Description	
	Deceleration process	Stopped
-1	Stop on max brake deceleration (set by 0x6087)	Dynamic brake
0	Stop based on 0x2AB1 subindex 01h setting	
1	Stop on max brake deceleration (set by 0x6087)	Freerun state

HM mode:

Value	Description	
	Deceleration process	Stopped
-1	Stop on max brake deceleration (set by 0x609A)	Dynamic brake
0	Stop based on 0x2AB1 subindex 01h setting	
1	Stop on max brake deceleration (set by 0x609A)	Freerun state

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x605D	---	Halt option code	RW	INTEGER16	---	1 to 3	0	NO

This object sets the motor's action when servo Halt.

Different settings based on different operation modes.

PP/PV/CSP/CSV mode:

Value	Description	
	Deceleration process	Stopped
1	Stop on max brake deceleration (set by 0x6084)	Stay in operation enabled state after stopped
2	Stop on max brake deceleration (set by 0x6085)	Stay in operation enabled state after stopped
3	Stop on max brake deceleration (set by 0x60C6)	Stay in operation enabled state after stopped

TQ/CST mode:

Value	Description	
	Deceleration process	Dynamic brake
1	Stop on max brake deceleration (set by 0x6087)	Stay in operation enabled state after stopped
2	Stop on max brake deceleration (set by 0x6087)	Stay in operation enabled state after stopped
3	Zero command torque	Stay in operation enabled state after stopped

HM mode:

Value	Description	
	Deceleration process	Dynamic brake
1	Stop on max brake deceleration (set by 0x609A)	Stay in operation enabled state after stopped
2	Stop on max brake deceleration (set by 0x6085)	Stay in operation enabled state after stopped
3	Stop on max brake deceleration (set by 0x60C6)	Stay in operation enabled state after stopped

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x605E	---	Fault reaction option code	RW	INTEGER16	---	-2 to 2	0	NO

This object sets the motor reaction option code when the servo reports an error.

Setting value	During deceleration	After stopping
-2	A: Ramp stop based on 6085h(P/V/HM)/6087h(T) setting B: Dynamic brake	Dynamic brake
-1	A: Ramp stop based on 6084h(P/V)/609Ah(HM)/6087h(T) setting B: Dynamic brake	Dynamic brake
0	Stop based on 2AB1:03h setting	
1	A: Ramp stop based on 6084h(P/V)/609Ah(HM)/6087h(T) setting B: Freerun	Freerun
2	A: Ramp stop based on 6085h(P/V/HM)/6087h(T) setting B: Freerun	Freerun

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6060	---	Modes of operation	RW	INTEGER8	---	0 to 10	0	RxPDO

This object sets the modes of operation of the servo.
When an unsupported mode of operation is set via SDO communications, an ABORT code is returned.
When an unsupported mode of operation is set via PDO communications, the servo will retain the previously active mode of operation.

Value	Description
0	Not specified
1	Profile position mode (PP)
3	Profile velocity mode (PV)
4	Profile torque mode (TQ)
6	Homing mode (HM)
8	Cyclic synchronous position mode (CSP)
9	Cyclic synchronous velocity mode (CSV)
10	Cyclic synchronous torque mode (CST)

(Note) For changing the mode of operation, refer to "*9-2 Modes of Operation* (P.9-6)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6061	---	Modes of operation display	RO	INTEGER8	---	---	0	TxPDO

This object indicates the mode of operation of the servo.

Value	Description
0	Not specified
1	Profile position mode (PP)
3	Profile velocity mode (PV)
4	Profile torque mode (TQ)
6	Homing mode (HM)
8	Cyclic synchronous position mode (CSP)
9	Cyclic synchronous velocity mode (CSV)
10	Cyclic synchronous torque mode (CST)

(Note) For changing the mode of operation, refer to "*9-2 Modes of Operation* (P.9-6)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6064	---	Position actual value	RO	INTEGER32	Pulses	---	0	TxPDO

This object indicates the present position of the Servomotor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x606C	---	Velocity actual value	RO	INTEGER32	Pulses/s	---	0	TxPDO

This object indicates the present velocity of the Servomotor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6071	---	Target torque	RW	INTEGER16	0.1%	-4,000 to 4,000	0	RxPDO

This object sets the target torque value of the servo in the Profile torque mode (TQ) and the Cyclic synchronous torque mode (CST).
100.0% corresponds to 1 times the rated torque of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6072	---	Max torque	RW	UNSIGNED16	0.1%	0 to 4,500	4,000	RxPDO

This object sets the maximum torque values of the Servomotor in various modes.
100.0% corresponds to 1 times the rated current of the motor.

(Note) If the value of this object is too small, the Servomotor may have insufficient torque during acceleration or deceleration process.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6073	---	Max current/1st torque limit	RW	UNSIGNED16	0.1%	0 to 4,000	4,000*	NO

This object sets the maximum torque limit of the Servomotor.
100.0% corresponds to 1 times the rated current of the motor.
* The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

(Note) If the value of this object is too small, the Servomotor may have insufficient torque during acceleration or deceleration process.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6074	---	Torque demand	RO	INTEGER16	0.1%	---	0	TxPDO

This object indicates the torque demand value inside the servo in the Profile torque mode (TQ) and the Cyclic synchronous torque mode (CST).
100.0% corresponds to 1 times the rated torque of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6077	---	Torque actual value	RO	INTEGER16	0.1%	---	0	TxPDO

This object indicates the present torque value of the Servomotor in the Profile torque mode (TQ) and the Cyclic synchronous torque mode (CST).
100.0% corresponds to 1 times the rated torque of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6078	---	Current actual value	RO	INTEGER16	0.1%	---	0	TxPDO

This object indicates the present current value of the Servomotor.
100.0% corresponds to 1 times the rated current of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x607A	---	Target position	RW	INTEGER32	Pulses	-2^{31} to $2^{31}-1$	0	RxPDO

This object sets the target position of the servo in the Profile position mode (PP) and the Cyclic synchronous position mode (CSP).

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x607C	---	Home offset	RW	INTEGER32	Pulses	-2^{31} to $2^{31}-1$	0	RxPDO

This object sets the configured difference between the zero position for the application and the mechanical home position (found during homing).
When the homing method is selected from the homing methods 1 to 35 defined in CiA402, the motor stops movement after returning to the mechanical home position, and the Position actual value (0x6064) is set to the value of Home offset (0x607C).
When the homing method is selected from the manufacturer specific homing methods -1 to -4, the motor continues to move the set home offset distance after returning to the mechanical home position. After the motion is completed, the position actual value (0x6064) is set to the value of Home offset (0x607C).

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x607D	---	Software positioin limit	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	2	NO
	0x01	Negative software limit	RW	INTEGER32	Pulses	-2^{31} to $2^{31}-1$	0	NO
	0x02	Positive software limit	RW	INTEGER32	Pulses	-2^{31} to $2^{31}-1$	0	NO

This object sets the software position limit of the servo.

- Subindex 0x01 defines the Min position limit, the position of this value is relative to the zero position.
- Subindex 0x02 defines the Max position limit, the position of this value is relative to the zero position.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x607F	---	Max velocity	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	80*OD0x2A90	RxPDO

This object sets the software position limit of the servo and is effective in the Profile torque mode and the Cyclic synchronous torque mode.

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 607\text{F}}{0 \times 2\text{A90}}$$

When the velocity is less than 0.25 rpm, the maximum velocity setting value is 0.

You can set the velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6081	---	Profile velocity	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	5*OD0x2A90	RxPDO

This object sets the target velocity of the servo in the Profile position mode (PP).

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 6081}{0 \times 2\text{A90}}$$

When the velocity is less than 0.25 rpm, the profile velocity setting value is 0.

You can set the profile velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6083	---	Profile acceleration	RW	UNSIGNED32	Pulses/s^2	0.167 to 5,461*OD 0x2A90	100*OD0x2A90	RxPDO

This object sets the acceleration of the servo in the Profile position mode (PP) and the Profile velocity mode (PV).

$$\text{Acceleration}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 6083}{0 \times 2\text{A90}}$$

When the acceleration is less than 10 rpm/s, the profile acceleration setting value is 0.

You can set the profile acceleration up to 300,000 rpm/s.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6084	---	Profile deceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)*OD0x2A90	100*OD0x2A90	RxPDO

This object sets the acceleration of the servo in the Profile position mode (PP) and the Profile velocity mode (PV).

$$\text{Deceleration}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 6084}{0 \times 2\text{A90}}$$

When the deceleration is less than 10 rpm/s, the profile deceleration setting value is 0.

You can set the profile deceleration up to 300,000 rpm/s.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6085	---	Quick stop deceleration	RW	UNSIGNED32	100 Pulses/s^2	(0.00167 to 54.61)* OD0x2A90	30*OD0x2A90	NO

This object sets the quick stop deceleration of the servo.

$$\text{Deceleration}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} \times 100 = \frac{60 \times 0 \times 6085}{0 \times 2A90} \times 100$$

When the deceleration is less than 10 rpm/s, the quick stop deceleration setting value is 0.
You can set the quick stop deceleration up to 300,000 rpm/s.
The profile acceleration/deceleration is limited by the quick stop deceleration.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6087	---	Torque ramp	RW	UNSIGNED32	0.1%/s	0 to 2^{32}-1	0	RxPDO

This object sets the torque demand acceleration/deceleration of the servo in the Profile torque mode (TQ).
This parameter value represents the increment of the torque demand per second relative to the rated torque of the motor.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6098	---	Homing method	RW	INTEGER8	---	-4 to 35	1	RxPDO

This object sets the homing method for the Servomotor.

(Note) For the homing method, refer to "*9-9 Homing Mode* (P.9-41)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6099	---	Homing speeds	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	2	NO
	0x01	Speed during search for switch	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	10*OD0x2A90	RxPDO
	0x02	Speed during search for zero	RW	UNSIGNED32	Pulses/s	0 to 135*OD0x2A90	1*OD0x2A90	RxPDO

This object sets two speed values of the Servomotor when selecting the homing methods 1 to 35 defined in CiA402 in the Homing mode (HM).

- Subindex 0x01 defines the high homing speed value.
- Subindex 0x02 defines the low homing speed value.

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times \text{Setting value}}{0 \times 2A90}$$

When the speed is less than 0.25 rpm, the homing speed setting value is 0.
You can set the velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x609A	---	Homing Acceleration/Deceleration	RW	UNSIGNED32	Pulses/s^2	(0.167 to 5,461)* OD0x2A90	100*OD0x2A90	RxPDO

This object sets the acceleration or deceleration of the Servomotor when selecting the homing methods 1 to 35 defined in CiA402 in the Homing mode (HM).

$$\text{Acceleration/Deceleration}_{(\text{rpm})} = \frac{60 \times \text{Setting value}}{\text{Number of pulses required for the motor to rotate one revolution}} = \frac{60 \times 0 \times 609A}{0 \times 2A90}$$

When the acceleration or deceleration is less than 10 rpm/s, the homing acceleration setting value is 0.
You can set the acceleration or deceleration up to 300,000 rpm/s.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60B8	---	Touch probe function control	RW	UNSIGNED16	---	0 to 2^{16}-1	0	RxPDO

This object sets the functions of the touch probes 1 and 2.

Bit definitions as follows:

Bit	Function	Value	Description	Bit	Function	Value	Description
0	Touch probe 1 enable	0	Disable touch probe 1	8	Touch probe 2 enable	0	Disable touch probe 2
		1	Enable touch probe 1			1	Enable touch probe 2
1	Touch probe 1 trigger type	0	Single trigger	9	Touch probe 2 trigger type	0	Single trigger
		1	Continuous trigger			1	Continuous trigger
2	Touch probe 1 trigger source select	0	X5 signal	10	Touch probe 2 trigger source select	0	X6 signal
		1	Z-Phase signal			1	Z-Phase signal
3	Reserved	0	Reserved	11	Reserved	0	Reserved
		1				1	
4	Enable sample at touch probe 1 rising edge	0	Not use sample at touch probe 1 rising edge	12	Enable sample at touch probe 2 rising edge	0	Not use sample at touch probe 2 rising edge
		1	Use sample at touch probe 1 rising edge			1	Use sample at touch probe 2 rising edge
5	Enable sample at touch probe 1 falling edge	0	Not use sample at touch probe 1 falling edge	13	Enable sample at touch probe 2 falling edge	0	Not use sample at touch probe 2 falling edge
		1	Use sample at touch probe 1 falling edge			1	Use sample at touch probe 2 falling edge
6	Reserved	0	Reserved	14	Reserved	0	Reserved
		1				1	
7	Reserved	0	Reserved	15	Reserved	0	Reserved
		1				1	

(Note) For the touch probe function, refer to "*10-4 Touch Probe Function* (P.10-12)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60B9	---	Touch probe function status	RO	UNSIGNED16	---	---	0	TxPDO

This object indicates the state of the touch probes 1 and 2.

Bit	Function	Value	Description
0	Touch probe 1 status	0	Touch probe 1 disabled
		1	Touch probe 1 enable
1	Touch probe 1 rising edge value stored	0	Touch probe 1 no rising edge value stored
		1	Touch probe 1 rising edge value stored
2	Touch probe 1 falling edge value stored	0	Touch probe 1 no falling edge value stored
		1	Touch probe 1 falling edge value stored
3 to 7	Reserved	0	Reserved, keep as "0"
8	Touch probe 2 status	0	Touch probe 2 disabled
		1	Touch probe 2 enable
9	Touch probe 2 rising edge value stored	0	Touch probe 2 no rising edge value stored
		1	Touch probe 2 rising edge value stored
10	Touch probe 2 falling edge value stored	0	Touch probe 2 no falling edge value stored
		1	Touch probe 2 falling edge value stored
11 to 15	Reserved	0	Reserved, keep as "0"

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60BA	---	Touch probe pos1 pos value	RO	INTEGER32	Pulses	---	0	TxPDO

This object indicates the position value of the touch probe 1 at rising edge.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60BB	---	Touch probe pos1 neg value	RO	INTEGER32	Pulses	---	0	TxPDO

This object indicates the position value of the touch probe 1 at falling edge.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60BC	---	Touch probe pos2 pos value	RO	INTEGER32	Pulses	---	0	TxPDO

This object indicates the position value of the touch probe 2 at rising edge.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60BD	---	Touch probe pos2 neg value	RO	INTEGER32	Pulses	---	0	TxPDO

This object indicates the position value of the touch probe 2 at falling edge.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60E0	---	Positive torque limit value	RW	UNSIGNED16	0.1%	0 to 4,000	0	RxPDO

This object sets the maximum positive torque of the motor.

100.0% corresponds to 1 times the rated torque of the motor.

(Note) For the torque limit function, refer to "*10-5 Torque Limit Function* (P.10-16)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60E1	---	Negative torque limit value	RW	UNSIGNED16	0.1%	0 to 4,000	0	RxPDO

This object sets the maximum negative torque of the motor.
100.0% corresponds to 1 times the rated torque of the motor.

(Note) For the torque limit function, refer to "*10-5 Torque Limit Function* (P.10-16)".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60F4	---	Following error actual value	RO	INTEGER32	Pulses	---	0	TxPDO

This object indicates the actual value of the following error.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60FD	---	Digital inputs	RO	UNSIGNED32	---	---	0	TxPDO

This object indicates the present status of digital inputs of the servo drive.
Bit definitions as follows:

Bit	Function	Description
0	State of negative limit switch	0: Limit switch inactive 1: Limit switch active
1	State of positive limit switch	
2	State of home switch	0: Home switch inactive 1: Home switch active
15 to 3	Reserved	Reserved, keep as "0".
16	Digital input 1	0: Input optocoupler open 1: Input optocoupler closed
17	Digital input 2	
18	Digital input 3	
19	Digital input 4	
20	Digital input 5	
21	Digital input 6	
31 to 22	Reserved	Reserved, keep as "0".

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60FE	---	Digital outputs	---	---	---	---	---	---
	0x00	Number of entries	RO	UNSIGNED8	---	---	2	NO
	0x01	Output status setting	RW	UNSIGNED32	---	0 to 2^{32}-1	0	RxPDO
	0x02	Output status enable	RW	UNSIGNED32	---	0 to 2^{32}-1	0	RxPDO

This object sets the status of digital outputs of the servo drive.

- Subindex 0x01 defines the output status of digital outputs.

Bit	Function	Description
15 to 0	Reserved	Reserved, keep as "0"
16	Digital output 1	0: Output optocoupler open 1: Output optocoupler closed
17	Digital output 2	
18	Digital output 3	
31 to 19	Reserved	Reserved, keep as "0"

• Subindex 0x02 defines whether to enable the digital outputs set by subindex 0x01.

Bit	Function	Description
15 to 0	Reserved	Reserved, keep as "0".
16	Digital output 1	0: Output disabled 1: Output enabled
17	Digital output 2	
18	Digital output 3	
31 to 19	Reserved	Reserved, keep as "0"

Example: Digital outputs 1 to 3 are set as general-purpose outputs. 0x60FE is used to control the closing of the optocouplers for digital output 1, and the opening of the optocouplers for digital outputs 2 and 3. The specific operating procedure is as follows:

Step 1: Enable the physical outputs for digital outputs 1 to 3, 0x60FE-Sub2=0x00070000

Step 2: Control the closing of the optocouplers for digital output 1, and the opening of the optocouplers for digital outputs 2 and 3, 0x60FE-Sub1=0x00010000

(Note) 1. When the digital output ports are set to special function outputs, the actual physical output status is controlled by the set function outputs and not affected by 0x60FE, function outputs that can be allocated. Refer to *"10-5 Torque Limit Function* (P.10-16)".

2. When using 0x60FE to control the status of digital output ports, the digital outputs must be set as general-purpose outputs.

3. For the actual physical output status, refer to 0x2002.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x60FF	---	Target velocity	RW	INTEGER32	Pulses/s	-2^{31} to $2^{31}-1$	0	RxPDO

This object sets the target velocity of the servo drive in the Profile velocity mode (PV) and the Cyclic synchronous velocity mode (CSV).

$$\text{Velocity}_{(\text{rpm})} = \frac{60 \times \text{Setting value} \times \text{Electronic gear ratio}}{\text{Pulses per revolution}} = \frac{60 \times 0\text{x}60\text{FF} \times 0\text{x}2\text{A}93\text{-Sub1}}{0\text{x}2\text{A}90 \times 0\text{x}2\text{A}93\text{-Sub2}}$$

When the |velocity| is less than 0.25 rpm, the target velocity setting value is 0.

You can set the target velocity up to 8,100 rpm.

Index	Subindex	Name	Access type	Data type	Unit	Setting range	Default setting	PDO
0x6502	---	Supported drive modes	RO	UNSIGNED32	---	---	0x000003AD	NO

This object indicates the modes of operation supported by the servo drive.

1: Supported, 0: Unsupported.

Bit	Description	Value
0	Profile position mode (PP)	1
1	Reserved	0
2	Profile velocity mode (PV)	1
3	Profile torque mode (TQ)	1
4	Reserved	0
5	Homing mode (HM)	1
6	Reserved	0
7	Cyclic synchronous position mode (CSP)	1
8	Cyclic synchronous velocity mode (CSV)	1
9	Cyclic synchronous torque mode (CST)	1
10 to 31	Reserved	0

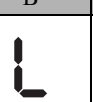
A

Appendices

The appendices provide the LED Display Character Reference Table and the Object Dictionary and Parameter Code Reference Table.

A-1 LED Display Character Reference Table A-2
A-2 Object Dictionary and Parameter Code Reference Table A-3
A-3 List of Changes to Drive Firmware Parameter Default Values A-13
A-4 List of Maximum Torque Parameters A-14
A-5 List of PDO Parameters A-15

A-1 LED Display Character Reference Table

									
1	2	3	4	5	6	7	8	9	10
									
A	B	C	D	E	F	G	H	I	J
									
K	L	M	N	O	P	Q	R	S	T
									
U	V	W	X	Y	Z	Forward	Reverse		

A-2 Object Dictionary and Parameter Code Reference Table

C6E-series AC Servo Drives has 7 groups of parameters classified by parameter function.

Parameter group	Type	Function
P0-XX	PID gain	Sets the gain parameters of the Servo Drive
P1-XX	Parameter configuration	Sets the various functional parameters of the Servo Drive
P2-XX	Trajectory planning	Sets the parameters related to motion trajectory when the Servo Drive works in an internal mode of operation
P3-XX	Encoder and input pulse settings	Sets the parameters related to encoder and pulse input/output
P4-XX	Analog settings	Sets the parameters related to analog input/output
P5-XX	I/O settings	Sets the parameters related to digital input/output
P6-XX	Reserved item	-
P7-XX	Extended gain	Sets the parameters for model control and anti-resonance & external disturbance compensation of the Servo Drive
P8-XX	Reserved item	-
P9-XX	Resonance suppression devices	Sets the parameters related to resonance suppression, such as notch filters

P0 group: PID gain settings

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2A50	---	P0-00	Parameter tuning mode	1	0 to 3	---	Enables immediately
---	---	P0-01	Reserved	---	---	---	---
0x2A52	---	P0-02	Load inertia ratio	2.5	0 to 100	---	Enables immediately
0x2A53	---	P0-03	1st rigidity level	14	1 to 42	---	Enables immediately
0x2A54	---	P0-04	2nd rigidity level	14	1 to 42	---	Enables immediately
0x2A55	---	P0-05	1st position loop gain	48.0	0.0 to 12,566.4	rad/s	Enables immediately
---	---	P0-06	Reserved	---	---	---	---
0x2A57	---	P0-07	1st position loop derivative time constant	0	0 to 30,000	ms	Enables immediately
0x2A58	---	P0-08	1st position loop derivative filter	2,000.0	0.0 to 4,000.0	Hz	Enables immediately
0x2A59	---	P0-09	Velocity feedforward gain	30.00	-300.00 to 300.00	%	Enables immediately
0x2A5A	---	P0-10	Velocity feedforward filter	2,000.0	0.0 to 4,000.0	Hz	Enables immediately
0x2A5B	---	P0-11	1st velocity command gain	100.00	-300.00 to 300.00	%	Enables immediately
0x2A5C	---	P0-12	1st velocity loop gain	30.0	0.0 to 3,000.0	Hz	Enables immediately
0x2A5D	---	P0-13	1st velocity loop integral time constant	166	0 to 30,000	ms	Enables immediately

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2A5E	---	P0-14	Acceleration feedforward gain	30.00	0.0 to 200.00	%	Enables immediately
0x2A5F	---	P0-15	Acceleration feedforward filter	2,000.0	0.0 to 4,000.0	Hz	Enables immediately
0x2A60	---	P0-16	1st torque command filter	241.1	0.0 to 8,000.0	Hz	Enables immediately
0x2A61	---	P0-17	2nd position loop gain	48.0	0.0 to 12,566.4	rad/s	Enables immediately
---	---	P0-18	Reserved	---	---	---	---
0x2A63	---	P0-19	2nd position loop derivative time constant	0	0 to 30,000	ms	Enables immediately
0x2A64	---	P0-20	2nd position loop derivative filter	2,000.0	0.0 to 4,000.0	Hz	Enables immediately
0x2A65	---	P0-21	2nd velocity command gain	100.00	-300.00 to 300.00	%	Enables immediately
0x2A66	---	P0-22	2nd velocity loop gain	30.0	0.0 to 3,000.0	Hz	Enables immediately
0x2A67	---	P0-23	2nd velocity loop integral time constant	166	0 to 30,000	ms	Enables immediately
0x2A68	---	P0-24	2nd torque command filter	241.1	0.0 to 8,000.0	Hz	Enables immediately
---	---	P0-25	Reserved	---	---	---	---
---	---	… …	Reserved	---	---	---	---
---	---	P0-32	Reserved	---	---	---	---
0x2A69	0x01	P0-33	Automatic gain swiching method	0	0 to 4	---	Enables immediately
	0x02	P0-34	Gain switch with position error condition change	0	0 to 2,147,483,647	Pulses	Enables immediately
	0x03	P0-35	Gain switch with actual velocity condition change	0	0 to 135	rps*3	Enables immediately
	0x04	P0-36	Gain switch with actual torque condition change	1.0	0.0 to 400.0	%	Enables immediately
	0x05	P0-37	Gain switching time 1	10	0 to 10,000	ms	Enables immediately
	0x06	P0-38	Gain switching time 2	10	0 to 10,000	ms	Enables immediately
0x2AC3	0x00	P0-39	Velocity feedback filter	0	0 to 3	---	Enables immediately
---	---	P0-40	Reserved	---	---	---	---
---	---	P0-41	Reserved	---	---	---	---
---	---	P0-42	Reserved	---	---	---	---

P1 group: Configuration parameters

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
---	---	P1-00	Reserved	---	---	---	---
---	---	P1-01	Reserved	---	---	---	---
0x2A32	---	P1-02	Operation mode when power-up	10	10	---	Enables after restart
0x2A33	---	P1-03	Velocity control clamp mode	2	1 to 2	---	Enables immediately
---	---	P1-04	Reserved	---	---	---	---
0x6071	---	P1-05	Target torque	0.0	-400.0 to 400.0	%	Enables immediately
0x6073	---	P1-06	Max current/1st torque limit	400.0*1	0.0 to 400.0	%	Enables immediately
0x2A18	---	P1-07	Target torque value when torque value reached	0.0	0.0 to 400.0	%	Enables immediately
0x2A08	---	P1-08	Torque limit for hard stop homing	100.0	0.0 to 400.0	%	Enables immediately
0x2A01	---	P1-09	Current overload continuous time	2,000	0 to 2,000	ms	Enables immediately
0x2A02	---	P1-10	Torque limit method	1	0 to 6	---	Enables immediately
0x2A0A	---	P1-11	Rotational direction setup	1	0 to 1	---	Enables after restart
---	---	P1-12	Reserved	---	---	---	---
		… …	Reserved				
---	---	P1-16	Reserved	---	---	---	---
0x2020	---	P1-17	EtherCAT node ID	0	0 to 65,535	---	Enables after restart
0x2022	---	P1-18	EtherCAT node ID	1	0 to 1	---	Enables after restart
0x2A34	0x01	P1-19	Regeneration resistor value	50*2	0 to 32,767	Ω	Enables immediately
0x2A34	0x02	P1-20	Regeneration resistor continuous wattage	50*2	0 to 32,767	W	Enables immediately
0x2A34	0x03	P1-21	Regeneration resistor time constant	1,000	0 to 8,000	ms	Enables immediately
0x2A35	0x00	P1-22	Keypad setting lock	0	0 to 1		Enables immediately
0x2A36	0x00	P1-23	Default display	0	0 to 20	---	Enables immediately
0x2A37	0x00	P1-24	Alarm mask	4,294,967,295	0 to 4,294,967,295	---	Enables immediately
0x2A04	0x00	P1-25	2nd torque limit	400.0*1	0.0 to 400.0	%	Enables immediately
0x2A05	0x00	P1-26	3rd torque limit	400.0*1	0.0 to 400.0	%	Enables immediately
0x2A06	0x00	P1-27	4th torque limit	400.0*1	0.0 to 400.0	%	Enables immediately
0x2A09	0x00	P1-28	Motor stall protection time	5,000	0 to 30,000	ms	Enables immediately

*1. The default values and maximum range values depend on the combination of the drive and motor. For the maximum torque value, refer to 📖 *"A-4 List of Maximum Torque Parameters* (P.A-14)".

*2. The default values vary depending on the drive type. Refer to 📖 *"2-2-4 Regeneration Resistor Relevant Specifications* (P.2-5)" for details.

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2AB1	0x01	P1-29	Operation when servo off	0	0 to 5	---	Enables immediately
0x2AB1	0x03	P1-30	Operation when fault occurs	6	0 to 7	---	Enables immediately
0x2AB1	0x02	P1-31	Mechanical brake action time during deceleration when servo off	500	0 to 30,000	ms	Enables immediately
0x2AB1	0x04	P1-32	Mechanical brake action time during deceleration when servo off	0	0 to 30,000	ms	Enables immediately
---	0x00	P1-33	Reserved	0*4	---	---	---
0x2AC1	0x00	P1-34	Current ramp limit	0.0	0.0 to 400.0	%	Enables immediately
---	---	P1-35	Reserved	---	---	---	---
		… …	Reserved				
---	---	P1-41	Reserved	---	---	---	---
0x2AC7	---	P1-42	EtherCAT sync deviation threshold	4.00	0.10 to 4.00	us	Enables after restart
0x2AC5	---	P1-43	EtherCAT csp mode command position variation rate	120	0 to 135	rps*3	Enables after restart
0x2AC9	0x00	P1-44	Extended Setting	768	0 to 2,147,483,647	---	Enables immediately
---	---	P1-45	Reserved	---	---	---	---
0x2ACB	0x00	P1-46	If the motor current exceeds the threshold set by P1-47 and remains above this threshold for the specified duration, the drive will trigger a runaway protection fault.	10	1 to 2,000	ms	Enables immediately
0x2ACA	0x00	P1-47	Test Current	200.0	0.0 to 400.0	%	Enables immediately

*3. When using the Sysmac Studio to connect the Servo Drive via ECT, the unit of speed is pulses/s, the unit of acceleration/deceleration is pulses/s², and the value needs to be multiplied by P3-05.

*4. For R88D-C6N20H-ECT, phase-loss detection is enabled (set to 1) by default.

P2 group: Trajectory planning

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2AA9	---	P2-00	Max velocity limit	100	0 to 135	rps*3	Enables immediately
0x6085	0x00	P2-01	Quick stop deceleration	3,000	0.167 to 5,461	rps/s*4	Enables immediately
0x2A4C	0x00	P2-05	Jerk time	10	0 to 250	ms	Enables immediately
0x6081	0x00	P2-06	Velocity in internal point-to-point mode	5	0 to 135	rps*3	Enables immediately
0x6083	0x00	P2-07	Acceleration in internal point-to-point mode	100	0.167 to 5,461	rps/s*3	Enables immediately
0x6084	0x00	P2-08	Deceleration in internal point-to-point mode	100	0.167 to 5,461	rps/s*3	Enables immediately
---	---	P2-09	Reserved	---	---	---	---
		… …	Reserved				
---	---	P2-17	Reserved	---	---	---	---
0x609A	0x00	P2-18	Homing Acceleration/Deceleration	100	0.167 to 5,461	rps/s*3	Enables immediately
---	---	P2-19	Reserved	---	---	---	---
		… …	Reserved				
---	---	P2-23	Reserved	---	---	---	---
0x6099	0x01	P2-24	Speed during search for switch	10	0 to 135	rps*3	Enables immediately
	0x02	P2-25	Speed during search for zero	1	0 to 135	rps*3	Enables immediately
---	---	P2-26	Reserved	---	---	---	---
0x607C	---	P2-27	Home offset	0	-2,147,483,648 to +2,147,483,647	pulses	Enables immediately
0x2A4D	---	P2-28	Jerk filter	10	0 to 1,000	ms	Enables immediately
0x2A4E	---	P2-29	Interpolation filter	10	0 to 250	ms	Enables immediately
0x607F	---	P2-30	Max profile velocity (Velocity limit in the torque mode)	80	0 to 135	rps*3	Enables immediately

*3 When using the Sysmac Studio to connect the Servo Drive via ECT, the unit of speed is pulses/s, the unit of acceleration/deceleration is pulses/s^2, and the value needs to be multiplied by P3-05.

*4 When using the Sysmac Studio to connect the Servo Drive via ECT, the unit of this parameter is 100pulses/s^2, and the value needs to be multiplied by P3-05/100.

P3 group: Encoder and input pulse settings

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2A93	0x01	P3-00	Electronic gear ratio - numerator	67,108,864	1 to 2,147,483,647	---	Enables after restart
	0x02	P3-01	Electronic gear ratio - denominator	8,388,608	1 to 2,147,483,647	---	Enables after restart
---	---	P3-02	Reserved	---	---	---	---
---	---	P3-03	Reserved	---	---	---	---
0x2AA8	---	P3-04	Position error limit	83,886,080	0 to 2,147,483,647	pulses	Enables immediately
0x2A90	---	P3-05	Command pulses per revolution	8,388,608	1 to 67,108,864	pulses/rev	Enables immediately*1
---	---	P3-06	Reserved	---	---	---	---
---	---	… …	Reserved	---	---	---	---
---	---	P3-14	Reserved	---	---	---	---
0x2A9C	0x04	P3-15	Absolute encoder usage	0	0 to 4	---	Enables after restart
0x2A93	0x03	P3-16	Electronic gear function enable	0	0 to 1	---	Enables after restart
---	---	P3-17	Reserved	---	---	---	---
0x2A9C	0x06	P3-18	Absolute encoder multi-turn counter overflow value	0	0 to 32,767	---	Enables after restart
---	---	P3-19	Reserved	---	---	---	---
0x2AC6	---	P3-20	Absolute encoder counter overflow value	0	0 to 2,147,483,647	pulses	Enables after restart
---	---	P3-21	Reserved	---	---	---	---

*1 As the parameter P3-05 is correlated with many other parameters, it is recommended to restart after making any changes.

P4 group: Analog settings

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
---	---	P4-00	Reserved	---	---	---	---
0x2A27	0x05	P4-01	Analog input velocity gain	50	0 to 135	rps*3	Enables immediately
	---	P4-02	Reserved	---	---	---	---
0x2A22	0x02	P4-03	Analog input 1 offset	0	-10,000 to 10,000	mV	Enables immediately
---	---	P4-04	Reserved	---	---	---	---
0x2A22	0x01	P4-05	Analog input 1 Dead-band	0	0 to 255	mV	Enables immediately
---	---	P4-06	Reserved	---	---	---	---
0x2A22	0x03	P4-07	Analog input 1 low-pass filter	100.0	1.0 to 2,000.0	Hz	Enables immediately
---	---	P4-08	Reserved	---	---	---	---
0x2A22	0x04	P4-09	Analog input 1 threshold	5,000	-10,000 to 10,000	mV	Enables immediately
---	---	P4-10	Reserved	---	---	---	---
0x2A27	0x01	P4-11	Speed limit source settings	0	0 to 2		Enables immediately
---	---	P4-12	Reserved	---	---	---	---
		… …	Reserved				
---	---	P4-19	Reserved	---	---	---	---

*3 When using the Sysmac Studio to connect the Servo Drive via ECT, the unit of speed is pulses/s, the unit of acceleration/deceleration is pulses/s^2, and the value needs to be multiplied by P3-05.

P5 group: I/O settings

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2A20	0x01	P5-00	Digital input 1 function	44	0 to 46	---	Enables immediately
	0x02	P5-01	Digital input 2 function	42	0 to 46	---	Enables immediately
	0x03	P5-02	Digital input 3 function	3	0 to 46	---	Enables immediately
	0x04	P5-03	Digital input 4 function	13	0 to 46	---	Enables immediately
	0x05	P5-04	Digital input 5 function	0	0 to 46	---	Enables immediately
	0x06	P5-05	Digital input 6 function	39	0 to 46	---	Enables immediately
---	---	P5-06	Reserved	---	---	---	---
		… …	Reserved				
---	---	P5-11	Reserved	---	---	---	---
0x2A10	0x01	P5-12	Digital output 1 function	0	0 to 44	---	Enables immediately
	0x02	P5-13	Digital output 2 function	23	0 to 44	---	Enables immediately
	0x03	P5-14	Digital output 3 function	1	0 to 44	---	Enables immediately
---	---	P5-15	Reserved	---	---	---	---
		… …	Reserved				
---	---	P5-23	Reserved	---	---	---	---
0x2A13	0x01	P5-24	Move command delay time after brake release	200	0 to 32,000	ms	Enables immediately
	0x02	P5-25	Servo-off delay time after brake engagement	200	0 to 32,000	ms	Enables immediately
---	---	P5-26	Reserved	---	---	---	---
---	---	P5-27	Reserved	---	---	---	---
0x2A21	0x01	P5-28	Digital input 1 filter	1	0 to 8,000	ms	Enables immediately
	0x02	P5-29	Digital input 2 filter	1	0 to 8,000	ms	Enables immediately
	0x03	P5-30	Digital input 3 filter	1	0 to 8,000	ms	Enables immediately
	0x04	P5-31	Digital input 4 filter	1	0 to 8,000	ms	Enables immediately
	0x05	P5-32	Digital input 5 filter	1	0 to 8,000	ms	Enables immediately
	0x06	P5-33	Digital input 6 filter	1	0 to 8,000	ms	Enables immediately
---	---	P5-34	Reserved	---	---	---	---
		… …	Reserved				
---	---	P5-37	Reserved	---	---	---	---

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2A15	0x01	P5-38	Dynamic following error threshold	8,388	0 to 2,147,483,647	pulses	Enables immediately
	0x03	P5-39	In-position output threshold	33,554	0 to 2,147,483,647	pulses	Enables immediately
	0x02	P5-40	Time constant of motion output condition	40	0 to 30,000	ms	Enables immediately
	---	P5-41	Reserved	---	---	---	---
0x2A16	0x01	P5-42	Zero velocity width	0.5	0.1 to 2	rps*3	Enables immediately
	0x03	P5-43	Velocity coincidence width	0.2	0.1 to 135	rps*3	Enables immediately
	0x02	P5-44	Target value of AT-speed output	10	0 to 135	rps*3	Enables immediately
0x2A17	---	P5-45	Torque ripple range when arrival	1.0	0.0 to 400.0	%	Enables immediately
0x2A14	---	P5-46	Reached position	8,388,608	-2,147,483,648 to +2,147,483,647	pulses	Enables immediately
0x607D	0x02	P5-47	Max position limit	0	-2,147,483,648 to +2,147,483,647	pulses	Enables immediately
	0x01	P5-48	Min position limit	0	-2,147,483,648 to +2,147,483,647	pulses	Enables immediately
0x6098	---	P5-49	Homing method	1	-4 to 35	---	Enables immediately
---	---	P5-50	Reserved	---	---	---	---
---	---	P5-51	Reserved	---	---	---	---

*3 When using the Sysmac Studio to connect the Servo Drive via ECT, the unit of speed is pulses/s, the unit of acceleration/deceleration is pulses/s^2, and the value needs to be multiplied by P3-05.

P7 group: Extended gain parameters

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
---	---	P7-00	Reserved	---	---	---	---
0x2B00	0x01	P7-01	Model control function	0	-32,768 to 32,767	---	Enables immediately
	0x02	P7-02	Model gain	80.0	1.0 to 2,000.0	rad/s	Enables immediately
	0x03	P7-03	Model damping	100.0	50.0 to 200.0	%	Enables immediately
	0x04	P7-04	Model Anti-Resonance frequency 1	100.0	1.0 to 250.0	Hz	Enables immediately
	0x05	P7-05	Model Anti-Resonance frequency 2	100.0	1.0 to 250.0	Hz	Enables immediately
	---	P7-06	Reserved	---	---	---	---
		… …	Reserved				
	---	P7-10	Reserved	---	---	---	---
	0x0B	P7-11	Vibration suppression frequency	100.0	1.0 to 200.0	Hz	Enables immediately
	0x0C	P7-12	Vibration suppression gain	100	10 to 1,000	%	Enables immediately
	---	P7-13	Reserved	---	---	---	---
		… …	Reserved				
	---	P7-19	Reserved	---	---	---	---
	0x14	P7-20	Extended function	0	-32,768 to 32,767	---	Enables immediately
	0x15	P7-21	Disturbance compensation gain1	100	10 to 1,000	%	Enables immediately
	0x16	P7-22	Disturbance compensation gain2	100	10 to 1,000	%	Enables immediately
	0x17	P7-23	Disturbance torque gain	0	0 to 100	%	Enables immediately
	0x18	P7-24	Disturbance delay compensation	0.0	-1,000.0 to 1,000.0	Hz	Enables immediately
	0x19	P7-25	Disturbance response compensation	100	1 to 1,000	1%	Enables immediately
	0x1A	P7-26	Velocity observer bandwidth	300	100 to 500	Hz	Enables immediately
	0x1B	P7-27	Velocity observer response compensation	100	1 to 1,000	%	Enables immediately
	0x1C	P7-28	Velocity observer delay compensation	0.0	-1,000.0 to 1,000.0	Hz	Enables immediately
	---	P7-29	Reserved	---	---	---	---
	0x1E	P7-30	Resonance frequency	1,000	100 to 1,000	Hz	Enables immediately
	0x1F	P7-31	Anti-Resonance gain1	0	0 to 300	%	Enables immediately
	0x20	P7-32	Anti-Resonance gain2	0	0 to 300	%	Enables immediately
	0x21	P7-33	Anti-Resonance compensation gain	100	1 to 1,000	%	Enables immediately
	0x22	P7-34	Anti-Resonance compensation frequency1	0	-1,000 to 1,000	Hz	Enables immediately
	0x23	P7-35	Anti-Resonance compensation frequency2	0	-1,000 to 1,000	Hz	Enables immediately
	0x24	P7-36	Anti-Resonance compensation frequency3	2,000	300 to 6,000	Hz	Enables immediately
	---	P7-37	Reserved	---	---	---	---
		… …	Reserved				
	---	P7-39	Reserved	---	---	---	---
	0x25	P7-40	Torque compensation control	0	0 to 1	---	Enables immediately
	0x26	P7-41	Torque gravity	0.0	-100.0 to 100.0	%	Enables immediately
---	---	P7-42	Reserved	---	---	---	---
		… …	Reserved				
---	---	P7-86	Reserved	---	---	---	---

P9 group: Resonance suppression devices

Index	Subindex	Code	Function	Default setting	Range	Unit	Enable mechanism
0x2A85	0x02	P9-00	Notch filter1 frequency	3,000.0	0.0 to 4,000.0	Hz	Enables immediately
	0x03	P9-01	Notch filter1 bandwidth level	0	0 to 20	---	Enables immediately
	0x04	P9-02	Notch filter1 depth level	1	0 to 100	---	Enables immediately
	0x01	P9-03	Notch filter1 switch	0	0 to 1	---	Enables immediately
0x2A86	0x02	P9-04	Notch filter2 frequency	3,000.0	0.0 to 4,000.0	Hz	Enables immediately
	0x03	P9-05	Notch filter2 bandwidth level	0	0 to 20	---	Enables immediately
	0x04	P9-06	Notch filter2 depth level	1	0 to 100	---	Enables immediately
	0x01	P9-07	Notch filter2 switch	0	0 to 1	---	Enables immediately
0x2A87	0x02	P9-08	Notch filter3 frequency	3,000.0	0.0 to 4,000.0	Hz	Enables immediately
	0x03	P9-09	Notch filter3 bandwidth level	0	0 to 20	---	Enables immediately
	0x04	P9-10	Notch filter3 depth level	1	0 to 100	---	Enables immediately
	0x01	P9-11	Notch filter3 switch	0	0 to 2	---	Enables immediately
0x2A88	0x02	P9-12	Notch filter4 frequency	3,000.0	0.0 to 4,000.0	Hz	Enables immediately
	0x03	P9-13	Notch filter4 bandwidth level	0	0 to 20	---	Enables immediately
	0x04	P9-14	Notch filter4 depth level	1	0 to 100	---	Enables immediately
	0x01	P9-15	Notch filter4 switch	0	0 to 2	---	Enables immediately

A-3 List of Changes to Drive Firmware Parameter Default Values

Due to an upgrade of the drive firmware version, the drive version has upgraded from Ver.1.0 to Ver.1.1.0, and the default values of some parameters have been changed accordingly. Refer to the table below for details.

Parameter code	OD address	Parameter description	Ver.1.0		Ver.1.1.0	
P5-00	2A20h sub 01h	Digital input 1 function	7	CCW limit	44	Virtual CCW limit
P5-01	2A20h sub 02h	Digital input 2 function	5	CW limit	42	Virtual CW limit
P3-01	2A93h sub 02h	Electronic gear ratio - denominator	10,000	Pulses	8,388,608	Pulses
P3-04	2AA8h	Position error limit	100,000	Pulses	83,886,080	Pulses
P3-05	2A90h	Command pulses per revolution	10,000	Pulses	8,388,608	Pulses
P5-38	2A15h sub 01h	Dynamic following error threshold	10	Pulses	8,388	Pulses
P5-39	2A15h sub 03h	In-position output threshold	40	Pulses	33,554	Pulses
P5-46	2A14h	Reached position	10,000	Pulses	8,388,608	Pulses
P1-18	2022h	EtherCAT alias source	0	Set through the configuration software/operation panel	1	Assigned by the ECT master
P1-46	2ACBh	RunOff Time	2	ms	10	ms
P1-47	2ACAh	Test Current	50	*0.1%	2,000	*0.1%

(Note) Depending on the change to the default value of P3-05:2A90h, the default values of the following parameters will be changed accordingly.

Parameter code	OD address	Parameter description
P2-30	607F	Max profile velocity (Velocity limit in the torque mode)
P2-06	6081	Profile velocity
P2-07	6083	Profile acceleration
P2-08	6084	Profile deceleration
P2-01	6085	Quick stop deceleration
P2-24	6099.01	Speed during search for switch
P2-25	6099.02	Speed during search for zero
P2-18	609A	Homing Acceleration/Deceleration
P5-42	2A16.01	Zero velocity width
P5-44	2A16.02	Target value of AT-speed output
P5-43	2A16.03	Velocity coincidence width
P4-01	2A27.05	Analog input velocity gain
P0-35	2A69.03	Gain switch with actual velocity condition change
P2-00	2AA9	Max velocity limit
P1-43	2AC5	Single DC synchronous cycle command position increment threshold in CSP mode

A-4 List of Maximum Torque Parameters

This list is intended to clearly specify the factory default parameters that vary depending on the motor or driver model, for quick verification.
The motor-drive combinations listed here are commonly used ones; for other combinations, parameters can be restored to the actual maximum torque value through initialization of parameters.

Servo Drive model	Motor model	Maximum torque P1-06, P1-25, P1-26, P1-27 (%)
R88D-C6EN04H-ECT	R88M-C6H05030T	400.0
	R88M-C6L10030T	400.0
	R88M-C6H10030T	400.0
	R88M-C6L20030T	317.6
	R88M-C6H20030T	347.0
	R88M-C6L40030T	357.1
	R88M-C6H40030T	350.0
R88D-C6EN08H-ECT	R88M-C6L75030T	311.1
	R88M-C6H75030T	333.3
R88D-C6EN10H-ECT	R88M-C6L1K030T- □□ -08	322.0
	R88M-C6L1K030T- □□ -10	350.0
	R88M-C6M1K020T	312.9
	R88M-C6H1K030T	355.9
	R88M-C6H85015T	316.6

A-5 List of PDO Parameters

This list is intended to provide an overview of optional PDO parameters for the drive, for reference purposes. The PDO parameters of different drive versions may vary in terms of the number of entries and the names of entries.

(Note) 1. When opening an existing project with different versions of the Sysmac Studio software, the assignment of global variables for some PDO mappings may be reset. Please reconfirm the relevant settings.

2. A single TxPDO can map up to 12 application objects, and a single RxPDO can map up to 12 application objects.

List of TxPDOs

Index	Data type	PDO entry name
0x603F:00	UINT	Error code
0x6041:00	WORD	Status word
0x6061:00	SINT	Modes of operation display
0x6064:00	DINT	Position actual value
0x60F4:00	DINT	Following error actual value
0x6077:00	INT	Torque actual value
0x60B9:00	WORD	Touch probe status
0x60BA:00	DINT	Touch probe pos1 pos value
0x60BB:00	DINT	Touch probe pos1 neg value
0x60BC:00	DINT	Touch probe pos2 pos value
0x60BD:00	DINT	Touch probe pos2 neg value
0x60FD:00	DWORD	Digital inputs *1
0x200B:00	UDINT	Status code / Status code
0x200F:00	UDINT	Alarm code / Alarm code
0x2100:02~0x2100:1A	DINT	User registers / User register 1~User registers / User register25
0x2A25:01	DINT	Analog input reading / Analog input 1 value
0x2A25:02	DINT	Analog input reading / 2A25 Reserved 1 *1
0x2A25:03	DINT	Analog input reading / 2A25 Reserved 2 *1
0x2AA2:00	DINT	2AA2 Reserved 1 / 2AA2 Reserved 1 *1
0x2AA3:00	DINT	Secondary encoder position / Secondary encoder position
0x606C:00	DINT	Velocity actual value / Velocity actual value
0x6074:00	INT	Torque demand / Torque demand
0x6078:00	INT	Current actual value / Current actual value

List of RxPDOs

Index	Data type	PDO entry name
0x6040:00	WORD	Control word
0x6060:00	SINT	Modes of operation
0x607A:00	DINT	Target position
0x60FF:00	DINT	Target velocity
0x6071:00	INT	Target torque
0x60B8:00	WORD	Touch probe function
0x60FE:01	DWORD	Physical outputs *1
0x60E0:00	UINT	Positive torque limit value
0x60E1:00	UINT	Negative torque limit value
0x607F:00	UDINT	Max profile velocity
0x2006:00	USINT	Clear alarm / Clear alarm
0x2100:02~0x2100:1A	DINT	User registers / User register 1~User registers / User register25
0x2AB0:01	UINT	Virtual digital inputs / Virtual inputs
0x2AB0:02	UINT	Virtual digital inputs / Bit mask1
0x6072:00	UINT	Max torque / Max torque
0x607C:00	DINT	Home offset / Home offset
0x607E:00	USINT	Polarity / Polarity
0x6081:00	UDINT	Profile velocity / Profile velocity
0x6083:00	UDINT	Profile acceleration / Profile acceleration
0x6084:00	UDINT	Profile deceleration / Profile deceleration
0x6087:00	UDINT	Torque slope / Torque slope
0x6098:00	SINT	Homing method / Homing method
0x6099:01	UDINT	Homing speeds / Speed during search for switch
0x6099:02	UDINT	Homing speeds / Speed during search for zero
0x609A:00	UDINT	Homing acceleration / Homing acceleration
0x60B0:00	DINT	Position offset / Position offset
0x60B1:00	DINT	Velocity offset / Velocity offset
0x60B2:00	INT	Torque offset / Torque offset
0x60FE:02	UINT	Digital outputs / Bit mask

*1 In Sysmac Studio V1.67 and later versions, the PDO entry names have been corrected. When opening projects across versions, the global variables mapped to the relevant drive PDOs may prompt "Invalid address." Please modify or delete the "invalid" global variables as needed before use.

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