

# **FV5 Series Rotary EtherCAT Bus Servo Drive**

## **User Manual**

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## Revision Record

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# Preface

## Overview

Thank you for choosing Flexem products. The FV5 series rotary EtherCAT bus servo drive is an essential component of servo systems. By receiving and responding to commands from the upper-level controller, it accurately controls the position, speed, and output torque of the rotary motor, meeting the application needs of customers in various production scenarios. The FV5 series rotary EtherCAT bus servo drive is rich in features, excellent in performance, has a high control bandwidth, and supports various command formats such as pulse command and analog input. It supports user-friendly functions such as automatic adjustment, adaptive vibration suppression, inertia recognition, low-frequency jitter suppression, error compensation, etc. It can also be optimized through Flexem Servo Configuration software, making it widely applicable in fields such as consumer electronics, semiconductors, lithium batteries, photovoltaics, and more.

This manual provides detailed instructions to the commissioning methods and functions of the FV5 series rotary EtherCAT bus servo drive.

The content provided in this manual serves as general guidance and does not guarantee coverage of all usage scenarios for all product models. Due to reasons such as version upgrades, different equipment models, and different configuration files, the information provided in the manual may not correspond exactly to the actual device interface used by the user. Therefore, users should refer to the actual information on the device interface for accuracy. The manual does not further explain the differences caused by the aforementioned situations.

For functionality introduction and configuration examples, this manual may use IP addresses, URLs, domain names, etc. If not specifically stated, the aforementioned content is provided as examples and does not represent any actual significance.

## Intended Audience

This document is primarily intended for readers who wish to understand the usage of the FV5 series rotary EtherCAT bus servo drive, including electrical engineers, mechanical engineers, etc. It is assumed that readers have a certain level of knowledge in the following areas:

- ◆ Principles of automatic control
- ◆ Basic electrical knowledge
- ◆ Principles of servo system's functionalities
- ◆ Applications of sensors





## Format Conventions

The format conventions of this manual are as follows.

Content	Description
Bold Text	Names and contents of various controls on the software interface. For example: "Select <b>Window/Current Window Properties</b> from the menu bar to enter the <b>Window Modification</b> page, and select the <b>Timer</b> tab."
/	Used to separate clickable objects (menu items, submenus, buttons, etc.) on the software interface introducing steps of operation. For example: "Select <b>Element/Switch/Bit Setting</b> from the menu bar to create a new bit setting switch element."

Content	Description
Italic Text	Variable parameters that must be replaced with actual values. For example: "Enter 'ftp://HMI's IP' in the browser's address bar, and press Enter to enter the file directory interface of the HMI."

The format conventions for icons in this manual are as follows.

Icon	Description
	Tip, operational tips to assist users in solving problems.
	Note, supplementary information and description to the main text.
	Caution, reminds of precautions in operation, improper operation may cause equipment damage or data loss.
	Warning, the content following this icon requires special attention, otherwise it may cause personal injury.

## Getting Help

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For more documents, please visit [https://www.flexem.com/info\\_download.html](https://www.flexem.com/info_download.html).

### Contact Information

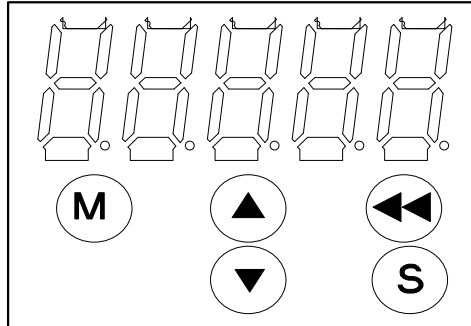
Address: 9th Floor, Building A, INNO Business Park, No. 386 Guo'an Road, Yangpu District, Shanghai

Zip Code: 200043

Website: <https://www.flexem.com>

# 1 Panel Display and Operation

## 1.1 Panel Button Introduction

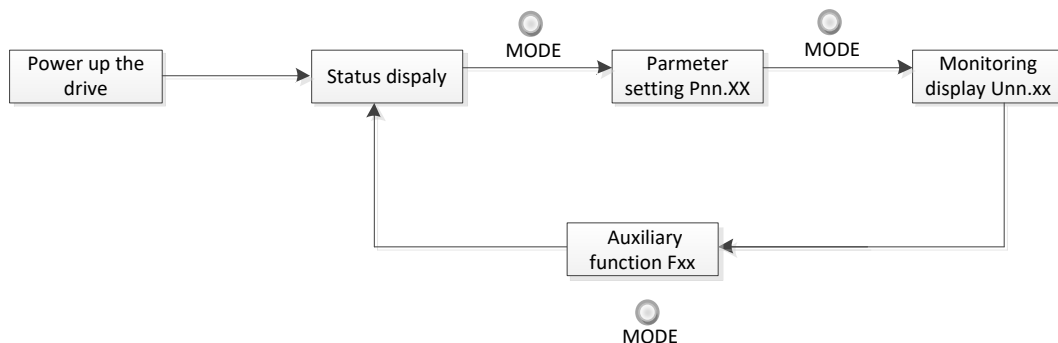


The panel of the servo driver consists of a display (LED Segment Display) and buttons. It can be used for various displays of the servo driver. Taking the P group parameter setting as an example, the regular functions of the buttons are shown in the table below.

Name		Regular Function
Ⓜ	MODE Key	Change operation mode and parameters
▲	UP Key	Increase the selected number (blinking number)
▼	DOWN Key	Decrease the selected number (blinking number)
◀	SHIFT Key	Short-press this key to shift left; long-press this key to toggle between higher and lower decimal digits.
Ⓢ	SET Key	Enter the next level menu or set parameters

## 1.2 Usage of Operation Mode

The panel by default displays the servo operating status.



Press the MODE key to switch the panel to the first-level menu. By default, the panel displays the status display menu after powering on. The status display includes the servo operating status and network status, which automatically switch between the two.

Servo Status / Network Status	Panel Display
Servo power-up / software reset	r-ESSt
Network Operational Status CSP Mode Servo Not Ready	88-nd4
Network Operational Status CSP Mode Servo Ready	88-r-d4
Network Operational Status CSP Mode Servo Enablement Status	88-run
Servo Fault Status	E-053
Servo Alarm Status	AL000

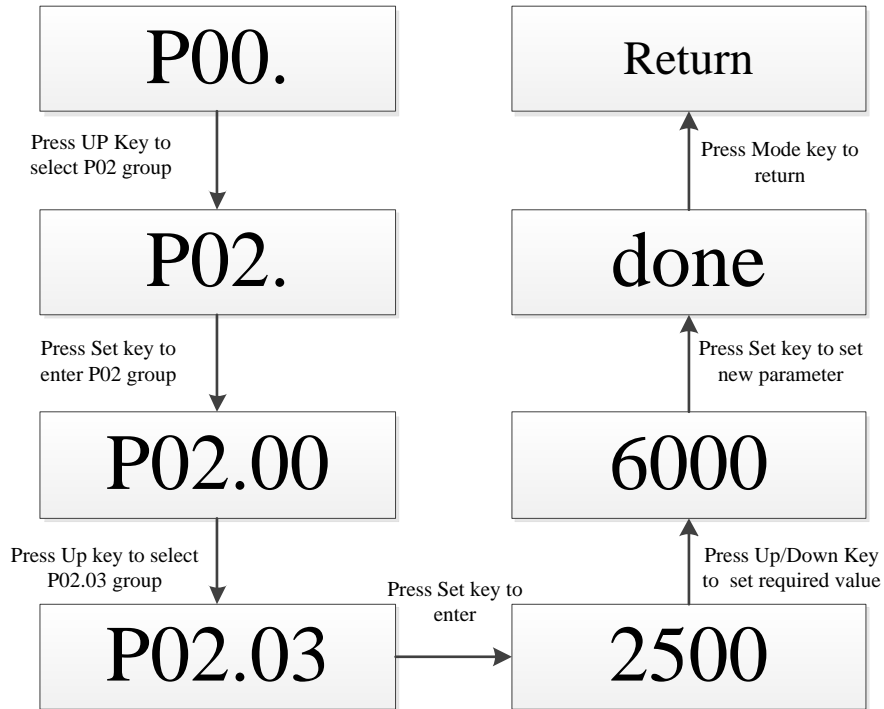
The first digit on the left represents the network status: 1 for Init (initial) state, 2 for Pre-Operational state, 4 for Safe-Operational state, and 8 for Operational state.

The second digit on the left represents the status of the object dictionary 6060h, representing the current operating mode (1 for profile position, 3 for profile velocity, 4 for profile torque, 6 for homing Mode, 8 for cyclic synchronous position, 9 for cyclic synchronous speed, A for cyclic synchronous torque). In normal CSP mode operation, it should display "88run", meaning the network status is Operational, the mode is CSP, and the servo status is enabled.

“ndy” indicates that servo is not ready, please check if the drive's power supply voltage is below the operating voltage range.

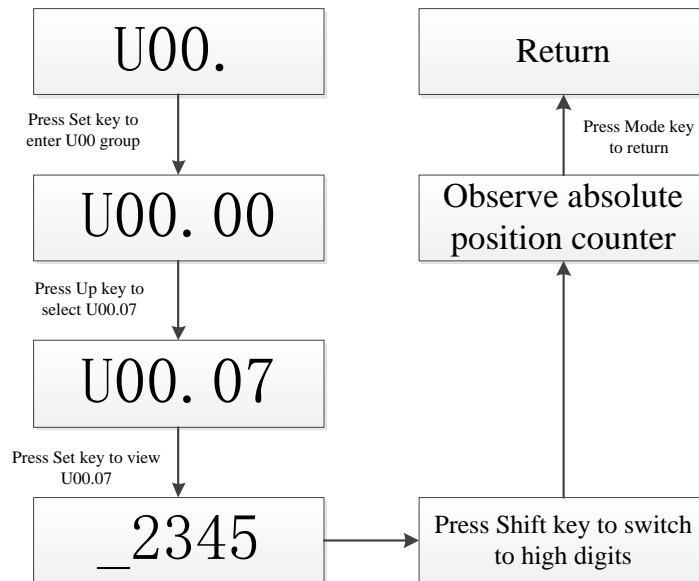
### 1.3 P Group Parameter Setting

Parameter Setting: To enter the parameter setting mode, the servo needs to change the parameters using this group. For example, to set P02.03:

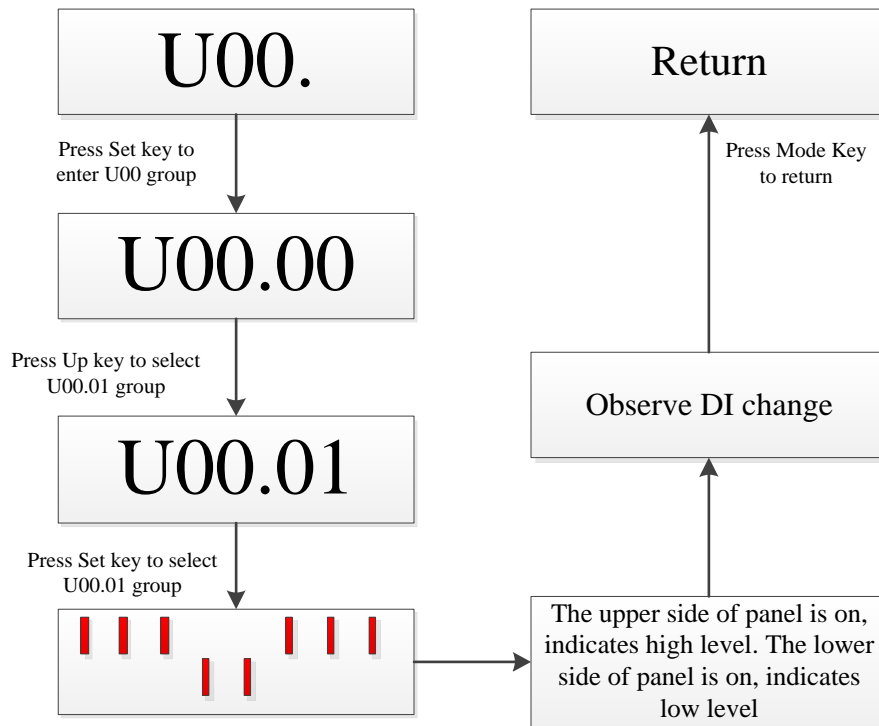


### 1.4 U Group Parameter Display

◆ Example: Select U00.07 to display the absolute position counter.



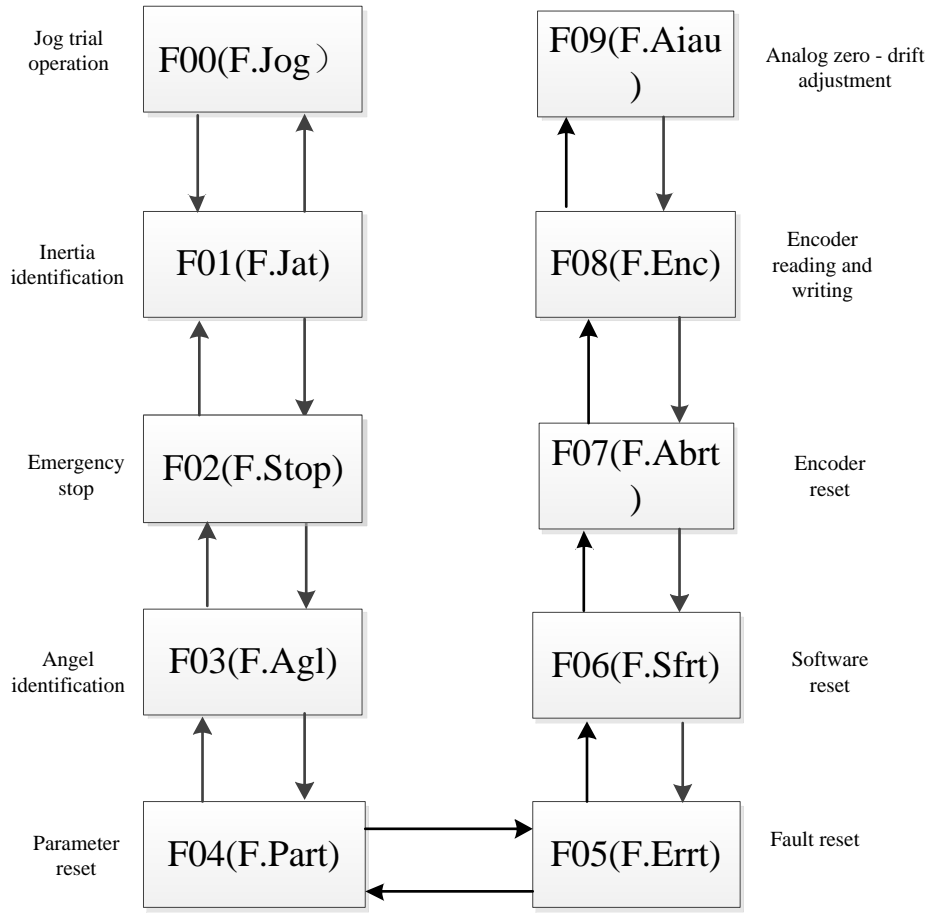
◆ For example: Select U00.01 to display the input DI status of the servo.



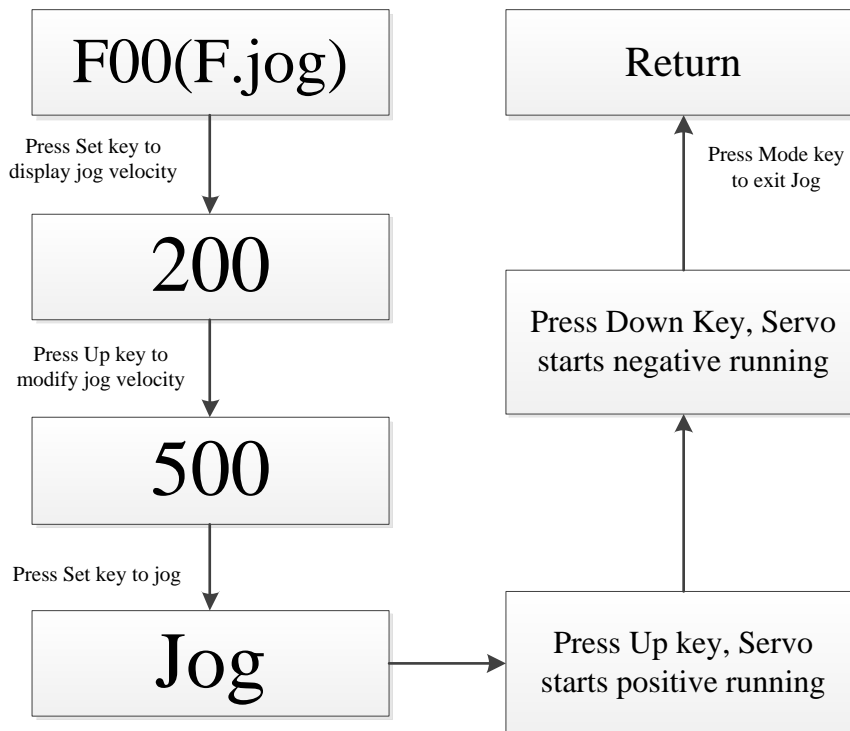
The rightmost digit represents the DI1 status, the second digit from the right represents the DI2 status, and so on from right to left corresponding to DI1 to DI8.

## 1.5 F Group Parameter Usage

Monitoring Display: Servo auxiliary function group

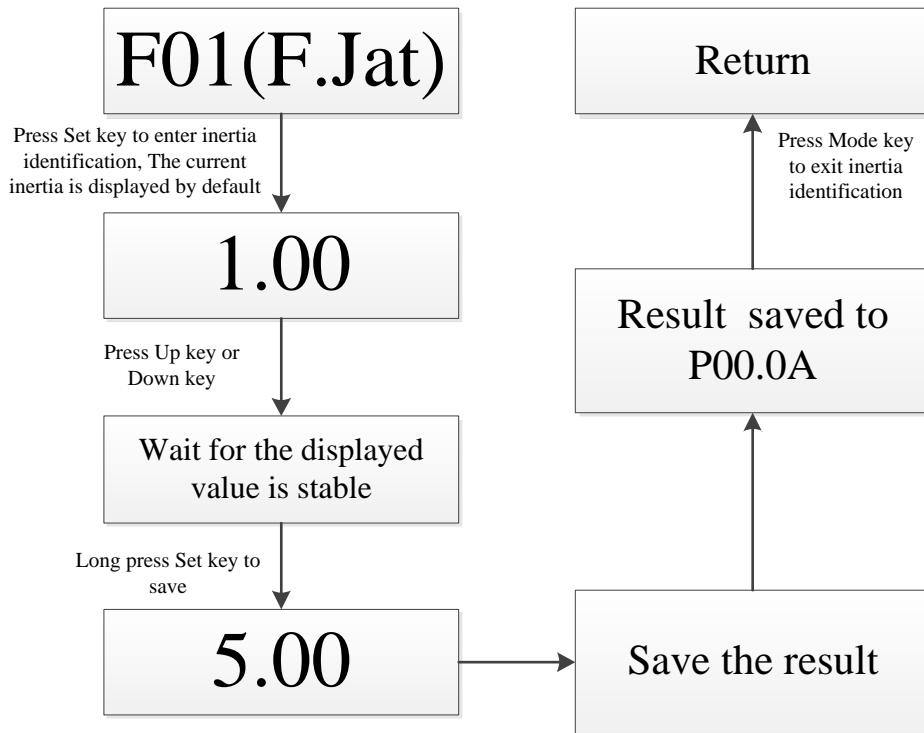


◆ Using the panel jog function



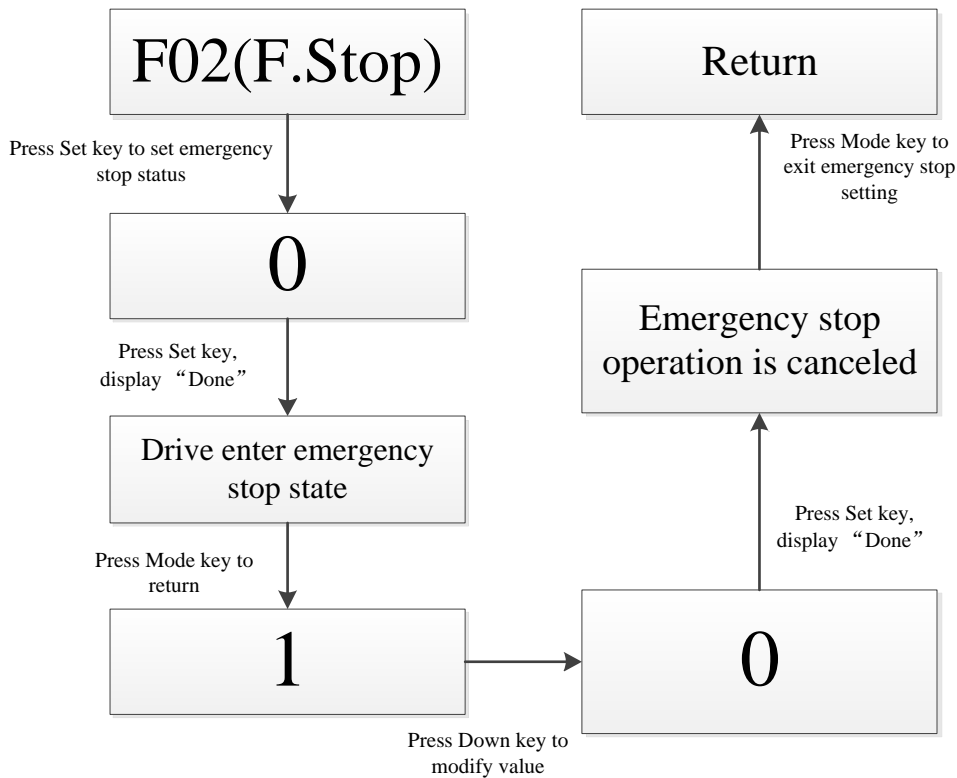
◆ Inertia identification function

Refer to the following diagram for the inertia identification operation process.

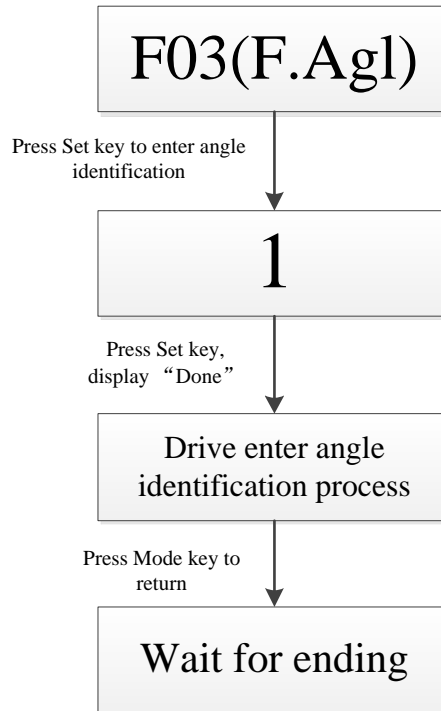


If the value fluctuation is less than 15%, it can be considered stable.

◆ Emergency stop function



◆ Angle identification function



## 1.6 Fault Display

Refer to the table below for error displays.

Display	Name	Content
Er.10.1	Current Error Code	Er.: Drive currently has a error 10.1: Error code (encoder fault)

Er.XX.Y: where XX represents the error category and Y represents the sub-error code.

Refer to the table below for alarm displays.

Display	Name	Content
Al.0C.0	Current Alarm Code	Al.: Drive currently has a alarm 0C.0: alarm code, indicating a power cycle is required

Al.XX.Y: where XX represents the alarm category and Y represents the sub-alarm code.

## 2 Communication

### 2.1 Setting Slave Station Alias

You can set the slave station alias of the drive in two ways:

- ◆ Set the slave station alias through object 2008h-13 (function code Pn0812). It takes effect immediately after setting.
- ◆ Write the slave station alias to the corresponding address (word address 0x4) of the ESC EEPROM through the EtherCAT master station. It takes effect after successful writing and power cycling.

### 2.2 Communication Specifications

The communication specifications related to the FV5 series rotary EtherCAT bus servo driver are as follows.

Item	Specification
Physical Layer	100Base-TX (IEEE802.3)
Topology	Line type
Terminals	2 RJ45 interfaces: IN, OUT
Cable	Cat5e
Communication Distance	Max 100m between stations
Number of Nodes	Max 65535
Synchronization Mode	DC (SYNC0 event synchronization) SM (SM2 event synchronization)
Synchronization Jitter	Less than 1μs in DC sync mode
Minimum Communication Cycle	250μs
Application Layer	CoE (CANopen over EtherCAT)
CoE Service Types	SDO Request, SDO Response
Maximum PDO Mapping Length	RxPDO: 40 bytes; TxPDO: 40 bytes
CiA402 Control Modes	HM (Homing Mode) CSP (Cyclic Synchronous Position Mode) CSV (Cyclic Synchronous Velocity Mode) CST (Cyclic Synchronous Torque Mode)

### 2.3 Slave Station Communication Model

This section introduces the EtherCAT slave station communication model based on CoE, as shown in the figure below. It is divided into the physical layer, data link layer, and application layer.

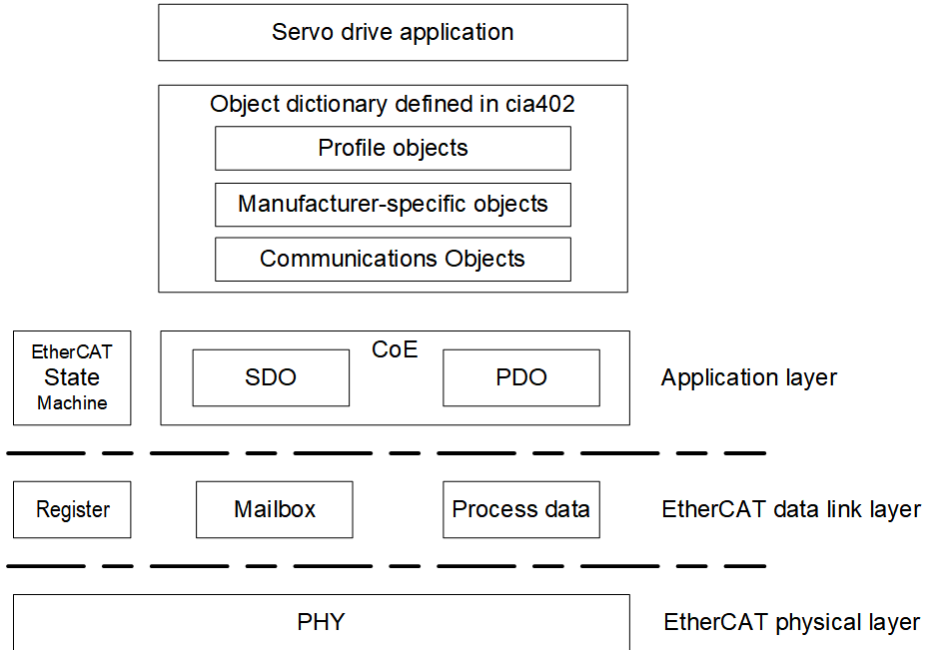
In the diagram, the application layer includes the object dictionary containing CiA402 objects, vendor-specific

objects, and communication objects.

**Process Data Communication:** It is carried out through PDO (Process Data Objects), periodically reading and writing the contents mapped to the corresponding PDO objects.

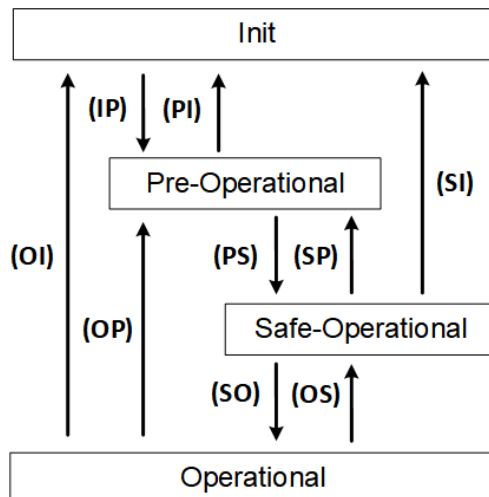
**Mailbox Data Communication:** It is conducted via SDO (Service Data Objects), allowing read and write access to all objects in the object dictionary.

**EtherCAT State Machine Module:** This module manages the task of switching communication state.



## 2.4 Communication State Machine

The FV5 series rotary EtherCAT bus servo drive supports the EtherCAT communication states: Init, Pre-Operational, Safe-Operational, and Operational. The state transitions are illustrated in the diagram below.



The table below describes the execution of SDO and PDO in each communication state of the slave station.

State	SDO	RxPDO	TxPDO	Description
			O	

Init	-	-	-	Communication is in initialization state
Pre-Operational	Yes	-	-	Objects can be accessed via SDO
Safe-Operational	Yes	-	Yes	The master station sends RxPDO, but the slave does not execute; the slave updates TxPDO in real-time
Operational	Yes	Yes	Yes	RxPDO and TxPDO are executed normally

The table below describes the master station’s actions on the slave station during communication state transitions.

State Transition	Description
I -> P	Enable SM0, SM1
P -> S	Configure PDO mapping parameters, enable SM2, SM3, configure FMMU and DC
S -> O	No other configurations, direct state switch

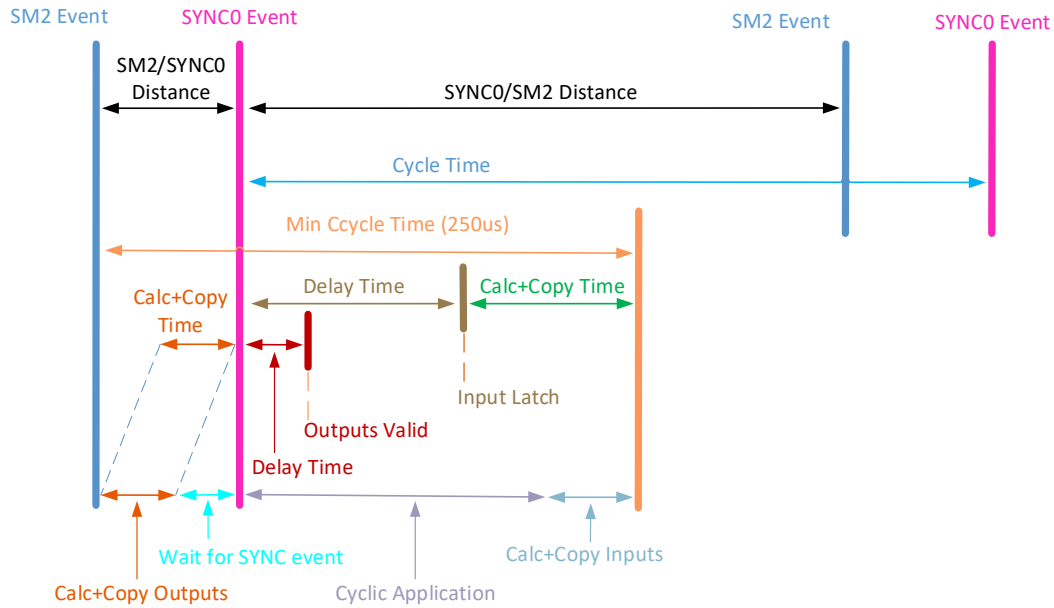
## 2.5 Communication Synchronization Mode

The FV5 series rotary EtherCAT bus servo drive supports two communication synchronization modes: DC and SM2 event modes.

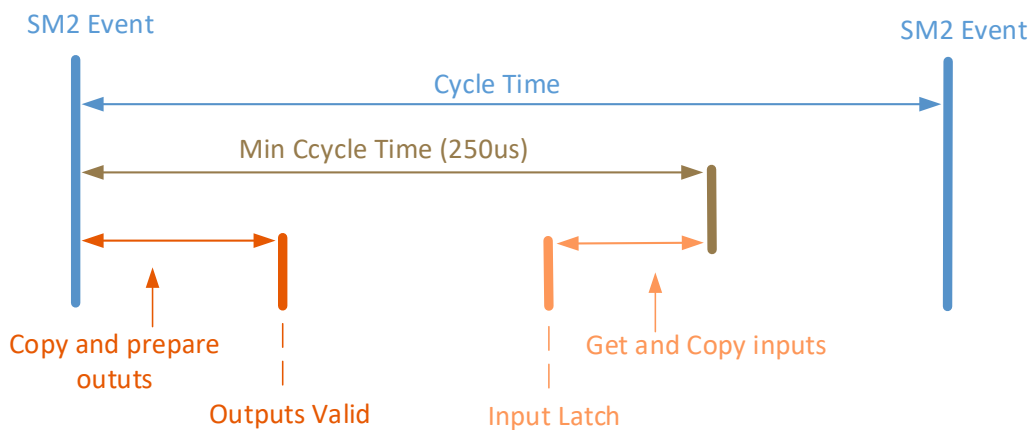
In SYNC0 mode (DC mode), with the first slave station as the reference clock, the ESCs of all slaves periodically generate SYNC synchronization trigger signals. The servo drive uses the synchronization signals for data transmission and reception processing.

When the SYNC0 event is received, the local cycle begins, and the slave station must complete processing the process data frame before receiving the next SYNC0 event. The Calc + Copy Time includes the minimum time difference between frame reception (SM2 event) and the SYNC0 event, as illustrated in the following diagram.

To ensure that the slave can periodically process input and output data, the SYNC0/SM2 Distance of the FV5 series rotary EtherCAT bus servo drive should be greater than the slave station loop control cycle (62.5µs). Additionally, attention should be paid to the jitter time of the SM2 Event caused by the master station. During operation, the value of SYNC0/SM2 Distance can be viewed through the background software of the FV5 series rotary EtherCAT bus servo drive.



In the SM2 event mode, the master station's clock is used as the reference. The master station periodically sends data, and the ESC of each slave station generates an SM2 event trigger signal after receiving data from the master station. The servo drive uses this signal for data transmission and reception processing. The sequence is illustrated in the following diagram.



## 2.6 Mailbox Data Communication (SDO)

The FV5 series rotary EtherCAT bus servo drive supports SDO communication. The SDO services only support SDO Request and SDO Response.

SDO communication is used for setting objects and monitoring the status of the drive.

The object addresses are allocated as follows.

Index	Description
1000h~1FFFh	Communication Objects
2000h~5FFFh	Manufacturer Custom Object Area
6000h~9FFFh	CiA402 Object Area

The address mapping between manufacturer custom objects and the local servo function code is as follows.

Function Code Address	Object Address
PXX.yy	Index: 0x20XX Subindex: yy+1 For example: For P00.0A, the index is 0x2000, and the subindex is 0xB
U00.xx	Index: 0x201A Subindex: xx+1 For example: For U00.0F, the index is 0x201A, and the subindex is 0x10

The error codes corresponding to errors during SDO communication are described in the following table.

Abort code	Meaning
05030000h	Toggle bit not changed
05040000h	SDO protocol timeout
05040001h	Client/Server command specifier not valid or unknown
05040005h	Out of memory
06010000h	Unsupported access to an object
06010001h	Attempt to read to a write only object
06010002h	Attempt to write to a read only object
06010003h	Subindex cannot be written, SI0 must be 0 for write access
06020000h	The object does not exist in the object directory
06040041h	The object can not be mapped into the PDO
06040042h	The number and length of the objects to be mapped would exceed the PDO length
06040043h	General parameter incompatibility reason
06040047h	General internal incompatibility in the device
06060000h	Access failed due to a hardware error
06070010h	Data type does not match, length of service parameter does not match
06070012h	Data type does not match, length of service parameter too high
06070013h	Data type does not match, length of service parameter too low
06090011h	Subindex does not exist
06090030h	Value range of parameter exceeded (only for write access)
06090031h	Value of parameter written too high
06090032h	Value of parameter written too low
06090036h	Maximum value is less than minimum value

Abort code	Meaning
08000000h	General error
08000020h	Data cannot be transferred or stored the application
08000021h	Data cannot be transferred or stored to the application because of local control
08000022h	Data cannot be transferred or stored to the application because of the present device state
08000023h	Object dictionary dynamic generation fails or no object dictionary is present

## 2.7 Process Data Communication (PDO)

Real-time data transfer is carried out through PDO, with RxPDO (master station writing data to the slave station) and TxPDO (slave station transmitting data to the master). The available PDOs for the servo drive are shown in the table below.

PDO Type	Mapping Parameters
RxPDO	Variable Mapping: 1600h Fixed Mapping: 1701h, 1702h, 1703h, 1704h, 1705h
TxPDO	Variable Mapping: 1A00h Fixed Mapping: 1B01h, 1B02h, 1B03h, 1B04h

The PDO allocation objects for the process data communication sync managers (SM) are as follows.

Process Communication Manager	Data Sync	Mapping Parameters
SM2 (RxPDO)		1C12h Default RxPDO: 1701h
SM3 (TxPDO)		1C13h Default TxPDO: 1B01h

Below are some typical combinations of RxPDO and TxPDO. The mapping parameters can be modified according to the application's requirements, with the default mappings as shown in the table below.

PDO Mapping Parameters	Object Dictionary Index	Description
1600h	6040h (Control Word) 607Ah (Target Position) 60B8h (Probe Function)	Mapping parameters are modifiable, maximum of 10 subindexes can be configured
1A00h	603Fh (Error Code) 6041h (Status Word) 6064h (Position Feedback) 60BCh (Probe 2 Rising Edge Position Feedback) 60B9h (Probe Status) 60BAh (Probe 1 Rising Edge	Mapping parameters are modifiable, maximum of 10 subindexes can be configured

	Position Feedback) 60FDh (DI Status)	
--	---	--

Fixed PDO mapping combinations in the table below can be used for Cyclic Synchronous Position (CSP) control and probe functions.

<b>PDO Mapping Parameters</b>	<b>Object Dictionary Index</b>	<b>Description</b>
1701h	6040h (Control Word) 607Ah (Target Position) 60B8h (Probe Function)	Mapping parameters are not modifiable, 8 bytes
1B01h	603Fh (Error Code) 6041h (Status Word) 6064h (Position Feedback) 6077h (Torque Feedback) 60F4h (Position Deviation) 60B9h (Probe Status) 60Bah (Probe 1 Rising Edge Position Feedback) 60FDh (DI Status)	Mapping parameters are not modifiable, 24 bytes

Fixed PDO mapping combinations in the table below can be used for Cyclic Synchronous Position (CSP) control, Cyclic Synchronous Velocity (CSV) control, Cyclic Synchronous Torque (CST) control, and probe functions.

<b>PDO Mapping Parameters</b>	<b>Object Dictionary Index</b>	<b>Description</b>
1702h	6040h (Control Word) 607Ah (Target Position) 60FFh (Target Velocity) 6071h (Target Torque) 6060h (Mode Selection) 60B8h (Probe Function) 607Fh (Max Velocity)	Mapping parameters are not modifiable, 19 bytes
1B02h	603Fh (Error Code) 6041h (Status Word) 6064h (Position Feedback) 6077h (Torque Feedback) 6061h (Mode Display) 60B9h (Probe Status) 60Bah (Probe 1 Rising Edge Position Feedback) 60BCh (Probe 2 Rising Edge Position Feedback)	Mapping parameters are not modifiable, 25 bytes

PDO Mapping Parameters	Object Dictionary Index	Description
	60FDh (DI Status)	

Fixed PDO mapping combinations in the table below can be used for Synchronous Position Control (CSP), Synchronous Speed Control (CSV), Synchronous Torque Control (CST), and torque limiting.

PDO Mapping Parameters	Object Dictionary Index	Description
1703h	6040h (Control Word) 607Ah (Target Position) 60FFh (Target Velocity) 6060h (Mode Selection) 60B8h (Probe Function) 60E0h (Positive Torque Limit) 60E1h (Negative Torque Limit)	Mapping parameters are not modifiable, 17 bytes
1B03h	603Fh (Error Code) 6041h (Status Word) 6064h (Position Feedback) 6077h (Torque Feedback) 60F4h (Position Deviation) 6061h (Mode Display) 60B9h (Probe Status) 60Bah (Probe 1 Rising Edge Position Feedback) 60BCh (Probe 2 Rising Edge Position Feedback) 60FDh (DI Status)	Mapping parameters are not modifiable, 29 bytes

Fixed PDO mapping combinations in the table below can be used for Cyclic Synchronous Position Control (CSP), Cyclic Synchronous Speed Control (CSV), Cyclic Synchronous Torque Control (CST), probe functionality, and torque limiting.

PDO Mapping Parameters	Object Dictionary Index	Description
1704h	6040h (Control Word) 607Ah (Target Position) 60FFh (Target Velocity) 6071h (Target Torque) 6060h (Mode Selection) 60B8h (Probe Function) 607Fh (Max Velocity) 60E0h (Positive Torque Limit) 60E1h (Negative Torque Limit)	Mapping parameters are not modifiable, 23 bytes

1B02h	603Fh (Error Code) 6041h (Status Word) 6064h (Position Feedback) 6077h (Torque Feedback) 6061h (Mode Display) 60F4h (Position Deviation) 60B9h (Probe Status) 60Bah (Probe 1 Rising Edge Position Feedback) 60BCh (Probe 2 Rising Edge Position Feedback) 60FDh (DI Status)	Mapping parameters are not modifiable, 25 bytes
-------	--	---

Fixed PDO mapping combinations in the table below can be used for Cyclic Synchronous Position Control (CSP), Cyclic Synchronous Speed Control (CSV), probe functionality, and torque limiting.

PDO Mapping Parameters	Object Dictionary Index	Description
1705h	6040h (Control Word) 607Ah (Target Position) 60FFh (Target Velocity) 6060h (Mode Selection) 60B8h (Probe Function) 60E0h (Positive Torque Limit) 60E1h (Negative Torque Limit) 60B2h (Torque Offset)	Mapping parameters are not modifiable, 19 bytes
1B04h	603Fh (Error Code) 6041h (Status Word) 6064h (Position Feedback) 6077h (Torque Feedback) 6061h (Mode Display) 60F4h (Position Deviation) 60B9h (Probe Status) 60Bah (Probe 1 Rising Edge Position Feedback) 60BCh (Probe 2 Rising Edge Position Feedback) 60FDh (DI Status)	Mapping parameters are not modifiable, 29 bytes

The following steps should be followed for configuring variable PDO mappings:

Step 1. Write 0 to subindex 0 of 1C12h (or 1C13h).

Step 2. Write 0 to subindex 0 of 1600h (or 1A00h).

Step 3. Write the mapping parameters to subindexes 01h ~ 0Ah of 1600h (or 1A00h).

Step 4. Write the number of valid subindexes to subindex 0 of 1600h (or 1A00h).

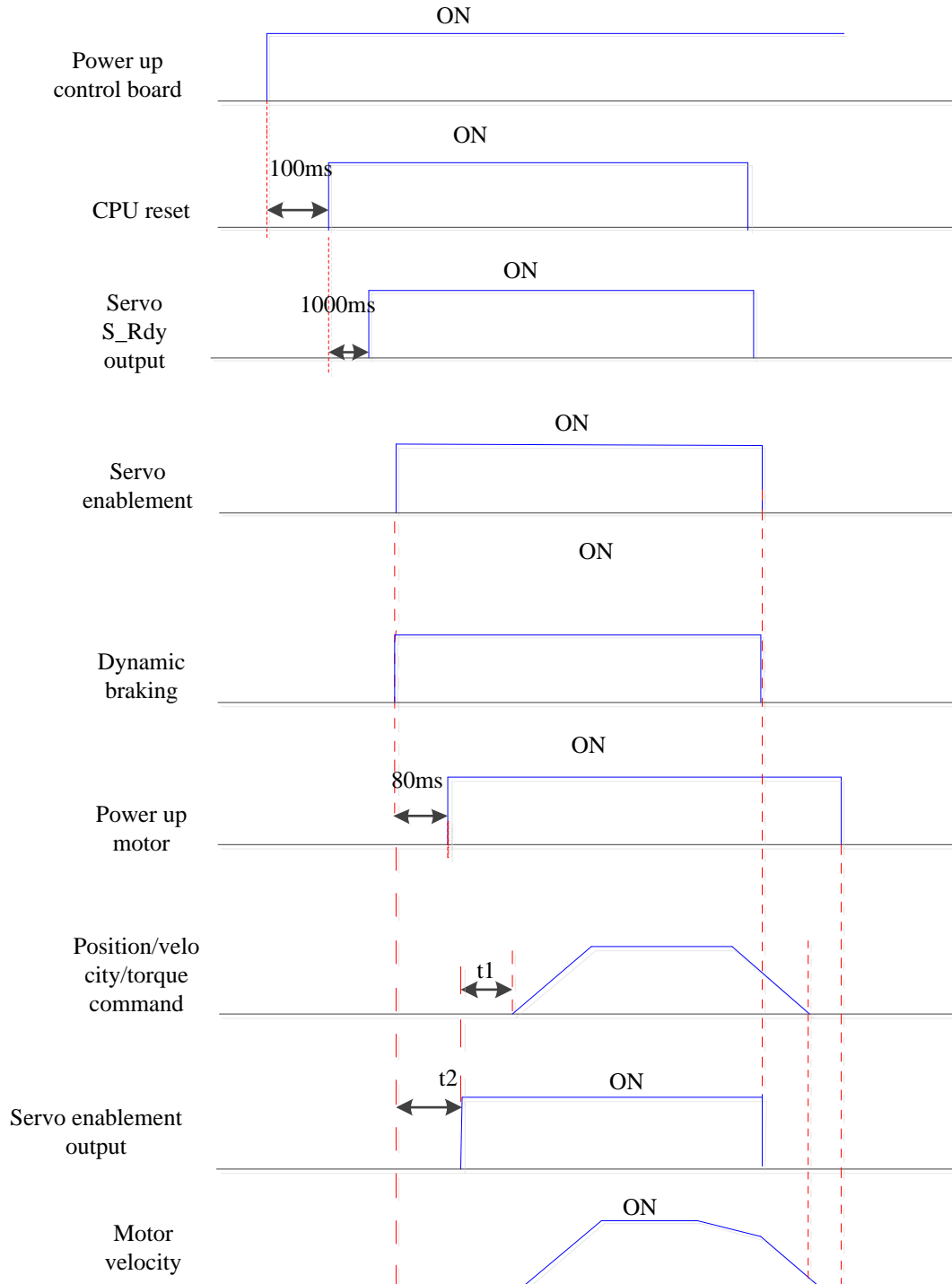
Step 5. Write the mapped PDO to subindex 1 of 1C12h (or 1C13h).

Step 6. Write 1 to subindex 0 of 1C12h (or 1C13h).

# 3 Control and Timing

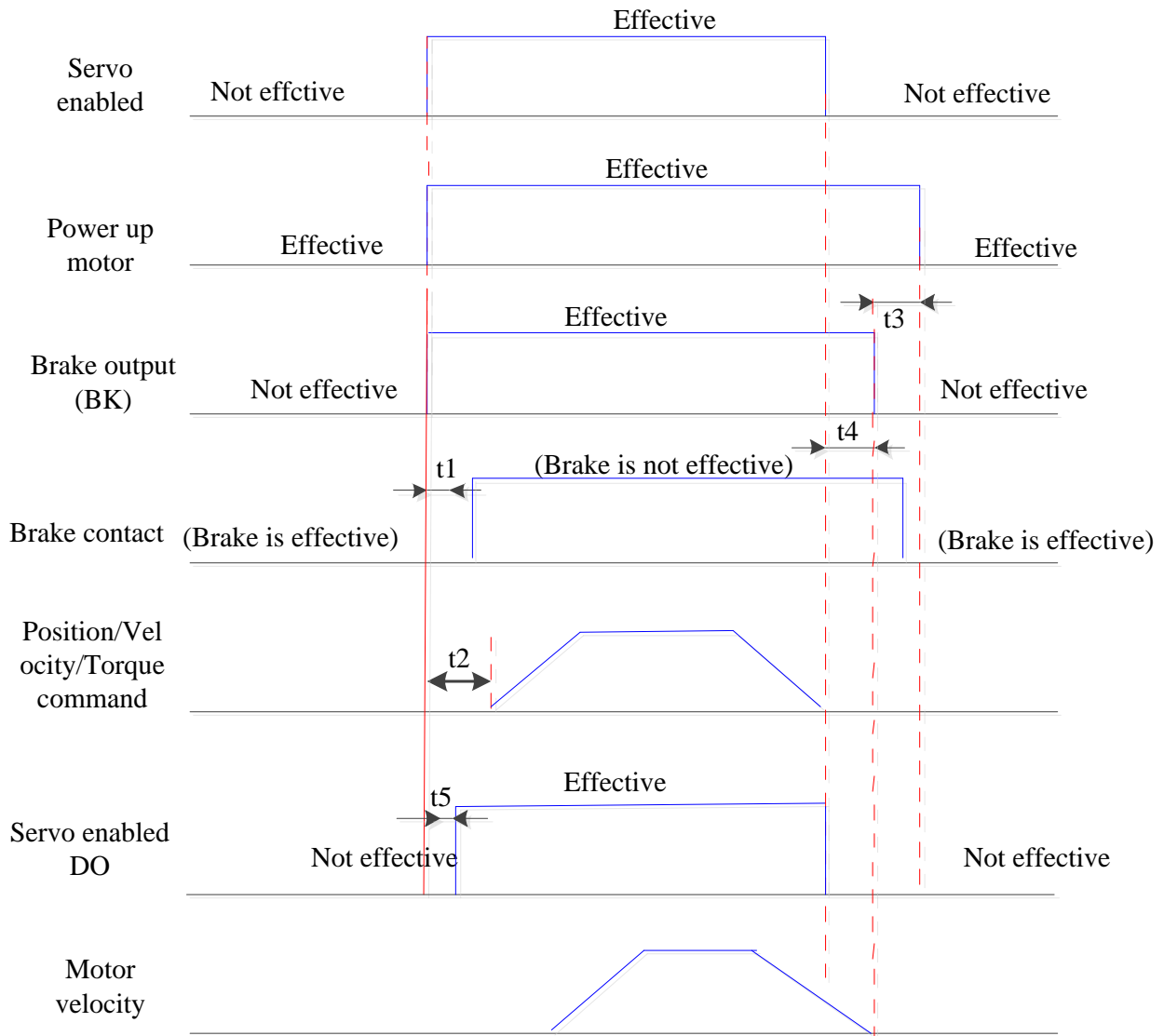
## 3.1 Power-On Timing Diagram

When powering on (sequence of receiving the servo enable signal)



$t2$  time is the bootstrap charging time inside the driver (80ms). The host needs to receive the servo enablement output signal before issuing commands or delay for more than 80ms.

## 3.2 Brake Enable Timing Diagram



$t_1$  time is the brake action time.

$t_2$  time is the time set by P0B.30, before which commands from host computer cannot be received.

$t_3$  time is the time set by P0B.31, the delay from brake activation to motor power off.

When the servo is disabled, the brake out is effective until it reaches the delay time  $t_4$  set by P0B.33.

$t_5$  time is the internal servo bootstrap circuit charging time.

Refer to the following table for brake-related function codes.

P02.0F Brake Enablement		Setting Range	Unit	Factory Default
		0~1	-	0
Explanation:				
◆ 0: Disable brake				
◆ 1: Enable brake				

After enabling the brake, use FunOut.6 (BKout) output to control the external relay (P05.02 = 6 by default).

<b>P0B.30 Delay from Brake Inactivation to Command Reception</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>
	0~500	ms	200

**Explanation:**  
 Upon receiving the servo enable command, the brake becomes inactive. Due to the brake relay action, a delay is needed before receiving commands.

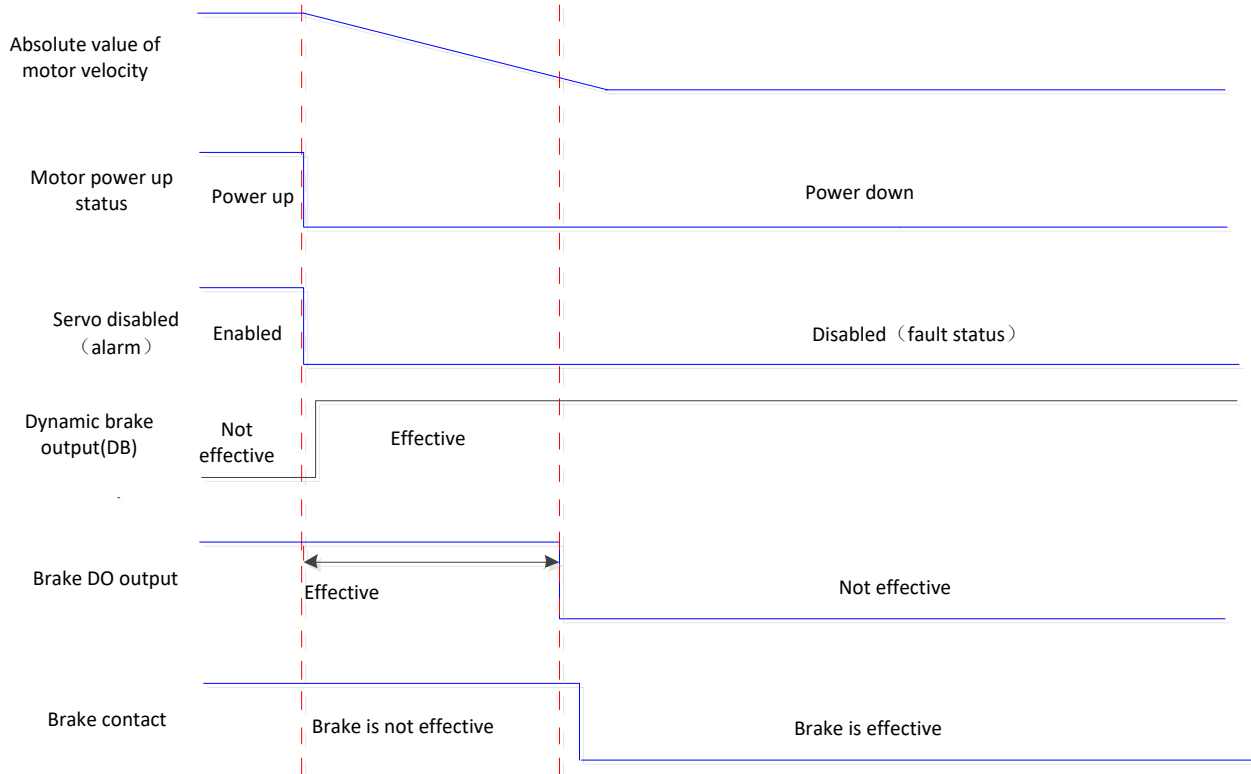
<b>P0B.31 Delay from Brake Activation to Servo Off</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>
	50~1000	ms	150

**Explanation:**  
 When the brake is active, a delay is required before cutting off motor output due to the brake relay action.

<b>P0B.33 Delay from zero command to brake actuation</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>
	1~1000	ms	500

**Explanation:**  
 After the servo receives an external disable command, there is a delay before the brake actuation is performed.

### 3.3 Stopping Timing Diagram



Stopping-Related Function Codes and Object Dictionary

Stopping-Related Function Codes

P02.10 Stop mode when servo off	Setting Range	Unit	Factory Default	Related Modes		
	-3~2	-	1	P	S	T
Description: The stopping method after servo disable can be modified according to actual conditions: <ul style="list-style-type: none"> <li>◆ 3: Zero-speed stop and stay in DB state</li> <li>◆ -2: Ramp stop and stay in DB state</li> <li>◆ -1: DB stop and stay in DB state</li> <li>◆ 0: Free stop and stay in free state</li> <li>◆ 1: Ramp stop and stay in free state</li> <li>◆ 2: Zero-speed stop and stay in free state</li> </ul>						

P02.11 Overtravel stop mode	Setting Range	Unit	Factory Default	Related Modes		
	0~2	-	1	P	S	T
Description: <ul style="list-style-type: none"> <li>0: Free stop and stay in free state</li> <li>1: Zero stop and stay in position locked state</li> <li>◆ 2: Velocity ramp stop and stay in position locked state</li> </ul>						

P02.12 Stop mode in case of uncontrollable fault	Setting Range	Unit	Factory Default	Related Modes		
	0~2	-	2	P	S	T

Description:  
Stop mode when uncontrollable fault occurs.

- ◆ 0: Free stop and stay in stop state
- ◆ 1: DB stop and stay in free state
- ◆ 2: DB stop and stay in DB state

P02.13 Stop mode in case of controllable fault	Setting Range	Unit	Factory Default	Related Modes		
	-4~3	-	-3	P	S	T

Description:  
Stop mode when controllable fault occurs:

- ◆ -4: Emergency torque stop and stay in DB state
- ◆ -3: Zero-velocity stop and stay in DB state
- ◆ -2: Ramp stop and stay in DB state
- ◆ -1: DB stop and stay in DB state
- ◆ 0: Free stop and stay in free state
- ◆ 1: Ramp stop and stay in free state
- ◆ 2: Zero-velocity stop and stay in free state
- ◆ 3: Emergency torque stop and stay in free state

P02.14 Stop Completion Threshold	Setting Range	Unit	Factory Default	Related Modes		
	10~1000	mm/s	20	P	S	T

Description:  
When the actual running speed of the motor is less than this threshold, it is considered to be in a stop state

P0B.20 Ramp stop Acceleration/Deceleration Time	Setting Range	Unit	Factory Default	Related Modes		
	0~10000	ms	50	P	S	T

Description:  
Ramp stop acceleration/deceleration time during fault shutdown or servo OFF shutdown

<b>P0B.22 Emergency Torque Stop Deceleration</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	0~3000	%	500	P	S	T
Torque change amount of the emergency torque stop ramp.						

Index	Subindex	Name	Setting Range	Unit	Factory Default
605Ah	00	Quick Stop Method Selection	<ul style="list-style-type: none"> <li>◆ 0: Free stop and stay in free state</li> <li>◆ 1: In HM mode, ramp stop via 609Ah; in other modes, ramp stop via 6084h and stay in free state</li> <li>◆ 2: Ramp stop via 6085h and stay in free state</li> <li>◆ 3: Emergency stop torque stop and stay in free state</li> <li>◆ 5: In HM mode, ramp stop via 609Ah; In other modes, ramp stop via 6084h and stay in position locked state</li> <li>◆ 6: Ramp stop by 6085h and stay in position locked state</li> <li>◆ 7: Emergency stop torque stop and stay in position locked state</li> </ul>	-	2
605Ch	00h	Servo OFF Stop Method Selection	<ul style="list-style-type: none"> <li>◆ 0: Stop mode as set by P02.10</li> <li>◆ 1: In HM mode, ramp stop via 609Ah; In CST/PT mode, ramp stop via 6087h; In other modes, ramp stop via 6084h and stay in free state</li> </ul>	-	0
605Dh	00h	HALT Stop Method Selection	<ul style="list-style-type: none"> <li>◆ 1: In HM mode, ramp stop via 609Ah; In CST/PT mode, ramp stop by 6087h; In other modes, ramp stop via 6084h and stay in position locked state</li> <li>◆ 2: In CST/PT mode, ramp stop via 6087h, In other modes ramp stop via 6085h and stay in position locked state</li> <li>◆ 3: Emergency stop torque stop and stay in position locked state</li> </ul>	-	1
605Eh	00h	Fault 2 Stop Method	<ul style="list-style-type: none"> <li>◆ 0: Stop mode set by Pn0213</li> </ul>	-	0

Index	Subindex	Name	Setting Range	Unit	Factory Default
		Selection	<ul style="list-style-type: none"> <li>◆ 1: In HM mode, ramp stop via 609Ah; In CST/PT mode torque ramp stop via 6087h, In other modes, ramp stop via 6084h stop and stay in free state</li> <li>◆ 2: In CST/PT mode torque ramp stop via 6087h; In other modes, ramp stop via 6085h and stay in free state</li> </ul>		
6084h	00h	Profile Deceleration	0~4294967295	Comm and unit / s <sup>2</sup>	1398 1013 33
6085h	00h	Quick Stop Deceleration	0~4294967295	Comm and unit / s <sup>2</sup>	4294 9672 95
609Ah	00h	Homing Acceleration	0~4294967295	Comm and unit / s <sup>2</sup>	1398 1013 33

### 3.4 Discharge Function Settings

When the external load inertia is significantly large (more than 5 times the motor inertia) and there is a high deceleration, the discharge function needs to be used to release the excess energy stored in the bus capacitor. Select an appropriate power and resistance value for the discharge resistor according to the guidelines.

Discharge Setting Related Function Codes

P02.20 Regenerative Resistor Operation Method Selection	Setting Range	Unit	Factory Default	Related Modes		
	0~2	-	1	P	S	T
Description: <ul style="list-style-type: none"> <li>◆ 0: Internal resistor</li> <li>◆ 1: External resistor</li> <li>◆ 2: No discharge</li> </ul>						

P02.21 Internal Regenerative Resistor Power	Setting Range	Unit	Factory Default	Related Modes		
	1~65535	w	800	P	S	T
Description: If the power is too small, the discharge resistor may overheat or overload.						

P02.22 Internal Regenerative Resistor Resistance	Setting Range	Unit	Factory Default	Related Modes		
	1~1000	Ω	50	P	S	T

Description:  
The selection of the discharge resistor resistance should be appropriate, typically between 40 Ω and 50 Ω. Too small a value can cause driver overcurrent, while too large affects the discharge effectiveness.

P02.23 External Regenerative Resistor Power	Setting Range	Unit	Factory Default	Related Modes		
	1~65535	W	800	P	S	T

Description:  
If the power is too small, the discharge resistor may overheat or overload.

P02.24 External Regeneration Resistor Resistance	Setting Range	Unit	Factory Default	Related Modes		
	1~1000	Ω	80	P	S	T

Description:  
The selection of the discharge resistor resistance should be appropriate, typically between 40 Ω and 50 Ω. Too small a value can cause driver overcurrent, while too large affects the discharge effectiveness.

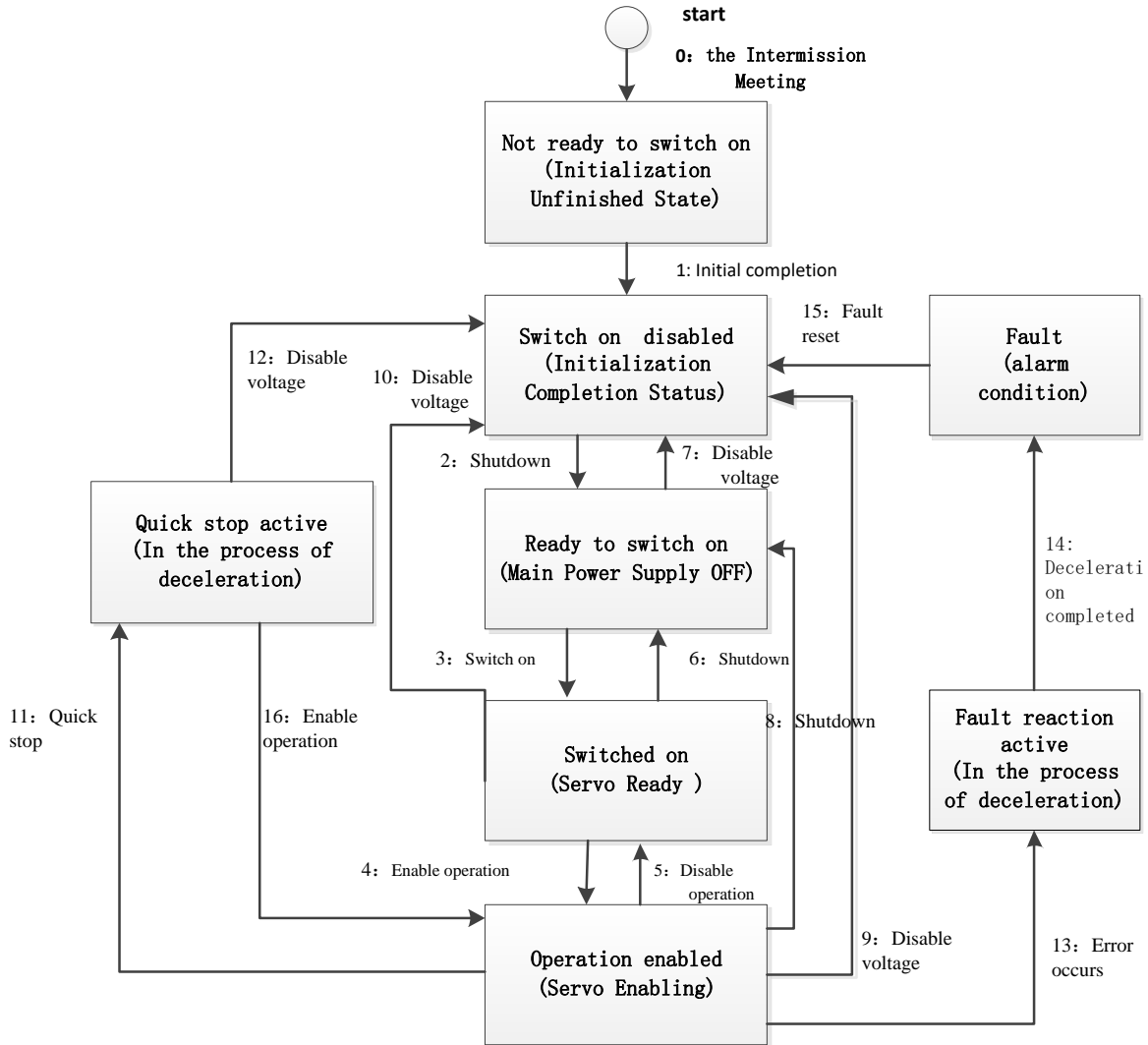
P02.26 Resistor Heat Dissipation Coefficient	Setting Range	Unit	Factory Default	Related Modes		
	1~100	%	60	P	S	T

Description:  
The heat dissipation coefficient of the discharge resistor. A larger setting indicates better heat dissipation of the discharge resistor, which can limit the overload of the discharge resistor to some extent.

# 4 Control Mode

## 4.1 Bus Communication Status and Conversion

Based on user control commands or error detection, the state transitions (FSA) of the servo drive's power control associated with the PDS(Power Drive Systems) are defined as shown in the following figure.



- ◆ The servo ready state requires the main power to be ON. When the main power is OFF, it cannot transition to the SWITCHED ON state.
- ◆ After becoming Operation Enabled (servo enabled), wait for at least 100 ms before inputting an action command.

During PDS transition, confirm the status has changed via 6041h (status word) before sending the next transition command.

The following table represents the conditions and actions for PDS state transition.

PDS Transitions		Event	Action
0	Power on	Automatically transition after power input or application layer reset	Initialization
1	Initialization complete	Automatically transition after initialization is complete	Communication connected
2	Shutdown	On receiving the Shutdown command	None
3	Switch on	On receiving the Switch On command	None
4	Enable operation	On receiving the Enable Operation command	Drive function enabled
5	Disable operation	On receiving the Disable Operation command	Drive function disabled
6	Shutdown	Main power off	None
7	Disable voltage	On receiving the Disable Voltage command ◆ On receiving the Quick Stop command ◆ When the ESM state is PreOP, SafeOP, or OP, transitioning to Init.	None
8	Shutdown	On receiving the Shutdown command	None
9	Disable voltage	On receiving the Disable Voltage command On power off	None
10	Disable voltage	On receiving the Disable Voltage command ◆ On receiving the Quick Stop command ◆ When the ESM state is PreOP, SafeOP, or OP, transitioning to Init.	None
11	Quick stop	On receiving the Quick Stop command On fault shutdown On power off	Execute quick stop
12	Disable voltage	◆ When the Quick stop selection code is the set values of 1, 2, or 3 and Quick stop action is complete ◆ When the Quick Stop selection code is the set values of 5, 6, or 7, Quick Stop action is complete, and on receiving the Disable Voltage command	None
13	Error occurs	Driver alarm	None
14	Stop Dec	Alarm ramp stop in case of anomaly	None
15	Fault reset	On receiving the Fault Reset command	Clear fault when not in a fault state
16	Enable operation	When the Quick Stop selection code is the set values of 5, 6, or 7 and on receiving the Enable Operation command	Enable driver

## 4.2 Control Word (6040h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																														
6040h	00h	Control word	0 ~ 65535	-	0	U16	rw	RxPDO	No																														
		Set control commands for PDS state transitions and other servo driver controls. bit information details: <table border="1" style="margin: 10px auto; width: 80%;"> <thead> <tr> <th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th> </tr> </thead> <tbody> <tr> <td colspan="6">r</td> <td>oms</td> <td>h</td> <td>fr</td> <td colspan="3">oms</td> <td>eo</td> <td>qs</td> <td>ev</td> <td>so</td> </tr> </tbody> </table> r: reserved fr: fault reset oms: operation mode specific eo: enable operation (control mode dependent bit) qs: quick stop h: halt ev: enable voltage so: switch on								15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	r						oms	h	fr	oms			eo	qs
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																								
r						oms	h	fr	oms			eo	qs	ev	so																								

bit7, 3~0 (fault reset / enable operation / quick stop / enable voltage / switch on): represents PDS commands. The following commands and corresponding bit combinations are represented.

Command	bits of the control word					PDS Transitions
	Bit7	Bit3	Bit2	Bit1	Bit0	
	fault reset	enable operation	quick stop	enable voltage	switch on	
Shutdown	0	-	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on +Enable operation	0	1	1	1	1	3+4
Enable operation	0	1	1	1	1	4,16
Disable voltage	0	-	-	0	-	7,9,10,12
Quick stop	0	-	0	1	-	7,10,11
Disable operation	0	0	1	1	1	5
Fault reset	Rising edge	-	-	-	-	15

After executing the Switch On command, execute the Enable Operation command.

The Bit logic of the Quick Stop command is valid under 0.

When bit8 (Halt) is 1, the motor decelerates to a stop according to 605Dh (Halt selection code). After pausing, return to 0 to start the action again.

However, in HM control mode, the action is interrupted by 1, and even if it returns to 0, it cannot be reopened.

Operation specific mode	Bit9	Bit6	Bit5	Bit4
PP	change on set-point	absolute / relative	change set immediately	new set-point
PV	-	-	-	-
TP	-	-	-	-
HM	-	-	-	start homing
IP	-	-	-	enable interpolation
CSP	-	-	-	-
CSV	-	-	-	-
CST	-	-	-	-

### 4.3 Status Word (6041h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																																
6041h		Status word	0 ~ 65535	-	0	U16	rw	TxPDO	No																																
	00h	bit information details: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th> </tr> </thead> <tbody> <tr> <td>r</td><td></td><td>oms</td><td>ila</td><td>oms</td><td>rm</td><td>r</td><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rtso</td><td></td> </tr> </tbody> </table> <p>                         r: reserved                          w: warning                          sod: switch on disabled                          oms: operation mode specific (control mode dependent bit)                          qs: quick stop                          ve: voltage enabled                          ila: internal limit active                          f: fault                          oe: operation enabled                          rm: remote                          so: switched on                          rtso: ready to switch on                     </p>								15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	r		oms	ila	oms	rm	r	w	sod	qs	ve	f	oe	so	rtso	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																										
r		oms	ila	oms	rm	r	w	sod	qs	ve	f	oe	so	rtso																											

bit6, bit5, bit3, bit2, bit1, bit0 (switch on disabled / quick stop / fault / operation enabled / switched on / ready to switch on): These bits can confirm the state of the PDS. The following shows the states and corresponding bits.

Status word	PDS state	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization not completed state
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization completed state
xxxx xxxx x01x 0001 b	Ready to switch on	Main circuit power OFF state
xxxx xxxx x01x 0011 b	Switched on	Servo enable off/Servo ready
xxxx xxxx x01x 0111 b	Operation enabled	Servo enable on
xxxx xxxx x00x 0111 b	Quick stop active	Immediate stop
xxxx xxxx x0xx 1111 b	Fault reaction active	Fault (alarm) detected
xxxx xxxx x0xx 1000 b	Fault	Fault (alarm) status

- ◆ When set to 1, it indicates that the main circuit power voltage is applied to the PDS.
- ◆ bit5 (quick stop): When set to 0, it indicates that the PDS has received a quick stop request. The quick stop bit logic is active at 0. Please note that it performs the opposite action of other bit logic.
- ◆ bit7 (warning): When set to 1, it indicates that a warning is occurring. During a warning, the PDS state remains unchanged, and the motor continues to operate.
- ◆ bit8 (reserved): This bit is unused (fixed at 0).
- ◆ bit9 (remote): When set to 1 (remote), it indicates that 6040h (control word) is being processed normally.
- ◆ For bit13, bit12, and bit10 (operation mode specific): Please refer to the table below.

operation mode specific	bit13	bit12	bit10
PP	following error	set-point acknowledge	target reached
PV	-	speed	target reached
TP	-	-	target reached
HM	homing error	homing attained	target reached
IP	-	ip mode active	target reached
CSP	following error	drive follows command value	-
CSV	-	drive follows command value	-
CST	-	drive follows command value	-

## 4.4 Control Mode Settings (6502h)

### 4.4.1 Mode Selection (6060h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6060h	00h	Mode Selection	-128 ~ 127	-	0	I8	rw	RxPDO	Yes
		Set the control mode of the servo drive.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
			Value	Modes of operation				Abbreviation	
			-128~-1	Reserved				-	
			0	Mode not set				-	
			1	Profile Position control mode				PP	
			2	-				-	
			3	Profile Velocity control mode				PV	
			4	Profile Torque control mode				PT	
			5	-				-	
			6	Homing Position control mode				HM	
			7	-				-	
			8	Cyclic Synchronous Position control mode				CSP	
			9	Cyclic Synchronous Speed control mode				CSV	
			10	Cyclic Synchronous Torque control mode				CST	
			11~127	Reserved				-	

#### 4.4.2 Mode Selection Display (6061h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6061h		Mode Selection Display	- 128~1 27	-	0	I8	r	TxPDO	No
	00h	Display the control mode of the servo drive							
			Value	Modes of operation				Abbreviation	
			-128~-1	Reserved				-	
			0	Mode not set				-	
			1	Profile Position control mode				PP	
			2	-				-	
			3	Profile Velocity control mode				PV	
			4	Profile Torque control mode				PT	
			5	-				-	

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
			6	Homing Position control mode				HM	
			7	-				-	
			8	Cyclic Synchronous Position control mode				CSP	
			9	Cyclic Synchronous Speed control mode				CSV	
			10	Cyclic Synchronous Torque control mode				CST	
			11~127	Reserved				-	

## 4.5 Position Control Function (PP/CSP/HM)

### 4.5.1 General Position Control Settings

Position command type:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
607Ah	00h	Target Position	-2147483648~2147483647	Command Unit	0	I32	rw	RxPDO0	No
		Set the target position in PP mode and CSP mode.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM				
607Eh		Command Polarity	0~255	-	0	U8	rw	RxPDO	No				
	00h	Set the polarity of position commands, speed commands, and torque commands.											
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>7</td> <td>                     Position Command Polarity                      ◆ 0: Maintain existing value                      ◆ 1: Command × (-1)                      CSP: Negate the position command (607Ah + 60B0h)                 </td> </tr> </tbody> </table>								Bit	Description	7	Position Command Polarity ◆ 0: Maintain existing value ◆ 1: Command × (-1) CSP: Negate the position command (607Ah + 60B0h)
Bit	Description												
7	Position Command Polarity ◆ 0: Maintain existing value ◆ 1: Command × (-1) CSP: Negate the position command (607Ah + 60B0h)												

Speed type:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
607Fh	00h	Max Profile Velocity	0 ~ 4294967295	Command Unit / s	0x32000000	U32	rw	RxPDO	YES
		Set the speed limit value. The maximum value is limited by 6080h (Max Motor Speed Setting).							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2018h (P182C)	2Dh	Max Motor Speed	0 ~ 9000	RPM	6000	U32	rw	-	YES
		Max motor speed, CSP mode's max speed command.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6081h	00h	Profile Velocity	0 ~ 4294967295	Command Unit / s	0x00D55555	U32	rw	RxPDO	YES
		Set the target speed. The maximum value is limited by the smaller value of 607Fh (Max Profile Velocity) and 2018h-2D (Max Motor Speed).							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60B1h	00h	Velocity Offset	-2147483648 ~ 2147483647	Command Unit / s	0x00D55555	I32	rw	RxPDO	No
		Set the offset value for speed command (speed feedforward).							

Torque Type:

Index	Subindex	Name	Setting	Unit	Factory	Data	ACCESS	PDO	EEPROM
-------	----------	------	---------	------	---------	------	--------	-----	--------

			Range		Default	TYPE			
6072h		Maximum Torque	0 ~ 65535	0.1%	3000	U16	rw	RxPDO	YES
	00h	Sets the maximum torque of the motor. The maximum value is limited based on the maximum torque read from the motor by internal processing. The maximum torque of the motor varies depending on the motor used.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60B2h	00h	Torque Offset	-32768 ~ 32767	0.1%	0	I16	rw	RxPDO	YES
		Sets the feedforward value for the torque command.							

Acceleration/deceleration type:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6083h	00h	Profile Acceleration	0 ~ 4294967295	Command unit / s <sup>2</sup>	0x53555555	U32	rw	RxPDO	YES
		Sets the profile acceleration. If set to 0, it is internally processed as 1.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6084h	00h	Profile Deceleration	0 ~ 4294967295	Command unit / s <sup>2</sup>	0x53555555	U32	rw	RxPDO	YES
		Sets the profile deceleration. If set to 0, it is internally processed as 1.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60C5	00h	Maximum	0 ~	Command	0x53555555	U32	rw	RxPDO	YES

h		Acceleration	42949672 95	d unit / s <sup>2</sup>	55			O	
		Sets the maximum acceleration. If set to 0, it is internally processed as 1.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM
60C6h	00h	Maximum Deceleration	0 ~ 42949672 95	Command unit / s <sup>2</sup>	0x535555 55	U32	rw	RxPDO	YES
		Sets the maximum deceleration. If set to 0, it is internally processed as 1.							

Refer to the tables below for software limit settings:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM
607Dh	-	Software Limits	-	-	-	-	-	-	-
		Sets the software limit values.							
	00h	Number of Supported Sub-Indices	2	-	2	U8	R	No	No
		Indicates the number of Sub-Indices for 607Dh (Software Limits)							
	01h	Negative Software Limit	-2147483648 – 2147483647	Command unit	0x800000 00	I32	RW	RxPDO	YES
		Sets the negative software limit value.							
	02h	Positive Software Limit	-2147483648 – 2147483647	Command unit	0x7FFFF FFF	I32	RW	RxPDO	YES
		Sets the positive software limit value.							

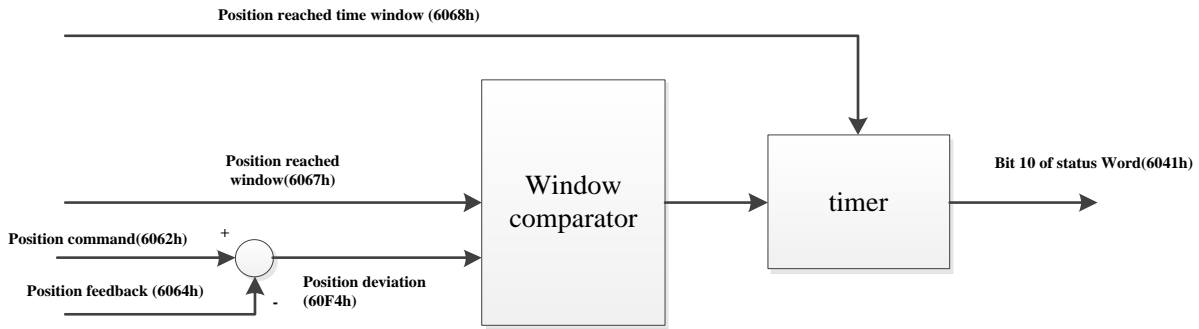
The setting range unit for 607Dh is the same as that of 6062h. Actual operational positions should not exceed the range set between 607Dh-01h (Negative Software Limit) and 607Dh-02h (Positive Software Limit).

Related Objects:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM
6040	00	Control Word	0~65535	-	0	U16	RW	RxPDO	No
6041	00	Status Word	-	-	0	U16	R	TxPDO	No
6060	00	Operation Mode	0~10	-	0	I8	RW	RxPDO	YES
6061	00	Mode Display	-	-	0	I8	R	TxPDO	No
6063	00	Position Feedback	-	Encoder Unit	-	I32	R	TxPDO	No
6064	00	Position Feedback	-	Command Unit	-	I32	R	TxPDO	No
606C	00	Speed Feedback	-	Command Unit / s	-	I32	R	TxPDO	No
607A	00	Target Position	- $2^{31} \sim (2^{31} - 1)$	Command Unit	0	I32	RW	RxPDO	Yes
607E	00	Command Polarity	0~255	-	0	U8	RW	RxPDO	yes
60B0	00	Position Offset	- $2^{31} \sim (2^{31} - 1)$	Command Unit	0	I32	RW	RxPDO	No
60B1	00	Speed Offset	- $2^{31} \sim (2^{31} - 1)$	Command Unit / s	0	I32	RW	RxPDO	No
60B2	00	Torque Offset	-3000 ~3000	0.1%	0	I16	RW	RxPDO	No

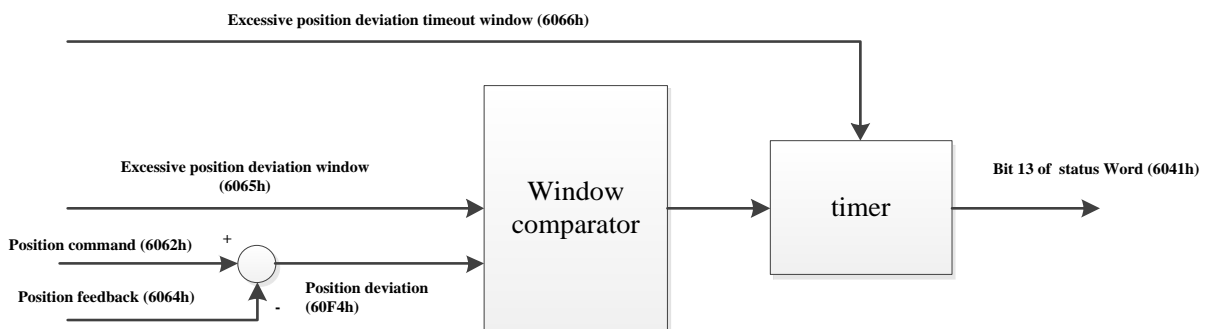
Deviation Related:

When the servo is enabled (operation valid state), and the **set-points** have all been given and the command generation state is complete, if the difference between 6062h (Position Command) and 6064h (Position Feedback) is within the range set by 6067h (Position Window), and if it remains so for the time set by 6068h (Position Window Time), bit 10 (Target Reached) of 6041h (Status Word) will be set to 1.



Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6067h	00h	Position Reached Window	0 ~ 4294967295	Command Unit	0x606700	U32	rw	RxPDO	YES
		If the difference between 6062h and 6064h is less than this set value, and remains so for the time set by 6068h, bit 10 of 6041h is set to 1; otherwise, it is 0.							
6068h	00h	Position Reached Time Window	0 ~ 65535	ms	0	U16	rw	RxPDO	YES
		Position reached holding time, combined with 6067h, determines the output value of bit 10 of 6041h.							

If the value of 60F4h (Position Deviation) exceeds the set range of 6065h (Excessive Position Deviation Threshold) and remains so for the time set by 6066h (Excessive Position Deviation Timeout Threshold), bit 13 of 6041h (Status Word) becomes 1, and the drive reports a position deviation error (Alarm Code: A1.05.3). Additionally, if the position deviation exceeds 1073741824, an alarm for position deviation overflow is triggered (Alarm Code: A1.05.B).



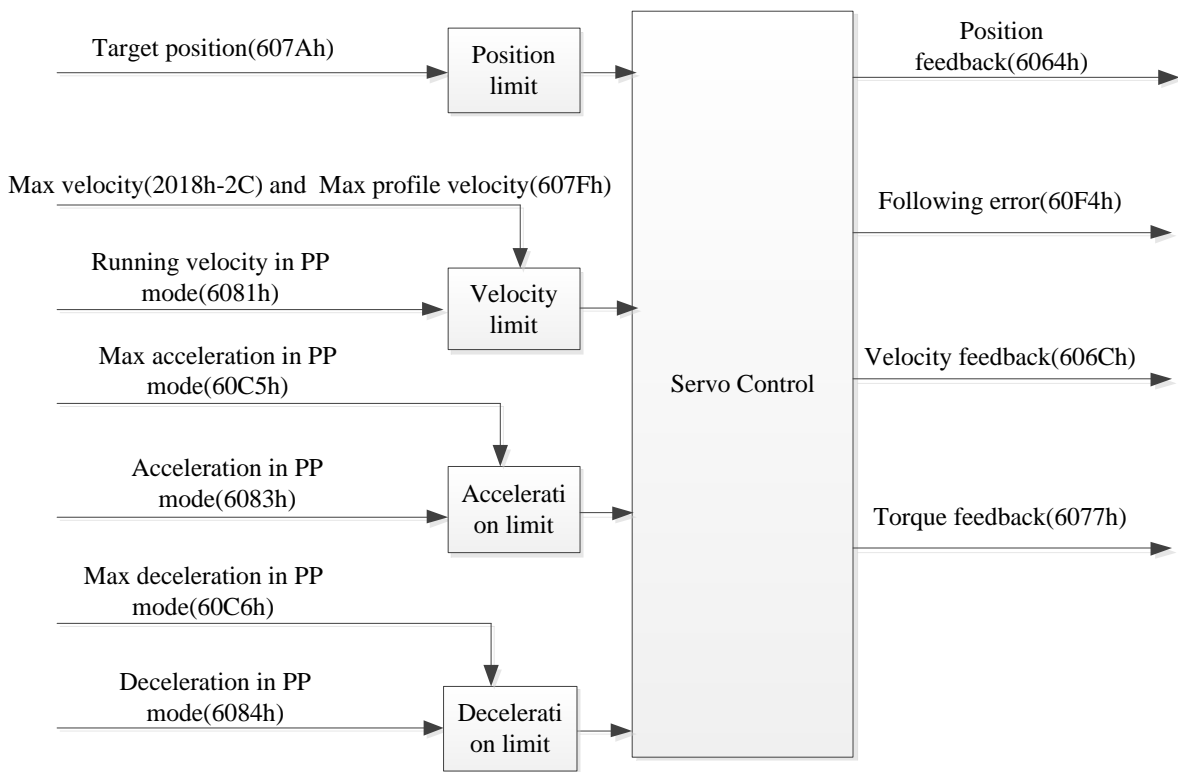
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6065h	00h	Excessive Position Deviation Window	0 ~ 4294967295	Command Unit	0x01A36AE7	U32	rw	RxPDO	YES

		If the value of 60F4h (Position Deviation) is outside the set value of this parameter, bit 13 of 6041h (Status Word) is set to 1, indicating "Excessive Position Deviation" (Error Code: Er.05.3).							
6066h	00h	Excessive Position Deviation Timeout Window	0 ~ 65535	ms	0	U16	rw	RxPDO	YES
		If the value of 60F4h (Position Deviation) exceeds the set range of 6065h (Excessive Position Deviation Threshold) and remains so for longer than the set value of this parameter, bit 13 of 6041h (Status Word) is set to 1, indicating a "Position Deviation Error" (Error Code: Er.05.3).							

### 4.5.2 Profile Position Control Mode (PP Mode)

In this mode, the upper controller specifies the target position, target speed, acceleration, and deceleration, and the servo drive generates the position command internally for position control mode.

The functional principle of PP mode is shown in the diagram below.



#### 4.5.2.1 PP Mode Control Word

The details of the PP mode control word are shown in the table below.

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6040h	00h	Control Word	0 ~ 65535	-	0	U16	rw	RxPDO	No

Description: Sets control commands for servo drive PDS state transitions, etc. Bit Information Details:																																	
9	8	7	6	5	4	3	2	1	0																								
oms	h	fr	absolute/relative	change set immediately	new set-point	eo	qs	ev	so																								
<ul style="list-style-type: none"> <li>◆ fr: fault reset</li> <li>◆ absolute/relative: choose between absolute or relative positioning</li> <li>◆ eo: enable operation (control mode dependent bit)</li> <li>◆ qs: quick stop</li> <li>◆ h: halt</li> <li>◆ ev: enable voltage</li> <li>◆ so: switch on</li> <li>◆ change set immediately: change target position immediately</li> <li>◆ new set-point: write new target position</li> </ul>																																	
<table border="1"> <thead> <tr> <th>bit</th> <th>name</th> <th>value</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>4</td> <td>new-set-point</td> <td>0~1</td> <td>Start positioning action, trigger to update setting value. Acquires new position determination tasks (e.g., 607Ah (Target position), 6081h (Profile velocity)).</td> </tr> <tr> <td rowspan="2">5</td> <td rowspan="2">change set immediately</td> <td>0</td> <td>Start next positioning action after completing the current positioning action.</td> </tr> <tr> <td>1</td> <td>Interrupt the current positioning action and immediately start the next positioning action.</td> </tr> <tr> <td rowspan="2">6</td> <td rowspan="2">absolute/relative</td> <td>0</td> <td>Treat 607Ah (Target position) as an absolute position.</td> </tr> <tr> <td>1</td> <td>Treat 607Ah (Target position) as a relative position.</td> </tr> <tr> <td>9</td> <td>change on set-point</td> <td>-</td> <td>Not supported in this software version.</td> </tr> </tbody> </table>										bit	name	value	Definition	4	new-set-point	0~1	Start positioning action, trigger to update setting value. Acquires new position determination tasks (e.g., 607Ah (Target position), 6081h (Profile velocity)).	5	change set immediately	0	Start next positioning action after completing the current positioning action.	1	Interrupt the current positioning action and immediately start the next positioning action.	6	absolute/relative	0	Treat 607Ah (Target position) as an absolute position.	1	Treat 607Ah (Target position) as a relative position.	9	change on set-point	-	Not supported in this software version.
bit	name	value	Definition																														
4	new-set-point	0~1	Start positioning action, trigger to update setting value. Acquires new position determination tasks (e.g., 607Ah (Target position), 6081h (Profile velocity)).																														
5	change set immediately	0	Start next positioning action after completing the current positioning action.																														
		1	Interrupt the current positioning action and immediately start the next positioning action.																														
6	absolute/relative	0	Treat 607Ah (Target position) as an absolute position.																														
		1	Treat 607Ah (Target position) as a relative position.																														
9	change on set-point	-	Not supported in this software version.																														
Note: The function of 60F2h is not supported at present.																																	

### 4.5.2.2 PP Mode Status Word

The details of the PP mode status word are shown in the table below.

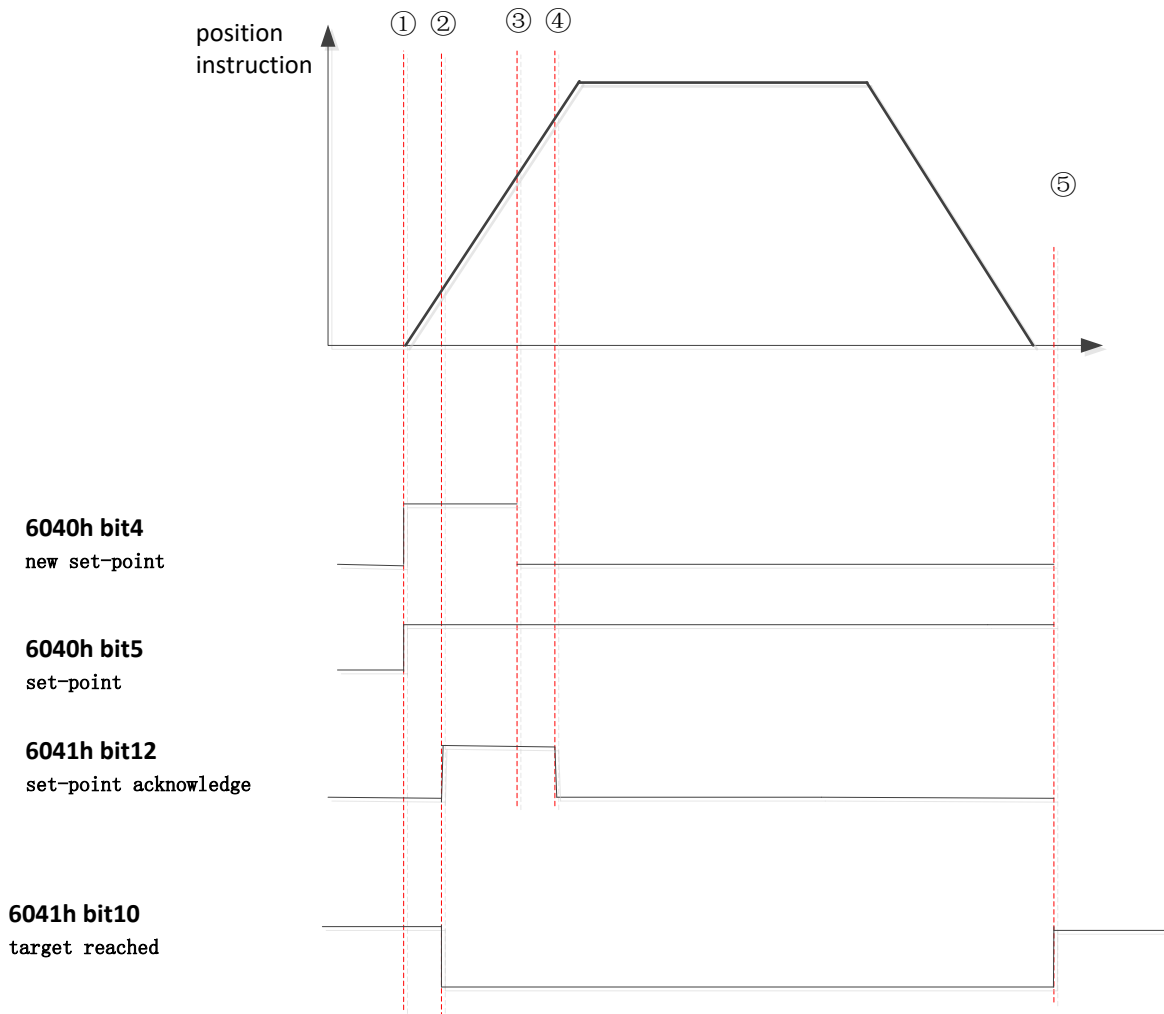
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6041h	00h	Status Word	0 ~ 65535	-	0	U16	rw	TxPDO	No
		Details of PP-specific bits in the status word are shown below.							

15~14	13	12	11	10	9~0
r	following error	set-point acknowledge	target reached	target reached	-

- ◆ r: reserved
- ◆ target reached: position reached
- ◆ following error: position deviation too large
- ◆ set-point acknowledge: The control word bit 4 (new-setpoint) is 0, and the buffer zone is empty while executing the current target position action (executing).

### 4.5.2.3 Detailed Operation Process of PP Mode

#### 4.5.2.3.1 Basic Set-point



Step 1. Master Station: After setting the value of 607Ah (Target Position), change bit 4 (new set-point) of 6040h (Control Word) from 0 to 1. Also, set 6081h (Profile Velocity). The motor will not move if 6081h (Profile Velocity)

is 0.

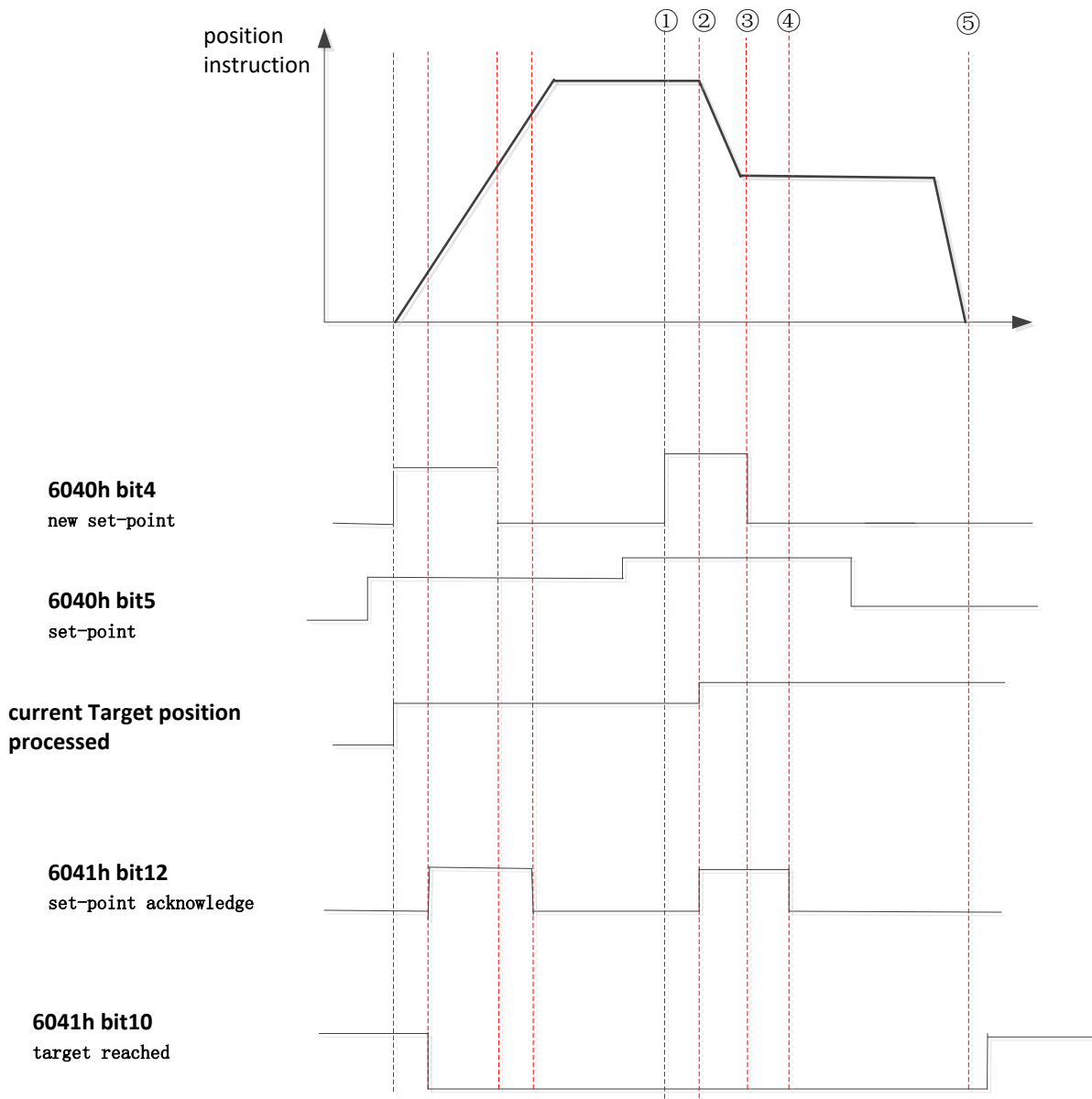
Step 2.Slave Station: Confirm the rising edge (0→1) of bit 4 (new set-point) of 6040h (Control Word). 607Ah (Target Position) starts positioning action as the target position. Bit 12 (set-point acknowledge) of 6041h (Status Word) changes from 0 to 1.

Step 3.Master Station: Confirm that bit 12 (set-point acknowledge) of 6041h (Status Word) has changed from 0 to 1, and bit 4 (new set-point) of 6040h (Control Word) returns to 0.

Step 4.Slave Station: Confirm that bit 4 (new set-point) of 6040h (Control Word) is 0, and bit 12 (set-point acknowledge) of 6041h (Status Word) changes to 0. When reaching the target position, bit 10 (target reached) of 6041h (Status Word) changes from 0 to 1.

### 4.5.2.3.2 Action Data Change without Buffering (single set-point)

When bit 5 (change set immediately) of 6040h (Control Word) is 1, any changes to the data for the positioning action in progress will interrupt the current positioning action and immediately start the next positioning action.



Step 1.Master Station: Confirm that bit 12 (set-point acknowledge) of 6041h (Status Word) is 0, then change the value of 607Ah (Target Position) and change bit 4 (new set-point) of 6040h (Control Word) from 0 to 1. Do not change acceleration and deceleration at this time.

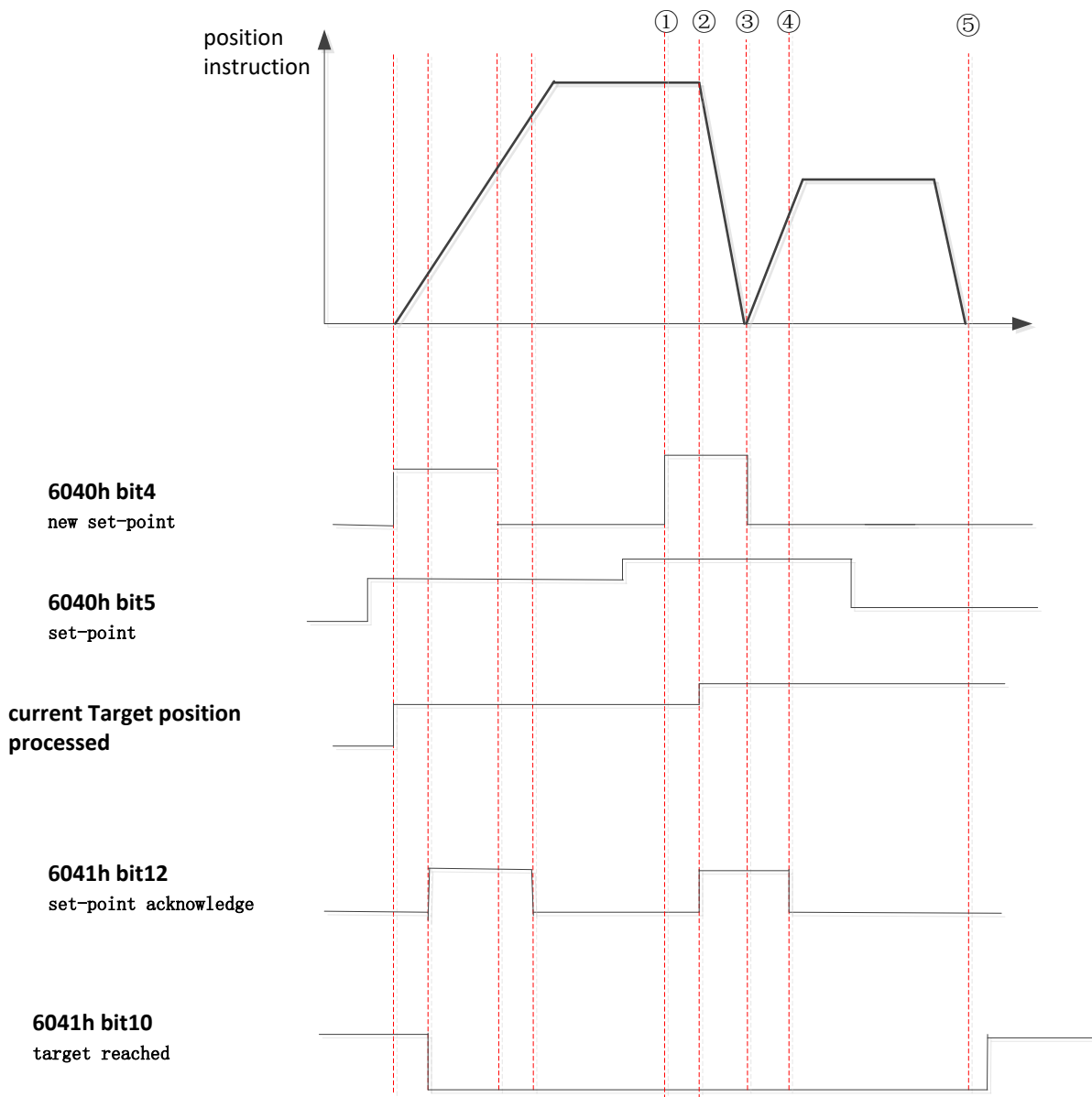
Step 2.Slave Station: Confirm the rising edge (0→1) of bit 4 (new set-point) of 6040h (Control Word). 607Ah (Target Position) is immediately updated as the new target position. Bit 12 (set-point acknowledge) of 6041h (Status Word) changes from 0 to 1.

Step 3.Master Station: Confirm that bit 12 (set-point acknowledge) of 6041h (Status Word) has changed from 0 to 1, and bit 4 (new set-point) of 6040h (Control Word) returns to 0.

Step 4.Slave Station: Confirm that bit 4 (new set-point) of 6040h (Control Word) is 0, and bit 12 (set-point acknowledge) of 6041h (Status Word) is 0.

**4.5.2.3.3 Action Data Change with Buffering (set of set-points)**

When bit 5 (change set immediately) of 6040h (Control Word) is 0, any changes to the data for the positioning action in progress will start the next positioning action after completing the current positioning action.



Step 1.Master Station: Confirm that bit 12 (set-point acknowledge) of 6041h (Status Word) is 0, then change the value of 607Ah (Target Position) and change bit 4 (new set-point) of 6040h (Control Word) from 0 to 1. Do not change acceleration and deceleration at this time.

Step 2.Slave Station: Confirm the rising edge (0→1) of bit 4 (new set-point) of 6040h (Control Word). 607Ah (Target Position) is buffered as the new target position. Bit 12 (set-point acknowledge) of 6041h (Status Word) changes from 0 to 1. Continue positioning action with the previous target position during this stage.

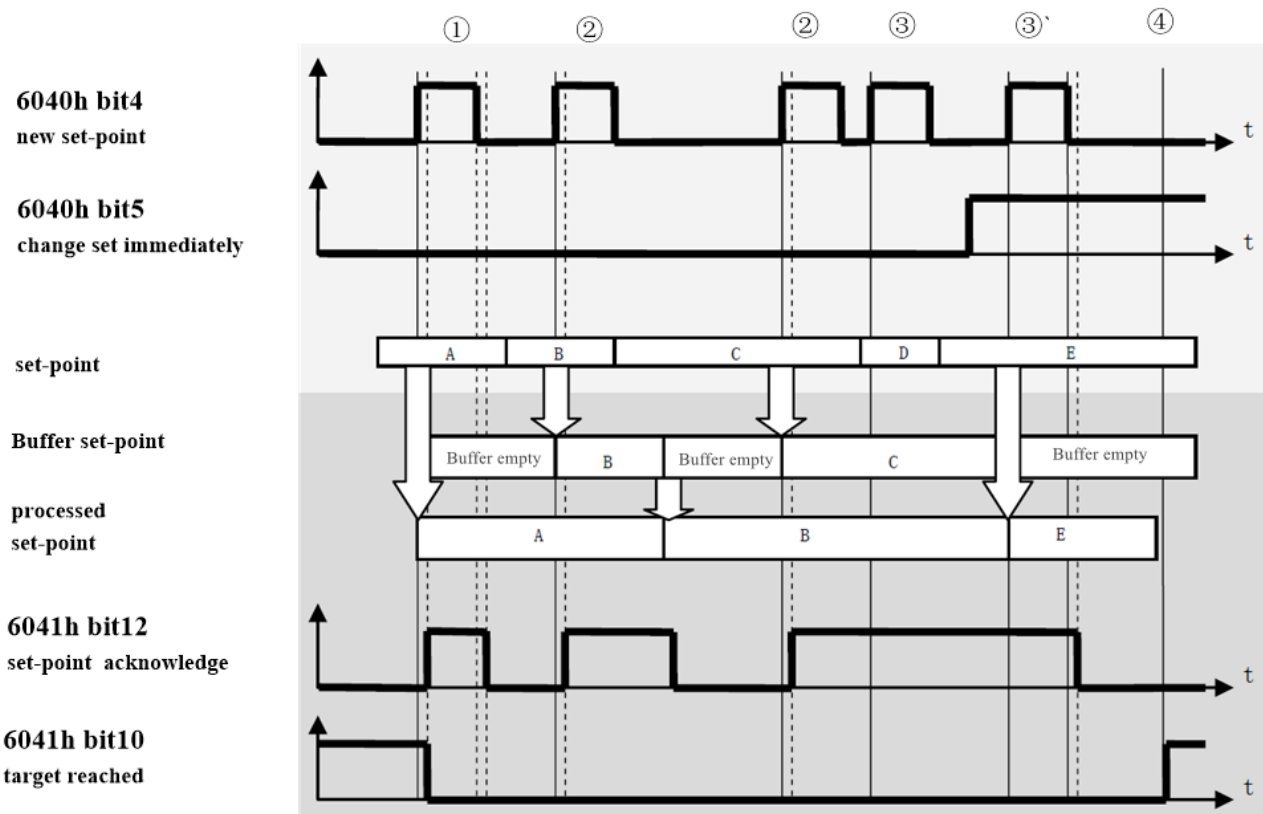
Step 3.Master Station: Confirm that bit 12 (set-point acknowledge) of 6041h (Status Word) has changed from 0 to 1, and bit 4 (new set-point) of 6040h (Control Word) returns to 0.

Step 4.Slave Station: Confirm that bit 4 (new set-point) of 6040h (Control Word) is 0. After completing the ongoing positioning action, start positioning action with the new target position. As the buffer is empty, bit 12 (set-point acknowledge) of 6041h (Status Word) is 0.

### 4.5.2.3.4 Buffering with Set-point

Set-points must take effect when the buffer zone is empty.

The set-point buffer is as shown below.



Step 1.If there is no set-point in execution, the new set-point (A) takes effect immediately.

Step 2.If a set-point is in execution, the new set-point is saved when the set-point buffer zone is empty.

Step 3.If the set-point buffer zone is in use, i.e., bit 12 (set-point acknowledge) of 6041h (Status Word) is 1, the update of the set-point buffer zone depends on bit 5 (change set immediately) of 6040h (Control Word). If bit 5 (change set immediately) of 6040h (Control Word) is not set to 1, the new set-point will not be processed and will be retained. If bit 5 (change set immediately) of 6040h (Control Word) is set to 1, the new set-point is processed immediately.

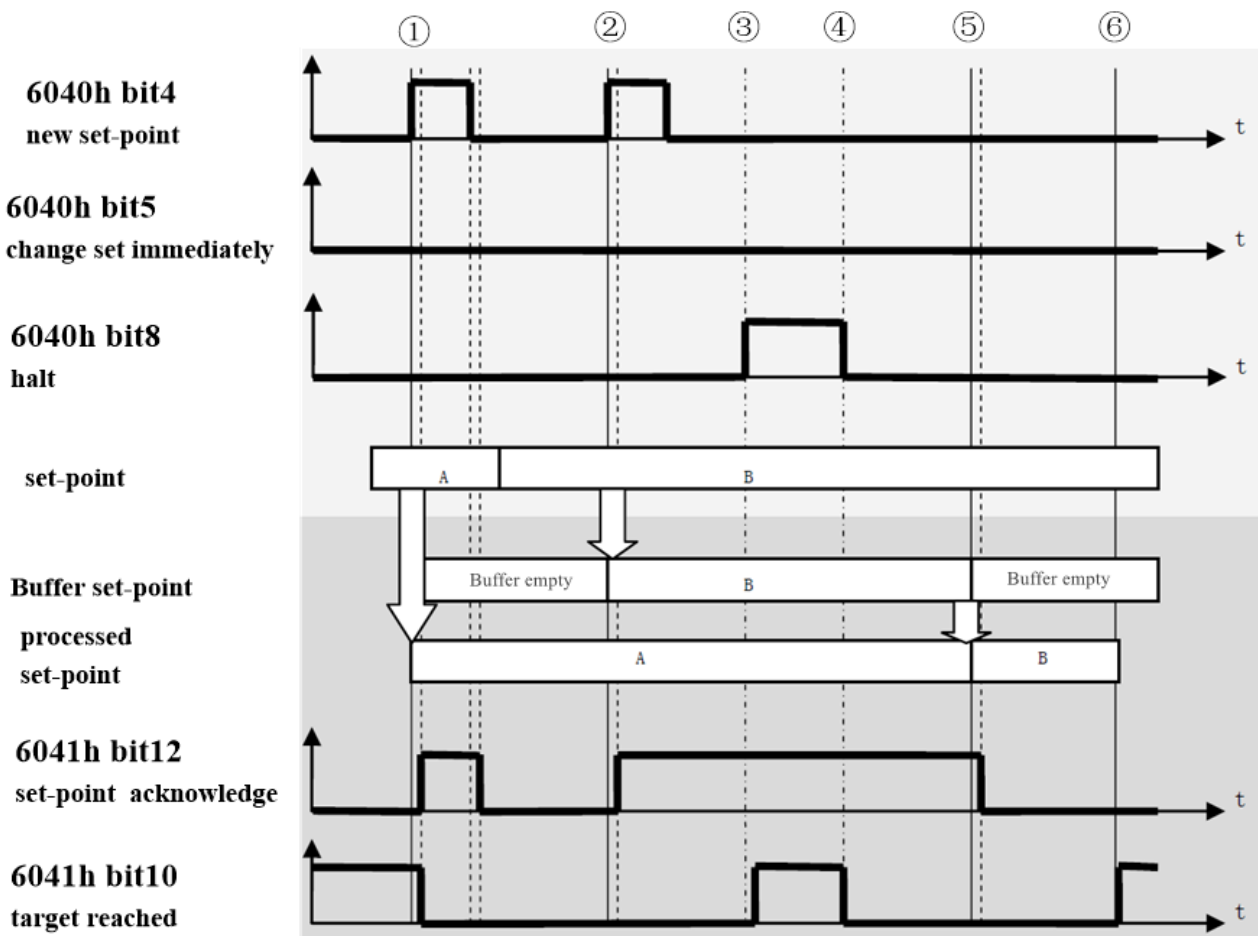
Step 4. At this time, all set-points previously stored before bit 5 (change set immediately) of 6040h (Control Word) is set to 1 are invalidated.

Step 5. Until all set-points are processed, bit 10 (target reached) of 6041h (Status Word) remains 0.

#### 4.5.2.3.5 Temporary Stop According to Halt

In PP action, if bit 8 (halt) of 6040h (Control Word) is 1, positioning operation is temporarily stopped. Positioning action resumes when bit 8 (halt) returns to 0.

The handshake of the set-point is as shown below.



Step 1. When there is no set-point in execution, the new set-point (A) takes effect immediately.

Step 2. If the set-point is in execution, and the new set-point (B) is saved when the set-point buffer zone is empty.

Step 3. If the first set-point (A) is in execution and bit 8 (halt) of 6040h (Control Word) is set to 1, the first set-point (A) is temporarily stopped. If the deceleration stop speed is 0, bit 10 (target reached) of 6041h (Status Word) changes to 1.

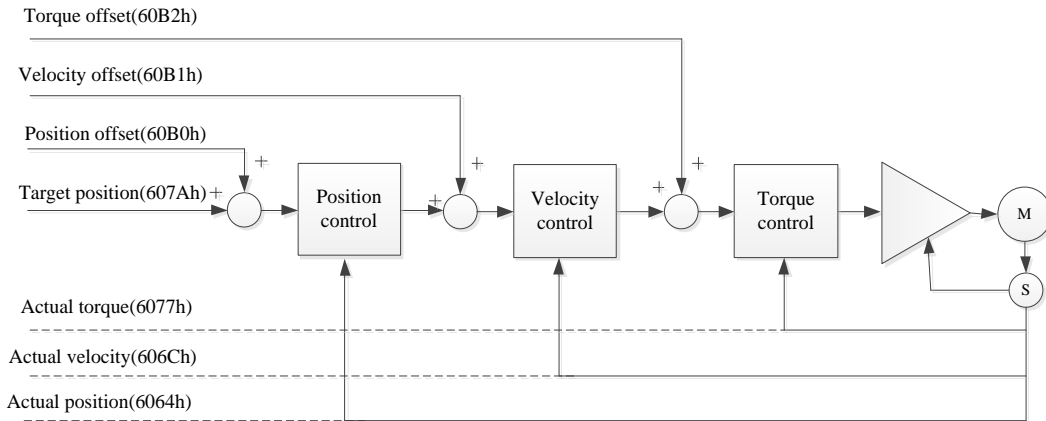
Step 4. Thereafter, when bit 8 (halt) of 6040h (Control Word) is set to 0, the action of the first set-point (A) resumes. Bit 10 (target reached) of 6041h (Status Word) changes to 0.

Step 5. When the action of the first set-point (A) is completed, the new set-point (B) is processed.

Step 6. Until all set-points are processed, bit 10 (target reached) of 6041h (Status Word) remains 0.

### 4.5.3 Cyclic Synchronous Position Mode (CSP Mode)

In CSP mode, the upper controller completes the position command planning and then periodically and synchronously sends the planned target position (607Ah) to the servo drive. Additionally, it can simultaneously send the calculated speed feedforward (60B1h) and torque feedforward (60B2h) to the servo drive. Use either DC or SM2 cyclic synchronous mode. The DC mode requires the communication cycle to be an integer multiple of 62.5 μs, with a maximum cycle of 10ms. The SM2 mode requires the communication cycle to be greater than 1ms and less than 10ms; otherwise, a communication cycle error will be triggered (error code Er.09.4).



associated object:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM
6040	00	Control Word	0~65535	-	0	U16	RW	RxPDO	No
6041	00	Status Word	-	-	0	U16	R	TxPDO	No
6060	00	Operation Mode	0~10	-	0	I8	RW	RxPDO	YES
6061	00	Mode Display	-	-	0	I8	R	TxPDO	No
6064	00	Position Feedback	-	Command Unit	-	I32	R	TxPDO	No
606C	00	Speed Feedback	-	Command Unit / s	-	I32	R	TxPDO	No
607A	00	Target Position	$-2^{31} \sim (2^{31}-1)$	Command Unit	0	I32	RW	RxPDO	Yes
607E	00	Command Polarity	0~255	-	0	U8	RW	RxPDO	Yes
60B0	00	Position Offset	$-2^{31} \sim (2^{31}-1)$	Command Unit	0	I32	RW	RxPDO	No

60B1	00	Speed Offset	$-2^{31} \sim (2^{31}-1)$	Command Unit / s	0	I32	RW	RxPDO	No
60B2	00	Torque Offset	-3000~3000	0.1%	0	I16	RW	RxPDO	No

### 4.5.3.1 CSP Mode Control Word

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																			
6040h	00h	Control Word	0~65535	-	0	U16	rw	RxPDO	No																			
		Details of the CSP mode control word bits are as follows: <table border="1" style="margin: 10px auto; width: 80%;"> <tr> <td>15~9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> </tr> <tr> <td>r</td> <td>h</td> <td>fr</td> <td>r</td> <td>r</td> <td>r</td> <td>eo</td> <td>qs</td> <td>ev</td> <td>so</td> </tr> </table> <ul style="list-style-type: none"> <li>◆ fr: fault reset</li> <li>◆ absolute/relative: choose absolute or relative positioning</li> <li>◆ eo: enable operation (mode-dependent bit)</li> <li>◆ qs: quick stop</li> <li>◆ h: halt</li> <li>◆ ev: enable voltage</li> <li>◆ so: switch on</li> <li>◆ r: not used in CSP mode</li> </ul>									15~9	8	7	6	5	4	3	2	1	0	r	h	fr	r	r	r	eo	qs
15~9	8	7	6	5	4	3	2	1	0																			
r	h	fr	r	r	r	eo	qs	ev	so																			

### 4.5.3.2 CSP Mode Status Word

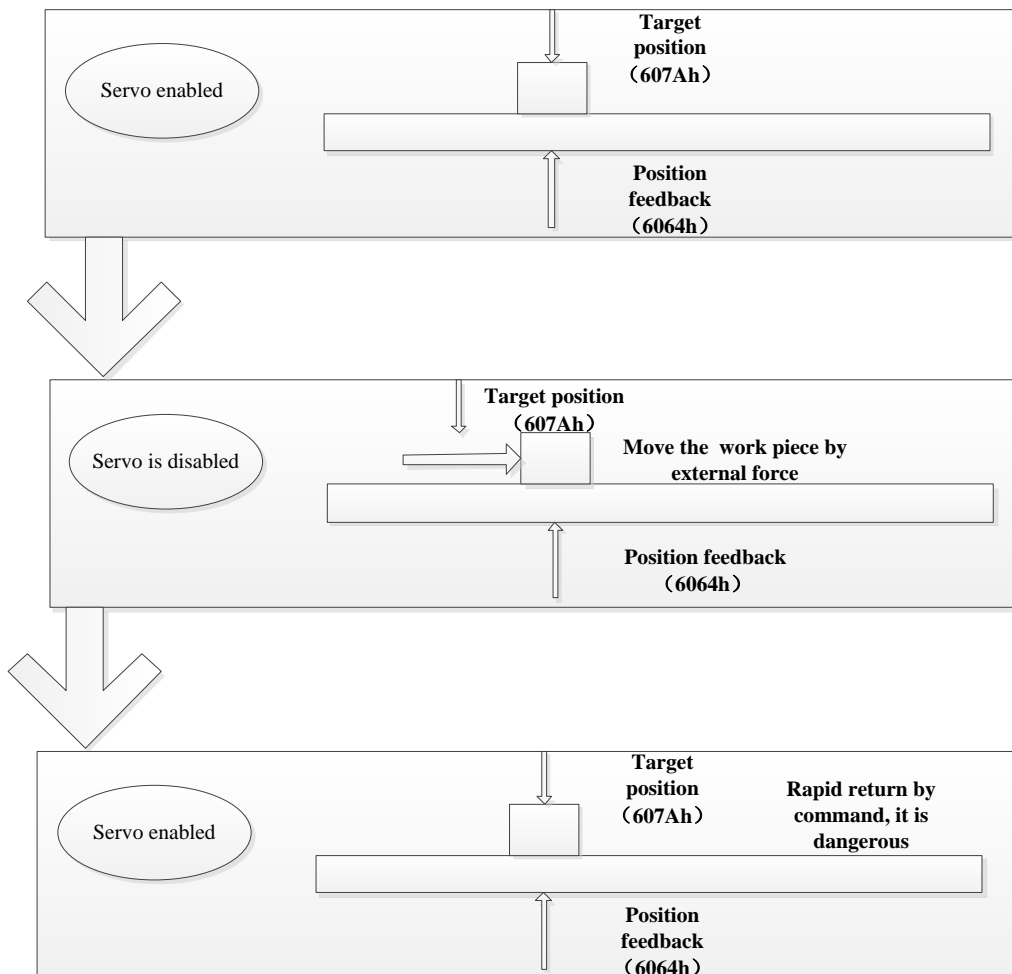
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																															
6041h		Status Word	0~65535	-	0	U16	rw	TxPDO	No																															
	00h	Details of the CSP mode status word bits are as follows: <table border="1" style="margin: 10px auto; width: 90%;"> <tr> <td>15</td> <td>14</td> <td>13</td> <td>12</td> <td>11</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <td>r</td> <td></td> <td>following error</td> <td>drive follows command value</td> <td>ila</td> <td>r</td> <td>rm</td> <td>r</td> <td>w</td> <td>sod</td> <td>qs</td> <td>ve</td> <td>f</td> <td>oe</td> <td>so</td> </tr> </table> <p style="margin-top: 10px;">                         r: reserved                          sod: switch on disabled                          ve: voltage enabled                          ila: internal limit active                          oe: operation enabled                          so: switched on                     </p> <p style="margin-top: 10px;">                         w: warning                          qs: quick stop                          f: fault                          rm: remote                          rtso: ready to switch on                     </p>									15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	r		following error	drive follows command value	ila	r	rm	r	w	sod	qs	ve	f	oe	so
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1																										
r		following error	drive follows command value	ila	r	rm	r	w	sod	qs	ve	f	oe	so																										

	following error: position offset error drive follows command value: always be 1
--	--

### 4.5.3.3 CSP Control Mode Actions

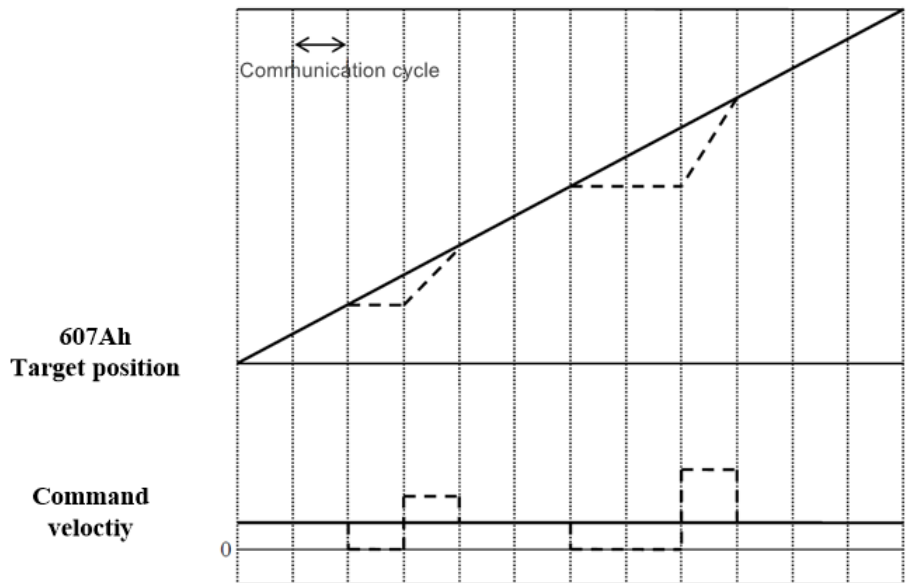
- ◆ In CSP mode, the action model (trajectory) is generated by the master station rather than the slave station.
- ◆ The position command is the sum of 607Ah (Target Position) and 60B0h (Position Offset), interpreted as an absolute position.
- ◆ The update of action commands (sending) should be input approximately 100 ms after the servo enable command (Operation enabled command) is issued.
- ◆ 60C2h (Synchronization Period) indicates the update period for the two objects, 607Ah (Target Position) and 60B0h (Position Offset). This value should be set to match the period defined in 1C32h-02h (Cycle Time). The upper device (master station) must ensure to update the target position via the period of 60C2h (Synchronization Period).
- ◆ When the servo enable is in the off state, the master station should ensure processing such that 607Ah + 60B0h = 6064h. If the motor moves under external force while the servo is disabled, it is dangerous to perform the input target position action upon the next servo enable. Furthermore, when switching from control modes other than CSP control mode to CSP control mode, follow-up processing should also be performed.

Anomalies: Master command process when servo is disabled(command position is not the actual position)



### 4.5.3.4 Compensation Handling During Communication Abnormalities

If communication abnormalities occur during operation and the 607Ah (Target Position) is not properly received, the driver will estimate the position that needs compensation and execute it. For DC mode, the FV5 series rotary EtherCAT bus type driver compensates for up to two consecutive lost instances. For SM mode, no compensation is currently provided. If there are lost instances causing significant speed fluctuations, use position command filtering with P03.06 and P03.07 to resolve the issue.



The dotted line is for the situation that not compensated, solid line is for the situation that is compensated

### 4.5.3.5 CSP Mode Command Protection Function

If the command speed exceeds P03.29 times the motor's maximum speed, the error "Er.04.8" will be reported. This situation can occur if 607Ah and 6064h are not aligned when the servo is enabled, if there is an issue with the 607Ah transmission during operation, or if there is a significant difference between the current and previous period's values. It can also occur if the given position command exceeds the software limit (607Dh) range.

If the command speed continuously exceeds the maximum speed for P03.29 cycles, the error "Er.04.9" will be reported. This can happen due to incorrect cycle settings or inaccurate clocks. It is recommended to use a DC clock to ensure the settings of 1C32h and 1C33h correspond to the actual clock.

## 4.5.4 Position Control in HM Mode (Homing Mode)

In Homing Mode (HM mode), the servo drive generates position commands internally to perform the homing action at a specified speed.

When using incremental mode, it is necessary to perform the homing action before executing any positioning operation after the driver is powered on and enabled.

Related Objects:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6040	00	Control Word	0~65535	-	0	U16	RW	RxPDO	No
6041	00	Status Word	-	-	0	U16	R	TxPDO	No
6060	00	Operation Mode	0~10	-	0	I8	RW	RxPDO	YES
6061	00	Modes of Operation Display	-	-	0	I8	R	TxPDO	No
6064	00	Position Feedback	-	Comm and Unit	-	I32	R	TxPDO	No
606C	00	Velocity Feedback	-	Comm and Unit / s	-	I32	R	TxPDO	No
607A	00	Target Position	$-2^{31} \sim (2^{31}-1)$	Comm and Unit	0	I32	RW	RxPDO	Yes
607E	00	Command Polarity	0~255	-	0	U8	RW	RxPDO	yes
60B0	00	Position Offset	$-2^{31} \sim (2^{31}-1)$	Comm and Unit	0	I32	RW	RxPDO	No
60B1	00	Velocity Offset	$-2^{31} \sim (2^{31}-1)$	Comm and Unit / s	0	I32	RW	RxPDO	No
60B2	00	Torque Offset	-3000~3000	0.1%	0	I16	RW	RxPDO	No
6098	00	Homing Mode	1~35	-	1	I8	RW	RxPDO	YES
6099	01	Homing Speed (high speed)	$10 \sim (2^{32}-1)$	Comm and Unit / s	0x00D555	U32	RW	-	YES
6099	02	Homing Speed (low speed)	$10 \sim (2^{32}-1)$	Comm and Unit / s	0x001555	U32	RW	-	YES
609A	00	Homing Accelerati	$0 \sim (2^{32}-1)$	Comm and	0x535555	U32	RW	-	YES

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		on		Unit / s <sup>2</sup>					
607C	00	Homing Offset	-2 <sup>31</sup> ~(2 <sup>31</sup> -1)	Command Unit	0	I32	RW	RxPDO	YES

#### 4.5.4.1 HM Mode Control Word

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																		
6040h	00h	Control Word	0 ~ 65535	-	0	U16	rw	RxPDO	No																		
		HM mode control word bit's detailed information: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>15~9</th> <th>8</th> <th>7</th> <th>6</th> <th>5</th> <th>4</th> <th>3</th> <th>2</th> <th>1</th> <th>0</th> </tr> </thead> <tbody> <tr> <td>r</td> <td>h</td> <td>fr</td> <td>r</td> <td>r</td> <td>start home</td> <td>eo</td> <td>qs</td> <td>ev</td> <td>so</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>◆ fr: fault reset</li> <li>◆ absolute/relative: choose absolute or relative positioning</li> <li>◆ eo: enable operation (mode-dependent bit)</li> <li>◆ qs: quick stop</li> <li>◆ h: halt</li> <li>◆ ev: enable voltage</li> <li>◆ so: switch on</li> </ul> <p>Start homing by setting bit4 (start homing) of 6040h (Control Word) to begin the homing action using the associated parameters (Homing method, speed, acceleration, etc.).</p> <p>Even if a new homing action is started during an ongoing homing action (by setting bit4 to 1 again), the new action will be ignored.</p>								15~9	8	7	6	5	4	3	2	1	0	r	h	fr	r	r	start home	eo	qs
15~9	8	7	6	5	4	3	2	1	0																		
r	h	fr	r	r	start home	eo	qs	ev	so																		

#### 4.5.4.2 HM Mode Status Word

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																															
6041h	00h	Status Word	0 ~ 65535	-	0	U16	rw	TxPDO	No																															
		HM mode status word bit's detailed information: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>15</th> <th>14</th> <th>13</th> <th>12</th> <th>11</th> <th>10</th> <th>9</th> <th>8</th> <th>7</th> <th>6</th> <th>5</th> <th>4</th> <th>3</th> <th>2</th> <th>1</th> <th>0</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>								15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																									

r	homing error	homing attained	ila	target reached	rm	r	w	sod	qs	ve	f	oe	so	rtso
---	--------------	-----------------	-----	----------------	----	---	---	-----	----	----	---	----	----	------

r: reserved  
sod: switch on disabled  
ve: voltage enabled  
ila: internal limit active  
oe: operation enabled  
so: switched on

w: warning  
qs: quick stop  
f: fault  
rm: remote  
rtso: ready to switch on

Refer to the table below for definitions of Bit13, Bit12, and Bit10:

bit	name	value	Definition
10	new-set-point	0	In motion
		1	Stopped
12	change set immediately	0	Homing action not completed
		1	Homing action completed without error
13	absolute/relative	0	No homing error detected (normal)
		1	Homing error detected

Refer to the table below for combinations of values of Bit13, Bit12, and Bit10:

bit13	bit12	bit10	Definition
0	0	0	Homing action in progress
0	0	1	Homing action interrupted or not started
0	1	0	Homing action completed but target not reached
0	1	1	Homing action completed successfully
1	0	0	Homing error detected, still in progress
1	0	1	Homing error detected, stopped

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6098h		Homing Method	-128 ~ 127	-	1	I8	rw	RxPDO	YES
	00h	Homing method settings:							
			<b>Value</b>	<b>Definition</b>					
			1	Run in the reverse direction until encounter the rising					

				edge of the negative limit signal, run forward until encounter the falling edge of the negative limit signal, run forward until encounter the Z signal.	
			2	Run forward until encounter the rising edge of the positive limit signal, run in the reverse direction until encounter the falling edge of the negative limit signal, run in reverse direction until encounter the Z signal.	
			3	Run forward until encounter the rising edge of the home signal, run in the reverse direction until encounter the falling edge of the home signal, run in the reverse direction until encounter the Z signal.	
			4	Run forward until encounter the rising edge of the home signal, run in the reverse direction until encounter the falling edge of the home signal, run forward until encounter the Z signal.	
			5	Run in the reverse direction until encounter the rising edge of the home signal, run forward until encounter the falling edge of the home signal, run in the reverse direction until encounter Z signal.	
			6	Run in the reverse direction until encounter the rising edge of home signal, run forward until encounter the falling edge of home signal, run forward until encounter Z signal.	
			7	1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed). 2.Run in the reverse direction until encounter the falling edge of home switch (on the same side). 3.Run in the reverse direction until encounter Z signal. or: 1.Run forward until encounter the rising edge of Positive limit switch. 2.Run in reverse direction until encounter the rising edge of home switch(switch from high speed to low speed). 3.Run in the reverse direction until encounter the falling edge of home switch. 4.Run in the reverse direction until encounter Z signal.	
			8	1.Run forward until encounter the rising edge of home switch (switch from high speed to low speed). 2.Run in the reverse direction until the falling edge of home switch(on the same side). 3.Run forward until encounter the rising edge of home switch.	

				<p>4.Run forward until encounter Z signal.</p> <p>or:</p> <p>1.Run forward until encounter the rising edge of positive limit switch.</p> <p>2.Run in the reverse direction until the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter the rising edge of home switch.</p> <p>5.Run in the reverse direction until encounter Z signal.</p>	
			9	<p>1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch (on the opposite side).</p> <p>3.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>4.Run in the reverse direction until encounter Z signal.</p> <p>Or:</p> <p>1.Run forward until encounter the rising edge of positive limit switch.</p> <p>2.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>5.Run in the reverse direction until encounter Z signal.</p>	
			10	<p>1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch on the opposite side.</p> <p>3.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>4.Run forward until encounter the falling edge of home switch.</p> <p>5.Run forward until encounter Z signal.</p> <p>Or:</p> <p>1.Run forward until encounter the rising edge of positive limit switch.</p> <p>2.Run in the reverse direction until encounter the rising</p>	

				<p>edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>5.Run forward until encounter the falling edge of home switch.</p> <p>6.Run forward until encounter Z signal.</p>	
			11	<p>1.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch on the same side.</p> <p>3.Run forward until encounter Z signal.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter Z signal.</p>	
			12	<p>1.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch on the same side.</p> <p>3.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>4.Run in the reverse direction until encounter Z signal.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch. .</p> <p>2.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>5.Run in the reverse direction until encounter Z signal.</p>	

			13	<p>1.Run in the reverse direct until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run in the reverse direction until encounter the falling edge of home switch on the opposite side.</p> <p>3.Run forward until encounter the rising edge of home switch.</p> <p>4.Run forward until encounter Z signal.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter the rising edge of home switch.</p> <p>5.Run forward until encounter Z signal.</p>	
			14	<p>1.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run in the reverse direction until encounter the falling edge of home switch on the opposite side.</p> <p>3.Run forward until encounter the rising edge of home switch.</p> <p>4.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>5.Run in the reverse direction until encounter Z signal.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter the rising edge of home switch.</p> <p>5.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>6.Run in the reverse direction until encounter Z signal.</p>	
			15~16	NA	

			17	Run in the reverse direction until encounter the rising edge of negative limit switch, run forward until encounter the falling edge of negative limit switch.	
			18	Run forward until encounter the rising edge of positive limit switch, run in the reverse direction until encounter the falling edge of positive limit switch.	
			19	Run forward until encounter the rising edge of home switch, run in the reverse direction until encounter the falling edge of home switch.	
			20	Run forward until encounter the rising edge of home switch, run in the reverse direction until encounter falling edge of home switch, run forward until encounter the rising edge of home switch.	
			21	Run in the reverse direction until encounter the rising edge of home switch, run forward until encounter the falling edge of home switch.	
			22	Run in the reverse direction until encounter the rising edge of home switch, run forward until encounter the falling edge of home switch, run in the reverse direction until encounter the rising edge of home switch.	
			23	1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed). 2.Run in the reverse direction until encounter the falling edge of home switch on the same side. Or: 1.Run forward until encounter the rising edge of positive limit switch. 2.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed). 3.Run in the reverse direction until encounter the falling edge of home switch.	
			24	1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed). 2.Run in the reverse direction until encounter the falling edge of home switch on the same side. 3.Run forward until encounter the rising edge of home switch. Or: 1.Run forward until encounter the rising edge of positive limit switch. 2.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low	

				<p>speed).</p> <p>3.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter the rising edge of home switch.</p>	
			25	<p>1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch on the opposite side.</p> <p>3.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>Or:</p> <p>1.Run forward until encounter the rising edge of positive limit switch.</p> <p>2.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run in the reverse direction until encounter the rising edge of home switch.</p>	
			26	<p>1.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch on the opposite side.</p> <p>3.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>4.Run forward until encounter the falling edge of home switch.</p> <p>Or:</p> <p>1.Run forward until encounter the rising edge of positive limit switch.</p> <p>2.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>5.Run forward until encounter the falling edge of home switch.</p>	
			27	<p>1.Run in the reverse direction until encounter the rising edge of home switch (switch from high speed to low</p>	

			<p>speed).</p> <p>2.Run forward until encounter the falling edge of home switch.</p> <p>Or</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p>	
		28	<p>1.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run forward until encounter the falling edge of home switch.</p> <p>3.Run in the reverse direction until encounter the rising edge of home switch.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch (switch from high speed to low speed).</p> <p>3.Run forward until encounter the falling edge of home switch.</p> <p>4.Run in the reverse direction until encounter the rising edge of home switch.</p>	
		29	<p>1.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>2.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>3.Run forward until encounter the rising edge of home switch.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch(switch from high speed to low speed).</p> <p>3.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter the rising edge of home switch.</p>	
		30	<p>1.Run in the reverse direction until encounter the rising edge of home switch(switch from high speed to low</p>	

				<p>speed).</p> <p>2.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>3.Run forward until encounter the rising edge of home switch.</p> <p>4.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>Or:</p> <p>1.Run in the reverse direction until encounter the rising edge of negative limit switch.</p> <p>2.Run forward until encounter the rising edge of home switch (switch from high speed to low speed).</p> <p>3.Run in the reverse direction until encounter the falling edge of home switch.</p> <p>4.Run forward until encounter the rising edge of home switch.</p> <p>5.Run in the reverse direction until encounter the falling edge of home switch.</p>	
			33	Reverse , the motor Z signal as the home position.	
			34	Forward, the motor Z signal as the home position.	
			35	The current position as the home position	
			-1	Run in the reverse direction until hit the hard limit , run forward until encounter Z signal	
			-2	Run forward until hit the hard limit, run in the reverse direction until encounter Z signal	
			-3	Go straight back to the home position using absolute position mode	
			-4	Run in the reverse direction until hit the hard limit, back off a fixed distance	
			-5	Run forward until hit the hard limit, back off a fixed distance	

6098h (Homing Method) Beyond the corresponding set value, if it is Homing Operation Start, Homing error (6041h (Status Word) bit13) is set to 1.

Switching the homing method is not possible while executing the homing position control mode (HM). If switching is required, please do so when the motor is stopped (HM not executing).

Homing Speed (6099h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6099h	-	Homing Speed	-	-	-	-	-	-	-

		Set the speed for homing position control mode (HM).							
	00h	Supported Subindex Number	-	-	2	U8	R	-	No
		Indicates the number of Sub-Indexes of 6099h (Homing speeds).							
	01h	Speed before reaching the deceleration point	0 ~ 4294967295	Command unit / s	0x00D55555	U32	rw	RxPDO	YES
		Set the speed before reaching the deceleration point. The maximum value is limited by the motor's maximum internal processing speed and the lower of 2147483647.							
		Speed to the origin detection position	0 ~ 4294967295	Command unit / s	0x00155555	U32	rw	RxPDO	YES
	02h	Set the speed to the origin detection position. If the edge of the deceleration point is used as the origin detection position, set the value as small as possible to reduce detection error. The maximum value is limited by the motor's maximum internal processing speed at 6080h and the lower of 2147483647.							

For details on the running speed of each homing method, refer to the description of each Homing method.

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
609Ah		Homing Acceleration	0~4294967295	Command unit / s <sup>2</sup>	0x53555555	U32	rw	RxPDO	YES
	00h	Set the acceleration and deceleration for the homing position control mode (HM). The deceleration of the homing position control mode (HM) is also used for this object.  The setting of this object is not required when stopping at the final position (origin detection position) during each homing method; servo lock stops. If set to 0, internal processing handles it as 1.							

### 4.5.4.3 Error Alarm During Homing Action

Homing timeout alarm: When the homing start is initiated and the homing operation is not completed within the time set by P03.35, an alarm (error code Er.05.4) occurs. If the timeout signal is not found, check the origin signal through U00.01 (whether the limit signal is correct), and verify the DI function settings.

DI signal error: When two of the origin signal, positive limit, and negative limit are simultaneously active, an alarm (error code Er.05.A) occurs. Check if the signal wiring is correct.

When an unsupported homing mode is set, an alarm (error code Er.0C.3) occurs, and 6098h can be reset.

When the 607Ch homing offset is set outside the specified soft limit range of 607Dh, an alarm (error code Er.06.A) occurs.

#### 4.5.4.4 Supported Homing Modes (60E3h)

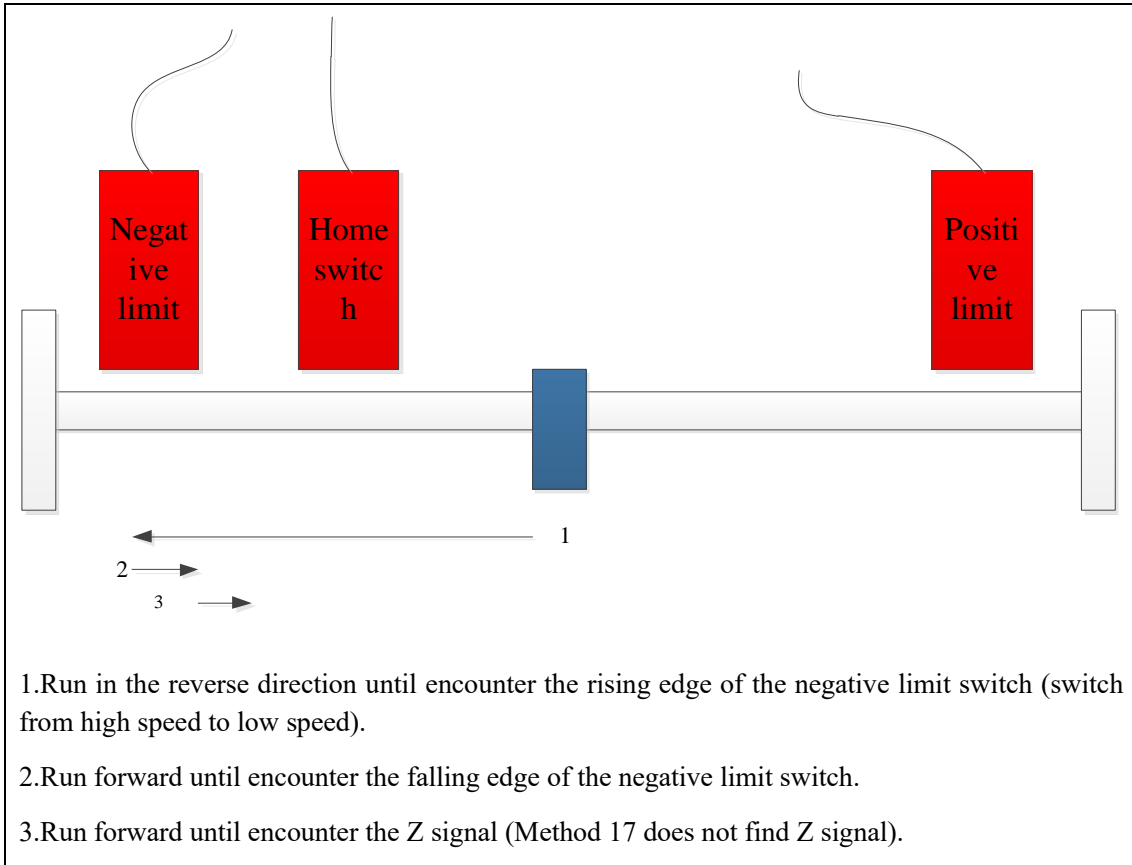
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM	
60E3h	-	Supported Homing Modes	-	-	-	-	-	-	-	
	Represents the supported homing modes									
	00h	Number of supported homing modes	0 ~ 65535	-	0	U8	R	No	No	
	Represents the number of supported homing methods of 60E3h									
	01h	1st supported homing method	0 ~ 65535	-	0	U16	R	No	No	
	Represents the first supported homing method									
	...	...								
	20h	32nd supported homing method	0 ~ 65535	-	0	U16	R	No	No	
Represents the 32nd supported homing method.。										

#### 4.5.4.5 Control Mode Actions (Homing Actions)

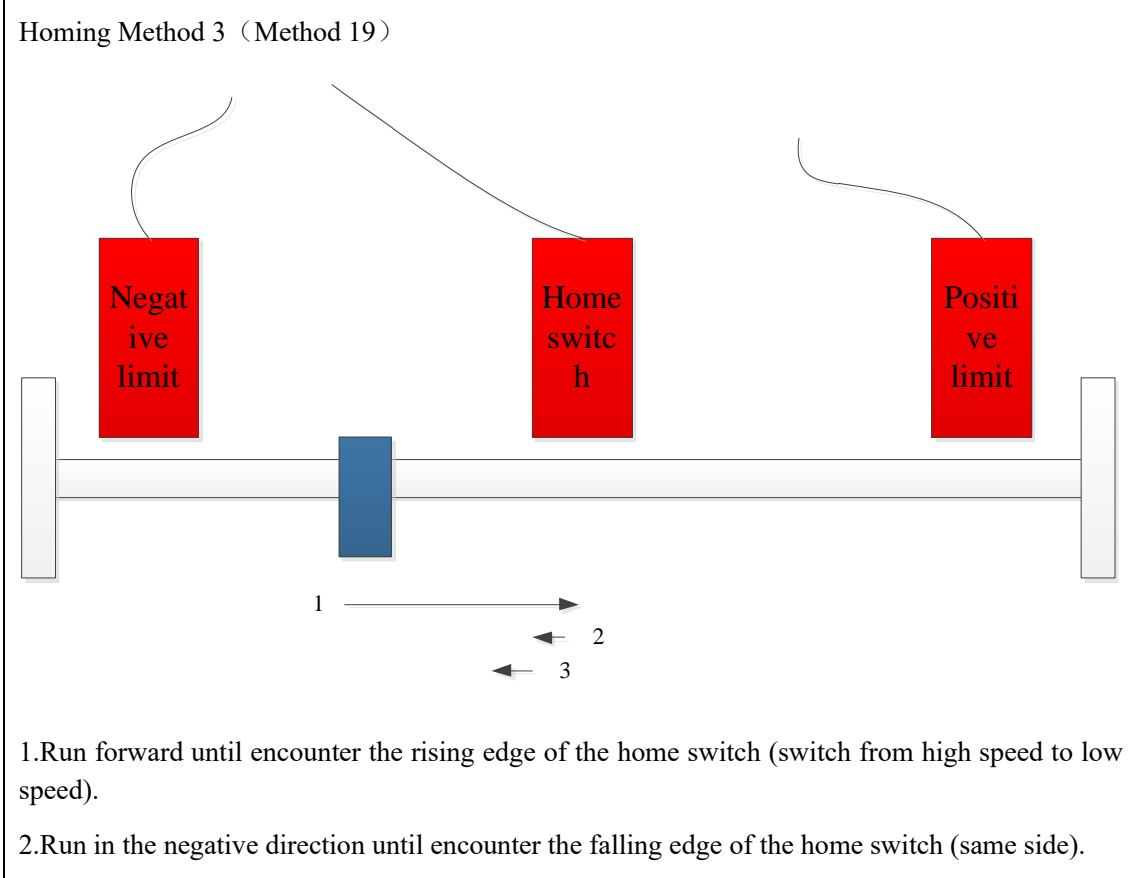
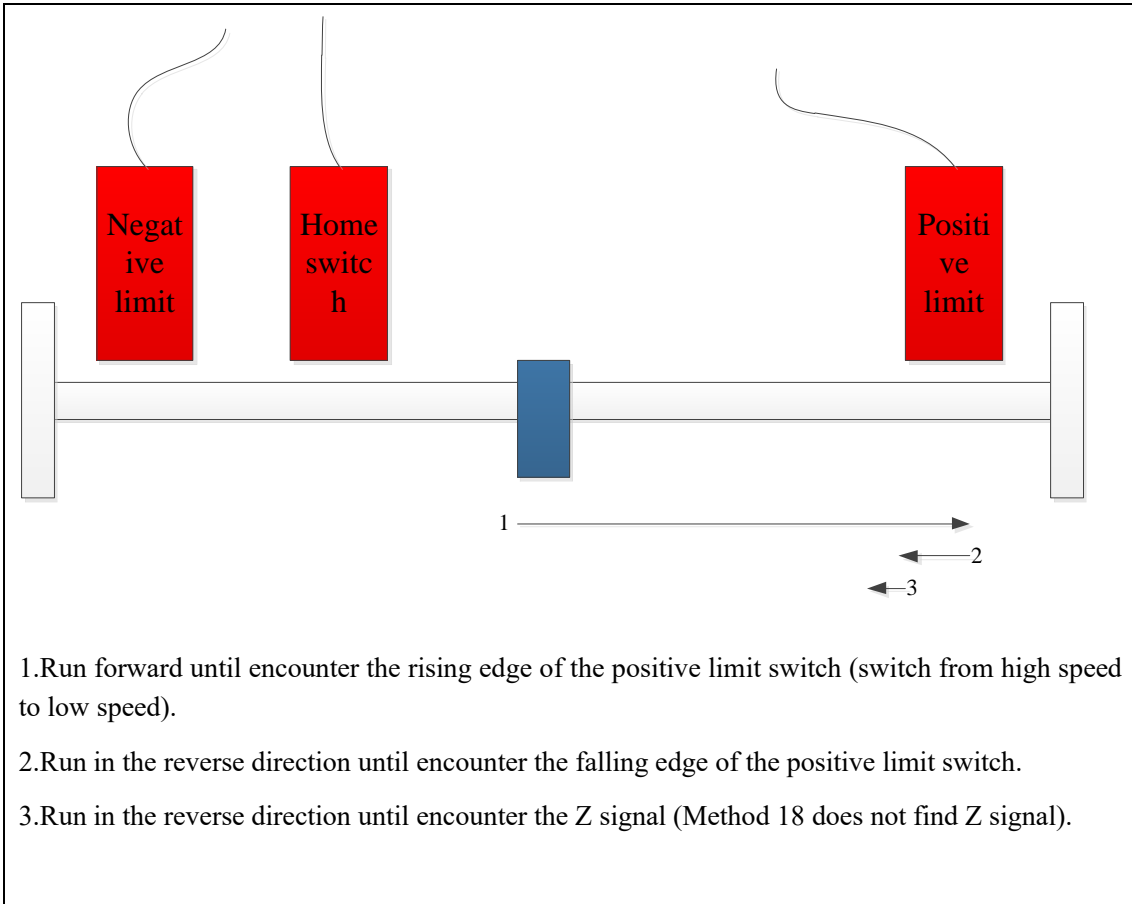
When used in incremental mode, execute the homing action to fix the initial position. After detecting the origin position, this position serves as the reference position. If homing is performed, the position information is initialized (preset). Therefore, data based on the old position information (such as Probe position) needs to be obtained again.

Whether 607Ch (Homing offset) changes or not during the homing action does not reflect on the executing homing action. It will be reflected in the next homing action (position information initialization upon completion).

Homing Method 1 (Method 17)



Homing Method 2 (Method18)



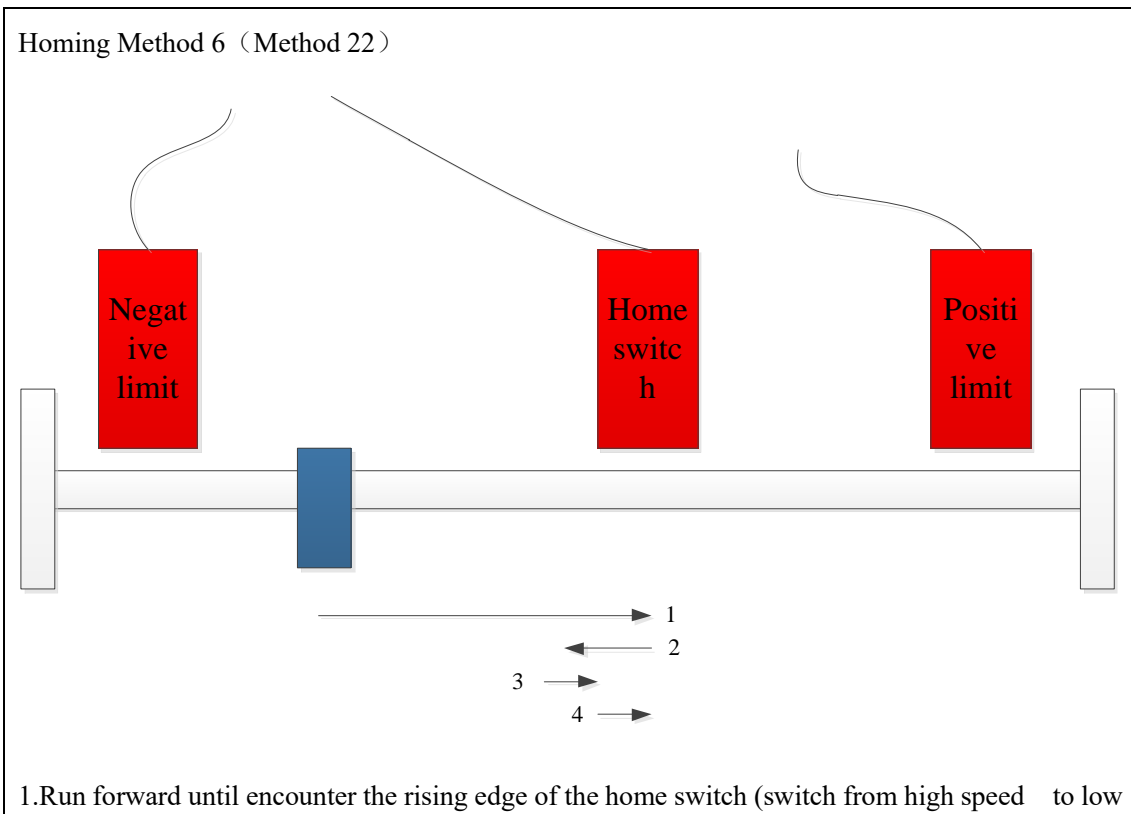
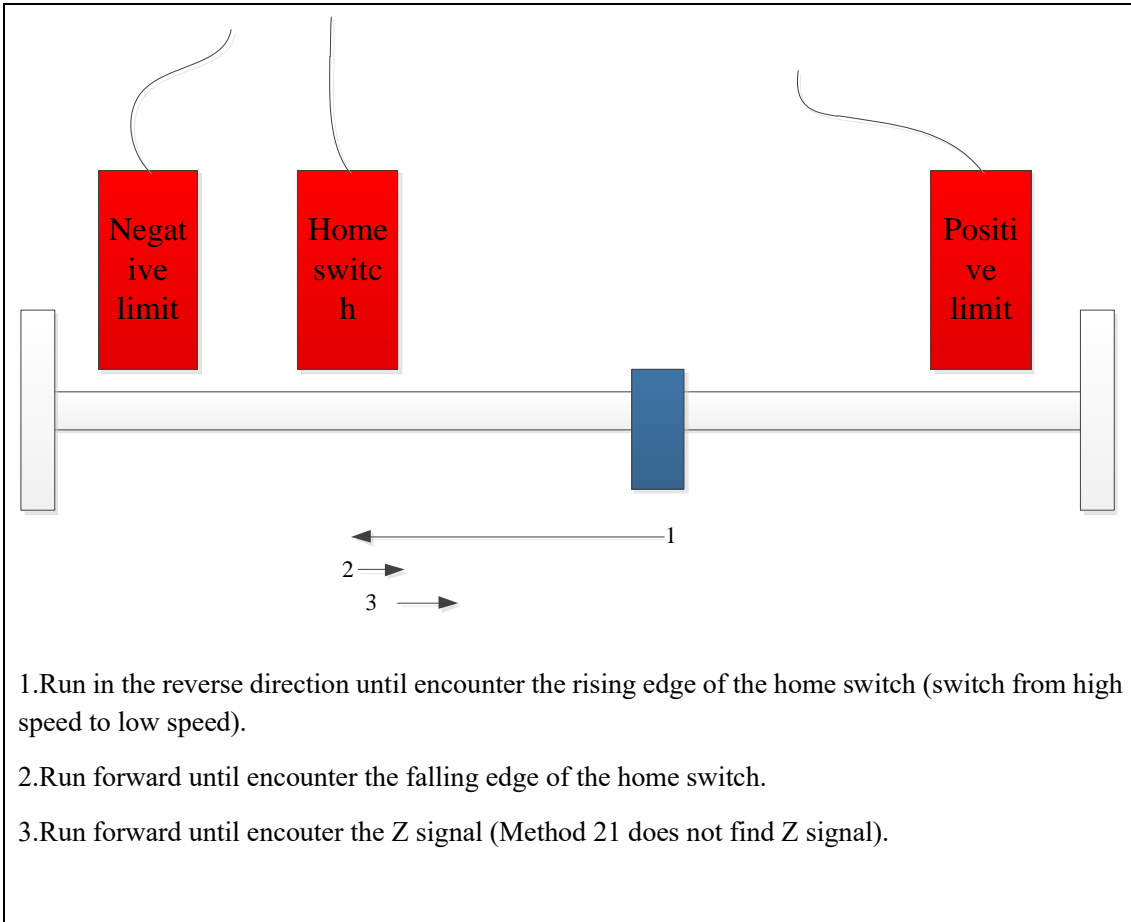
3.Run in the reverse direction until encounter the Z signal (Method 19 does not find Z signal).

Homing Method 4 (Method 20)

The diagram illustrates the homing process for Method 4. A horizontal rail is shown with a motor (blue rectangle) in the center. On the left end of the rail is a vertical bar labeled 'Negative limit'. On the right end is a vertical bar labeled 'Positive limit'. A red rectangle labeled 'Home switch' is positioned on the rail to the right of the motor. Four numbered arrows indicate the sequence: 1. Forward arrow from the motor to the home switch; 2. Reverse arrow from the home switch back to the motor; 3. Forward arrow from the motor to the home switch; 4. Forward arrow from the motor towards the positive limit.

- 1.Run forward until encounter the rising edge of the home switch (switch from high speed to low speed).
- 2.Run in the reverse direction until encounter the falling edge of the home switch .
- 3.Run froward until encounter the rising edge of the home switch.
- 4.Run forward until encounter the Z signal (Method 20 does not find Z signal).

Homing Method 5 (Method 21)



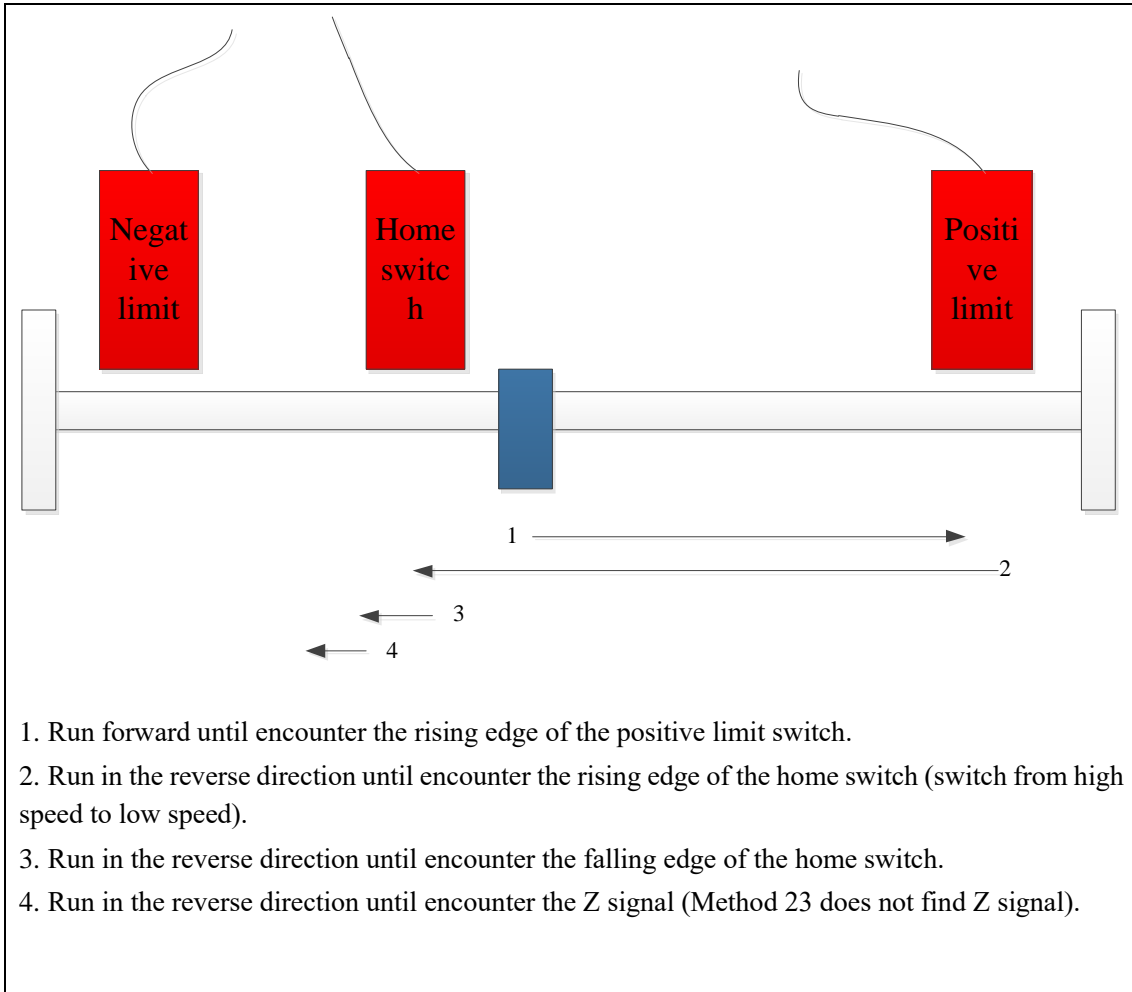
- speed).
- 2.Run in the reverse direction until encounter the falling edge of the home switch.
  - 3.Run forward until encounter the rising edge of the home switch.
  - 4.Run forward until encounter the Z signal (Method 22 does not find Z signal).

Homing Method 7(Method 23)

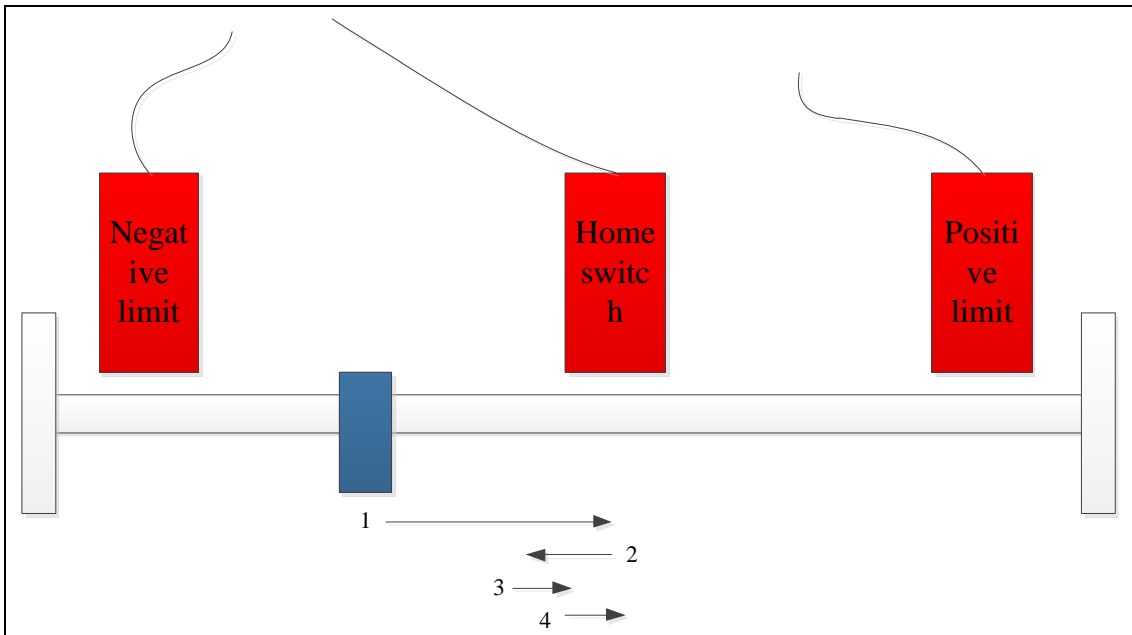
The diagram illustrates the homing process for Method 7 (Method 23). It shows a horizontal shaft with a blue rectangular home switch in the center. To the left of the home switch is a red box labeled 'Negative limit', and to the right is a red box labeled 'Positive limit'. Three arrows indicate the homing sequence: arrow 1 points right towards the home switch; arrow 2 points left away from the home switch; arrow 3 points left towards the negative limit.

- 1.Run forward until encounter the rising edge of the home switch (switch from high speed to low speed).
- 2.Run in the reverse direction until encounter the falling edge of the home switch.
- 3.Run in the reverse direction until encounter the Z signal (Method 23 does not find Z signal).

or

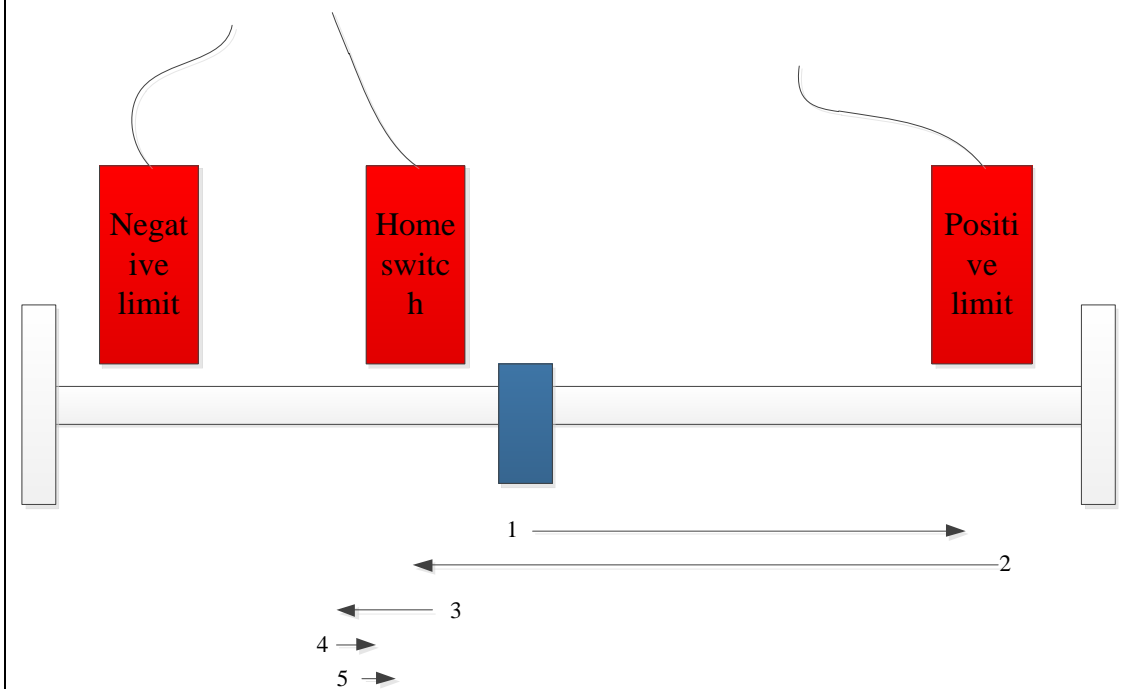


Homing Method 8 (Method 24)



- 1.Run forward until encounter the rising edge of the home switch (switch from high speed to low speed).
- 2.Run in the reverse direction until encounter the falling edge of the home switch.
- 3.Run forward until encounter the rising edge of the home switch.
- 4.Run in the reverse direction until encounter the Z signal (Method 24 does not find Z signal).

or



- 1.Run forward until encounter the rising edge of the positive limit switch.
- 2.Run in the reverse direction until encounter the rising edge of the home switch (switch from high

speed to low speed).

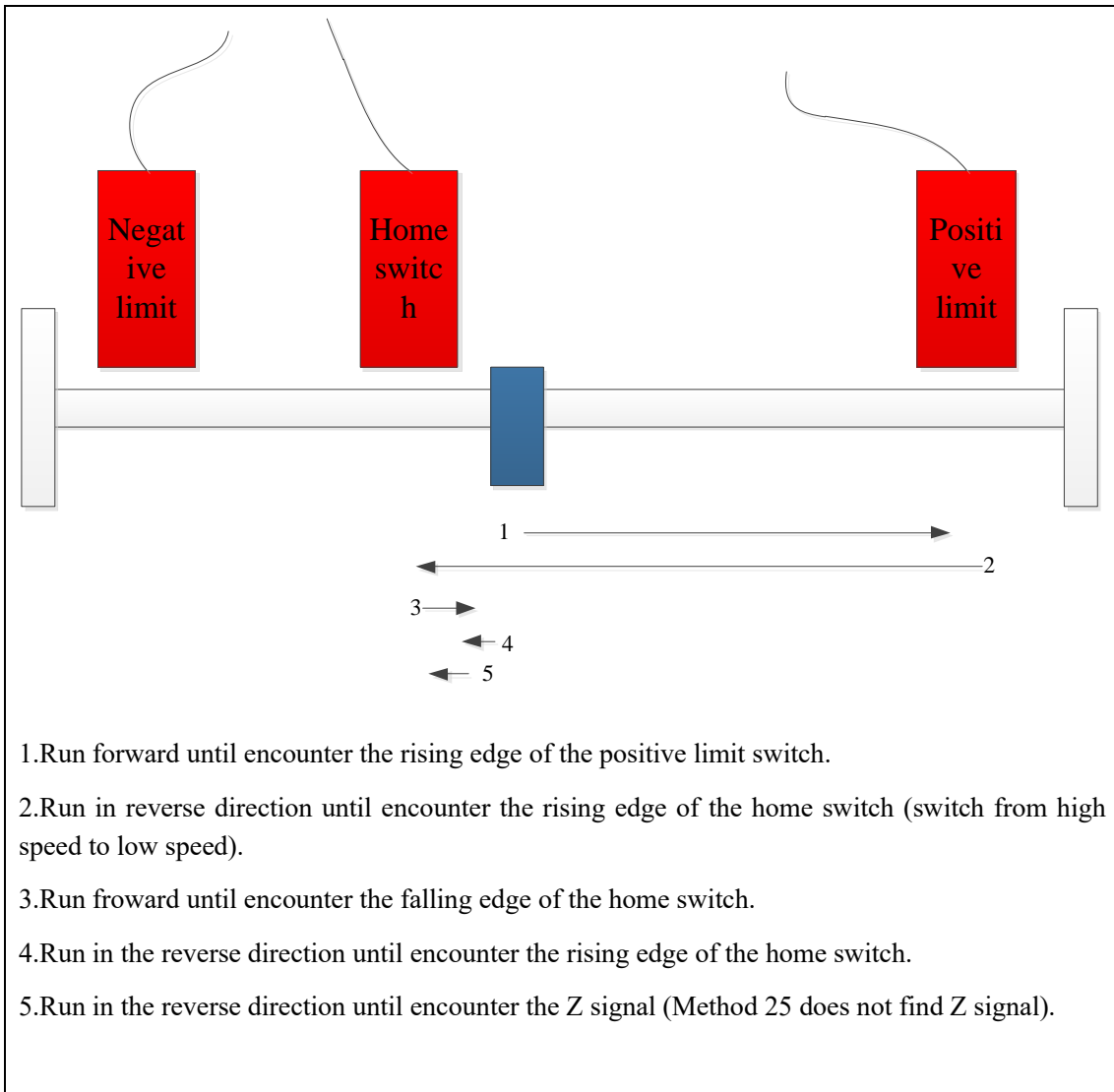
- 3.Run in the reverse direction until encounter the falling edge of the home switch.
- 4.Run forward until encounter the rising edge of the home switch.
- 5.Run forward until encounter the Z signal (Method 24 does not find Z signal).

Homing Method 9 (Method 25)

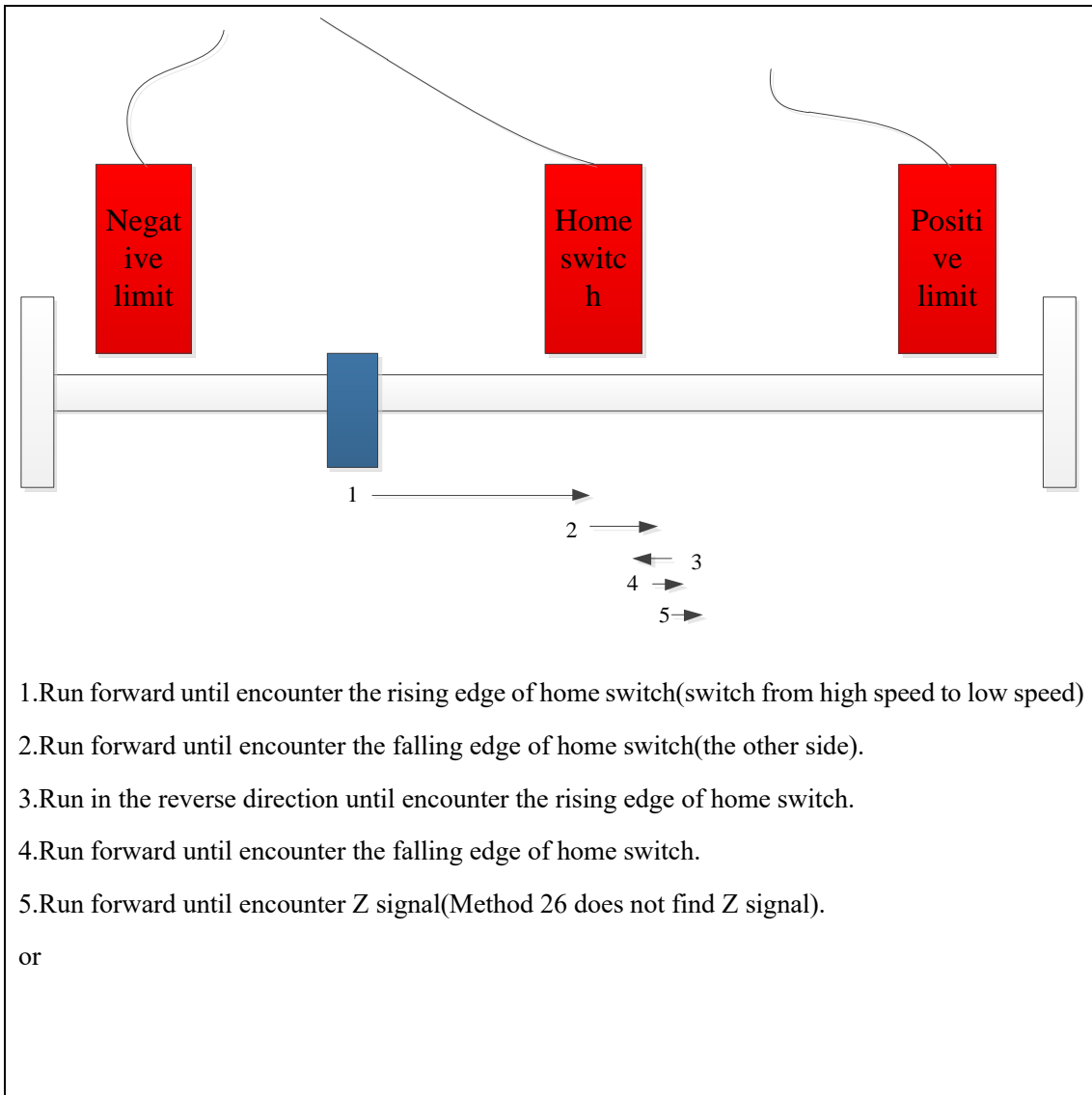
The diagram illustrates the homing process on a linear rail. A blue rectangular block representing the motor is positioned between the 'Negative limit' and 'Home Switch' markers. The rail is bounded by 'Negative limit' and 'Positive limit' markers. The sequence of steps is shown with numbered arrows: 1. Forward movement to the rising edge of the Home Switch; 2. Forward movement to the falling edge of the Home Switch; 3. Reverse movement to the rising edge of the Home Switch; 4. Reverse movement to the Z signal.

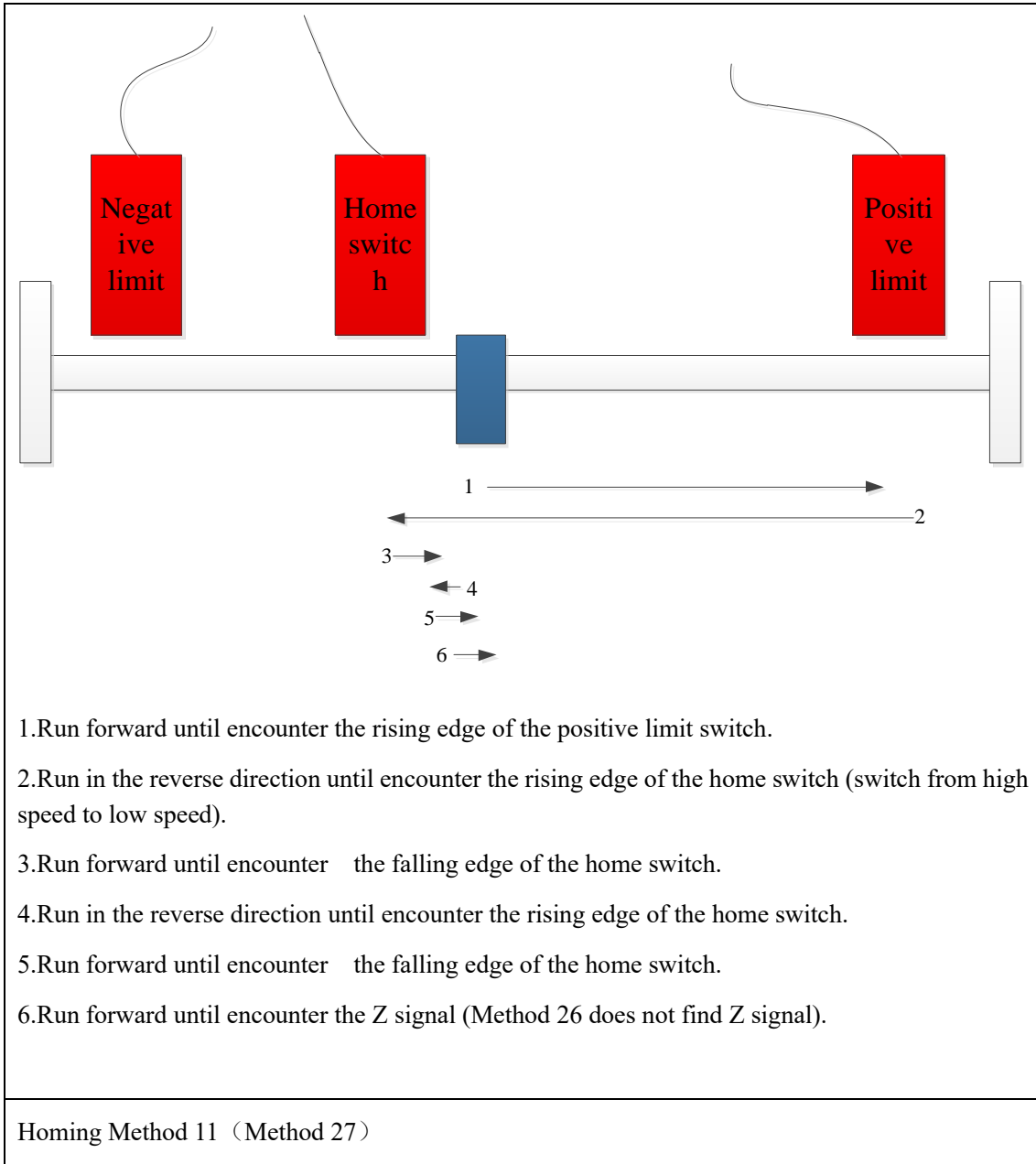
- 1.Run forward until encounter the rising edge of the home switch (switch from high speed to low speed).
- 2.Run forward until encounter the falling edge of the home switch.
- 3.Run in the reverse direction until encounter the rising edge of the home switch.
- 4.Run in the reverse direction until encounter the Z signal (Method 25 does not find Z signal).

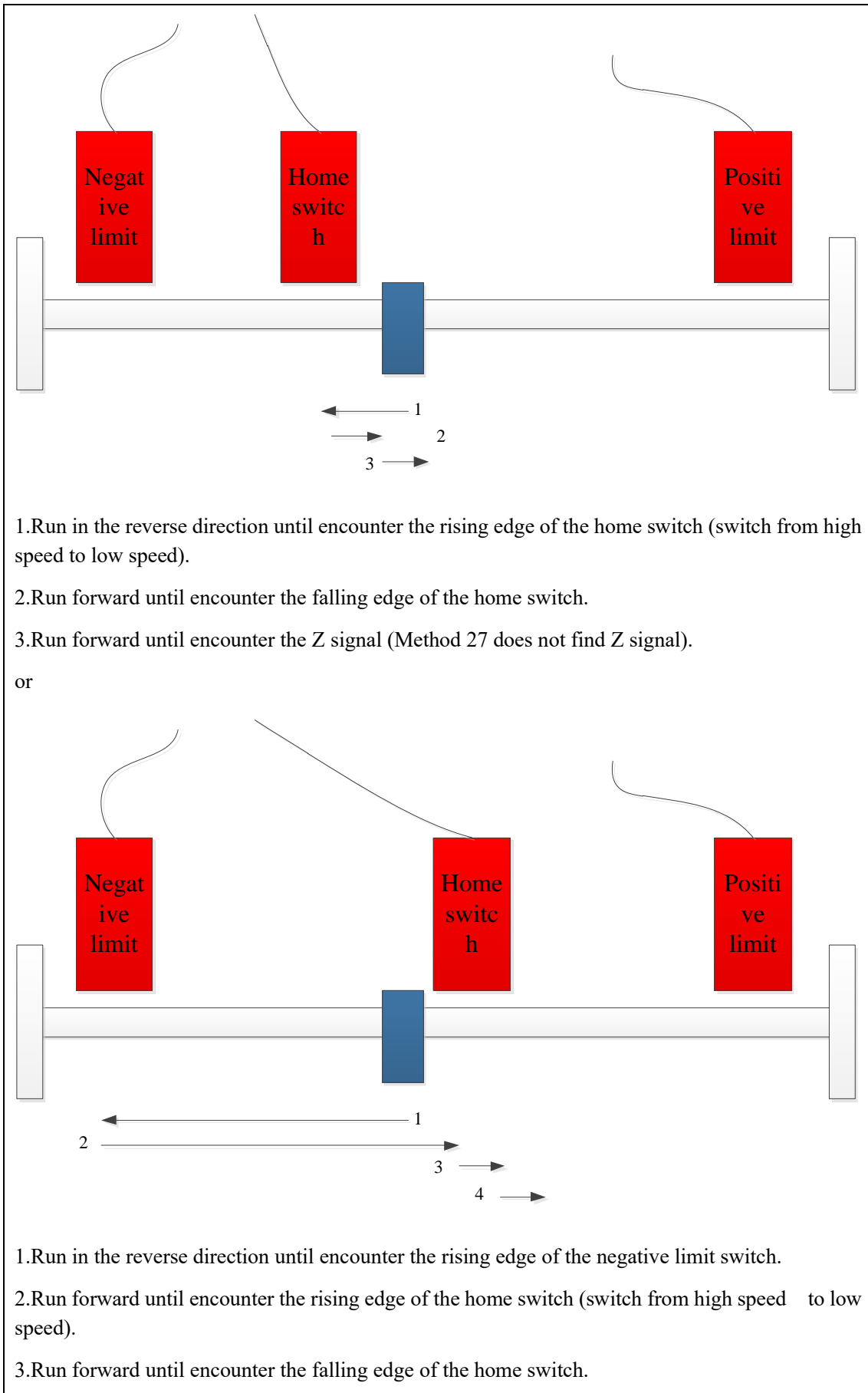
or



Homing Method10 (Method 26)







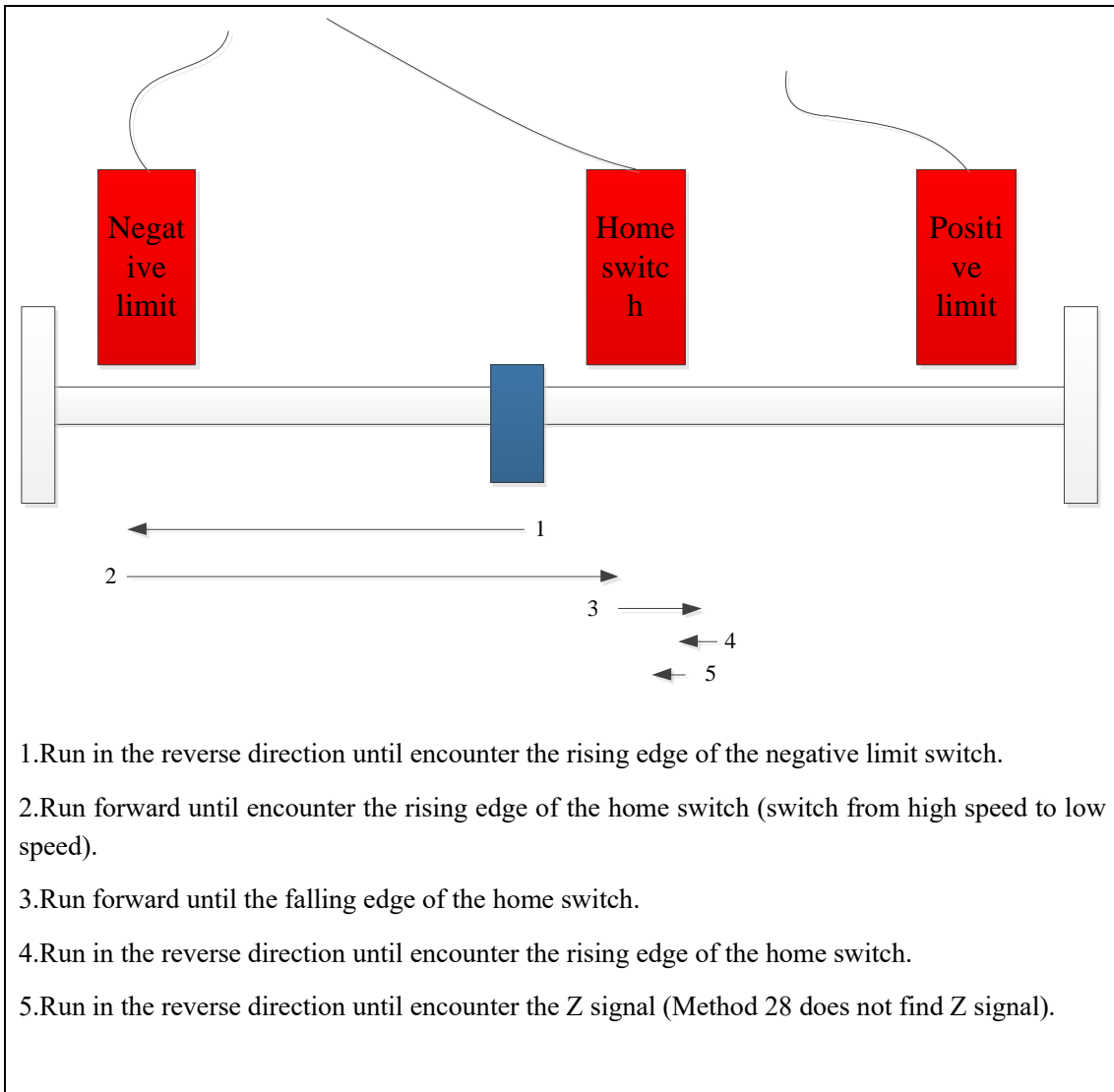
4.Run forward until encounter the Z signal (Method 27 does not find Z signal).

Homing Method 12 (Method 28)

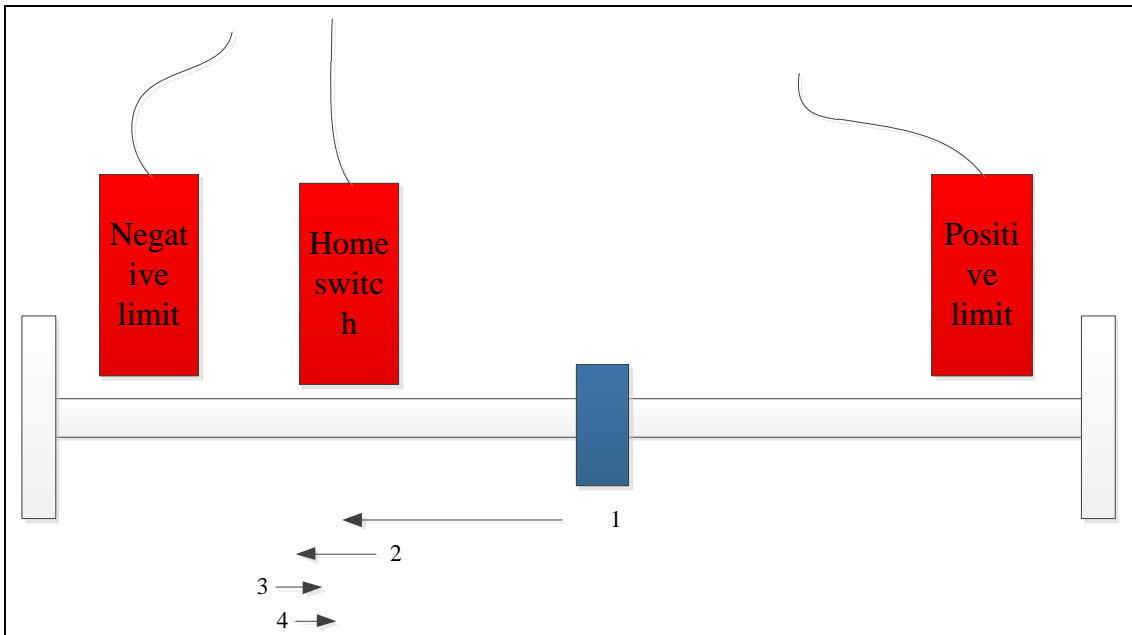
The diagram illustrates a motor on a rail with a home switch and limits. The components are labeled: Negative limit, Home switch, and Positive limit. The motor is shown in a blue block. Arrows 1, 2, 3, and 4 indicate the sequence of movements: 1. Reverse to rising edge of home switch; 2. Forward to falling edge; 3. Reverse to rising edge; 4. Reverse to Z signal.

- 1.Run in the reverse direction until encounter the rising edge of the home switch (switch from high speed to low speed).
- 2.Run forward until encounter the falling edge of the home switch.
- 3.Run in the reverse direction until encounter the rising edge of the home switch.
- 4.Run in the reverse direction until encounter the Z signal (Method 28 does not find Z signal).

or

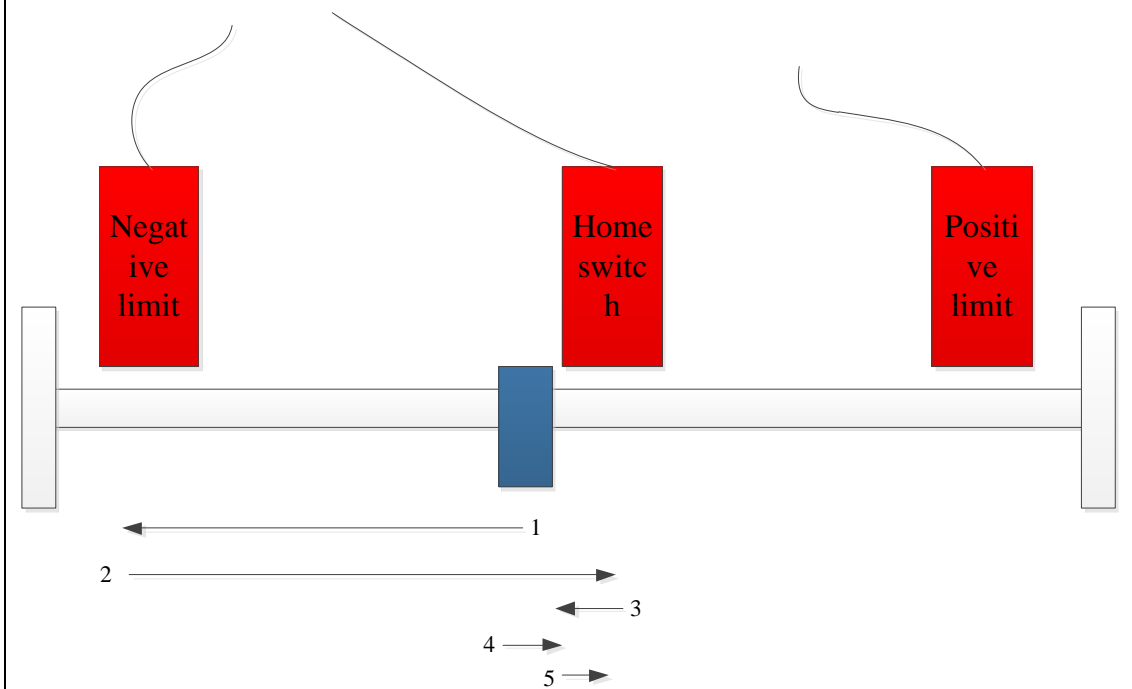


Homing Method 13 (Method 29)



- 1.Run in the reverse direction until encounter the rising edge of the home switch (switch from high speed to low speed).
- 2.Run in the reverse direction until encounter the falling edge of the home switch.
- 3.Run forward until encounter the rising edge of the home switch.
- 4.Run forward until encounter the Z signal (Method 29 does not find Z signal).

or

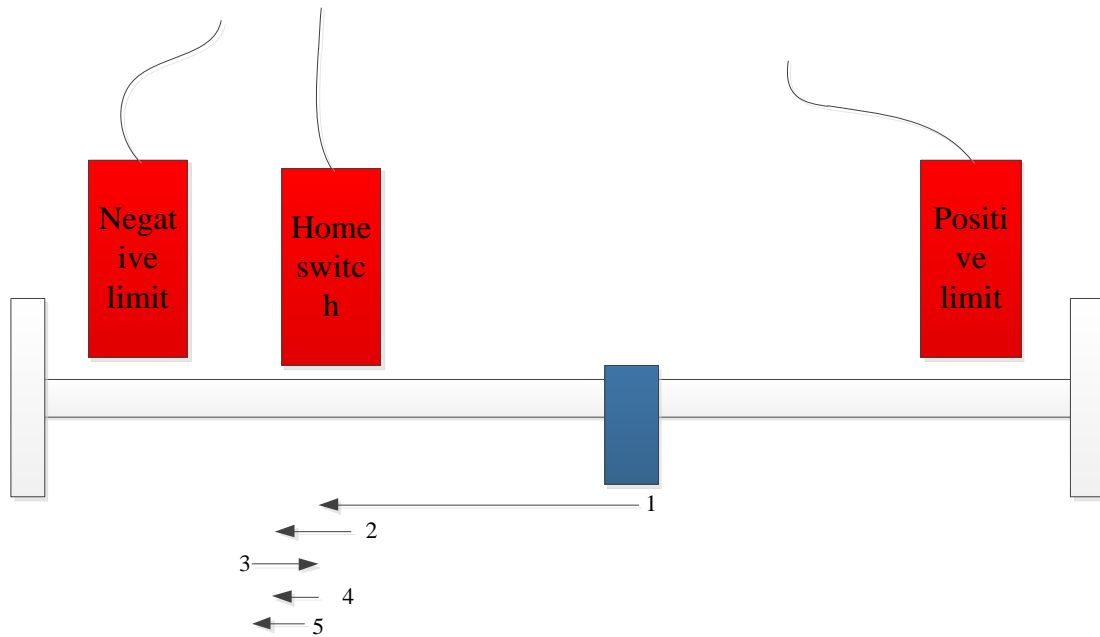


- 1.Run in the reverse direction until encounter the rising edge of the negative limit switch.
- 2.Run forward until encounter the rising edge of the home switch (switch from high speed to low

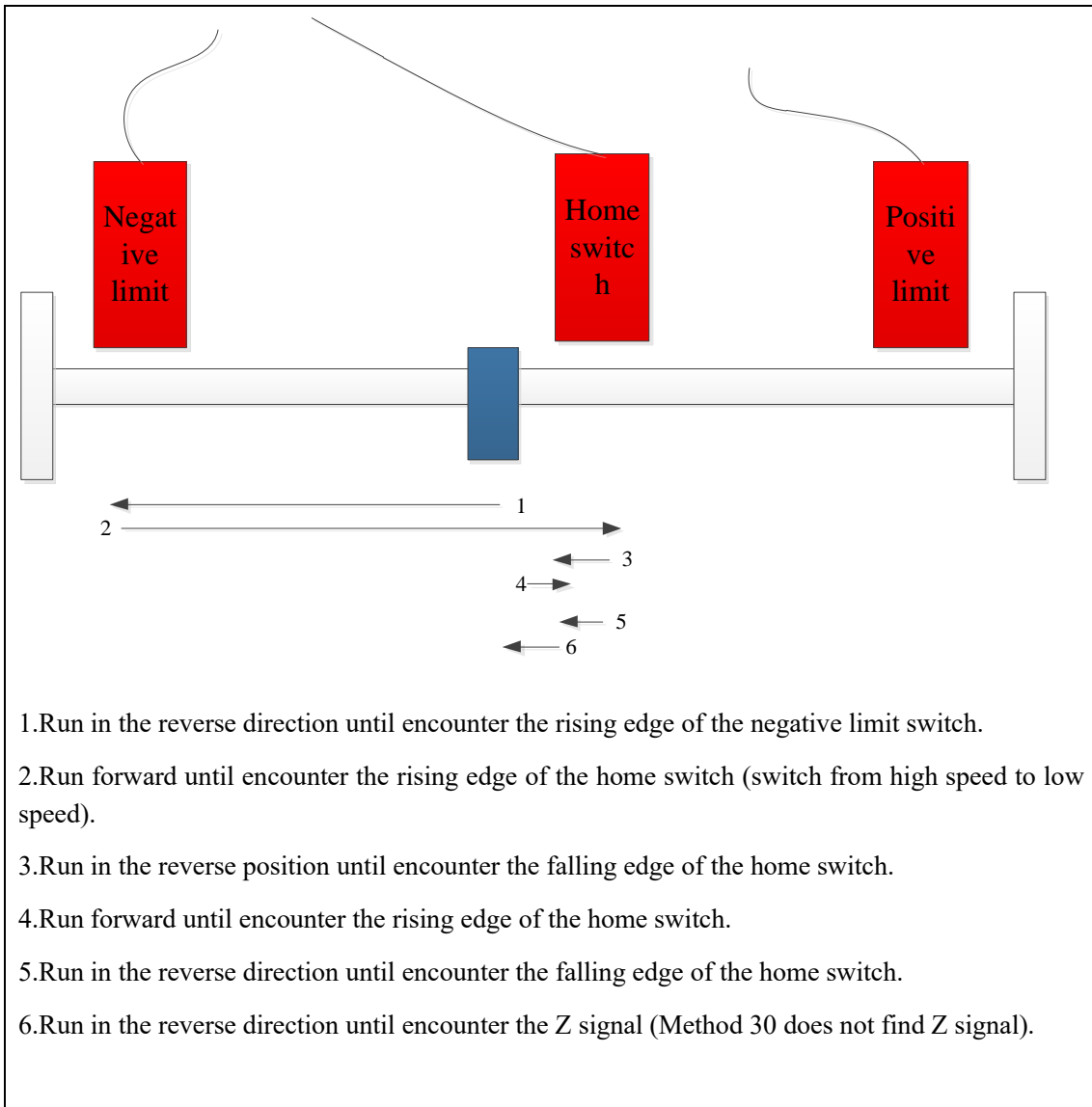
speed).

- 3.Run in the reverse direction until encounter the falling edge of the home switch.
- 4.Run forward until encounter the rising edge of the home switch.
- 5.Run forward until encounter the Z signal (Method 29 does not find Z signal).

Homing Method 14 (Method 30)



- 1.Run in the reverse direction until encounter the rising edge of the home switch (switch from high speed to low speed).
  - 2.Run in reverse direction until encounter the falling edge of the home switch .
  - 3.Run forward until encounter the rising edge of the home switch.
  - 4.Run in the reverse direction until encounter the falling edge of the home switch.
  - 5.Run in the reverse direction until encounter the Z signal (Method 30 does not find Z signal).
- or



Homing Method (Method 33)  
 Homing in the reverse direction, using the motor Z signal as home .

Homing Method (Method 34)  
 Homing forward, using the motor Z signal as home.

Homing Method (Method 35)  
 Use the current position as home.

Other Manufacturer Custom Modes:

Homing Method (Method -1)  
 Run in the reverse direction until encounter the hardware limit, then run forward until encounter the nearest Z signal

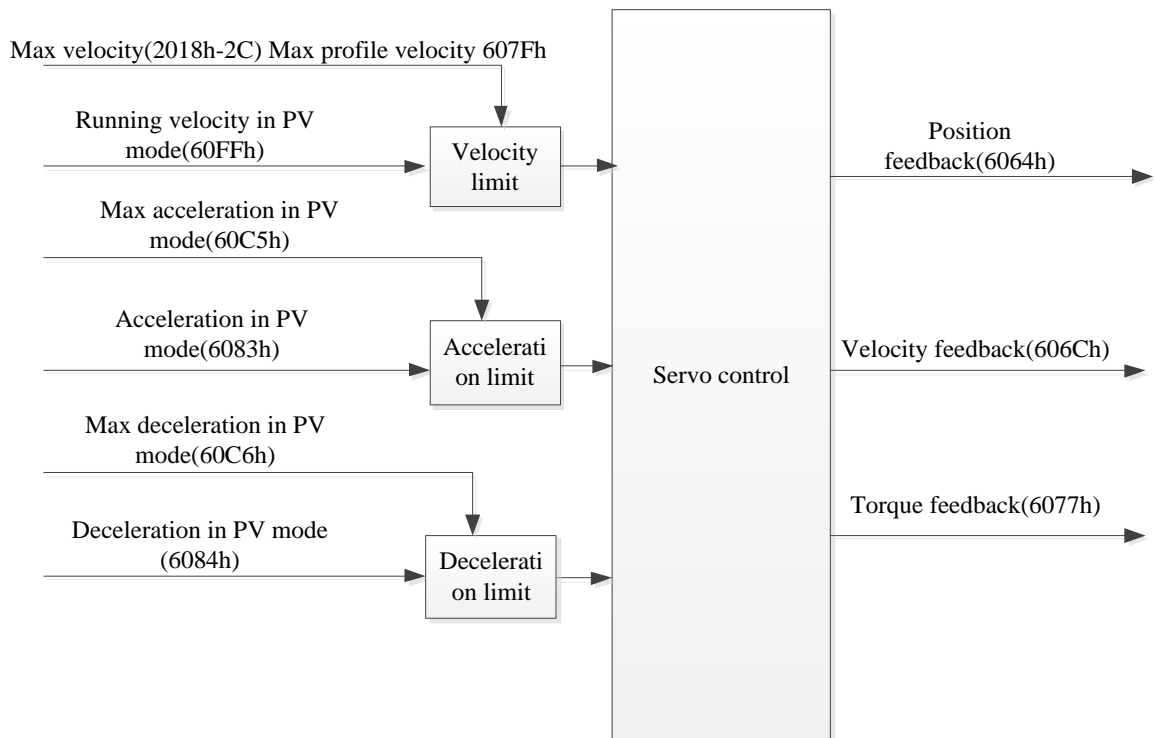
Homing Method (Method -2)  
 Run forward until hit the hardware limit, then run in the reverse direction until encounter the nearest Z signal

Homing Method (Method -4)  
 Run in the reverse direction until hit hardware limit (back off at fixed distance, do not find Z signal)

Homing Method (Method -5)  
 Run forward until hit the hardware limit (back off at fixed distance, do not find Z signal)

### 4.6 Velocity Control Function (PV/CSV)

PV mode refers to a speed control mode where the upper-level controller specifies the target speed, acceleration/deceleration, etc., and the servo drive internally generates position command actions. This control mode should be used when the communication cycle is 250 μs or more.



Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
607Eh		Command Polarity	0~255	-	0	U8	rw	RxPDO	No
	00h	Set the polarities of position command, speed command, and torque command.							
		<b>Bit</b>	<b>Description</b>						
		6	Set speed command polarity						

			<ul style="list-style-type: none"> <li>◆ 0: Keep existing value</li> <li>◆ 1: Command × (-1), negate target velocity 60FFh</li> </ul>
--	--	--	---

### 4.6.1 PV Mode Control Word

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																													
6040h	00h	Control Word	0 ~ 65535	-	0	U16	rw	RxPDO	No																													
		Set commands for controlling servo drive state transitions, etc. Bit information details: <table border="1" style="width: 100%; text-align: center;"> <tr> <td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td> </tr> <tr> <td colspan="5">r</td> <td>r</td> <td>h</td> <td>fr</td> <td colspan="3">r</td> <td>eo</td> <td>qs</td> <td>ev</td> <td>so</td> </tr> </table> r: reserved fr: fault reset eo: enable operation (control mode dependent bit) qs: quick stop h: halt ev: enable voltage so: switch on								15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	r					r	h	fr	r			eo	qs
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																							
r					r	h	fr	r			eo	qs	ev	so																								

### 4.6.2 PV Mode Status Word

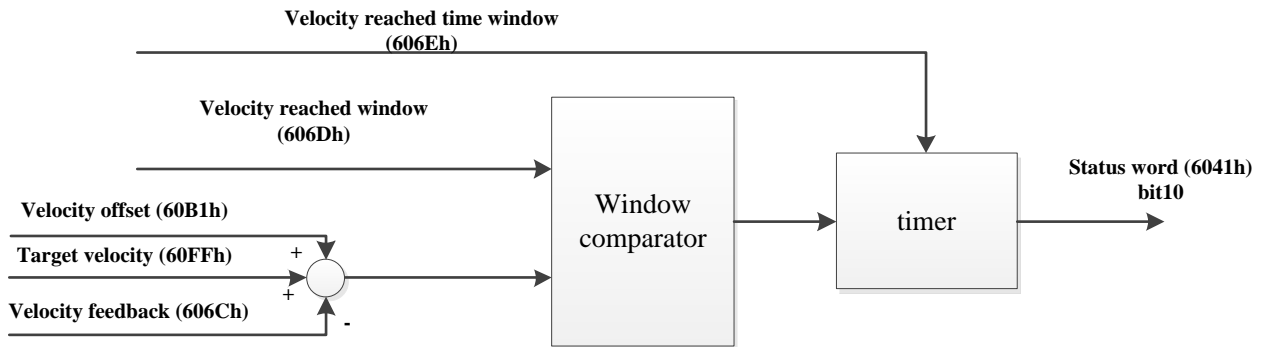
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																												
6041h		Status Word	0~65535	-	0	U16	rw	TxPDO	No																												
	00h	Bit information details: <table border="1" style="width: 100%; text-align: center;"> <tr> <td>15~13</td> <td>12</td> <td>11</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> </tr> <tr> <td>r</td> <td>Zero Speed</td> <td>ila</td> <td>Target Reach</td> <td>rm</td> <td>r</td> <td>w</td> <td>sod</td> <td>qs</td> <td>ve</td> <td>f</td> <td>oe</td> <td>so</td> <td>rtso</td> </tr> </table> r: reserved w: warning sod: switch on disabled qs: quick stop ve: voltage enabled								15~13	12	11	10	9	8	7	6	5	4	3	2	1	0	r	Zero Speed	ila	Target Reach	rm	r	w	sod	qs	ve	f	oe	so	rtso
15~13	12	11	10	9	8	7	6	5	4	3	2	1	0																								
r	Zero Speed	ila	Target Reach	rm	r	w	sod	qs	ve	f	oe	so	rtso																								

ila: internal limit active	f: fault
oe: operation enabled	rm: remote
so: switched on	rtso: ready to switch on

bit10 (target reached):

When the sum of 60FFh (target speed) and 60B1h (speed bias) is within the range set by 606Dh (speed reach threshold), and the time set by 606Eh (speed reach time threshold) has passed, bit10 of 6041h (status word) becomes 1.

bit	name	value	Definition
10	TargetReach	0	Speed control not completed (speed is 0 if disabled or limit switch is hit)
		1	Speed control completed (speed is not 0 if disabled or limit switch is hit)



Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
606Dh		Velocity Reached Window	0 ~ 65535	Command unit / s	10	U16	rw	RxPDO	YES
	00h	If the speed difference between the sum of 60FFh (target speed) and 60B1h (speed bias) and 606Ch (speed feedback) is within this parameter, after the time set by 606Eh (speed reach time threshold), bit10 (target reach flag) of 6041h (status word) becomes 1. If the speed deviation is beyond this parameter, bit10 of 6041h becomes 0.							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
606Eh	00h	Velocity Reached Time	0 ~ 65535	ms	0	U16	rw	RxPDO	YES

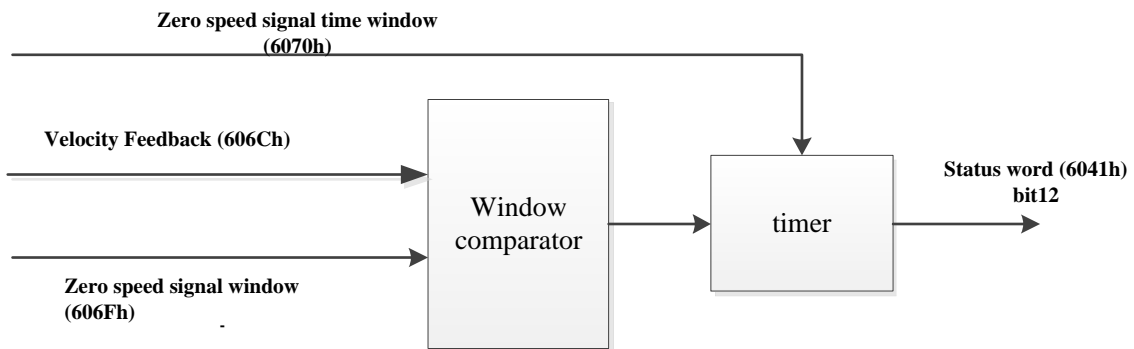
	Window							
	After the speed difference between the sum of 60FFh (target speed) and 60B1h (speed bias) and 606Ch (speed feedback) reaches the value set by 606Dh (speed reach threshold), the time for bit10 (target reach flag) of 6041h (status word) to become 1.							

bit12 (ZeroSpeed):

If 606Ch (speed feedback) exceeds the value set by 606Fh (zero speed signal threshold) and for the duration set by 6070h (zero speed signal time threshold), bit12 of 6041h (status word) becomes 0.

If 606Ch (speed feedback) is below the value set by 606Fh (zero speed signal threshold), bit12 of 6041h becomes 1, indicating the motor is stopped.

bit	name	value	Definition
12	ZeroSpeed	0	Motor is in motion
		1	Motor is stopped



Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
606Fh	00h	Zero Speed Signal Window	0 ~ 65535	Command unit / s	10	U16	rw	RxPDO	YES
		If 606Ch (speed feedback) exceeds this parameter, after the time set by 6070h (zero speed signal time threshold), bit12 (speed) of 6041h (status word) becomes 0. If the speed is below this parameter, bit12 of 6041h becomes 1.							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6070h	00h	Zero Speed Signal Time	0 ~ 65535	ms	0	U16	rw	RxPDO	YES

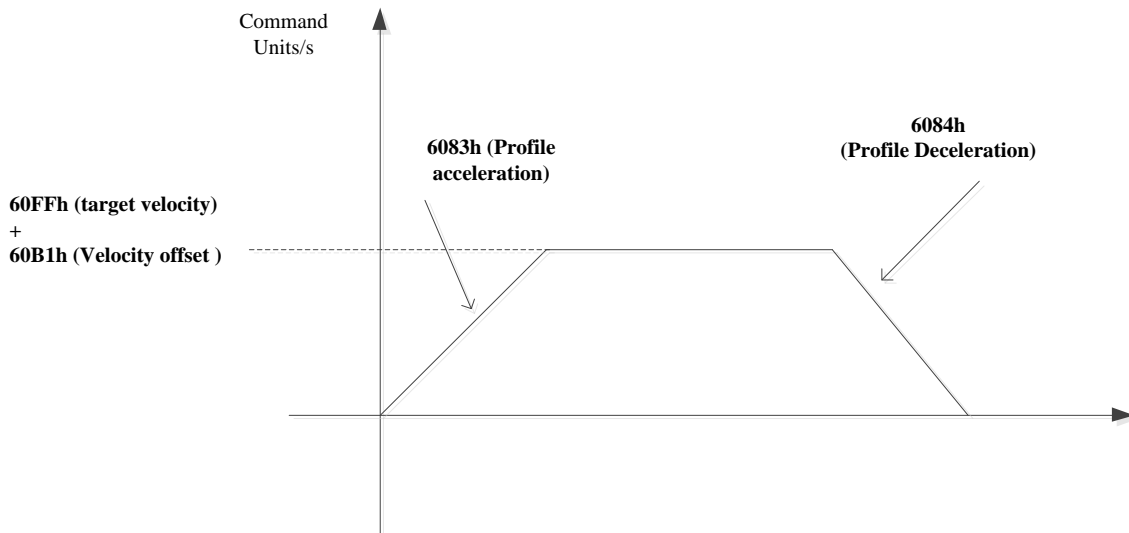
	Window							
	Time for bit12 of 6041h (status word) to become 0 after 606Ch (speed feedback) exceeds 606Fh (zero speed signal threshold) value.							

### 4.6.3 PV Control Mode Actions

The contour speed control mode generates speed command values based on the following parameters.

- ◆ Target Velocity (60FFh)
- ◆ Velocity Offset (60B1h)
- ◆ Profile Acceleration (6083h)
- ◆ Profile Deceleration (6084h)

The velocity command is the sum of 60FFh (target velocity) and 60B1h (velocity offset). After enabling the servo, please input and update the action command approximately 100 ms later. For monitoring purposes, 606Ch (velocity feedback) is provided.



The sum of 60FFh (target speed) and 60B1h (velocity offset) is limited by 607Fh (maximum profile velocity) and 6080h (set motor maximum speed).

However, the values of 607Fh and 6080h can be changed during operation.

### 4.6.4 Cycle Synchronous Speed Control Mode (CSV mode)

In CSV mode, the controller periodically sends the calculated target speed 60FFh to the servo drive, which realizes speed control. Use DC or SM2 cycle synchronous modes.

#### 4.6.4.1 Control Word in CSV Mode

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6040h	00h	Control Word	0 ~ 65535	-	0	U16	rw	RxPDO	No

		Bit information details:																				
		<table border="1"> <tr> <td>15~9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> </tr> <tr> <td>r</td> <td>h</td> <td>fr</td> <td colspan="3">r</td> <td>eo</td> <td>qs</td> <td>ev</td> <td>so</td> </tr> </table>	15~9	8	7	6	5	4	3	2	1	0	r	h	fr	r			eo	qs	ev	so
15~9	8	7	6	5	4	3	2	1	0													
r	h	fr	r			eo	qs	ev	so													
		r: reserved fr: fault reset eo: enable operation (control mode dependent bit) qs: quick stop h: halt ev: enable voltage so: switch on																				

#### 4.6.4.2 Status Word in CSV Mode

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																												
6041h		Status Word	0 ~ 65535	-	0	U16	rw	TxPDO	No																												
	00h	Bit information details: <table border="1"> <tr> <td>15~13</td> <td>12</td> <td>11</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> </tr> <tr> <td>r</td> <td>drive follows command value</td> <td>ila</td> <td>r</td> <td>r</td> <td>r</td> <td>w</td> <td>sod</td> <td>qs</td> <td>ve</td> <td>f</td> <td>oe</td> <td>so</td> <td>rtso</td> </tr> </table> <p>                         r: reserved                          sod: switch on disabled                          ve: voltage enabled                          ila: internal limit active                          oe: operation enabled                          so: switched on                     </p> <p>                         w: warning                          qs: quick stop                          f: fault                          rm: remote                          rtso: ready to switch on                     </p>								15~13	12	11	10	9	8	7	6	5	4	3	2	1	0	r	drive follows command value	ila	r	r	r	w	sod	qs	ve	f	oe	so	rtso
15~13	12	11	10	9	8	7	6	5	4	3	2	1	0																								
r	drive follows command value	ila	r	r	r	w	sod	qs	ve	f	oe	so	rtso																								

bit	name	value	Definition
12	drive follows command value	0	Does not execute according to target speed
		1	Executes according to target speed

#### CSV Control Mode Actions:

- ◆ In CSV control mode, the motion model (trajectory) is generated on the host, not on the slave.
- ◆ The speed command is the sum of 60FFh (target speed) and 60B1h (speed bias).
- ◆ After enabling the servo (Operation enabled command), please input and update the action command approximately 100 ms later.

- ◆ 60C2h (synchronization cycle) indicates the cycle for updating 60FFh (target speed) and 60B1h (speed bias). Set this value to the same cycle as 1C32h-02h (cycle time).
- ◆ For monitoring purposes, 606Ch (speed feedback) is provided.

## 4.7 Torque Control Function (PT/CST)

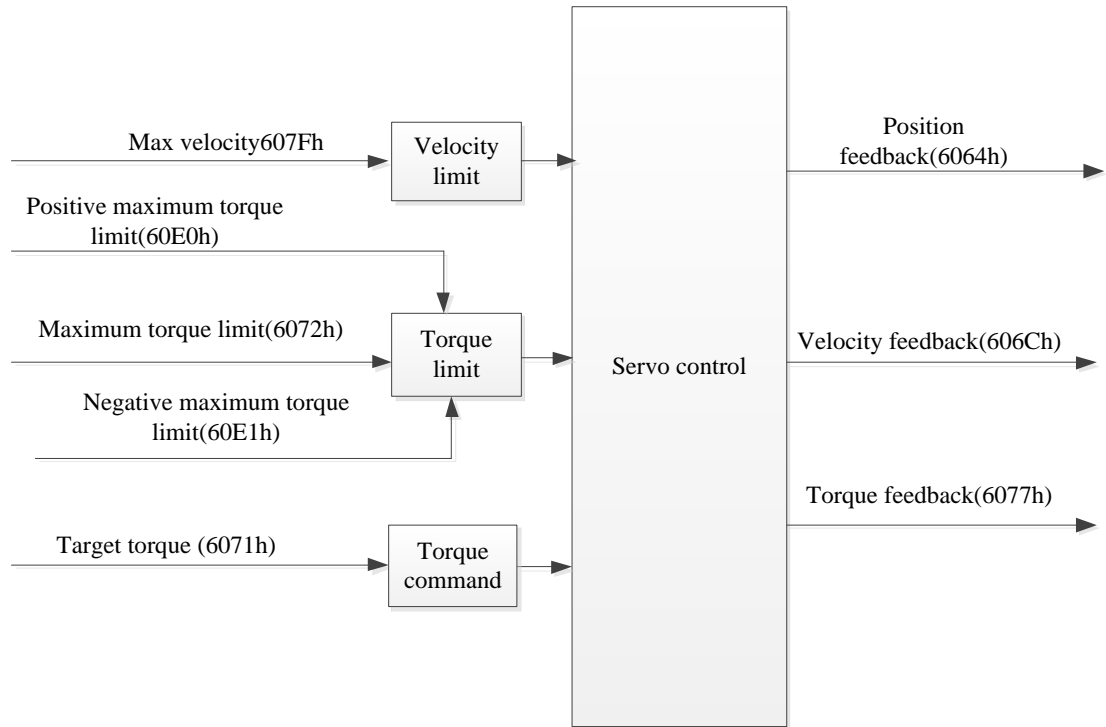
Related Objects:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6071h	00h	Target Torque	-5000 ~ 5000	0.1%	0	I16	rw	RxPDO	YES
		Sets target torque in profile torque mode (PT) and cycle synchronous torque mode (CST). Limited by the value of 6072h (maximum torque).							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6072h	00h	Maximum Torque	0 – 5000	0.1%	3000	U16	rw	RxPDO	YES
		Sets the motor's maximum torque. Limited internally by the maximum torque read from the motor, which varies by motor.							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6087h	00h	Torque Slope	0 ~ 4294967295	0.1 %/s	4294967295	U32	rw	RxPDO	YES
		Sets the torque change rate when stopping. Effective only during deceleration stop in cycle synchronous torque mode (CST). If set to 0, it operates internally as 1.							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60B2h	00h	Torque Offset	-5000 ~ 5000	0.1%	0	I16	rw	RxPDO	YES
		Sets the offset value (torque feedforward) of the torque command.							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60E0h	00h	Positive Torque Limit	0~5000	0.1%	3000	U16	rw	RxPDO	YES

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM			
		Sets the motor's positive maximum torque. The smaller value of 6072h is used as the torque limit.										
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM			
60E1h	00h	Negative Torque Limit	0~5000	0.1%	3000	U16	rw	RxPDO	YES			
		Sets the motor's negative maximum torque. The smaller value of 6072h is used as the torque limit.										
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM			
607Eh	00h	Command Polarity	0~255	-	0	U8	rw	RxPDO	No			
		Set torque command polarity.		<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>                     Set torque command polarity                      ◆ 0: Keep current value                      ◆ 1: Command × (-1), negate target torque 6072h                 </td> </tr> </tbody> </table>						Bit	Description	5
Bit	Description											
5	Set torque command polarity ◆ 0: Keep current value ◆ 1: Command × (-1), negate target torque 6072h											

### 4.7.1 Profile Torque Mode (PT mode)

The upper controller sends the target torque 6071h and torque ramp constant 6087h to the servo driver, with torque adjustment executed internally by the servo. Use this control mode with a communication cycle of 250 μs or more.



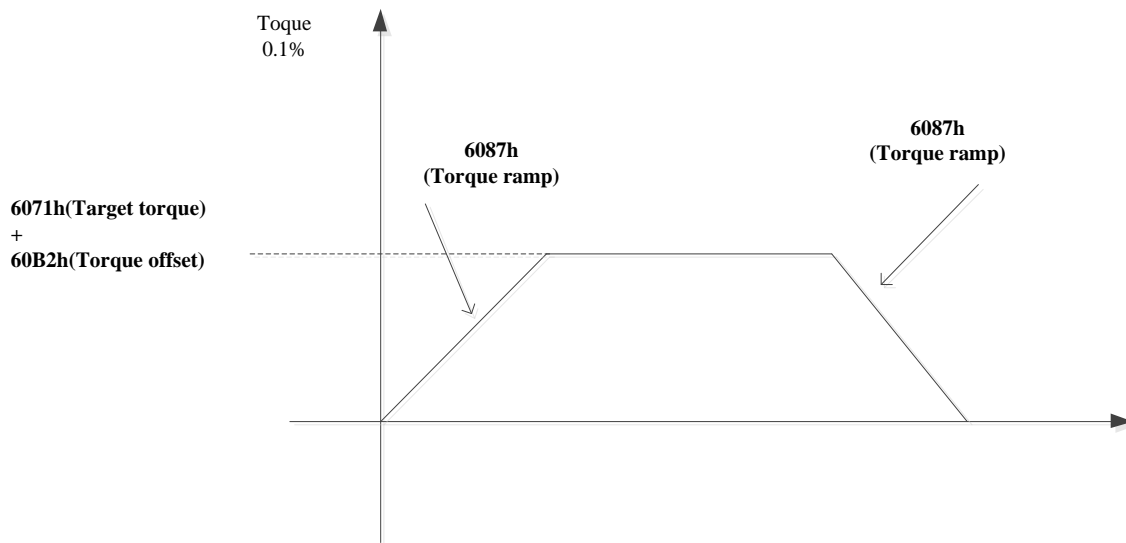
### 4.7.1.1 Control Word in PT Mode

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM																					
6040h	00h	Control Word	0 ~ 65535	-	0	U16	rw	RxPDO	No																					
		Detailed bit information is shown in the table below.																												
		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>15~9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> </tr> <tr> <td>r</td> <td>h</td> <td>fr</td> <td>r</td> <td></td> <td></td> <td>eo</td> <td>qs</td> <td>ev</td> <td>so</td> </tr> </table>								15~9	8	7	6	5	4	3	2	1	0	r	h	fr	r			eo	qs	ev	so	
15~9	8	7	6	5	4	3	2	1	0																					
r	h	fr	r			eo	qs	ev	so																					
		r: reserved fr: fault reset eo: enable operation (control mode dependent bit) qs: quick stop h: halt ev: enable voltage so: switch on																												

### 4.7.1.2 Status Word in PT Mode

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6041h	00h	Status Word	0 ~ 65535	-	0	U16	rw	TxPDO	No

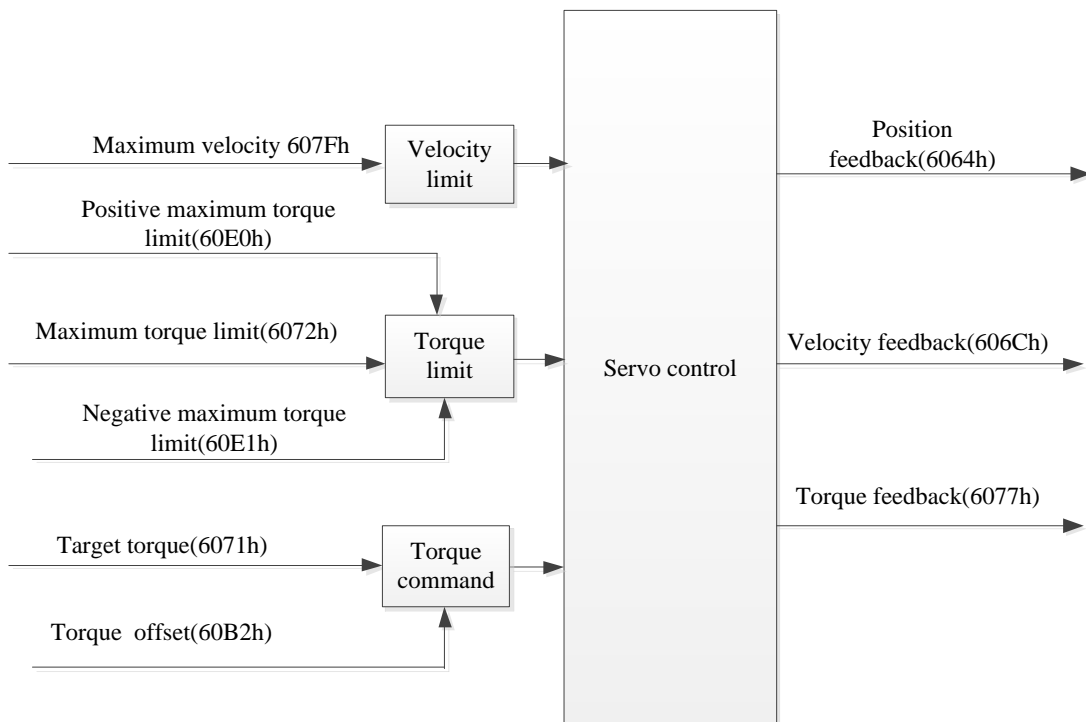




Note: The sum of 6071h (target torque) and 60B2h (torque offset) is limited by the minimum value among 6072h (maximum torque), 60E1h, and 60E0h.

### 4.7.2 Cyclic Synchronous Torque Mode (CST mode)

The host controller generates the torque command and sends it to the servo driver based on the synchronization cycle, with torque control completed internally by the servo. Use in DC or SM2 cyclic synchronous mode.



#### 4.7.2.1 Control Word in CST Mode

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
-------	----------	------	---------------	------	-----------------	-----------	--------	-----	--------

6040h	00h	Control Word	0 ~ 65535	-	0	U16	rw	RxPDO	No		
		Detailed bit information is shown in the table below.									
		15~9	8	7	6	5	4	3	2	1	0
		r	h	fr	r			eo	qs	ev	so
		r: reserved fr: fault reset eo: enable operation (control mode dependent bit) qs: quick stop h: halt ev: enable voltage so: switch on									

### 4.7.2.2 Status Word in CST Mode

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM							
6041h	00h	Status Word	0 ~ 65535	-	0	U16	rw	TxPDO	No							
		Detailed bit information is shown in the table below.														
		15~13	12	11	10	9	8	7	6	5	4	3	2	1	0	
		r	drive follows command value	ila	r	r	m	r	w	sod	qs	ve	f	oe	so	rtso
		r: reserved sod: switch on disabled ve: voltage enabled ila: internal limit active oe: operation enabled so: switched on w: warning qs: quick stop f: fault rm: remote rtso: ready to switch on														

bit	name	value	Definition
12	drive follows command value	0	Does not act according to target torque
		1	Acts according to target torque

### 4.7.2.3 Actions in CST control mode

- ◆ Target torque is the sum of 6071h (target torque) and 60B2h (torque offset).

- ◆ Update action command (transmission) approximately 100 ms after enabling the servo.
- ◆ Update cycle is 1C32h-02h (cycle time), periodically updating 6071h (target torque) and 60B2h (torque offset).
- ◆ Provides monitoring information such as 6077h (torque feedback).
- ◆ The sum of 6071h (maximum torque) and 60B2h (torque offset) is limited by the minimum value among 6072h (maximum torque), 60E0h (positive torque limit), and 60E1h (negative torque limit).
- ◆ Speed limit is 607Fh (maximum profile velocity).

## 4.8 Common Functions in All Modes

### 4.8.1 Probe Function

#### 4.8.1.1 Physical Signal Configuration

The probe function connects an external switch to the servo drive DI, enabling high-speed capture of DI signals (or Z signals) to latch positions.

Two sets of probes can be freely assigned to the driver's 5 DIs. FunIN.31 corresponds to the first probe function, FunIn.32 corresponds to the second probe function. Configurations can be based on external signals; when using the Z signal as a probe, wiring is not required.

DI	CN1 Pin	Probe 1 Setting	Probe 2 Setting
DI1	39	P04.04=31	P04.04=32
DI2	38	P04.06=31	P04.06=32
DI3	37	P04.08=31	P04.08=32
DI4	36	P04.10=31	P04.10=32
DI5	35	P04.12=31	P04.12=32

Note: DI functions cannot be duplicated; otherwise, an alarm (alarm code Er.06.4) will be triggered. Connect probe functions according to actual configuration requirements. DI logic levels do not take effect when used as probes and should be configured according to objects 60B8h, 60B9h.

Related Functions:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2004h (P0441)	42h	Probe Filtering Time <sup>1</sup>	0 ~ 6000	ns	300	U16	rw	NO	YES
		Set probe 1 filtering time.							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2004h (P0442)	43h	Probe Filtering Time <sup>w</sup>	0 ~ 6000	ns	300	U16	rw	NO	YES
		Set probe 2 filter time.							

### 4.8.1.2 Probe Function (60B8h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60B8	00h	Probe Function	0 ~ 65535	-	0	U16	rw	RxPDO	No
		Configure execution of the probe function.							

Bit description for probe 1 configuration:

bit	value	Description
0	0	Switch off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	Continuous
2	0	Trigger with touch probe 1 input
	1	Trigger with zero impulse signal of position encoder
3	0	Reserved
	1	Reserved
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6~7		Reserved

Bit description for probe 2 configuration:

bit	value	Description
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	Continuous
10	0	Trigger with touch probe 2 input
	1	Trigger with zero impulse signal of position encoder
11	0	Reserved
	1	Reserved
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2

bit	value	Discription
	1	Enable sampling at negative edge of touch probe 2
14~15	-	Reserved

#### 4.8.1.3 Probe Status (60B9h)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60B9	00h	Probe Status	0 ~ 65535	-	0	U16	rw	TxPDO	No
		Represents the state of the probe function.							

Bit description of corresponding probe 1 status:

bit	value	Description
0	0	Touch probe 1 is switch off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 positive edge value stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 negative edge value stored
3~7	-	Reserved

Bit description of corresponding probe 2 status:

bit	value	Description
8	0	Touch probe 2 is switch off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 positive edge value stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 negative edge value stored
11~15	-	Reserved

#### 4.8.1.4 Probe Latch Position (60BAh ~ 60BDh)

Represents the obtained latch position:

Index	Subindex	Name	Setting Range	Unit	Factor y	Data TYP	ACCESS	PDO	EEPRO M
-------	----------	------	---------------	------	----------	----------	--------	-----	---------

					Default	E			
60BA	00h	Probe 1 Rising Edge Latch Position	- 214748364 8 ~ 214748364 7	Comman d Unit	0	I32	R	TxPD O	No
Represents the rising edge latch position of Probe 1.									
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60BB	00h	Probe 1 Falling Edge Latch Position	- 214748364 8 ~ 214748364 7	Comman d Unit	0	I32	R	TxPD O	No
Represents the falling edge latch position of Probe 1.									
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60BC	00h	Probe 2 Rising Edge Latch Position	- 214748364 8 ~ 214748364 7	Comman d Unit	0	I32	R	TxPD O	No
Represents the rising edge latch position of Probe 2.									
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60BD	00h	Probe 2 Falling Edge Latch Position	- 214748364 8 ~ 214748364 7	Comman d Unit	0	I32	R	TxPD O	No
Represents the falling edge latch position of Probe 2.									

### 4.8.1.5 Probe Event Mode

When bit0/bit8 (Probe execute/stop) of 60B8h (Probe function) changes from 0 (stop) to 1 (start), various setting conditions (60B8h: bit17/bit915) are obtained, and the Probe action starts.

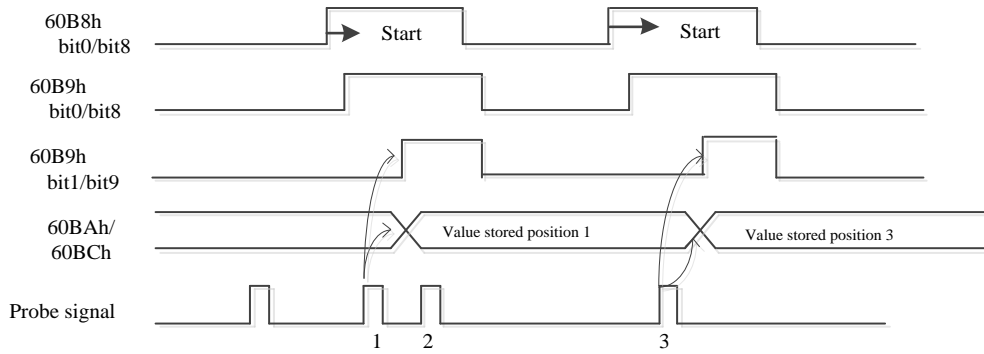
To apply changes to various setting conditions, set bit0/bit8 back to 0 (stop) and then back to 1 (start).

According to bit1/bit9 (event mode selection) of 60B8h (Probe function), you can select 0 (Trigger first event mode)

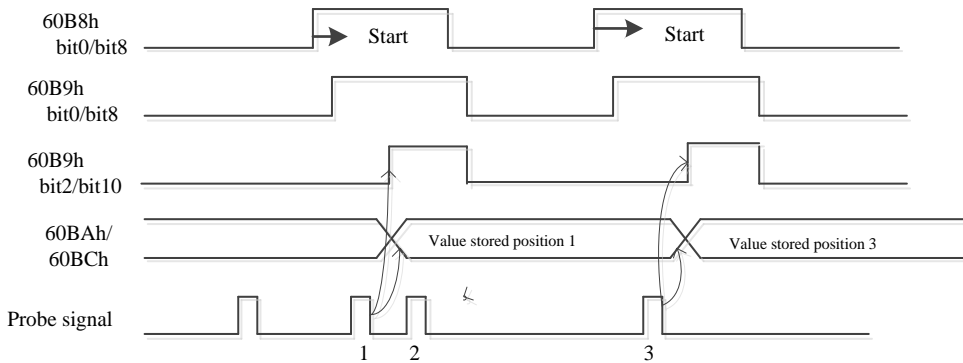
or 1 (Continuous mode).

<Trigger first event mode> (60B8h: bit1=0 / bit9=0)

After starting, the probe position is latched only when the trigger signal is effective for the first time. To obtain it again, it is necessary to restart the Probe.



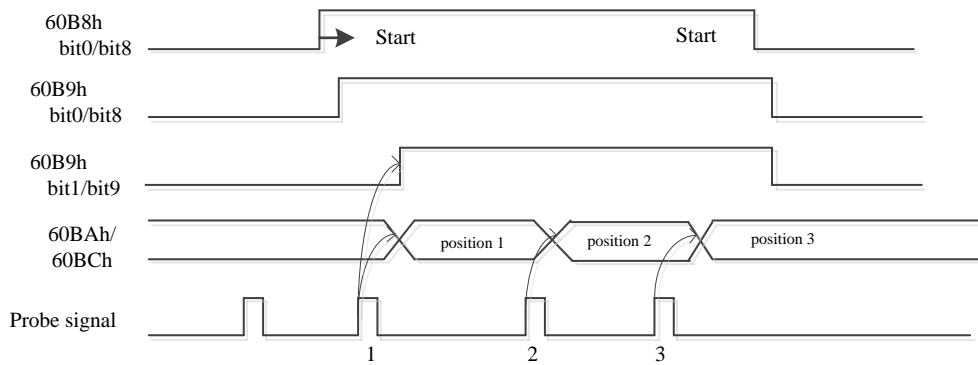
Rising edge



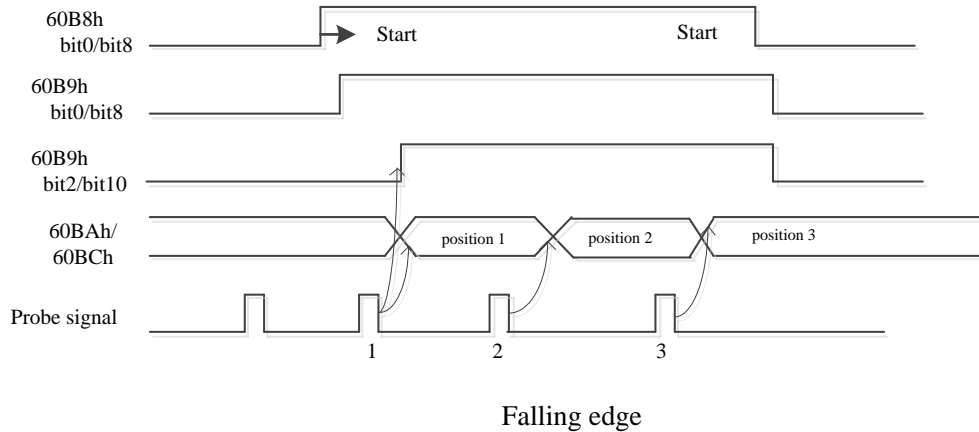
Falling edge

<Continuous mode> (60B8h: bit1=1 / bit9=1)

After starting, the probe position is latched every time the trigger signal becomes effective, and it is maintained until the next Probe signal.



Rising edge



## 4.8.2 Stop Functions

### 4.8.2.1 Brake Motor Stop Sequence

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2002h (P020F)		Brake Enable	0: Disable brake control 1: Enable brake control	-	1	U16	rw	NO	YES
	10h	Controls the brake (FunOut.6) DO output. To ensure the vertical axis drops a short distance while also preventing brake pad wear, the internal stop method is fixed and not adjustable. When brake control is enabled: Disable operation option code (servo off): Fixed to zero-speed stop, entering DB state after stopping, brake output. Fault reaction option code (resettable fault): Fixed to zero-speed stop, entering DB state after stopping, brake output. Servo fault 1 (non-resettable fault): DB stop, entering DB state after stopping, brake output. Overtravel stop: Zero-speed stop, position lock.							

Refer to the explanations for each stop method for the stop sequence.

### 4.8.2.2 Quick Stop Method Selection (605Ah)

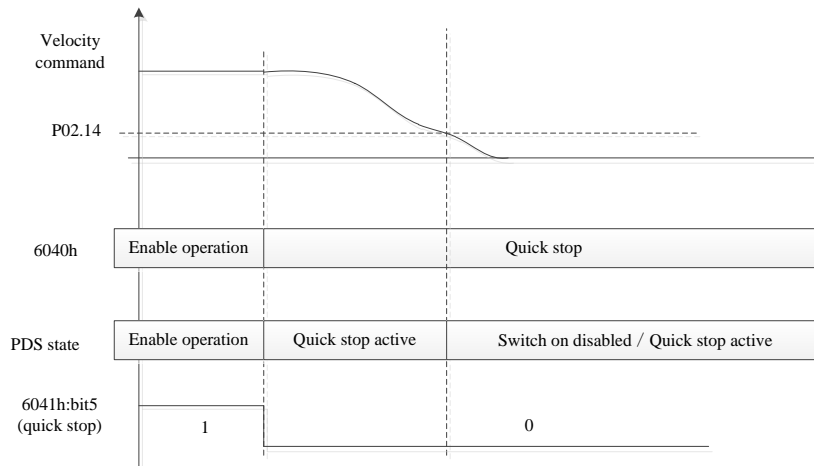
Sets the motor deceleration stop method upon receiving the PDS command 「Quick Stop」.

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
605Ah	00h	Quick Stop Method	0~7	-	2	I16	rw	NO	YES

	Selection							
	0: Free stop, maintain free running state. 1: Ramp stop via 6084h/609Ah (HM) and stay in free running state. 2: Ramp stop via 6085h and stay in free running state. 3: Emergency torque stop and stay in free running state. 5: Ramp stop via 6084h/609Ah (HM) and stay in position-locked state. 6: Ramp stop via 6085h and stay in position locked state. 7: Emergency torque stop and stay in position locked state. Other: Free stop and stay in free state.							

Example of deceleration stop action according to quick stop command:

- ◆ If bit2 (quick stop) of 6040h (status word) changes from 1 to 0, deceleration stop begins. The PDS state during deceleration becomes Quick Stop active.
- ◆ If the detected actual speed is below P02.14, the motor is considered stopped. The PDS state after stopping is Switch On disabled or Quick Stop active.



### 4.8.2.3 Servo OFF Stop Method Selection (605Ch)

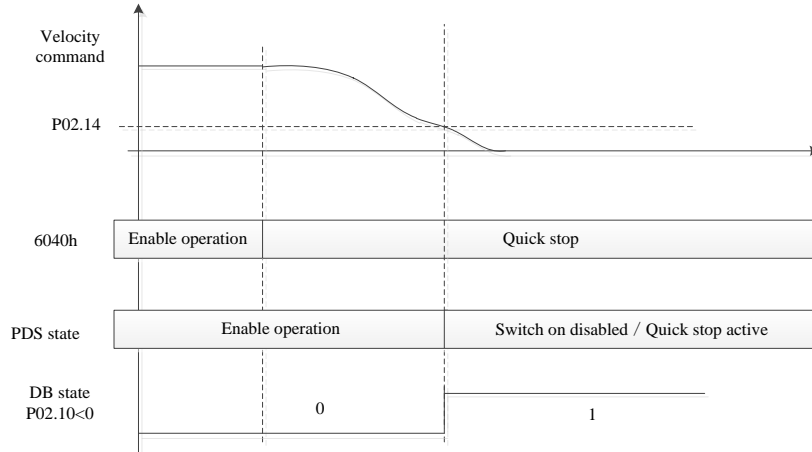
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
605Ch	00h	Servo OFF Stop Method Selection	0~7	-	0	I16	rw	NO	YES
		0: Stop method set in P02.10 1: HM mode ramp stop at 609Ah; CST, PT mode emergency torque stop at 6087h; other modes ramp stop at 6084h, maintain free running state.							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
-------	----------	------	---------------	------	-----------------	-----------	--------	-----	--------

2002h (P0210)		Servo Enable Invalid Stop Method	-3~2	-	0	I16	rw	NO	YES
	11h	-3: Zero-speed stop, maintain DB state. -2: Ramp stop, maintain DB state. -1: DB stop, maintain DB state. 0: Free stop, maintain free state. 1: Ramp stop, maintain free state. 2: Zero-speed stop, maintain free state.  HM mode ramp stop at 609Ah, CST, PT mode emergency torque stop at 6087h, other modes ramp stop at 6084h.							

Example of deceleration stop action according to disable operation command:

- ◆ If the PDS command "Disable Operation" is received, deceleration stop begins. The PDS state during deceleration remains Operation Enabled.
- ◆ If the detected actual speed is below P02.14, the motor is considered stopped.. The PDS state after stopping is Switched On.



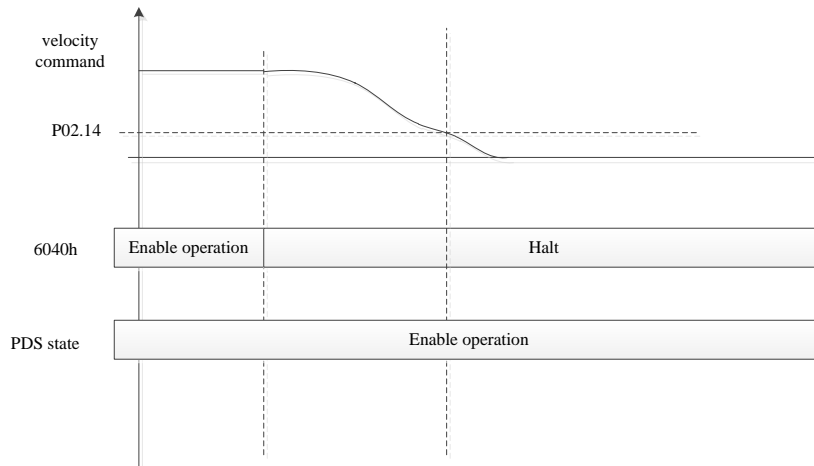
#### 4.8.2.4 Halt Stop Method Selection (605Dh)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
605Dh	00h	Halt Stop Method Selection	1~3	-	0	I16	rw	NO	YES
		1: Ramp stop at 6084h/609Ah (HM), maintain position lock state.							

	<p>2: Ramp stop at 6085h, maintain position lock state.</p> <p>3: Emergency torque stop, maintain position lock state.</p> <p>In torque mode, use emergency torque stop, maintain position lock state.</p>
--	--

Example of deceleration stop action according to halt function:

- ◆ If bit8 (halt) of 6040h (status word) changes from 0 to 1, deceleration stop begins. The PDS state during deceleration remains Operation Enabled.
- ◆ If the detected actual speed is below P02.14, the motor is considered stopped. The PDS state after stopping remains Operation Enabled.



#### 4.8.2.5 Stopping method for Category 2 faults (605Eh)

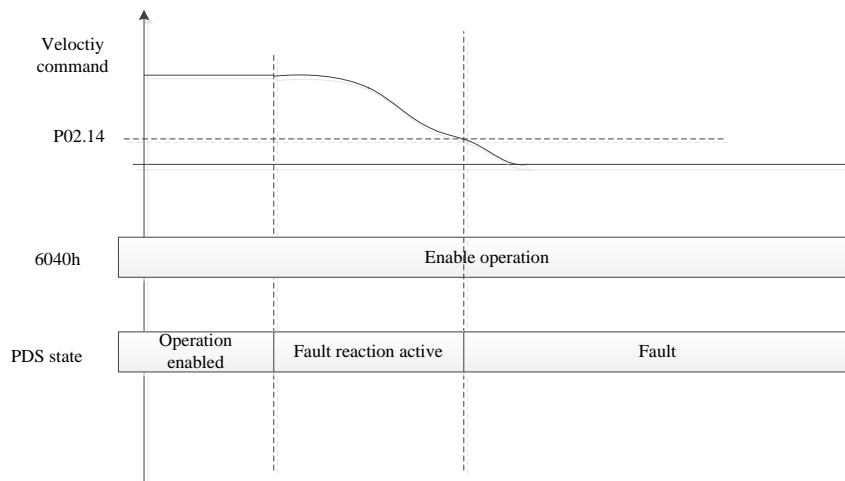
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
605Eh		Stopping method for Category 2 faults	0~7	-	0	I16	rw	NO	YES
	00h	<p>0: Stop method set in Pn0213</p> <p>1: In HM mode, ramp stop via 609Ah; In CST, PT mode, emergency torque stop via 6087h; In other modes, ramp stop via 6084h and stay in free running state.</p> <p>2: In CST, PT mode, emergency torque stop via 6087h; In other modes, ramp stop via 6085h and stay in free running state.</p>							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2002h (P0213)	14h	Stopping method for Category 1 faults	-4~3	-	0	I16	rw	NO	YES

		-4: Emergency torque stop and stay in DB state. -3: Emergency stop and stay in DB state. -2: Ramp stop and stay in DB state. -1: DB stop and stay in DB state. 0: Free stop and stay in free state. 1: Ramp stop and stay in free state. 2: Emergency stop and stay in free state. 3: Emergency torque stop and stay in free state.
--	--	--

Example of deceleration stop action according to alarm:

- ◆ If an alarm occurs, deceleration stop begins. The PDS state during deceleration is Fault Reaction active.
- ◆ When the detected actual velocity is below P02.14, the motor is considered stopped. The PDS state after stopping is Fault.



### 4.8.2.6 Fault 1 Stop Method

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2002h (P0212)	13h	Uncontrollable Fault 1 Stop Method	0~1	-	0	I16	rw	NO	YES
		0: Free stop, maintain free state. 1: DB stop, maintain DB state.							

### 4.8.2.7 Driver Input Disabled (POT, NOT) Sequence

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
-------	----------	------	---------------	------	-----------------	-----------	--------	-----	--------

2002h (P0211)	12h	Overtravel Stop Method	0~2	-	1	I16	rw	NO	YES
		0: Free stop, maintain free state. 1: Zero-speed stop, maintain position lock state. 2: Deceleration stop at 6085h, maintain position lock state.							

### 4.8.2.8 Stop Related Objects

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM
6084h	00h	Profile Deceleration	0~4,294,967,295	Command unit / s <sup>2</sup>	0x53555555	U32	RW	RxPDO	YES
6085h	00h	Quick Stop Deceleration	0~4,294,967,295	Command unit / s <sup>2</sup>	0xFF FFFF	U32	RW	RxPDO	YES
609Ah	00h	Homing Acceleration	0~4,294,967,295	Command unit / s <sup>2</sup>	0x53555555	U32	RW	RxPDO	YES
6087h	00h	Torque Ramp	0~4,294,967,295	0.1%/ s <sup>2</sup>	0xFF FFFF	U32	RW	RxPDO	YES

### 4.8.3 Digital Inputs / Digital Outputs

#### 4.8.3.1 Digital Input Status (60FDh)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM																		
60FD	00h	Digital Input Status	0~4294967295	-	0	U32	rw	TxPDO	No																		
		Details of bit information are shown in the table below. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>bit</th> <th>31~19</th> <th>18</th> <th>17</th> <th>16~4</th> <th>3</th> <th>2</th> <th>1</th> <th>0</th> </tr> </thead> <tbody> <tr> <td></td> <td>reserved</td> <td>Probe2</td> <td>Probe1</td> <td>reserved</td> <td>Not supported</td> <td>Home</td> <td>POT</td> <td>NO T</td> </tr> </tbody> </table>								bit	31~19	18	17	16~4	3	2	1	0		reserved	Probe2	Probe1	reserved	Not supported	Home	POT	NO T
bit	31~19	18	17	16~4	3	2	1	0																			
	reserved	Probe2	Probe1	reserved	Not supported	Home	POT	NO T																			

							d	Switc h								
<p>NOT: Negative limit switch                  POT: Positive limit switch                  HomeSwitch: Homing switch                  Probe1: Probe 1                  Probe2: Probe 2</p> <table border="1"> <thead> <tr> <th>Value</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Switched off (logical input state OFF)</td> </tr> <tr> <td>1</td> <td>Switched on (logical input state ON)</td> </tr> </tbody> </table> <p>Note: 60FDh indicates whether the function is effective, not the level state.</p>											Value	Definition	0	Switched off (logical input state OFF)	1	Switched on (logical input state ON)
Value	Definition															
0	Switched off (logical input state OFF)															
1	Switched on (logical input state ON)															

When using the digital input function, set the function to the corresponding physical DI using 2004h-05h~0Eh (P04.04)~250Dh (P04.0D) and set the DI effective level.

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2004	41h	DI Filtering Time	0 ~ 65535	0.01µm	1000	U16	rw	No	YES
P04.40		Indicating the DI filtering time: It can be appropriately increased when there is DI signal interference, but a corresponding delay will occur when set too large.							

DI Function Settings:

DI Function Number	DI Function Description
FunIn.1	Servo Enable SRV_ON: When not using the EtherCAT protocol (P02.00<3), this DI can be used to enable the servo.
FunIn.2	Positive Limit POT: In positive limit, does not respond to positive command and alarms (Alarm Code Al.05.0).
FunIn.3	Negative Limit NOT: In negative limit, does not respond to negative command and alarms (Alarm Code Al.05.1).
FunIn.4	Homing Switch: Used in HM mode, connects to an external homing switch.
FunIn.7	Fault Reset A_Clr: Fault reset, can reset faults when a resettable fault occurs.
FunIn.13	Positive Jog JogCmdP: Positive jog, jogging speed set by P04.02.
FunIn.14	Negative Jog JogCmdN: Negative jog, jogging speed set by P04.02.
FunIn.16	Gain Switching Gain

DI Function Number	DI Function Description
FunIn.19	Pulse Deviation Clear CL
FunIn.31	Probe 1 (Probe1): When used as Probe 1, this function needs to be set.
FunIn.32	Probe 2 (Probe2): When used as Probe 2, this function needs to be set.

### 4.8.3.2 Digital Output Status (60FEh)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60FE	-	Digital Output Status	-	-	-	-	-	-	-
		Used to output the configured DO signal from the drive.							
	00h	Number of Supported Sub-Indexes	2	-	0	U8	R	No	No
		Represents the number of sub-indexes for 60FEh							
	01h	Output Active Bit	0 ~4294967 295	-	0	U32	rw	RxPDO	No
		DO output active bit setting.							
	02h	Output Enable Setting	0 ~4294967 295	-	0	U32	rw	RxPDO	No
		DO enable output setting.							

Refer to the table below for detailed bit information:

bit	31~25	24	23~20	19	18	17	16	15~1	0
	reserved	GainSel	reserved	Ex_Out 4	Ex_Out 3	Ex_Out 2	Ex_Out 1	reserved	Set Break

Value	Definition
0	DO output invalid
1	DO output valid

Set Break is not supported at the moment. Please use the internal control of the servo to control the brake DO, FunOut.6 brake output.

60FEh_01	60FEh_02	Output Status	Description
bit16=1	bit16=1	1	Ex_Out1=1, FunOut.25 output valid, other states invalid
bit17=1	bit17=1	1	Ex_Out2=1, FunOut.26 output valid, other states invalid
bit18=1	bit18=1	1	Ex_Out3=1, FunOut.27 output valid, other states invalid
bit19=1	bit19=1	1	Ex_Out4=1, FunOut.28 output valid, other states invalid
bit24=1	bit24=1	1	Gain switching is active when valid

**DO Function Settings:**

DO Function Index	DO Function Description
FunOut.1	Active: Servo state is ready, can receive enable commands Inactive: Alarm state or servo power not ready
FunOut.2	Active: Servo is in enabled state Inactive: Servo is in disabled state
FunOut.3	Active: In position control, positioning is complete Inactive: In position control, positioning is incomplete, or not in position mode
FunOut.4	Active: Warning signal output Inactive: Warning signal not output
FunOut.5	Active: Fault alarm output Inactive: Fault alarm not output
FunOut.6	Active: Brake release output Inactive: Brake engagement output
FunOut.13	Active: Zero speed signal output Inactive: Zero speed signal not output
FunOut.14	Active: Speed command signal achieved Inactive: Speed command not yet achieved
FunOut.15	Active: Actual motor speed exceeds speed command Inactive: Motor speed not at speed command
FunOut.16	Active: In torque mode, torque feedback matches torque command Inactive: Torque feedback does not match torque command
FunOut.28	Active: Position comparison output within set range Inactive: Position comparison not within set range

DO Function Index	DO Function Description
FunOut.29	Active: 60FEh control output 1 Inactive: 60FEh control not active
FunOut.30	Active: 60FEh control output 2 Inactive: 60FEh control not active
FunOut.31	Active: 60FEh control output 3 Inactive: 60FEh control not active
FunOut.32	Active: 60FEh control output 4 Inactive: 60FEh control not active

## 4.8.4 Position Information

### 4.8.4.1 Electronic Gear Ratio

The electronic gear function multiplies the position command input from the upper device by the electronic gear ratio set through the object, serving as the position command for the position control unit. Using this function, you can arbitrarily set the motor rotation\* movement amount per command unit. The electronic gear ratio is set according to objects 608Fh (Encoder Resolution), 6091h-01h (Motor Resolution), and 6091h-02h (Load Shaft Resolution) defined by CoE (CiA402).

Relevant Objects:

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
608Fh	00h	Incremental Encoder Resolution	0 ~4294967295	-	-	-	-	-	No
		Currently not supported							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6091h	01h	Motor Resolution	1~4294967295	-	1	U32	rw	RxPDO	No
		Set the numerator of the electronic gear ratio							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6091h	02h	Load Shaft Resolution	1 ~4294967295	-	1	U32	rw	RxPDO	No
		Set the denominator of the electronic gear ratio							

Electric gear ratio setting  $Gear = \frac{\text{Motor revolutions}(6091h-01)}{\text{Shaft revolutions}(6091h-02)}$ , represents the relationship between command units

and encoder units:

Command units  $\times$  Gear = Encoder units.

Position demand value  $\times$  Electronic gear ratio = Position demand internal value.

This object is automatically set based on information read from the motor connected to the servo drive.

Example: In the case of a 23bit/r encoder connection

6091h-01h (Motor Resolution) = 8388608.

6091h-02h (Load Shaft Resolution) = 10000.

Send 10000 command units, the motor rotates one revolution.

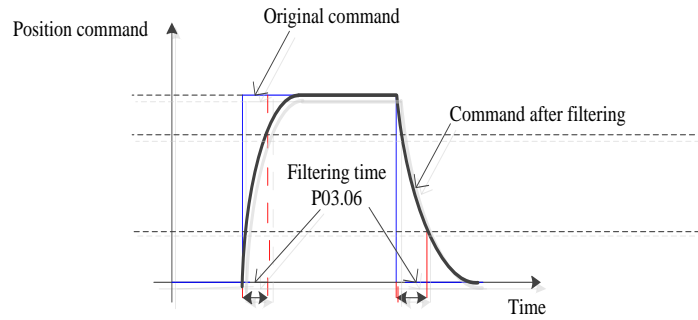
When the electronic gear ratio is set incorrectly, an alarm is triggered (alarm code Er.06.5). The reasons for the alarm include:

- ◆ The numerator is set to 0.
- ◆ The denominator is set to 0.
- ◆ Greater than 0.4 times the encoder resolution.
- ◆ Less than 0.0000001 times the encoder resolution.

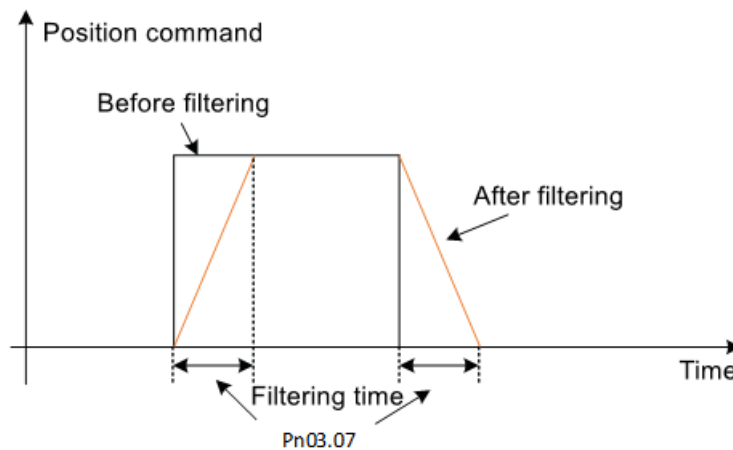
#### 4.8.4.2 Position Command Filtering

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2003h P03.06	07h	Command Low-Pass Filtering Time Constant	0~65535	0.01ms	0	U16	rw	No	YES
		Set the time constant for the low-pass filter for position commands							
Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2003h P03.07	08h	Average Filtering Time Constant	0~2560	0.1ms	0	U16	rw	No	YES
		Set the time constant for the average filter for position commands (encoder units)							

When the upper computer clock is inaccurate or the DC clock is not enabled, causing significant position command jitter, position command filtering can be used to improve this. If the set value is too large, the response delay will increase, and the filtering time constant should be set according to the actual situation.



Position Command Low Pass Filter chart



Position Command Average Filtering chart

### 4.8.4.3 Command Polarity (607Eh)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM						
607Eh		Command Polarity	0~255	-	0	U8	rw	RxPDO	No						
	00h	<p>Set the polarity when transferring the values of position command, speed command, torque command, position offset, speed offset (speed addition), and torque offset (torque addition) from the object to internal processing, and set the polarity when transferring the values of position feedback, speed feedback, and torque feedback from internal processing to the object.</p> <p>Note: Please set the polarity of position, speed, and torque to 0 (bit75 all 0) or 224 (bit75 all 1). Actions under other settings are not guaranteed.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Setting Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No inversion of the sign for position, speed, and torque</td> </tr> <tr> <td>224</td> <td>Inversion of the sign for position, speed, and torque</td> </tr> </tbody> </table>								Setting Value	Description	0	No inversion of the sign for position, speed, and torque	224	Inversion of the sign for position, speed, and torque
Setting Value	Description														
0	No inversion of the sign for position, speed, and torque														
224	Inversion of the sign for position, speed, and torque														

		Other Values	Not supported (do not set)
<p>bit7: Position polarity, 0: No inversion; 1: Inversion  bit6: Speed polarity, 0: No inversion; 1: Inversion  bit5: Torque polarity, 0: No inversion; 1: Inversion  bit4~0: Reserved, set to 0  Objects &lt;Command Setting Class&gt;</p> <ul style="list-style-type: none"> <li>◆ 607Ah (Target Position)</li> <li>◆ 60B0h (Position Offset)</li> <li>◆ 60FFh (Target Speed)</li> <li>◆ 60B1h (Velocity Offset)</li> <li>◆ 6071h (Target Torque)</li> <li>◆ 60B2h (Torque Offset)</li> </ul> <p>&lt;Monitoring Class&gt;</p> <ul style="list-style-type: none"> <li>◆ 6062h (Position Command)</li> <li>◆ 6064h (Position Feedback)</li> <li>◆ 606Bh (Velocity Command)</li> <li>◆ 606Ch (Velocity Feedback)</li> <li>◆ 6074h (Torque Command)</li> <li>◆ 6077h (Torque Feedback)</li> </ul>			

#### 4.8.4.4 Position Range Limit (607Bh)

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
607Bh	-	Soft Limit	-	-	-	-	-	-	-
		Set the soft limit function							
	00h	Number of Supported Sub-Indexes	2	-	2	U8	R	-	-
		Represents the number of sub-indexes for 607Bh (Soft Limit)							
	01h	Soft Limit Lower Value	- 21474836 48 ~ 21474836 47	Command and Unit	0	I32	RW	RxPDO	YES

		Set the lower value of the soft limit							
	02h	Soft Limit Upper Value	- 21474836 48 ~ 21474836 47	Command Unit	0	I32	RW	RxPDO	YES
		Set the upper value of the soft limit							

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
2003h P03.20	21h	Soft Limit Function Setting	0~2	-	0	U8	rw	RxPDO	YES
		0: Disable soft limit function 1: Directly enable soft limit function 2: Enable soft limit function after homing is complete							

When the set soft limit lower value (607Bh-01) is greater than or equal to the soft limit upper value (607Bh-02), an error is set, and an alarm is triggered (alarm code Er.06.A).

When the set home offset (607Ch) is outside the soft limit lower value (607Bh-01) and the soft limit upper value (607Bh-02), an alarm is triggered (alarm code Er.06.9).

#### 4.8.4.5 Home Offset (607Ch)

This object can be updated at any time but must be reflected in the actual position information through the following sequences:

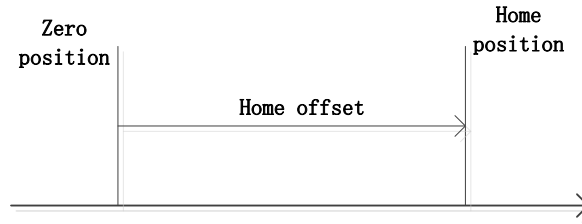
- ◆ When control power is input
- ◆ When communication is established (ESM state transitions from Init to PreOP)
- ◆ When homing is completed

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
607C	01h	Home Offset	- 2147483648 ~ 2147483647	Command Unit	0	I32	rw	RxPDO	YES
		After the home reset control mode (HM) is executed, the position detected by the Index Pulse is set as the position information according to the value of this object. Additionally, under the following sequences, the value of this object is added to the position information. When set incorrectly, an alarm is triggered (alarm code Al.04.9).							

Home position: The position where the Index pulse is detected (home position)

Zero position: For incremental systems = 0 (the position when the power is input, or the position from which the

Home Offset is subtracted from the position where the Index Pulse is detected in HM)



### 4.8.5 Position Comparison Output Function

The motor can output pulse signals from general output or encoder output terminals when it reaches a set position.

Related Functions:

P11.03 Position Comparison Origin Selection	Setting Range	Unit	Factory Default	Related Modes		
	0~1	-	0.0	P	S	T

When set to 1, latches the current position as the origin of the position comparison output when encounter the rising edge of trigger signal (The same effect can be achieved by using the servo's internal homing function.).  
Once set to 1, it automatically resets to 0.

P11.04 Position Comparison Output DO Time Width	Setting Range	Unit	Factory Default	Related Modes		
	0.1~1000.0	0.1ms	1.0	P	S	T

Description:  
After the position comparison output becomes effective, the output width requires an appropriate time setting. If the setting is too small, the host controller may not detect the level change. If set too large, it may affect adjacent position triggers.

P11.05 Position Comparison Point Offset	Setting Range	Unit	Factory Default	Related Modes		
	-2147483648~2147483647	Encoder	0	P	S	T

Description:  
The position comparison point is acquired by subtracting this offset from the set comparison position.  
Unit: For ABZ incremental encoders, it is the encoder unit. For bus encoders, the unit uses the divisor set in P11.07.

P11.0D Display the Current Comparison Position of the Output Point	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T

Description:  
Displays the comparison position of the current output point.  
Unit: For ABZ incremental encoders, it is the encoder unit. For bus encoders, the unit uses the divisor set in P11.07.

P11.0F Current Comparison Output Point Count	Setting Range	Unit	Factory Default	Related Modes		
	1~10	Encoder	10	P	S	T

Description:  
Displays the number of current comparison output points.

Position Comparison Output Settings:

P11.16 Comparison Output Position 1 Attribute	Setting Range	Unit	Factory Default	Related Modes		
	0~3	-	0	P	S	T

Description:  
0: Disabled  
1: Triggered during forward motion  
2: Triggered during reverse motion  
3: Triggered during either forward or reverse motion

P11.17 Comparison Output Position 1	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T

Description:  
The comparison position of the first output point. When the actual motor position matches this position, the DO output is triggered.

P11.19 Comparison Output	Setting Range	Unit	Factory	Related
--------------------------	---------------	------	---------	---------

Position 2 Attribute				Default	Modes		
		0~3	-	0	P	S	T
Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion 3: Triggered during either forward or reverse motion							
P11.1A Comparison Output Position 2		Setting Range	Unit	Factory Default	Related Modes		
		-2147483648~2147483647	Encoder	-	P	S	T
Description: The comparison position for the second output point; when the actual motor position matches this position, DO output is triggered.							

P11.1C Comparison Output Position 3 Attribute		Setting Range	Unit	Factory Default	Related Modes		
		0~3	-	0	P	S	T
Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion 3: Triggered during either forward or reverse motion							
P11.1D Comparison Output Position 3		Setting Range	Unit	Factory Default	Related Modes		
		-2147483648~2147483647	Encoder	-	P	S	T
Description: The comparison position of the second output point. When the actual motor position matches this position, the DO output is triggered.							

P11.1F Comparison Output Position 4 Attribute		Setting Range	Unit	Factory Default	Related Modes		
		0~3	-	0	P	S	T

Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion 3: Triggered during either forward or reverse motion						
P11.20 Comparison Output Position 4	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T
Description: The comparison position of the third output point. When the actual motor position matches this position, the DO output is triggered.						

P11.22 Comparison Output Position 5 Attribute	Setting Range	Unit	Factory Default	Related Modes		
	0~3	-	0	P	S	T
Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion 3: Triggered during either forward or reverse motion						
P11.23 Comparison Output Position 5	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T
Description: The comparison position of the fifth output point. When the actual motor position matches this position, the DO output is triggered.						

P11.25 Comparison Output Position 6 Attribute	Setting Range	Unit	Factory Default	Related Modes		
	0~3	-	0	P	S	T
Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion						

3: Triggered during either forward or reverse motion						
P11.26 Comparison Output Position 6	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~21474 83647	Enco der	-	P	S	T
<p>Description:</p> <p>The comparison position of the sixth output point. When the actual motor position matches this position, the DO output is triggered.</p>						

<b>P11.28 Comparison Output Position 7 Attribute</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	0~3	-	0	P	S	T
<p>Description:</p> <p>0: Disabled</p> <p>1: Triggered during forward motion</p> <p>2: Triggered during reverse motion</p> <p>3: Triggered during either forward or reverse motion</p>						
P11.29 Comparison Output Position 7	Setting Range	Unit	Factory Default	Related Modes		
	2147483648~21474 83647	Enco der	-	P	S	T
<p>Description:</p> <p>The comparison position of the seventh output point. When the actual motor position matches this position, the DO output is triggered.</p>						

<b>P11.2B Comparison Output Position 8 Attribute</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	0~3	-	0	P	S	T
<p>Description:</p> <p>0: Disabled</p> <p>1: Triggered during forward motion</p> <p>2: Triggered during reverse motion</p> <p>3: Triggered during either forward or reverse motion</p>						

P11.2C Comparison Output Position 8	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T
Description: The comparison position of the eighth output point. When the actual motor position matches this position, the DO output is triggered.						

P11.2E Comparison Output Position 9 Attribute	Setting Range	Unit	Factory Default	Related Modes		
	0~3	-	0	P	S	T
Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion 3: Triggered during either forward or reverse motion						
P11.2F Comparison Output Position 9	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T
Description: The comparison position of the ninth output point. When the actual motor position matches this position, the DO output is triggered.						

P11.31 Comparison Output Position 10 Attribute	Setting Range	Unit	Factory Default	Related Modes		
	0~3	-	0	P	S	T
Description: 0: Disabled 1: Triggered during forward motion 2: Triggered during reverse motion 3: Triggered during either forward or reverse motion						
P11.32 Comparison Output Position 10	Setting Range	Unit	Factory Default	Related Modes		
	- 2147483648~2147483647	Encoder	-	P	S	T

	83647					
<p><b>Description:</b>                  The comparison position of the tenth output point. When the actual motor position matches this position, the DO output is triggered.</p>						

Note: FV5 series rotary EtherCAT Bus type servo drive support 32 comparison output positions, and are not repeated here.

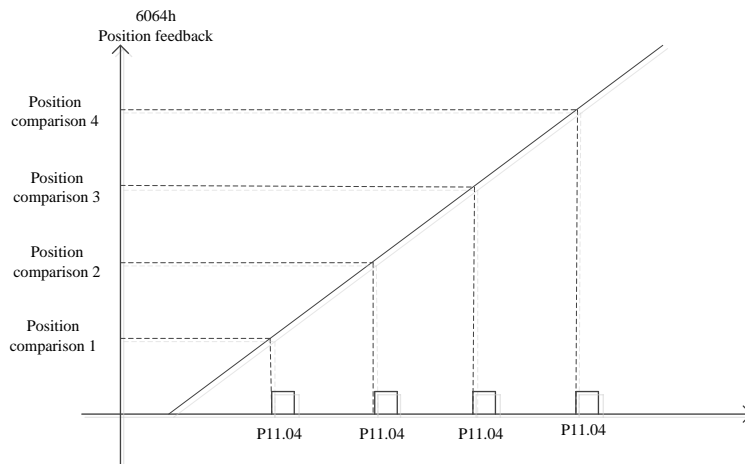
**DO Output:**

Use FunOut.28 to set the position comparison output function, setting the corresponding DO terminal logic level, and setting the effective level of the position comparison output function. For example, to set DO3 to enable the position comparison output function with high level effective:

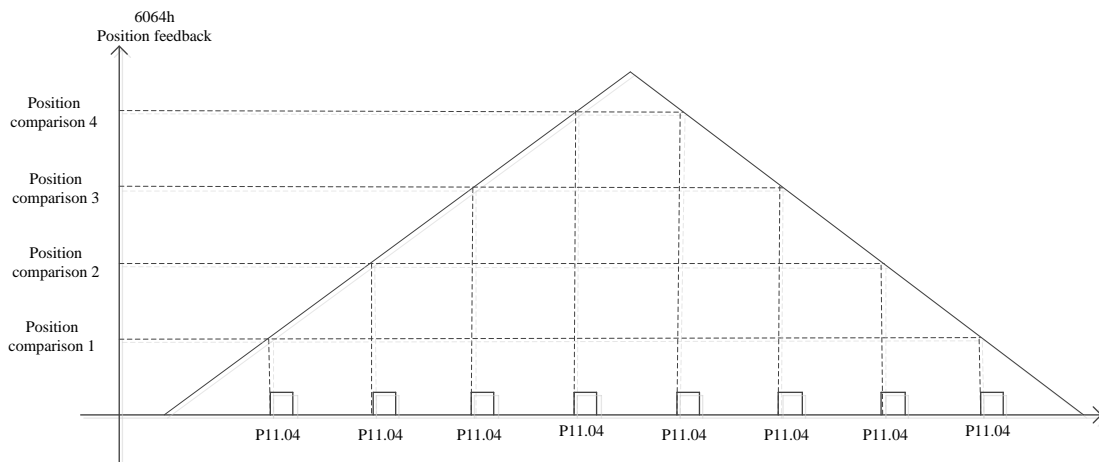
Set P05.04 to 28, P05.05 to 1

The comparison output actions are as follows:

◆ Unidirectional operation:



◆ Reciprocal operation:



### 4.8.6 Operation Monitoring Function

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PD O	EEPROM
201Ah	01h	Real-time Running Speed	-	RPM	-	I16	R	No	-
(U00.00)		isplays real-time motor speed feedback in RPM. If there are large fluctuations, use P07.15 to set the speed display filtering time.							
201Ah	02h	DI Level Display	-	-	-	U16	R	No	-
(U00.01)		Displays the high and low levels of DI. "I" at the bottom indicates low level, and at the top indicates high level. From right to left, it shows DI1~DI5.							
201Ah	04h	DO Output Level Display	-	-	-	U16	R	No	-
(U00.03)		isplays the high and low levels of DO. "I" at the bottom indicates low level, and at the top indicates high level. From right to left, it shows DO1~DO4.							
201Ah	06h	Current Position Command	- 214748364 8 ~ 214748364 7	Command Unit	-	I32	R	No	-
(U00.05)		Same as 6062h position command.							
201Ah	08h	Current Position Feedback	- 214748364 8 ~ 214748364 7	Command Unit	-	I32	R	No	-
(U00.07)		Same as 6064h feedback.							
201Ah	0Ah	Current Position Feedback	- 214748364 8 ~ 214748364 7	Encoder Unit	-	I32	R	No	-
(U00.09)		Same as 6064h position command total * electronic gear ratio.							
201Ah	0Ch	Current Position Offset	- 214748364 8 ~	Encoder Unit	-	I32	R	No	-

Index	Subindex	Name	Setting Range	Unit	Factory Default	Data Type	ACCESS	PDO	EEPROM
			2147483647						
(U00.0B)		Equivalent to 60F4h * electronic gear ratio.							
201Ah	0Eh	Discharge Resistor Load Rate	-	0.1%	-	I16	R	No	-
(U00.0D)		Calculates the current load rate of the discharge resistor based on the set power and resistance value of the external discharge resistor. When it reaches 100%, it will alarm (alarm code A1.04.A, discharge resistor overload).							
201Ah	0Fh	Average Load Rate	-	0.1%	-	I16	R	No	-
(U00.0E)		Calculates the average load rate based on real-time current and motor rated current. High average load rate may cause severe heating of the driver and motor.							
201Ah	10h	Speed Command	-	RPM	-	I16	R	No	-
(U00.0F)		Speed command unit is RPM.							
201Ah	11h	Torque Command	-	0.1%	-	I16	R	No	-
(U00.10)		Calculates according to the percentage of the motor's rated current.							
201Ah	15h	Current Motor Current	-	0.01A	-	I16	R	No	-
(U00.14)		Displays motor vector current value.							
201Ah	16h	Current Bus Voltage	-	0.1V	-	U16	R	No	-
(U00.15)		Displays bus voltage value.							

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
201Ah h	1Bh	Driver Temperature Display	-	°C	-	U16	R	No	-
(U00.1A)		Displays the core temperature inside the heat sink of the driver.							
201Ah	1Eh	Driver Operation Time	-	°C	-	U32	R	No	-
(U00.1D)		Drive power-on operation time, saved every half an hour. If less than half an hour, it is not saved.							
201Ah	24h	Encoder Multi-turn Position	-	-	-	U16	R	No	-
(U00.23)									
201Ah	25h	Encoder Single-turn Position	0~8388607	Encoder Unit	-	U32	R	No	-
(U00.24)									
201Ah	37h	Incremental Encoder AB Count	-2147483648 ~ 2147483647	Encoder Unit	-	I32	R	No	-
(U00.36)		Feedback count when using a linear motor or ABZ encoder motor.							
201Ah	39h	Increment Encoder Z Pulse Count	0~65535	-	-	U16	R	No	-
(U00.38)		Z pulse count when using a linear motor or ABZ encoder motor.							

## 4.8.7 Multi-turn Absolute Position

The drive uses a multi-turn absolute encoder to record the position of the motor, to prevent the loss of absolute position when power off. After powering on, the machine does not need to execute homing operation before motion, widely used in robotics, machine tools and other industries.

Precautions:

- ◆ To use this function, you need use encoder cable with battery, and the encoder of motor must be multi-turn absolute encoder.
- ◆ When modifying P02.01 (rotation direction setting) and F07 (absolute encoder reset operation), the absolute position of the encoder changes, resulting in a change in the mechanical absolute home position. Therefore it requires a mechanical homing operation. When using the drive internal homing feature, The absolute position deviation of the machine and the absolute position deviation of the encoder are automatically calculated. and the deviations are assigned to P02.5A and P02.5C and saved in EEPROM

### 4.8.7.1 Usage of Absolute Encoder Battery Box

Absolute position mode requires the usage of encoder cable with battery box. It report Er.10.6(encoder battery failure) when the battery is connected at first time , you need to set the F07 to 2 to reset multi-turn position and reset failure, repwoer up the drive then perform absolute position operation.

If the Er.10.6 alarm can not be eliminated, please refer to trouble-shooting for this alarm code.

The encoder battery should be stored at the specified ambient temperature during storage, and ensure that the battery contact is reliable and the power is sufficient, otherwise it may result in loss of encoder position information.

### 4.8.7.2 Calculation method of Encoder Feedback Position

The parameters involved in the feedback position of the encoder are shown in the following table.

Index (Function code)	Sub index	Name	Setting (display) range	Unit	Setting mode	Activate mode
201Ah (U00.23)	24	Number of encoder multi-turn	0~65535	-	Display	Real-time
201Ah (U00.24)	25	Encoder single-turn position	0~8388608	Encoder unit	Display	Real-time
201Ah (U00.26)	27	Low 32-bit of absolute position in encoder unit	0~4294967295	Encoder unit	Display	Real-time
201Ah (U00.28)	29	High 32-bit of absolute position in encoder unit	0~4294967295	Encoder unit	Display	Real-time

If the encoder resolution is  $R_E$  (for example:  $2^{23}$ ), encoder absolute position is  $P_E$ ,  $P_E = U00.28 \times R_E + U00.26$

When  $U00.23 < 32768$ ,  $P_E = (U00.23 \times R_E + U00.24)$  ;

When  $U00.23 \geq 32768$ , the format of value of  $U00.28 + U00.26$  is Two's Complement, need to be converted to decimal.  $P_E = -(2^{64} - U00.28 \times 2^{32} + U00.26)$  ;  $P_E = (U00.23 - 65536) \times R_E + U00.24$ .

### 4.8.7.3 Absolute Linear Mode

The absolute linear mode (P02.29=1) is primarily used in scenarios where the equipment load operates linearly and travel limit protection is not required. The parameters related to this mode are shown in the table below.

Index (Function code)	Sub-index	Name	Setting (display) range	Unit	Setting mode	Activate mode
6091h	01	Gear ratio motor resolution	1~4294967295	-	Any	Real-time

Index (Function code)	Sub-index	Name	Setting (display) range	Unit	Setting mode	Activate mode
6091h	02	Gear ratio load shaft resolution	1~4294967295	-	Any	Real-time
2002h (P02.5A)	5B	Absolute position offset	-2147483648 ~2147483647	Encoder unit	Stop	Real-time
2002h (P02.5C)	5D	High 32-bit of absolute position offset	-2147483648 ~2147483647	Encoder unit	Stop	Real-time
201Ah (U00.07)	08	Absolute position counting	-2147483648 ~2147483647	Command unit	Display	Real-time
201Ah (U00.23)	24	Number of encoder multi-turn	0~65535	-	Display	Real-time
201Ah (U00.24)	25	Encoder single-turn position	0~8388608	Encoder unit	Display	Real-time
201Ah (U00.2A)	2B	Low 32-bit of absolute mechanical position	0~4294967295	Encoder unit	Display	Real-time
201Ah (U00.2C)	2D	High 32-bit of absolute mechanical position	0~4294967295	Encoder unit	Display	Real-time

When  $U00.2C < 2,147,483,648$ , absolute mechanical position  $P_M = U00.2C \times 2^{32} + U00.2A$

When  $U00.2C \geq 2,147,483,648$ , absolute mechanical position  $P_M = -(2^{64} - U00.2C \times 2^{32} - U00.2A)$

Encoder absolute position  $P_E$ , absolute position offset(P02.5A and P02.5C) is  $P_o$ ,  $P_M = P_E - P_o$  (The number of turns does not change from 32767 to 32768 during forward rotation or from 32768 to 32767 during reverse rotation)

Absolute position counter(U00.07) Indicates the current absolute position of the mechanism(in encoder unit), absolute position counter(U00.07)  $\times$  Electronic gear ratio =  $P_M$

Among them, electronic gear ratio = Gear ratio motor resolution / Gear ratio load shaft resolution

This mode disable multi-turn overflow alarm.

Index(Function code)	Sub index	Name	Setting ( display ) range	Unit	Default	Setting mode	Activate mode
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200Bh (P0B.03)	04	Multi-turn encoder overflowing alarm enablement	0 :Enable 1: Disable	-	0	Stop	Real-time
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#### 4.8.7.4 Absolute Rotary Mode

Absolute rotary mode (P02.29=2) is primary used in the scenarios where the travel range of the equipment load is not restricted. The parameters related to this mode are listed in the table below..

Index(Function code)	Sub index	Name	Setting(display) range	Unit	Setting mode	Activate mode
6091h	01	Gear ratio motor resolution	1~4294967295	-	Any	Real-time
6091h	02	Gear ratio load shaft resolution	1~4294967295	-	Any	Real-time
2002h (P02.2A)	2B	Numerator of mechanical load gear ratio	1~65535	-	Stop	Real-time
2002h (P02.2B)	2C	Denominator of mechanical load gear ratio	1~65535	-	Stop	Real-time
2002h (P02.5A)	5B	Absolute position offset	-2147483648~2147483647	Encoder unit	Stop	Real-time
2002h (P02.5C)	5D	High 32-bit of absolute position offset	-2147483648~2147483647	Encoder unit	Stop	Real-time
201Ah (U00.07)	08	Absolute position counting	-2147483648~2147483647	Command unit	Display	Real-time
201Ah (U00.23)	24	Number of encoder multi-turn	0~65535	-	Display	Real-time

Index(Function code)	Sub index	Name	Setting(display) range	Unit	Setting mode	Activate mode
201Ah (U00.24)	25	Encoder single-turn position	0~8388608	Encoder unit	Display	Real-time
201Ah (U00.2A)	2B	Low 32-bit of absolute mechanical position	0~4294967295	Encoder unit	Display	Real-time
201Ah (U00.2C)	2D	High 32-bit of absolute mechanical position	0~4294967295	Encoder unit	Display	Real-time
201Ah (U00.32)	33	Rotary load single-turn position	-	Command unit	Display	Real-time

If the resolution of encoder is  $R_E$  ( $R_E = 2^{23}$ ), the value range of rotary load single-turn position(in command unit, U00.32) is  $0 \sim [R_E / (\text{Gear ratio motor resolution} / \text{Gear ratio load shaft resolution}) \times (\text{Numerator of mechanical load gear ratio} / \text{Denominator of mechanical load gear ratio})]$

Rotary load single-turn position( in encoder unit)= rotary load single-turn position (in command uni, U003.32)  $\times$  (numerator of the first electronic gear ratio / denominator of the first electronic gear ratio)

Absolute mechanical position  $P_M = (U00.2C \times 2^{32} + U00.2A)$

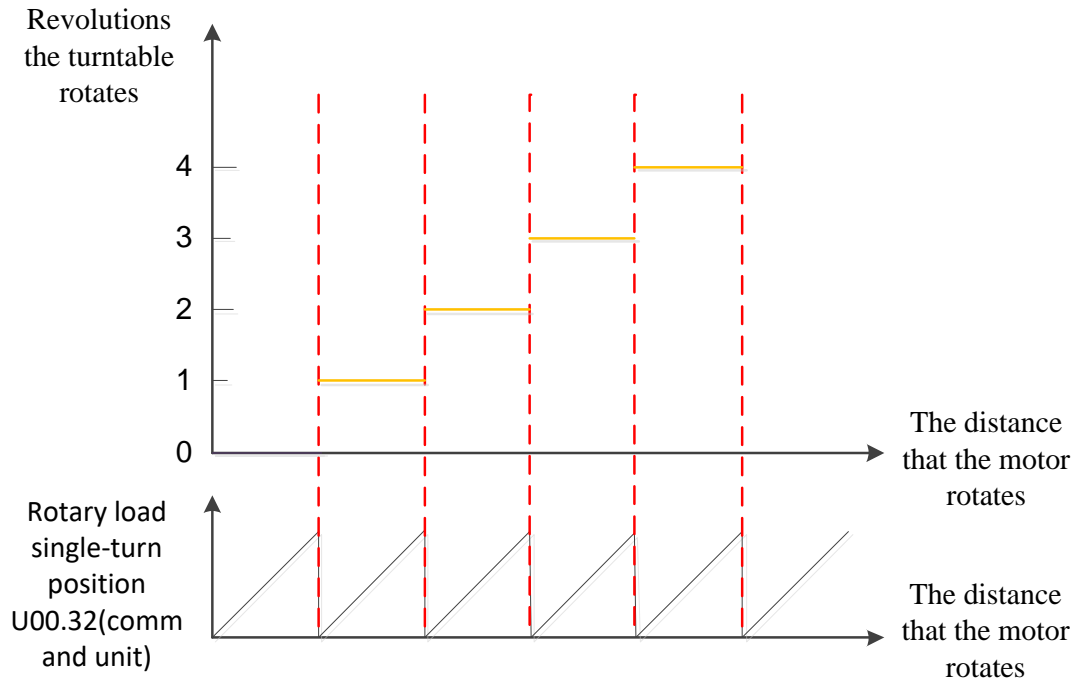
$P_M =$  Rotary load single-turn position(in encoder unit) + the number of revolutions of the turntable  $\times$  The number of pulses corresponding to one revolution of the rotary load  $R_M$

$R_M = R_E \times (\text{numerator of mechanical load gear ratio} / \text{denominator of mechanical load gear ratio})$

Absolute position counter( U00.07) =  $P_M / \text{Gear ratio motor resolution} \times \text{Gear ratio load shaft resolution}$

In absolute position rotation mode, the multi-turn data range is unlimited, and the Er10.8 alarm (encoder multi-turn count overflow fault) is disabled.

The relationship between the single-turn position of the rotary load and the number of revolutions of the turntable is shown in the figure below.



### 4.8.7.5 Linear Mode

linear mode(P02.29=3)is mainly used in scenarios with limited travel or requiring positioning protection. The parameters related to this mode are shown in the table below.

Index (Function code)	Sub-index	Name	Setting (display) range	Unit	Setting mode	Activate mode
6091h	01	Gear ratio motor resolution	1~4294967295	-	Any	Real-time
6091h	02	Gear ratio load shaft resolution	1~4294967295	-	Any	Real-time
2002h (P02.5A)	5B	Absolute position offset	-2147483648 ~2147483647	Encoder unit	Stop	Real-time
2002h (P02.5C)	5D	High 32-bit of absolute position offset	-2147483648 ~2147483647	Encoder unit	Stop	Real-time
201Ah (U00.07)	08	Absolute position counting	-2147483648 ~2147483647	Command unit	Display	Real-time
201Ah (U00.23)	24	Number of encoder multi-turn	0~65535	-	Display	Real-time
201Ah (U00.24)	25	Encoder single-turn position	0~8388608	Encoder unit	Display	Real-time

Index (Function code)	Sub-index	Name	Setting (display) range	Unit	Setting mode	Activate mode
201Ah (U00.2A)	2B	Low 32-bit of absolute mechanical position	0~4294967295	Encoder unit	Display	Real-time
201Ah (U00.2C)	2D	High 32-bit of absolute mechanical position	0~4294967295	Encoder unit	Display	Real-time

When  $U00.2C < 2,147,483,648$ , absolute mechanical position  $P_M = U00.2C \times 2^{32} + U00.2A$

When  $U00.2C \geq 2,147,483,648$ , absolute mechanical position  $P_M = -(2^{64} - U00.2C \times 2^{32} - U00.2A)$

Encoder absolute position  $P_E$ , absolute position offset(P02.5A and P02.5C) is  $P_o$ ,  $P_M = P_E - P_o$  (The number of turns does not change from 32767 to 32768 during forward rotation or from 32768 to 32767 during reverse rotation)

Absolute position counter(U00.07) Indicates the current absolute position of the mechanism(in encoder unit), absolute position counter(U00.07) × Electronic gear ratio =  $P_M$

Among them, electronic gear ratio = Gear ratio motor resolution / Gear ratio load shaft resolution

In linear mode, the actual value range for the encoder's multi-turn data is -32768 to 32767. This means that if the number of turns (U00.23) during forward rotation increases by more than 32767 turns compared to that when homing, or decreases by more than 32768 turns during reverse rotation compared to that when homing, a fault Er.10.8 (encoder multi-turn count overflow fault) will be triggered.

### 4.8.7.6 Configuration Method

Step 1. Select the operating mode of absolute encoder via P02.29(according to the actual application scenario).

Index(Function code)	Sub index	Name	Setting range	Unit	Default	Data type	ACCESS	PDO	EEPROM
2002h (P02.29)	2A	Absolute encoder operating mode	<ul style="list-style-type: none"> <li>◆ 0: Incremental mode</li> <li>◆ 1: Absolute linear mode</li> <li>◆ 2: Absolute rotary mode</li> </ul>	-	0	U16	rw	NO	Yes

			◆ 3: Linear mode						
--	--	--	------------------	--	--	--	--	--	--

Step 2. Set F07 to 2 to reset multi-turn position and fault, restart the drive( It may report Er.10.6, Er.10.7 or Er.10.8 error after the operation, execute step 2 again).

Index(Function code)	Sub index	Name	Setting range	Unit	Default	Data type	ACCESS	PDO	EEPROM
201Fh (F07)	0x08	Absolute encoder reset operation	<ul style="list-style-type: none"> <li>◆ 0: Disabled</li> <li>◆ 1: Reset fault</li> <li>◆ 2 : Reset multi-turn position and fault</li> <li>◆ 3: Operate failure (When the value is set to 1 or 2, this parameter is automatically to set to 0 after resetting successfully, otherwise, it is set to 3)</li> </ul>	-	0	U16	rw	NO	Yes

Step 3. After the reset operation of encoder multi-turn position, the absolute encoder position changes, it need to execute homing operation (please refer to [Position Control in HM Mode \(Homing Mode\)](#)).

## 4.9 EtherCAT Related Faults

### 4.9.1 Er.09.0 EtherCAT Hardware Initialization Failure

Possible Cause	Solution and Verification Method
Driver hardware issue	Replace the driver.

### 4.9.2 Er.09.1 ESI Check Error

Possible Cause	Solution and Verification Method
XML file not burned	Confirm if the XML file is burned, check the U02.05 version number of the XML file, if not, burn the XML file again.
Driver hardware issue	Cannot read ESC's EEPROM.

### 4.9.3 Er.09.2 Bus EEPROM Data Check Error

Possible Cause	Solution and Verification Method
XML file version data incorrect	Confirm if the XML file is burned, check the XML file version number, it may be that the XML file does not match the software version. You can burn the corresponding XML file again.

### 4.9.4 Er.09.3 Bus EEPROM Operation Timeout

Possible Cause	Solution and Verification Method
XML file not burned	Confirm if the XML file is burned, check the XML file version number, it may be that the XML file does not match the software version. You can burn the corresponding XML file again.
Driver hardware error	Replace the driver.

### 4.9.5 Er.09.4 EtherCAT Synchronization Cycle Setting Error

Possible Cause	Solution and Verification Method
The set synchronization cycle is not an integer multiple of the command cycle	Adjust the upper computer program and configure it as an integer multiple of the command cycle. The default command cycle is 250 $\mu$ s.
The set synchronization cycle is too large	Adjust the upper computer program to make it less than 10ms. If the cycle is too large, it will cause sparse commands and running jitter.
The set synchronization cycle is too small	The minimum in DC mode is one command cycle (250 $\mu$ s), the minimum in SM mode is 1ms.

### 4.9.6 Er.09.5 PDO Mapping Object Invalid

Possible Cause	Solution and Verification Method
PDO mapping configuration error	Reconfigure PDO on the upper computer.

### 4.9.7 Er.09.6 SYNC Signal Lost

Possible Cause	Solution and Verification Method
Cable interference	Check the wiring and recommend using Cat 5e cables.
Master station issue, clock abnormality	Check if the master station sends abnormal SYNC signals.

### 4.9.8 Er.09.7 IRQ Signal Lost

Possible Cause	Solution and Verification Method
Cable interference	Check the wiring and recommend using Cat 5e cables.
Master station issue	Check if the master station sends abnormal IRQ signals.

### 4.9.9 Er.09.8 EtherCAT SYNC Signal Jitter Too Large

Possible Cause	Solution and Verification Method
SYNC signal jitter exceeds $2 \mu s$	Cable interference, master station issues, etc.

### 4.9.10 Er.09.9 Bus EEPROM Write Check Error

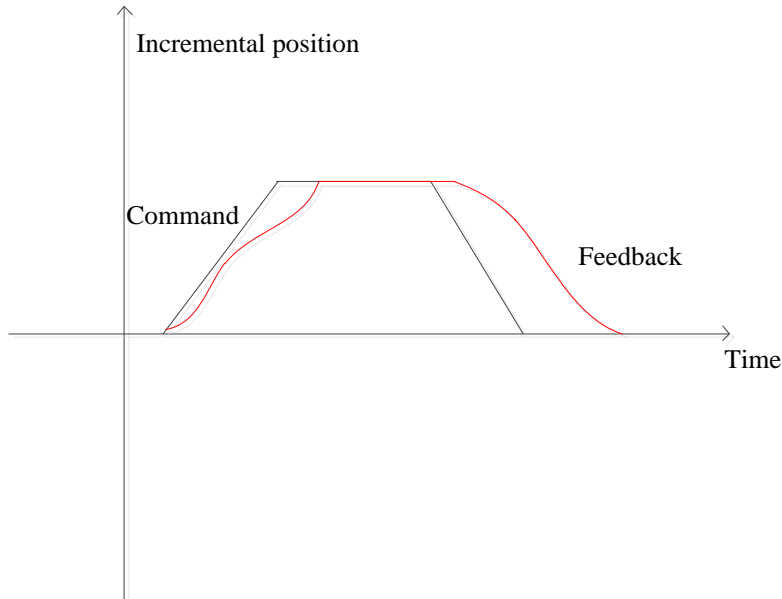
Possible Cause	Solution and Verification Method
Hardware error	Replace the driver.
Cable issue	Replace cables, communication lines, etc.

# 5 Gain Adjustment / Vibration Suppression

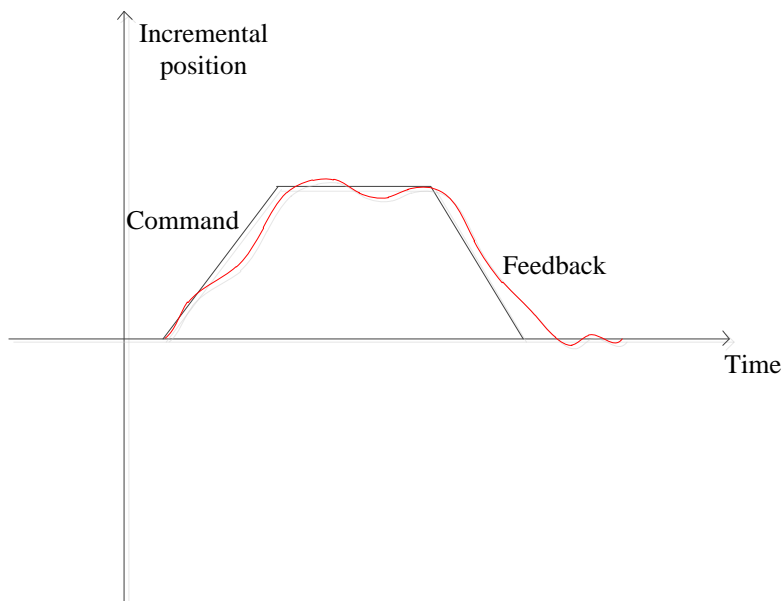
## 5.1 Gain Adjustment Objectives

Gain adjustment aims to ensure that the motor operates according to the commands from the upper computer without delay, maximizing mechanical performance. Users often need to adjust the related gains of the position loop and the speed loop.

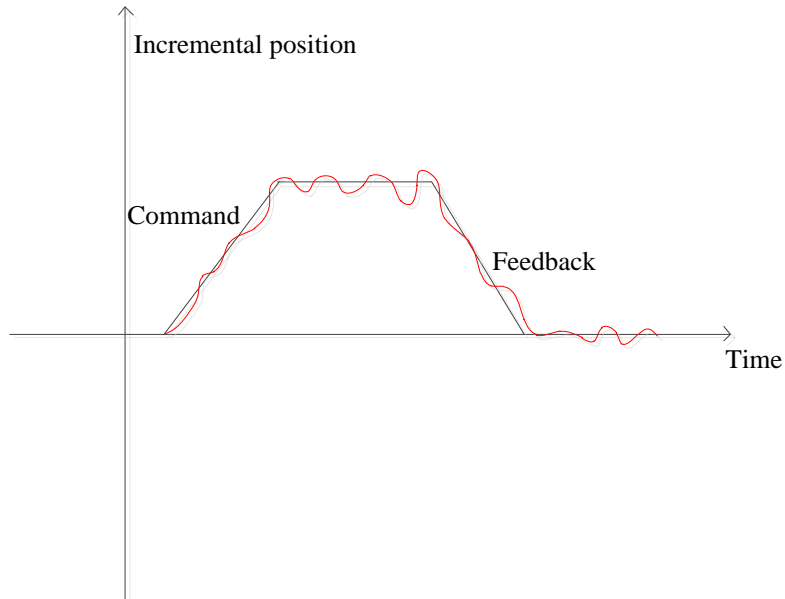
Below are some common debugging waveform:



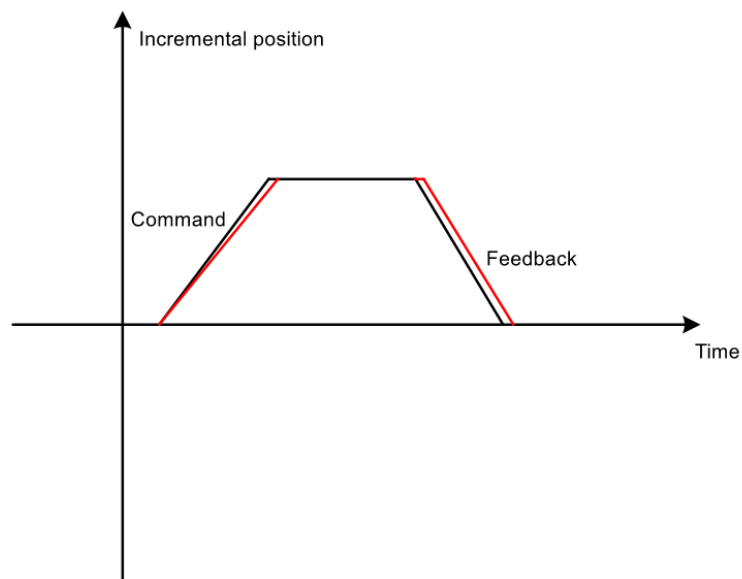
When the servo gain adjustment is too weak, the response is slow, resulting in a long trailing time.



Mismatch between position loop and speed loop gains results in overshoot.



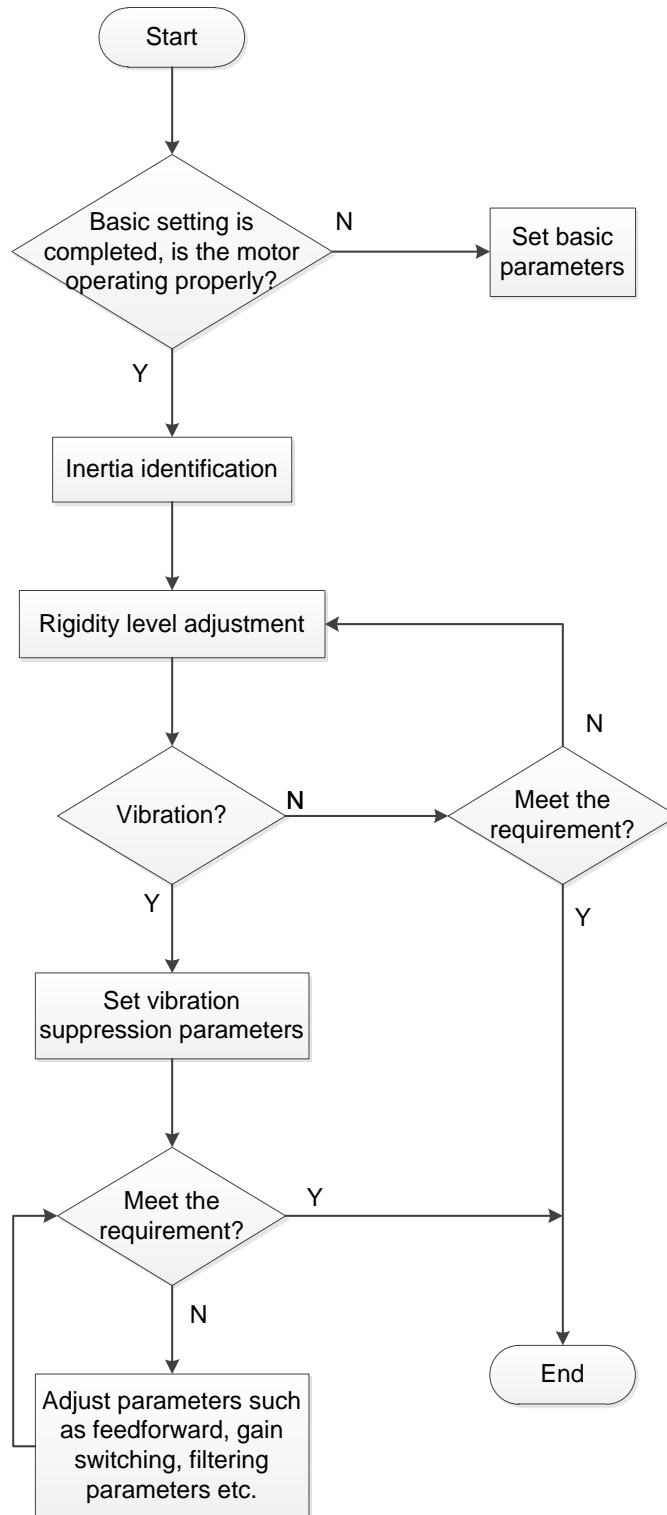
Excessive gains in the position loop or speed loop lead to oscillations. Ideal position response is achieved by strengthening the gains of the position and speed loops, as well as parameters such as feedforward.



During actual debugging, due to mechanical factors, it is difficult for position feedback to perfectly match the command. As long as the response has no overshoot, no oscillation, and the positioning time is less than the required value, it is acceptable.

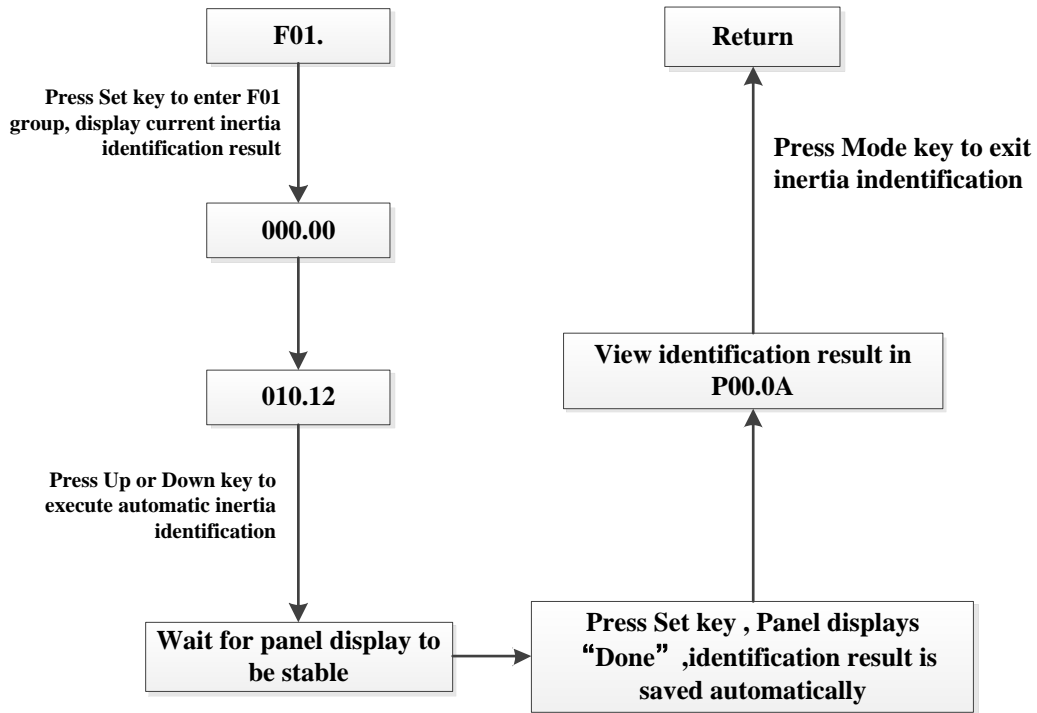
## 5.2 Manual Gain Adjustment

Gain adjustment often follows the steps below.



### 5.2.1 Inertia Identification

Inertia identification is the first step in parameter adjustment. It can be identified through the panel or the Flexem Servo Configuration software. If using the Flexem Servo Configuration software, a wizard can guide the process. If using the panel, the operation process is as follows:



Related Function Codes for Inertia Identification

P00.0A Load Inertia Ratio	Setting Range	Unit	Factory Default	Related Modes		
	0.00~120.00	-	1.00	P	S	T

Description:  
 Load Inertia Ratio = External Load Inertia / Motor Load Inertia

P02.30 Inertia Identification Operation Mode	Setting Range	Unit	Factory Default	Related Modes		
	0~1	-	0	P	S	T

Explanation:

- ◆ 0: Positive and negative operation mode (limited mechanical travel, motor runs in both directions).
- ◆ 1: Jog mode (unlimited mechanical travel, motor runs in one direction).

### 5.2.2 Rigidity Level Adjustment

When setting initial parameters, the self-tuning mode can be selected by setting P00.00 to a non-zero parameter to

group set the gain parameters. Then, P00.01 can be set to gradually enhance the servo response. The different modes affected by Pn00.00 are shown in the table below ( “○” represents support; “×” represents no support):

Function Code	Name	Rigidity Mode	Table	Positioning Mode	Single-click Tuning Mode
P00.02	Speed Loop Gain Group 1	○		○	○
P00.03	Speed Loop Integration Time Constant Group 1	○		○	○
P00.04	Position Loop Gain Group 1	○		○	○
P00.05	Torque Filter Constant Group 1	○		○	○
P00.06	Speed Loop Gain Group 2	×		○	○
P00.07	Speed Loop Integration Time Constant Group 2	×		○	○
P00.08	Position Loop Gain Group 2	×		○	○
P00.09	Torque Filtering Constant Group 2	×		○	○
P00.10	Speed Feedforward Gain	×		○	○
P00.12	PDFF Control Coefficient	×		×	○
P00.14	Torque Feedforward Gain	×		×	○
P00.19	Gain Switching Method	×		○	○
P00.31	Friction Compensation Percentage	×		×	○

#### Gain Setting Related Function Codes

P00.00 Automatic adjustment Mode Selection	Setting Range	Unit	Factory Default	Related Modes		
	0~3	-	1	P	S	T

Explanation:

- ◆ 0: Manual Gain Setting
- ◆ 1: Automatically adjust rigidity table
- ◆ 2: Positioning Mode
- ◆ 3: Single-click Adjustment Mode

Choose different adjustment methods according to the load condition and operation mode to maximize the system's responsiveness and stability.

P00.01 Rigidity Level Selection	Setting Range	Unit	Factory Default	Related Modes		
	1~31	-	11	P	S	T

Explanation:

The higher the rigidity, the better the system's responsiveness. However, excessive rigidity can lead to system oscillations. Therefore, it should be set according to the actual situation.

P00.02 First Velocity Loop Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~2000.0	Hz	18.0	P	S	T

Explanation:

The larger the proportional gain setting of the velocity loop, the faster the response of the velocity loop. However, setting it too large can easily lead to system oscillation.

P00.03 First Velocity Loop Integral Time	Setting Range	Unit	Factory Default	Related Modes		
	0.15~512.00	ms	31.00	P	S	T

Explanation:

The larger the integral time constant of the velocity loop, the smaller the integral action of the velocity loop.

P00.04 First Position Loop Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~2000.0	Hz	40.0	P	S	T

Explanation:

The larger the proportional gain of the position loop, the faster the position following.

P00.05 First Torque Filtering Time	Setting	Unit	Factory	Related
------------------------------------	---------	------	---------	---------

	Range	ms	Default	Modes		
	0.0~30.00		1.26	P	S	T
Explanation: Torque command low-pass filtering time.						

P00.06 Second Velocity Loop Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~2000.0	Hz	40.0	P	S	T
Explanation: The higher the proportional gain setting of the velocity loop , the quicker the velocity loop responds. However, setting it too high can lead to system oscillations.						

P00.07 Second Velocity Loop Integral Time	Setting Range	Unit	Factory Default	Related Modes		
	0.15~512.00	ms	20.00	P	S	T
Explanation: The larger the integral time constant of the velocity loop, the smaller the integral action of the velocity loop.						

P00.08 Second Position Loop Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~2000.0	Hz	64.0	P	S	T
Explanation: TThe larger the proportional gain of the position loop, the quicker the position following.						

P00.09 Second Torque Filtering Time	Setting Range	Unit	Factory Default	Related Modes		
	0.00~30.00	ms	1.26	P	S	T
Explanation: Torque command low-pass filtering time						

P00.10 Velocity Feedforward Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	%	0.0	P	S	-

Explanation:  
Used to set the velocity feedforward compensation

P00.12 PDFF Control Coefficient	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	%	100.0	P	S	T

Explanation:  
This parameter can adjust the overshoot of velocity response

P00.19 Gain Switching Mode	Setting Range	Unit	Factory Default	Related Modes		
	0~4	-	0	P	S	T

Explanation:

- ◆ 0: No gain switching
- ◆ 1: DI switches P/PI mode
- ◆ 2: DI switches between the first and second groups
- ◆ 3: Position command + velocity feedback mode
- ◆ 4: Position command three-group gain switching mode

When setting different rigid levels P00.01, the corresponding loop gains for different levels are as follows:

Rigidity Level	First gain group				Second gain group			
	P00.04	P00.02	P00.03	P00.05	P00.08	P00.06	P00.07	P00.09
	First Position Loop Gain (Hz)	First Velocity Loop Gain(Hz)	First Velocity Loop Integral Time Constant (ms)	First Torque Filtering Time Constant(ms)	Second Position Loop Gain(Hz)	Second Velocity Loop Gain(Hz)	Second Velocity Loop Integral Time Constant(ms)	Second Torque Filtering Time Constant(ms)
0	2.0	1.5	370.00	15.00	3.0	1.5	512.00	15.00
1	2.5	2.0	280.00	11.00	4.0	2.0	512.00	11.00
2	3.0	2.5	220.00	9.00	4.5	2.5	512.00	9.00
3	4.0	3.0	190.00	8.00	5.5	3.0	512.00	8.00

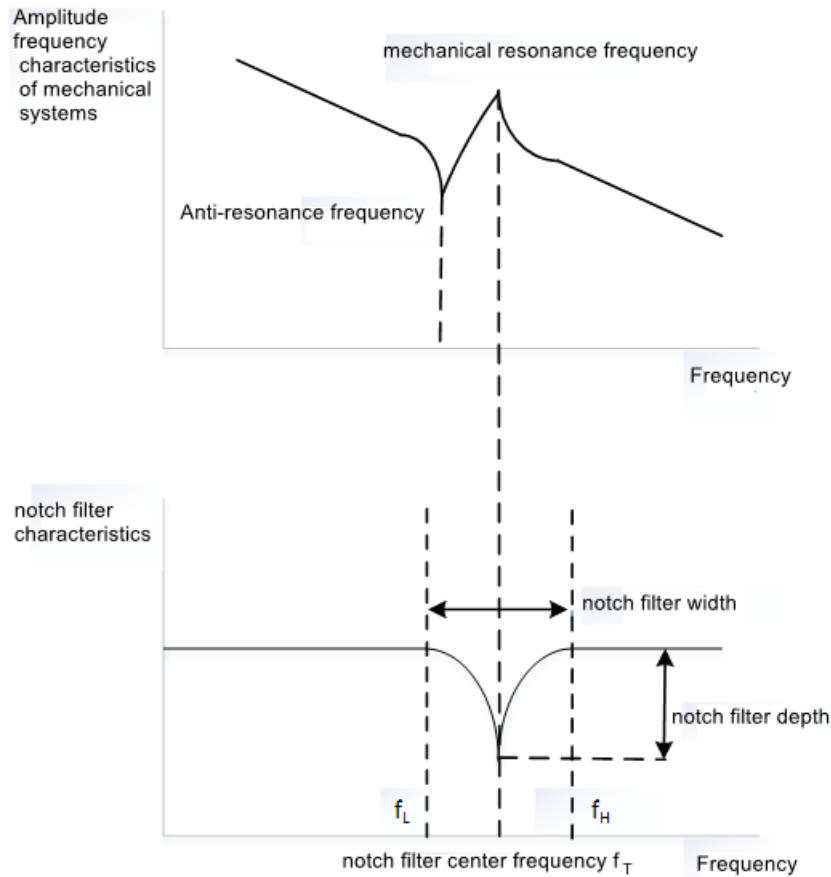
Rigidity Level	First gain group				Second gain group			
	P00.04	P00.02	P00.03	P00.05	P00.08	P00.06	P00.07	P00.09
	First Position Loop Gain (Hz)	First Velocity Loop Gain(Hz)	First Velocity Loop Integral Time Constant (ms)	First Torque Filtering Time Constant(ms)	Second Position Loop Gain(Hz)	Second Velocity Loop Gain(Hz)	Second Velocity Loop Integral Time Constant(ms)	Second Torque Filtering Time Constant(ms)
4	4.5	3.5	160.00	6.00	7.5	3.5	512.00	6.00
5	5.5	4.5	120.00	5.00	9.5	4.5	512.00	5.00
6	7.5	6.0	90.00	4.00	11.5	6.0	512.00	4.00
7	9.5	7.5	70.00	3.00	14.0	7.5	512.00	3.00
8	11.5	9.0	60.00	3.00	17.5	9.0	512.00	3.00
9	14.0	11.0	50.00	2.00	32.0	11.0	512.00	2.00
10	17.5	14.0	40.00	2.00	39.0	14.0	512.00	2.00
11	32.0	18.0	31.00	1.26	48.0	18.0	512.00	1.26
12	39.0	22.0	25.00	1.03	63.0	22.0	512.00	1.03
13	48.0	27.0	21.00	0.84	72.0	27.0	512.00	0.84
14	63.0	35.0	16.00	0.65	90.0	35.0	512.00	0.65
15	72.0	40.0	14.00	0.57	108.0	40.0	512.00	0.57
16	90.0	50.0	12.00	0.45	135.0	50.0	512.00	0.45
17	108.0	60.0	11.00	0.38	162.0	60.0	512.00	0.38
18	135.0	75.0	9.00	0.30	206.0	75.0	512.00	0.30
19	162.0	90.0	8.00	0.25	251.0	90.0	512.00	0.25
20	206.0	115.0	7.00	0.20	305.0	115.0	512.00	0.20
21	251.0	140.0	600	0.16	377.0	140.0	512.00	0.16
22	305.0	170.0	5.00	0.13	449.0	170.0	512.00	0.13
23	377.0	210.0	4.00	0.11	500.0	210.0	512.00	0.11
24	449.0	250.0	4.00	0.09	560.0	250.0	512.00	0.09
25	500.0	280.0	3.50	0.08	610.0	280.0	512.00	0.08
26	560.0	310.0	3.00	0.07	660.0	310.0	512.00	0.07
27	610.0	340.0	3.00	0.07	720.0	340.0	512.00	0.07
28	660.0	370.0	2.50	0.06	810.0	370.0	512.00	0.06
29	720.0	400.0	2.50	0.05	900.0	400.0	512.00	0.05
30	810.0	450.0	2.00	0.05	900.0	450.0	512.00	0.05
31	900.0	500.0	2.00	0.04	900.0	500.0	512.00	0.04

The factory default rigid level is level 11.

## 5.2.3 Vibration Suppression Settings

### 5.2.3.1 Manual Resonance Frequency Setting

In cases where the servo parameters continuously strengthen the gain, the mechanical system may lack sufficient rigidity, leading to mechanical resonance. The vibration frequency can vary, being either high-frequency or low-frequency. In such cases, it is necessary to set a notch filter at the resonance frequency to suppress mechanical resonance in the system. The amplitude characteristic of the system during resonance is shown in the following figure.



The servo drive provides five sets of notch filter parameters for resonance point suppression. Each notch filter can set the resonance point, anti-resonance point, filter width, and filter depth. The significance of these parameters is shown in the figure above. When obtaining the mechanical resonance point, there are usually two methods: one is by observing the vibration period of the background torque command waveform and then calculating it by  $f_0 = \frac{1}{T}$ ; the other is by using the background frequency sweep function to obtain the mechanical resonance frequency. The function codes for each notch filter are as follows:

	Setting Range	Unit	Factory Default	Related Modes
<b>P01.04 Anti-resonance Frequency of the 1st Notch Filter</b>				

		10~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system anti-resonance frequency</p>							

P01.05 Frequency of the 1st Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	50~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system resonance frequency.</p>						

P01.06 Bandwidth of the 1st Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	0~9	-	2	P	S	T
<p>Explanation: Set the frequency range of the 1st Notch Filter to suppress the system resonance.</p>						

P01.07 Depth of the 1st Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	0~99	-	0	P	S	T
<p>Explanation: Set the depth of suppression for the system resonance frequency.</p>						

P01.08 Anti-resonance Frequency of the 2nd Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	10~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system anti-resonance frequency</p>						

P01.09 Frequency of the 2nd Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
--	---------------	------	-----------------	---------------	--	--

		50~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system resonance frequency.</p>							

<b>P01.0A Bandwidth of the 2nd Notch Filter</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	0~9	-	2	P	S	T
<p>Explanation: Set the frequency range of the 2nd Notch Filter to suppress the system resonance.</p>						

<b>P01.0B Depth of the 2nd Notch Filter</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	0~99	-	0	P	S	T
<p>Explanation: Set the depth of suppression for the system resonance frequency.</p>						

<b>P01.0C Anti-resonance Frequency of the 3rd Notch Filter</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	10~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system anti-resonance frequency</p>						

<b>P01.0D Frequency of the 3rd Notch Filter</b>	<b>Setting Range</b>	<b>Unit</b>	<b>Factory Default</b>	<b>Related Modes</b>		
	50~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system resonance frequency.</p>						

<b>P01.0E Bandwidth of the 3rd Notch Filter</b>	<b>Setting</b>	<b>Unit</b>	<b>Factory</b>	<b>Related</b>
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	Range		Default	Modes		
	0~9	-	2	P	S	T

Explanation:  
Set the frequency range of the 3rd Notch Filter to suppress the system resonance.

P01.0F Depth of the 3rd Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	0~99	-	0	P	S	T

Explanation:  
Set the depth of suppression for the system resonance frequency.

P01.10 Anti-resonance Frequency of the 4th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	10~5000	Hz	5000	P	S	T

Explanation:  
Corresponding system anti-resonance frequency.

P01.11 Frequency of the 4th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	50~5000	Hz	5000	P	S	T

Explanation:  
Corresponding system resonance frequency.

P01.12 Bandwidth of the 4th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	0~9	-	2	P	S	T

Explanation:  
Set the frequency range of 4th Notch Filter to suppress the system resonance.

P01.13 Depth of the 4th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
--------------------------------------	---------------	------	-----------------	---------------	--	--

		0~99	-	0	P	S	T
<p>Explanation: Set the depth of suppression for the system resonance frequency.</p>							

P01.14 Anti-resonance Frequency of the 5th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	10~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system anti-resonance frequency.</p>						

P01.15 Frequency of the 5th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	50~5000	Hz	5000	P	S	T
<p>Explanation: Corresponding system resonance frequency.</p>						

P01.16 Bandwidth of the 5th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	0~9	-	0	P	S	T
<p>Explanation: Set the frequency range of 5th Notch Filter to suppress the system resonance.</p>						

P01.17 Depth of the 5th Notch Filter	Setting Range	Unit	Factory Default	Related Modes		
	0~99	-	50	P	S	T
<p>Explanation: Set the depth of suppression for the system resonance frequency.</p>						

The bandwidth is defined as shown in the table below:

Bandwidth Setting	Actual Filter Suppression Bandwidth
0	$0.3 * f_0$
1	$0.5 * f_0$

Bandwidth Setting	Actual Filter Suppression Bandwidth
2	$0.7 * f_0$
3	$0.9 * f_0$
4	$1.1 * f_0$
5	$1.3 * f_0$
6	$1.5 * f_0$
7	$1.7 * f_0$
8	$1.9 * f_0$
9	$2 * f_0$

The depth represents the ratio of input to output at the resonance frequency point. The smaller the value, the deeper the suppression; the larger the value, the shallower the suppression. The output amplitude/input amplitude = depth level/100. The smaller the depth value, the deeper the notch suppression.

### 5.2.3.2 Automatic Resonance Frequency Setting

If you do not want to manually set function codes to suppress resonance, you can enable the adaptive filter to suppress resonance frequencies. This function can automatically set the related parameters of the third and fourth notch filters. If no resonance point is found after enabling, it will automatically exit after 30 minutes. If a resonance point is found and the notch filter is set but vibration becomes more severe, the adaptive function will automatically exit and reset the notch filter parameters.

The function codes related to the adaptive filter are as follows:

P01.00 Adaptive Filter Mode Selection	Setting Range	Unit	Factory Default	Related Modes		
	0~4	-	0	P	S	T

Explanation:

- ◆ 0: Disable adaptive filter
- ◆ 1: Automatic update of parameters for the third notch filters
- ◆ 2: Automatic update of parameters for the third and fourth notch filters
- ◆ 3: Only test resonance frequency, displayed in P01.02
- ◆ 4: Reset the third and fourth notch filters

P01.01 Determining thresholds	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	%	2.0	P	S	T

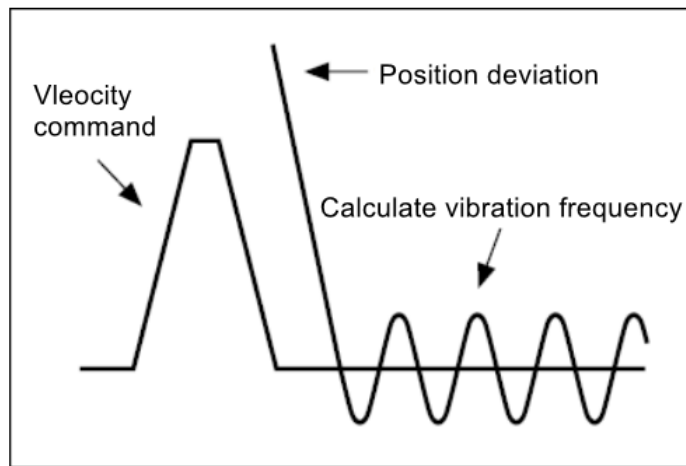
Explanation:  
100% corresponds to the motor's rated torque

P01.02 Resonance Frequency Identification Result	Setting Range	Unit	Factory Default	Related Modes		
	-	Hz	-	P	S	T

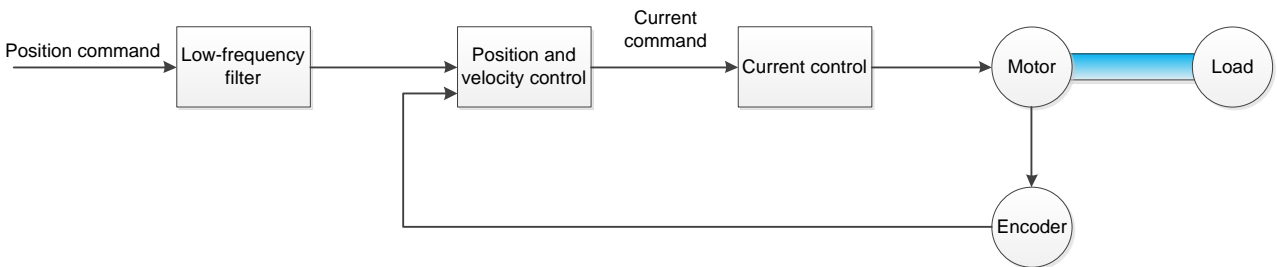
Explanation:  
Display the detected resonance frequency value

### 5.2.3.3 Low Frequency Jitter Suppression

On some flexible loads such as robotic arms, when the motor tracks the command to reach the given position, due to the load not being rigidly connected, the load will overshoot, driving the motor to overshoot as well, causing low-frequency jitter as shown in the figure below.



At this time, the low-frequency vibration frequency can be set to suppress this jitter. This filter directly acts on the position command as shown in the figure below.



The function codes related to the low-frequency filter are as follows:

P01.1F Low-frequency Vibration Suppression Mode	Setting Range	Unit	Factory Default	Related Modes		
	0~1	-	0	P	-	-

Explanation:

- ◆ 0: No suppression
- ◆ 1: Suppression of one low-frequency vibration point

P01.21 Low-frequency Vibration Frequency	Setting Range	Unit	Factory Default	Related Modes		
	1.0~100.0	Hz	100.0	P	-	-
Explanation: Measured low-frequency vibration frequency						

P01.22 Low Frequency Vibration Filter Settings	Setting Range	Unit	Factory Default	Related Modes		
	0~10	-	2	P	-	-
Explanation: The larger the value, the wider the filtering width, but it also leads to greater delay.						

P01.23 Low frequency coefficient resonance frequency attenuation ratio	Setting Range	Unit	Factory Default	Related Modes		
	1.2~10.0	1	1.2	P	-	-
Explanation: The larger the value, the deeper the filtering, and the smaller the delay in the position command.						

### 5.2.3.4 Full Closed-Loop Vibration Suppression

In a full closed-loop system, the servo controls speed through the motor encoder and controls position through the encoder on the load. Due to the torque between the motor and the load, the speeds fed back by these two encoders are not synchronized, resulting in shaking at the load end. To suppress this vibration caused by unsynchronized feedback, the following parameters can be set:

P06.04 Vibration Suppression Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~300.0	Hz	0.0	P	-	-
Explanation: Used to adjust the vibration suppression rate, which is particularly effective when there is large torque between the motor and the load.						

P06.05 Vibration Suppression Filter Cut-off Frequency	Setting Range	Unit	Factory Default	Related Modes		
	10~5000	Hz	500	P	-	-

Explanation:  
Vibration suppression filtering cut-off frequency setting

P06.06 Full Closed-loop Velocity Correction Coefficient	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	%	0.0	P	-	-

Explanation:  
Compensates the feedback of the load-end encoder velocity to the actual velocity control loop.

P06.07 Inner and Outer Loop Position Deviation Filtering Time Coefficient	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	ms	0.0	P	-	-

Explanation:  
Filters the position feedback from both the load end and the motor end.

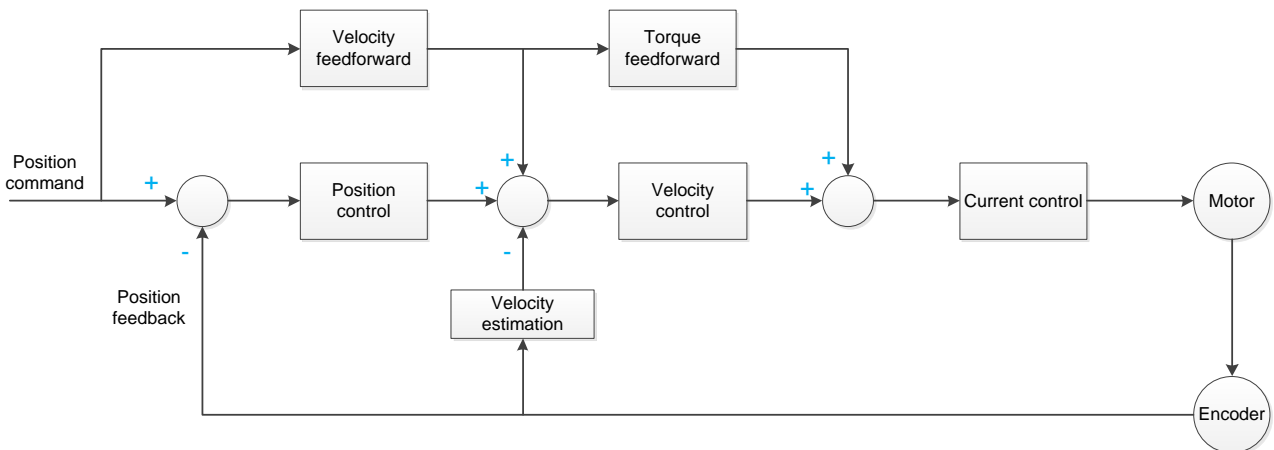
## 5.2.4 Practical Application Gain Adjustment

### 5.2.4.1 Feedforward Function

In position control, the velocity command for the next cycle is estimated based on the position command, which can be directly compensated into the speed control loop. By outputting torque in advance, the position offset during position control is effectively reduced.

Similarly, in speed control, the torque command for the next cycle is estimated based on the speed command, which can be directly compensated into the current control loop, effectively improving the response of speed control.

The control loop is shown in the figure below.



The function codes used for debugging are shown in the tables below:

P00.0F Velocity Control Feedforward Selection	Setting Range	Unit	Factory Default	Related Modes		
	0~2	-	1	P	S	-

Explanation:

- ◆ 0: No velocity feedforward
- ◆ 1: Internal velocity feedforward
- ◆ 2: External velocity feedforward

P00.10 Velocity Feedforward Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	%	0	P	-	-

Explanation:

Only valid in position mode. A larger velocity feedforward results in better following-performance of the position command and smaller position deviation. However, excessive feedforward can lead to system overshoot. It should be set according to the actual situation.

P00.11 Velocity Feedforward Filtering Time	Setting Range	Unit	Factory Default	Related Modes		
	0.00~64.00	ms	0.50	P	-	-

Explanation:

Applies low-pass filtering to the velocity feedforward to prevent abrupt changes.

P00.13 Torque Feedforward Control Selection	Setting Range	Unit	Factory Default	Related Modes		
	0~2	-	1	P	S	-

Explanation:

- ◆ 0: No torque feedforward
- ◆ 1: Internal torque feedforward
- ◆ 2: External torque feedforward

P00.14 Torque Feedforward Gain	Setting Range	Unit	Factory Default	Related Modes		
	0.0~100.0	%	0.0	P	S	-

**Explanation:**  
 The larger the torque feedforward, the faster it follows the velocity command. However, excessive feedforward can lead to system overshoot, deteriorated stability, and other issues. It should be set according to the actual situation.

P00.15 Torque Feedforward Filtering Time	Setting Range	Unit	Factory Default	Related Modes		
	0.00~64.00	ms	0.50	P	S	-

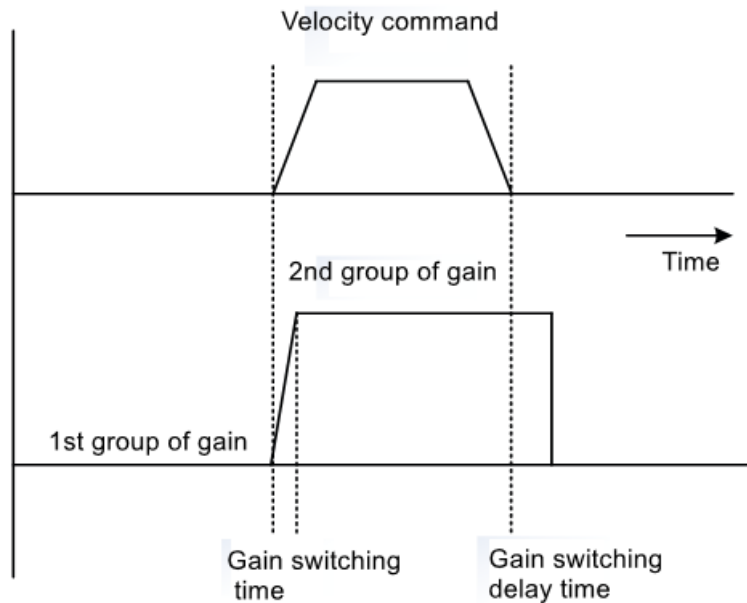
**Explanation:**  
 Applies low-pass filtering to the torque feedforward to prevent abrupt changes in torque command.

### 5.2.4.2 Gain Switching

During servo operation and stop, different response characteristics are often required:

- ◆ Low gain is needed when stopped to avoid zero position vibration
- ◆ High gain is needed when stopped to improve servo locking ability
- ◆ High gain is needed during operation to improve servo tracking ability

To meet the needs of both operation and stop, the gain switching function needs to be introduced, as shown in the figure below.



The gain switching function mainly switches between the first and second groups of gains. The function codes used are shown in the table below:

P00.19 Gain Switching Mode Selection	Setting	Unit	Factory	Related
--------------------------------------	---------	------	---------	---------

	Range		Default	Modes		
	0~4		-	0	P	-

Explanation:

- ◆ 0: Fixed as the first set of gains
- ◆ 1: Maintain the first group of gain, DI toggle integral time is 0
- ◆ 2: Use DI to switch between the first and second group of gains
- ◆ 3: Use position command + velocity feedback switching
- ◆ 4: Position command three-group gain switching mode

P00.1A Gain Switching Delay Time	Setting Range	Unit	Factory Default	Related Modes		
	0.0~1000.0	ms	5.0	P	-	-

Explanation:  
Used to set the delay time for switching from the second group of gain to the first group of gain.

P00.1B Gain Switching Level	Setting Range	Unit	Factory Default	Related Modes		
	0~20000	-	50	P	-	-

Explanation:  
If switching condition > P00.1B + P00.1C, switches to the second group of gain. If switching condition < P00.1B + P00.1C, switches to the first group of gain.

P00.1C Gain Switching Time-lag	Setting Range	Unit	Factory Default	Related Modes		
	0~20000	-	30	P	-	-

Explanation:  
If switching condition > P00.1B + P00.1C, switches to the second group of gain. If switching condition < P00.1B + P00.1C, switches to the first group of gain.

P00.1D Gain Switching Time	Setting Range	Unit	Factory Default	Related Modes		
	0.0~1000.0	ms	3.0	P	-	-

Explanation:  
Used to set the time taken to switch from the first group of gain to the second group of gain.

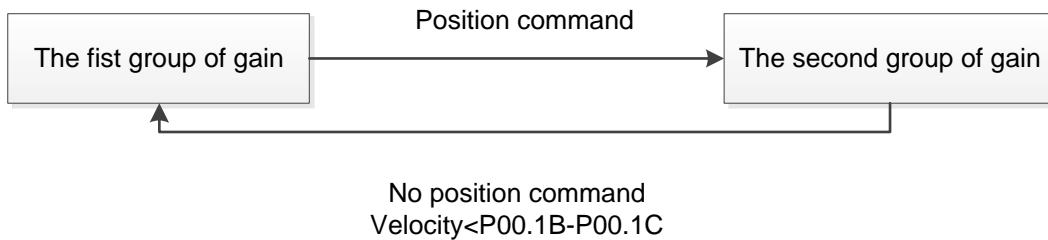
P00.1E 3rd Group of Gain Coefficient	Setting Range	Unit	Factory Default	Related Modes		
	50~10000	%	100	P	-	-

Explanation:  
Used to set the amplification factor of the third group of gain and the first group of gain when stopping. It only amplifies the position proportional gain and the velocity proportional gain.

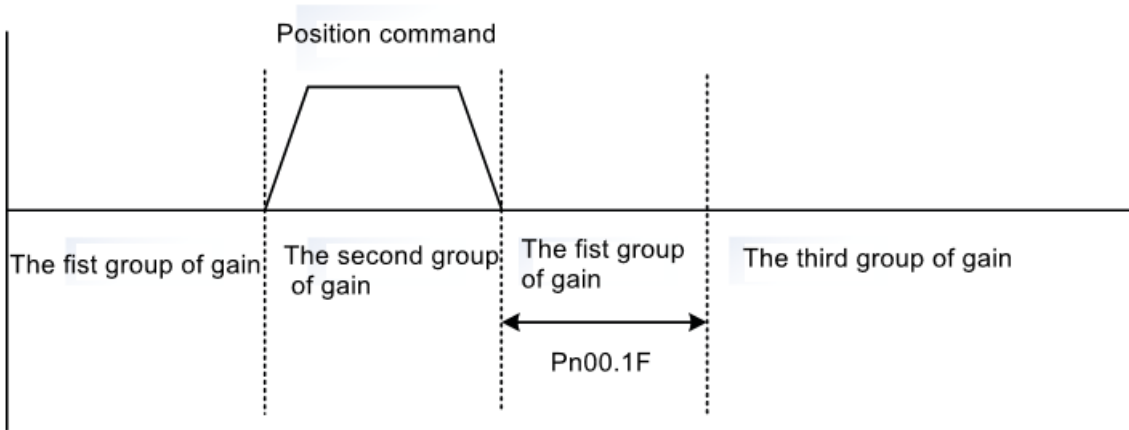
P00.1F Third group of gain switching waiting time	Setting Range	Unit	Factory Default	Related Modes		
	0.0~1000.0	ms	0	P	-	-

Explanation:  
Used to set the hold time of the 1st group gains

When the gain switching mode selection is 3, the switching process is as shown in the figure below:



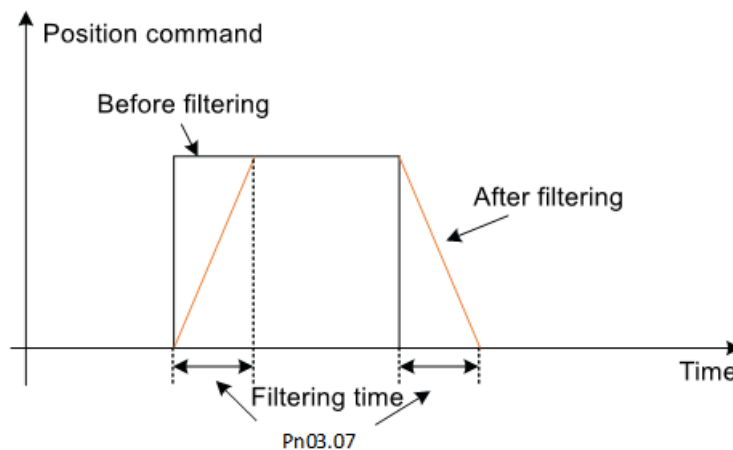
When the switching mode is selected as 4, a new group of gains is introduced based on 3. The third group gain magnification coefficient P00.1E only targets the proportional gain of the first group of gains in position and speed, while the speed integration time and torque filter coefficient remain the same as the first group. The switching process is as shown in the figure below.



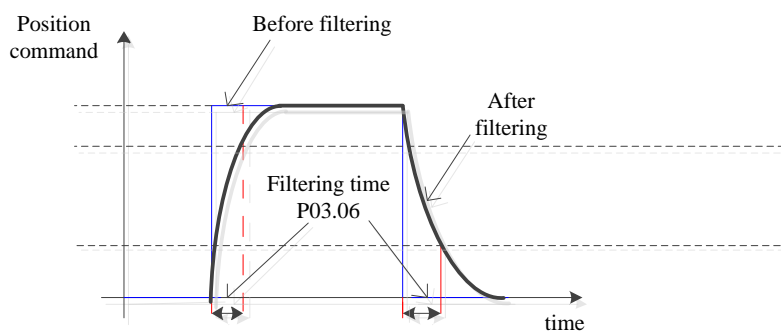
### 5.2.4.3 Command Filtering Function

In position control, if the upper computer command sending frequency is too fast, exceeding the servo motor's overload capacity, or if the upper computer command fluctuates greatly, causing a noticeable start-up impact sound from the servo motor, position command filtering is necessary. This makes the servo start smoothly, reduces the impact on the load, and lowers the servo load rate.

Position command smooth filtering: When the filtering time is set, the position command changes as shown below.



Position command low-pass filtering: When the filtering time is set, the command changes significantly decrease during acceleration to maximum speed and deceleration to minimum speed, as shown below.



## 5.2.4.4 External Disturbance Suppression

### 5.2.4.4.1 Disturbance Observer

During servo motor operation, if the load suddenly experiences external force, it may cause speed fluctuations in the servo motor, resulting in mechanical noise or vibration. To suppress the impact of load fluctuations and reduce speed fluctuations, a disturbance observer can be used, with the following adjustable function codes:

P00.2E Torque Disturbance Observer Cut-off Frequency Adjustment	Setting Range	Unit	Factory Default	Related Modes		
	10~200	%	100	P	V	
Explanation: 100% refers to the set bandwidth of the speed loop (i.e., the speed loop gain).						

P00.2F Torque Disturbance Observer Inertia Compensation Coefficient	Setting Range	Unit	Factory Default	Related Modes		
	10~1000	%	100	P	V	
Explanation: Set inertia dynamic compensation coefficient of the torque disturbance observer. If the inertia is set correctly, it can default to 100%.						

P00.30 Torque Disturbance Observer Filtering Frequency	Setting Range	Unit	Factory Default	Related Modes		
	0.0~1000.0	Hz	0.0	P	V	
Description: Set the torque disturbance observer compensation filtering frequency. When compensation causes oscillation, the filtering frequency can be appropriately increased to suppress the oscillation.						

P00.31 Torque Disturbance Observer Compensation Percentage	Setting Range	Unit	Factory Default	Related Modes		
	0~200	%	0	P	V	
Description: Set the compensation percentage of torque disturbance observer. When it is set to 0, torque disturbance compensation has no effect.						

### 5.2.4.4.2 Instantaneous Speed Observation and Speed Filtering

When the motor encoder resolution is low, increasing the loop gain may lead to strong noise and even mechanical vibration at zero position. To suppress this noise, speed feedback processing is required to reduce speed measurement fluctuations.

P00.20 Times of mean filtering for velocity Feedback	Setting Range	Unit	Factory Default	Related Modes		
	0~5	-	0	P	S	T

Explanation:

- ◆ 0: No mean filtering
- ◆ 1: mean filtering for 2 times
- ◆ 2: mean filtering for 4 times
- ◆ 3: mean filtering for 8 times
- ◆ 4: mean filtering for 16 times
- ◆ 5: mean filtering for 32 times

P00.21 Velocity Feedback Low-pass Filtering Cut-off Frequency	Setting Range	Unit	Factory Default	Related Modes		
	50~5000	Hz	5000	P	S	T

Explanation:  
When set to 5000, it has no filtering effect. The smaller the set value, the stronger the filtering effect.

P00.22 Velocity feedback robust regulator cutoff frequency	Setting Range	Unit	Factory Default	Related Modes		
	10~2000	Hz	60	P	S	T

Explanation:  
Setting the observer bandwidth, the larger the setting, the smaller the observation delay, but increasing the observation noise.

P00.23 Velocity feedback robust regulator dynamic coefficient	Setting Range	Unit	Factory Default	Related Modes		
	10~10000	%	100	P	S	T

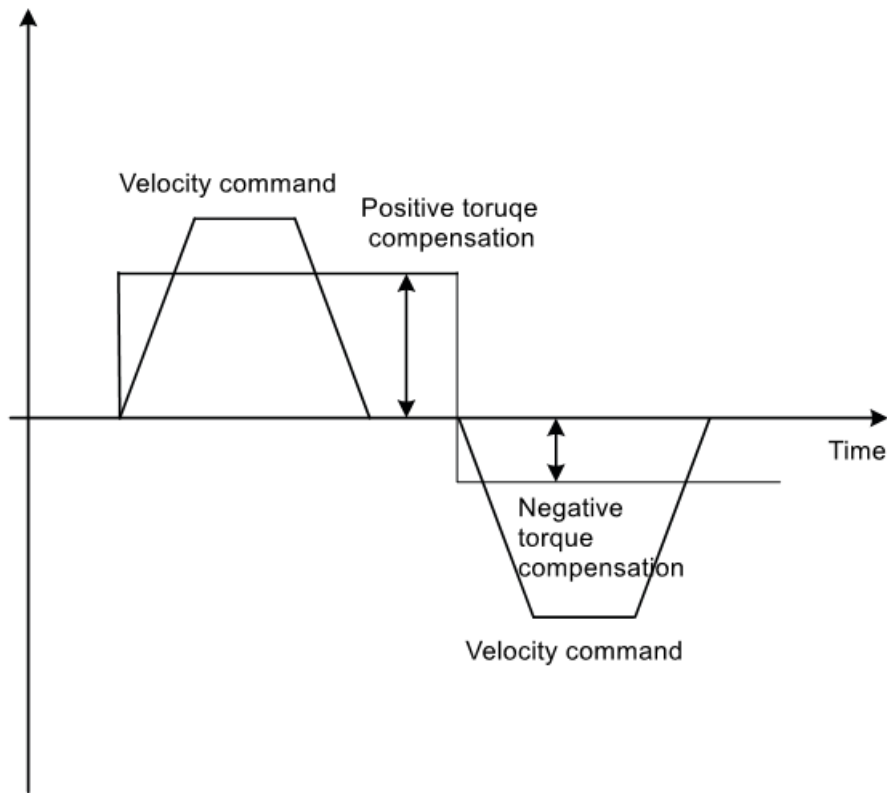
Explanation:  
Setting the observer bandwidth, the larger the setting, the smaller the observation delay, but increasing the observation noise.

P00.24 Velocity feedback robust regulator filtering time	Setting Range	Unit	Factory Default	Related Modes		
	0.00~20.00	ms	0.40	P	S	T

Explanation:  
Low pass filtering time to reduce observation noise

### 5.2.4.4.3 Friction Compensation

Friction compensation is used to solve the start delay problem caused by friction. With friction compensation, the servo motor can start quickly, reducing start position offset. The compensation method is as follows:



Related function code settings are as follows:

P01.1D Positive Friction Compensation	Setting Range	Unit	Factory Default	Related Modes		
	-100.0~100.0	%	0.0	P	S	-

Explanation:  
Compensation value for positive direction operation

P01.1E Negative Friction Compensation	Setting Range	Unit	Factory Default	Related Modes		
	-100.0~100.0	%	0	P	S	-
Explanation: Compensation value for negative direction operation						

## 6 Troubleshooting

Refer to the table below for alarm information.

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
Er.01.0	Overvoltage	Resettable error (Fault 1 shutdown)	Power supply voltage is too high	Confirm the input power supply specification of the drive, use multimeters to measure the voltage between L1 and L2 or R, S, T. Ensure that the measured voltage of the drive with rated voltage 220V is 200V~240V, for drive with rated voltage 380V, the measured voltage is 380V~440V.	Replace power supply according to the power supply specification
			Power supply is not stable	Measure voltage of the input power supply to confirm whether there are large fluctuations in the input power supply	Optimize power quality: Power up the drive by using independent power supply, ensure that the drive input voltage and wiring is normal, if it still fails, replace the drive or return it to the factory for repair
			Shorter deceleration time, maximum brake energy exceeds absorbable value	High load rate, frequent positive and negative rotating, running too fast, frequent alarm during the deceleration process	1. Decrease running speed, increase acceleration and deceleration time 2. Increase smoothing coefficient 3. Add the proper brake resistor
			The resistance value of the external brake resistor is too large	Brake resistor is not hot	Replace the external brake resistance with the recommended resistance value
			The power of the external resistor	Brake resistor is too hot	Replace external resistors with more

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
			is too small		power
Er.01.1	Undervoltage	Resettable error (Fault 2 shutdown)	Power supply voltage is too low	Confirm the input power supply specification of the drive, use multimeters to measure the voltage between L1 and L2 or R, S, T. Ensure that the measured voltage of the drive with rated voltage 220V is 200V~240V, for drive with rated voltage 380V, the measured voltage is 380V~440V.	Replace or change power supply according to power supply specification
			Power supply is not stable	Measure voltage of the input power supply to confirm whether there are large fluctuations in the input power supply	Optimize power quality: Power up the drive by using independent power supply, ensure that the drive input voltage and wiring is normal, if it still fails, replace the drive or return it to the factory for repair
Er.01.2	Power failure	Resettable error (Fault 2 shutdown)	External power supply power off when servo is enabled. Or Servo is power off for short time during operating	1. Check wiring of L1, L2 or R, S, T 2. Check whether the connection of main circuit terminals is reliable	1. Increase power supply capacity 2. Replace power cable and connect to the main circuit power supply
Er.01.3	Power phase loss	Resettable error (Fault 2 shutdown)	External power supply powers off when servo is enabled	Confirm the input power supply specification of the drive, use multimeters to measure the voltage between L1 and L2 or R, S, T. Ensure that the measured voltage of the drive with rated voltage 220V is	Optimize power supply quality, improve power supply capacity

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				200V~240V, for drive with rated voltage 380V, the measured voltage is 380V~440V.	
			Use single-phase 220V power supply to power up the drive of three-phase 220 V power supply	Check whether the wiring is reliable, the default value of P0B.06 is 0(detect AC input and disable phase loss alarm)	Set P0B.05 to 2 after ensuring that the wiring is reliable, do not detect AC input and disable phase loss alarm
Er.01.5	Phase sequence error	Non-resettable error (Fault 1 shutdown)	Motor power line U, V and W wiring error	Ensure that Motor power line U, V and W phase sequence is correct	Compare U, V, W on motor drawing with U, V, W terminal wiring
			Motor internal power line phase sequence anomaly	Verify that the power line U, V, W phase sequence are correct, but it still alarm, motor internal abnormalities	Replace the drive or return it to the factory for repair
Er.01.6	Control power undervoltage	Resettable error(Fault 2 shutdown)	Power supply voltage is too low	Confirm the input power supply specification of the drive, use multimeters to measure the voltage between L1 and L2C. Ensure that the measured voltage of the drive with rated voltage 220V is 200V~240V, for drive with rated voltage 380V, the measured voltage is 380V~440V.	Optimize power supply quality, improve power supply capacity
			L1C and L2C wiring error or control power error	Control power for drive with rated 220V requires 220 V input, Control power for drive with rated 380V requires 380 V input	Control power input is consistent with the specification of the drive, or parallel to the main circuit power input terminal L1 and or R, S, and T

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
Er.02.0	Bus phase P overcurrent	Non-resettable error (Fault 1 shutdown)	Brake resistor overcurrent	Resistance of the brake resistor is too small or the brake resistor is shorted, remove the brake resistor, measure the resistance of resistor	1.Replace the resistor 2.Rewire
			Gain parameters are set incorrectly	Check whether there is jitter and noise during starting-up and operating	1.Motor parameters are set incorrectly, modify motor parameters 2.Gain is too large, decrease rigidity and gain appropriately
Er.02.1	Bus phase n overcurrent	Non-resettable error (Fault 1 shutdown)	Brake resistor overcurrent	Resistance of the brake resistor is too small or the brake resistor is shorted, remove the brake resistor, measure the resistance of resistor	1.Replace the resistor 2.Rewire
			Gain parameters are set incorrectly	Check whether there is jitter and noise during starting-up and operating	1.Motor parameters are set incorrectly, modify motor parameters 2.Gain is too large, decrease rigidity and gain appropriately
Er.02.2	Phase U overcurrent	Non-resettable error (Fault 1 shutdown)	Poor contact in power cable	Check whether there is poor contact in power cable connected to the drive and motor	Compare the U, V W wiring with U, V, W wiring in motor drawing, secure the cable, re-plug
			The motor is in poor insulation	Shorted to ground(U, V, W is shorted to PE), disconnect power cable, measure the resistance between motor U, V, W and PE, it is MΩ level in normal state	The motor is in poor insulation, replace the motor
			Motor is burnout	Disconnect power cable, measure the resistance between U and V(U and W, V and W), check whether	Unbalanced winding, replace the motor

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				these three is balanced	
Er.02.3	Phase V overcurrent	Non-resettable error (Fault 1 shutdown)	Poor contact in power cable	Check whether there is poor contact in power cable connected to the drive and motor	Compare the U, V W wiring with U, V, W wiring in motor drawing, secure the cable, re-plug
			The motor is in poor insulation	Shorted to ground(U, V, W is shorted to PE), disconnect power cable, measure the resistance between motor U, V, W and PE, it is MΩ level in normal state	The motor is in poor insulation, replace the motor
			Motor is burnout	Disconnect power cable, measure the resistance between U and V(U and W, V and W), check whether these three is balanced	Unbalanced winding, replace the motor
Er.02.4	Shorted to ground	Non-resettable error (Fault 1 shutdown)	Power cable is shorted to ground	Disconnect the power cable, measure the resistance between U and PE(V and PE, W and PE),no resistance value can be measured in normal state	Wire again or replace power cable
			The motor is in poor insulation	Shorted to ground(U, V, W is shorted to PE), disconnect power cable, measure the resistance between motor U, V, W and PE, it is MΩ level in normal state	The motor is in poor insulation, replace the motor
			Drive failure	Power up after the drive disconnects the motor and power cable, still faulty	Replace the drive or return it to the factory for repair
Er.02.5	Discharge overcurrent	Non-resettable error (Fault 1)	Brake resistor is shorted	1.Check whether the wiring of brake resistor is normal 2.Remove the brake	Use the brake resistance of the recommended specifications, ensure that the wiring of the

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
		shutdown)		resistor, measure the resistance of the resistor, check whether it is consistent with the specification	resistor is right
			Resistance of the brake resistor is too small	The recommended resistance value for brake resistance selection is not less than P19.18, the default brake resistance minimum	Ensure that the wiring is right, replace with the brake resistor with recommended resistance value
Er.02.7	Temperature of the drive is too high	Non-resettable error (Fault 2 shutdown)	Excessive ambient temperature or poor heat dissipation	Measure ambient temperature, check drive operating environment	Decrease ambient temperature, Increase heat dissipation space
			Frequent overload	View fault logs for frequent overloads alarm	Extended stop time, increase acceleration time, decrease average load rate
Er.02.8	Drive overload	Non-resettable error (Fault 1 shutdown)	Load rate of the drive is too high	Check for excessive friction or stuck	1.Increase smoothing coefficient 2.Decrease acceleration or deceleration or increase acceleration time or deceleration time 3.Reinstall machinery to eliminates installation problems
			Gain parameters is set incorrectly	1.Rigidity is too high 2.Resonance, jitter, noise of the motor	Adjust gain parameters
			Accelerate too often	1.Inertia of load is too large 2.High frequently high speed start and stop operation	1.Increase smoothing coefficient 2.Decrease acceleration or deceleration or increase acceleration time or deceleration time 3.If the load is undiminished, disable

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
					the alarm by setting parameter P0B.01 to 2 when it is confirmed that it will be stable for a long time
Er.02.9	Motor overload	Non-resettable error (Fault 1 shutdown)	Power cable U, V, W wiring anomaly	Alarm as soon as it runs, check for the correct power line U, V, W wiring	Wire the U, V, W according to the motor drawing
			Motor is stall	1.Disable the servo, release the brake, manually push the machine, check whether it is smooth 2.Reach mechanical limit	Exclude alarms caused by mechanical stuck
			Acceleration time or deceleration time is too short, frequent acceleration or deceleration operation or the inertia of the load is too large	Confirm servo motor cycle time and application conditions	1.The upper device adjusts the running curve, or increases the wait time, increases the smoothing coefficient, and reduces the average running current 2.When the motor is not hot, properly increase P0B.11(motor overload protection gain) 3.Replace with the drive and motor with more power
			Gain parameters is set incorrectly	1.Rigidity is too high 2.Resonance, jitter, noise of the motor	Adjust gain parameters
Er.02.A	Motor stall	Non-resettable error (Fault 1 shutdown)	Mechanical jamming	1.Disable the servo, release the brake, manually push the machine, check whether it is smooth 2.Release the brake of motor, manually push the machine, check whether it is smooth	Reinstall machine

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
			Power cable is disconnected	Check whether the wiring of power cable U, V, W is normal	Secure the power cable, re-plug, replace the cable
Er.02.B	PTC motor temperature is too high	Non-resettable error (Fault 1 shutdown)	PTC monitor enablement parameter is set incorrectly	When you do not use the PTC feature, check if the PTC parameter is enabled incorrectly	1.The upper device adjusts the running curve, or increases the wait time, increases the smoothing coefficient, and reduces the average running current 2. Replace with the motor and drive with more power
			PTC alarm level Pn0B.0A is set incorrectly	Check PTC alarm level P0B.0A setting	Set P0B.0A to 0 (default value)
			External thermistor anomalies	1.Check if the wiring is correct 2.Check the pins for false welding abnormalities 3.Check if the thermistor specifications meet the requirements	2.3k Ohm is in the range of resistance corresponding to the response temperature $\pm 5^{\circ}\text{C}$
AL.02.D	Discharge resistor overload	Warning	Parameter is set incorrectly	1.Check if Brake resistance related parameters P02.23 ~ P02.26 is the set consistent with the actual resistance parameters 2.Resistor is not hot	Set P02.23~P02.26 refer to the specification of the resistor
			The resistance of the brake resistor is too small	1.Parameter is set to be consistent with the actual situation, alarm frequently 2.Resistor is too hot	Replace with the brake resistor with lager power
AL.02.E	Drive current	Warning	Abnormal phase current sampling	-	Ask Flexem technical support engineer for

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
	zero drift overflow				help
ER.04.1	STO Monitoring Anomalies	Reset Error (Fault 1 shutdown)	At least 1 STO terminal exception	1. Check that the STO1 and STO2 wires are fine 2. Are STO1 and STO2 powered by 24V 3. Whether there is a low voltage or a fluctuation in the power supply of STO	Properly connect STO wiring to ensure 24V power is stable
ER.04.2	STO Monitoring Chip Anomalies	Reset Error (Fault 1 shutdown)	hardware failure	Power up again still faulty, back to factory	Replace the drive or return it to the factory for repair
Er.04.3	EEPROM read abnormality	Resettable error (Fault 2 shutdown)	Read or write function code too frequent	Check if the reading and writing function code is too frequent, if the restart still alarm can unplug the RS485 wiring reboot to confirm that it is related to the RS485 port, check the control program	1.Restart to reset alarm 2.Modify unreasonable control program, avoid reading or writing parameters too frequent 3.Set P08.0F to 1, do not write to EEPROM when modify parameters
			Reach the limit of reading and writing EEPROM	Frequently read and write function codes cause EEPROM life to run out, For the function code triggers the alarm, modify the function code via panel or debug software, after the restart, re-read to see if the function code is normal, to confirm that whether the hardware is abnormal	Replace the drive or return it to the factory for repair
Er.04.4	EEPROM write error	Resettable error (Fault 2)	Read or write function code too frequently	Check if reading and writing function code too often, if still alarm	1.Restart to reset alarm 2.Modify the unreasonable control

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
		shutdown)		after restart, unplug the Ethernet cable then restart to check if it is related to Ethernet port, check control program	program, avoid reading or writing parameters too often 3.Set P08.0F to 1, do not write to EEPROM when modify parameters
			Reach the limit of reading and writing EEPROM	Frequently read and write function codes cause EEPROM life to run out, For the function code triggers the alarm, modify the function code via panel or debug software, after the restart, re-read to see if the function code is normal, to confirm that whether the hardware is abnormal	Replace the drive or return it to factory for repair
Er.04.5	EEPROM abnormality	Resettable error (Fault shutdown)	Read or write function code too frequently	Check if reading and writing function code too often, if still alarm after restart, unplug the Ethernet cable then restart to check if it is related to Ethernet port, check control program	1.Restart to reset alarm 2.Modify the unreasonable control program, avoid reading or writing parameters too often 3.Set P08.0F to 1, do not write to EEPROM when modify parameters
			Reach the limit of reading and writing EEPROM	Frequently read and write function codes cause EEPROM life to run out, For the function code triggers the alarm, modify the function code via panel or debug software, after the restart, re-read to see if the function code is normal, to confirm that whether the hardware is abnormal	Replace the drive or return it to factory for repair

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
Er.04.E	EEPROM write error	Resettable error (Fault 2 shutdown)	Read or write function code too frequently	Check if reading and writing function code too often, if still alarm after restart, unplug the Ethernet cable then restart to check if it is related to Ethernet port, check control program	1.Restart to reset alarm 2.Modify the unreasonable control program, avoid reading or writing parameters too often 3.Set P08.0F to 1, do not write to EEPROM when modify parameters
			Reach the limit of reading and writing EEPROM	Frequently read and write function codes cause EEPROM life to run out, For the function code triggers the alarm, modify the function code via panel or debug software, after the restart, re-read to see if the function code is normal, to confirm that whether the hardware is abnormal	Replace the drive or return it to factory for repair
Er.04.F	EEPROM read error	Resettable error (Fault 2 shutdown)	Read or write function code too frequently	Check if reading and writing function code too often, if still alarm after restart, unplug the Ethernet cable then restart to check if it is related to Ethernet port, check control program	1.Restart to reset alarm 2.Modify the unreasonable control program, avoid reading or writing parameters too often 3.Set P08.0F to 1, do not write to EEPROM when modify parameters
			Reach the limit of reading and writing EEPROM	Frequently read and write function codes cause EEPROM life to run out, For the function code triggers the alarm, modify the function code via panel or debug software, after the restart, re-read to see if the function code is	Replace the drive or return it to factory for repair

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				normal, to confirm that whether the hardware is abnormal	
A1.05.0	Positive over travel	Warning	Detect external (or software limit) positive over travel signal, the servo no longer responds to positive command	Check the state of positive limit sensor and logical state of the corresponding DI function terminal	Remove the machine from its current position after de-hazard
A1.05.1	Negative over travel	Warning	Detect external (or software limit) negative over travel signal, the servo no longer responds to negative command	Check the state of negative limit sensor and logical state of the corresponding DI function terminal	Remove the machine from its current position after de-hazard
A1.05.2	Emergency stop	Warning	Detect external stop signal	Check the logic state of the corresponding DI terminal	Reset DI terminal state after de-hazard
Er.05.3	Position deviation is too large	Non-resettable error (Fault 1 shutdown)s	Input position command is too large	1.Use Flexem Servo Configuration software to capture running waveforms to see if there are abnormal mutations in command 2.Try Servo internal position mode operation to see if the same exception occurs	1.Decrease position command value that the upper device issues 2.Check the connection of encoder cables and power cables if the same abnormality occurs when operating in internal position mode
			Mechanical stuck	1.Disable the sevrvo( release the brake of the motor that with brake ), manually push the machine, check if it is smooth, if it is stuck 2.Check if it reach the mechanical limit during operation	Manually push the machine, remove from the current position

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
			Position deviation threshold is too small or gain is too small	Theoretical value of following position deviation=operating velocity/P00.04, for example, operating velocity is 1000mm/s, rigidity in level 12, P00.04 is 390, Theoretical value of following position deviation= $1000/390*10=25.6$ mm	1.The recommended setting is 20% larger than the theoretical value 2.Check if the unit of excessive position deviation (P03.25) is set correctly (when P03.25 is set to 2, the unit of P03.26 is mm)
Al.05.4	Homing timeout error	Warning	Homing timeout error, time for homing is more than the setting value of P03.35	1.Check if home position limit is normal 2.Check if P03.35 setting is proper	1.Check the wiring of home position limit ,ensure that the home position limit signal is normal 2.Increase P03.35 (home position seeking time) 3.Set P03.35 to 0, disable alarm
Er.05.5	Motor run-away	Non-resettable error (Fault 1 shutdown)	Phase sequence error	Check if the wiring of power cable U, V, W is normal	Compare the U, V, W terminal with the U, V W terminal in motor drawing, secure the wire, re-plug
			Gain parameter is set incorrectly	Check the motor for resonance or jitter	Adjust parameters to eliminate resonance jitter
			False alarm	Gain is not adjusted, system vibration, may cause false alarm	Increase alarm threshold(P0B.13) appropriately
			Electrical angle loss	Servo System collision, The motor does remain at a fixed position whenever an alarm occurs	Perform angle identification
			Motor stall	The motor remains at a fixed position whenever an alarm	Inspect the mechanical structure to prevent jamming

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				occurs.	
Er.05.6	Overspeed	Non-resettable error (Fault 1 shutdown)	Phase sequence error	Check if the wiring of power cable U, V, W is normal	Compare the U, V, W terminal with the U, V W terminal in motor drawing, secure the wire, re-plug
			Motor stuck	Machine is located at the fixed position when alarming	Check mechanical structure and installation, eliminate mechanical jamming cause motor stuck
			grating ruler feedback abnormality cause incorrect electric angle calculation	1.Check if the grating ruler feedback is normal, manually push the motor (servo is disabled) for specified distance, check if U00.09 feedback pulse is consistent with the actual distance 2.Check encoder feedback circuit, check if grating ruler indicator is normal, check if the wiring is normal(must use shielded twisted pair) 3.Adjust P19.24(feedback filtering) according to the feedback frequency of the grating ruler	1.Check wiring, re-install grating ruler to ensure that the wiring is correct 2.Use shielded twisted pair 3.Adjust P192.4 (feedback filtering)
Er.05.7	Servo enabled failure	resettable error (Fault 2 shutdown)	Use multiple enablers at the same time	Check servo enabled via DI, Fn group function code setting, Servo enabled during jog, inertia identification, or two position operation	Cancel all servo enabled state or restore the parameter to default, only one servo enabled function is used
Er.05.8	Position command scheduling	Resettable error (Fault 1)	High speed command are not supported by the	-	Reset all function code,if it still abnormal after reset, ask Flexem

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
	exception	shutdown)	software		technical support engineer for help
Er.05.9	Internal and external loop deviation is too large in full-closed loop feature	Resettable error (Fault 1 shutdown)	After enabling full-closed loop, the difference between the expected value of full-closed loop feedback calculated by P06.02 and the actual full-closed loop feedback value is more than P06.0C	1. Check P06.02(external encode resolution ) 2. Set appropriate deviation range(P06.0V) 3.Check if external encoder feedback signal is correct 4.Check if the direction of external encoder feedback is correct 5.Testing machinery for slippage	1.Modify P06.02 according to external encoder resolution 2.Increase P06.0C(Maximum deviation between internal loop and external loop encoder 3.Use shielded twisted pair cable 4.Re-connect, secure or plug communication cable of the external encoder 5.Re-install the external encoder
Er.05.A	Brake current is too large	Resettable error (Fault 1 shutdown)	Average load ratio is too large	Monitor U00.0E( average load ratio), check if the load ratio is too large or the motor specification is too small	Set P0B.24 to 0 to disable this alarm
			instantaneous load ratio is too large	Monitor U00.10 or samp Q axe current feedback waveform, check if there is abnormal rising current	Set P0B.27 to 0 to disable this alarm
Er.05.B	Position deviation overflow	Non-resettable error (Fault 1 shutdown)	Input position command is too large	1.Sample waveform by debug software, check the command for abnormal mutation 2.Try servo internal position mode to check if there is the same abnormality	1.Decrease position command from the upper device 2.If the same when operating in internal position mode, check encoder cable and power cable for the motor
			Mechanical jamming	1. Disable the servo(release brake for the motor with brake), manually push the	Manually push the machine to remove from the current position

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				machine, check if it is smoothing Check if the machine reach the mechanical limit position	
			Position deviation threshold is too small or gain is too small	Theoretical value of following position deviation=operating velocity/P00.04, for example, operating velocity is 1000mm/s, rigidity in level 12, P00.04 is 390, Theoretical value of following position deviation= $1000/390*10=25.6$ mm	1.The recommended setting is 20% larger than the theoretical value 2.Check if the unit of excessive position deviation(P03.25) is set correctly (when P03.25 is set to 2, the unit of P03.26 is mm)
Er.05.C	Discharge resistor is too small	Non-resettable error (Fault 1 shutdown)	P02.22or P02.24 setting value is less than P19.18 limit	View parameter setting via panel or debug software	1.Set the resistance of rake resistor P02.24 $\geq$ P19.81 2.Power of brake resistor P0.22 is too small, increase this parameter
Er.06.0	No corresponding drive	Non-resettable error (Fault 1 shutdown)	Drive parameter is abnormal	View P19.00 to check if it is the drive model	1.Restore the parameter to factory state 2.Replace the drive
Er.06.1	No corresponding motor code	Non-resettable error (Fault 1 shutdown)	Motor code set by P18.02 does not exist	1.Check if the drive model is non-standard 2.View setting of the P18.02	1.Non-standard drive, confirm the motor model with the motor manufacturers, modify P18.02 2.For common model, need to set P18.02 to 0, manually enter the Pn18 group parameter
Er06.2	No corresponding encoder	Non-resettable error	Encoder model set by P18.00 does not exist or is not supported by the	1.Check if the motor is the matched model 2.Check if the	1.Use the motor model recommended by the manufacturer

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
	model	(Fault 1 shutdown)	drive	resolution of the motor encoder matches the drive	2.motor with 23 bit resolution requires R3 series drive
Er.06.3	Model is not set	Non-resettable error (Fault 1 shutdown)	Lack of drive model information	If it still faulty after restart, return it to factory for repair	Replace the drive or ask Flexme technical support engineer for help
Er.06.4	DI error	Resettable error (Fault 2 shutdown)	Different DI terminals are assigned the same function	Check if there is a duplicate parameter setting in the DI terminal P04.04~P04.0A	Reassign DI terminal function
Er.06.5	Electronic gear ratio setting error	Resettable Error (Fault 2 shutdown)	Electronic gear ratio parameter setting out of range	Check whether the gear ratio set by P03.12 ~ P03.18 exceeds the 0.001 ~ 100,000 range	Reset the ratio of electronic gears
Er.06.7	Frequency division setting error	Resettable Error (Fault 2 shutdown)	The number of pulses set by the motor divider output is greater than the motor encoder resolution	Resolution needs to be set less than hardware supported resolution, view P02.03 set values	Reduce P02.03 Set Values
Er.06.9	Software limit setting error	Resettable error (Fault 2 shutdown)	Parameter is set incorrectly	Software upper limit(P03.23) is less than lower limit(P03.21)	Set P03.23 and P03.21 correctly
Er.06.A	Home position setting error	Resettable error (Fault 2 shutdown)	Parameter is set incorrectly	Mechanical home position offset(P03.36) is out of the range of software limit(the upper software limit P03.23, the lower software limit P03.21)	Set P03.36 correctly
Er.06.C	Multi-turn encoder is not supported	Resettable error (Fault 2 shutdown)	Parameter setting conflicts	P18.00 is set to single-turn, but P02.29 is set to enable absolute position	Set P18.00 correctly or set P02.29 to 0 to disable absolute position
	Angle	Resettable	P02.3B=2(micro-	1. Check if the wiring	1 Check if the mover is

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
Er.07.0	identification failure	error (Fault 1 shutdown)	motion method 1), motor mover does not move when searching for angle	of power cable U, V, W is correct 2. Ensure that P18 parameters is right, especially number of motor pole number, pole distance and encoder resolution 3. Disable the servo, push manually the motor to ensure that feedback is right and feedback pulse matches the pushed distance 4. Check for external disturbances, including excessive friction, overriding hard limits, or loads drop down due to gravity, etc.	stuck 2. Check if grating feedback is normal 3. Check if motor parameter is right, especially the P18.06 (grating ruler resolution) 4. Check if the U, V W wiring is normal. Set P02.3A to 1, set F03 (F.Agl) to enable initial angle identification, if reported alarm Er.01.5, take corresponding measures
			P02.3B=3 (micro-motion method 2) Motor Kinematics Operating Distance Exceeds 90 Degrees (Electric Angle) on First Identification	1 Check if the motor is driven by external forces during identification 2. Check if grating feedback is abnormal 3. Ensure that the motor parameter is right 4. Check if the wiring of U, V W is normal, check for phase loss 5. Motor magnetic tension is not uniform, increasing the P0A.0C (threshold of micro-motion)	1 Check if motor is pushed by external force during identification 2. Check if grating feedback is abnormal. 3. Check if motor parameter is right, especially the P18.06 (grating ruler resolution) 4. Check if the U, V W wiring is normal. Set P02.3A to 1, set F03 to enable initial angle identification, if reported alarm Er.01.5, take corresponding measures 5. Distance abnormality during identification action, try to adjust P02.3C, P02.3D,

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
					P02.42~P02.44 to optimize identification action
			P02.3B=4 ( Hall identification ) ,Unable to enter the enable state before running to find the HALL state; 6 HALL status has not been found for more than 16 seconds. Movement distance exceeds 2 poles	1. Hall signal feedback abnormal, check if Hall signal feedback is abnormal via U00.39 2.Check if grating feedback is abnormal 3.check wiring of power cable U,V, W, check for phase loss 4.Can't get stuck near the hard limit during hall identification	P02.3F and P02.41 are set to 0, do not use the Hall function for one angle recognition, oscilloscope add channel "Hall status," "position feedback" and "electrical angle," manually push motor (Servo is disabled) or jog more than one point period distance, Acquisition of waveforms to see if the Hall state is satisfied "in an electrical angle cycle, The motor moves an extreme distance of state 1 ~6 with a total of 6 Hall states. "If a state other than 1 ~ 6 appears or a state value is missing, then check the Hall wiring and check the P18 parameters
Er.07.1	Angle identification failure 1	Resettable error (Fault 1 shutdown)	1、 P02.38 = 1, The action distance exceeds 90 degrees at the second repeat recognition (The micro-motion action distance should be very small, and the action distance exceeds 90 degrees, exceeds 1/4 pole ) 2、 P02.38 = 1, the difference between the two repeated	1 Check if the motor is pushed by external force during identification 2.Check if grating feedback is abnormal 3.Check if motor parameters is correct 4.Check if the wiring of U, V , W is correct, check for phase loss	1.Uneven motor magnetic tension, increase P02.3C(threshold of angle for angle identification micro-motion ) 2.Increase P02.3D (threshold for stop)

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
			identification results exceeds the P02.37 allowable error value; 3、 Do not detect stop over 2s during micro-motion identification		
Er.07.2	Angle identification failure 2	Resettable error (Fault 1 shutdown)	P02.3B = 3, the identification failed, the micro-motion method repeated recognition, the difference of the electric angle set in two identification action is more than 70 degree	Check motor kinematics for external disturbances such as cable pulling, need to be eliminated	Increase P02.3C (micro-motion threshold), Avoid possible misjudgment of external disturbances during identification
Er.07.3	Offline inertia identification failure	Resettable error (Fault 2 shutdown)	U、 V、 W wiring error	1.Check if the power cable is connected correctly 2.Check for phase sequence for power cable 3.Check power cable for damage	Compare the U,V, W terminals with the U, V, W terminals in motor drawing, secure the cable, re-plug
			Mechanical jamming	1.For motor without brake, manually rotate the machine, check if it is smoothing 2.For motor with brake, release the brake, manually push the machine, check if it is smoothing	Manually push the machine, remove from the current position
Er.07.4	Stuck during angle identification	Resettable error (Fault 1 shutdown)	Motor movements are small or inactive	Check if the motor mover is stuck	Reinstall the machine
				Check if grating is abnormal, manually push the motor to move a specified	Wire correctly, replace grating

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				distance(servo is disabled), view U00.09 (encoder feedback pulse counting) is normal	
				Check if P18.06(grating ruler resolution) is normal	Set P18.06 correctly
Er.09.0	ESC Initialization Failure	Non-resettable error (Fault 1 shutdown)	Drive PHY chip abnormality	Check if drive Ethernet cable is connected correctly	If it still alarm after restart, replace the drive
Er.09.1	ESI check error	Resettable error (Fault 1 shutdown)	Slave station configuration information in ESC EEPROM check error	-	Restart, if still alarm, ask Flexem technical support engineer for help
Er.09.2	ESI file not burned	Non-resettable error (Fault 1 shutdown)	ESI file not burned	-	Restart, if still alarm, ask Flexem technical support engineer for help
Er.09.3	ESC EEPROM read or write timeout	Non-resettable error (Fault 1 shutdown)	ESC EEPROM read or write timeout	-	Restart, if still alarm, replace the drive
Er.09.7	Receiving Data Loss	Resettable error (Fault 1 shutdown)	Do not receive the data from the master for multiple consecutive cycles, not caused by EMC interference, maybe the previous slave or the master does not send data	Check if cable and Ethernet port indicator is normal	If it still alarm after restart, ask Flexem technical support engineer for help
Er.09.9	Check error on data writing in ESC	Non-resettable error (Fault 1 shutdown)	ESC EEPROM write check error	-	Restart, if still alarm, replace the drive

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
	EEPROM				
A1.09.A	PHY_RxErr early warning	Warning	Detect RxErr in PHY	Check Ethernet cable wiring and UVW power line magnetic ring	Ensure no electromagnetic interference
A1.0C.0	Parameters take effect after restart	Warning	The parameters set take effect after restart	Set the parameters that takes effective after restart	Restart the drive
A1.0C.2	Power Defect Alarm	Warning	L1 and L2, or R, S, and T input power supply missing phase alarm	Check if external power supply has phase loss	1.Connect power cable correctly 2.P0B.05 = 2 can be set to block this alarm when external power specifications and wiring are good
A1.0C.3	Homing parameter setting error	Warning	Homing method is not effective	View the homing methods that are supported by the drive	Check wiring of home position and limit position, set home position, limit position, and state correctly
			Respond to limit switch abnormally during homing	Home position switch, positive limit and negative limit, two or more among the three are triggered at the same time	Rewire, reinstall grating ruler or set the parameters correctly
A1.0C.4	Quadrature encoder feedback interference alarm	Warning	Feedback interference or grating ruler abnormality	1.Check encoder feedback circuit, ensure that grating ruler indicator is normal 2.Wiring correctly(must use shielded twisted pair)	Rewire, reinstall grating ruler or reset parameters
A1.0C.6	External battery of the encoder is undervoltage	Warning	Battery voltage is lower than 2.5V	1.Check if the absolute position is enabled while not using battery 2.Check if the external battery wire of the encoder is normal 3.Remove the battery,	Replace the battery, battery box or cable with battery box

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				measure the voltage of the battery, check if it is lower than 2.5V	
Er.10.0	Encoder is disconnected	Non-resettable error (Fault 1 shutdown)	Drive is disconnected with the the encoder at the moment that the drive is powered up	1.Check if P18.00 is set correctly 2.Check if the wiring of encoder is correct	Reset parameter, rewire,if it still alarm after restart, replace the motor
Er.10.1	Encoder parameter error	Non-resettable error (Fault 1 shutdown)	Data check error or parameter is not saved to the motor EEPROM	Non-standard motor not match the drive	If it still alarm after restart, replace the motor
Er.10.2	Encoder communication failure	Non-resettable error (Fault 1 shutdown)	Drive communicate with the motor encoder normally, the communication is suddenly disconnected	1.Check if P18.00 is set correctly 2.Check if the wiring of encoder is normal	Reset the parameter, rewire, if it still alarm after restart, replace the motor
Er.10.3	Encoder Settlement Error	Non-resettable error (Fault 1 shutdown)	Bus encoder itself alarm	1.Check if P18.00 is set correctly 2.Check if the wiring of the encoder is correct, generally contaminated with optical encoder disk, causing the encoder to calculate incorrectly	Reset parameters, rewire, if it still alarm after restart, replace the motor
Er.10.4	Encoder incremental-counting abnormality	Non-resettable error (Fault 1 shutdown)	P18.00 is set incorrectly or wiring of the encoder is incorrect	1.Check if P18.00 is set correctly 2.Check if the wiring of the encoder is correct	Reset parameter, rewire, if it still alarm after restart, replace the motor
Er.10.5	Encoder parameters write error	Non-resettable error (Fault 1 shutdown)	P18.00 is set incorrectly or wiring of the encoder is incorrect	1.Check if P18.00 is set correctly 2.Check if the wiring of the encoder is correct	Reset parameter, rewire, if it still alarm after restart, replace the motor
	Encoder	Non-	The drive switches	Normal alarm prompt	Set F07 to 1 to reset

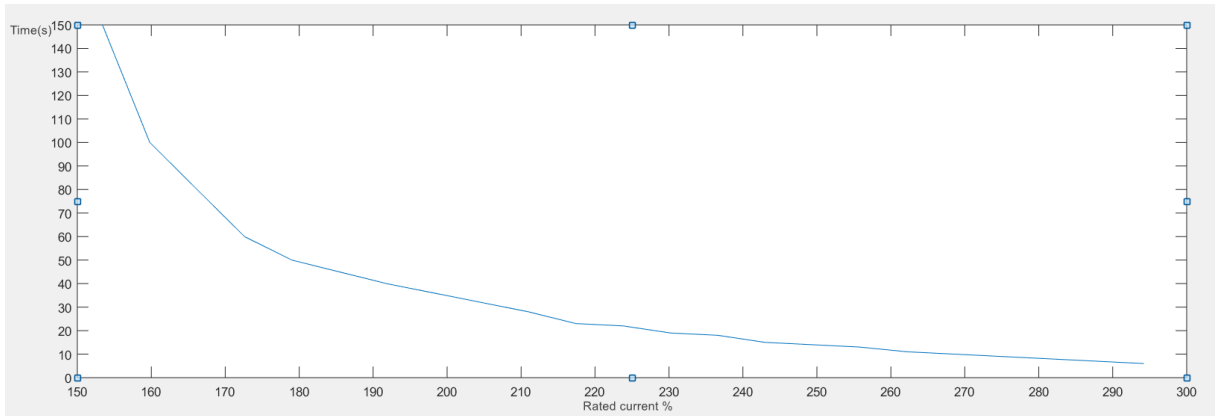
Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
Er.10.6	battery is ineffective	resettable error (Fault 1 shutdown)	from incremental mode to absolute mode	after the switching	fault, restart the drive or perform software reset via servo commissioning software
			The voltage of battery is lower than 2.5V	Remove the battery, measure the voltage of the battery, check if it is lower than 2.5V	After replacing the battery, set F07 to 1 to reset fault, restart the drive or perform software reset via servo commissioning software
			External wire of the battery is disconnected	It still alarm after using F07 to reset fault	Re-welding, re-plug motor side encoder cable or replace encoder cable, battery box
Er.10.7	Encoder multi-turn counting error	Non-resettable error (Fault 1 shutdown)	Motor hardware failure	Code disk dirt, etc.	Set F07 to 1 to reset fault, restart the drive or perform software reset via servo commissioning software
Er.10.8	Encoder multi-turn counting overflow	Non-resettable error (Fault 1 shutdown)	Chip of encoder counting overflow	Drive get abnormal multi-turn data from the encoder, check if U002.3 and U00.24 are normal, disable this alarm by setting POB.03 to 1	SSet F07 to 1 to reset fault, restart the drive or perform software reset via servo commissioning software
Er.10.A	Incremental encoder phase A/phase B interference	No reset error (fault 1 shutdown)	Feedback interference or grating ruler anomalies	1. Check the encoder feedback loop to make sure the raster indicator is OK 2. Make sure the wiring is correct (twisted shields must be used)	Reconnect, reload, or reset parameters
Er.10.B	Incremental encoder phase Z interference failure	No reset error (fault 1 shutdown)	Feedback interference or abnormal phase A/phase B count	1. Verify that P18.00 settings are correct 2. Check encoder wiring	1. Correct Setting P18.00 Motor Encoder Model 2. Reconnect

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
Er.10.C	Hall error when incremental encoder is powered up	Non-resettable error (Fault 1 shutdown)	Hall feedback abnormality	In case of P02.3B=4, P02.3F and 02.41 are both set to 0, perform angle identification not using Hall function, oscilloscope channel adds “Hall status”, “position feedback”, and “electric angle”, manually push the motor or jog more than 1 cycle distance, samp waveform to observe if the Hall state meet the condition, which is “During an electric angle cycle, the motor moves one pole distance and appears 6 Hall states(state 1~6)”	If a state other than 1 ~ 6 appears in the Hall state or a state value is missing, check the Hall wiring and reset the P18 group of parameters
Er.10.E	Linear encoder interference	Non-resettable error (Fault 1 shutdown)	Feedback reference or grating ruler abnormality	1.Check the encoder feedback circuit, ensure that the grating ruler indicator is normal 2.Ensure that the wiring is correct(must use shielded twisted pair)	Rewire, reinstall grating ruler, or reset parameters
	Linear encoder interference	Non-resettable error (Fault 1 shutdown)	Hall feedback abnormality	In case of P02.3B=4, P02.3F and 02.41 are both set to 0, perform angle identification not using Hall function, oscilloscope channel adds “Hall status”, “position feedback”, and “electric angle”, manually push the motor(Servo not enabled) or jog more than 1 cycle distance,	If a state other than 1 ~ 6 appears in the Hall state or a state value is missing, check the Hall wiring and reset the P18 group of parameters

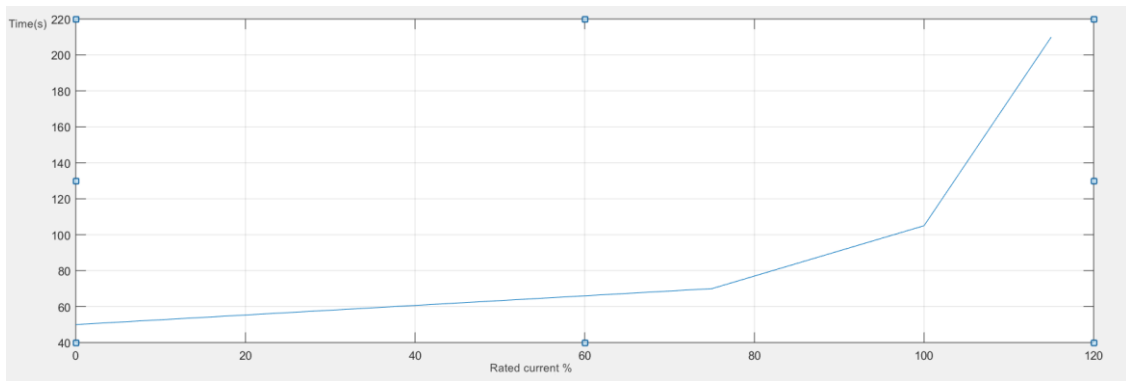
Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
				samp waveform to observe if the Hall state meet the condition, which is “During an electric angle cycle, the motor moves one pole distance and appears 6 Hall states(state 1~6)”	
			No Hall magnetic pole identification	Does not perform Hall magnetic pole identification after replacing the drive or Hall device	Set P02.3F to 0, perform Hall identification again, if it succeed, reset P02.3F to 3
Er.12.0	FPGA burn	Non-resetable error (Fault 1 shutdown)	FPGA fault	It still alarm after restart	Replace the drive or ask the Flexem technical support engineer for help
Er12.2	Function code abnormality	Non-resetable error (Fault 1 shutdown)	Parameters of P00 group to P17 group exceed the limit	View U00.3E and U00.3F(address of abnormal parameter function code that exceed the limit)	1.Modify the function code according to the address 2.Set F04 to 1 to reset function code in group P00 to group P17(firstly save the configuration file), restart the drive
Er.12.3	Manufacture parameter abnormality	Non-resetable error (Fault 1 shutdown)	Parameters in group P18 and P19 exceed the limit	View U00.3E and U00.3F(address of abnormal parameter function code that exceed the limit)	1.Modify the function code according to the address 2.Set F04 to 4 to restore to the factory state( firstly save the configuration file), restart the drive
Er.12.4	EEPROM storage range exceed the limit	Non-resetable error (Fault 1 shutdown)	EEPROM storage range exceed the limit	It still alarm after restart	Replace the drive or ask Flexem technical support engineer for help
Er.12.6	Encryption chip	Non-resetable	Encryption chip hardware failure	It still alarm after restart	Replace the drive or ask Flexem technical

Alarm code	Alarm name	Alarm type	Cause of failure	Troubleshooting methods	Fault Remediation Procedures
	abnormality	error (Fault 1 shutdown)			support engineer for help
Er.12.8	MCU loss	Non-resettable error (Fault 1 shutdown)	Drive internal software program fault	It still alarm after restart	Replace the drive or ask Flexem technical support engineer for help
Er.12.9	System parameter abnormality/FPGA parallel port error	Non-resettable error (Fault 1 shutdown)	The FPGA is not working properly	1.Set F10 to 1 to reload FPGA FLASH(load file for about 100s, wait for the drive to automatically restart ) 2.Burn the program again	Replace the drive or ask Flexem technical support engineer for help
Er.12.A	Current timeout	Non-resettable error (Fault 1 shutdown)	Internal current sampling chip fault	It still alarm after restart	Replace the drive or ask Flexem technical support engineer for help
Er.12.B	Encoder timeout	Non-resettable error (Fault 1 shutdown)	Motor hardware failure	It still alarm after restart	Replace the drive or ask Flexem technical support engineer for help
Er.12.C	FPGA timeout	Non-resettable error (Fault 1 shutdown)	FPGA failure	It still alarm after restart	Replace the drive or ask Flexem technical support engineer for help

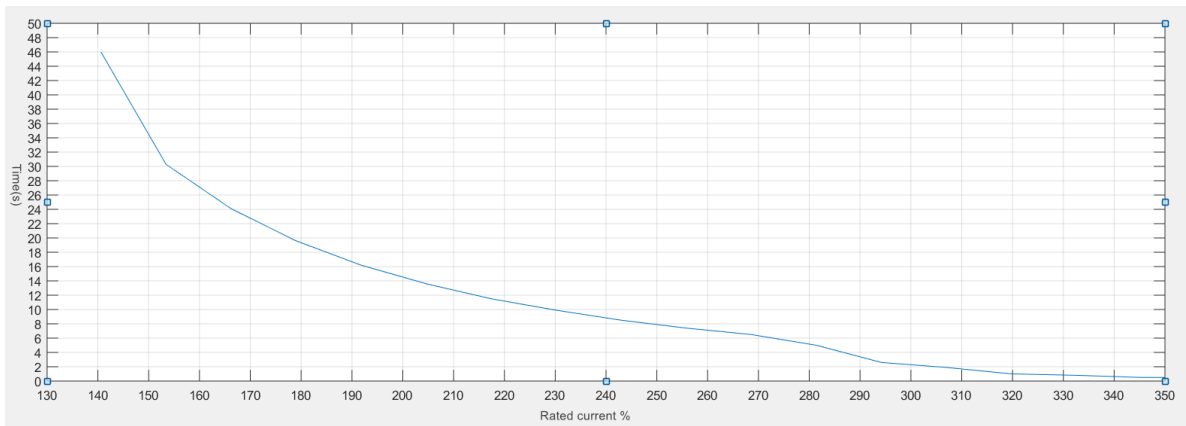
\*Motor Overload Protection Time Table: (When the alarm Er.02.9 occurs, if the motor heating is not severe, you can appropriately adjust P0B.11)



\*Motor Cooling Time:



\*Driver (400W~750W) Overload Time:



# 7 Object Dictionary

The object address allocation is as shown in the table below.

Index	Description
1000h~1FFFh	Communication Objects
2000h~5FFFh	Manufacturer Custom Area
6000h~9FFFh	CiAS402 Object Area

DATA TYPE represents the data type of the object, including:

- ◆ U32: Unsigned 4 bytes
- ◆ U16: Unsigned 2 bytes
- ◆ U8: Unsigned 1 byte
- ◆ I32: Signed 4 bytes
- ◆ I16: Signed 2 bytes
- ◆ I8: Signed 1 byte
- ◆ VS: Character 20 bytes

ACCESS represents the object access attributes, including:

- ◆ RO: Read-only attribute
- ◆ RW: Read and write attribute

PDO indicates whether the PDO can be mapped, including:

- ◆ No: RxPDO, TxPDO cannot be mapped (only SDO can be mapped).
- ◆ RxPDO: RxPDO can be mapped.
- ◆ TxPDO: TxPDO can be mapped.

EEPROM indicates whether the object is stored in EEPROM:

- ◆ YES: Stored in EEPROM
- ◆ NO: Not stored in EEPROM

## 7.1 Communication Object Area (1000h~1FFFh)

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
1000h	00h	Device Type	-	-	00000192h	U32	RO	NO	NO
1001h	00h	Error Register	-	-	00h	U8	RO	NO	NO
1008h	00h	Device Name	-	-	ES100N	VS	RO	NO	NO
1009h	00h	Hardware Version	-	-	-	VS	RO	NO	NO
100Ah	00h	Software	-	-	-	VS	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Version							
1018h	00h	Maximum Sub-indexes Contained in ID Object Index Number	-	-	4	U8	RO	NO	NO
1018h	01h	Vendor ID	-	-	10001000h	U32	RO	NO	NO
1018h	02h	Product Code	-	-	00000100h	U32	RO	NO	NO
1018h	03h	Revision Number	-	-	10001000h	U32	RO	NO	NO
1018h	04h	Serial Number	-	-	00000000h	U32	RO	NO	NO
1C00h	00h	Maximum Sub-index of Sync Manager Comm Type	-	-	4	U8	RO	NO	NO
1C00h	01h	SM0 Communication Type	-	-	1	U8	RO	NO	NO
1C00h	02h	SM1 Communication Type	-	-	2	U8	RO	NO	NO
1C00h	03h	SM2 Communication Type	-	-	3	U8	RO	NO	NO
1C00h	04h	SM3 Communication Type	-	-	4	U8	RO	NO	NO
1600h	00h	Number of Mapped Objects in Group 1600	0~10	-	3	U8	RW	NO	NO
1600h	01h	First Mapped	0~FFFFFF	-	60400010h	U32	RW	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Object	FFFh						
1600h	02h	Second Mapped Object	0~FFFFFF FFFh	-	60600008h	U32	RW	NO	NO
1600h	03h	Third Mapped Object	0~FFFFFF FFFh	-	60B80010h	U32	RW	NO	NO
1600h	04h	Fourth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1600h	05h	Fifth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1600h	06h	Sixth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1600h	07h	Seventh Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1600h	08h	Eighth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1600h	09h	Ninth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1600h	0Ah	Tenth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1701h	00h	Number of Mapped Objects in Group 1701	-	-	4	U8	RO	NO	NO
1701h	01h	First Mapped Object	-	-	60400010h	U32	RO	NO	NO
1701h	02h	Second Mapped Object	-	-	607A0020h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
1701h	03h	Third Mapped Object	-	-	60B80010h	U32	RO	NO	NO
1701h	04h	Fourth Mapped Object	-	-	60FE0120h	U32	RO	NO	NO
1702h	00h	Number of Mapped Objects in Group 1702	-	-	7	U8	RO	NO	NO
1702h	01h	First Mapped Object	-	-	60400010h	U32	RO	NO	NO
1702h	02h	Second Mapped Object	-	-	607A0020h	U32	RO	NO	NO
1702h	03h	Third Mapped Object	-	-	60FF0020h	U32	RO	NO	NO
1702h	04h	Fourth Mapped Object	-	-	60710010h	U32	RO	NO	NO
1702h	05h	Fifth Mapped Object	-	-	60600008h	U32	RO	NO	NO
1702h	06h	Sixth Mapped Object	-	-	60B80010h	U32	RO	NO	NO
1702h	07h	Seventh Mapped Object	-	-	607F0020h	U32	RO	NO	NO
1701h	00h	Number of Mapped Objects in Group 1703	-	-	7	U8	RO	NO	NO
1703h	01h	First Mapped Object	-	-	60400010h	U32	RO	NO	NO
1703h	02h	Second Mapped	-	-	607A0020h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Object							
1703h	03h	Third Mapped Object	-	-	60FF0020h	U32	RO	NO	NO
1703h	04h	Fourth Mapped Object	-	-	60600008h	U32	RO	NO	NO
1703h	05h	Fifth Mapped Object	-	-	60B80010h	U32	RO	NO	NO
1703h	06h	Sixth Mapped Object	-	-	60E00010h	U32	RO	NO	NO
1703h	07h	Seventh Mapped Object	-	-	60E10010h	U32	RO	NO	NO
1704h	00h	Number of Mapped Objects in Group 1704	-	-	9	U8	RO	NO	NO
1704h	01h	First Mapped Object	-	-	60400010h	U32	RO	NO	NO
1704h	02h	Second Mapped Object	-	-	607A0020h	U32	RO	NO	NO
1704h	03h	Third Mapped Object	-	-	60FF0020h	U32	RO	NO	NO
1704h	04h	Fourth Mapped Object	-	-	60710010h	U32	RO	NO	NO
1704h	05h	Fifth Mapped Object	-	-	60600008h	U32	RO	NO	NO
1704h	06h	Sixth Mapped Object	-	-	60B80010h	U32	RO	NO	NO
1704h	07h	Seventh Mapped	-	-	607F0020h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Object							
1704h	08h	Eighth Mapped Object	-	-	60E00010h	U32	RO	NO	NO
1704h	09h	Ninth Mapped Object	-	-	60E10010h	U32	RO	NO	NO
1705h	00h	Number of Mapped Objects in Group 1705	-	-	8	U8	RO	NO	NO
1705h	01h	First Mapped Object	-	-	60400010h	U32	RO	NO	NO
1705h	02h	Second Mapped Object	-	-	607A0020h	U32	RO	NO	NO
1705h	03h	Third Mapped Object	-	-	60FF0020h	U32	RO	NO	NO
1705h	04h	Fourth Mapped Object	-	-	60600008h	U32	RO	NO	NO
1705h	05h	Fifth Mapped Object	-	-	60B80010h	U32	RO	NO	NO
1705h	06h	Sixth Mapped Object	-	-	60E00010h	U32	RO	NO	NO
1705h	07h	Seventh Mapped Object	-	-	60E10010h	U32	RO	NO	NO
1705h	08h	Eighth Mapped Object	-	-	60B20010h	U32	RO	NO	NO
1A00h	00h	Number of Mapped	0~10	-	7	U8	RW	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Objects in Group 1A00							
1A00h	01h	First Mapped Object	0~FFFFFF FFFh	-	60410010h	U32	RW	NO	NO
1A00h	02h	Second Mapped Object	0~FFFFFF FFFh	-	60640020h	U32	RW	NO	NO
1A00h	03h	Third Mapped Object	0~FFFFFF FFFh	-	60B90010h	U32	RW	NO	NO
1A00h	04h	Fourth Mapped Object	0~FFFFFF FFFh	-	60BA0020h	U32	RW	NO	NO
1A00h	05h	Fifth Mapped Object	0~FFFFFF FFFh	-	60BC0020h	U32	RW	NO	NO
1A00h	06h	Sixth Mapped Object	0~FFFFFF FFFh	-	603F0010h	U32	RW	NO	NO
1A00h	07h	Seventh Mapped Object	0~FFFFFF FFFh	-	60FD0010h	U32	RW	NO	NO
1A00h	08h	Eighth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1A00h	09h	Ninth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1A00h	0Ah	Tenth Mapped Object	0~FFFFFF FFFh	-	0	U32	RW	NO	NO
1B01h	00h	Number of Mapped Objects in Group 1B01	-	-	9	U8	RO	NO	NO
1B01h	01h	First Mapped	-	-	603F0010h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Object							
1B01h	02h	Second Mapped Object	-	-	60410010h	U32	RO	NO	NO
1B01h	03h	Third Mapped Object	-	-	60640020h	U32	RO	NO	NO
1B01h	04h	Fourth Mapped Object	-	-	60770010h	U32	RO	NO	NO
1B01h	05h	Fifth Mapped Object	-	-	60F40020h	U32	RO	NO	NO
1B01h	06h	Sixth Mapped Object	-	-	60B90010h	U32	RO	NO	NO
1B01h	07h	Seventh Mapped Object	-	-	60BA0020h	U32	RO	NO	NO
1B01h	08h	Eighth Mapped Object	-	-	60BC0020h	U32	RO	NO	NO
1B01h	09h	Ninth Mapped Object	-	-	60FD0010h	U32	RO	NO	NO
1B02h	00h	Number of Mapped Objects in Group 1B02	-	-	9	U8	RO	NO	NO
1B02h	01h	First Mapped Object	-	-	603F0010h	U32	RO	NO	NO
1B02h	02h	Second Mapped Object	-	-	60410010h	U32	RO	NO	NO
1B02h	03h	Third Mapped Object	-	-	60640020h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
1B02h	04h	Fourth Mapped Object	-	-	60770010h	U32	RO	NO	NO
1B02h	05h	Fifth Mapped Object	-	-	60610008h	U32	RO	NO	NO
1B02h	06h	Sixth Mapped Object	-	-	60B90010h	U32	RO	NO	NO
1B02h	07h	Seventh Mapped Object	-	-	60BA0020h	U32	RO	NO	NO
1B02h	08h	Eighth Mapped Object	-	-	60BC0020h	U32	RO	NO	NO
1B02h	09h	Ninth Mapped Object	-	-	60FD0010h	U32	RO	NO	NO
1B03h	00h	Number of Mapped Objects in Group 1B03	-	-	10	U8	RO	NO	NO
1B03h	01h	First Mapped Object	-	-	603F0010h	U32	RO	NO	NO
1B03h	02h	Second Mapped Object	-	-	60410010h	U32	RO	NO	NO
1B03h	03h	Third Mapped Object	-	-	60640020h	U32	RO	NO	NO
1B03h	04h	Fourth Mapped Object	-	-	60770010h	U32	RO	NO	NO
1B03h	05h	Fifth Mapped Object	-	-	60F40020h	U32	RO	NO	NO
1B03h	06h	Sixth Mapped	-	-	60610008h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Object							
1B03h	07h	Seventh Mapped Object	-	-	60B90010h	U32	RO	NO	NO
1B03h	08h	Eighth Mapped Object	-	-	60BA0020h	U32	RO	NO	NO
1B03h	09h	Ninth Mapped Object	-	-	60BC0020h	U32	RO	NO	NO
1B03h	0Ah	Tenth Mapped Object	-	-	60FD0010h	U32	RO	NO	NO
1B04h	00h	Number of Mapped Objects in Group 1B04	-	-	10	U8	RO	NO	NO
1B04h	01h	First Mapped Object	-	-	603F0010h	U32	RO	NO	NO
1B04h	02h	Second Mapped Object	-	-	60410010h	U32	RO	NO	NO
1B04h	03h	Third Mapped Object	-	-	60640020h	U32	RO	NO	NO
1B04h	04h	Fourth Mapped Object	-	-	60770010h	U32	RO	NO	NO
1B04h	05h	Fifth Mapped Object	-	-	60610008h	U32	RO	NO	NO
1B04h	06h	Sixth Mapped Object	-	-	60F40020h	U32	RO	NO	NO
1B04h	07h	Seventh Mapped	-	-	60B90010h	U32	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Object							
1B04h	08h	Eighth Mapped Object	-	-	60BA0020h	U32	RO	NO	NO
1B04h	09h	Ninth Mapped Object	-	-	60BC0020h	U32	RO	NO	NO
1B04h	0Ah	Tenth Mapped Object	-	-	606C0020h	U32	RO	NO	NO
1C12h	00h	Maximum Sub-index Assigned to Sync Management 2 RxPDO	-	-	1	U8	RO	NO	NO
1C12h	01h	Index of Object 1 Assigned to RxPDO	0~FFFFh	-	1701h	U16	RW	NO	NO
1C13h	00h	Maximum Sub-index Assigned to Sync Management 2 TxPDO	-	-	1	U8	RO	NO	NO
1C13h	01h	Index of Object 1 Assigned to TxPDO	0~FFFFh	-	1B01h	U16	RW	NO	NO

## 7.2 Manufacturer Custom Area (2000h~5FFFh)

The conversion relationship between objects in the manufacturer custom area and local servo parameter addresses is shown in the table below.

Function Code Address	Object Address
PXX.YY	PXX.YY Index: 20XXh Sub-index: YYh+1 For example, for P000A, the index is 2000h, and the sub-index is 0Bh
U00.YY	U00.YY Index: 201Ah Sub-index: YYh+1 For example, for U01.02, the index is 201Bh, and the sub-index is 03h
Fxx	Fxx Index: 201Fh Sub-index: xxh+1 For example, for F02, the index is 201Fh, and the sub-index is 03h

## 7.3 Parameter Overview Table

In the related modes, “P” represents position mode, “S” represents speed mode, and “T” represents torque mode.

### 7.3.1 P00 Group Gain Parameters

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Mode	Activate Mode	Data Type
2000h (P00.00)	01	Gain adjustment Mode Selection	0: Manual Gain Adjustment 1: Automatic Rigidity Table Adjustment 2: Positioning Mode	-	1	Any	Real-time	U16
2000h (P00.01)	02	Automatically Adjust Mechanical Rigidity Settings	1~31	-	11	Any	Real-time	U16
2000h (P00.02)	03	1st velocity loop gain	0.0~2000.0	Hz	18.0	Any	Real-time	U16
2000h (P00.03)	04	1st Velocity Loop Integral Time	0.15~512.00	ms	31.00	Any	Real-time	U16
2000h (P00.04)	05	1st position loop gain	0.0~2000.0	Hz	32.0	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Mode	Activate Mode	Data Type
2000h (P00.05)	06	1st torque filtering time	0.00~30.00	ms	1.26	Any	Real-time	U16
2000h (P00.06)	07	2nd velocity loop gain	0.0~2000.0	Hz	40.0	Any	Real-time	U16
2000h (P00.07)	08	2nd velocity loop integral time	0.15~512.00	ms	20.00	Any	Real-time	U16
2000h (P00.08)	09	2nd speed loop gain	0.0~2000.0	Hz	64.0	Any	Real-time	U16
2000h (P00.09)	0A	2nd torque filtering constant	0.00~30.00	ms	1.26	Any	Real-time	U16
2000h (P00.0A)	0B	Load Inertia Ratio	0.00~120.00	-	1.00	Any	Real-time	
2000h (P00.0B)	0C	Velocity Feedback Robustness Regulator Enablement	0: Disable 1: Enable	-	0	Stop	Real-time	U16
2000h (P00.0C)	0D	Torque Command Filter Selection	0: First Order Low-Pass Filter 1: Second Order Low-Pass Filter	-	0	Stop	Real-time	U16
2000h (P00.0F)	10	Velocity Feedforward Control Selection	0: No Velocity Feedforward 1: Internal Velocity Feedforward 2: External Velocity Feedforward	-	1	Stop	Real-time	U16
2000h (P00.10)	11	Velocity Feedforward Gain	0.0~100.0	%	0.0	Any	Real-time	U16
2000h (P00.11)	12	Velocity Feedforward Filtering Time	0.00~64.00	ms	0.50	Any	Real-time	U16
2000h	13	PDFF Control	0.0~100.0	%	100.0	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Mode	Activate Mode	Data Type
(P00.12)		Coefficient						
2000h (P00.13)	14	Torque Feedforward Selection	0: No Torque Feedforward 1: Internal Torque Feedforward 2: External Torque Feedforward	-	1	Any	Real-time	U16
2000h (P00.14)	15	Torque Feedforward Gain	0.0~500.0	%	0.0	Any	Real-time	U16
2000h (P00.15)	16	Torque Feedforward Filtering Time	0.00~64.00	ms	0.50	Any	Real-time	U16
2000h (P00.16)	17	Current Loop Gain Coefficient	0~500	%	100	Any	Real-time	U16
2000h (P00.19)	1A	Gain Switching Method	0: No Gain Switching 1: DI Switching P/PI Mode 2: DI Switching First and Second Group 3: Position Command + Velocity Feedback Mode 4: Position Command Three Group Gain Switching	-	0	Any	Real-time	U16
2000h (P00.1A)	1B	Gain Switching Delay Time	0.0~1000.0	ms	5.0	Any	Real-time	U16
2000h (P00.1B)	1C	Gain Switching Level	0~20000	-	50	Any	Real-time	U16
2000h (P00.1C)	1D	Gain Switching	0~20000	-	30	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Mode	Activate Mode	Data Type
		Lag						
2000h (P00.1D)	1E	Position Gain Switching Time	0.0~1000.0	ms	3.0	Any	Real-time	U16
2000h (P00.1E)	1F	Third Group Gain Coefficient	10~1000	%	100	Any	Real-time	U16
2000h (P00.1F)	20	Third Group Gain Switching Wait Time	0.0~1000.0	ms	0.0	Any	Real-time	U16
2000h (P00.20)	21	Number of times the velocity feedback is filtered by moving mean filter	0~5	-	0	Any	Real-time	U16
2000h (P00.21)	22	Velocity Feedback Low-Pass Filtering Cutoff Frequency	50~5000	Hz	5000	Any	Real-time	U16
2000h (P00.22)	23	Velocity Feedback Robust Regulator Gain	10~2000	Hz	60	Any	Real-time	U16
2000h (P00.23)	24	Velocity Feedback Robust Regulator Dynamic Coefficient	10~10000	%	100	Any	Real-time	U16
2000h (P00.24)	25	Velocity Feedback Robust Regulator Filtering Time	0.00~20.00	ms	0.40	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Mode	Activate Mode	Data Type
2000h (P00.2E)	2F	Torque Disturber Observer Cutoff Frequency Adjustment Percentage	10~200	1%	100	Any	Real-time	U16
2000h (P00.2F)	30	Torque Disturber Observer Inertia Compensation Coefficient	0~1000	%	100	Any	Real-time	U16
2000h (P00.30)	31	Torque Disturber Observer Filtering Frequency	0.0~1000.0	Hz	0.0	Any	Real-time	U16
2000h (P00.31)	32	Torque Disturber Observer Compensation Percentage	0~200	%	0	Any	Real-time	U16

### 7.3.2 P01 Group Vibration Suppression Parameters

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Activate Method	Data Type
2001h (P01.00)	01	Adaptive Filtering Mode Selection	0: Disable adaptive filtering 1: 3rd notch filter adaptive 2: 3rd and 4th notch filter adaptive 3: Detection mode, resonance frequency displayed on	-	0	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Activate Method	Data Type
			Pn0102 4: Reset 3rd and 4th notch filter					
2001h (P01.01)	02	Current Threshold for Resonance Determination	0.0~100.0	%	2.0	Any	Real-time	U16
2001h (P01.02)	03	Resonance Frequency Identification Result	-	Hz	-	Display	-	U16
2001h (P01.03)	04	Resonance Determination Frequency Threshold	80~1000	Hz	120	Any	Real-time	U16
2001h (P01.04)	05	Anti-resonance frequency of the 1st notch filter	10~5000	Hz	5000	Any	Real-time	U16
2001h (P01.05)	06	Frequency of the 1st notch filter	50~5000	Hz	5000	Any	Real-time	U16
2001h (P01.06)	07	Bandwidth of the 1st notch filter	0~9	-	2	Any	Real-time	U16
2001h (P01.07)	08	Attenuation level of interference signals by the 1st notch filer	0~99	-	0	Any	Real-time	U16
2001h (P01.08)	09	Anti-resonance frequency of the 2nd notch filter	10~5000	Hz	5000	Any	Real-time	U16
2001h (P01.09)	0A	Frequency of the 2nd notch filter	50~5000	Hz	5000	Any	Real-time	U16
2001h (P01.0A)	0B	Bandwidth of the 2nd notch filter	0~9	-	2	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Activate Method	Data Type
2001h (P01.0B)	0C	Attenuation level of interference signals by the 2nd notch filter	0~99	-	0	Any	Real-time	U16
2001h (P01.0C)	0D	Anti-resonance frequency of the 3rd notch filter	10~5000	Hz	5000	Any	Real-time	U16
2001h (P01.0D)	0E	Frequency of the 3rd notch filter	50~5000	Hz	5000	Any	Real-time	U16
2001h (P01.0E)	0F	Bandwidth of the 3rd notch filter	0~9	-	2	Any	Real-time	U16
2001h (P01.0F)	10	Attenuation level of interference signals by the 3rd notch filter	0~99	-	0	Any	Real-time	U16
2001h (P01.10)	11	Anti-resonance frequency of the 4th notch filter	10~5000	Hz	5000	Any	Real-time	U16
2001h (P01.11)	12	Frequency of the 4th notch filter	50~5000	Hz	5000	Any	Real-time	U16
2001h (P01.12)	13	Bandwidth of the 4th notch filter	0~9	-	2	Any	Real-time	U16
2001h (P01.13)	14	Attenuation level of interference signals by the 4th notch filter	0~99	-	0	Any	Real-time	U16
2001h (P01.14)	15	Anti-resonance Frequency of the 5th Notch Filter	10~5000	Hz	5000	Any	Real-time	U16
2001h	16	Frequency of the 5th Notch	50~5000	Hz	5000	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Activate Method	Data Type
(P01.15)		Filter						
2001h (P01.16)	17	Bandwidth of the 5th Notch Filter	0~9	-	2	Any	Real-time	U16
2001h (P01.17)	18	Attenuation level of interference signals by the 5th notch filer	0~99	-	50	Any	Real-time	U16
2001h (P01.18)	19	Vibration times 1 per pole pitch	0~65535	-	0	Any	Real-time	U16
2001h (P01.19)	1A	Vibration times 2 per pole pitch	0~65535	-	0	Any	Real-time	U16
2001h (P01.1A)	1B	Vibration times 3 per pole pitch	0~65535	-	0	Any	Real-time	U16
2001h (P01.1D)	1E	Positive Friction Compensation	-100.0~100.0	%	0.0	Any	Real-time	U16
2001h (P01.1E)	1F	Negative Friction Compensation	-100.0~100.0	%	0.0	Any	Real-time	U16
2001h (P01.1F)	20	Low-Frequency Vibration Suppression Mode Selection	0: No suppression 1: One low- frequency vibration suppression point	-	0	Any	Real-time	U16
2001h (P01.21)	22	Frequency of Low-Frequency Vibration	1.0~100.0	Hz	100.0	Any	Real-time	U16
2001h (P01.22)	23	Bandwidth of Low-Frequency Vibration	0~10	-	2	Any	Real-time	U16
2001h (P01.23)	24	Low Frequency Vibration Attenuation System	1.2~10.0	-	1.2	Any	Real-time	U16
2001h (P01.26)	27	Unit of vibration times	0: 0.01	-	0	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Activate Method	Data Type
			1: 0.1					

### 7.3.3 P02 Group Basic Parameter Settings

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
2002h (P02.00)	01h	Mode selection	0: Velocity Mode 1: Position Mode 2: Torque Mode 3: Torque/velocity/position hybrid mode 20: EtherCAT Communication Mode	-	20	Stop	Real-time	U16
2002h (P02.01)	02h	Rotation Direction Selection	0: CCW 1: CW	-	0	Any	Real-time	U16
2002h (P02.02)	03h	Encoder Pulse Output Logic Flip	0: A is ahead of B 1: B is ahead of A	-	0	Any	Restart	U16
2002h (P02.03)	04h	Number of output pulses per pole pitch	1~1073741824	-	2500	Any	Restart	U16
2002h (P02.05)	06h	Z Pulse Output Level Setting	0: Low level when Z pulse is effective 1: High level when Z pulse is effective	-	1	Any	Restart	U16
2002h (P02.06)	07h	Source Selection of Pulse Division Output	0: Communication encoder 1: Pulse encoder 2: Communication encoder error compensation mode 3: Error Compensation Mode of Pulse Encoder	-	0	Any	Restart	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
			4: No output					
2002h (P02.09)	0Ah	Ratio of Frequency Division Pulses to Encoder Pulses	0~65535	-	0	Any	Restart	
2002h (P02.0A)	0Bh	High-precision AI enablement	0: Disable 1: Enable	-	0	stop	Real-time	U16
2002h (P02.0E)	0Fh	Emergency Stop Mode Selection	0: Free stop 1: Slow down on slow down ramp 2: Slow down on quick stop ramp 3: Emergency torque stop 4: Slow down on slow down ramp 5: Slow down on quick stop ramp 6: Emergency torque stop	-	0	Any	Real-time	U16
2002h (P02.0F)	10h	Brake Enablement	0: Disable 1: Enable	-	0	Stop	Real-time	U16
2002h (P02.10)	11	Stop mode when servo off	-3 : zero velocity stop and stay in DB state -2: ramp stop and stay in DB state -1: DB stop and stay in DB state 0: free stop and stay in free stop 1: ramp stop and stay in free state	-	1	Any	Real-time	I16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
			2: zero velocity stop and stay in free state					
2002h (P02.11)	12h	Overtravel Stop Mode	0: Free stop and stay in free state 1: Zero speed stop and stay in position-locked state 2: Velocity ramp stop and stay in position-locked state	-	1	Any	Real-time	U16
2002h (P02.12)	13h	Stop Mode in Case of Uncontrollable Fault (Type 1)	0: Free stop 1: DB stop and stay in free state 2: DB stop and stay in DB state	-	2	Any	Real-time	U16
2002h (P02.13)	14h	Stop Mode in Case of Controllable Fault (Type 2)	-4 : Emergency torque stop and stay in DB state -3 : zero velocity stop and stay in DB state -2: Ramp stop and stay in DB state -1: DB stop and stay in DB state 0: Free stop and stay in free state 1: Ramp stop and stay in free state 2: zero velocity stop and stay in free state 3 : Emergency torque stop and stay in free state	-	3	Any	Real-time	I16
2002h (P02.14)	15h	Stop Completion Threshold	10~1000	RPM(m/s)	100	Any	Real-time	U16
2002h (P02.1A)	1B	Weak magnetic function	0: Disable 1: Enable	-	0	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
		enablement						
2002h (P02.1B)	1C	Weak magnetic depth	60~115	%	105	Any	Real-time	U16
2002h (P02.1C)	1D	Maximum Allowable Demagnetization Current	0~100	%	20	Any	Real-time	U16
2002h (P02.1D)	1E	Weak magnetic gain	0~4000	Hz	40	Any	Real-time	U16
2002h (P02.20)	21	Regenerative Resistor Operating Mode Selection	0: Internal Resistor Discharge 1: External Resistor Discharge 2: No Discharge	-	1	Any	Real-time	U16
2002h (P02.21)	22h	Built-in regenerative resistor power	1~65535	w	50	Any	Real-time	U16
2002h (P02.22)	23h	Built-in regenerative resistance value	1~1000	Ω	50	Any	Real-time	U16
2002h (P02.23)	24h	External Regenerative Resistor Power	1~65535	W	800	Any	Real-time	U16
2002h (P02.24)	25h	External Regenerative Resistance	1~1000	Ω	50	Any	Real-time	U16
2002h (P02.26)	27h	Resistor Heat Dissipation	10~100	%	60	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
		n Coefficient						
2002h (P02.29)	2Ah	Absolute Encoder Usage Mode	0: Incremental Mode 1: Linear Mode 2: cycle mode	-	0	Any	Restart	U16
2002h (P02.2A)	2Bh	Mechanical Load Gear Ratio Numerator	1~65535	-	1	stop	Real-time	U16
2002h (P02.2B)	2Ch	Mechanical Load Gear Ratio Denominator	1~65535	-	1	stop	Real-time	U16
2002h (P02.30)	31h	Offline Inertia Identification Mode	0: positive and negative operation mode 1: JOG mode	-	1	stop	Real-time	U16
2002h (P02.32)	33h	Inertia Identification Velocity	10~1000	RPM/m m/s	200 (linear motor) 500 (rotary motor)	Any	Real-time	U16
2002h (P02.33)	34h	Inertia Identification Acceleration Time	20~800	ms	80	Any	Real-time	U16
2002h (P02.34)	35h	Inertia Identification Waiting Time	50~10000	ms	1500	Any	Real-time	U16
2002h (P02.35)	36h	Inertia Identification Running Distance	-	mm	-	Display	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
2002h (P02.36)	37h	Inertia Identification Mode Selection	0: position mode 1: velocity mode	-	1	Stop	Real-time	U16
2002h (P02.37)	38h	Micro-motion repeat identification allowable error	0.0~180.0	°C	30.0	Any	Real-time	U16
2002h (P02.38)	39h	Micro-motion repeat identification enablement	0: Disable 1: Enable	-	1	Any	Real-time	U16
2002h (P02.3A)	3Bh	U, V, W Phase Sequence Identification Enablement	0: Disable 1: Enable	-	1	stop	Real-time	U16
2002h (P02.3B)	3Ch	Angle Identification Mode Selection	0: Pre-positioning identification 1: Given Electric Angle Identification 2: Micro-motion method 1 3: Micro-motion method 2 4: Hall Identification 5: Open Loop Identification	-	0	stop	Real-time	U16
2002h (P02.3C)	3Dh	Angle Identification Micro	1~900	Set by P02.4A	2	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
		-motion Method Electric Angle Action Threshold						
2002h (P02.3D)	3Eh	Angle Identification Micro-motion Method Stop Threshold	1~300	Set by P02.4A	1	Any	Real-time	U16
2002h (P02.3E)	3Fh	Direct Positioning Method Set Electric Angle	0~180	°C	0	Any	Real-time	U16
2002h (P02.3F)	40h	Hall Identification Enablement	0: Disable 1: Enable	-	0	Stop	Real-time	U16
2002h (P02.40)	41h	Closed-Loop Velocity Loop Gain during Angle Identification	1~20000	-	30	Any	Real-time	U16
2002h (P02.41)	42h	Hall Monitoring Enablement	0: Disable 1: Monitor Hall Level Change for Abnormalities 2: Use Hall Level to Detect Electric Angle Abnormalities 3: Enable Monitoring Er10.C and Er.10.E	-	3	Any	Restart	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
			Alarms					
2002h (P02.42)	43h	Closed-loop velocity setting during angle identification	0~500	RPM(m/s)	30	Any	Real-time	U16
2002h (P02.43)	44h	Maximum Current Amplification Ratio During Angle Identification	10~200	%	100	Any	Real-time	U16
2002h (P02.44)	45h	Time To Accelerate To Maximum Current During Angle Identification	10~8000	ms	250	Any	Real-time	U16
2002h (P02.45)	46h	Electric Angle Adjustment Gain	0~1000	-	30	Any	Real-time	U16
2002h (P02.46)	47h	Current Amplification Coefficient during Electric Angle Compensation	0~300	%	150	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
2002h (P02.47)	48h	Linear Vertical Axis Enablement	0: Disable 1: Enable	-	0	Stop	Real-time	U16
2002h (P02.48)	49h	Execute angle identification after power on	0: Disable 1: Enable	-	0	Stop	Real-time	U16
2002h (P02.49)	4Ah	Maximum Current Duration	100~10000	ms	2000	Any	Real-time	U16
2002h (P02.4A)	4Bh	Open Loop Identification Operation Unit	◆ 0: 0.1 degree ◆ 1: Encoder unit	-	0	Stop	Real-time	U16
2002h (P02.4C)	4Dh	Motor Parameter Identification Current Loop Gain	◆ 0~65535	Hz	50	Any	Real-time	U16
2002h (P02.4F)	50h	Automatically adjust the running distance	0~2147483648	Command unit	10000	Any	Real-time	U16
2002h (P02.51)	52h	Automatically adjust the running velocity	0~3000	RPM(m/s)	300	Any	Real-time	U16
2002h (P02.52)	53h	Automatically adjust the acceleration and deceleration	0~10000	ms	30	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factory value	Setting Mode	Activate Mode	Data Type
		on time						
2002h (P02.53)	54h	Automatically adjust the waiting time	0~10000	ms	1000	Any	Real-time	U16
2002h (P02.54)	55h	Automatically adjust the mode	0: Positioning mode 1: Trajectory mode	-	0	Any	Real-time	U16
2002h (P02.55)	56h	Automatically adjust the positioning time requirements	1.0~6553.5	ms	30.0	Any	Real-time	U16
2002h (P02.56)	57h	Automatically adjust the positioning error requirements	2~65535	Command unit	10	Any	Real-time	U16
2002h (P02.5A)	5Bh	Absolute Position Offset	-2147483648 ~2147483647	Encoder unit	0	Stop	Real-time	I32
2002h (P02.5C)	5Dh	High 32-bit of absolute position offset	-2147483648 ~2147483647	Encoder unit	0	Stop	Real-time	I32
2002h (P02.5E)	5Fh	Multi-Turn Data Offset	0~65535	-	0	Any	Real-time	U16
2002h (P02.5F)	60h	Multi-Turn Data Overflow	0~65535	-	0	Any	Real-time	U16

### 7.3.4 P03 Group Command Setting Parameters

Index(Function code)	Sub index	Name	Setting Range	Unit	Factor y value	Setting mode	Activate mode	Data type
2003h (P03.00)	01h	Location Command Mode Settings	0: No internal instructions 1: Internal position mode	-	0	Stop	Real-time	U16
2003h (P03.06)	07h	Position Command low-pass Filtering Time	0.0~500.0	ms	0.0	Any	Real-time	U16
2003h (P03.07)	08h	Moving average filtering time 1	0.0~256.0	ms	0.0	Any	Real-time	U16
2003h (P03.0A)	0Bh	Moving average filtering time 2	0.0~256.0	ms	0.0	Any	Real-time	U16
2003h (P03.20)	21h	Absolute Position Limit Setting	0: Disable 1: Immediately enable 2: Enable after homing	-	0	-	Real-time	
2003h (P03.25)	26h	Unit of Excessive Position Deviation	0: Set by CIA402 Object Dictionary 1: Set by CIA402 Object Dictionary 2: Mechanical travel unit(mm)	-	2	Any	Real-time	U16
2003h (P03.26)	27h	Excessive position deviation fault setting(effective only when P03.25=2)	1~ 1073741824	Set by P03.25	10	Any	Real-time	U32
2003h (P03.29)	2Ah	Allowable threshold of CSP command error times	1~7	-	3	Any	Real-time	U16
2003h	2Fh	Homing completed	0~5000	ms	300	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factor y value	Setting mode	Activate mode	Data type
(P03.2E)		delay						
2003h (P03.2F)	30h	Torque limit on hardware limit	20.0~150.0	%	100.0	Any	Real-time	U16
2003h (P03.30)	31h	Homing enablement	0: Disable 1: Enable	-	0	Any	Real-time	U16
2003h (P03.35)	36h	Maximum time for homing	0~65535	ms	50000	Any	Real-time	U16
2003h (P03.40)	41h	Velocity command mode setting	0: Given by internal DI 1: Analog Input 2: Analog volume controlled using DI 5: Internal velocity	-	0	Any	Real-time	U16
2003h (P03.41)	42h	Velocity command set by DI	-6000~6000	RPM	300	Any	Real-time	I16
2003h (P03.42)	43h	DI jog velocity setting	-6000~6000	RPM	100	Any	Real-time	I16
2003h (P03.43)	44h	Velocity Command Acceleration Ramp Time	0~65535	ms	20	Any	Real-time	U16
2003h (P03.44)	45h	Velocity Command Deceleration Ramp Time	0~65535	ms	20	Any	Real-time	U16
2003h (P03.45)	46h	Jog velocity initial value	1~9000	RPM	30 (Linear Motor) 300 (rotary motor)	Any	Real-time	U16
2003h (P03.46)	47h	Jog velocity acceleration ramp time	0~65535	ms	20	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factor y value	Setting mode	Activate mode	Data type
2003h (P03.47)	48h	Analog Volume 10V Corresponding Speed	-10000~10000	RPM	3000	Any	Real-time	U16
2003h (P03.4A)	4Bh	Torque command selection	0: Given by internal DI 1: Given analog quantity 2: Analog Quantity Given 2	-	0	Any	Real-time	U16
2003h (P03.4B)	4Ch	Toque command setting	-300.0~300.0	%	0.0	Any	Real-time	I16
2003h (P03.4C)	4Dh	Analog 10V corresponding torque value	-800.0~800.0	%	100.0	Any	Real-time	U16
2003h (P03.4F)	50h	Emergency stop torque	0.0~300.0	%	100.0	Any	Real-time	U16
2003h (P03.50)	51h	Positive limit of velocity	0~8000	RPM	6000	Any	Real-time	U16
2003h (P03.51)	52h	Negative limit of velocity	0~8000	RPM	6000	Any	Real-time	U16
2003h (P03.52)	53h	Positive limit of torque	0.0~600.0	%	300.0	Any	Real-time	U16
2003h (P03.53)	54h	Negative limit of torque	0.0~600.0	%	300.0	Any	Real-time	U16
2003h (P03.54)	55h	Positive limit of internal velocity in torque mode	0~6000	RPM	3000	Any	Real-time	U16
2003h (P03.55)	56h	Negative limit of internal velocity in torque mode	0~6000	RPM	3000	Any	Real-time	U16
2003h (P03.5A)	5Bh	Source of limit of torque	0 : Internal digital input 1: Analog input 2 : Positive	-	1	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting Range	Unit	Factor y value	Setting mode	Activate mode	Data type
			torque limited by AI, negative torque limited by DI 3 : Positive torque limited by DI, negative torque limited by AI					
2003h (P03.5B)	5Ch	Torque limit filtering time	0.0~6000.0	ms	0.0	Any	Real-time	U16
2003h (P03.5D)	5Eh	Hard Limit Return Retention	0~65535	ms	15	Any	Real-time	U16
2003h (P03.5E)	5Fh	Distance for no Z retraction after seeking hardware limit	500~1073741824	Encoder unit	4194304	Any	Real-time	U32
2003h (P03.60)	61h	Disconnection Detection Threshold	0.0~6553.5	%	1.0	Any	Real-time	U16
2003h (P03.61)	62h	Disconnection Detection Filter Time	0~655.5	ms	30	Any	Real-time	U16

### 7.3.5 P04 Group Input Parameters

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2004h (P04.04)	05	DI1 function selection	0~63	-	1	Any	Real-time	U16
2004h (P04.05)	06	DI1 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.06)	07	DI2 function selection	0~63	-	2	Any	Real-time	U16
2004h (P04.07)	08	DI2 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2004h (P04.08)	09	DI3 function selection	0~63	-	3	Any	Real-time	U16
2004h (P04.09)	0A	DI3 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.0A)	0B	DI4 function selection	0~63	-	0	Any	Real-time	U16
2004h (P04.0B)	0C	DI4 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.0C)	0D	DI5 function selection	0~63	-	0	Any	Real-time	U16
2004h (P04.0D)	0E	DI5 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.35)	36h	High precision AI offset	-5000~5000	mV	0	Any	Real-time	U16
2004h (P04.36)	37h	High precision AI filtering time	0.00~655.35	ms	2.00	Any	Real-time	U16
2004h (P04.37)	38h	High precision AI Dead Band	0.0~1000.0	mV	10.0	Any	Real-time	U16
2004h (P04.38)	39h	High precision AI Zero Drift	-500.0~500.0	mV	0.0	Any	Real-time	U16
2004h (P04.3F)	40h	60FDh Display Settings	0: 60FDh Show only protocol features 1: 60FDh bit20~bit24 Display DI1~DI5 Status	-	0	Any	Real-time	U16
2004h (P04.40)	41h	DI Filtering Time	0.00~655.35	μs	10.00	Any	Real-time	U16
2004h (P04.41)	42h	Probe 1 Filtering Time	0~6000	ns	300	Any	Real-time	U16
2004h (P04.42)	43h	Probe 2 Filtering Time	0~6000	ns	300	Any	Real-time	U16
2004h (P04.43)	44h	Effective level of probes	0: Probe 1 negative logic, Probe 2 negative logic 1: Probe 1 positive logic, Probe 2 negative	-	0	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
			logic 2: Probe 1 negative logic, Probe 2 positive logic 3: Probe 1 positive logic, Probe 2 positive logic					

### 7.3.6 P05 Group Output Parameters

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2004h (P04.04)	05	DI1 function selection	0~63	-	1	Any	Real-time	U16
2004h (P04.05)	06	DI1 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.06)	07	DI2 function selection	0~63	-	2	Any	Real-time	U16
2004h (P04.07)	08	DI2 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.08)	09	DI3 function selection	0~63	-	3	Any	Real-time	U16
2004h (P04.09)	0A	DI3 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.0A)	0B	DI4 function selection	0~63	-	0	Any	Real-time	U16
2004h (P04.0B)	0C	DI4 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.0C)	0D	DI5 function selection	0~63	-	0	Any	Real-time	U16
2004h (P04.0D)	0E	DI5 effective level	0: Positive logic 1: Negative logic	-	0	Any	Real-time	U16
2004h (P04.35)	36h	High precision AI offset	-5000~5000	mV	0	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setti ng mode	Activ ate mode	Data type
2004h (P04.36)	37h	High precision AI filtering time	0.00~655.35	ms	2.00	Any	Real-time	U16
2004h (P04.37)	38h	High precision AI Dead Band	0.0~1000.0	mV	10.0	Any	Real-time	U16
2004h (P04.38)	39h	High precision AI Zero Drift	-500.0~500.0	mV	0.0	Any	Real-time	U16
2004h (P04.3F)	40h	60FDh Display Settings	0: 60FDh Show only protocol features 1: 60FDh bit20~bit24 Display DI1~DI5 Status	-	0	Any	Real-time	U16
2004h (P04.40)	41h	DI Filtering Time	0.00~655.35	μs	10.00	Any	Real-time	U16
2004h (P04.41)	42h	Probe 1 Filtering Time	0~6000	ns	300	Any	Real-time	U16
2004h (P04.42)	43h	Probe 2 Filtering Time	0~6000	ns	300	Any	Real-time	U16
2004h (P04.43)	44h	Effective level of probes	0: Probe 1 negative logic, Probe 2 negative logic 1: Probe 1 positive logic, Probe 2 negative logic 2: Probe 1 negative logic, Probe 2 positive logic 3: Probe 1 positive logic, Probe 2 positive logic	-	0	Any	Real-time	U16

### 7.3.7 Full Closed-Loop Function and Error Compensation Parameters

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factor y Setting	Setti ng Method	Effec tive Method	Data Type
2006h (P06.00)	01	Full Closed-Loop Operation Mode	0: Semi-Closed Loop Operation 1: Full Closed Loop Operation	-	0	Stop	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factor y Setting	Setting Method	Effective Method	Data Type
			2: Full Closed Loop / Semi-Closed Loop Switching					
2006h (P06.01)	02	External Encoder Operation Direction Selection	0: CW is the Positive Direction 1: CCW is the Positive Direction	-	0	Stop	Restart	U16
2006h (P06.02)	03	External Encoder Resolution	1~2147483647	External Encoder Unit	10000	Stop	Restart	U32
2006h (P06.04)	05	Full Closed-Loop Vibration Suppression Gain	0.0~300.0	%	0	Any	Real-time	I16
2006h (P06.05)	06	Full Closed-Loop Vibration Suppression Cutoff Frequency	10~5000	Hz	500	Any	Real-time	U16
2006h (P06.06)	07	Full Closed-Loop Speed Feedback Correction Coefficient	0.0~100.0	%	0.0	Any	Real-time	U16
2006h (P06.07)	08	Inner and Outer Loop Position Deviation Filtering Time Constant	0.0~100.0	ms	0.0	Any	Real-time	U16
2006h (P06.08)	09	Full Closed-Loop Frequency Division Pulse Count Setting	0: Set Pulse Count Based on P02.03 1: Set Frequency Division Ratio Based on P06.09 and P06.0A	-	0	Stop	Restart	U16
2006h (P06.09)	0A	Numerator of frequency	1~65535	-	1	Stop	Restart	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factor y Setting	Setting Method	Effective Method	Data Type
		division output in full closed loop						
2006h (P06.0A)	0B	Denominator of frequency division output in full closed loop	1~65535	-	1	Stop	Restart	U16
2006h (P06.0B)	0C	Z signal for homing in full closed-loop mode	0: Use Motor Encoder Z Signal 1: Use Grating Scale Z Signal	-	0	Stop	Real-time	U16
2006h (P06.0C)	0D	Inner and Outer Loop Encoder Maximum Allowable Deviation	-2,147,483,648~2,147,483,647	External encoder units	10000	Any	Real-time	I32
2006h (P06.0E)	0F	Inner and Outer Loop Encoder Actual Deviation	-2,147,483,648~2,147,483,647	External encoder units	-	show only	immediate effect	I32
2006h (P06.10)	11	Internal Encoder Count Value	-2,147,483,648~2,147,483,647	Encoder Units	-	Display	-	I32
2006h (P06.12)	13	External Encoder Count Value	-2,147,483,648~2,147,483,647	External encoder units	-	Display	-	I32
2006h (P06.20)	21	Error Compensation Enablement	0: Disabled 1: Enabled	-	0	Stop	Real-time	U16
2006h (P06.21)	22	Compensation Position Unit Setting	0: Encoder Unit 1: Command Unit 2: $\mu$ m 3: mm	-	3	Any	Real-time	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type
2006h (P06.22)	23	Compensation Error Unit Setting	0: Encoder Unit 1: Command Unit 2: $\mu$ m 3: mm	0	2	Any	Real-time	U16
2006h (P06.23)	24	Encoder Pulses Corresponding to 1mm for Rotating Motor	1~1073741824	-	100	Any	Real-time	U32
2006h (P06.25)	26	Error Compensation Origin Selection	0: Internal Homing Automatically Selects Origin 1: Use FunIN.21 or Fn000C to Select Error Compensation Origin	-	-	Any	Real-time	U16
2006h (P06.27)	28	Total Compensation Points	0~1024	-	0	s		U16
2006h (P06.28)	29	Starting Position Setting	0~ 1,073,741,824	Set by P06.21	0	Any	Real-time	I32
2006h (P06.2A)	2B	Compensation Interval Setting	0~ 1,073,741,824	Set by P06.21	0	Any	Real-time	I32

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type
2008h ( P08.00)	01	Node Address	1~127	-	1	set arbitrarily	immediate effect	U16
2008h ( P08.01)	02	Modbus Baud Rate	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps 4: 38400bps	-	6	set arbitrarily	immediate effect	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type
			5: 57600bps 6: 115200bps					
2008h (P08.02)	03	Modbus Data Format	0: No Parity, 2 Stop Bits 1: Even Parity, 1 Stop Bit 2: Odd Parity, 1 Stop Bit 3: No Parity, 1 Stop Bit	-	0	set arbitrarily	immediate effect	U16
2008h (P08.03)	04	Modbus Response Delay	0~20	ms	0	set arbitrarily	immediate effect	U16
2008h (P08.0A)	0B	Background Baud Rate Setting	0: 115200 1: 750000	-	1	set arbitrarily	immediate effect	U16
2008h (P08.0F)	10	EEPROM Storage Prohibition	0: Parameter Saving Allowed 1: Parameter Saving Prohibited	-	0	set arbitrarily	immediate effect	U16
2008h (P08.12)	13	EtherCAT Station Alias Setting	0x0~0xFFFF	-	0x0	set arbitrarily	Power up again	U16
2008h (P08.15)	16	EtherCAT Allowable Synchronization Interrupt Loss Count	1~20	-	8	set arbitrarily	immediate effect	U16
2008h (P08.16)	17	Maximum Invalid Frame and Error Count for Port 0 on EtherCAT Communication Fault	Read-Only	-	-	show only	immediate effect	U16
2008h (P08.17)	18	Maximum Invalid Frame and RxErr Error	Read-Only	-	-	show only	immediate effect	U16

Index (Function Code)	Sub-index	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type
		Count for Port 1 on EtherCAT Communication Fault						
2008h (P08.18)	19	Maximum Port Forwarding Error Count on EtherCAT Communication Fault	Read-Only	-	-	show only	immediate effect	U16
2008h (P08.19)	1A	Maximum Data Frame Processing Unit Error Count on EtherCAT Communication Fault	Read-Only	-	-	show only	immediate effect	U16
2008h (P08.1A)	1B	Maximum Port Link Loss Count on EtherCAT Communication Fault	Read-Only	-	-	show only	immediate effect	U16
2008h (P08.1C)	1D	EtherCAT Synchronization Mode Setting	0: Asynchronous Mode 1: Bus Synchronous Mode 2: Bus Synchronous Command Delay Mode	-	1	Downtime Settings	immediate effect	U16
2008h (P08.1D)	1E	EtherCAT Synchronization Error Threshold	0~8000	ns	2000	Downtime Settings	immediate effect	U16

### 7.3.8 P08 Group Communication Setting Parameters

Index(Function code)	Sub index	Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2008h (P08.0A)	0Bh	RS232 Communication Baud Rate Selection	0: 115200 1: 750000	-	1	Any	Real-time	U32
2008h (P08.0F)	10h	EEPROM Storage Prohibition	0: Parameters are allowed to save during SDO communication 1: Parameters are prohibited to save during SDO communication	-	1	Any	Real-time	U16
2008h (P08.12)	13h	EtherCAT Station Alias Setting	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2008h (P08.15)	16h	Allowed times of synchronization signal has been lost in EtherCAT communication	1~20	-	8	Any	Real-time	U16
2008h (P08.16)	17h	EtherCAT port 0 invalid frame and error maximum in case of failure	-	-	-	Display	Real-time	U16
2008h (P08.17)	18h	EtherCAT port 1 invalid frame and error maximum in case of failure	-	-	-	Display	Real-time	U16
2008h (P08.18)	19h	Maximum forwarding errors on EtherCAT port when fault occurs	-	-	-	Display	Real-time	U16
2008h (P08.19)	1Ah	Maximum error count for EtherCAT data frame processing unit in case of failure	-	-	-	Display	Real-time	U16
2008h (P08.1A)	1Bh	Maximum value of EtherCAT port link lost in failure	-	-	-	Display	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2008h (P08.1C)	1Dh	EtherCAT Synchronization Mode Setting	0: Asynchronous Mode 1: Bus Synchronous Mode	-	1	Stop	Real-time	U16
2008h (P08.1D)	1Eh	EtherCAT Synchronization Error Threshold	0~8000	ns	4000	Stop	Real-time	U16

### 7.3.9 P0B Group Extended Function Parameters

Index(Function code)	Sub index	Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
200Bh (P0B.00)	01h	Stall over heat protection enablement	0: Disable 1: Use torque feedback to determine 2: Use torque command to determine	-	1	Stop	Real-time	U16
200Bh (P0B.01)	02h	Disable overload warning	0: Enable drive and motor overload warning 1: Disable motor overload warning 2: Disable drive overload warning 3: Disable motor and drive overload warning	-	0	Stop	Real-time	U16
200Bh (P0B.02)	03h	Motor run-away protection enablement	0: Disable 1: Enable	-	1	Stop	Real-time	U16
200Bh (P0B.03)	04h	Multi-turn encoder overflow warning	0: Enable 1: Disable	-	0	Stop	Real-time	U16
200Bh (P0B.04)	05h	Encoder battery alarm enablement	0: Disable 1: Enable	-	0	Stop	Real-time	U16
200Bh (P0B.05)	06h	Power supply phase loss protection selection	0: Detect AC input, disable phase loss alarm 1: Detect AC input, enable phase loss alarm 2: Do not detect AC	-	0	stop	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
			input, disable phase loss alarm					
200Bh (P0B.06)	07h	Fault Record Storage Enablement	0:Enable 1: Disable	-	0	Stop	Real-time	U16
200Bh (P0B.07)	08h	Special fault reset enablement	0: Disable 1: Enable	-	0	Any	Real-time	U16
200Bh (P0B.09)	0Ah	Panel status display settings	0~0x25 Use the back panel to display U00.XX corresponding status by default	-	0x0	Any	Real-time	U16
200Bh (P0B.0A)	0Bh	PTC alarm resistance	0: High resistance 1: Low resistance	-	0	Any	Real-time	U16
200Bh (P0B.10)	11h	time window of stall overheating protection	10~65535	ms	20	Any	Real-time	U16
200Bh (P0B.11)	12h	Motor Overload Protection Gain	50~300	%	100	Any	Real-time	U16
200Bh (P0B.12)	13h	PTC Monitoring Enablement	0: Disable 1: Enable	-	0	Any	Real-time	U16
200Bh (P0B.13)	14h	Torque threshold to determine whether the motor run-away occurs	0~500	%	100 (linear motor) 200 (rotary motor)	Any	Real-time	U16
200Bh (P0B.14)	15h	Overspeed Determination Threshold	0~65535	RPM(mm/s)	0	Any	Real-time	U16
200Bh (P0B.15)	16h	Filtering time of displayed velocity	0~5000	ms	0	Any	Real-time	U16
200Bh (P0B.16)	17h	Filtering time of phase current RMS	0~1000	ms	5	Any	Real-time	U16
200Bh (P0B.18)	19h	Communication Encoder Continuous Error Count	0~31	-	5	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
200Bh (P0B.1A)	1Bh	Nikon encoder power on and reset selection	0: Reset upon power on 1: Do not reset upon power on	-	-	Any	Real-time	U16
200Bh (P0B.1B)	1Ch	Bus encoder power on and read ROM selection	0 : Read the encoder ROM upon power on 1: Do not read encoder ROM upon power on 2: Protocol configuration prohibited	-	0	Any	Real-time	U16
200Bh (P0B.1C)	1Dh	Encoder Counting Error alarm Enable	0: Disable 1: Enable	-	1	Any	Real-time	U16
200Bh (P0B.1E)	1Fh	Enable QEP phase error alarm	0: When QEP phase error occurs, alarm Al.0C.4 1: When QEP phase error occurs, alarm Al.10.A	-	0	Any	Real-time	U16
200Bh (P0B.20)	21h	Ramp stop acceleration and deceleration time	0~10000	ms	50	Any	Real-time	U16
200Bh (P0B.22)	23h	Emergency torque stop deceleration	0~3000	%	500	Stop	Real-time	U16
200Bh (P0B.24)	25h	Brake protection determination threshold	0~3000	% load rate	0	Any	Real-time	U16
200Bh (P0B.25)	26h	Current Protection Alarm Duration	0~65535	ms	200	Any	Real-time	U16
200Bh (P0B.26)	27h	Current protection determination threshold	200~3000	%	1000	Any	Real-time	U16
200Bh (P0B.27)	28h	Current protection Determine alarm duration	0~65535	ms	0	Any	Real-time	U16
200Bh (P0B.30)	31h	Delay time from brake opened to zero command state of servo	0~500	ms	200	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
200Bh (P0B.31)	32h	Delay from brake actuation to servo off	50~1000	ms	150	Any	Real-time	U16
200Bh (P0B.32)	33h	Delay Time from Zero command to Brake Actuation	20~300	ms	30	Any	Real-time	U16
200Bh (P0B.33)	34h	Delay from zero command state to brake actuation	1~1000	ms	500	Any	Real-time	U16

### 7.3.10 P0F Group Internal Speed Mode

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
200Fh (P0F.00)	01h	Velocity Scheduled Operation Mode	0: Continuous operation by time 1: DI switch operation 2: Communication setting	-	0	Any	Real-time	U16
200Fh (P0F.01)	02h	Maximum Number of Segments to Run	1~16	-	3	Any	Real-time	U16
200Fh (P0F.02)	03h	Starting segment set by communication	0~15	-	3	Any	Real-time	U16
200Fh (P0F.04)	05h	Run Time Unit Selection	0: ms 1: 10ms 2: 100ms 3: s	-	0	Any	Real-time	U16
200Fh (P0F.08)	09h	Segment 1 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.09)	0Ah	Segment 1 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.0A)	0Bh	Segment 1 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.0B)	0Ch	Segment 1 Velocity Deceleration Ramp	0~65535	ms	200	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
		Time						
200Fh (P0F.0C)	0Dh	Segment 2 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.0D)	0Eh	Segment 2 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.0E)	0Fh	Segment 2 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.0F)	10h	Segment 2 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.10)	11h	Segment 3 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.11)	12h	Segment 3 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.12)	13h	Segment 3 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.13)	14h	Segment 3 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.14)	15h	Segment 4 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.15)	16h	Segment 4 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.16)	17h	Segment 4 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.17)	18h	Segment 4 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.18)	19h	Segment 5 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.19)	1Ah	Segment 5 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.1A)	1Bh	Segment 5 Velocity Acceleration Ramp	0~65535	ms	200	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
		Time						
200Fh (P0F.1B)	1Ch	Segment 5 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.1C)	1Dh	Segment 6 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.1D)	1Eh	Segment 6 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.1E)	1Fh	Segment 6 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.1F)	20h	Segment 6 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.20)	21h	Segment 7 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.21)	22h	Segment 7 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.22)	23h	Segment 7 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.23)	24h	Segment 7 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.24)	25h	Segment 8 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.25)	26h	Segment 8 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.26)	27h	Segment 8 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.27)	28h	Segment 8 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.28)	29h	Segment 9 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh	2Ah	Segment 9 Velocity	0~65535	Set by	10	Any	Real-	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
(P0F.29)		Run Time		P0F.04			time	
200Fh (P0F.2A)	2Bh	Segment 9 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.2B)	2Ch	Segment 9 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.2C)	2Dh	Segment 10 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.2D)	2Eh	Segment 10 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.2E)	2Fh	Segment 10 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.2F)	30h	Segment 10 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.30)	31h	Segment 11 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.31)	32	Segment 11 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.32)	33h	Segment 11 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.33)	34h	Segment 11 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.34)	35h	Segment 12 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.35)	36h	Segment 12 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.36)	37h	Segment 12 Speed Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
200Fh (P0F.37)	38h	Segment 12 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.38)	39h	Segment 13 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.39)	3Ah	Segment 13 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.3A)	3Bh	Segment 13 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.3B)	3Ch	Segment 13 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.3C)	3Dh	Segment 14 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.3D)	3Eh	Segment 14 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.3E)	3Fh	Segment 14 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.3F)	40h	Segment 14 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.40)	41h	Segment 15 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.41)	42h	Segment 15 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.42)	43h	Segment 15 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.43)	44h	Segment 15 Velocity Deceleration Ramp	0~65535	ms	200	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
		Time						
200Fh (P0F.44)	45h	Segment 16 Velocity Setting	-6000~6000	RPM	300	Any	Real-time	I16
200Fh (P0F.45)	46h	Segment 16 Velocity Run Time	0~65535	Set by P0F.04	10	Any	Real-time	U16
200Fh (P0F.46)	47h	Segment 16 Velocity Acceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16
200Fh (P0F.47)	48h	Segment 16 Velocity Deceleration Ramp Time	0~65535	ms	200	Any	Real-time	U16

### 7.3.11 P10 Group Task Position Mode

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.00)	01h	Starting Segment Selection	0: Start from the first segment 1: Set by DI 2: Set by P10.02	-	0	Any	Real-time	U16
2010h (P10.02)	03h	Set Starting Segment Value	0~19	-	0	Any	Real-time	U16
2010h (P10.04)	05h	Task Cancel Ramp Stop	0~65535	ms	10	Any	Real-time	U16
2010h (P10.05)	06h	Current Running Segment Number	-	-	-	Only display	-	U16
2010h (P10.08)	09h	Segment 1 target position	-1073741824 ~1073741824	Command unit	10000	Any	Real-time	I32
2010h (P10.0A)	0Bh	Segment 1 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h	0Ch	Segment 1 Acceleration Time	0~65535	ms	10	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
(P10.0B)								
2010h (P10.0C)	0Dh	Segment 1 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.0D)	0Eh	Segment 1 Wait Time	0~65535	ms	0	Any	Real-time	U16
2010h (P10.0E)	0Fh	Segment 1 Attribute Configuration	16#0~FFFF	-	16#0	Any	Real-time	U16
2010h (P10.0F)	10h	Running times of Segment 1 and the Next Running Segment	16#1~0xFFFF	-	16#1	Any	Real-time	U16
2010h (P10.10)	11h	Segment 2 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.12)	13h	Segment 2 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.13)	14h	Segment 2 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.14)	15h	Segment 2 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.15)	16h	Segment 2 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.16)	17h	Segment 2 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.17)	18h	Running Times of Segment 2 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.18)	19h	Segment 3 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.1A)	1Bh	Segment 3 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.1B)	1Ch	Segment 3 Acceleration Time	0~65535	ms	10	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.1C)	1Dh	Segment 3 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.1D)	1Eh	Segment 3 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.1E)	1Fh	Segment 3 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.1F)	20h	Running Times of Segment 3 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.20)	21	Segment 4 target position	-1073741824~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.22)	23	Segment 4 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.23)	24	Segment 4 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.24)	25	Segment 4 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.25)	26	Segment 4 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.26)	27	Segment 4 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.27)	28	Running Times of Segment 4 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.28)	29	Segment 5 target position	-1073741824~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.2A)	2B	Segment 5 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.2B)	2C	Segment 5 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.2C)	2D	Segment 5 Deceleration Time	0~65535	ms	10	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.2D)	2E	Segment 5 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.2E)	2F	Segment 5 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.2F)	30	Running Times of Segment 5 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.30)	32	Segment 6 target position	-1073741824~1073741824	Command unit	10000	Any	Real-time	I32
2010h (P10.32)	33	Segment 6 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.34)	34	Segment 6 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.34)	35	Segment 6 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.35)	36	Segment 6 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.36)	37	Segment 6 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.37)	38	Running Times of Segment 6 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.38)	39	Segment 7 target position	-1073741824~1073741824	Command unit	10000	Any	Real-time	I32
2010h (P10.3A)	3B	Segment 7 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.3B)	3C	Segment 7 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.3C)	3D	Segment 7 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.3D)	3E	Segment 7 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
)								
2010h (P10.3E)	3F	Segment 7 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.3F)	40	Running Times of Segment 7 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.40)	41	Segment 8 target position	-1073741824~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.42)	43	Segment 8 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.43)	44	Segment 8 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.44)	45	Segment 8 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.45)	46	Segment 8 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.46)	47	Segment 8 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.47)	48	Running Times of Segment 8 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.48)	49	Segment 9 target position	-1073741824~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.4A)	4B	Segment 9 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.4B)	4C	Segment 9 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.4C)	4D	Segment 9 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.4D)	4E	Segment 9 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.4E)	4F	Segment 9 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.4F)	50	Running Times of Segment 9 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.50)	51	Segment 10 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.52)	53	Segment 10 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.53)	54	Segment 10 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.54)	55	Segment 10 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.55)	56	Segment 10 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.56)	57	Segment 10 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.57)	58	Running Times of Segment 10 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.58)	59	Segment 11 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.5A)	5B	Segment 11 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.5B)	5C	Segment 11 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.5C)	5D	Segment 11 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.5D)	5E	Segment 11 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.5E)	5F	Segment 11 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.5F)	60	Running Times of Segment 11 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.60)	61	Segment 12 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.62)	63	Segment 12 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.63)	64	Segment 12 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.64)	65	Segment 12 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.65)	66	Segment 12 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.66)	67	Segment 12 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.67)	68	Running Times of Segment 12 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.68)	69	Segment 13 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.6A)	6B	Segment 13 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.6B)	6C	Segment 13 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.6C)	6D	Segment 13 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.6D)	6E	Segment 13 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setti ng mode	Activ ate mode	Data type
2010h (P10.6E)	6F	Segment 13 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.6F)	70	Running Times of Segment 13 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.70)	72	Segment 14 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.72)	73	Segment 14 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.73)	74	Segment 14 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.74)	75	Segment 14 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.75)	76	Segment 14 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.76)	77	Segment 14 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.77)	78	Running Times of Segment 14 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.78)	79	Segment 15 target position	-1073741824 ~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.7A)	7B	Segment 15 Velocity	0~9000	RPM	300	Any	Real-time	U16
2010h (P10.7B)	7C	Segment 15 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.7C)	7D	Segment 15 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.7D)	7E	Segment 15 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.7E)	7F	Segment 15 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.7F)	80	Running Times of Segment 15 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.80)	81	Segment 16 target position	-1073741824~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.82)	83	Segment 16 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.83)	84	Segment 16 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.84)	85	Segment 16 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.85)	86	Segment 16 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.86)	87	Segment 16 Attribute Configuration	0x0~0xFFFF	-	16#0	Any	Real-time	U16
2010h (P10.87)	88	Running Times of Segment 16 and the Next Running Segment	0x1~0xFFFF	-	16#1	Any	Real-time	U16
2010h (P10.88)	89	Segment 17 target position	-1073741824~1073741824	Comm and unit	10000	Any	Real-time	I32
2010h (P10.8A)	8B	Segment 17 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.8B)	8C	Segment 17 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.8C)	8D	Segment 17 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.8D)	8E	Segment 17 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.8E)	8F	Segment 17 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.8F)	90	Running Times of Segment 17 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.90)	91	Segment 18 target position	-1073741824~1073741824	Command unit	10000	Any	Real-time	I32
2010h (P10.92)	93	Segment 18 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.93)	94	Segment 18 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.94)	95	Segment 18 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.95)	96	Segment 18 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.96)	97	Segment 18 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.97)	98	Running Times of Segment 18 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.98)	99	Segment 19 target position	-1073741824~1073741824	Command unit	10000	Any	Real-time	I32
2010h (P10.9A)	9B	Segment 19 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.9B)	9C	Segment 19 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.9C)	9D	Segment 19 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.9D)	9E	Segment 19 Wait Time	0~65535	ms	100	Any	Real-time	U16

Index(Function code)	Sub index	Name	Setting range	Unit	Factor y value	Setting mode	Activate mode	Data type
2010h (P10.9E)	9F	Segment 19 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.9F)	A0	Running Times of Segment 19 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16
2010h (P10.A0)	A1	Segment 20 target position	-1073741824 ~1073741824	Command unit	10000	Any	Real-time	I32
2010h (P10.A2)	A3	Segment 20 Velocity	1~9000	RPM	300	Any	Real-time	U16
2010h (P10.A3)	A4	Segment 20 Acceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.A4)	A5	Segment 20 Deceleration Time	0~65535	ms	10	Any	Real-time	U16
2010h (P10.A5)	A6	Segment 20 Wait Time	0~65535	ms	100	Any	Real-time	U16
2010h (P10.A6)	A7	Segment 20 Attribute Configuration	0x0~0xFFFF	-	0x0	Any	Real-time	U16
2010h (P10.A7)	A8	Running Times of Segment 20 and the Next Running Segment	0x1~0xFFFF	-	0x1	Any	Real-time	U16

### 7.3.12 P17 Group Non-Standard Function Parameters

Function Code	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type
P17	30 Encoder Single-Turn Absolute Position	-	Encoder Units	-	Display	-	-

Function Code	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type	
	Corresponding to Station Origin							
P17	32	Set Current Position as Station Origin	0: No Operation 1: Set Current Position as Station Origin	-	0	Any	Real-time	U16
P17	33	Operating Speed during Automatic Return to Station	1~500	rpm	30	Any	Real-time	U16
P17	34	Acceleration/Deceleration Time during Automatic Return to Station	0~65535	ms	100	Any	Real-time	U16
P17	35	Number of Stations	1~64	-	4	Any	Real-time	U16
P17	36	Return to Station Direction Selection	0: Positive 1: Negative 2: Nearest	-	0	Any	Real-time	U16
P17	37	Return to Station Trigger Method	0: Enable Automatic Return to Station 1: Use DI Function FunIn53 to Trigger Return to Station	-	1	Any	Real-time	U16
P17	38	Return to Station triggered by function code	0: No Operation 1: Trigger Return to Station	-	0	Any	Real-time	U16
P17	3E	Velocity for running to station	1~1000	rpm	30	Any	Real-time	U16
P17	3F	Acceleration/Deceleration Time for running to station	0~65535	ms	100	Any	Real-time	U16
P17	40	Current Station Number Display	-	-	-	Display	-	-
P17	44	Encoder Single-Turn Absolute	- 2147483648~214748	Encoder	0	Any	Real-	I32

Function Code	Name	Setting Range	Unit	Factory Setting	Setting Method	Effective Method	Data Type
	Position Corresponding to Station 1	3647	Units			time	
P17	Encoder Single-Turn Absolute Position Corresponding to Station 2	- 2147483648~2147483647	Encoder Units	0	Any	Real-time	I32
P17	Encoder Single-Turn Absolute Position Corresponding to Station 3	- 2147483648~2147483647	Encoder Units	0	Any	Real-time	I32
P17	Encoder Single-Turn Absolute Position Corresponding to Station 4	- 2147483648~2147483647	Encoder Units	0	Any	Real-time	I32
P17	Encoder Single-Turn Absolute Position Corresponding to Station 5	- 2147483648~2147483647	Encoder Units	0	Any	Real-time	I32
P17	Encoder Single-Turn Absolute Position Corresponding to Station 6	- 2147483648~2147483647	Encoder Units	0	Any	Real-time	I32

### 7.3.13 P18 Motor Parameters Group

Function code	Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2018h (P18.00)	01h Motor Encoder Model	16#0~16#FFFF	-	16#1012	Any	Restart	U16

Function code		Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2018h (P18.02)	03h	Motor Code	0~65535	-	0	Any	Restart	U16
2018h (P18.03)	04h	Rotary motor encoder resolution	0~2147483647	-	2500	Stop	Restart	U32
2018h (P18.07)	08h	Zero electric angle shift for bus encoder	0~65535	-	0	Stop	Restart	U16
2018h (P18.08)	09h	Electric angle corresponding to Z signal	-	degree	-	Display	-	U16
2018h (P18.0F)	10h	Bus Encoder Data Transmission Compensation Time	-30.0~30.0	μs	0.0	Stop	Restart	U16
2018h (P18.10)	11h	Rotary motor bus encoder resolution selection	0: one-turn resolution of motor is same as protocol resolution 1: one-turn resolution of motor is set by P18.03( P18.03*4)	ns	0	Stop	Restart	U16
2018h (P18.11)	12h	Back Electromotive Force Compensation Coefficient	0.0~6553.5	%	50.0	Any	Real-time	U16
2018h (P18.12)	13h	D-axis Coupling Voltage Compensation Coefficient	0.0~6553.5	%	50.0	Any	Real-time	U16
2018h (P18.13)	14h	Q-axis Coupling Voltage Compensation Coefficient	0.0~6553.5	%	50.0	Any	Real-time	U16

Function code		Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2018h (P18.14)	15h	D-axis Proportional Gain	0~65535	Hz	300	Any	Real-time	U16
2018h (P18.15)	16h	D-axis Integral Compensation Factor	0.00~655.35	-	1.00	Any	Real-time	U16
2018h (P18.16)	17h	Q-axis Proportional Gain	0~65535	Hz	300	Any	Real-time	U16
2018h (P18.17)	18h	Q-axis Integral Compensation Factor	0.00~655.35	-	1.00	Any	Real-time	U16
2018h (P18.20)	21h	Rated Power	0.00~655.35	kW	-	Stop	Restart	U16
2018h (P18.22)	23h	Rated Current	0.00~655.35	A	-	Stop	Restart	U16
2018h (P18.24)	25h	Maximum Current	0.00~655.35	A	-	Stop	Restart	U16
2018h (P18.26)	27h	Rated Torque	0.00~21474836.47	Nm	-	Stop	Restart	U32
2018h (P18.2A)	2Bh	Rated Velocity	0~65535	rpm	-	Stop	Restart	U16
2018h (P18.2C)	2Dh	Maximum Velocity	0~65535	rpm	-	Stop	Restart	U16
2018h (P18.2E)	2Fh	Rotational Inertia	0.00~21474836.47	kg*cm <sup>2</sup>	-	Stop	Restart	U32
2018h (P18.30)	31h	Permanent Magnet Synchronous Motor Pole	0~65535	-	-	Stop	Restart	U16

Function code	Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
	Pairs						
2018h (P18.31)	32h Stator Phase Resistance	0.000~65.535	Ω	-	Stop	Restart	U16
2018h (P18.32)	33h Q-axis Inductance	0.00~655.35	mH	-	Stop	Restart	U16
2018h (P18.33)	34h D-axis Inductance	0.00~655.35	mH	-	Stop	Restart	U16
2018h (P18.34)	35h Back Electromotive Force Coefficient	0.00~21474836.47	mV/rpm	-	Stop	Restart	U32
2018h (P18.3C)	3Dh Internal Encoder Check	16#0~16#FFFF	-	-	Any	Real-time	U16
2018h (P18.3D)	3Eh Internal Encoder Configuration	16#0~16#FFFF	-	-	Any	Real-time	U16
2018h (P18.47)	48h BISS Protocol Encoder Configuration C	16#0~16#FFFF	-	16#0	Stop	Restart	U16



For Tamagawa 23bit encoder ,P18.00 set to 0x1012; For Tamakawa 17bit encoders ,P18.00 set to 0x1010; For 2500 line encoders ,P18.00 set to 0x2020.

### 7.3.14 P19 Group Driver Parameters

Function code	Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2019h (P19.00)	01h Drive series code	0~65535	-	-	Stop	Restart	U16
2019h	03h Rated power	-	kW	-	Displ	Real-	U16

Function code		Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
( P19.02 )						ay	time	
2019h ( P19.08 )	09h	Maximum output current	-	A	-	Display	Real-time	U16
2019h ( P19.0A )	0Bh	Carrier wave frequency	4000~20000	Hz	-	Stop	Restart	U16
2019h ( P19.0B )	0Ch	Dead band time	0.00~20.00	μs	-	Stop	Restart	U16
2019h ( P19.0C )	0Dh	Bootstrap Time	0.0~20.0	μs	-	Stop	Restart	U16
2019h ( P19.0E )	0Fh	Temperature Alarm Point	0.0~6553.5	°C	-	Stop	Restart	U16
2019h ( P19.10 )	11h	Current Sensor Range	0.00~655.35	A	-	Stop	Restart	U16
2019h ( P19.12 )	13h	Overcurrent Point Setting	0.0~6553.5	%	-	Stop	Restart	U16
2019h ( P19.13 )	14h	Drive Rated Voltage	-	V	-	Display	Real-time	U16
2019h ( P19.14 )	15h	Drive Overvoltage Point	0~1000	V	-	Stop	Restart	U16
2019h ( P19.15 )	16h	Drive Discharge Point	0~1000	V	-	Stop	Restart	U16
2019h ( P19.16 )	17h	Drive Undervoltage Point	0~1000	V	-	Stop	Restart	U16

Function code		Name	Setting range	Unit	Factory value	Setting mode	Activate mode	Data type
2019h ( P19.17 )	18h	Bus Voltage Correction Coefficient	0.0~200.0	%	-	Stop	Restart	U16
2019h ( P19.18 )	19h	Minimum Braking Resistance	1~150	Ω	-	Stop	Restart	U16
2019h ( P19.1B )	1C h	Command Dispatch Frequency	0: 4kHz 1: 2kHz 2: 1kHz	-	0	Stop	Restart	U16
2019h ( P19.1C )	1D h	Voltage Filtering Cutoff Frequency	3000~65535	Hz	20000	Stop	Restart	U16
2019h ( P19.20 )	21h	Current Sampling Filtering Time	0~3	-	1	Stop	Restart	U16
2019h ( P19.21 )	22h	Current sampling extraction rate	0~3	-	1	Stop	Restart	U16
2019h ( P19.22 )	23h	Overcurrent Filtering Time	0~750	ns	375	Stop	Restart	U16
2019h ( P19.24 )	25h	ABZ encoder input Filtering Time	0~6000	ns	25	Stop	Restart	U16

### 7.3.15 U00 Group Status Display Parameters

Index (Function Code)	Sub-Index	Name	Unit	Type
201Ah (U00.00)	01	Motor Speed	RPM	I16
201Ah (U00.01)	02	Input Signal Level	-	U16

Index (Function Code)	Sub- Index	Name	Unit	Type
201Ah (U00.03)	04	Output Signal Level	-	U16
201Ah (U00.05)	06	Input Command Pulse Counter	Command Unit	I32
201Ah (U00.07)	08	Absolute Position Counter	Directive Units	I32
201Ah (U00.09)	0A	Encoder Feedback Pulse Counter	Encoder Units	I32
201Ah (U00.0B)	0C	Position Offset	Encoder Units	I32
201Ah (U00.0D)	0E	Discharge Resistor Load Rate	%	U16
201Ah (U00.0E)	0F	Average Load Rate	%	U16
201Ah (U00.0F)	10	Speed Command	RPM	I16
201Ah (U00.10)	11	Internal Torque Command	%	I16
201Ah (U00.11)	12	Motor Mechanical Angle	°	U16
201Ah (U00.12)	13	Motor Electrical Angle	°	U16
201Ah (U00.13)	14	Input Command Pulse Speed	RPM	I16
201Ah (U00.14)	15	U Current Sampling Value (Effective Value)	A	I16
201Ah (U00.15)	16	Bus Voltage	V	U16
201Ah (U00.17)	18	A11 Voltage Value	V	U16
201Ah (U00.18)	19	A12 Voltage Value	V	U16
201Ah (U00.1A)	1B	Driver Temperature	°C	I16

Index (Function Code)	Sub-Index	Name	Unit	Type
201Ah (U00.1D)	1E	Total Running Time	s	U32
201Ah (U00.20)	21	Total Input Pulses	-	I32
201Ah (U00.23)	24	Encoder Multiturn Count	-	U16
201Ah (U00.24)	25	Encoder Single-Turn Position	-	U32
201Ah (U00.26)	27	Encoder Unit Absolute Position Low 32 Bits	Encoder Units	U32
201Ah (U00.28)	29	Encoder Unit Absolute Position High 32 Bits	Encoder Units	U32
201Ah (U00.2A)	2B	Mechanical Absolute Position Low 32 Bits	Encoder Units	U32
201Ah (U00.2C)	2D	Mechanical Absolute Position High 32 Bits	Encoder Units	U32
201Ah (U00.32)	33	Rotary Load Single-Turn Position	Directive Units	U16
201Ah (U00.36)	37	Incremental Encoder AB Count	-	I32
201Ah (U00.38)	39	Incremental Encoder Z Signal Count	-	U16
201Ah (U00.39)	3A	Hall State	-	U16
201Ah (U00.3E)	3F	Parameter Abnormalities Function Code Group Number	-	U16
201Ah (U00.3F)	40	Parameter Abnormalities Function Code Group Offset	-	U16
201Ah (U00.40)	41	FPGA Records Absolute Encoder Fault Information	-	U16
201Ah (U00.41)	42	FPGA System Status Information	-	U16

Index (Function Code)	Sub-Index	Name	Unit	Type
201Ah (U00.42)	43	FPGA System Fault Information		U16
201Ah (U00.43)	44	Orthogonal Encoder Error Information	-	U16
201Ah (U00.44)	45	Nikon Encoder Status Information	-	U16
201Ah (U00.45)	46	Tamagawa Encoder Error Information	-	U16
201Ah (U00.50)	51h	EtherCAT Slave Station Alias	-	U16
201Ah (U00.52)	53h	Desync Count	-	U16
201Ah (U00.53)	54h	Real-time EtherCAT Port 0 Invalid Frame and Error Maximum Value	-	U16
201Ah (U00.54)	55h	Real-time EtherCAT Port 1 Invalid Frame and Error Maximum Value	-	U16
201Ah (U00.55)	56h	Real-time EtherCAT Port Forwarding Error Maximum Value	-	U16
201Ah (U00.56)	57h	Real-time EtherCAT Data Frame Processing Unit Error Count Maximum Value	-	U16
201Ah (U00.57)	58h	Real-time EtherCAT Port Link Loss Count Maximum Value	-	U16
201Ah (U00.58)	59h	EtherCAT State Machine Status and Port Connection Status	-	U16
201Ah (U00.59)	5Ah	ECAT AL Status Code	-	U16
201Ah (U00.90)	91	Current Fault Code	-	U16
201Ah (U00.91)	92	Current Servo Status	-	U16
201Ah (U00.92)	93	Current Warning Code	-	U16

Index (Function Code)	Sub-Index	Name	Unit	Type
201Ah (U00.93)	94	Fault Record Sequence Number	-	U16
201Ah (U00.94)	95	Fault Record Fault Code	-	U16
201Ah (U00.96)	97	Selected Fault Timestamp	-	U32
201Ah (U00.98)	99	Selected Fault Speed	RPM	I16
201Ah (U00.99)	9A	U Phase Current when fault occurs	A	I16
201Ah (U00.9A)	9B	V Phase Current when fault occurs	A	I16
201Ah (U00.9B)	9C	Bus Voltage when fault occurs	V	U16
201Ah (U00.9C)	9D	Input Terminal Status when fault occurs	-	U16
201Ah (U00.9E)	9F	Output Terminal Status when fault occurs	-	U16

### 7.3.16 Group U01 Software Version Display Parameters

Index (Function Code)	Sub-Index	Name	Display Range	Type
201Bh (U01.00)	01	MCU Software Version	-	U32
201Bh (U01.02)	03	FPGA Software Version	-	U32
201Bh (U01.04)	05	Temporary Version	-	U16
201Bh (U01.05)	06	Encoder Version		U16
201Bh (U01.06)	07	XML File Version		U16

### 7.3.17 F Group Auxiliary Function Parameters

Function	Index	Sub index	Name	Setting range	Data type
F02(F.Stop)	201Fh	03h	Emergency stop	0: Disable 1: Enable	U16
F03(F.Agl)	201Fh	04h	Absolute encoder initial angle identification	0: Disable 1: Enable 2: Fault	U16
F04(F.Part)	201Fh	05h	Parameter reset	0: No operation 1: Reset function code 2: Reset object dictionary 3: Reset function code and object dictionary 4: Restore to factory parameters 5: Reset function code (rotation motor) 6: Reset function code(linear motor)	U16
F05(F.Errt)	201Fh	06h	Fault reset	0: Disable 1: Enable	U16
F06(F.Sfirt)	201Fh	07h	Software reset operation	0: Disable 1: Enable	U16
F07(F.Abrt)	201Fh	08h	Absolute encoder reset	0: Disable 1: Reset fault 2: Reset fault and multi-turn value 3: Operation failed(When write it to 1 or 2, after successfully reset, value of this parameter is automatically set to 0, otherwise is set to 3)	U16
F08(F.Enc)	201Fh	09h	Encoder ROM operation	1: Write ROM 2: Read ROM 3: Operation failed( when this parameter is set to 1 or 2, write ROM or read ROM fails, this parameter is automatically set to 3)	U16
F09(F.Aiau)	201Fh	0Ah	AI Automatic Zero Offset Adjustment	0: Disable 2:High precision adjustments(For U3 series)	U16
F0B	201Fh	0Ch	Fault record reset	0: Disable 1: Enable	U16
F0C	201Fh	0Dh	Error compensation	0: No operation	U16

Function	Index	Sub index	Name	Setting range	Data type
			specified origin	1: Specify origin	
F0D	201Fh	0Eh	Motor parameter identification	0: Disable 1: Enable	U16
F0E	201Fh	0Fh	Fault status of reading Nikon encoder	0: Disable 1: Enable	
F0F	201Fh	10h	Single-click adjustment operation	0: Disable 1: Enable	U16
F10	201Fh (F10h)	11h	Reload FPGA FLASH	0: Disable 1: Enable	U16
F31	201Fh	32h	Operation Control Communication Address 1	0~65535	U16
F32	201Fh	33h	Operation Control Communication Address 2	0~65535	U16

## 7.4 DI and DO Functions

### 7.4.1 DI Function Parameter Setting

DI function number	DI function description
1	Enablement
2	Positive Over Travel
3	Negative Over Travel
4	Home position signal
6	Enable internal position command
7	Fault reset
8	Switch command polarity
9	Emergency stop
10	Internal position halt
13	Positive velocity jog
14	Negative velocity jog
15	Zero position clamping enablement

DI function number	DI function description
16	Gain switching enablement
17	Full-closed loop/Semi-closed loop switching
19	Clear position deviation
20	Position-comparison output origin setting
21	Error compensation origin setting
22	Internal task canceled
25	Internal task SN Selection 1
26	Internal task SN Selection 2
27	Internal task SN Selection 3
28	Internal task SN Selection 4 When using internal position (velocity), the specified number of segments for operation is (FunIn.28*8+FunIn27*4+FunIn26*2+FunIn25)
31	Probe 1
32	Probe 2
48	DDR non-standard Next1
49	DDR non-standard Next2
50	DDR Non-standard Save Single-turn Position
51	DDR Non-standard Correction Position
52	DDR Non-standard Triggered to Automatically Homing
53	DDR Non-standard Functional Combination
54	Torque Limit Switching
55	Adjustable Gain Parameter Switching
56	Analog Jog Forward
57	Analog Jog Reverse

## 7.4.2 DO Function Parameter Settings

DO function number	DO function description
1	Servo is ready
2	Servo on
3	Position reached
4	Warning output
5	Fault output
6	Brake signal

DO function number	DO function description
7	Homing completed
8	Angle identification completed
9	Torque limit state
10	Auxiliary gain is effective
13	Zero velocity signal
14	Velocity consistent signal
15	Velocity reached signal
16	Torque demand value reached
19	DDR automatically homing completed
24	DDR non-standard position 1 output
25	DDR non-standard position 2 output
26	DDR non-standard position 3 output
28	Position-comparison output is effective
29	EtherCAT 60FEh control output 1
30	EtherCAT 60FEh control output 2
31	EtherCAT 60FEh control output 3
32	EtherCAT 60FEh control output 4

## 7.5 CiA402 Object Area (6000h~9FFFh)

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
603Fh	00h	Error Code	-	-	-	U16	RO	TxPDO	NO
6040h	00h	Control Word	-	-	-	U16	RW	RxPDO	NO
6041h	00h	Status Word	-	-	-	U16	RO	TxPDO	NO
605Ah	00h	Quick Stop Method Selection	0: free stop and stay in free state 1: for HM mode, ramp stop via 609Ah, for other modes, ramp stop via	-	2	I16	RW	NO	YES

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
			6084h and stay in free state 2: ramp stop via 6085h and stay in free state 3: emergency torque stop and stay in free state 5: for HM mode, ramp stop via 609Ah, for other modes, ramp stop via 6084h and stay in position-locked state 6: ramp stop via 6085h and stay in position-locked state 7: emergency torque stop and stay in position-locked state						
605Ch	00h	Servo OFF Stop Method Selection	0: stop method set by P02.10 1: for HM mode, 609Ah ramp stop; for CST and PT modes, 6087h ramp stop; for other modes, 6084h ramp stop and stay in free state	-	0	I16	RW	NO	YES
605Dh	00h	Halt Stop Method Selection	1: for HM mode, 609Ah ramp stop; for CST and PT modes, 6087h torque ramp stop; for other modes, 6084h ramp stop and stay in position-locked state 2: for CST and PT modes, torque ramp stop via 6087h; for other modes, ramp stop via 6085h and stay in position-locked state 3: emergency stop and stay in position-locked state	-	1	I16	RW	NO	YES

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
605Eh	00h	Fault 2 Stop Method Selection	0: stop method set by P02.13 1: for HM mode, ramp stop via 609Ah; for CST and PT modes, torque ramp stop via 6087h; for other modes, ramp stop via 6084h and stay in free state 2: for CST and PT modes, torque ramp stop via 6087h; for other modes, ramp stop via 6085h and stay in free state	-	0	I16	RW	NO	YES
6060h	00h	Mode Selection	1: Profile position mode 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 8: Cyclic synchronization position mode 9: Cyclic synchronization velocity mode 10: Cyclic synchronization torque mode	-	0	I8	RW	RxPDO	YES
6061h	00h	Mode Selection Display	1: Profile position mode 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 8: Cyclic synchronization position mode 9: Cyclic synchronization velocity mode 10: Cyclic synchronization torque mode	-	-	I8	RO	TxPDO	NO
6062h	00h	Position Command	-	Directive Units	-	I32	RO	TxPDO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
6063h	00h	Position Feedback	-	Encoder Units	-	I32	RO	TxPDO	NO
6064h	00h	Position Feedback	-	Directive Units	-	I32	RO	TxPDO	NO
6065h	00h	Position following error window	0~4294967295	Directive Units	27486951	I32	RW	RxPDO	YES
6066h	00h	Position following error timeout	0~65535	ms	0	U16	RW	RxPDO	YES
6067h	00h	Position window	0~4294967295	Directive Units	5000	U32	RW	RxPDO	YES
6068h	00h	Position window time	0~65535	ms	0	U16	RW	RxPDO	YES
606Bh	00h	Velocity command	-	Directive Units/s	-	I32	RO	TxPDO	NO
606Ch	00h	Velocity Feedback	-	Directive Units/s	-	I32	RO	TxPDO	NO
606Dh	00h	Velocity window	0~65535	RPM	10	U16	RW	RxPDO	YES
606Eh	00h	Velocity window time	0~65535	ms	0	U16	RW	RxPDO	YES
606Fh	00h	Zero Speed Signal Threshold	0~65535	RPM	10	U16	RW	RxPDO	YES

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		d							
6070h	00h	Zero Speed Signal Time Threshold	0~65535	ms	0	U16	RW	RxPDO	YES
6071h	00h	Target Torque	-5000~5000	0.1%	0	I16	RW	RxPDO	YES
6072h	00h	Maximum Torque	0~5000	0.1%	3000	U16	RW	RxPDO	YES
6074h	00h	Torque Command	-	0.1%	-	I16	RO	TxPDO	NO
6077h	00h	Torque Feedback	-	0.1%	-	I16	RO	TxPDO	NO
607Ah	00h	Target Position	- 2147483648~2147483647	Directive Units	0	I32	RW	RxPDO	YES
607Ch	00h	Origin Offset	- 2147483648~2147483647	Directive Units	0	I32	RW	RxPDO	YES
607Dh	00h	Software Absolute Position Limit Sub-Index Count	-	-	2	U8	RO	RxPDO	NO
607Dh	01h	Minimum Software Absolute Position	- 2147483648~2147483647	Directive Units	- 2147483648	I32	RW	RxPDO	YES

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEROM
		Limit							
607Dh	02h	Maximum Software Absolute Position Limit	- 2147483648~2147483647	Directive Units	2147483647	I32	RW	RxPDO	YES
607Eh	00h	Command Polarity	0~255	-	0	U8	RW	RxPDO	YES
607Fh	00h	Maximum Profile Velocity	0~4294967295	Directive Units/s	838860800	U32	RW	RxPDO	YES
6081h	00h	Profile Velocity Command	- 2147483648~2147483647	Directive Units/s	13981013	I32	RW	RxPDO	YES
6083h	00h	Profile Acceleration	0~4294967295	Directive Units/s <sup>2</sup>	1398101333	U32	RW	RxPDO	YES
6084h	00h	Profile Deceleration	0~4294967295	Directive Units/s <sup>2</sup>	1398101333	U32	RW	RxPDO	YES
6085h	00h	Quick Stop Deceleration	0~4294967295	Directive Units/s <sup>2</sup>	4294967295	U32	RW	RxPDO	YES
6087h	00h	Torque Slope	0~4294967295	0.1%/s	4294967295	U32	RW	RxPDO	YES
6091h	00h	Gear Ratio Sub-Index	-	-	-	U8	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Count							
6091h	01h	Gear Ratio Motor Resolution	1~4294967295	-	1	U32	RW	RxPDO	YES
6091h	02h	Gear Ratio Load Shaft Resolution	1~4294967295	-	1	U32	RW	RxPDO	YES
6098h	00h	Homing Method	-2~35	-	1	I8	RW	RxPDO	YES
6099h	00h	Homing Speed Sub-Index Count	-	-	2	U8	RO	NO	NO
6099h	01h	High Speed during homing	0~4294967295	Direct ive Units/ s	1398 1013	U32	RW	RxPDO	YES
6099h	02h	Low Speed during homing	0~4294967295	Direct ive Units/ s	1398 101	U32	RW	RxPDO	YES
609Ah	00h	Homing Acceleration	0~4294967295	Direct ive Units/ s <sup>2</sup>	1398 1013 33	U32	RW	RxPDO	YES
60B0h	00h	Position Offset	- 2147483648~2147483647	Direct ive Units	0	I32	RW	RxPDO	NO
60B1h	00h	Velocity Offset	- 2147483648~2147483647	Direct ive	0	I32	RW	RxPDO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
			7	Units/s					
60B2h	00h	Torque Offset	-5000~5000	0.1%	0	I16	RW	RxPDO	NO
60B8h	00h	Probe Mode	0~65535	-	0	U16	RW	RxPDO	NO
60B9h	00h	Probe Status	-	-	0	U16	RO	NO	NO
60BAh	00h	Probe 1 Rising Edge Lock Position	-	Directive Units	-	I32	RO	NO	NO
60BBh	00h	Probe 1 Falling Edge Lock Position	-	Directive Units	-	I32	RO	NO	NO
60BCh	00h	Probe 2 Rising Edge Lock Position	-	Directive Units	-	I32	RO	NO	NO
60BDh	00h	Probe 2 Falling Edge Lock Position	-	Directive Units	-	I32	RO	NO	NO
60C5h	00h	Maximum Acceleration	0~4294967295	Directive Units/s <sup>2</sup>	4294967295	U32	RW	RxPDO	YES
60C6h	00h	Maximum Deceleration	0~4294967295	Directive Units/s <sup>2</sup>	4294967295	U32	RW	RxPDO	YES

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		tion		s <sup>2</sup>					
60D5h	00h	Probe 1 Rising Edge Count Value	-	-	-	U16	RO	TxPDO	NO
60D6h	00h	Probe 1 Falling Edge Count Value	-	-	-	U16	RO	TxPDO	NO
60D7h	00h	Probe 2 Rising Edge Count Value	-	-	-	U16	RO	TxPDO	NO
60D8h	00h	Probe 2 Falling Edge Count Value	-	-	-	U16	RO	TxPDO	NO
60E0h	00h	Positive Torque Limit	0~5000	0.1%	3000	U16	RW	RxPDO	YES
60E1h	00h	Negative Torque Limit	0~5000	0.1%	3000	U16	RW	RxPDO	YES
60E3h	00h	Supported Home Sub-Index Count	-	-	31	U8	RO	NO	NO
60E3h	01h	Supported Method 1	-	-	-	U8	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60E3h	02h	Supported Method 2	-	-	-	U8	RO	NO	NO
60E3h	03h	c	-	-	-	U8	RO	NO	NO
60E3h	04h	Supported Method 4	-	-	-	U8	RO	NO	NO
60E3h	05h	Supported Method 5	-	-	-	U8	RO	NO	NO
60E3h	06h	Supported Method 6	-	-	-	U8	RO	NO	NO
60E3h	07h	Supported Method 7	-	-	-	U8	RO	NO	NO
60E3h	08h	Supported Method 8	-	-	-	U8	RO	NO	NO
60E3h	09h	Supported Method 9	-	-	-	U8	RO	NO	NO
60E3h	0Ah	Supported Method 10	-	-	-	U8	RO	NO	NO
60E3h	0Bh	Supported	-	-	-	U8	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Method 11							
60E3h	0Ch	Supported Method 12	-	-	-	U8	RO	NO	NO
60E3h	0Dh	Supported Method 13	-	-	-	U8	RO	NO	NO
60E3h	0Eh	Supported Method 14	-	-	-	U8	RO	NO	NO
60E3h	0Fh	Supported Method 15	-	-	-	U8	RO	NO	NO
60E3h	10h	Supported Method 16	-	-	-	U8	RO	NO	NO
60E3h	11h	Supported Method 17	-	-	-	U8	RO	NO	NO
60E3h	12h	Supported Method 18	-	-	-	U8	RO	NO	NO
60E3h	13h	Supported Method 19	-	-	-	U8	RO	NO	NO
60E3h	14h	Supporte	-	-	-	U8	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		d Method 20							
60E3h	15h	Supported Method 21	-	-	-	U8	RO	NO	NO
60E3h	16h	Supported Method 22	-	-	-	U8	RO	NO	NO
60E3h	17h	Supported Method 23	-	-	-	U8	RO	NO	NO
60E3h	18h	Supported Method 24	-	-	-	U8	RO	NO	NO
60E3h	19h	Supported Method 25	-	-	-	U8	RO	NO	NO
60E3h	1Ah	Supported Method 26	-	-	-	U8	RO	NO	NO
60E3h	1Bh	Supported Method 27	-	-	-	U8	RO	NO	NO
60E3h	1Ch	Supported Method 28	-	-	-	U8	RO	NO	NO

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
60E3h	1Dh	Supported Method 29	-	-	-	U8	RO	NO	NO
60E3h	1Eh	Supported Method 30	-	-	-	U8	RO	NO	NO
60E3h	1Fh	Supported Method 31	-	-	-	U8	RO	NO	NO
60E6h	00h	Actual Position Calculation Method	0 : absolute position homing 1 : Incremental position homing	-	0	U16	RW	NO	YES
60F4h	00h	Position Offset	-	Directive Units	-	I32	RO	TxPDO	NO
60FCh	00h	Position Command	-	Directive Units	-	I32	RO	TxPDO	NO
60FDh	00h	DI Status	-	-	-	U32	RO	TxPDO	NO
60FEh	00h	DO Sub-Index Count	-	-	2	U8	RO	NO	NO
60FEh	01h	Output Setting	0~4294967295	-	0	U32	RW	RxPDO	NO
60FEh	02h	Output Enable Setting	0~4294967295	-	0	U32	RW	RxPDO	NO
60FFh	00h	Target	- 2147483648~214748364	Directive	0	I32	RW	NO	YES

Index	Sub index	Name	Setting Range	Unit	Factory Default	Data TYPE	ACCESS	PDO	EEPROM
		Speed	7	Units/s					
6502h	00h	Supported Drive Modes	-	-	-	U32	RO	TxPDO	NO

## 8 Appendix - Terminology

Term	Description
AI	<p>AI (Analog Input) refers to inputs that are continuously varying physical quantities. The higher the sampling bits of the input, the more precisely this analog quantity is quantified, resulting in more accurate outcomes.</p> <p>Physical quantities of analog inputs include temperature, pressure, flow rate, etc., sensed by corresponding sensors, and often converted to electrical signals and sent to the controller's analog input port by transmitters.</p>
AO	<p>AO (Analog Output) is the analog quantity output by the driver. In microcontroller control systems, there are quite a few analog outputs. These are digital signals output by the microcontroller processed through the analog output channel. The task of the analog output channel is to convert the digitally processed signal from the driver into an analog voltage signal through a D/A converter, amplify it, and use it to drive corresponding actuators, thus achieving control.</p>
CANopen	<p>CANopen is a high-level communication protocol based on the Controller Area Network (CAN). It includes communication sub-protocols and device sub-protocols, commonly used in embedded systems and industrial control as a fieldbus.</p> <p>CANopen materializes protocols above the network layer (including the network layer) of the OSI model. The CANopen standard includes addressing schemes, several small communication sub-protocols, and application layers defined by device sub-protocols. It supports network management, device monitoring, and inter-node communication, including a simple transport layer for segmenting and reassembling data. Generally, the data link layer and physical layer are implemented by CAN. Other communication protocols (like EtherCAT) also use CANopen device sub-protocols.</p> <p>The CANopen standard is drafted and reviewed by the non-profit organization CiA (CAN in Automation). Basic CANopen devices and communication sub-protocols are defined in CAN in Automation (CiA) draft standard 301, and specific device sub-protocols expand on this, such as CiA401 for I/O modules and CiA402 for motion control.</p>
CoE	<p>CoE (CANopen over EtherCAT) is a protocol that combines the CANopen application layer protocol (mainly CiA301 and CiA402) with the EtherCAT underlying layer protocol. CoE protocol uses object and object dictionary functions to implement mailbox communication.</p>
DB	<p>DB (Dynamic Brake) consists of a dynamic braking resistor that uses energy consumption braking to shorten the mechanical feed distance of the servo motor during faults, emergency stops, or power outages.</p>
DC	<p>DC (Distributed Clock) is a high-precision time synchronization mode (synchronized with the first device with DC). This mode uses the time of the first DC device as the system time, and then all devices use this system time (adding transmission delay, jitter, etc.) to generate SYNC0 or SYNC1 synchronization signals. This mode requires strong real-time performance from the master station, as some slave stations require time jitter not exceeding 100ns in this mode, or a Sync Error alarm will occur.</p>
DI	<p>DI (Digital Input) converts switch signals with only two states in the production process into a signal format identifiable by the driver and inputs it to the driver. For example, the status of a field limit switch.</p>

Term	Description
DO	DO (Digital Output) converts the switch signal represented by the binary code output by the driver into a switch signal that can control the production process or display status. For example, the status control and display of on/off indicator lights, motor start/stop, valve open/close, and relay on/off.
EEPROM	EEPROM (Electrically Erasable Programmable Read Only Memory) refers to a memory chip that retains data even when powered off. It can be erased and reprogrammed on a computer or specialized equipment, commonly used in plug-and-play scenarios.
ESC	ESC (EtherCAT Slave Controller) controls the output speed of the servo motor by adjusting voltage and current, achieving more precise motion control.
EtherCAT	<p>EtherCAT (Ethernet for Control Automation Technology) is an open architecture Ethernet-based fieldbus system. It is a deterministic industrial Ethernet developed by the German company Beckhoff.</p> <p>EtherCAT's short cycle time is due to the slave station's microprocessor not needing to process Ethernet packets; all program data is processed by the hardware of the slave controller. This feature, combined with EtherCAT's functional principle, makes it a high-performance distributed I/O system: exchanging program data with 1,000 distributed digital I/O only takes 30us, equivalent to transmitting 125 bytes of data over a 100Mbit/s Ethernet. Reading and writing a system of 100 servo axes can be updated at a rate of 10kHz. Common update rates are around 1~30kHz, but lower rates can also be used to avoid frequent direct memory access affecting the master station's operation.</p>
FSA	FSA (Finite Status Automaton) is an abstract computing model used to study computational processes with finite memory and certain language classes. FSA has a finite number of states, each capable of transitioning to zero or more states, with input strings determining which state transitions to execute. FSA can be represented as a directed graph and is a research object in automate theory.
PDFF	PDFF (Pseudo-Derivative Feedback and Feedforward) introduces a feedforward gain in the speed loop PI regulator. This allows the system setpoint to be added to the control quantity through a feedforward channel, increasing integral gain without causing excessive overshoot, filtering many low-frequency interference signals through the integral link, improving system response and interference resistance, enabling quick positioning, and good following ability during motor operation.
PDO	PDO (Process Data Object) is an object type used for real-time data transmission in CANopen networks. It is used to send real-time data from one node to other nodes. PDO has high real-time performance and low latency, suitable for applications requiring fast data transmission. PDO data transmission is event-triggered; once the event is triggered, PDO data is transmitted immediately without additional requests and responses.
PI	PI control (Proportional-Integral control) is a widely used closed-loop control system in industrial automation. In such systems, the controller adjusts the control quantity based on the error between the actual output and the desired output through proportional and integral links, making the actual output value as close as possible to the desired output value.
RxPDO	RxPDO (Receive Process Data Object) is the PDO sent by the master station to the slave station.
SDO	SDO (Service Data Object) is an object type used to configure and manage node parameters

Term	Description
	in CANopen networks. It materializes data reading and writing through a request-response mechanism. SDO is suitable for scenarios such as configuring node parameters, reading device status, and fault diagnosis. SDO data transmission is request-response based, requiring interaction between nodes.
SM2	SM2 event synchronization mode processes EtherCAT frame data reading and writing according to SM2 or SM3 events (SM events are triggered when the slave station receives EtherCAT data). However, some devices always have SM3 output enabled, so some devices cannot use SM3 as a synchronization signal.
TxPDO	TxPDO (Transmit Process Data Object) is the PDO sent by the slave station to the master station, used to periodically transmit real-time data, such as sensor data, actuator status, etc.
Object Dictionary	The CANopen object dictionary is the core concept of the CANopen protocol. It is an ordered set of objects describing all parameters corresponding to the CANopen node, including communication data storage locations indexed in an EDS file (Electronic Data Sheet).