SV660N Series Servo Drive

Function Guide

Data code 19011434 A01

Preface

Overview

The SV660N series high-performance AC servo drive covers a power range from 50 W to 7.5 kW. It supports EtherCAT communication protocol and carries Ethernet communication interfaces to work with the host controller for a networked operation of multiple servo drives.

The SV660N series servo drive supports stiffness level setting, inertia auto-tuning and vibration suppression to simplify the operation process. It allows a quiet and stable operation together with an MS1 series high-response servo motor with low or medium inertia and a 23-bit single-turn or multi-turn absolute encoder.

The SV660N series servo drive aims to implement fast and accurate control in automation equipment such as semi-conductor manufacturing equipment, chip mounters, PCB punching machines, handling machineries, food processing machineries, machine tools, and transmission machineries.

This guide presents commissioning process, parameters, and solutions to faults and warnings, including the keypad, software tool, and commissioning procedure.

More Documents

Name	Data Code
SV660N Series Servo Drive Selection Guide	19011431
SV660N Series Servo Drive Hardware Guide	19011432
SV660N Series Servo Drive Commissioning Guide	19011433
SV660N Series Servo Drive Communication Guide	19011435

Revision History

Date of Revision	Version	Revision
October 2020	A00	First release
February 2021	A01	Minor corrections

Document Acquisition

This guide is not delivered along with the product. To download the PDF version, visit *http://en.inovance.cn/support/download.html*.

Table of Contents

Fundamental Safety Instructions

Safety Precautions

1. This chapter presents essential safety instructions for a proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe personal injuries, or equipment damage.
2. "CAUTION", "WARNING", and "DANGER" items in the guide only indicate some of the precautions that need to be followed; they just supplement the safety precautions.
3. Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
4. Inovance shall take no responsibility for any personal injuries or property damage caused by improper use.

Safety Levels and Definitions

DANGER	Indicates that failure to comply with the notice will result in death or severe personal injuries.
WARNING	Indicates that failure to comply with the notice may result in death or severe personal injuries.
CAUTION	Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

General Safety Instructions

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.

Unpacking
WARNING
• Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.

CAUTION

- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the package by following the unpacking sequence. Do not strike the package violently.
- Check whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking.
- Check whether the package contents are consistent with the packing list before unpacking.

Storage and Transportation

WARNING

- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.

CAUTION

- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the equipment for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation

DANGER

- The equipment must be operated only by professionals with electrical knowledge.

WARNING

- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply will result in a fire.

CAUTION

- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on the top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all the power supplies of the equipment, and wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply will result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply will result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply will result in an electric shock.

WARNING
• Do not connect the input power supply to the output end of the equipment. Failure to comply will result in equipment damage or even a fire. • When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation. • Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end. • Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire. • After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in an electric shock or equipment damage.
CAUTION • During wiring, follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap. Failure to comply will damage the equipment or the internal circuits of the equipment. • Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.
Power-on
DANGER • Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted. • Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire. • After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.
WARNING • Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injuries or equipment damage. • Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire. • Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.
Operation

DANGER

- The equipment must be operated only by professionals. Failure to comply will result in death or personal injuries.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply will result in an electric shock.

WARNING

- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply will result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply will result in an electric shock.

WARNING

- Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply will result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.

WARNING

- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injuries or equipment damage.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not use damaged equipment. Failure to comply may result in death, personal injuries, or severe equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal

WARNING

- Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death.
- Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Safety Labels

For safe equipment operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

Safety Label	Description
	• Read through the safety instructions before operating the equipment. Failure to comply may result in death, personal injuries, or equipment damage. • Do not touch the terminals or remove the cover with power ON or within 10 min after power-off. Failure to comply will result in an electric shock.

1 Function Overview

Basic functions of the servo drive are listed in the following table. See function details in corresponding chapters/sections.

Function	Description
Cyclic synchronous position mode	The host controller generates position references and sends references cyclically through the bus. The servo drive performs positioning control.
Cyclic synchronous velocity mode	The host controller generates speed references and sends references cyclically through the bus. The servo drive performs speed control.
Cyclic synchronous torque mode	The host controller generates torque references and sends references cyclically through the bus. The servo drive performs torque control.
Profile position mode	The host controller sets parameters through the bus. The servo drive generates position references and performs positioning control.
Profile velocity mode	The host controller sets parameters through the bus. The servo drive generates speed references and performs speed control.
Profile torque mode	The host controller sets parameters through the bus. The servo drive generates torque references and performs torque control.
Homing mode	The host controller selects the homing mode through parameters. The servo drive performs homing, with the position feedback set to the preset value.
Touch probe function	The servo drive latches the position information when an external DI signal or motor Z signal changes.
High-resolution encoder	The servo drive is equipped with a high-performance encoder with resolution up to 8388608 PPR.
Mechanical characteristics analysis	The servo drive analyzes the resonance frequency and characteristics of the mechanical system through a PC installed with Inovance software tool.
Gain auto-tuning	The servo drive generates gain parameters automatically to match the actual operating conditions through just one parameter.
Gain switchover	Different gains can be applied to different status (running or stop) of the motor. Gains can also be switched by external terminals during operation.
Torque disturbance observer	The servo drive estimates the disturbance torque suffered by the system to suppress vibration through compensation.
Resonance suppression	The servo drive sets filter characteristics automatically to suppress mechanical system vibration after detecting the resonance point.

Function	Description
Torque reference filter	The servo drive suppresses the mechanical resonance generated when the response speed is excessively high.
Position first-order low-pass filter	The servo drive enables smooth acceleration and deceleration through the first-order low-pass filter.
Torque limit	The servo drive limits the output torque of the servo motor.
Speed limit	The servo drive limits the servo motor speed.
External regenerative resistor	The external regenerative resistor comes into rescue when the braking capacity of the built-in regenerative resistor is insufficient.
DI signal assignment	DI functions such as emergency stop can be assigned to corresponding pins.
Fault log	The servo drive records the latest ten faults/warnings, which can also be cleared.
Status display	The servo drive displays servo drive status through the LEDs on the keypad.
External I/O display	The servo drive displays ON/OFF status of external I/O signals.
Forced signal output	The servo drive outputs signals unrelated to the servo status forcibly, which can be used to check the wiring of output signals.
Trial run mode	The servo drive enables the motor through the keypad without a start signal.
Inovance software tool	The servo drive allows you to set parameters, perform trial run, and check status through a PC.
Warning code output	The servo drive outputs a four-bit warning code when a warning occurs.
Position comparison	The servo drive outputs a DO signal with designated width after reaching the preset target position.
Black box	The servo drive captures the data before and after the designated condition and works with the software tool to read the data for further analysis.

2 Basic Functions of the Servo Drive

The servo system consists of three critical parts, the servo drive, servo motor, and feedback encoder.

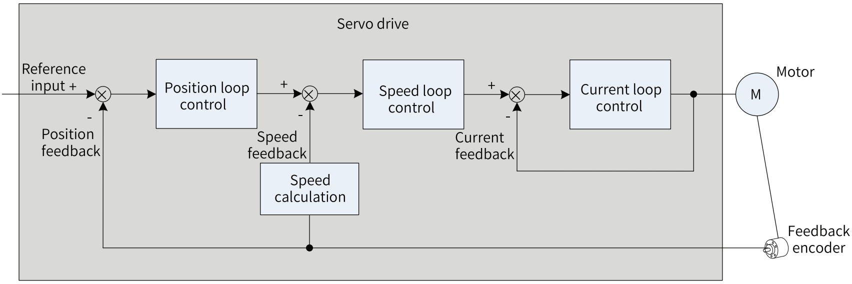


Figure 2-1 Structure of a basic servo system

As the control core of the servo system, the servo drive serves to perform accurate position control, speed control, and torque control on the servo motor through four control modes, which are position control, speed control, torque control, and compound control modes. Among the four control modes, position control is the most important and common control mode of the servo system.

Descriptions of the control modes are as follows:

- Position control
  In the position control mode, the target position of the motor is determined by the sum of position references, and the motor speed is determined by the position reference frequency. The servo drive performs quick and accurate position control and speed control through the feedback encoder installed on the motor or an external encoder (fully closed-loop control). The position control mode mainly applies to applications requiring positioning control, such as manipulators, SMT machines, engraving and milling machines, and CNC machine tools.
- Speed control
  In the speed control mode, the servo drive performs quick and accurate speed control with speed references set through communication. The speed control mode mainly applies to applications (such as engraving and milling machines) requiring speed control or where a host controller is used for position control or the commands sent from the host controller are used as speed references.
- Torque control
  In the torque control mode, the motor current is in linear relationship with the torque. Therefore, torque control can be implemented through current control. The output torque of the motor is controlled by torque references. The torque reference can be set through communication. The torque control mode mainly applies to applications requiring strict tension control. For example, in winding/

unwinding devices, torque references are used to prevent the material from being affected by changes in the winding radius.

2.1 Conversion Factor Setting

Gear ratio refers to the motor displacement (encoder unit) corresponding to the load shaft displacement of one reference unit.

The gear ratio is comprised of the numerator (6091-01h) and denominator (6091-02h). It determines the proportional relation between the load shaft displacement (reference unit) and the motor displacement (encoder unit), as shown below.

Motor displacement = Load shaft displacement x Gear ratio

The motor is connected to the load through the reducer and other mechanical transmission mechanisms. Therefore, the gear ratio is related to the mechanical reduction ratio, mechanical dimensions and encoder resolution.

The calculation formula is as follows.

$$\text{Gear ratio} = \frac{\text{Encoder resolution}}{\text{Load shaft resolution}}$$

<table>
<tr><td rowspan="2">Index 6091h</td><td>Name</td><td colspan="3">Gear ratio</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>ARR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>-</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>OD Data Range</td><td>Default</td><td>OD Default Value</td></tr>
<tr><td colspan="11">Defines the proportional relation between the load shaft displacement designated by the user and the motor shaft displacement.
The relation between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows.
Motor position feedback = Load shaft position feedback x Gear ratio
The relation between the motor speed (RPM) and the load shaft speed (reference unit/s) is as follows.
$$\text{Motor speed (RPM)} = \frac{\text{Load shaft speed x Gear ratio (6091h)}}{\text{Motor revolutions}} \times 60$$
The relation between the motor acceleration (RPM/ms) and the load shaft acceleration (reference unit/s^2) is as follows.
$$\text{Motor acceleration} = \frac{\text{Load shaft acceleration x Gear ratio (6091h)}}{\text{Motor revolutions}} \times \frac{1000}{60}$$</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 00h</td><td>Name</td><td colspan="3">Highest sub-index supported</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>-</td><td>Default</td><td>2</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 01h</td><td>Name</td><td colspan="3">Motor revolutions</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>1 to (2^{32} - 1)</td><td>Default</td><td>Encoder dependent</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 02h</td><td>Name</td><td colspan="3">Shaft revolutions</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>1 to (2^{32} - 1)</td><td>Default</td><td>1</td></tr>
</table>

Taking the ball screw as an example:

Minimum reference unit (fc) = 1 mm

Lead (PB) = 10 mm/r

Reduction ratio (n) = 5:1

Resolution of Inovance motor with 23-bit serial-type encoder (P) = 8388608 PPR

The position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P x n}}{\text{PB}}$$

$$= \frac{8388608 \times 5}{10}$$

$$= \frac{41943040}{10}$$

$$= 4194304$$

Therefore, 6091-01h = 4194304, 6091-02h = 1, which means when the load shaft displacement is 1 mm, the motor displacement is 4194304.

Reduce the values of 6091-01h and 6091-02h to a point where there is no common divisor, and take the final value.

2.2 Servo Status Setting

To make the servo drive operate in the designated status, observe the process stipulated in the CiA402 protocol.

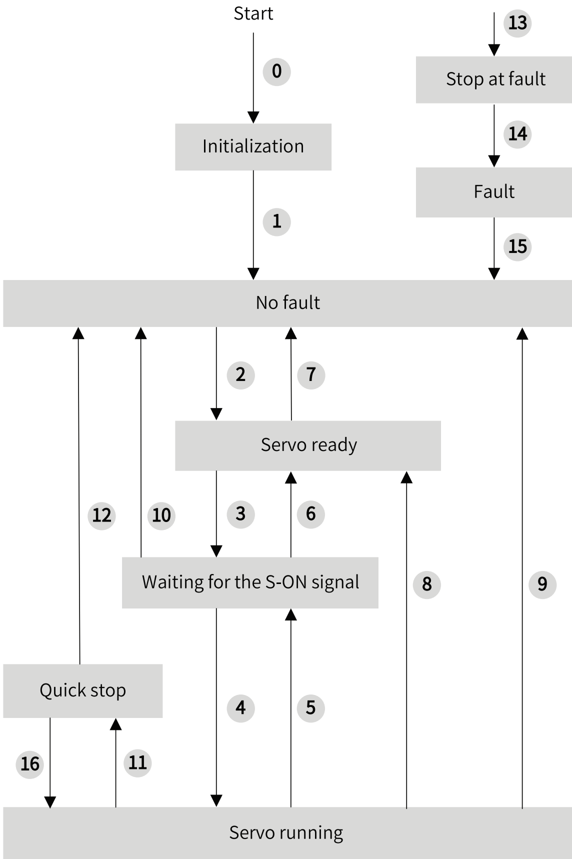


Figure 2-2 Status switchover of CiA402 state machine

See the following table for descriptions of different status.

Initialization	Initialization of the servo drive and internal self-inspection are done. Parameters cannot be set. Drive functions cannot be executed.
No fault	No fault exists in the servo drive or the fault has been cleared. Parameters can be set.
Servo ready	The servo drive is ready to run. Parameters can be set.
Waiting for the S-ON signal	The servo drive is waiting for the S-ON signal. Parameters can be set.

Servo running	The servo drive is running properly and a certain operation mode has been enabled. The motor is energized and starts rotating when the speed reference value inputted is not 0. Only parameters whose "Setting Condition" is "During running" can be set.
Quick stop	Quick stop is activated and the servo drive is in the process of quick stop. Only parameters whose "Setting Condition" is "During running" can be set.
Stop at fault	A fault occurs and the servo drive is in the process of stop. Only parameters whose "Setting Condition" is "During running" can be set.
Fault	The stop process is done and all the drive functions are disabled. Parameters can be modified for troubleshooting purpose.

The following table describes the control commands and status switchover.

CiA402 Status Switchover		Control Word 6040h	Bit0 to Bit9[1] of Status Word 6041h
0	Power-on → Initialization	Natural transition, control command not required	0x0000
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly enters status 13.	0x0250/0x270
2	No fault → Servo ready	0x0006	0x0231
3	Servo ready→Waiting for the S-ON signal	0x0007	0x0233
4	Waiting for the S-ON signal→Servo running	0x000F	0x0237
5	Servo running→Waiting for the S-ON signal	0x0007	0x0233
6	Waiting for the S-ON signal→Servo ready	0x0006	0x0231
7	Servo ready → No fault	0x0000	0x0250
8	Servo running → Servo ready	0x0006	0x0231
9	Servo running → No fault	0x0000	0x0250
10	Waiting for the S-ON signal → No fault	0x0000	0x0250

CiA402 Status Switchover		Control Word 6040h	Bit0 to Bit9[1] of Status Word 6041h
11	Servo running → Quick stop	0x0002	0x0217
12	Quick stop → No fault	Set 605A to a value between 0 and 3. Natural transition applies after stop and no control command is required.	0x0250
13	→ Stop at fault	If a fault occurs in any status other than "fault", the servo drive automatically switches to the stop-at-fault state, without the need for a control command.	0x021F
14	Stop at fault→Fault	Natural transition applies after stop and no control command is required.	0x0218
15	Fault→No fault	0x80 Bit7 is rising edge-triggered. If bit7 is kept to 1, other control commands are invalid.	0x0250
16	Quick stop → Servo running	Set 605A to a value between 5 and 7. 0x0F will be sent after stop.	0x0237

Note

[1]: bit10 to bit15 of 6041h are related to the operating state of the servo drive, and their values are represented as "0" in the preceding table. For details on the status of these bits, check the operation mode of the servo drive.

2.2.1 Control Word 6040h

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
</table>

Defines the control command.

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
4 to 6	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault reset	0: Inactive 0→1: Fault reset is available only for faults and warnings that can be reset. 1: Other control commands are invalid. 1→0: Inactive
8	Halt	1: Active, 0: Inactive
9	Operation mode specific	Related to the operation mode of the servo drive.
10	Reserved	Undefined
11 to 15	Manufacturer-specific	Manufacturer-specific

Note:

- All bits in the control word constitute a control command.
- The meanings of bit0...bit3 and bit7 are the same in each mode. The servo drive switches to the preset status according to the CiA402 state machine switchover process only when commands are sent in sequence. Each command corresponds to a certain status.
- bit4...bit6 are related to each mode (see the control commands in different modes for details).
- bit9 is not defined.

2.2.2 Status Word 6041h

<table>
<tr><td rowspan="2">Index 6041h</td><td>Name</td><td colspan="3">Status word</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>0</td></tr>
</table>

Indicates the servo drive status.

<table>
<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="2">ms</td><td colspan="2">oms</td><td>ila</td><td>tr</td><td>rm</td><td>ms</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>

MSB LSB

Note：ms=manufacturer-specific；oms=operation mode specific；ila =internal limit active；tr=target reached; rm=remote；w=warning；sod=switch on disabled；qs=quick stop；ve=voltage enabled；f=fault；oe=operation enabled；so=switch on；rtso=ready to switch on

Table 2–1 Description of each bit of 6041h

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	1: Active, 0: Inactive
11	Internal limit active	1: Active, 0: Inactive
12 to 13	Operation mode specific	Related to the servo drive operation mode.
14	Manufacturer-specific	Undefined
15	Home found	1: Active, 0: Inactive

Table 2–2 Descriptions of 6041h setpoints

Binary Value	Description
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switched on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Note

- Meanings of bit0 to bit9 are the same in each mode of operation. After commands are sent in sequence by the control word 6040h, the servo drive feeds back the acknowledged status.
- Meanings of bit12 and bit13 vary with the mode of operation. For details, see parameters related to each mode.
- Meanings of bit10, bit11, and bit15 are the same in each mode of operation and indicate the servo drive status after a certain mode of operation is implemented.

2.3 Setting and Display of the Operation Modes

Introduction to the operation modes

The SV660N series servo drive supports seven operation modes, as defined in 6502h.

Index 6502h	Name	Supported drive modes			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0

Indicates the operation modes supported by the servo drive.

bit	Description	Supported or Not 0: No 1: Yes
0	Profile position (PP) mode	1
1	Velocity (VL) mode	0
2	Profile velocity (PV) mode	1
3	Profile torque (PT) mode	1
4	N/A	0
5	Homing (HM) mode	1
6	Interpolation (IP) mode	0
7	Cyclic synchronous position (CSP) mode	1
8	Cyclic synchronous velocity (CSV) mode	1
9	Cyclic synchronous torque (CST) mode	1
10 to 31	Manufacturer-specific	Reserved and undefined

If 6502h is supported, you can get the supported drive modes through 6502h.

The pre-operational mode of the servo drive can be set in 6060h. The present operation mode of the servo drive can be viewed in 6061h.

Index 6060h	Name	Modes of operation			Setting Condition & Effective Time	At once	Data Structure	VAR	Data Type	Int8
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 10	Default	-

Defines the servo drive operation mode.

Setpoint	Modes of Operation	
0	N/A	Reserved
1	Profile position (PP) mode	See *" Profile Position (PP) Mode" on page 42*.
2	N/A	Reserved
3	Profile velocity (PV) mode	See *" Profile Velocity (PV) mode" on page 53*.
4	Profile torque (PT) mode	See *" Profile Torque (PT) Mode" on page 61*.
5	N/A	Reserved
6	Homing (HM) mode	See *" Homing Mode (HM)" on page 70*.
7	Interpolation (IP) mode	Not supported
8	Cyclic synchronous position (CSP) mode	See *" Cyclic Synchronous Position (CSP) Mode" on page 24*.
9	Cyclic synchronous velocity (CSV) mode	See *" Cyclic Synchronous Velocity (CSV) Mode" on page 30*.
10	Cyclic synchronous torque (CST) mode	See *" Cyclic Synchronous Torque (CST) Mode" on page 35*.

If an unsupported operation mode is set through SDO, a SDO error will be returned. For details, see *"8.5 SDO Transfer Abort Code" on page 500*.
If an operation mode not supported is set through PDO, this operation mode is invalid.

<table>
<tr><td rowspan="2">Index 6061h</td><td>Name</td><td colspan="3">Modes of operation display</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int8</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 10</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Displays the current operation mode of the servo drive.</td></tr>
</table>

Setpoint	Modes of Operation	
0	N/A	Reserved
1	Profile position (PP) mode	See *" Profile Position (PP) Mode" on page 42*.
2	N/A	Reserved
3	Profile velocity (PV) mode	See *" Profile Velocity (PV) mode" on page 53*.
4	Profile torque (PT) mode	See *" Profile Torque (PT) Mode" on page 61*.
5	N/A	Reserved
6	Homing (HM) mode	See *" Homing Mode (HM)" on page 70*.
7	Interpolation (IP) mode	Not supported
8	Cyclic synchronous position (CSP) mode	See *" Cyclic Synchronous Position (CSP) Mode" on page 24*.
9	Cyclic synchronous velocity (CSV) mode	See *" Cyclic Synchronous Velocity (CSV) Mode" on page 30*.
10	Cyclic synchronous torque (CST) mode	See *" Cyclic Synchronous Torque (CST) Mode" on page 35*.

Communication Cycles

The SV660N series servo drive supports a synchronization cycle of 125 μs or an integer multiple of 125 μs.

2.4 Cyclic Synchronous Position (CSP) Mode

In CSP mode, the host controller generates gposition references and sends the target position to the servo drive cyclically. The servo drive executes position control, speed control, and torque control.

2.4.1 Configuration Block Diagram

CSP mode (0x6060 = 8)

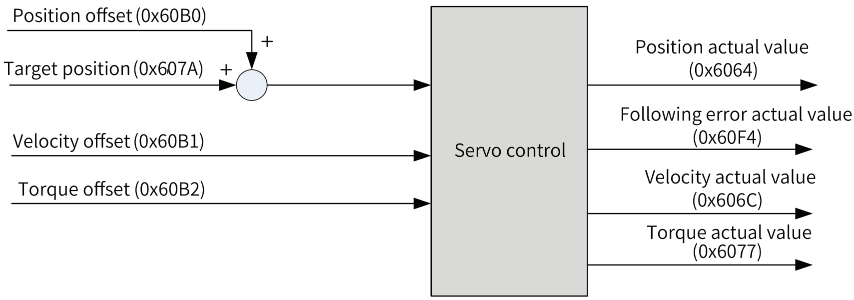
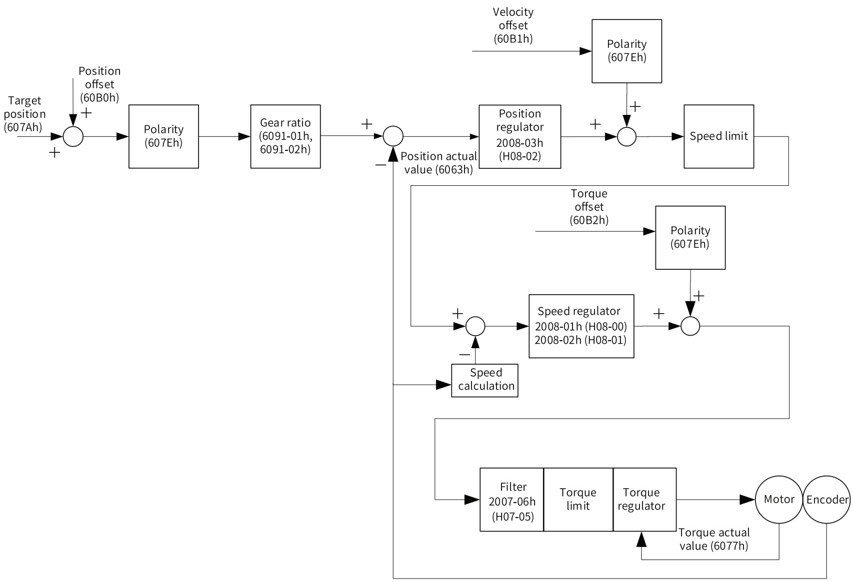


Figure 2-3 Cyclic synchronous position mode

2.4.2 Recommended Configuration

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
607A: Target position	6064: Position actual value	Mandatory
6060: Modes of operation	6061: Modes of operation display	Optional

2.4.3 Function Block Diagram



2.4.4 Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040	00	Control word	RW	Uint16	-	0 to 65535	0
6041	00	Status word	RO	Uint16	-	-	-
6060	00	Modes of operation	RW	Int8	-	0 to 10	0
6061	00	Modes of operation display	RO	Int8	-	-	-
6064	00	Position actual value	RO	Int32	Reference unit	-	-
6065	00	Following error window	RW	Int32	Reference unit	0 to (2^{32} - 1)	3145728
6066	00	Following error time out	RW	Uint16	ms	0 to 65535	0
606C	00	Velocity actual value	RO	Int32	Reference unit/s	-	-
6077	00	Torque actual value	RO	Int16	0.1%	-	-
607A	00	Target position	RW	Int32	Reference unit	-2^{31} to +(2^{31} - 1)	0
607E	00	Polarity	RW	Uint8	-	0 to 255	0
60B0	00	Position offset	RW	Int32	Reference unit	-2^{31} to +(2^{31} - 1)	0
60B1	00	Velocity offset	RW	Int32	Reference unit/s	-2^{31} to +(2^{31} - 1)	0
60B2	00	Torque offset	RW	Int16	0.1%	-4000 to +4000	0
60F4	00	Following error actual value	RO	Int32	Reference unit	-	-

Description of related parameters

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the control command.
<table><tr><th>bit</th><th>Name</th><th>Description</th></tr><tr><td>0</td><td>Switch on</td><td>1: Active, 0: Inactive</td></tr><tr><td>1</td><td>Enable voltage</td><td>1: Active, 0: Inactive</td></tr><tr><td>2</td><td>Quick stop</td><td>0: Active, 1: Inactive</td></tr><tr><td>3</td><td>Enable operation</td><td>1: Active, 0: Inactive</td></tr></table>
The CSP mode only supports absolute position references.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6041h</td><td>Name</td><td colspan="3">Status word</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the servo drive status.
<table><tr><th>bit</th><th>Name</th><th>Description</th></tr><tr><td>0</td><td>Ready to switch on</td><td>1: Active, 0: Inactive</td></tr><tr><td>1</td><td>Switch on</td><td>1: Active, 0: Inactive</td></tr><tr><td>2</td><td>Operation enabled</td><td>1: Active, 0: Inactive</td></tr><tr><td>3</td><td>Fault</td><td>1: Active, 0: Inactive</td></tr><tr><td>4</td><td>Voltage enabled</td><td>1: Active, 0: Inactive</td></tr><tr><td>5</td><td>Quick stop</td><td>0: Active, 1: Inactive</td></tr><tr><td>6</td><td>Switch on disabled</td><td>1: Active, 0: Inactive</td></tr><tr><td>7</td><td>Warning</td><td>1: Active, 0: Inactive</td></tr><tr><td>8</td><td>Manufacturer-specific</td><td>Undefined</td></tr><tr><td>9</td><td>Remote</td><td>1: Active, control word activated
0: Inactive</td></tr><tr><td>10</td><td>Target reached</td><td>Not supported, always being 1</td></tr><tr><td>11</td><td>Internal limit active</td><td>0: Position reference within the limit
1: Position reference beyond the limit</td></tr><tr><td>12</td><td>Drive follow the command value</td><td>Not supported, always being 1</td></tr><tr><td>13</td><td>Following error</td><td>0: EB00.0 (Excessive position deviation) not reported
1: EB00.0 (Excessive position deviation) reported</td></tr><tr><td>14</td><td>Manufacturer-specific</td><td>Undefined</td></tr><tr><td>15</td><td>Home found</td><td>0: Home not found
1: Home found</td></tr></table></td></tr>
</table>

<table>
<tr><td rowspan="2">Index 607Ah</td><td>Name</td><td colspan="3">Target position</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/CSP</td><td>Data Range</td><td>-2^{31} to (2^{31} - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the target position in PP mode and CSP mode.
In CSP mode, 607Ah indicates the absolute target position.
In PP mode, 607Ah indicates either the incremental position or absolute position as defined by the control word.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60B0h</td><td>Name</td><td colspan="3">Position offset</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>CSP</td><td>Data Range</td><td>-2^{31} to (2^{31} - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the position reference offset in CSP mode.
The sum of 607Ah and 60B0h determines the target position of the servo drive.
Target position = 607Ah + 60B0h</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60B1h</td><td>Name</td><td colspan="3">Velocity offset</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>CSP/CSV</td><td>Data Range</td><td>-2^{31} to (2^{31} - 1) (reference unit/s)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the external speed feedforward signal of EtherCAT in CSP mode (activated when 2005-14h is set to 2). 60B1h can be used to reduce the position deviation during positioning. After positioning is done, set the velocity offset to 0. Failure to comply will result in deviation between the target position and the position feedback.
60B1h also defines the speed reference offset in CSV mode.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60B2h</td><td>Name</td><td colspan="3">Torque offset</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>CSP/CSV/ CST</td><td>Data Range</td><td>-4000 to +4000 (0.1%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the external torque feedforward signal of EtherCAT in CSP and CSV modes (activated when 2006-0Ch is set to 2).
You can also set the torque reference offset in CST mode through 60B2h.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6064h</td><td>Name</td><td colspan="3">Position actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the absolute position feedback (reference unit).
In case of an absolute encoder in rotary mode, 6064h indicates the single-turn position feedback (reference unit) of the mechanical load.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 606Ch</td><td>Name</td><td colspan="3">Velocity actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the speed actual value (reference unit/s).</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6077h</td><td>Name</td><td colspan="3">Torque actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the internal torque feedback of the servo drive (unit: 0.1%).
The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60F4h</td><td>Name</td><td colspan="3">Following error actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>PP/HM/ CSP</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the position deviation (reference unit).</td></tr>
</table>

2.4.5 Related Function Settings

Position deviation monitoring function

☆ Related parameters:

Index 6065h	Name	Following error window			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/HM/CSP	Data Range	0 to (2^{32} - 1) (reference unit)	Default	3145728
Defines the threshold of excessive position deviation (reference unit). If 6065h is set to an excessively high value, the threshold of excessive position deviation will be 2147483647 in encoder unit.										

Index 6066h	Name	Following error time out			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PP/HM/CSP	Data Range	0 to 65535 (ms)	Default	0
Defines the time lapse to trigger excessive position deviation (EB00.0). If the position deviation exceeds the threshold of excessive position deviation and such status persists after the time defined by 6066h elapses, EB00.0 (Excessive position deviation) will occur.										

Position reference polarity

You can change the position reference direction through setting the position reference polarity.

☆ Related parameter:

Index 607Eh	Name	Polarity			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint8
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 255	Default	0
Defines the polarity of position, speed, and torque references.										

bit	Description
7	Position reference polarity 0: Multiply by 1 1: Multiply by -1 PP: Inverts the target position (607Ah) CSP: Inverts the position reference (607Ah + 60B0h)

2.5 Cyclic Synchronous Velocity (CSV) Mode

In CSV mode, the host controller sends the target speed to the servo drive synchronously and cyclically, and the servo drive executes speed control and torque control.

2.5.1 Configuration Block Diagram

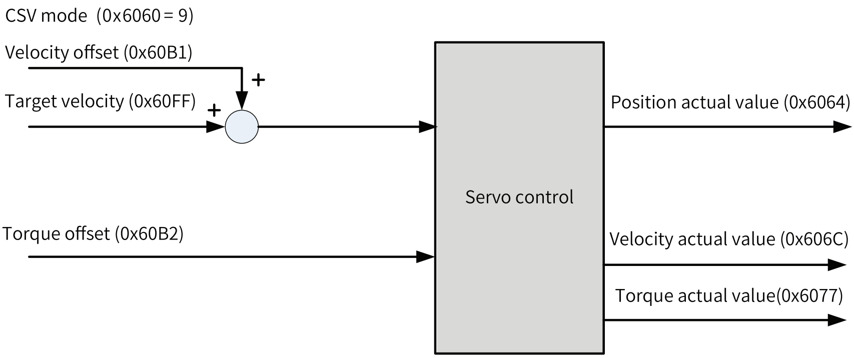


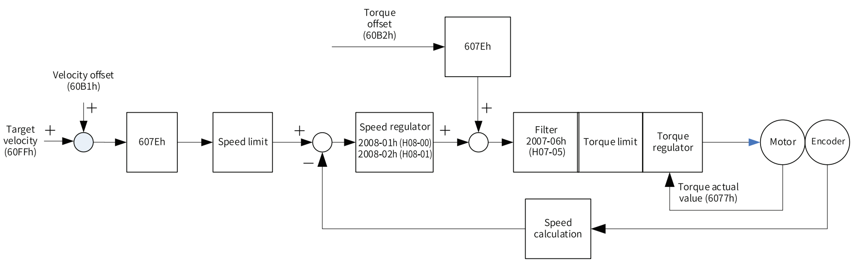
Figure 2-4 CSV mode

2.5.2 Recommended Configuration

The basic configuration for CSV mode is shown in the following table.

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
60FF: Target velocity	-	Mandatory
-	6064: Position actual value	Optional
-	606C: Velocity actual value	Optional
6060: Modes of operation	6061: Modes of operation display	Optional

2.5.3 Function Block Diagram



2.5.4 Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040	00	Control word	RW	Uint16	-	0 to 65535	0
6041	00	Status word	RO	Uint16	-	-	-
6060	00	Modes of operation	RW	Int8	-	0 to 10	0
6061	00	Modes of operation display	RO	Int8	-	-	-
6064	00	Position actual value	RO	Int32	Reference unit	-	-
606C	00	Velocity actual value	RO	Int32	Reference unit/s	-	-
6077	00	Torque actual value	RO	Int16	0.1%	-	0
607E	00	Polarity	RW	Uint8	-	0 to 255	0
60B1	00	Velocity offset	RW	Int32	Reference unit/s	-2^{31} to $+(2^{31} - 1)$	0
60B2	00	Torque offset	RW	Int16	0.1%	-4000 to +4000	0
60FF	00	Target velocity	RW	Int32	Reference unit/s	-2^{31} to $+(2^{31} - 1)$	0

Description of related parameters

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the control command.</td></tr>
</table>

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive

Index 6041h	Name	Status word			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	-

Indicates the servo drive status.

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	Not supported, always being 1
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follow the command value	Not supported, always being 1
13	-	N/A
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

Index 60B1h	Name	Velocity offset			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int32
	Access	RW	Mapping	RPDO	Related Mode	CSP/CSV	Data Range	-2^{31} to (2^{31} - 1) (reference unit/s)	Default	0

Defines the speed reference offset in CSV mode. After setting, the following formula applies:
Target speed = 60FFh + 60B1h

Index 60B2h	Name	Torque offset			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	RPDO	Related Mode	CSP/CSV/ CST	Data Range	-4000 to +4000 (0.1%)	Default	0

Defines the external torque feedforward signal of EtherCAT in CSV mode (active when 2006-0Ch is set to 2).

Index 6064h	Name	Position actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	-

Indicates the absolute position feedback (reference unit).
In case of an absolute encoder in rotary mode, 6064h indicates the single-turn position feedback (reference unit) of the mechanical load.

Index 606Ch	Name	Velocity actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	-

Indicates the speed feedback value (reference unit/s).

Index 6077h	Name	Torque actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	-

Indicates the internal torque feedback of the servo drive (unit: 0.1%).
The value 100.0% corresponds to the rated torque of the motor.

Index 60FFh	Name	Target velocity			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int32
	Access	RPDO	Mapping	Yes	Related Mode	PV/CSV	Data Range	-2^{31} to $+(2^{31} - 1)$	Default	0

Defines the target velocity in PV and CSV modes.
The maximum operating speed of the motor in CSV mode is determined by the maximum motor speed.

2.5.5 Related Function Settings

Velocity reference polarity

You can change the speed reference direction through setting the speed reference polarity.

☆ Related parameter:

<table>
<tr><td rowspan="2">Index 607Eh</td><td>Name</td><td colspan="3">Polarity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 255</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the polarity of position, speed, and torque references.</td></tr>
</table>

bit	Description
6	Speed reference polarity 0: Multiply by 1 1: Multiply by -1 PT: Inverts the target torque (6071h). CSP: Inverts the velocity offset (60B1h) CSV: Inverts the speed reference (60FFh + 60B1h).

2.6 Cyclic Synchronous Torque (CST) Mode

In CST mode, the host controller sends the target torque to the servo drive synchronously and cyclically, and the servo drive executes torque control.

2.6.1 Configuration Block Diagram

CST mode (0x6060 = 10)

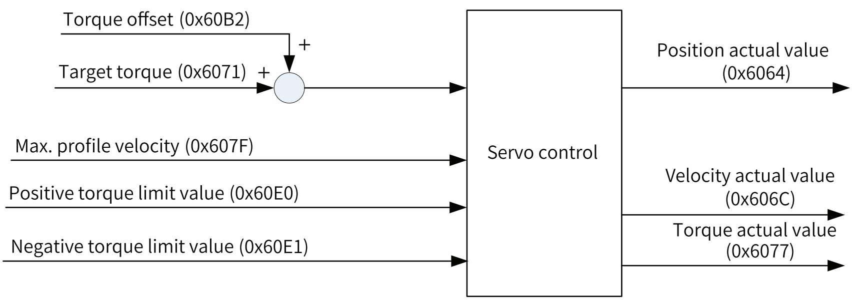


Figure 2-5 CST mode

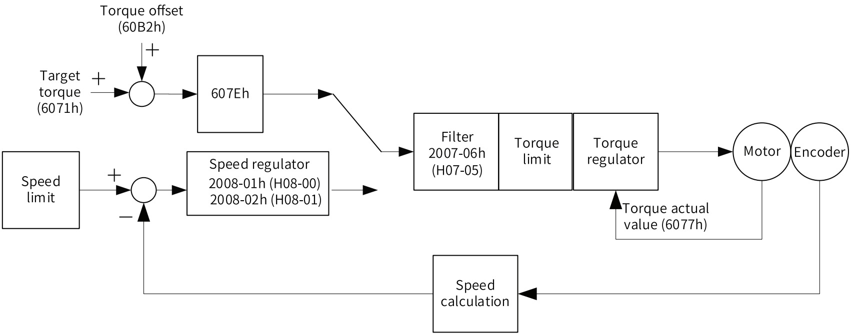
2.6.2 Recommended Configuration

The basic configuration of CST mode is shown in the following table.

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
6071: Target torque	-	Mandatory
-	6064: Position actual value	Optional
-	606C: Velocity actual value	Optional

RPDO	TPDO	Remarks
-	6077: Torque actual value	Optional
6060: Modes of operation	6061: Modes of operation display	Optional

2.6.3 Function Block Diagram



2.6.4 Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040	00	Control word	RW	Uint16	-	0 to 65535	0
6041	00	Status word	RO	Uint16	-	-	-
6060	00	Modes of operation	RW	Int8	-	0 to 10	0
6061	00	Modes of operation display	RO	Int8	-	-	-
6071	00	Target torque	RW	Int16	0.1%	-4000 to +4000	0
6072	00	Max. torque	RW	Uint16	0.1%	0 to 4000	3500
6074	00	Torque demand value	RO	Int16	0.1%	-	0
6077	00	Torque actual value	RO	Int16	0.1%	-	0
607E	00	Polarity	RW	Int8	-	0 to 255	0
607F	00	Max. profile velocity	RW	Int32	Reference unit/s	0 to (2^{32} - 1)	104857600
60B2	00	Torque offset	RW	Int16	0.1%	-4000 to +4000	0

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
60E0	00	Positive torque limit value	RW	Uint16	0.1%	0 to 4000	3500
60E1	00	Negative torque limit value	RW	Uint16	0.1%	0 to 4000	3500

Description of related parameters

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the control command.</td></tr>
</table>

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive

<table>
<tr><td rowspan="2">Index 6041h</td><td>Name</td><td colspan="3">Status word</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the servo drive status.</td></tr>
</table>

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	Not supported, always being 1
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follow the command value	Not supported, always being 1
13	N/A	N/A
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

<table>
<tr><td rowspan="2">Index 6071h</td><td>Name</td><td colspan="3">Target torque</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PT/CST</td><td>Data Range</td><td>-4000 to +4000 (0.1%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the target torque in PT and CST modes.
The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6074h</td><td>Name</td><td colspan="3">Torque demand value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>- (0.1%)</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the torque reference output value during operation.
The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

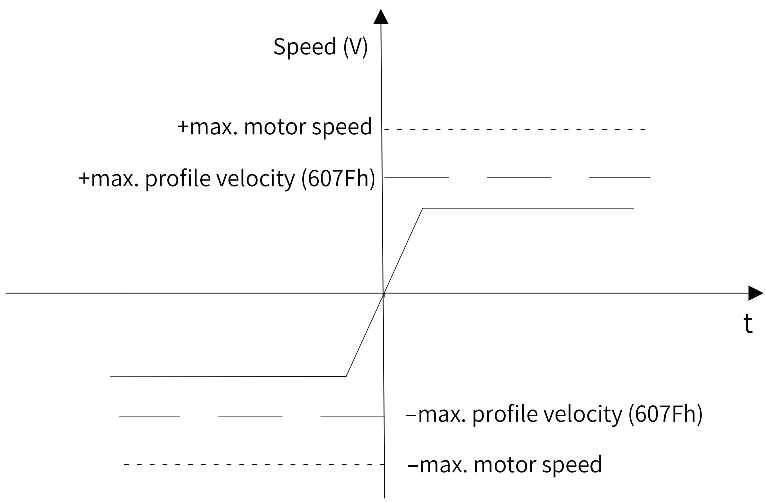
Index 6077h	Name	Torque actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	- (0.1%)	Default	-
Indicates the actual torque output of the servo drive. The value 100.0% corresponds to the rated torque of the motor.										

Index 60B2h	Name	Torque offset			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	RPDO	Related Mode	CSP/CSV/ CST	Data Range	-4000 to +4000 (0.1%)	Default	0
Defines the torque reference offset in CST, CSV, and CSP modes. After offset, the following formula applies: Target torque = 6071h + 60B2h										

2.6.5 Related Function Settings

Speed limit in the torque control mode

In the torque mode, 607Fh can be used to limit the maximum speed in forward/ reverse operation. Note that the maximum operating speed allowed by the motor cannot be exceeded.

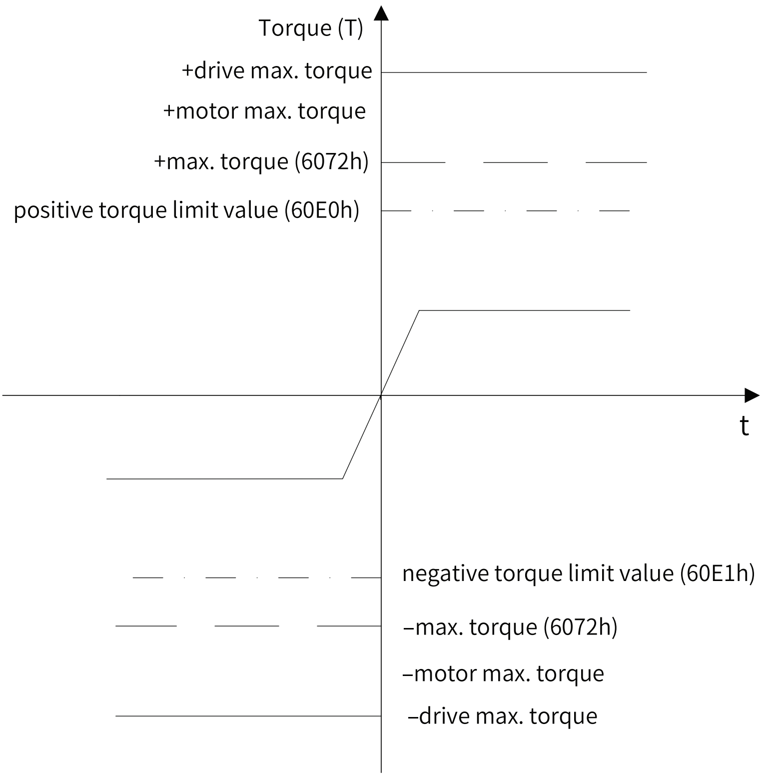


☆ Related parameter:

Index 607Fh	Name	Max. profile velocity			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/PV/PT/HM/CST	Data Range	0 to (2^{32} - 1) (reference unit/s)	Default	104857600
Defines the speed limit in PP, PV, PT, CST, and HM modes.										

Torque limit

To protect the mechanical devices, you can limit the torque references of the servo drive in the position control, speed control, and torque control modes by setting 6072h (Max torque), 60E0h (Positive torque limit value), and 60E1h (Negative torque limit value). Note that the maximum torque allowed by the servo drive cannot be exceeded.



☆ Related parameters:

<table>
<tr><td rowspan="2">Index 6072h</td><td>Name</td><td colspan="3">Max. torque</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 4000 (0.1%)</td><td>Default</td><td>3500</td></tr>
<tr><td colspan="11">Defines the maximum torque limit of the servo drive in the forward/reverse direction.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60E0h</td><td>Name</td><td colspan="3">Positive torque limit value</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 4000 (0.1%)</td><td>Default</td><td>3500</td></tr>
<tr><td colspan="11">Defines the maximum torque limit of the servo drive in the forward direction.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60E1h</td><td>Name</td><td colspan="3">Negative torque limit value</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 4000 (0.1%)</td><td>Default</td><td>3500</td></tr>
<tr><td colspan="11">Defines the maximum torque limit of the servo drive in the reverse direction.</td></tr>
</table>

Torque reference polarity

You can change the torque reference direction through setting the torque reference polarity.

<table>
<tr><td rowspan="2">Index 607Eh</td><td>Name</td><td colspan="3">Polarity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 255</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the polarity of position, speed, and torque references.</td></tr>
</table>

bit	Description
5	Torque reference polarity 0: Multiply by 1 1: Multiply by -1 PT: Inverts the target torque (6071h). CSP/CSV: Inverts the torque offset (60B2h) CST: Inverts the torque reference (6071h + 60B2h).

2.7 Profile Position (PP) Mode

The PP mode mainly applies to point-to-point positioning. In PP mode, the host controller sets the target position, operating speed, acceleration rate, and deceleration rate. The position profile generator inside the servo drive generates position profiles based on preceding settings, and the servo drive executes position control, speed control, and torque control.

2.7.1 Configuration Block Diagram

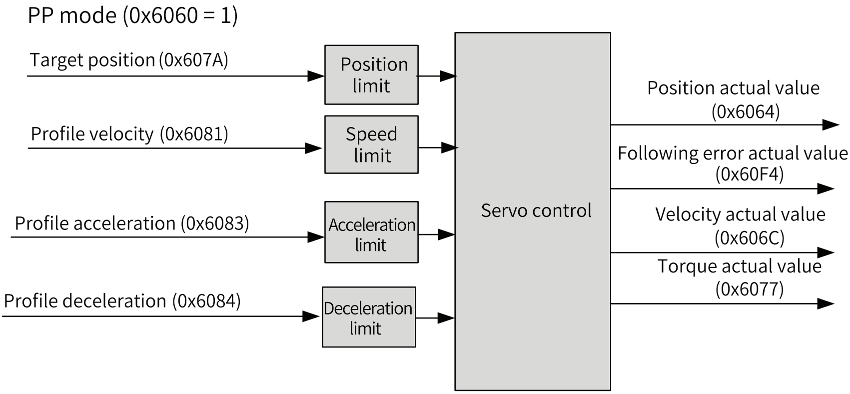


Figure 2-6 PP mode

In PP mode, the target position is triggered and activated based on the sequence of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word .

The controller sets the New set-point bit (bit4 of the control word) to 1 to inform the servo drive of the new target position. The servo drive, after receiving the new target position, sets the Set-point acknowledge bit (bit12 of the status word) to 1. After the controller sets bit4 (New set-point) to 0, if the servo drive can receive the new target position, bit12 (Set-point acknowledge) bit will be set to 0. Otherwise, it is kept to 1.

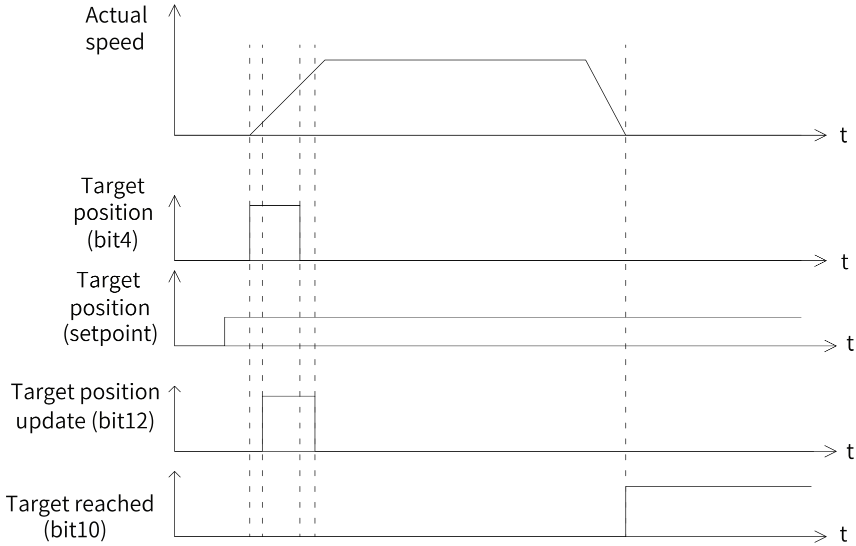


Figure 2-7 Sequence in sequential mode

The linkage mode of position references is determined by bit5 (Change set immediately) of the control word. When bit5 is set to 1 (Sequential mode), sequential linkage applies to position references, which is called sequential mode. When bit5 is set to 0 (Single-point mode), zero-cross linkage applies to position references, which is called single-point mode.

Sequential mode:

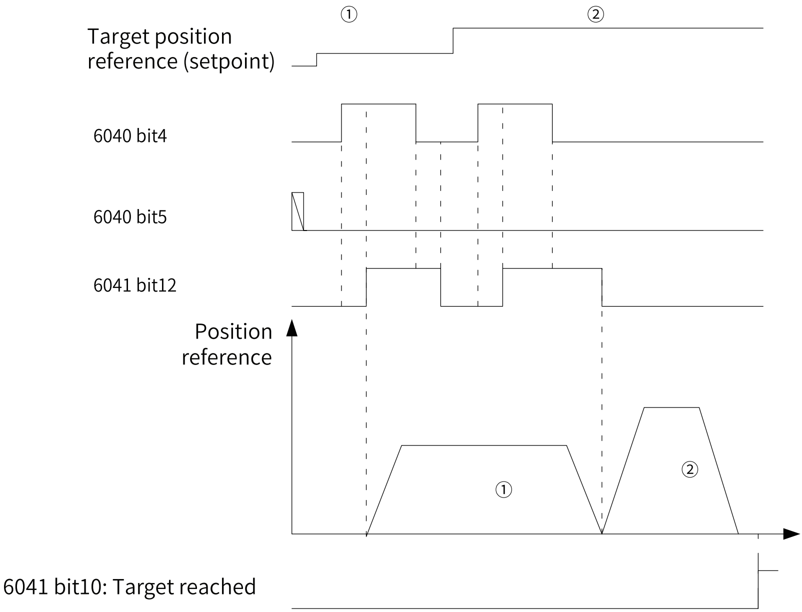
The target position of present segment is in the process of positioning. After the new target position is generated, the controller sets the New set-point bit to 1, and the servo drive performs positioning towards the new target position.

In sequential mode, the sequence diagram of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word is shown in the following figure.

Single-point mode:

The target position of current segment is in the process of positioning. After the new target position is generated, the controller sets the New set-point bit to 1, and the servo drive performs positioning towards the new target position after the position reference of current segment is done transmitting.

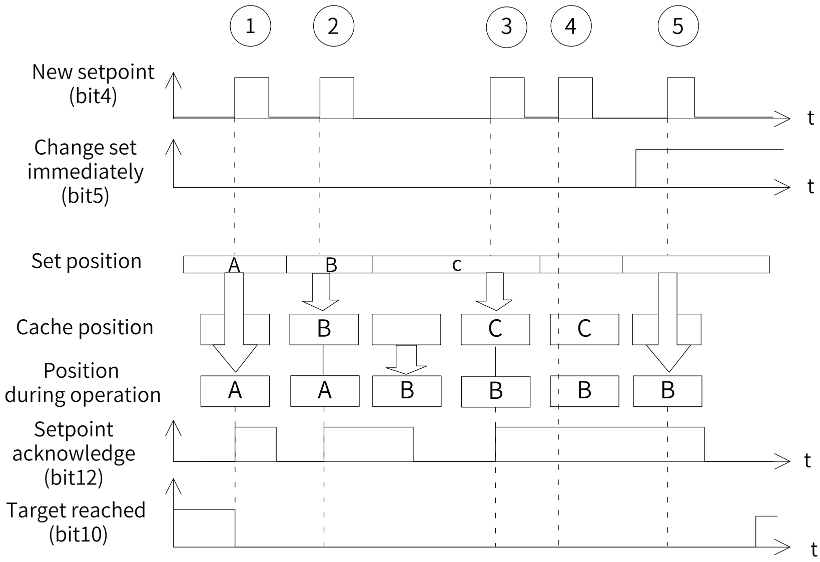
The sequence diagram of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word is shown in the following figure.



Note: To modify the target position reference (setpoint), the new target position bit (bit4) must be sent again.

Figure 2-8 Sequence in the single-point mode

In the single-point mode, the servo drive caches one target position, which is to cache a new segment of target position when current target position is under execution. The sequence diagram is as follows.



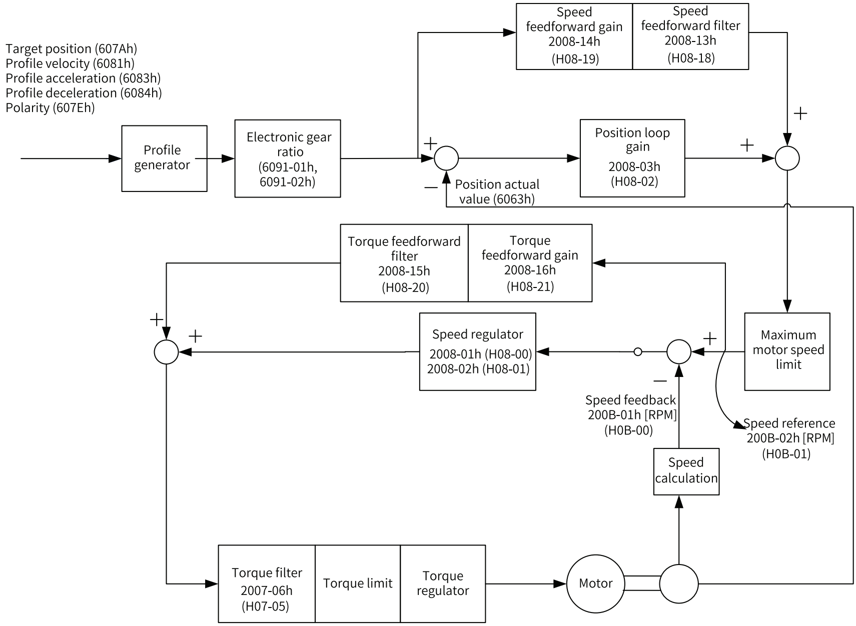
- ① If the cache position is empty, the set position will be executed immediately.
- ②③ If a position reference is under execution currently, the new position setpoint will be saved in the cache. After current position reference is done transmitting, the cached setpoint will be executed, after which a new setpoint can be received.
- ④⑤ The new setpoint cannot be received if the cache is full. In this case, you can set the attribute bit (Change set immediately) of the setpoint to 1 to activate the setpoint.

2.7.2 Recommended Configuration

The basic configuration for PP mode is shown in the following table.

RPDO	TPDO	Remarks
6040h: Control word	6041h: Status word	Mandatory
607Ah: Target position	6064h: Position actual value	Mandatory
6081h: Profile velocity	-	Mandatory
6083h: Profile acceleration	-	Optional
6084h: Profile deceleration	-	Optional
6060h: Modes of operation	6061h: Modes of operation display	Optional

2.7.3 Function Block Diagram



2.7.4 Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040	00	Control word	RW	Uint16	-	0 to 65535	0
6041	00	Status word	RO	Uint16	-	-	-
6060	00	Modes of operation	RW	Int8	-	0 to 10	0
6061	00	Modes of operation display	RO	Int8	-	-	-
6064	00	Position actual value	RO	Int32	Reference unit	-	-
6065	00	Following error window	RW	Uint32	Reference unit	0 to (2^{32} - 1)	3145728
6066	00	Following error time out	RW	Uint16	ms	0 to 65535	0
6067	00	Position window	RW	Uint32	Reference unit	0 to (2^{32} - 1)	734

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6068	00	Position window time	RW	Uint16	ms	0 to 65535	0
607A	00	Target position	RW	Int32	Reference unit	-2 to (2^{31} - 1)	0
607E	00	Polarity	RW	Uint8	-	0 to 255	0
607F	00	Max. profile velocity	RW	Uint32	Reference unit/s	0 to (2^{32} - 1)	104857600
6081	00	Profile velocity	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	1747627
6083	00	Profile acceleration	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	1747626667
6084	00	Profile deceleration	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	1747626667

Description of related parameters

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
</table>

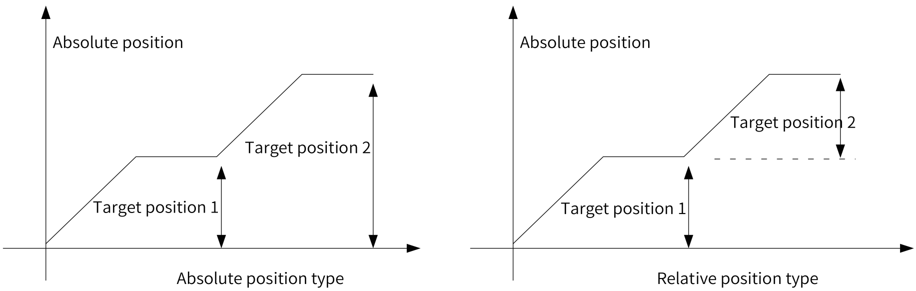
Defines the control command.

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
4	New set-point	0->1: Trigger new target position 1 -> 0: Clear bit12 of the status word
5	Change set immediately	0: Target set-point cannot be updated immediately 1: Target set-point can be updated immediately
6	abs/rel	0: Target position being absolute 1: Target position being relative
7	Halt	0: Keep present operating state 1: Halt

Index 6041h	Name	Status word			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	-

Indicates the servo drive status.

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	Not supported, always being 1
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Set-point acknowledge	0: Set-point can be updated 1: Set-point cannot be updated
13	Following error	0: EB00.0 (Excessive position deviation) not reported 1: EB00.0 (Excessive position deviation) reported
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

<table>
<tr><td rowspan="2">Index 607Ah</td><td>Name</td><td colspan="3">Target position</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/CSP</td><td>Data Range</td><td>-2^{31} to $(2^{31}$ - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the target position of the servo drive in PP and CSP modes.
The target position type (absolute or relative) can be designated through bit6 of 6040h in PP mode.

</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6081h</td><td>Name</td><td colspan="3">Profile velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP</td><td>Data Range</td><td>0 to $(2^{32}$ - 1) (reference unit/s)</td><td>Default</td><td>174762</td></tr>
<tr><td colspan="11">Defines the constant operating speed towards the target position in PP mode.
$$\text{Motor speed (RPM)} = \frac{\text{6081h x 6091h (Gear ratio)}}{\text{Encoder resolution}} \times 60$$</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6083h</td><td>Name</td><td colspan="3">Profile acceleration</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/PV</td><td>Data Range</td><td>0 to $(2^{32}$ - 1) (reference unit/s^2)</td><td>Default</td><td>174762666 7</td></tr>
<tr><td colspan="11">Defines the position reference acceleration in PP and PV modes.
In PP mode, if the value of 6083h exceeds that of 60C5h, the value of 60C5h will be used.
For 6083h, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

Index 6084h	Name	Profile deceleration			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/PV	Data Range	0 to (2^{32} - 1) (reference unit/s^2)	Default	17476266667
Defines the position reference deceleration in PP and PV modes. In PP mode, if the value of 6084h exceeds that of 60C6h, the value of 60C6h will be used. For 6084h, the setpoint 0 will be forcibly changed to 1.										

2.7.5 Related Function Settings

Monitoring on positioning completed

When position deviation fulfills the set condition, the positioning process is done. In this case, the servo drive sets bit10 of the status word, and the host controller, once receives the signal, acknowledges that positioning is done.

☆ Related parameter:

Index 6067h	Name	Position window			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP	Data Range	0 to (2^{32} - 1) (reference unit)	Default	734
Defines the threshold for position reach. When the position deviation is within ±6067h and the time reaches the value defined by 6068h, the position is reached and bit10 of 6041h is set to 1. This flag bit is valid only when the S-ON signal is active in the PP mode.										

Index 6068h	Name	Position window time			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PP	Data Range	0 to 65535 (ms)	Default	0
Defines the time window for position reach.										

Note

6067h only reflects the threshold of absolute position deviation when positioning is done. It is not related to the positioning accuracy.

Monitoring on position deviation

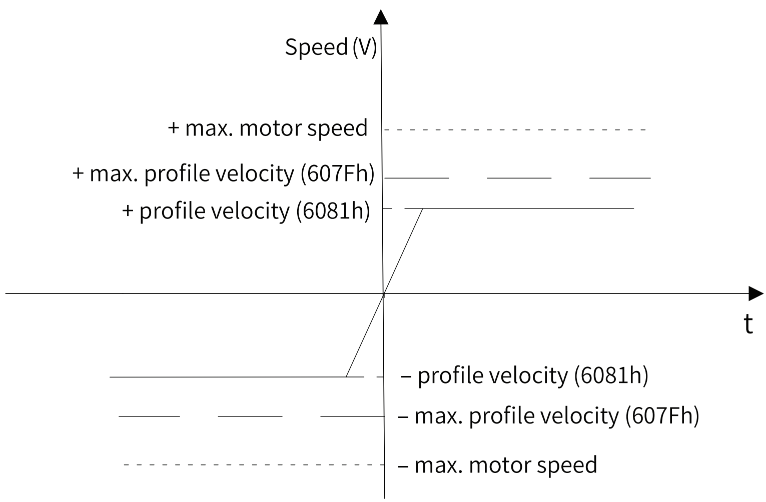
☆ Related parameter:

<table>
<tr><td rowspan="2">Index 6065h</td><td>Name</td><td colspan="3">Following error window</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit)</td><td>Default</td><td>3145728</td></tr>
<tr><td colspan="11">Defines the threshold of excessive position deviation (reference unit).
If 6065h is set to an excessively high value, the threshold of excessive position deviation will be forcibly set to 2147483647 (encoder unit).</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6066h</td><td>Name</td><td colspan="3">Following error time out</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to 65535 (ms)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the time (ms) lapse to trigger excessive position deviation (EB00.0).
If the position deviation exceeds the threshold of excessive position deviation and such status persists after the time defined by 6066h elapses, EB00.0 (Excessive position deviation) will be reported.</td></tr>
</table>

Speed limit

In PP mode, 607Fh can be used to limit the maximum speed in forward/reverse operation. Note that the maximum operating speed of the motor cannot be exceeded.



☆ Related parameter:

<table>
<tr><td rowspan="2">Index 607Fh</td><td>Name</td><td colspan="3">Max. profile velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/PV/PT/HM/CST</td><td>Data Range</td><td>0 to (2^{31} - 1) (reference unit/s)</td><td>Default</td><td>104857600</td></tr>
<tr><td colspan="11">Defines the speed limit in PP, PV, PT, CST, and HM modes.</td></tr>
</table>

Acceleration and deceleration limits

In PP mode, the change rate of position references can be limited through the acceleration and deceleration limits.

☆ Related parameters:

<table>
<tr><td rowspan="2">Index 60C5h</td><td>Name</td><td colspan="3">Max. acceleration</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s^2)</td><td>Default</td><td>2^{31} - 1</td></tr>
<tr><td colspan="11">Defines the maximum limit of acceleration.
In PP mode, if the value of 6083h exceeds that of 60C5h, the value of 60C5h will be used.
For 60C5h, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60C6h</td><td>Name</td><td colspan="3">Max. deceleration</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s^2)</td><td>Default</td><td>2^{31} - 1</td></tr>
<tr><td colspan="11">Defines the maximum limit of deceleration.
In PP mode, if the value of 6084h exceeds that of 60C6h, the value of 60C6h will be used.
For 60C6h, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

Polarity

You can change the position reference direction through setting the position reference polarity.

☆ Related parameter:

<table>
<tr><td rowspan="2">Index 607Eh</td><td>Name</td><td colspan="3">Polarity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 255</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the polarity of position, speed, and torque references.</td></tr>
</table>

bit	Description
7	Position reference polarity 0: Multiply by 1 1: Multiply by -1 PP: Inverts the target position (607Ah)

2.8 Profile Velocity (PV) Mode

In PV mode, the host controller sends the target speed, acceleration rate, and deceleration rate to the servo drive. The servo drive generates speed reference profiles and executes speed control and torque control.

2.8.1 Configuration Block Diagram

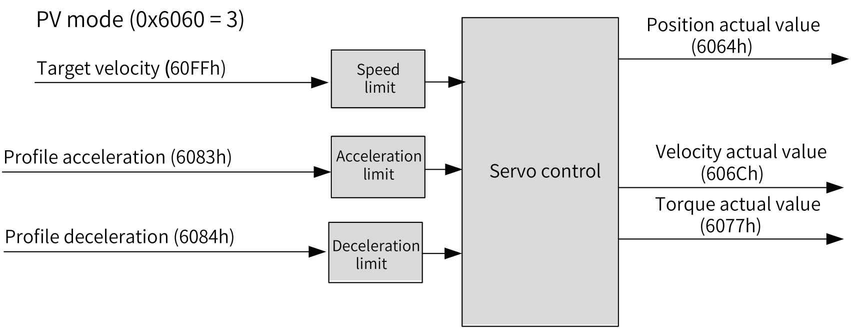


Figure 2-9 PV mode

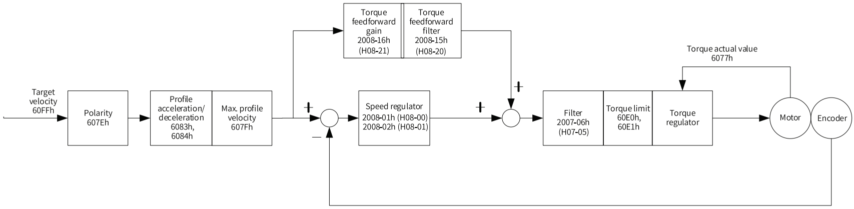
2.8.2 Recommended Configuration

The basic configuration for PV mode is shown in the following table.

RPDO	TPDO	Remarks
6040h: Control word	6041h: Status word	Mandatory
60FFh: Target velocity	-	Mandatory
-	6064h: Position actual value	Optional
-	606Ch: Velocity actual value	Optional
6083h: Profile acceleration	-	Optional

RPDO	TPDO	Remarks
6084h: Profile deceleration	-	Optional
6060h: Modes of operation	6061h: Modes of operation display	Optional

2.8.3 Function Block Diagram



2.8.4 Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040	00	Control word	RW	Uint16	-	0 to 65535	0
6041	00	Status word	RO	Uint16	-	-	-
6060	00	Modes of operation	RW	Int8	-	0 to 10	0
6061	00	Modes of operation display	RO	Int8	-	-	-
606C	00	Velocity actual value	RO	Int32	Reference unit/s	-	-
606D	00	Velocity window	RW	Uint16	RPM	0 to 65535	10
606E	00	Velocity window time	RW	Uint16	ms	0 to 65535	0
606F	00	Velocity threshold	RW	Uint16	RPM	0 to 65535	10
6070	00	Velocity threshold time	RW	Uint16	ms	0 to 65535	0
607E	00	Polarity	RW	Int8	-	0 to 255	0
607F	00	Max. profile velocity	RW	Int32	Reference unit/s	0 to (2^{32} - 1)	104857600
6083	00	Profile acceleration	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	1747626667

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6084	00	Profile deceleration	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	1747626667
60FF	00	Target velocity	RW	Int32	Reference unit/s	-2^{31} to +(2^{31} - 1)	0

Description of related parameters

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the control command.</td></tr>
</table>

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
8	Halt	0: Keep present operating state 1: Halt

<table>
<tr><td rowspan="2">Index 6041h</td><td>Name</td><td colspan="3">Status word</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the servo drive status.</td></tr>
</table>

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	0: Target velocity not reached 1: Target velocity reached
11	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12	Speed	0: Speed not being 0 1: Speed being 0
13	-	N/A
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

<table>
<tr><td rowspan="2">Index 60FFh</td><td>Name</td><td colspan="3">Target velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>PP/CSV</td><td>Data Range</td><td>-2^{31} to (2^{31} - 1) (reference unit/s)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the target velocity in PV and CSV modes.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6083h</td><td>Name</td><td colspan="3">Profile acceleration</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/PV</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s^2)</td><td>Default</td><td>17476266667</td></tr>
<tr><td colspan="11">Defines the speed reference acceleration in PV and PP modes.
For 6083h, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6084h</td><td>Name</td><td colspan="3">Profile deceleration</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/PV</td><td>Data Range</td><td>0 to (2^{31} - 1) (reference unit/s^2)</td><td>Default</td><td>17476266667</td></tr>
<tr><td colspan="11">Defines the speed reference deceleration in PV and PP modes.
For 6084h, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

2.8.5 Related Functions

Monitoring on speed reach

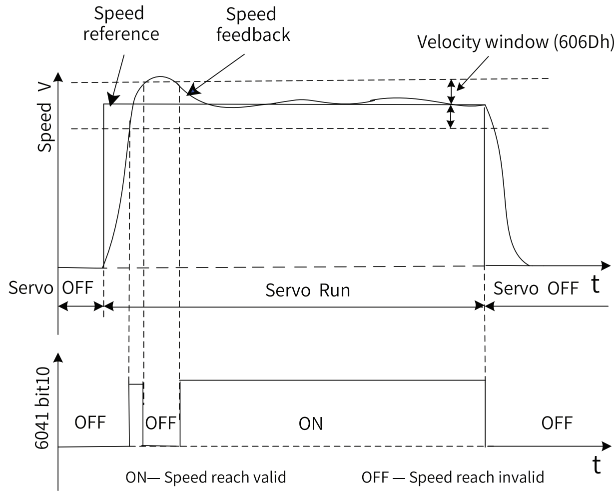
The servo drive checks whether the motor speed feedback is consistent with the speed reference.

☆ Related parameter:

<table>
<tr><td rowspan="2">Index 606Dh</td><td>Name</td><td colspan="3">Velocity window</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PV</td><td>Data Range</td><td>0 to 65535 (RPM)</td><td>Default</td><td>10</td></tr>
</table>

Index 606Eh	Name	Velocity window time			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PV	Data Range	0 to 65535 (ms)	Default	0

606Dh is used to set the threshold for speed reach. 606Eh is used to set the window time for speed reach.



When the difference between the speed reference and speed feedback is within ±606D and such status persists for the time defined by 606E, the speed is reached. In this case, bit10 (Target reached) of 6041h is set to 1.
This flag bit is valid only when the S-ON signal is active in PV mode.

Monitoring on zero speed

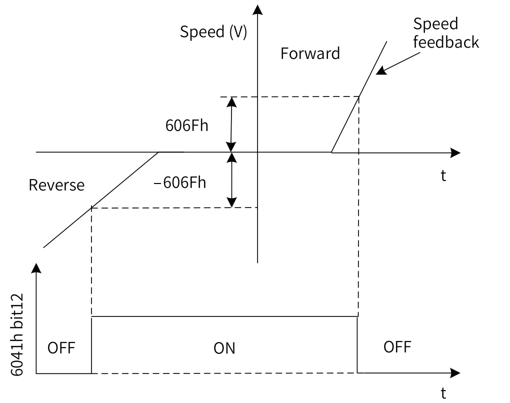
The servo drive checks whether the absolute value of motor speed feedback is lower than the set threshold. If yes, the motor is close to a standstill (zero speed) and bit12 of the status word is set to 1.

☆ Related parameter:

Index 606Fh	Name	Velocity threshold			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PV	Data Range	0 to 65535 (RPM)	Default	10

Index 6070h	Name	Velocity threshold time			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PV	Data Range	0 to 65535 (ms)	Default	0

Defines the threshold for zero speed.

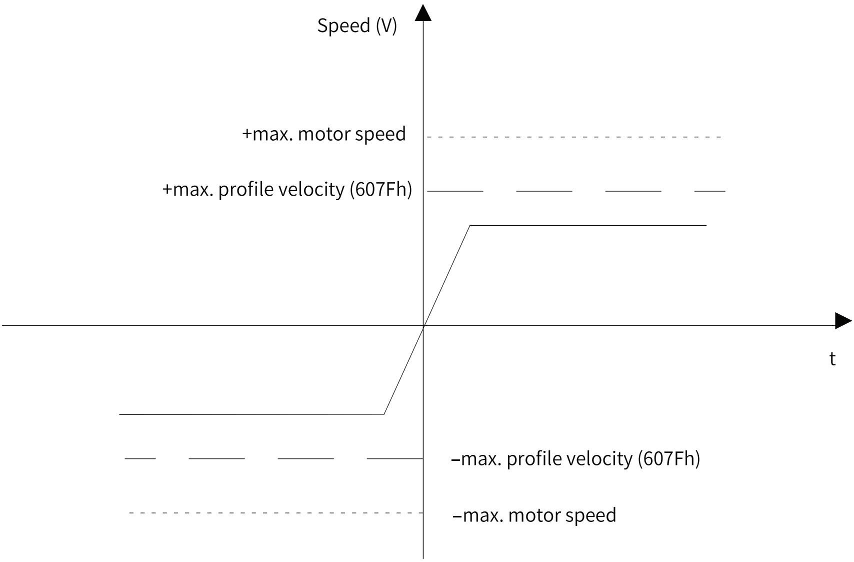


ON — Zero speed signal active OFF — Zero speed signal inactive

When the speed feedback is within ±606F and the time defined by 6070 elapses, the motor speed is acknowledged to be 0. In this case, bit12 of 6041 is set to 1.
This flag bit is valid only in PV mode.

Speed limit

In PV mode, 607Fh can be used to limit the maximum speed in the forward/reverse operation. Note that the maximum operating speed of the motor cannot be exceeded.



☆ Related parameter:

Index 607Fh	Name	Max. profile velocity			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/PV/PT/ HM/CST	Data Range	0 to (2^{32} - 1) (reference unit/s)	Default	104857600
Defines the speed limit in PP, PV, PT, CST, and HM modes.										

Acceleration and deceleration limits

In PV mode, the change rate of speed references can be limited through acceleration and deceleration limits.

Index 60C5h	Name	Max. acceleration			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to (2^{32} - 1) (reference unit/s^2)	Default	2^{31} - 1
Defines the maximum limit of acceleration. In PV mode, if the value of 6083h exceeds that of 60C5h, the value of 60C5h will be used. For 60C5h, the setpoint 0 will be forcibly changed to 1.										

<table>
<tr><td rowspan="2">Index 60C6h</td><td>Name</td><td colspan="3">Max. deceleration</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s^2)</td><td>Default</td><td>2^{31} - 1</td></tr>
<tr><td colspan="11">Defines the maximum limit of deceleration.
In PV mode, if the value of 6084h exceeds that of 60C6h, the value of 60C6h will be used.
For 60C6h, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

Reference polarity

You can change the speed reference direction through setting the speed reference polarity.

☆ Related parameter:

<table>
<tr><td rowspan="2">Index 607Eh</td><td>Name</td><td colspan="3">Polarity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 255</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the polarity of position, speed, and torque references.</td></tr>
</table>

bit	Description
6	Velocity reference polarity 0: Multiply by 1 1: Multiply by -1 PV: Inverts the target velocity (60FFh)

2.9 Profile Torque (PT) Mode

In PT mode, the host controller sends the target torque (6071h) and the torque slope (6087h) to the servo drive. The servo drive generates torque reference profiles and executes torque control.

2.9.1 Configuration Block Diagram

PT mode (0x6060 = 4)

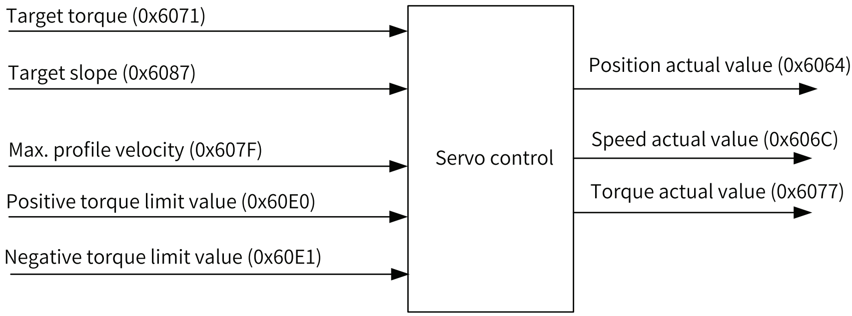


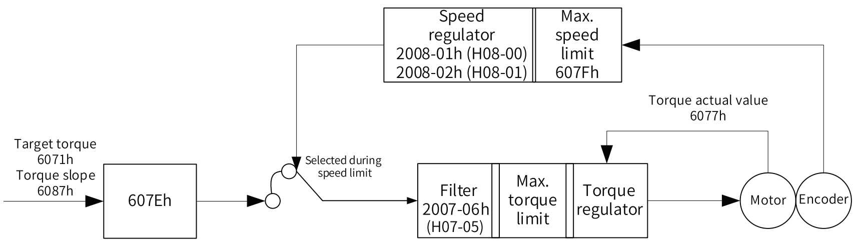
Figure 2-10 PT mode

2.9.2 Recommended Configuration

The basic configuration for the PT mode is described in the following table.

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
6071: Target torque	-	Mandatory
6087: Torque slope	-	Optional
-	6064: Position actual value	Optional
-	606C: Velocity actual value	Optional
-	6077: Torque actual value	Optional
6060: Modes of operation	6061: Modes of operation display	Optional

2.9.3 Function Block Diagram



2.9.4 Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040h	00	Control word	RW	Uint16	-	0 to 65535	0
6041h	00	Status word	RO	Uint16	-	-	-
6060h	00	Modes of operation	RW	Int8	-	0 to 10	0
6061h	00	Modes of operation display	RO	Int8	-	-	-
6071h	00	Target torque	RW	Int16	0.1%	-4000 to +4000	0
6072h	00	Max. torque	RW	Uint16	0.1%	0 to 4000	3500
6074h	00	Torque demand value	RO	Int16	0.1%	-	-
6077h	00	Torque actual value	RO	Int16	0.1%	-	-
6087h	00	Torque slope	RW	Uint32	0.1%/s	0 to 2^{32} - 1	2^{32} - 1
607Eh	00	Polarity	RW	Int8	-	0 to 255	0
607Fh	00	Max. profile velocity	RW	Int32	Reference unit/s	0 to (2^{32} - 1)	104857600
60E0h	00	Positive torque limit value	RW	Uint16	0.1%	0 to 4000	3500
60E1h	00	Negative torque limit value	RW	Uint16	0.1%	0 to 4000	3500
2007h	16	Base value for torque reach	RW	Uint16	%	0 to 400.0	0
2007h	17	Threshold of valid torque reach	RW	Uint16	%	0 to 400.0	20
2007h	18	Threshold of invalid torque reach	RW	Uint16	%	0 to 400.0	10

Description of related parameters

Index 6040h	Name	Control word			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 65535	Default	0

Defines the control command.

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
8	Halt	0: Keep present operating state 1: Halt

Index 6041h	Name	Status word			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	0

Indicates the servo drive status.

bit	Name	Description
0	Servo ready	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	0: Target velocity not reached 1: Target velocity reached
11	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12 to 14	N/A	No assignment, always being 0
15	Home found	0: Home not found 1: Home found

Index 6071h	Name	Target torque			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	RPDO	Related Mode	PT/CST	Data Range	-4000 to +4000 (0.1%)	Default	0
Defines the target torque in PT and CST modes. The value 100.0% corresponds to the rated torque of the motor.										

Index 6074h	Name	Torque demand value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	- (0.1%)	Default	-
Indicates the torque reference output value during operation. The value 100.0% corresponds to the rated torque of the motor.										

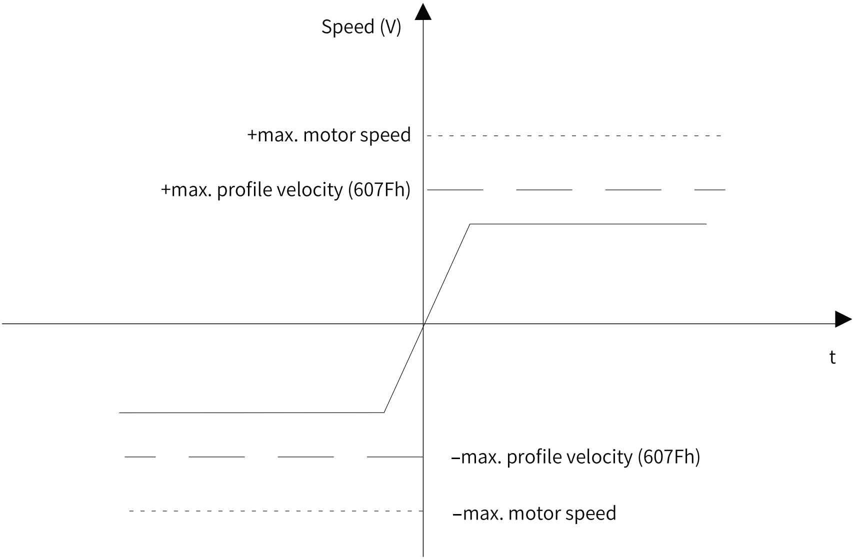
Index 6077h	Name	Torque actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	- (0.1%)	Default	-
Indicates the actual torque output of the servo drive. The value 100.0% corresponds to the rated torque of the motor.										

Index 6087h	Name	Torque slope			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PT/CST	Data Range	0 to 2^{32} - 1 (0.1%/s)	Default	2^{32} - 1
Defines the acceleration rate (torque reference increment per second) of the torque reference in PT and CST modes. For 6087h, the setpoint 0 will be forcibly changed to 1.										

2.9.5 Related Function Settings

Speed limit in the torque control mode

In the torque control mode, 607Fh can be used to limit the maximum speed in forward/reverse operation. Note that the maximum operating speed of the motor cannot be exceeded.

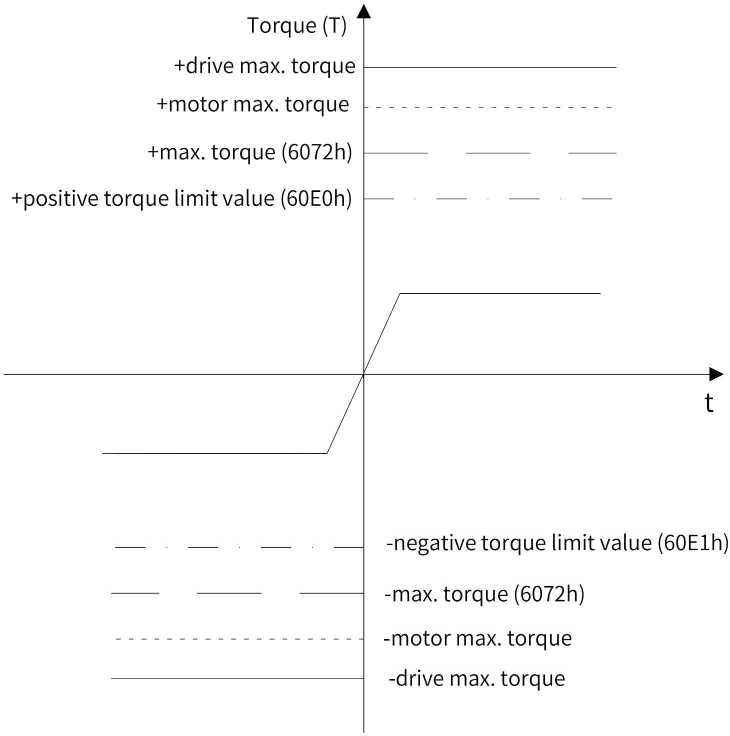


☆ Related parameter:

Index 607Fh	Name	Max. profile velocity			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int32
	Access	RW	Mapping	RPDO	Related Mode	PP/PV/PT/ HM/CST	Data Range	0 to (2^{32} - 1) (reference unit/s)	Default	104857600
Defines the speed limit in PP, PV, PT, CST, and HM modes.										

Torque limit

To protect the mechanical devices, you can limit torque references of the servo drive in the position control, speed control, and torque control modes by setting 6072h (Max. torque), 60E0h (Positive torque limit value), and 60E1h (Negative torque limit value). Note that the maximum torque allowed by the servo drive cannot be exceeded.



☆ Related parameter:

Index 6072h	Name	Max. torque			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 4000 (0.1%/s)	Default	3500
Defines the maximum torque limit of the servo drive in the forward/reverse direction.										

Index 60E0h	Name	Positive torque limit value			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 4000 (0.1%/s)	Default	3500
Defines the maximum torque limit of the servo drive in the forward direction.										

Index 60E1h	Name	Negative torque limit value			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 4000 (0.1%/s)	Default	3500
Defines the maximum torque limit of the servo drive in the reverse direction.										

Torque reference polarity

You can change the torque reference direction through setting the torque reference polarity.

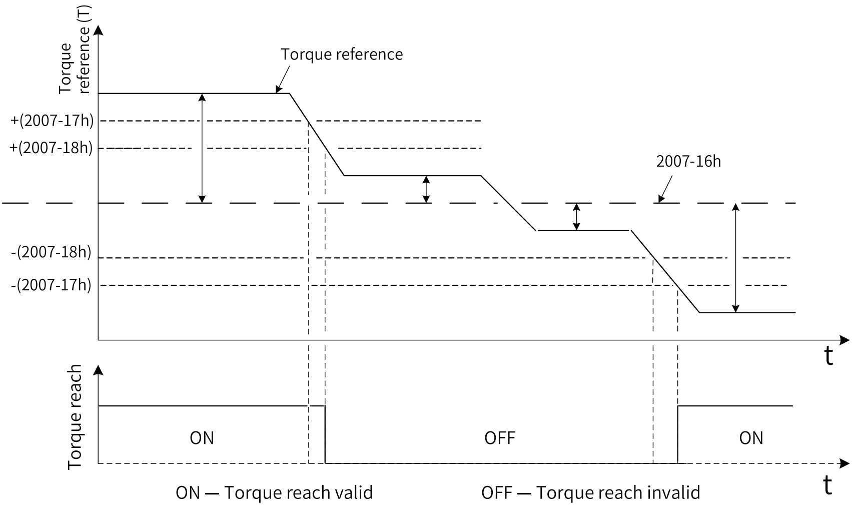
☆ Related parameter:

Index 607Eh	Name	Polarity			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Int8
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 255	Default	0
Defines the polarity of position, speed, and torque references.										

bit	Description
5	Torque reference polarity: 0: Multiply by 1 1: Multiply by -1 CSP/CSV: Inverts the torque offset (60B2h) CST: Inverts the torque reference (6071h + 60B2h).

Monitoring on torque reach

The servo drive checks whether the torque reference reaches the base value. If yes, a corresponding torque reach signal will be outputted to the host controller.



If the absolute difference between the torque reference and 2007-16h (Base value for torque reach) is higher than 2007-17h (Threshold of valid torque reach), the torque reach signal is valid. Otherwise, the original status stays unchanged.

If the absolute difference between the torque reference and 2007-16h (Base value for torque reach) is lower than 2007-18h (Threshold of invalid torque reach), the torque reach signal is invalid. Otherwise, the original status stays unchanged.

☆ Related parameters:

Sub-index 16h	Name	Base value for torque reach			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PT	Data Range	0.0 to 400.0 (%)	Default	0

Sub-index 17h	Name	Threshold of valid torque reach			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PT	Data Range	0.0 to 400.0 (%)	Default	20.0

Sub-index 18h	Name	Threshold of invalid torque reach			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PT	Data Range	0.0 to 400.0 (%)	Default	10.0

2.10 Homing Mode (HM)

The homing mode is used to search for the mechanical home and determine the position relation between the mechanical home and mechanical zero.

- Mechanical home: a fixed position on the machine, which corresponds to a certain home switch or the motor Z signal.
- Mechanical zero: absolute zero point on the machine

After homing is done, the motor stops at the mechanical home. The relation between the mechanical home and mechanical zero can be set in 607Ch.

Mechanical home = Mechanical zero + 607Ch (Home offset)

When 607Ch = 0, the mechanical home coincide with the mechanical zero.

2.10.1Configuration Block Diagram

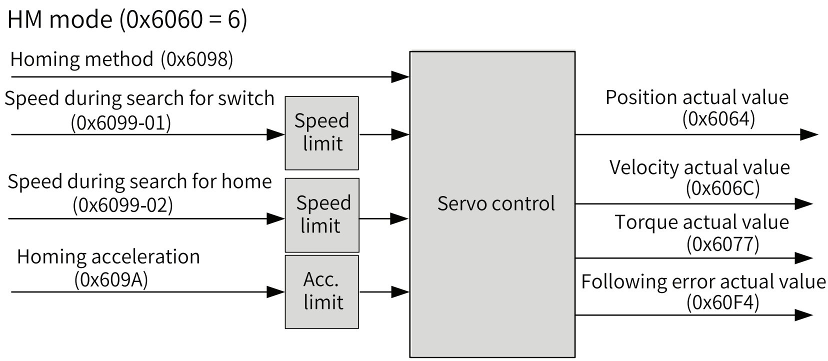


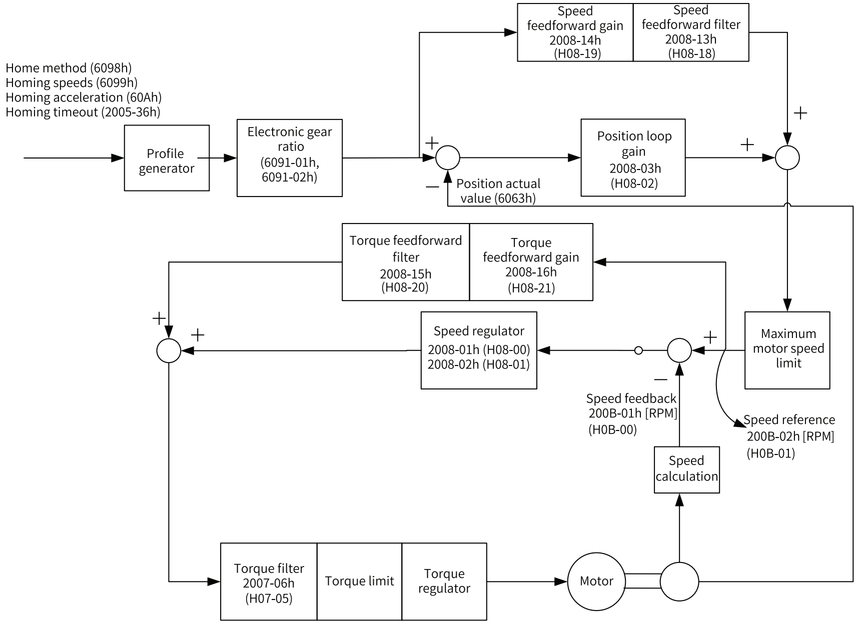
Figure 2-11 HM mode

2.10.2Recommended Configuration

The basic configuration for the homing mode is shown in the following table.

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
6098: Homing method	-	Optional
6099-01: Speed during search for switch	-	Optional
6099-02: Speed during search for zero	-	Optional
609A: Homing acceleration	-	Optional
-	6064: Position actual value	Optional
6060: Modes of operation	6061: Modes of operation display	Optional

2.10.3Function Block Diagram



2.10.4Related Parameters

List of related parameters

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
6040h	00	Control word	RW	Uint16	-	0 to 65535	0
6041h	00	Status word	RO	Uint16	-	-	-
6060h	00	Modes of operation	RW	Int8	-	0 to 10	0
6061h	00	Modes of operation display	RO	Int8	-	-	-
6064h	00	Position actual value	RO	Int32	Reference unit	-	-
6065h	00	Following error window	RW	Uint32	Reference unit	0 to (2^{32} - 1)	3145728
6066h	00	Following error time out	RW	Uint16	ms	0 to 65535 (ms)	0
607Ch	00	Home offset	RW	Int32	Reference unit	-2^{31} to +(2^{31} - 1)	0

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
607Fh	00	Max. profile velocity	RW	Int32	Reference unit/s	0 to (2^{32} - 1)	104857600
6098h	00	Homing method	RW	Int8	-	1 to 35	1
6099h	01	Speed during search for switch	RW	Uint32	Reference unit/s	0 to (2^{32} - 1)	1747627
	02	Speed during search for zero	RW	Uint32	Reference unit/s	10 to (2^{32} - 1)	174763
609Ah	00	Homing acceleration	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	1747626667
60E6h	00	Actual position calculation method	RW	Uint8	-	0 to 1	0
60C5h	00	Max. acceleration	RW	Uint32	Reference unit/s^2	0 to (2^{32} - 1)	2^{31} - 1
2005h	24	Homing time limit	RW	Uint16	s	0 to 6553.5	5000.0

List of related parameters

<table>
<tr><td rowspan="2">Index 6040h</td><td>Name</td><td colspan="3">Control word</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
</table>

Defines the control command.

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
8	Halt	0: Keep present operating state 1: Halt

<table>
<tr><td rowspan="2">Index 6041h</td><td>Name</td><td colspan="3">Status word</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
</table>

Indicates the servo drive status.

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	1: Home located or homing interrupted
12	Homing attained	0: Home signal not found 1: Home signal found
13	Homing error	0: Homing error not occurred 1: Homing error occurred
15	Home found	0: Home not found 1: Home found

Index 6098h	Name	Homing method			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Int8
	Access	RW	Mapping	RPDO	Related Mode	HM	Data Range	-2 to +35	Default	0

Indicates the servo drive status.

Value	Description
-2	Forward, positive mechanical limit as deceleration point and Z signal as home
-1	Reverse, negative mechanical limit as deceleration point and Z signal as home
1	Reverse, negative limit switch as deceleration point and Z signal as home, falling edge of the negative limit switch signal must be reached before Z signal
2	Forward, positive limit switch as deceleration point and Z signal as home, falling edge of positive limit switch signal must be reached before Z signal
3	Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
4	Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
5	Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
6	Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
7	Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
8	Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
9	Forward, home switch as deceleration point and Z signal as home, rising edge on the other side of the home switch signal must be reached before Z signal
10	Forward, home switch as deceleration point and Z signal as home, falling edge on the other side of the home switch signal must be reached before Z signal
11	Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
12	Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
13	Reverse, home switch as deceleration point and Z signal on the other side of the home switch signal as home, rising edge on the other side of the home switch signal must be reached before Z signal
14	Reverse, home switch as deceleration point and Z signal on the other side of the home switch signal as home, falling edge on the other side of the home switch signal must be reached before Z signal
15 to 16	N/A
17 to 32	Similar to setpoints 1...14 except that the deceleration point coincide with the home
33	Reverse, Z signal as home
34	Forward, Z signal as home
35	Current position as home

Index 6099h	Name	Homing speeds			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint32
	Access	-	Mapping	Yes	Related Mode	HM	Data Range	OD Data Range	Default	OD Default Value
Defines the two speed values used in the homing mode. 1) Speed during search for switch 2) Speed during search for zero										

Sub-index 0h	Name	Highest sub-index supported			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-

Sub-index 1h	Name	Speed during search for switch			Setting Condition & Effective Time	During running & At stop	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	HM	Data Range	0 to (2^{32} - 1) (reference unit/s)	Default	1747627
Defines the speed in searching for the deceleration point signal. A high setpoint prevents occurrence of E601.0 (Homing timeout). Note: After finding the deceleration point, the slave decelerates and blocks the change of the home signal during deceleration. To prevent the slave from encountering the home signal during deceleration, set the switch position of the deceleration point signal properly to leave sufficient deceleration distance or increase the homing acceleration rate to shorten the deceleration time.										

Sub-index 2h	Name	Speed during search for zero			Setting Condition & Effective Time	During running & At stop	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	HM	Data Range	10 to (2^{32} - 1) (reference unit/s)	Default	174763
Defines the speed in searching for the home signal. Set this sub-index to a low value to avoid overshoot during stop at high speed, preventing excessive deviation between the stop position and the preset mechanical home.										

<table>
<tr><td rowspan="2">Index 609A</td><td>Name</td><td colspan="3">Homing acceleration</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s^2)</td><td>Default</td><td>100</td></tr>
<tr><td colspan="11">Defines the acceleration rate in HM mode.
The setpoint is activated after homing is started.
In HM mode, if 605Dh (Stop option code) is set to 2, the servo drive decelerates to stop as defined by 609Ah.
609A indicates the position reference (reference unit) increment per second. For 609A, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

2.10.5Related Function Settings

Homing timeout

When the homing duration exceeds the value defined by 2005-24h (H05–35), the servo drive reports E601.0 (Homing timeout).

E601.0 can be used to determine whether the homing speed and acceleration setpoint are proper and whether the deceleration point signal and home signal are connected properly.

☆ Related parameter:

<table>
<tr><td rowspan="2">Index 2005-24h</td><td>Name</td><td colspan="3">Homing time limit</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>0 to 6553.5</td><td>Default</td><td>5000.0</td></tr>
<tr><td colspan="11">Defines the duration of homing and used to detect E601.0 (Homing timeout).</td></tr>
</table>

Actual position calculation method

After homing, the calculation method for current mechanical position can be set in 60E6h.

<table>
<tr><td rowspan="2">Index 60E6h</td><td>Name</td><td colspan="3">Actual position calculation method</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the method for calculating the mechanical position after homing is done.
<table><tr><th>Setpoint</th><th>Actual position calculation method</th></tr><tr><td>0</td><td>Absolute homing
After homing is done, the following formula applies:
6064h (Position actual value) = 607Ch (Home offset)</td></tr><tr><td>1</td><td>Relative homing
After homing is done, the following formula applies:
6064h (Position actual value) = Current position feedback + 607Ch (Home offset)</td></tr></table>
After homing is triggered, changes in 60E6h will be blocked.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 607Ch</td><td>Name</td><td colspan="3">Home offset</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>-2^{31} to (2^{31} - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the physical distance between the mechanical zero and the motor home in HM mode.
The home offset is activated only after homing is done upon power-on and bit15 of 6041h is set to 1.
Home offset is used in the following cases:
● Determine current position according to 60E6h after homing is done.
● If 607Ch is set to a value outside 607Dh (Software position limit), EE09.1 (Home setting error) will occur.</td></tr>
</table>

Monitoring on position deviation

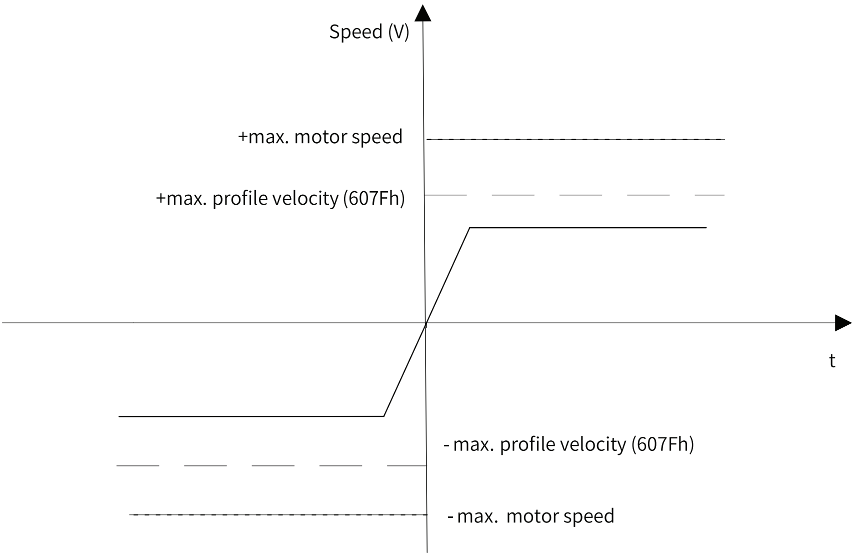
☆ Related parameters:

<table>
<tr><td rowspan="2">Index 6065h</td><td>Name</td><td colspan="3">Following error window</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit)</td><td>Default</td><td>3145728</td></tr>
<tr><td colspan="11">Defines the threshold of excessive position deviation (reference unit).
For 6065h, setpoints beyond 2147483647 will be forcibly changed to 2147483647.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6066h</td><td>Name</td><td colspan="3">Following error time out</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to 65535 (ms)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the time lapse to trigger excessive position deviation (EB00.0).
When the position deviation (reference unit) exceeds ±6065h and such status persists after the time defined by 6066h elapses, EB00.0 (Excessive position deviation) will occur.</td></tr>
</table>

Speed limit

In HM mode, 607Fh can be used to limit the maximum speed in forward/reverse operation. Note that the maximum operating speed of the motor cannot be exceeded.



☆ Related parameter:

<table>
<tr><td rowspan="2">Index 607Fh</td><td>Name</td><td colspan="3">Max. profile velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/PV/PT/HM/CST</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s)</td><td>Default</td><td>104857600</td></tr>
<tr><td colspan="11">Defines the speed limit in PP, PV, PT, CST, and HM modes.</td></tr>
</table>

Acceleration limit

In the homing mode, the change rate of position references can be limited through the acceleration limit.

☆ Related parameter:

Index 60C5h	Name	Max. acceleration			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to (2^{32} - 1) (reference unit/s^2)	Default	2^{31} - 1
Defines the maximum limit of acceleration. In HM mode, if the value of 609Ah exceeds that of 60C5h, the value of 60C5h will be used. For 60C5h, the setpoint 0 will be forcibly changed to 1.										

2.10.6Introduction to the Homing Modes

6098h = 1

Mechanical home: Z signal

Deceleration point: negative limit switch (N-OT)

- N-OT signal inactive at start

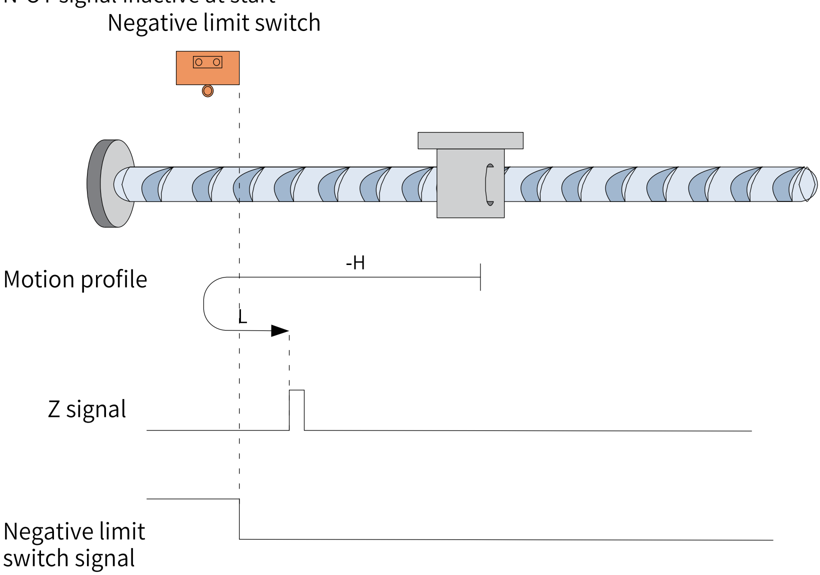


Figure 2-12 N-OT signal inactive at start

Note

Note: In the figure, "H" represents 6099-01h (Speed during search for switch), and "L" represents 6099-02h (Speed during search for zero).

The N-OT signal is inactive at start, and the motor starts homing in the reverse direction at high speed. After reaching the rising edge of the N-OT signal, the motor decelerates and changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the falling edge of the N-OT signal.

- N-OT signal active at start

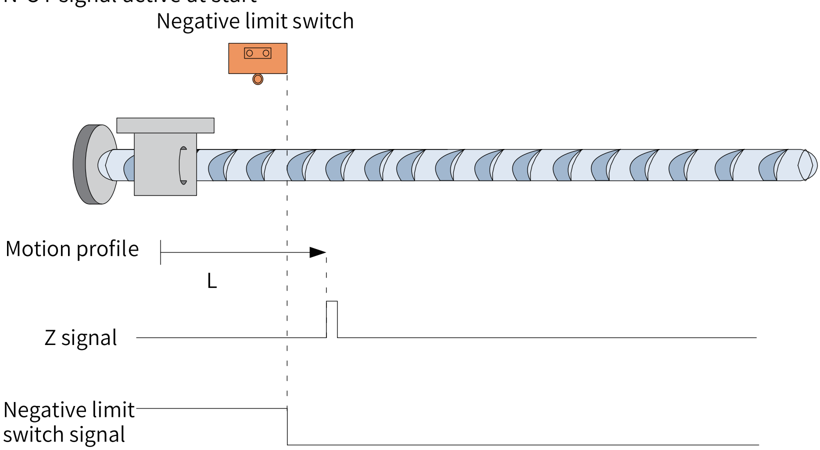


Figure 2-13 N-OT signal active at start

The N-OT signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the N-OT signal, the motor stops at the first Z signal.

6098h = 2

Home: Z signal

Deceleration point: positive limit switch (P-OT)

- P-OT signal inactive at start

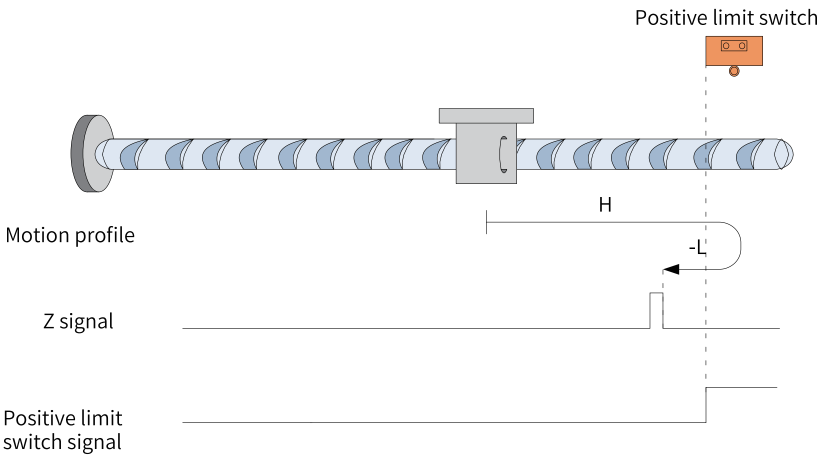


Figure 2-14 P-OT signal inactive at start

The P-OT signal is inactive at start, and the motor starts homing in the forward direction at high speed. After reaching the rising edge of the P-OT signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the falling edge of the P-OT signal.

- P-OT signal active at start

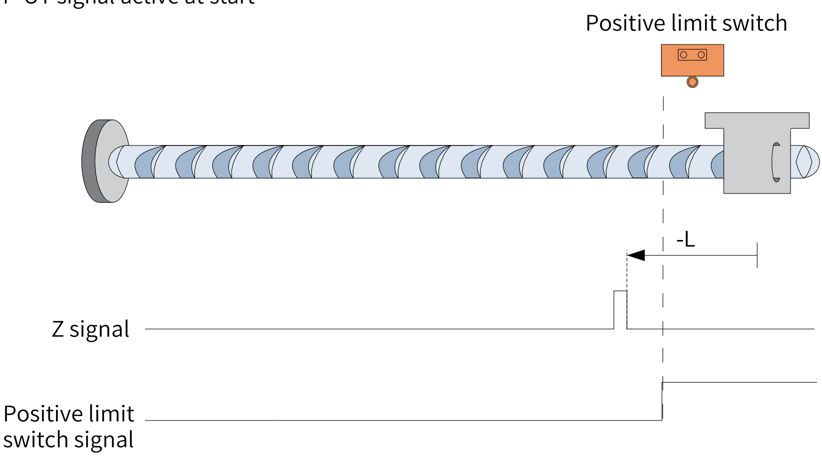


Figure 2-15 P-OT signal active at start

The P-OT signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the P-OT signal, the motor stops at the first Z signal.

6098h = 3

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start

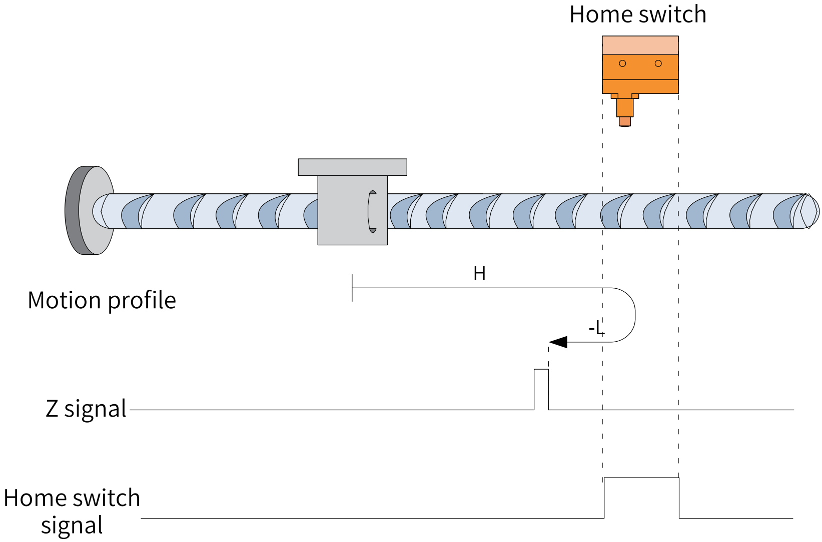


Figure 2-16 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal active at start

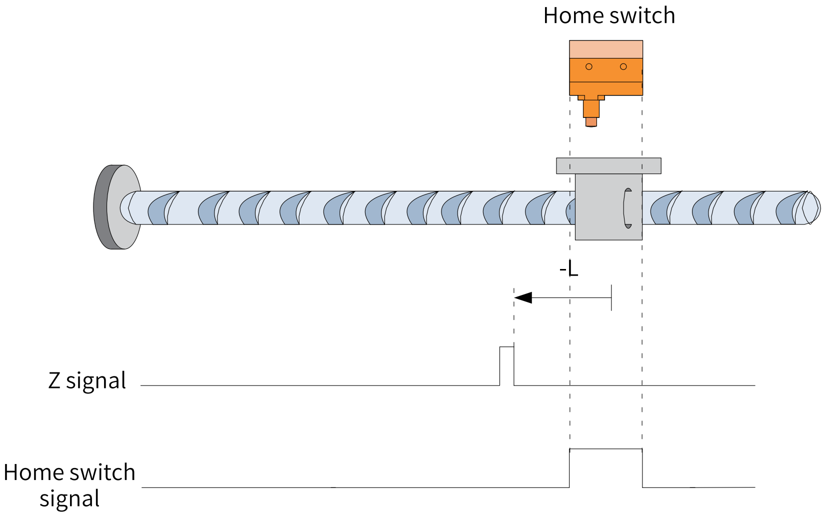


Figure 2-17 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor stops at the first Z signal.

6098h = 4

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start

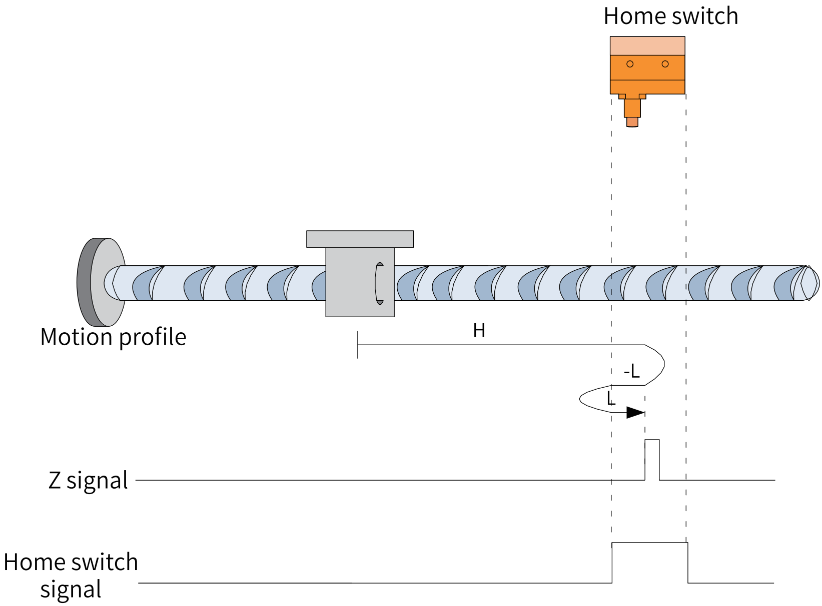


Figure 2-18 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the forward direction until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal active at start

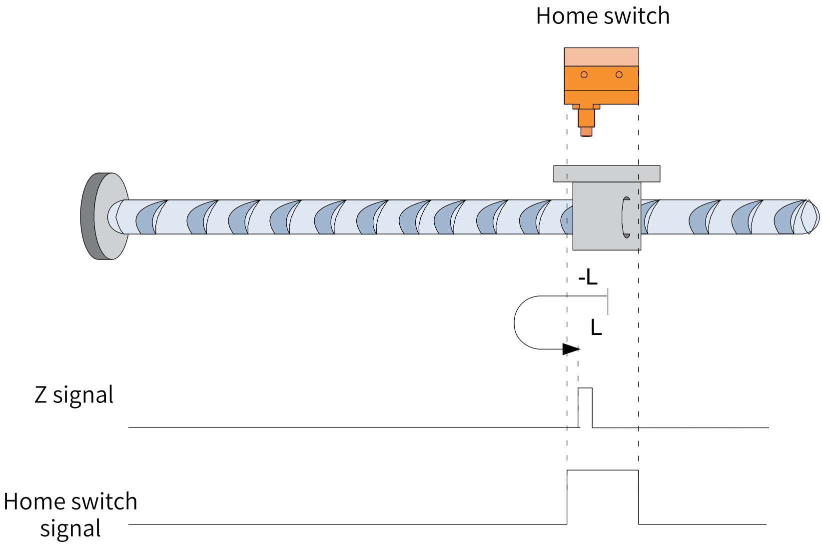


Figure 2-19 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor decelerates and changes to run in the forward direction until it stops at the first Z signal after reaching the rising edge of the HW signal.

6098h = 5

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start

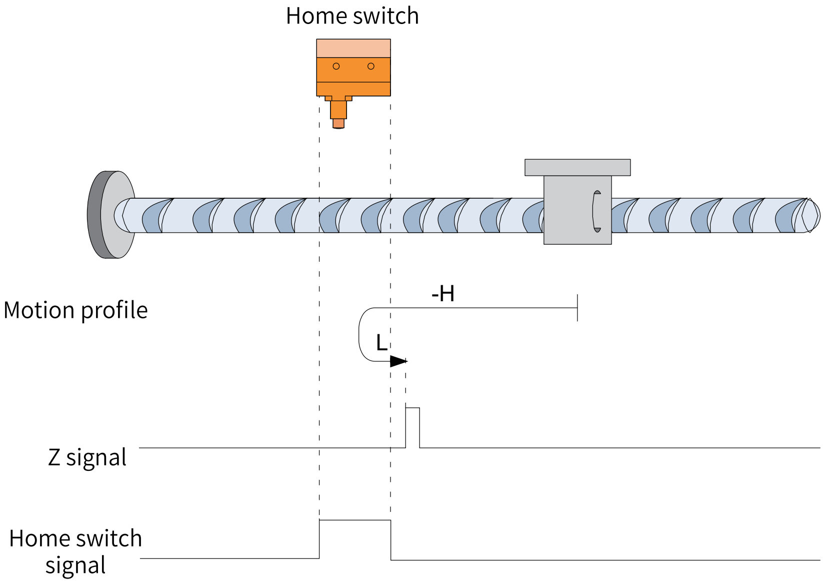


Figure 2-20 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal active at start

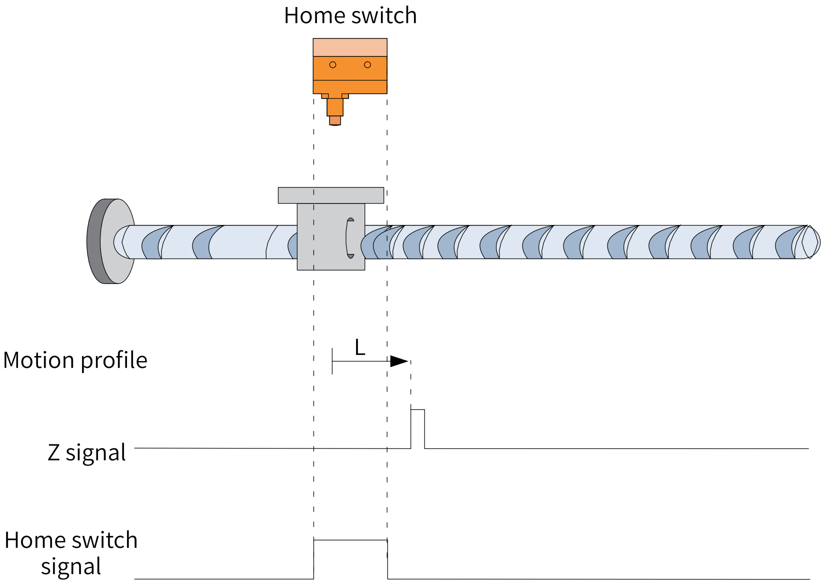


Figure 2-21 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor stops at the first Z signal.

6098h = 6

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start

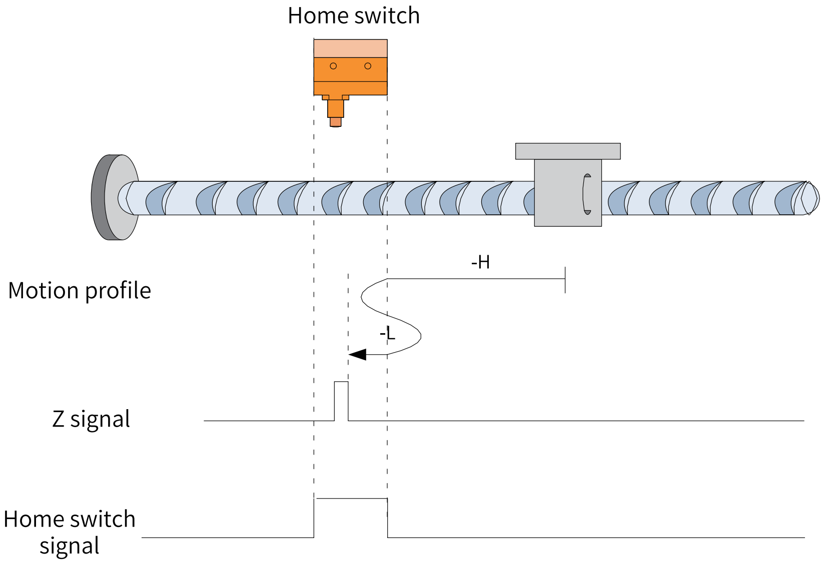


Figure 2-22 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed. Then, after reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal active at start

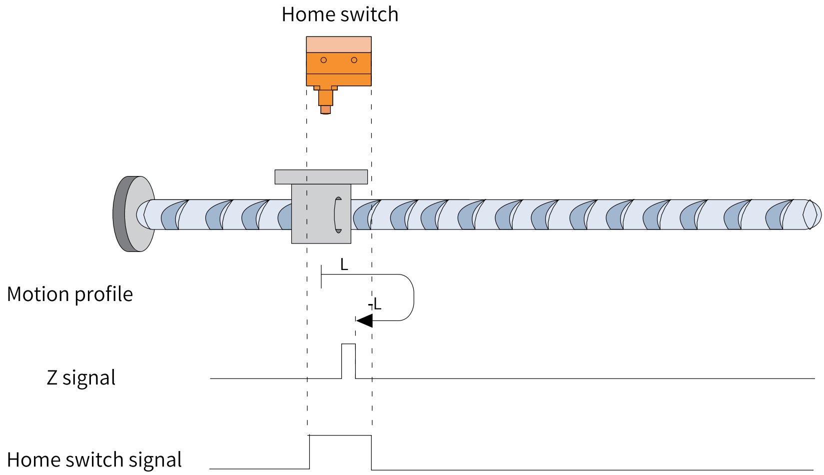


Figure 2-23 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the rising edge of HW signal.

6098h = 7

Home: Z signal

Deception point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

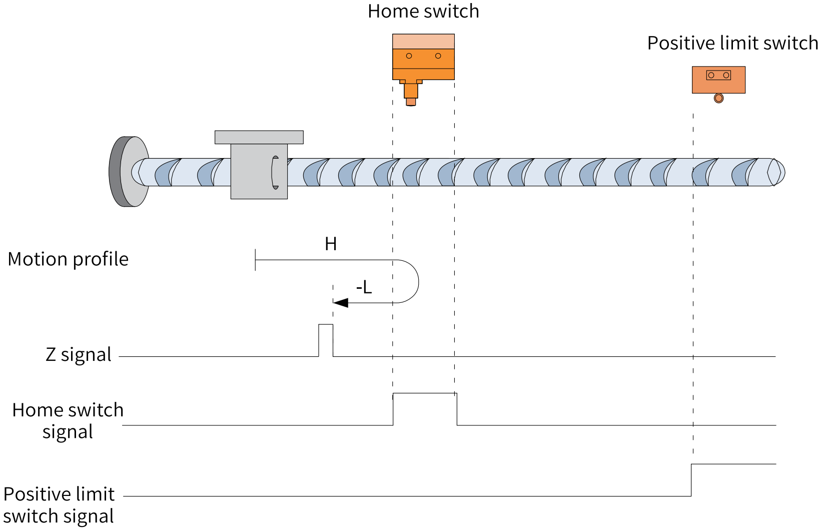


Figure 2-24 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor stops at the first Z signal.

- HW signal inactive at start, hitting the positive limit switch

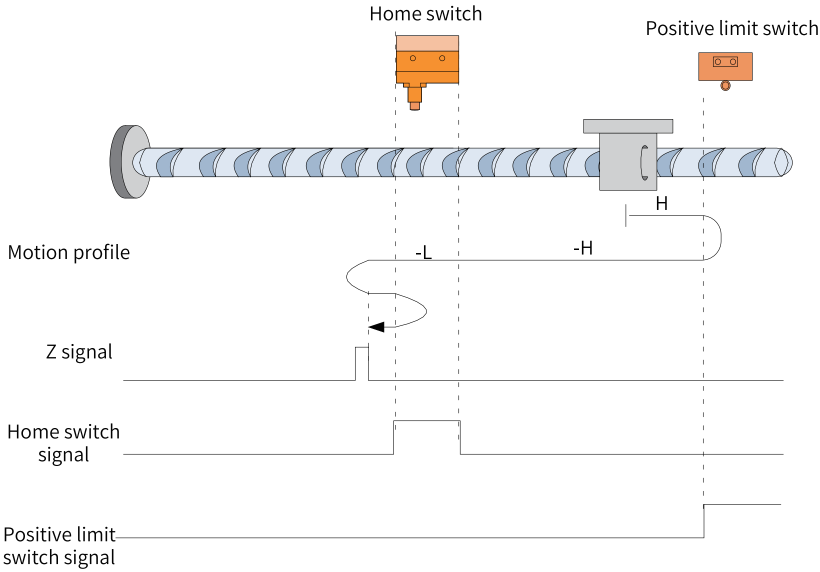


Figure 2-25 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and runs in the reverse direction at low speed. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it reaches the rising edge of HW signal. After that it changes to run in the reverse direction at low speed. Finally, the motor stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal active at start

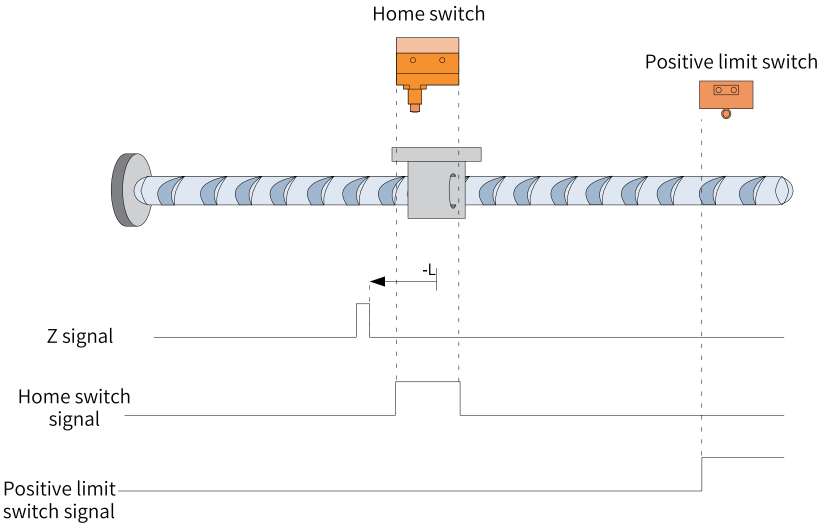


Figure 2-26 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor stops at the first Z signal.

6098h = 8

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

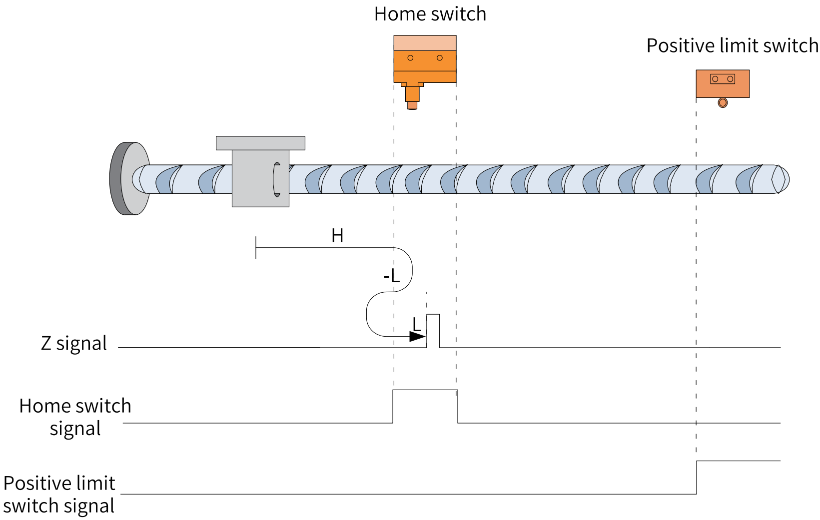


Figure 2-27 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

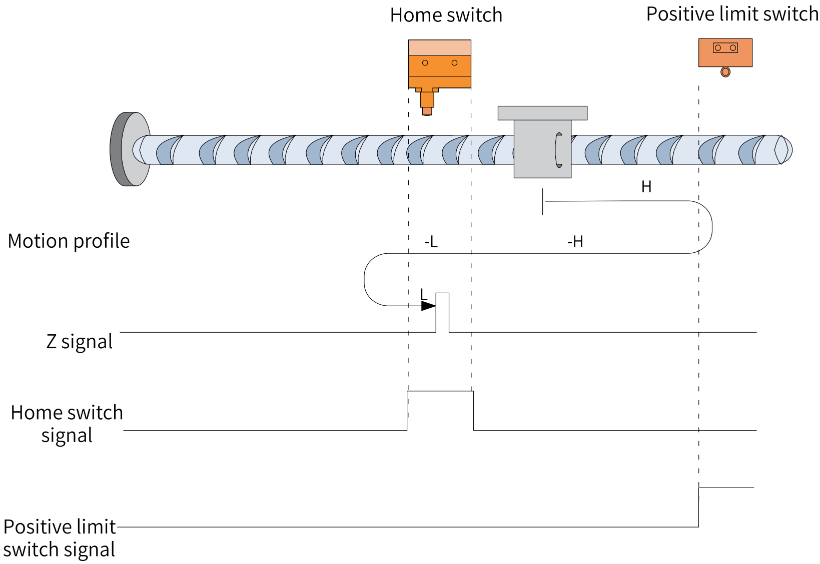


Figure 2-28 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction at high speed. After reaching the rising edge of HW signal, the motor decelerates and continues running in the reverse direction at low speed. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops at the first motor Z signal after reaching the rising edge of the HW signal.

- HW signal active at start

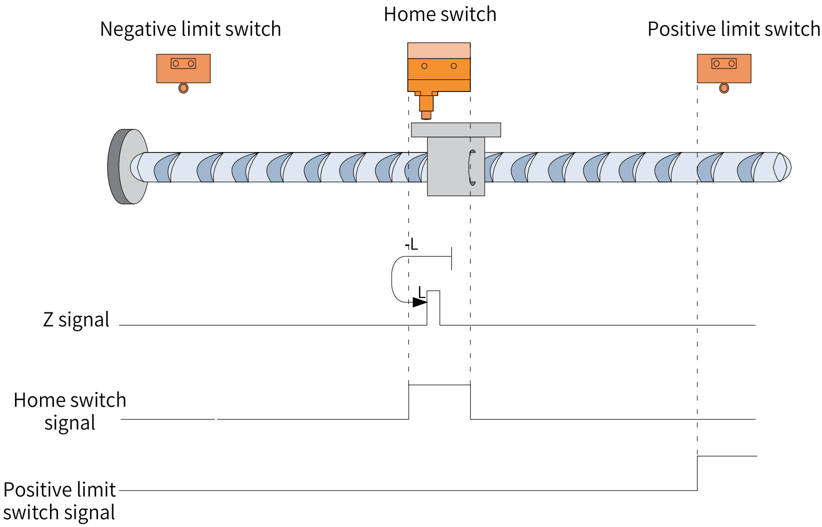


Figure 2-29 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of HW signal, the motor changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the rising edge of HW signal.

6098h = 9

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

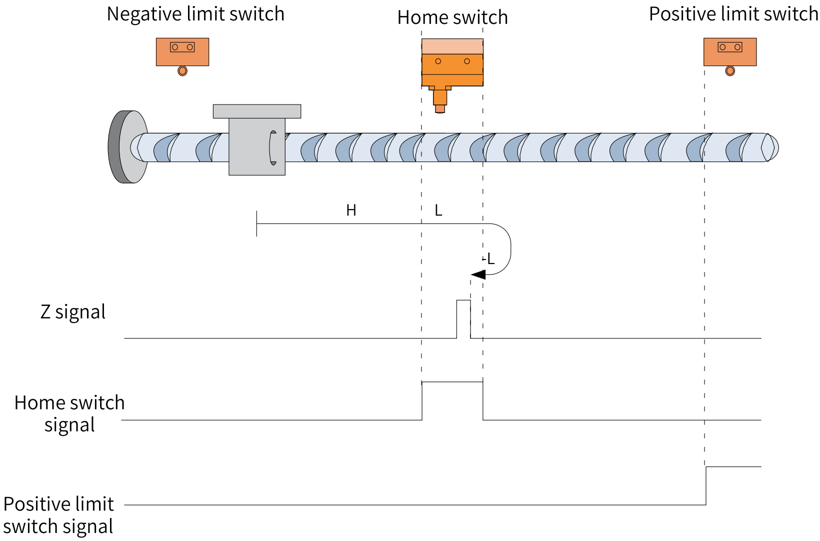


Figure 2-30 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and runs in the forward direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

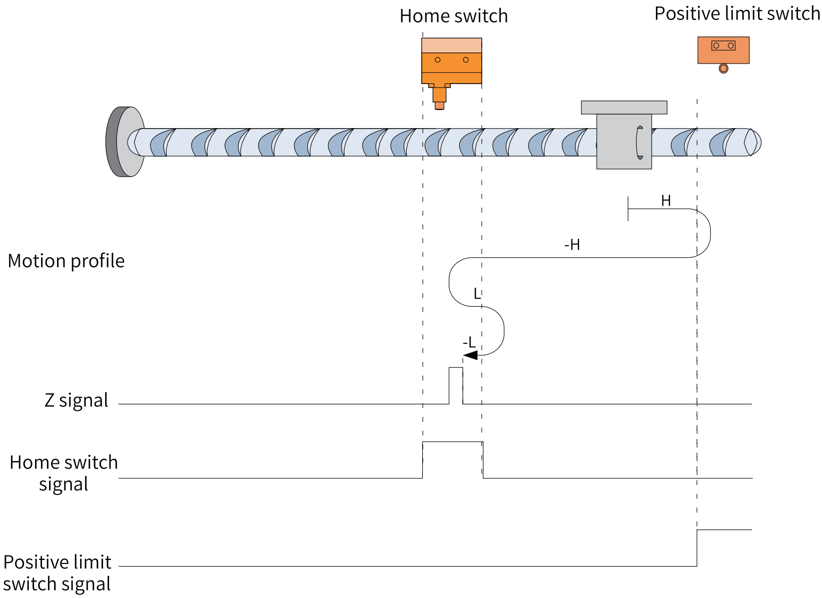


Figure 2-31 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed. Then after reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed. Finally, the motor stops at the first Z signal after reaching the rising edge of HW signal.

- HW signal active at start

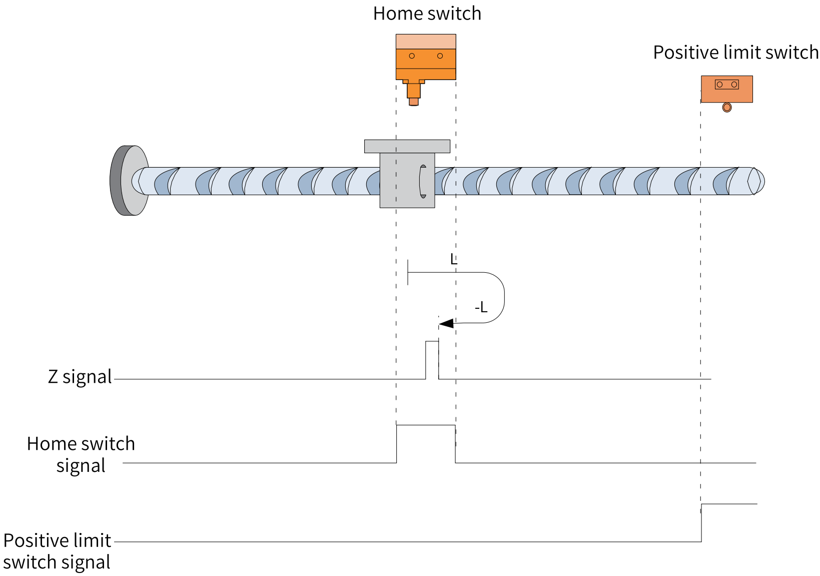


Figure 2-32 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the reverse direction until it stops at the first Z signal after reaching the rising edge of the HW signal.

6098h = 10

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

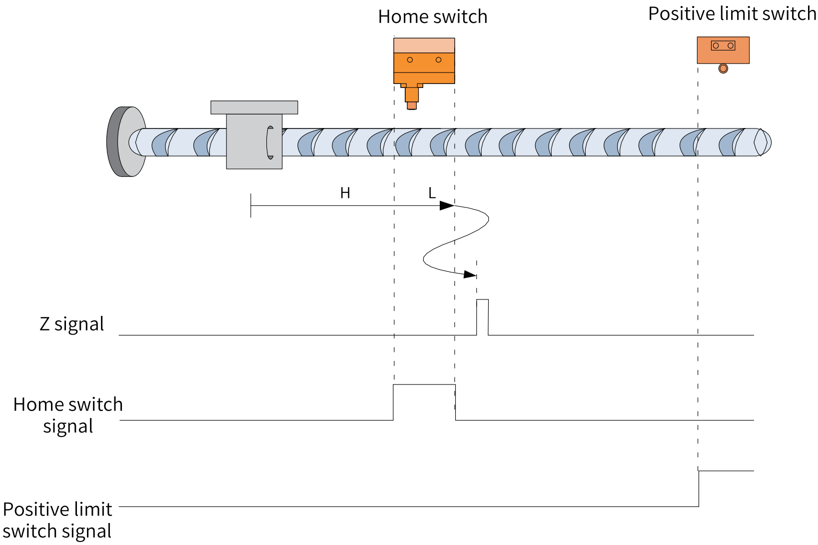


Figure 2-33 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and runs in the forward direction at low speed after reaching the rising edge of HW signal. After reaching the falling edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it reaches the rising edge of the HW signal. After that, it changes to run in the forward direction at low speed. Finally, it stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

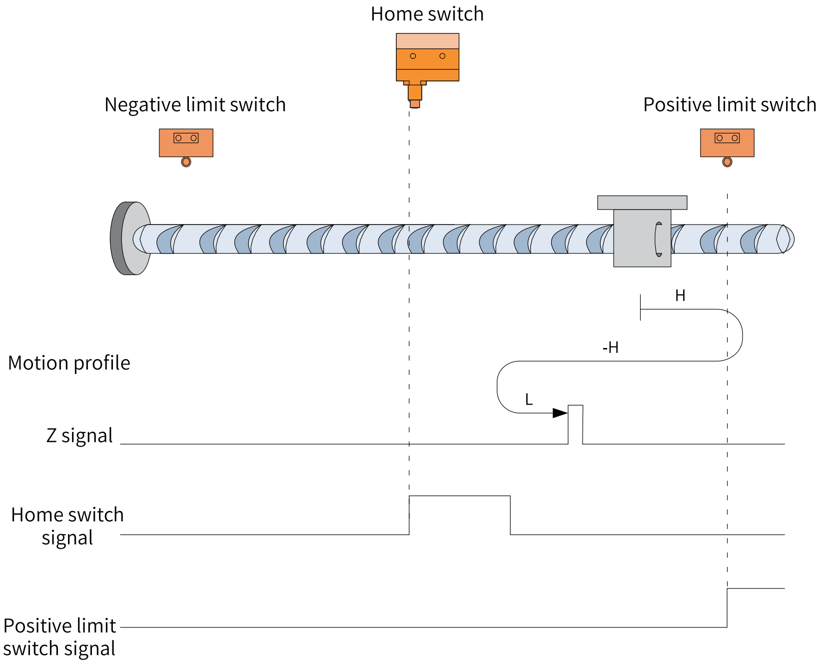


Figure 2-34 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal active at start

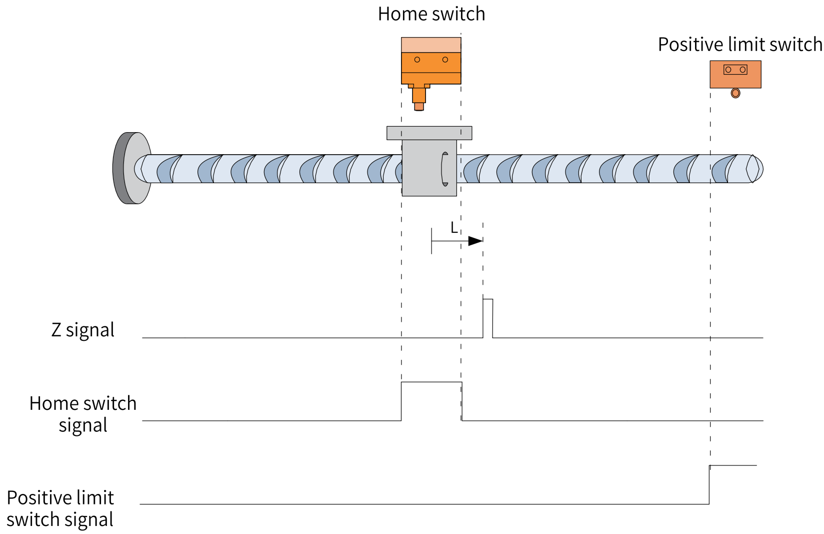


Figure 2-35 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of HW signal, the motor stops at the first Z signal.

6098h = 11

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

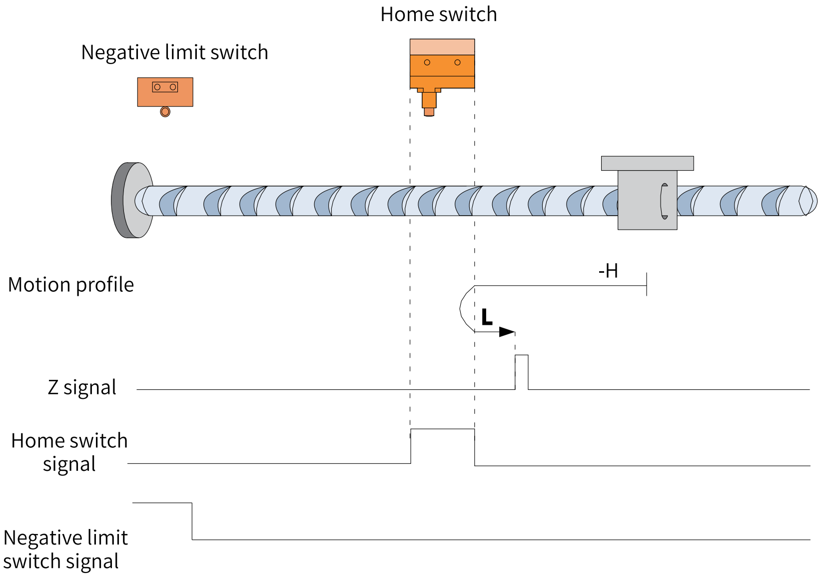


Figure 2-36 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the forward direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor stops at the first Z signal.

- HW signal inactive at start, hitting the negative limit switch

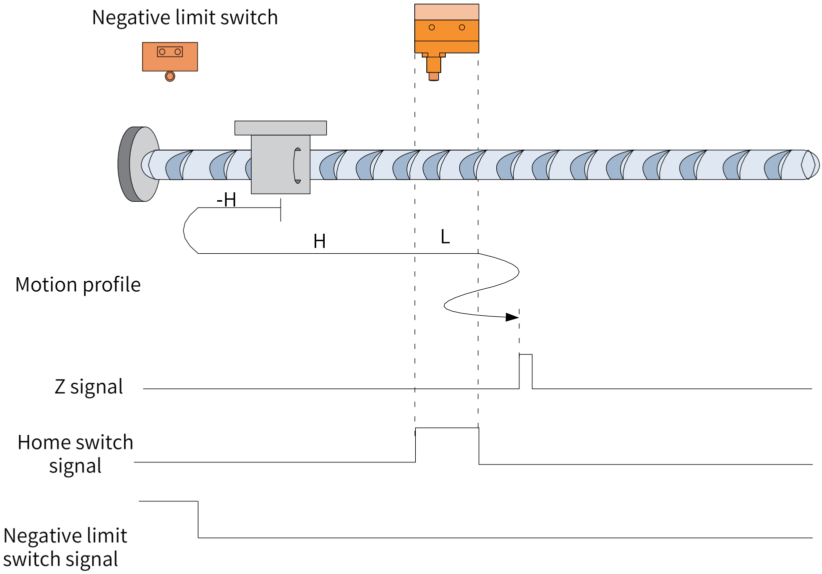


Figure 2-37 HW signal inactive at start, hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction. After reaching the rising edge of the HW signal, the motor decelerates and runs in the forward direction at low speed. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until reaching the rising edge of the HW signal where it decelerates and changes to run in the forward direction at low speed. Finally, the motor stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal active at start

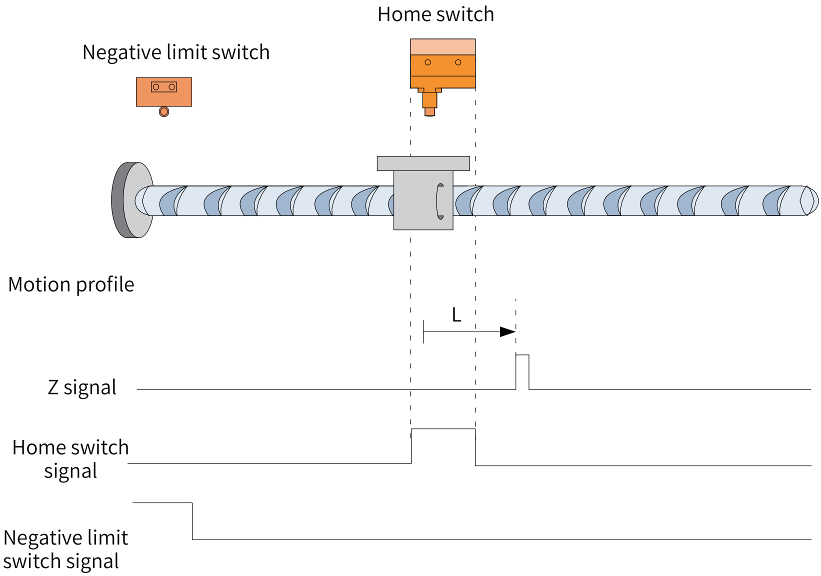


Figure 2-38 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor stops at the first Z signal.

6098h = 12

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

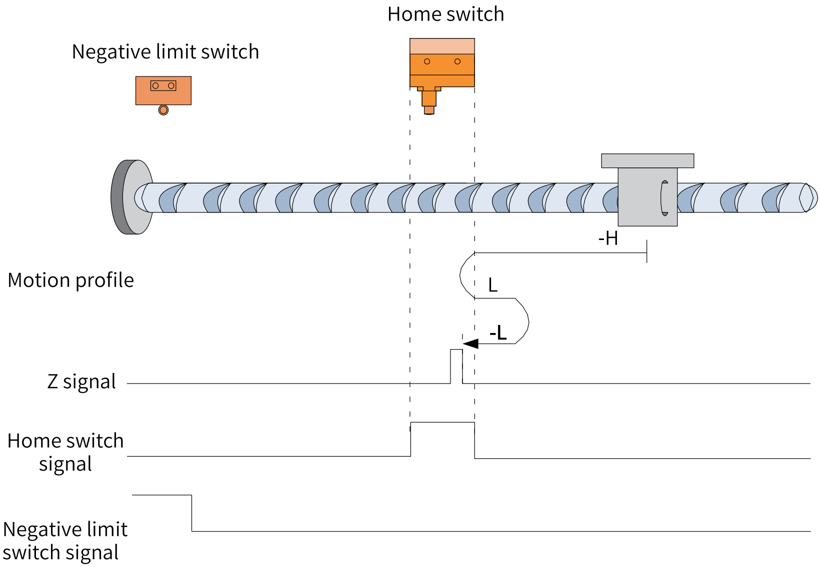


Figure 2-39 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the forward direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of HW signal, the motor changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

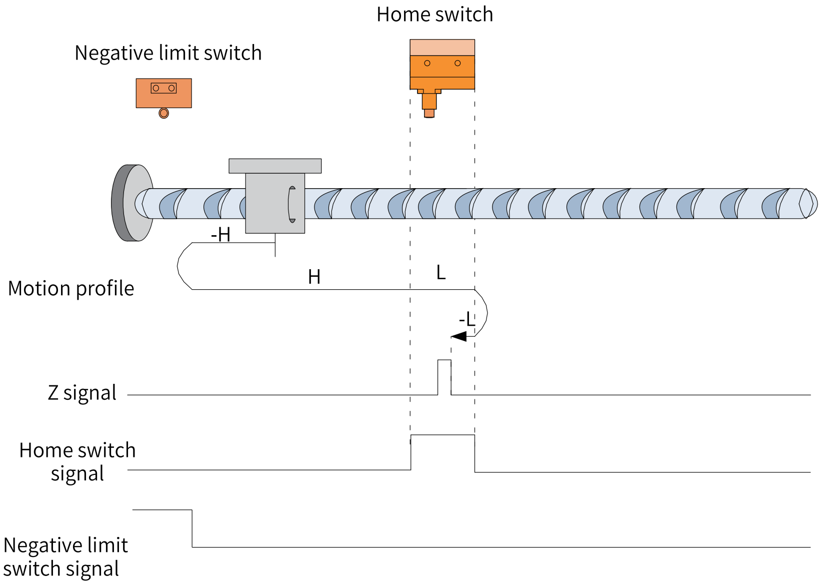


Figure 2-40 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at high speed. After reaching the rising edge of HW signal, the motor decelerates and runs in the forward direction at low speed. Then, after reaching the falling edge of HW signal, the motor changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal active at start

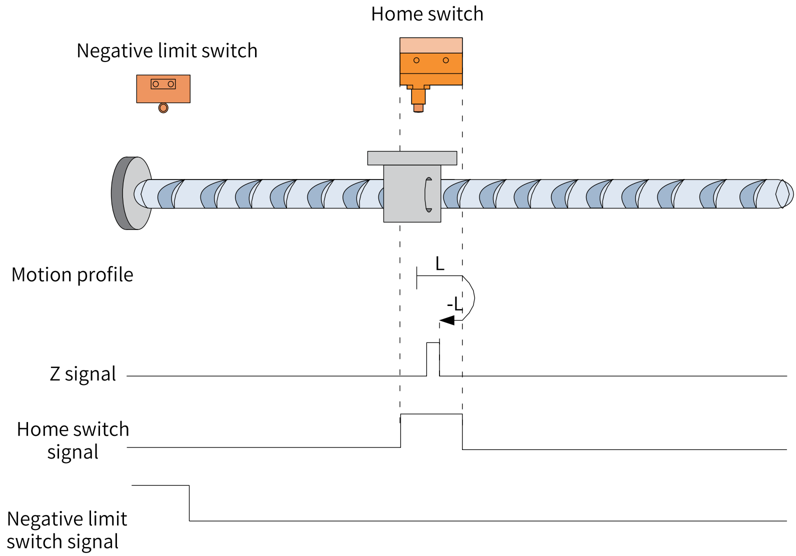


Figure 2-41 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

6098h = 13

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

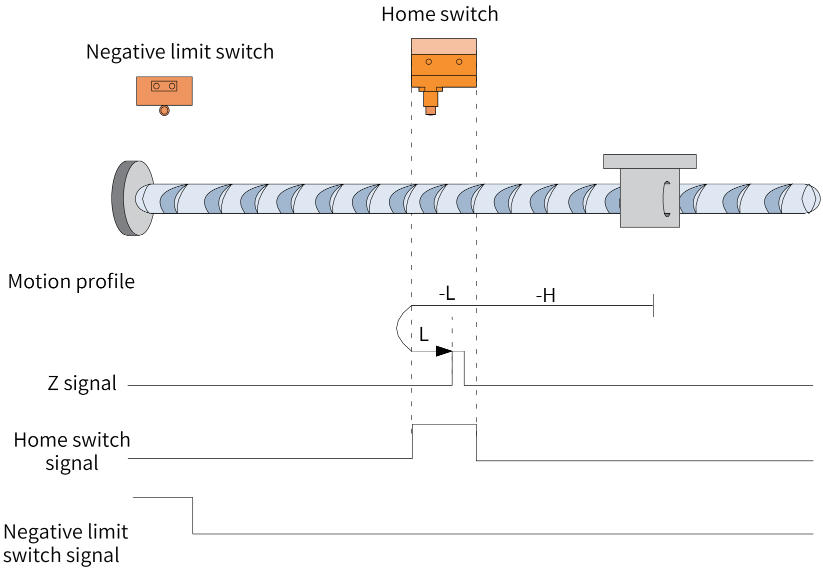


Figure 2-42 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the negative limit switch

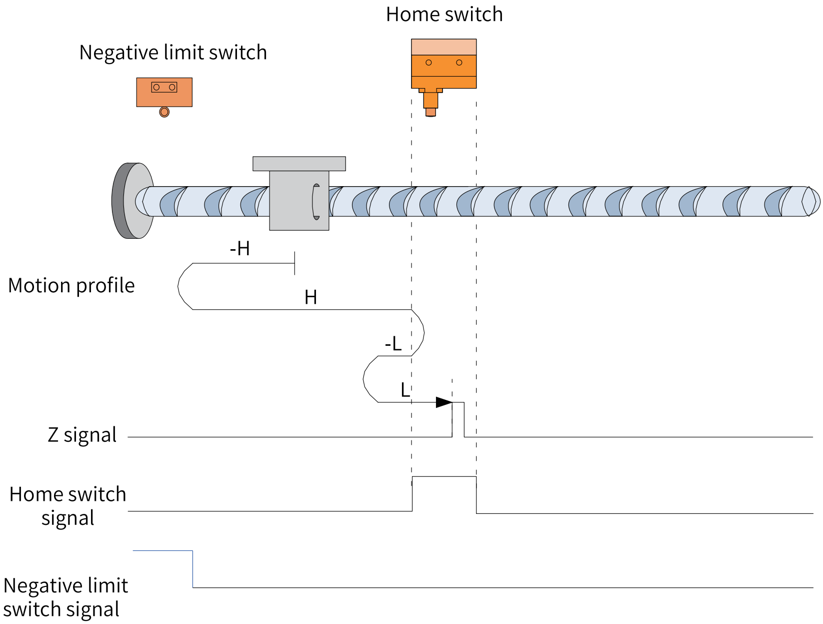


Figure 2-43 HW signal inactive at start, hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

- HW signal active at start

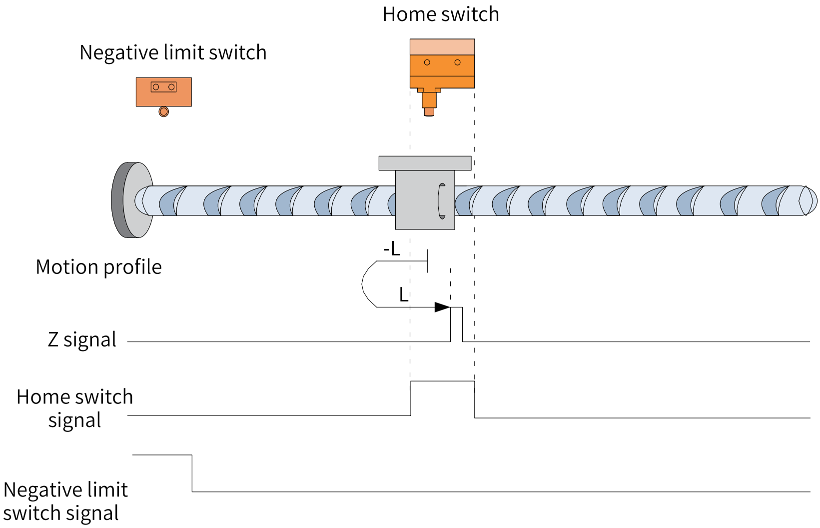


Figure 2-44 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops at the first Z signal after reaching the rising edge of the HW signal.

6098h = 14

Home: Z signal

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

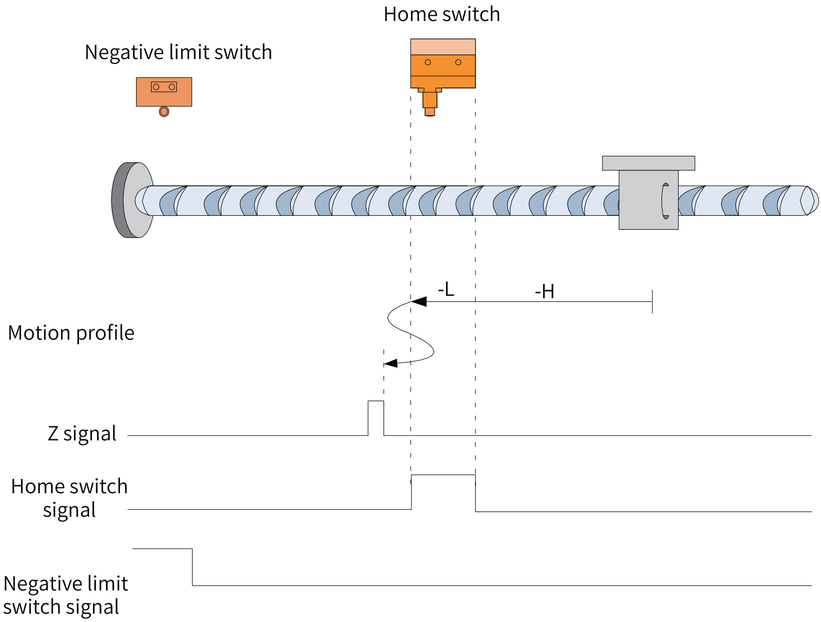


Figure 2-45 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and runs in the reverse direction at low speed after reaching the rising edge of HW signal. Then, after reaching the falling edge of HW signal, the motor decelerates and changes to run in the forward direction at low speed until reaching the rising edge of the HW signal where it decelerates and changes to run in the reverse direction at low speed. Finally, the motor stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal inactive at start, hitting the negative limit switch

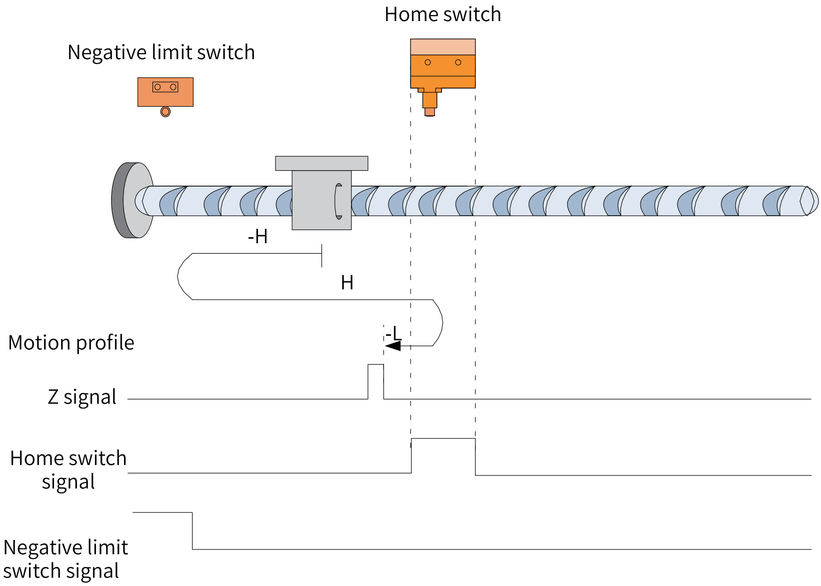


Figure 2-46 HW signal inactive at start, hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops at the first Z signal after reaching the falling edge of the HW signal.

- HW signal active at start

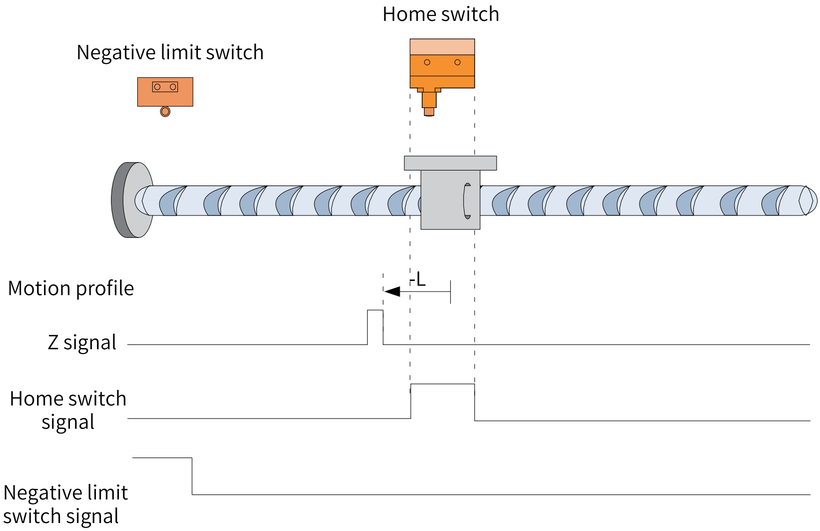


Figure 2-47 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor stops at the first Z signal.

6098h = 17

Home: negative limit switch

Deceleration point: negative limit switch (N-OT)

- N-OT signal inactive at start

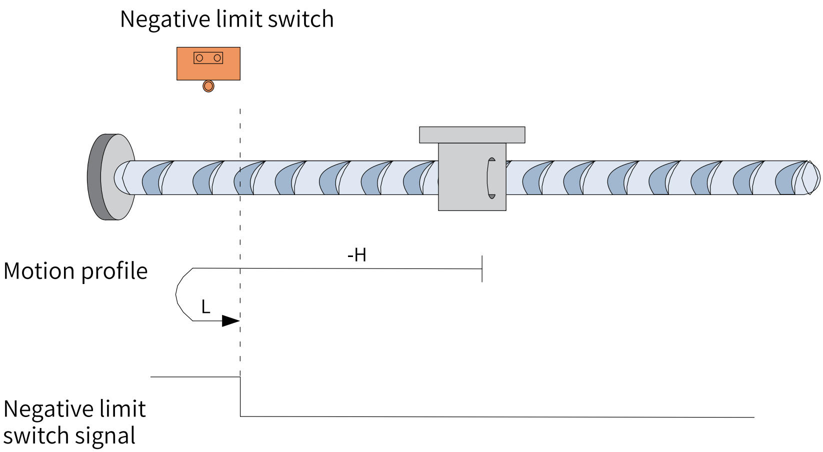


Figure 2-48 N-OT signal inactive at start

The N-OT signal is inactive at start, and the motor starts homing in the reverse direction at high speed. After reaching the rising edge of the N-OT signal, the motor decelerates and changes to run in the forward direction at low speed until it stops after reaching the falling edge of the N-OT signal.

- N-OT signal active at start

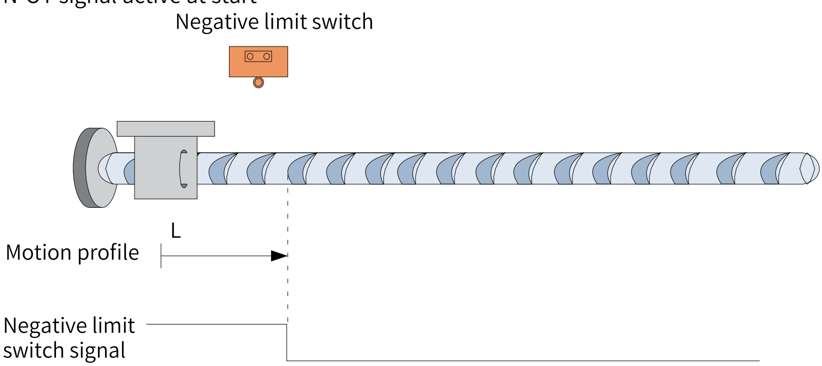


Figure 2-49 N-OT signal active at start

The N-OT signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the N-OT signal, the motor stops.

6098h = 18

Home: positive limit switch

Deceleration point: positive limit switch (P-OT)

- P-OT signal inactive at start

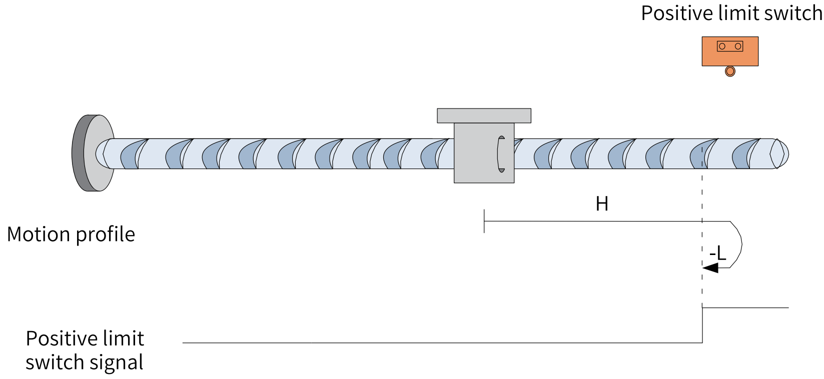


Figure 2-50 P-OT signal inactive at start

The P-OT signal is inactive at start, and the motor starts homing in the forward direction at high speed. After reaching the rising edge of the P-OT signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops after reaching the falling edge of the P-OT signal.

- P-OT signal active at start

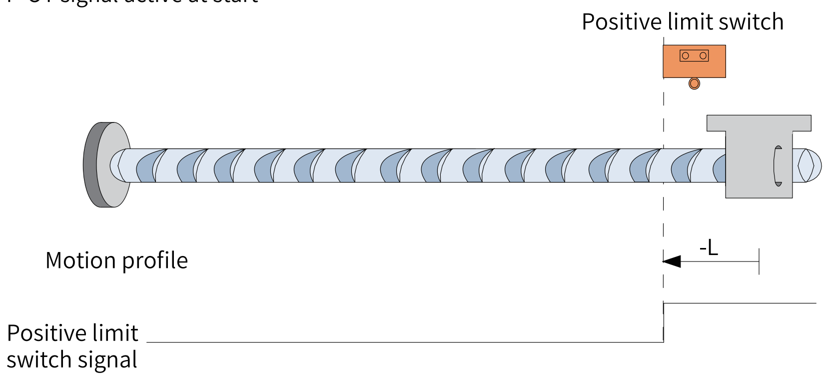


Figure 2-51 P-OT signal active at start

The P-OT signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the P-OT signal, the motor stops.

6098h = 19

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start

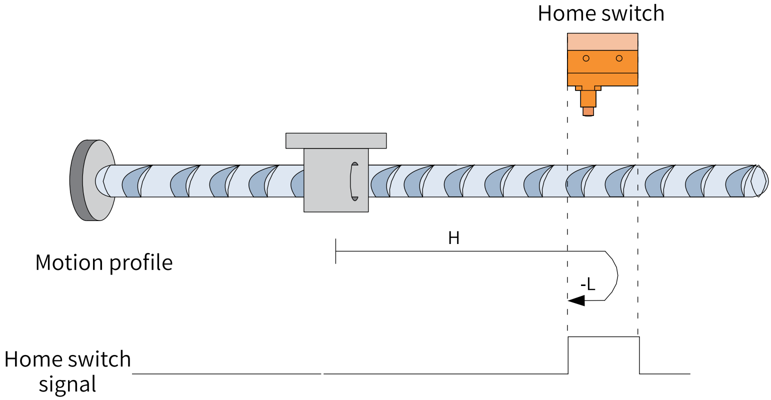


Figure 2-52 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops after reaching the falling edge of the HW signal.

- HW signal active at start

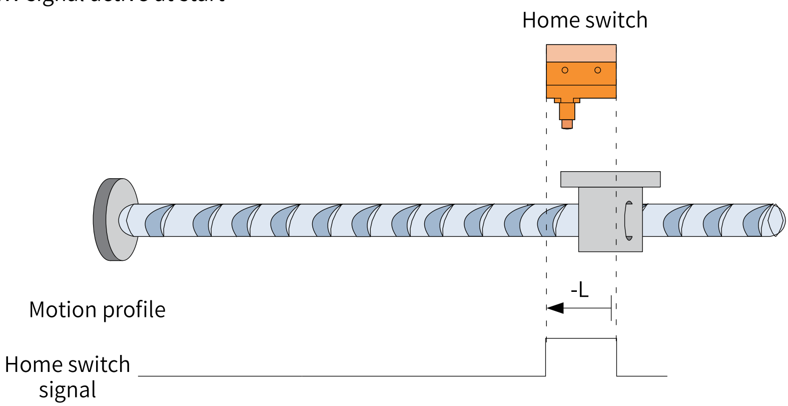


Figure 2-53 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor stops.

6098h = 20

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start

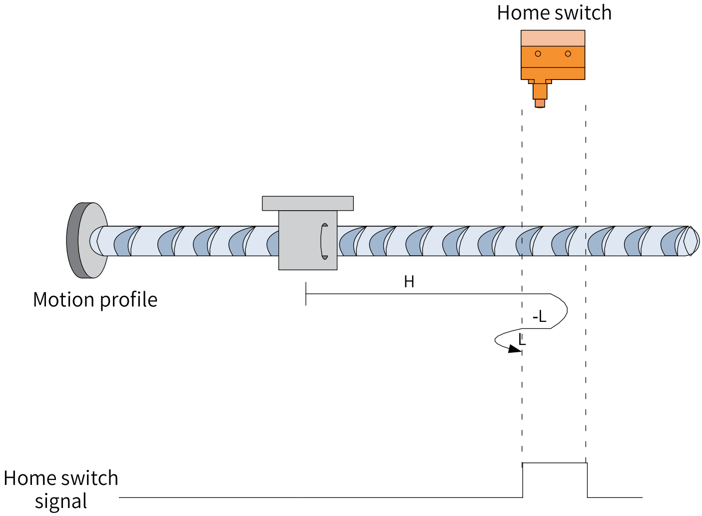


Figure 2-54 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops after reaching the rising edge of the HW signal.

- HW signal active at start

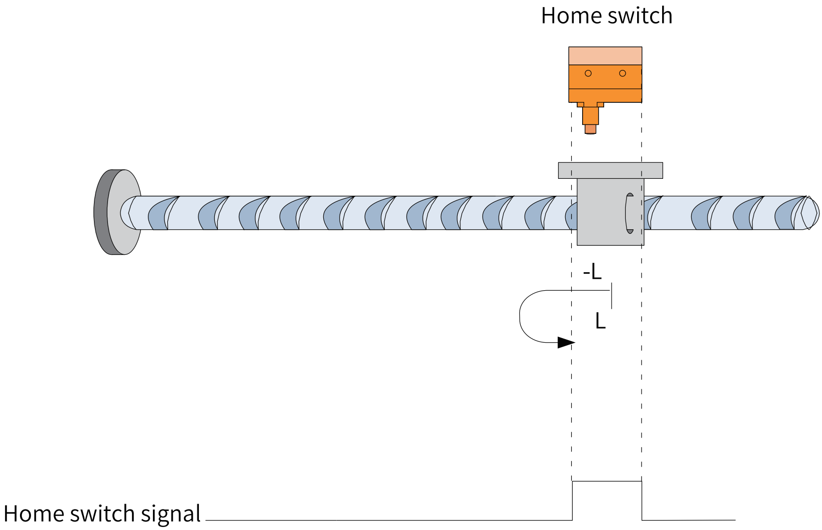


Figure 2-55 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops after reaching the rising edge of the HW signal.

6098h = 21

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start

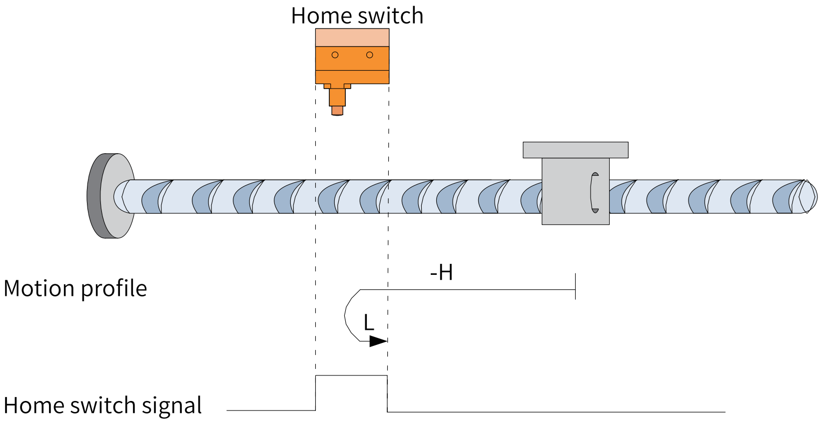


Figure 2-56 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops after reaching the falling edge of the HW signal.

- HW signal active at start

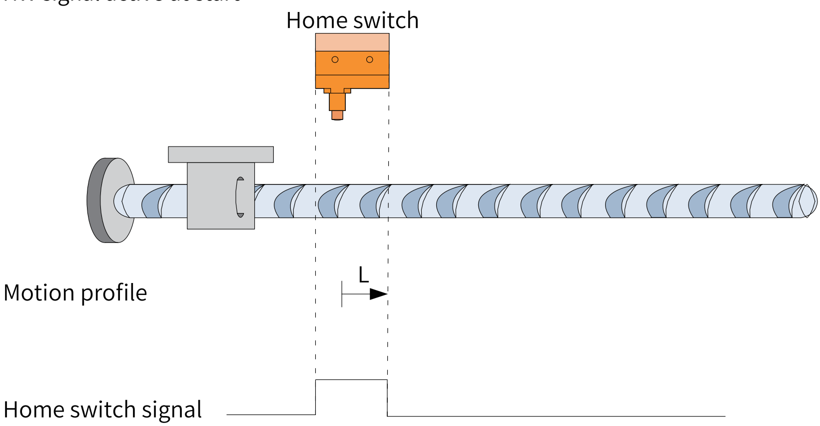


Figure 2-57 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor stops.

6098h = 22

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start

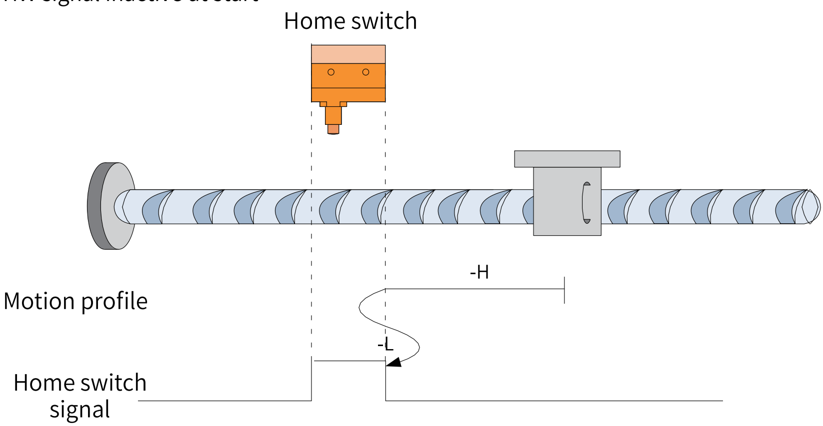


Figure 2-58 HW signal inactive at start

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the reverse direction until it stops after reaching the rising edge of the HW signal.

- HW signal active at start

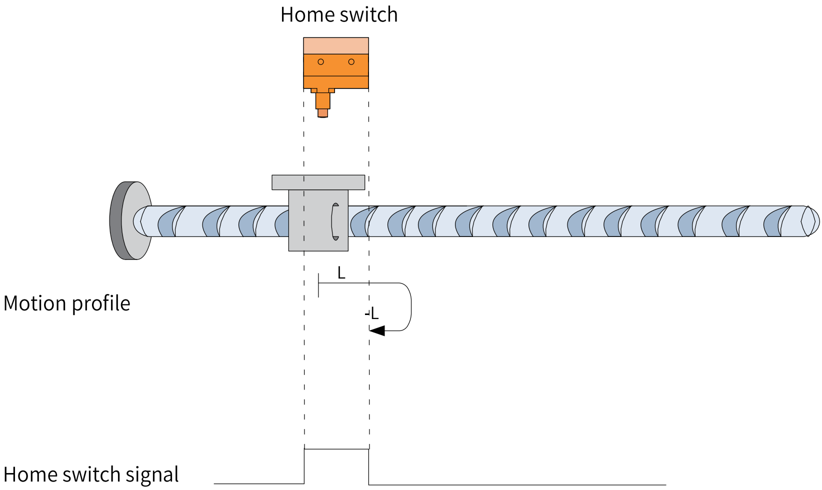


Figure 2-59 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops after reaching the rising edge of the HW signal.

6098h = 23

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

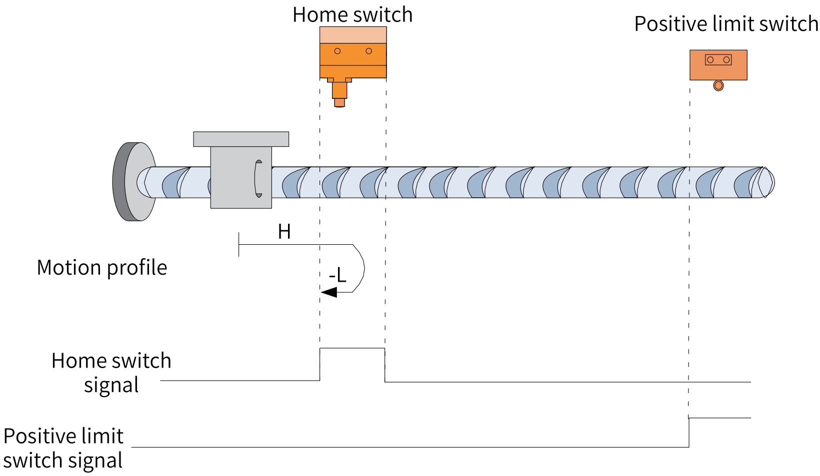


Figure 2-60 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor stops.

- HW signal inactive at start, hitting the positive limit switch

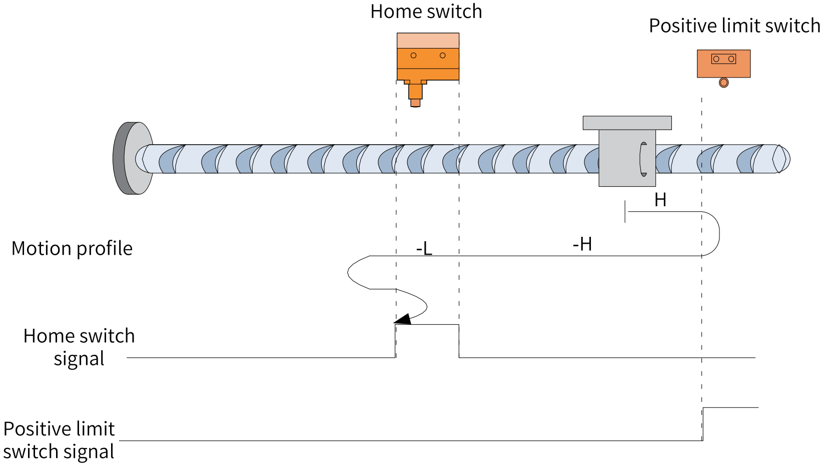


Figure 2-61 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction at high speed until it reaches the rising edge of the HW signal, where it decelerates to run in the reverse direction at low speed. Then, after reaching the falling edge of the HW signal, it decelerates and changes to run in the forward direction at low speed until it reaches the rising edge of the HW signal. After that, it decelerates and changes to run in the reverse direction at low speed. Finally, the motor stops after reaching the falling edge of the HW signal.

- HW signal active at start

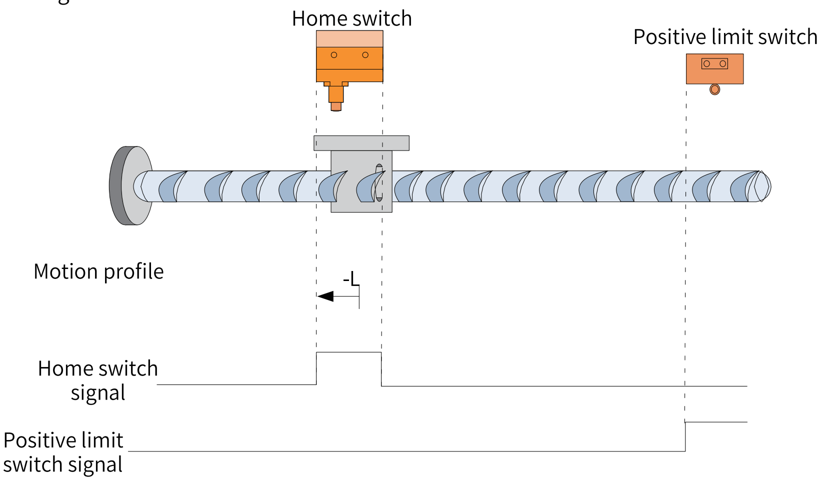


Figure 2-62 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed until it stops after reaching the falling edge of the HW signal.

6098h = 24

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

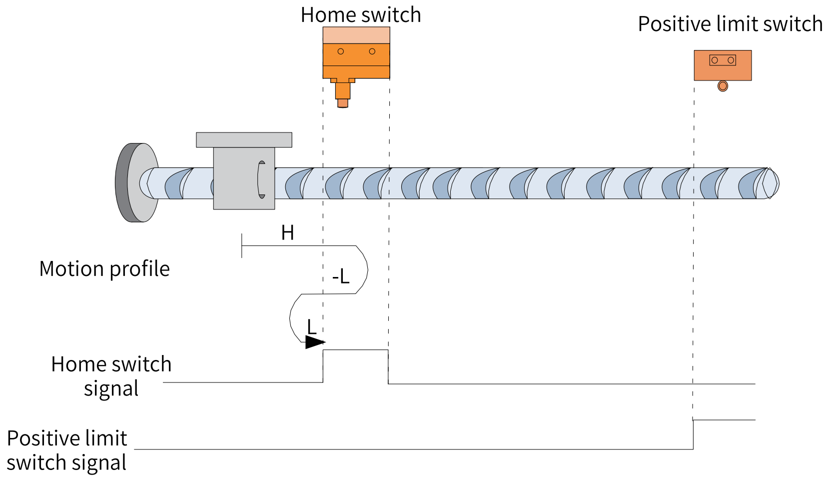


Figure 2-63 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

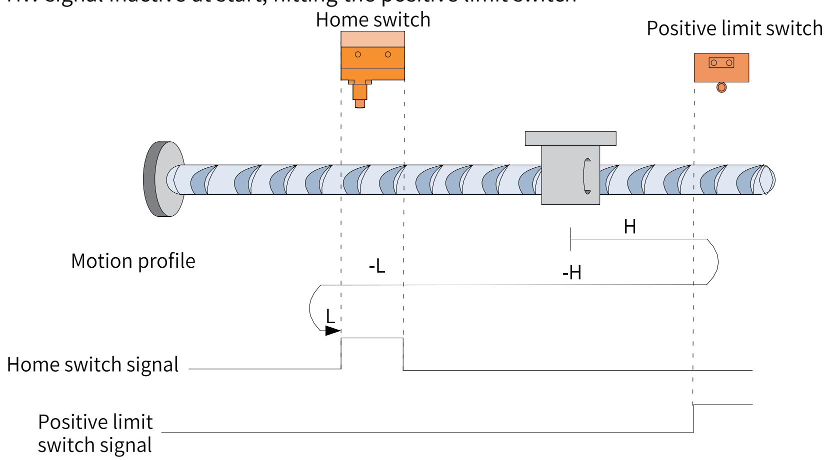


Figure 2-64 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction at high speed until it decelerates after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed. Finally, the motor stops after reaching the rising edge of the HW signal.

- HW signal active at start

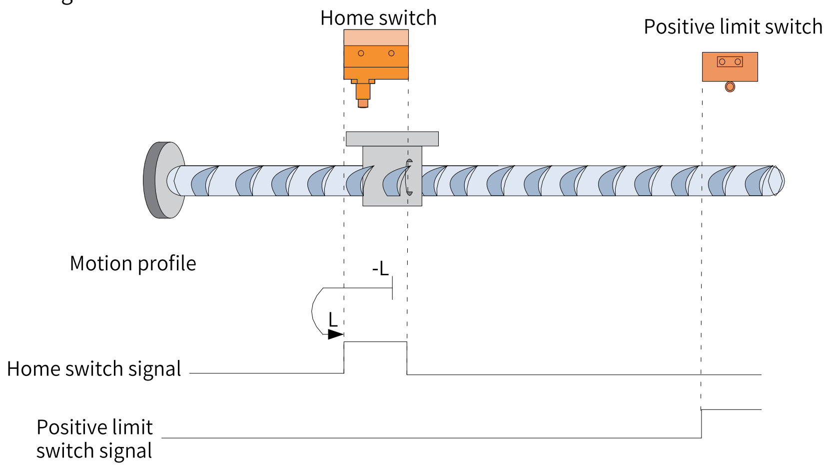


Figure 2-65 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops after reaching the rising edge of the HW signal.

6098h = 25

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

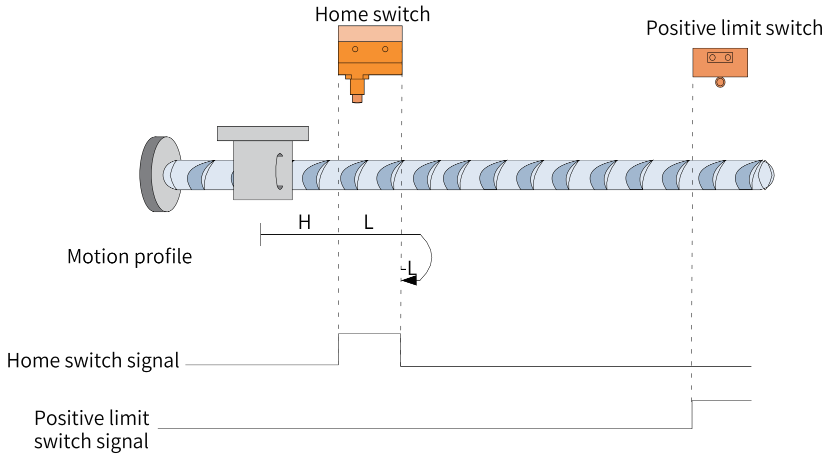


Figure 2-66 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and runs in the forward direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

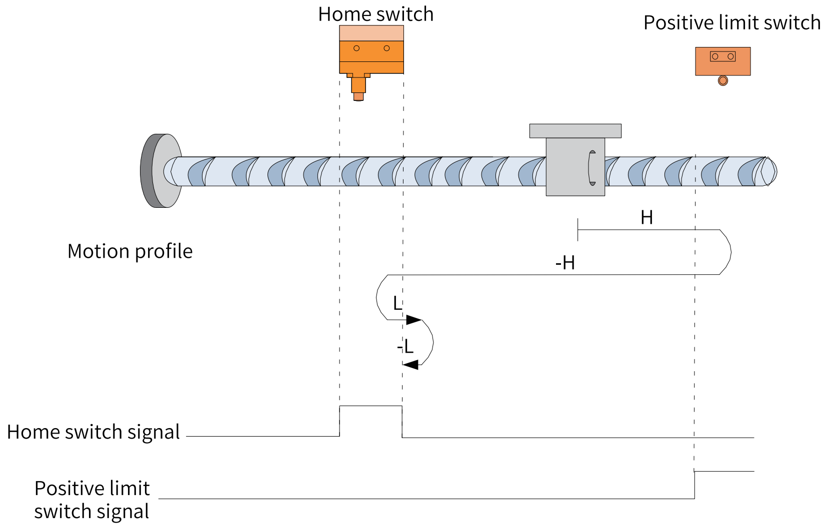


Figure 2-67 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until reaching the falling edge of the HW signal where it changes to run in the reverse direction at low speed. Finally, the motor stops after reaching the rising edge of the HW signal.

- HW signal active at start

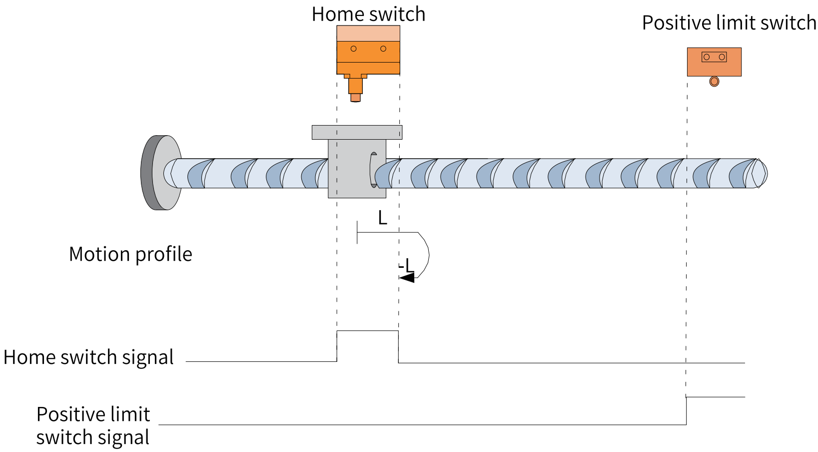


Figure 2-68 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops after reaching the rising edge of the HW signal.

6098h = 26

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the positive limit switch

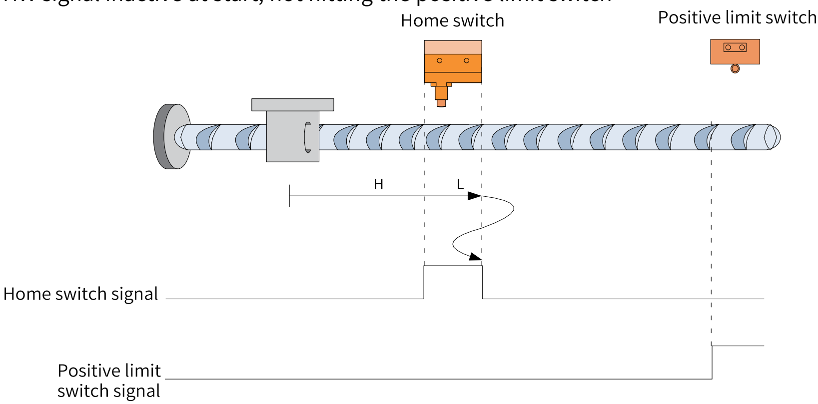


Figure 2-69 HW signal inactive at start, not hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis does not hit the limit switch, the motor decelerates and runs in the forward direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until reaching the rising edge of the HW signal where it decelerates and changes to run in the forward direction at low speed. Finally, the motor stops after reaching the falling edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

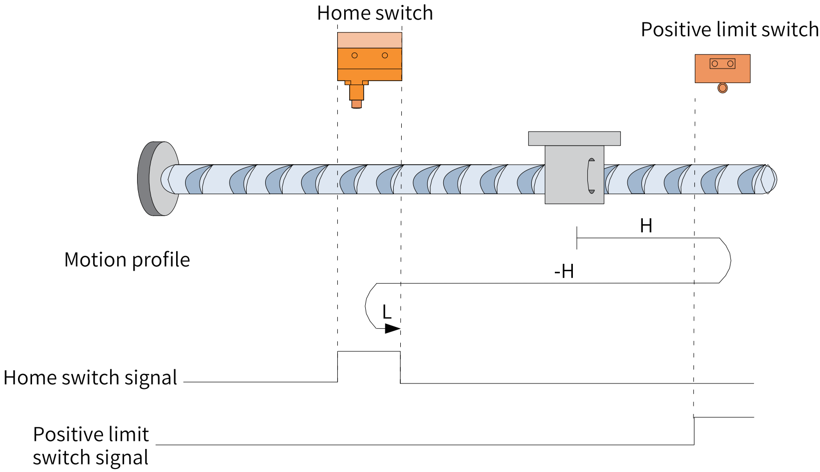


Figure 2-70 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the forward direction at high speed. If the axis hits the limit switch, the motor changes to run in the reverse direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops after reaching the falling edge of the HW signal.

- HW signal active at start

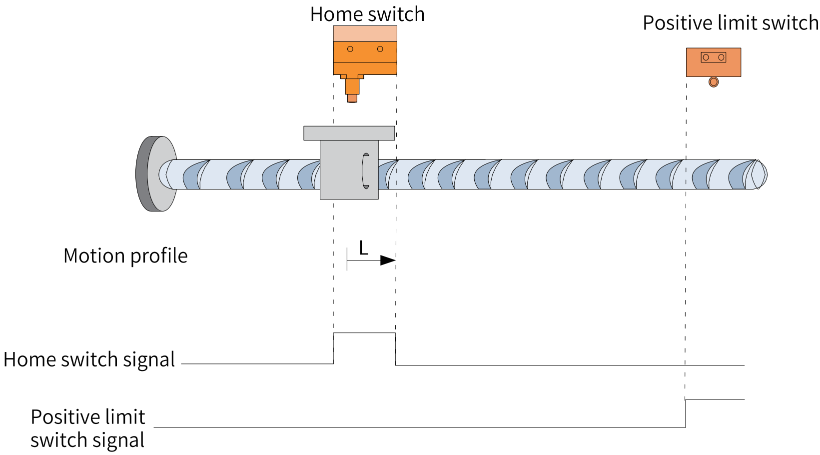


Figure 2-71 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor stops.

6098h = 27

Home: home switch

Deceleration point: home switch (HW)

- HW inactive at start, not hitting the negative limit switch

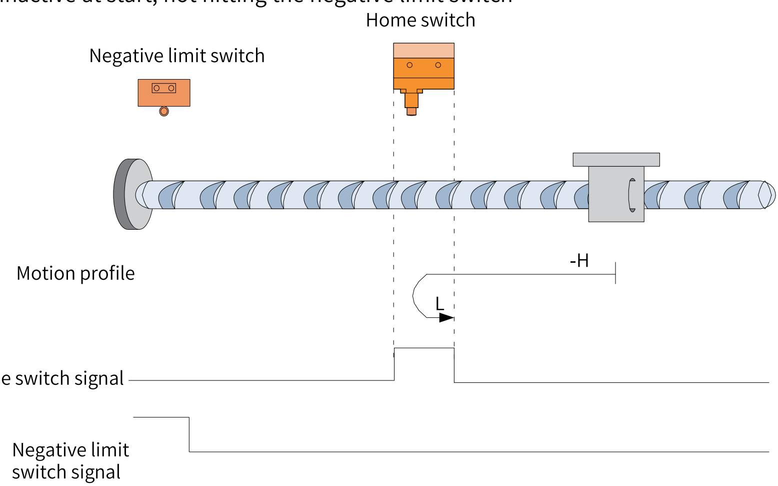


Figure 2-72 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start. The motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the forward direction at low speed after reaching the rising edge of the HW signal. Then, the motor stops after reaching the falling edge of the HW signal.

- HW signal inactive at start, hitting the negative limit switch

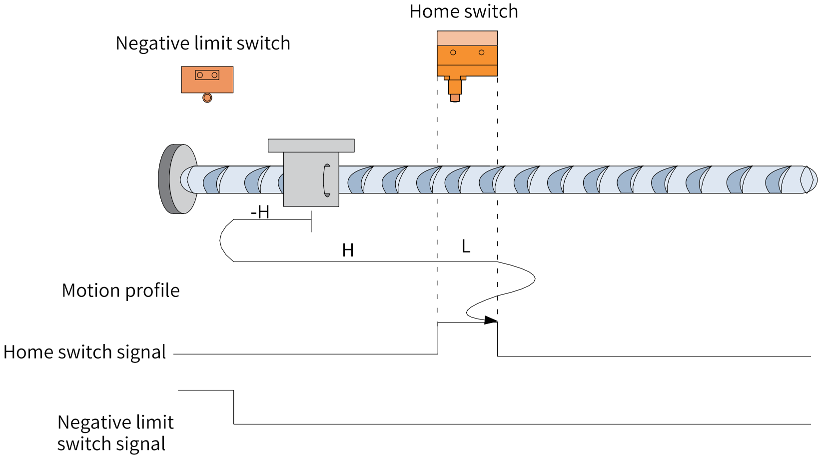


Figure 2-73 HW signal inactive at start, hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at low speed. After reaching the rising edge of the HW signal, the motor decelerates and keeps running in the forward direction at low speed until reaching the falling edge of the HW signal where it decelerates and changes to run in the reverse direction at low speed. Then, after reaching the rising edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until it stops after reaching the falling edge of the HW signal.

- HW signal active at start

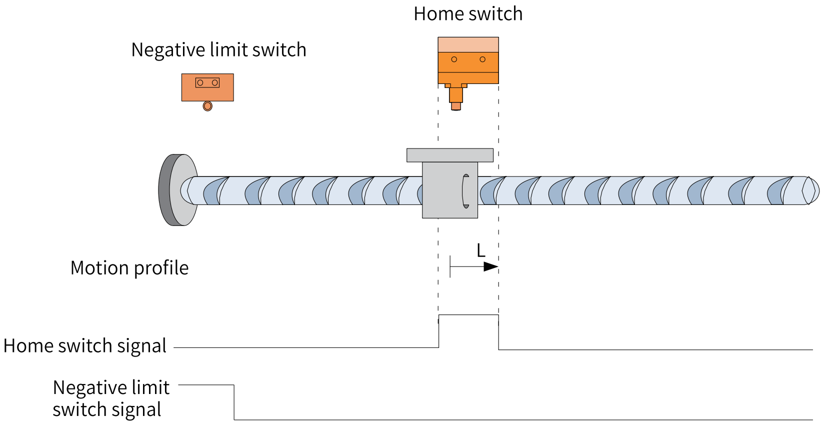


Figure 2-74 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor stops.

6098h = 28

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

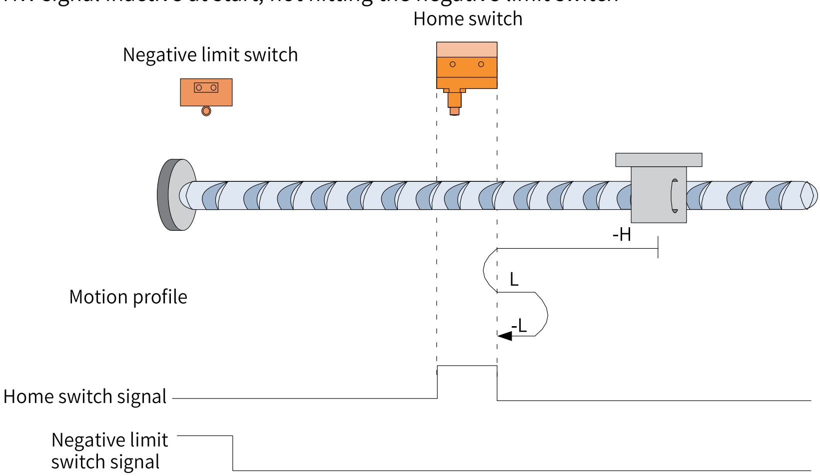


Figure 2-75 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and changes to run in the forward direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the positive limit switch

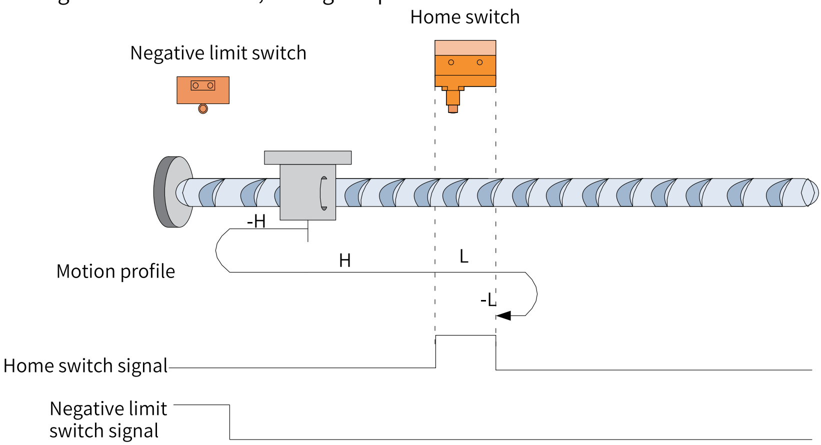


Figure 2-76 HW signal inactive at start, hitting the positive limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at high speed until it decelerates after reaching the rising edge of the HW signal. Then, after reaching the falling edge of HW signal, the motor decelerates and changes to run in the reverse direction at low speed. Finally, the motor stops after reaching the rising edge of the HW signal.

- HW signal active at start

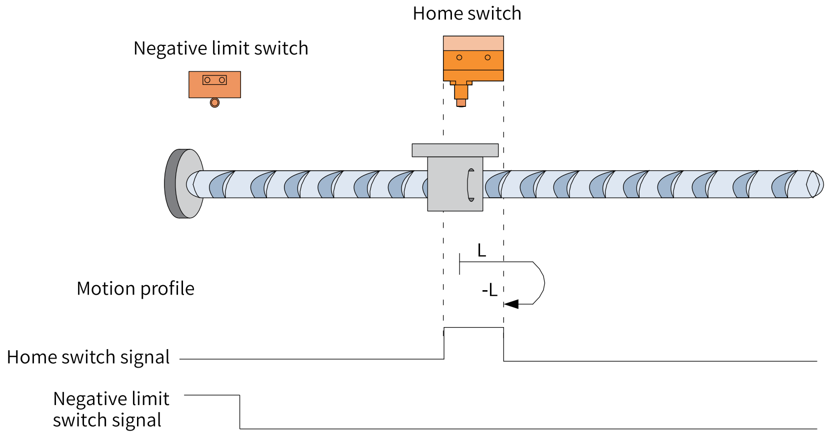


Figure 2-77 HW signal active at start

The HW signal is active at start, and the motor starts homing in the forward direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the reverse direction at low speed until it stops after reaching the rising edge of the HW signal.

6098h = 29

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

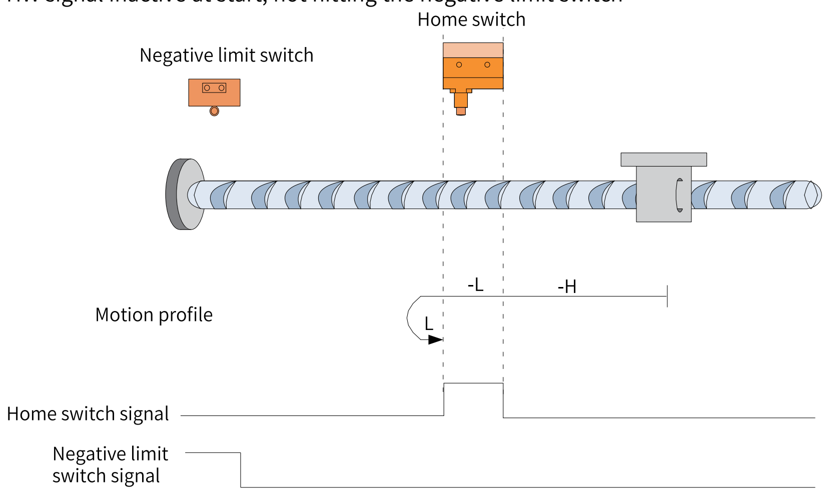


Figure 2-78 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and runs in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops after reaching the rising edge of the HW signal.

- HW signal inactive at start, hitting the negative limit switch

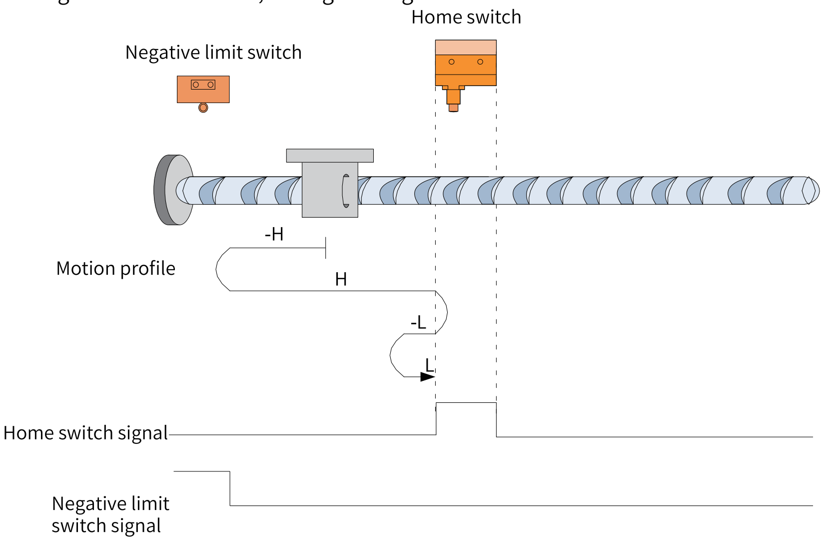


Figure 2-79 HW signal inactive at start, hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it reaches the falling edge of the HW signal, where it changes to run in the forward direction at low speed. Finally, the motor stops after reaching the rising edge of the HW signal.

- HW signal active at start

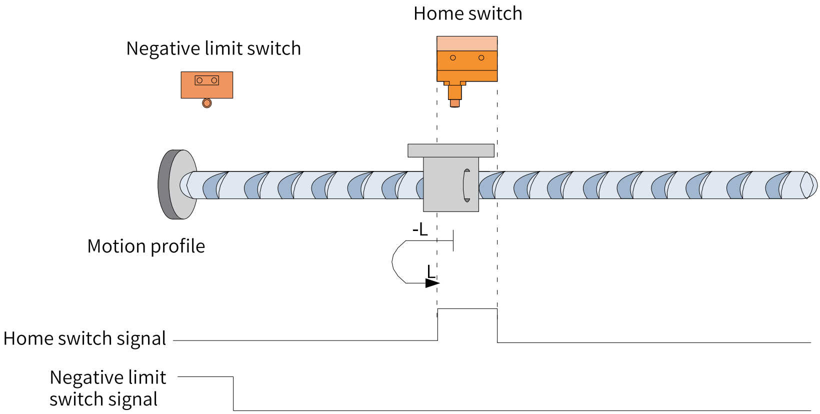


Figure 2-80 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed. After reaching the falling edge of the HW signal, the motor changes to run in the forward direction at low speed until it stops after reaching the rising edge of the HW signal.

6098h = 30

Home: home switch

Deceleration point: home switch (HW)

- HW signal inactive at start, not hitting the negative limit switch

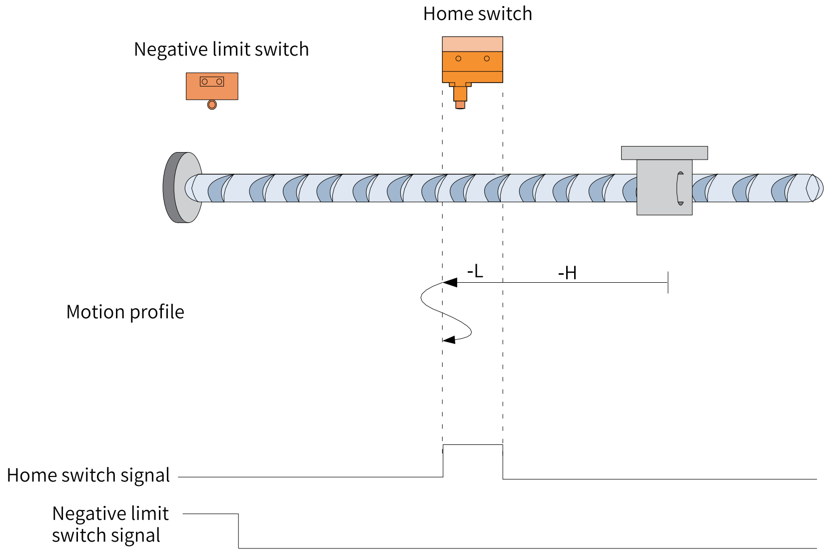


Figure 2-81 HW signal inactive at start, not hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis does not hit the limit switch, the motor decelerates and keeps running in the reverse direction at low speed after reaching the rising edge of the HW signal. Then, after reaching the falling edge of the HW signal, the motor decelerates and changes to run in the forward direction at low speed until reaching the rising edge of the HW signal where it changes to run in the reverse direction at low speed. Finally, the motor stops after reaching the falling edge of the HW signal.

- HW signal inactive at start, hitting the negative limit switch

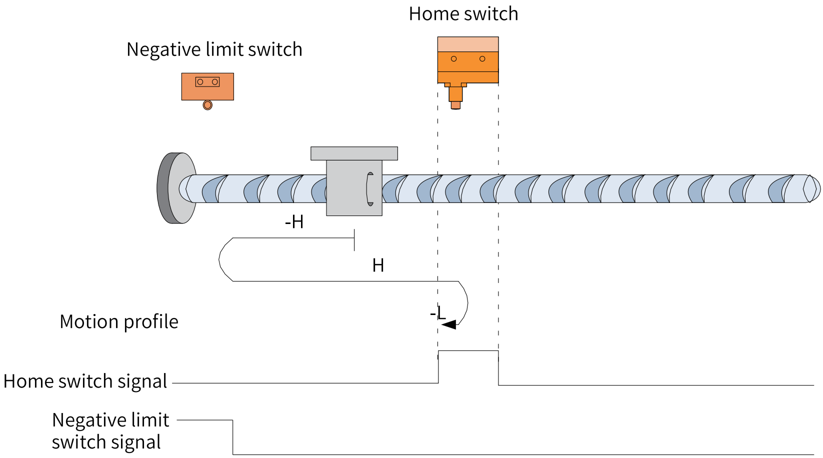


Figure 2-82 HW signal inactive at start, hitting the negative limit switch

The HW signal is inactive at start, and the motor starts homing in the reverse direction at high speed. If the axis hits the limit switch, the motor changes to run in the forward direction at high speed. After reaching the rising edge of the HW signal, the motor decelerates and changes to run in the reverse direction at low speed until it stops after reaching the falling edge of the HW signal.

- HW signal active at start

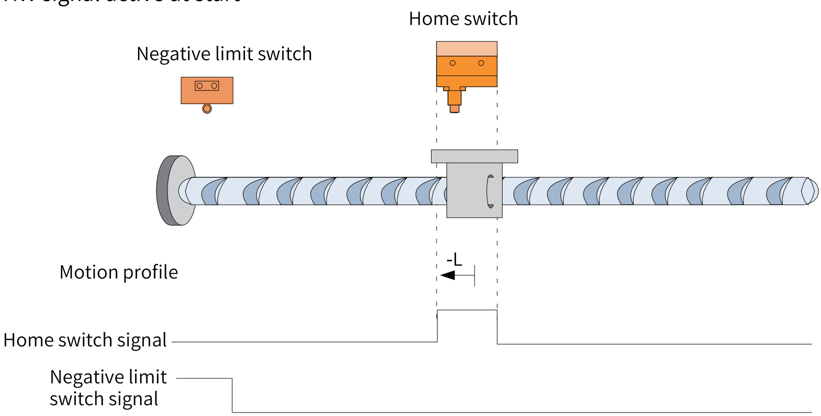


Figure 2-83 HW signal active at start

The HW signal is active at start, and the motor starts homing in the reverse direction at low speed and stops after reaching the falling edge of the HW signal.

6098h = 31/32

This mode is not defined in the CiA402 protocol. It can be used for extension purpose.

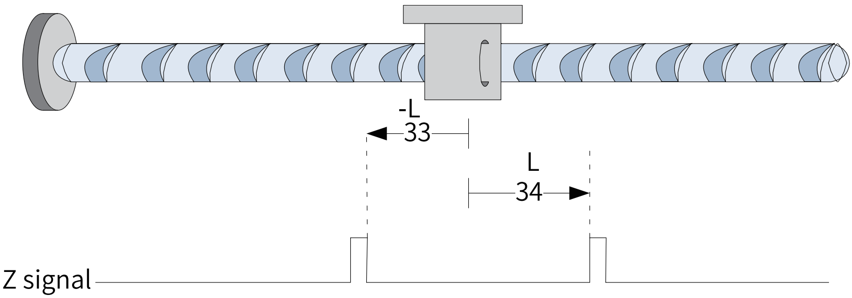
6098h = 33/34

Home: Z signal

Deceleration point: None

Homing mode 33: The motor runs in the reverse direction at low speed and stops at the first Z signal.

Homing mode 34: The motor runs in the forward direction at low speed and stops at the first Z signal.



6098h = 35

Homing mode 35: The present position is taken as the mechanical home. After homing is triggered (control word 6040: 0x0F → 0x1F):

60E6h = 0 (Absolute homing)

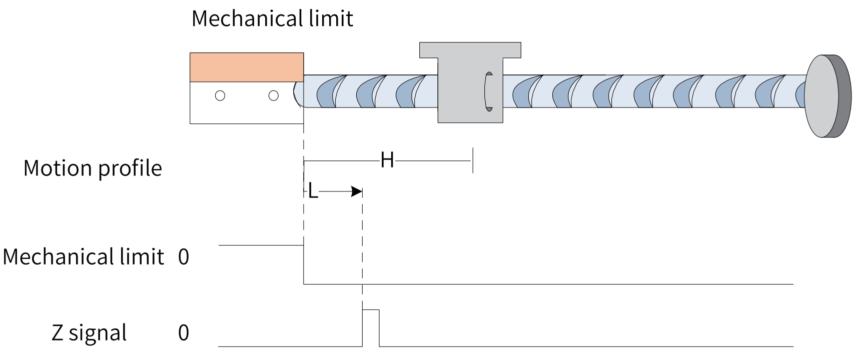
6064h (Position actual value) is equal to 607Ch (Home offset) after homing is done.

60E6h = 1 (Relative homing)

6064h is the sum of the original value plus 607Ch (Home offset) after homing is done.

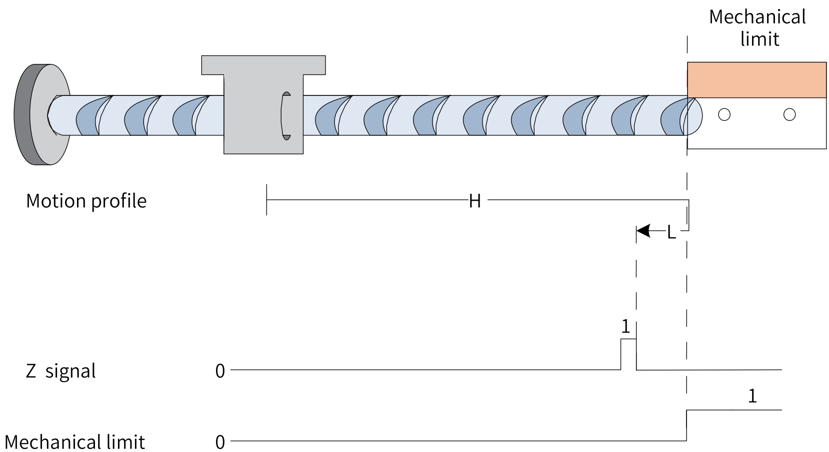
6098h = -1

The motor runs in the reverse direction at high speed first. If the status where the torque reaches the limit and the speed is near zero after the axis hits the mechanical limit persists, it indicates the axis has reached the mechanical limit position. In this case, the motor runs in the forward direction at low speed and stops after reaching the rising edge of the Z signal for the first time.



6098h = -2

The motor runs in the forward direction at high speed first. If the status where the torque reaches the limit and the speed is near zero after the axis hits the mechanical limit persists, it indicates the axis has reached the mechanical limit position. In this case, the motor runs in the reverse direction at low speed and stops after reaching the rising edge of the Z signal for the first time.



Note

Keep sufficient distance between the limit switch and the positive/negative limit switch and set a proper acceleration value. Failure to comply may result in collision.

2.11 Introduction to the Absolute Encoder System

For wiring and installation of the absolute encoder battery box, see section "Connecting the Servo Drive and Encoder Cable" in SV660N Series Servo Drive Hardware Guide.

2.11.1Absolute Encoder System

- Overview
  The absolute encoder, which carries a resolution of 8388608 (2^{23}) PPR, detects the motor position within one revolution and counts the number of revolutions, with 16-bit multi-turn data saved. The absolute encoder system works in the position control, speed control, and torque control modes. When the servo drive is powered off, the encoder battery serves as the power supply to enable the encoder to save the position data. The servo drive therefore can calculate the absolute mechanical position through the encoder after power-on, removing the need for homing.

  When using the absolute encoder, set 2000-01h (H00-00) to 14101 (Inovance 23-bit absolute encoder) and set 2002-02h (H02–01) (Absolute system selection) based on actual conditions. E731.0 will be reported when the battery is connected for the first time. In the case, set 200D-15h (H0D-20) to 1 to reset the encoder fault, and then perform homing.

Note

When the value of 2002-03h (H02-02 (Direction of rotation)), 200D-15h (H02-04 (Absolute encoder reset selection)), or the mechanical gear ratio is modified, the mechanical position will change abruptly, requiring a homing operation. After homing is done, the deviation between the mechanical absolute position and that saved in the encoder will be calculated automatically and saved in the EEPROM of the servo drive.

- Setting related parameter
  Absolute encoder system setting

  Set 2000-01h (H00-00) to 14101 to select Inovance motor equipped with 23-bit absolute encoder, and select the absolute position mode in 2002-02h (H02-01).

<table>
<tr><td>H00-00</td><td>Name</td><td colspan="3">Motor code</td><td>Setting Condition & Effective Time</td><td>At stop & Next power-on</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>2000-01h</td><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>14101</td></tr>
<tr><td colspan="11">Defines the code of the servo motor.</td></tr>
</table>

Setpoint	Motor code	Remarks
14000	Inovance motor equipped with incremental encoder	Encoder resolution: 1048576 (2^{20})
14101	Inovance motor equipped with absolute encoder	Encoder resolution: 8388608 (2^{23})

<table>
<tr><td>H02-01</td><td>Name</td><td colspan="3">Absolute system selection</td><td>Setting Condition & Effective Time</td><td>At stop & Next power-on</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>2002-02h</td><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 4</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the mode of the absolute system.</td></tr>
</table>

Setpoint	Absolute system selection	Remarks	Description
0	Incremental position mode	The encoder is used as a serial incremental encoder without power-off memory.	No battery needed, no battery fault or multi-turn fault
1	Absolute position linear mode	The encoder is used as an absolute encoder with power-off memory. This mode is applicable to applications where the load travel range is fixed and multi-turn data does not overflow. The multi-turn data range in the absolute position linear mode is [-32768 to +32767].	Battery needed, indications of battery fault, multi-turn counting error and overflow fault available
2	Absolute position rotation mode	The encoder is used as an absolute encoder with power-off memory. This mode is mainly applicable to applications where the load travel range is unlimited and only single-turn position feedback is needed.	Battery needed, indication of battery fault available, indication of multi-turn overflow fault not available
3	Absolute position linear mode (encoder overflow not detected)	The encoder is used as an absolute encoder with power-off memory. This mode is applicable to applications where multi-turn data overflow can be neglected.	Battery needed, indication of battery fault available, indication of multi-turn overflow fault not available
4	Absolute position single-turn mode	In this mode, only the single-turn position of the encoder is saved.	No battery needed, no battery fault or multi-turn fault

- Encoder feedback data

The feedback data of an absolute encoder includes the number of revolutions and the motor position within one revolution. In the incremental position mode, the number of revolutions will not be counted.

<table>
<tr><td>H0B-70</td><td>Name</td><td colspan="3">Number of revolutions fed back by the absolute encoder</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>200B-47h</td><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the number of revolutions fed back by the absolute encoder.</td></tr>
</table>

<table>
<tr><td>H0B-71</td><td>Name</td><td colspan="3">Single-turn position feedback of the absolute encoder</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>200B-48h</td><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>(encoder unit)</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Displays the single-turn position feedback of the encoder. If the encoder resolution is R_E (for example, $R_E = 2^{23}$), then the range is 0 to (R_E - 1).</td></tr>
</table>

<table>
<tr><td>H0B-77</td><td>Name</td><td colspan="3">Absolute position feedback of the encoder (low 32 bits)</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>200B-4Eh</td><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>(encoder unit)</td><td>Default</td><td>-</td></tr>
<tr><td>H0B-79</td><td>Name</td><td colspan="3">Absolute position feedback of the absolute encoder (high 32 bits)</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>200B-08h</td><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>(encoder unit)</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the absolute position feedback of the encoder.</td></tr>
</table>

2.11.2Absolute Position Linear Mode

This mode applies to applications where the axis travel range is fixed without multi-turn data overflow.

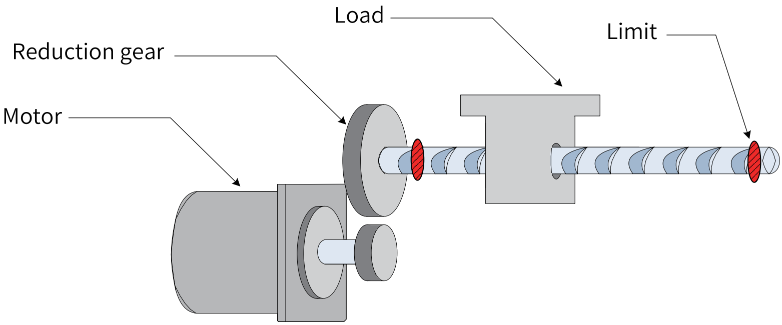


Figure 2-84 Application mechanism in the linear mode

Assume the absolute mechanical position (200B-3Bh (H0B-58) and 200B-3Dh (H0B-60)) is P_M, the encoder absolute position is P_E, the position offset in the absolute position linear mode (2005-2Fh (H05-46) and 2005-31h (H05-48)) is P_O, their relation will be as follows: $P_M = P_E - P_O$

Assume the electronic gear ratio is B/A, and the mechanical absolute position (reference unit) is 200B-08h (H0B-07), then the following formula applies: 200B-08h (H0B-07) = P_M/(B/A)

The multi-turn data range in the absolute position linear mode is -32768 to +32767. If the number of forward revolutions is higher than 32767 or the number of reverse revolutions is lower than -32768, E735.0 (Encoder multi-turn counting overflow) will occur. In this case, set 200D-15h (H0D-20) to 2 to reset the multi-turn data, and then perform homing again. In special occasions, you can set 200A-25h (H0A-36) to 1 to hide E735.0 or use absolute position linear mode where the encoder overflow fault will not be reported.

H05-46	Name	Position offset in absolute position linear mode (low 32 bits)			Setting Condition & Effective Time	At stop & Next power-on	Data Structure	-	Data Type	Int32
2005-2Fh	Access	RW	Mapping	-	Related Mode	All	Data Range	-2^{31} to $(2^{31} - 1)$ (encoder unit)	Default	0
H05-48	Name	Position offset in absolute position linear mode (high 32 bits)			Setting Condition & Effective Time	At stop & Next power-on	Data Structure	-	Data Type	Int32

2005-31h	Access	RW	Mapping	TPDO	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (encoder unit)	Default	0
These parameters define the offset of the absolute mechanical position (encoder unit) against the absolute position (encoder unit) fed back by the encoder in the linear mode (2002-02 (H02-02) = 1). Position offset in the absolute position linear mode = Absolute position fed back by the encoder - Mechanical absolute position										

Note

The offset of the absolute position linear mode (2005-2Fh (H05-46) and 2005-31h (H05-48)) is 0 by default. If
homing is performed, the servo drive calculates the deviation between the absolute position fed back by the encoder and the mechanical absolute position after homing, assigns the deviation to 2005-2Fh (H05-46) and 2005-31h (H05-48), and saves the deviation in EEPROM.

H0B-07	Name	Absolute position counter			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
200B-08h	Access	RO	Mapping	-	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (reference unit)	Default	-
Indicates current mechanical absolute position (reference unit) in the position control mode.										

H0B-58	Name	Mechanical absolute position (low 32 bits)			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
200B-3Bh	Access	RO	Mapping	-	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (p)	Default	0
H0B-60	Name	Mechanical absolute position (high 32 bits)			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
200B-3Dh	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (p)	Default	0
Indicates the mechanical absolute position.										

Index 6063h	Name	Position actual value*			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	(encoder unit)	Default	0
Indicates the absolute position of the motor (encoder unit). This value is equal to 200B-3Bh (H0B-58) in the absolute position mode.										

Index 6064h	Name	Position actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	(reference unit)	Default	0
Indicates the absolute position feedback in user-defined unit. This value is equal to 200B-08h (H0B-07) in the absolute position mode. Position actual value (6064h) x Gear ratio (6091h) = Position actual value* (6063h)										

H0A-36	Name	Encoder multi-turn overflow fault			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
200A-25h	Access	RW	Mapping	No	Related Mode	All	Data Range	0 to 1	Default	0
Defines whether to hide E735.0 (Encoder multi-turn counting overflow) in the absolute position linear mode.										

Setpoint	Description
0	0: Not hide
1	1: Hide

2.11.3Absolute Position Rotation Mode

This mode applies in cases where the load travel range is unlimited and the number of unidirectional revolutions is lower than 32767, as shown in the following figure.

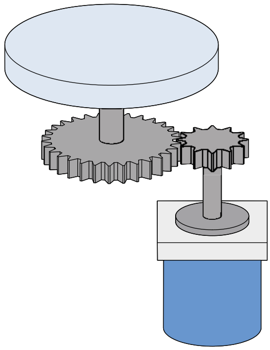
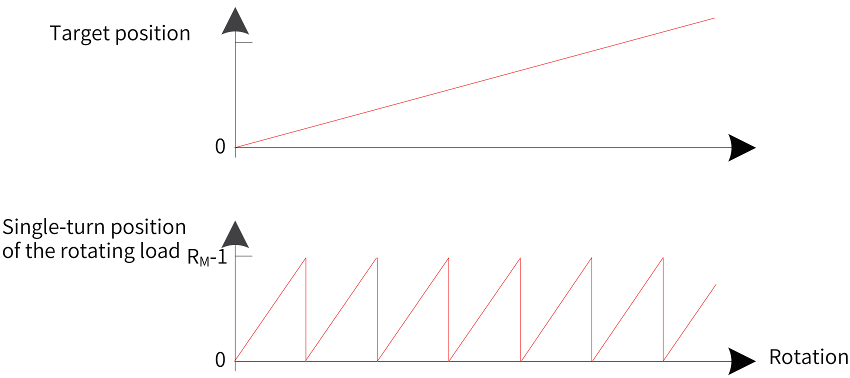
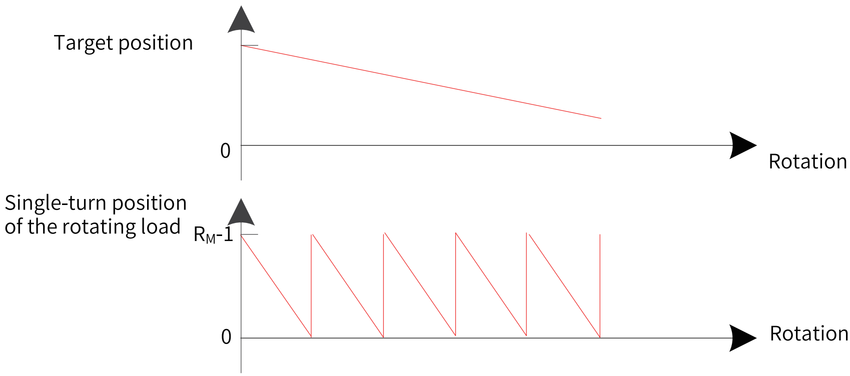


Figure 2-85 Rotating load

The single-turn position range of the rotating load is 0 to (R_M - 1) (R_M: Encoder pulses per load revolution). When the gear ratio is 1:1, the variation law of the target position and the single-turn position of the rotating load during forward operation is as follows.



The variation law of the target position and the single-turn position of the rotating load during reverse operation is as follows.



When the motor works in the absolute position rotation mode while the servo drive works in the HM mode, the home offset setting range is 0 to (R_M - 1). If the home offset is set to a value outside this range, the servo drive reports EE09.1 (Home setting error).

The multi-turn data range is unlimited in the absolute position rotation mode. Therefore, E735.0 (Encoder multi-turn counting overflow) is hidden automatically.

Related parameters:

H05-50	Name	Mechanical gear ratio (numerator) in the absolute position rotation mode			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
2005-33h	Access	RW	Mapping	-	Related Mode	All	Data Range	1 to 65535	Default	1
H05-51	Name	Mechanical gear ratio (denominator) in absolute position rotation mode			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
2005-34h	Access	RW	Mapping	-	Related Mode	All	Data Range	1 to 65535	Default	1

H05-52	Name	Pulses per load revolution in absolute position rotation mode (low 32 bits)			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint32
2005-35h	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to (2^{32} - 1) (encoder unit)	Default	0
H05-54	Name	Pulses per load revolution in absolute position rotation mode (high 32 bits)			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint32

2005-37h	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to (2^{32} - 1) (encoder unit)	Default	0
Defines the ratio of the feedback pulses (encoder unit) per load revolution to the absolute position (encoder unit) fed back by the encoder when the absolute encoder system works in the rotation mode (2002-02 (H02-01) = 2). Assume the encoder resolution is R_E, the encoder pulses per revolution is R_M: 1) when 2005-35h (H05-52) or 2005-37h (H05-54) is set to 0: $R_M = R_E$ x 2005-33h (H05-50)/2005-34h (H05-51) 2) when 2005-35h (H05-52) or 2005-37h (H05-54) is set to a non-zero value: R_M = (2005-37h) x 2^{32} + (2005-35h)										

Note

The servo drive calculates the upper limit of the mechanical absolute position using 2005-35h (H05-52) and 2005-37h (H05-54) first. If 2005-35h (H05-52) and 2005-37h (H05-54) are both set to 0, the servo drive employs 2005h-33h (H05-50) and 2005-34h (H05-51) for calculation.

H0B-81	Name	Single-turn position of the rotating load (low 32 bits)			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
200B-08h	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-(encoder unit)	Default	-
H0B-83	Name	Single-turn position of the rotating load (high 32 bits)			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
200B-08h	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-(encoder unit)	Default	-
Displays the single-turn position (encoder unit) of the rotating load. Value range: ($-R_M$ + 1) to (R_M - 1)										

H0B-85	Name	Single-turn position of the rotating load			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
200B-08h	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-(reference unit)	Default	-
Indicates the single-turn position of the rotating load (reference unit).										

<table>
<tr><td rowspan="2">6063h</td><td>Name</td><td colspan="3">Position actual value*</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-(encoder unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the absolute single-turn position of the rotating load (encoder unit). This value is equal to 200B-52h (H0B-81) in the absolute position mode.</td></tr>
</table>

<table>
<tr><td rowspan="2">6064h</td><td>Name</td><td colspan="3">Position actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-(reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the single-turn absolute position feedback of the rotating load in real time in user-defined unit. This value is equal to 200B-08h (H0B-07) in the absolute position mode.
Position actual value (6064h) x Gear ratio (6091h) = Position actual value* (6063h)</td></tr>
</table>

2.11.4Single-turn Absolute Mode

This mode applies to applications where the load travel range is within the single-turn range of the encoder. In this case, the absolute encoder needs no battery as it saves the single-turn data only.

Target position input range of EtherCAT communication

If a 23-bit absolute encoder is used in the single-turn absolute mode, the servo drive operates in the CSP or PP mode, and the electronic gear ratio 1:1, then:

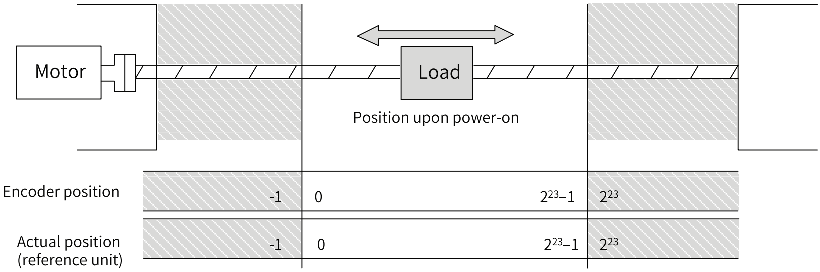
When 607Ch (Home offset) is set to 0, the target position range is 0 to (2^{23} - 1).

After homing is done, the target position range is 607Ch to (2^{23} - 1 + 607Ch).

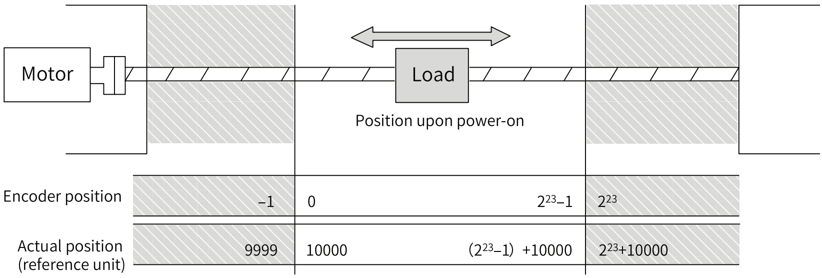
If the target position is set to a value outside the preceding range, EB01.4 (Target position beyond upper/lower limit) will be reported.

Example

- When the gear ratio is 1:1 and 607Ch is set to 0, the position range is shown as follows.



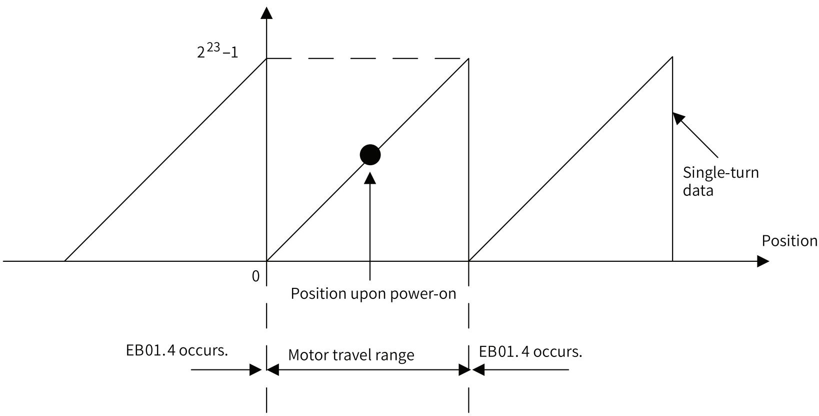
- When the gear ratio is 1:1, and 607Ch is set to 10000, the position range is shown as follows.



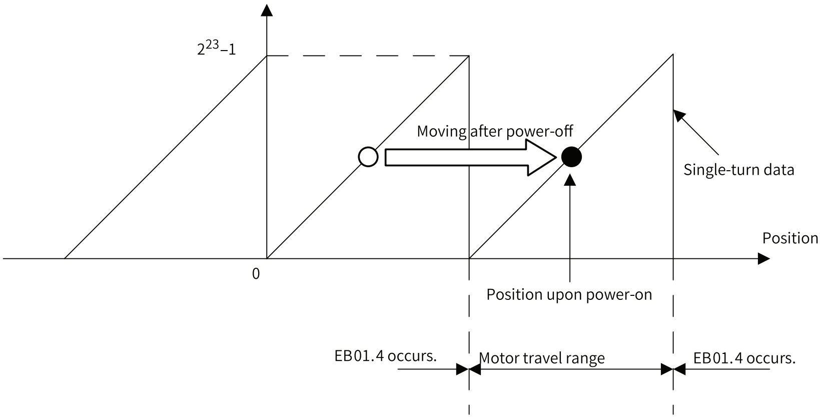
Precaution for the motor position upon power-on

The motor travel range is determined by the motor position upon power-on (take the 23-bit absolute encoder as an example).

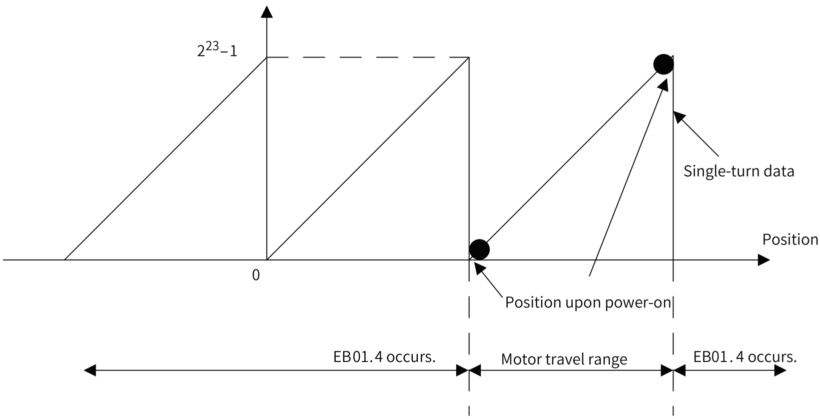
- Position upon power-on: The motor travel range shown in the following figure is derived from the single-turn data range at the power-on position.



- To change the motor travel range, turn off the power supply at the position shown in the preceding figure, and turn on the power supply again after the motor moves to the position shown in the following figure.



- Note: When the power supply is switched on near the motor travel range, EB01.4 (Target position beyond upper/lower limit) may easily occur.



2.11.5Precautions for Use of the Battery Box

E731.0 (Encoder battery fault) will be reported when the battery is connected for the first time. In this case, set 200D-15h (H0D-20) to 1 to reset the fault before further operations.

When the battery voltage detected is lower than 3.0 V, E730.0 (Encoder battery warning) will be reported. In this case, replace the battery based on the following steps:

1. Power on the servo drive and make it stay in the non-operational state.

2. Replace the battery.
3. After E730.0 (Encoder battery warning) is cleared, if no other warning/fault occurs, you can continue operating the servo drive.

If you replace the battery after power-off, E731.0 (Encoder battery fault) will be reported, with the multi-turn data changed abruptly. In this case, set 200D-15h (H0D-20) to 1 to reset the fault, and then perform homing again.

Ensure the motor speed does not exceed 6000 RPM after the servo drive is powered off. This is to enable the encoder to save the position data accurately.

Keep the battery in environments within the required ambient temperature and ensure the battery is in reliable contact with sufficient power reserved. Failure to comply may result in encoder data loss

Related parameter:

H0D-20	Name	Absolute encoder reset selection			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
200D-15h	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 2	Default	0

Defines whether to reset the encoder fault or the multi-turn data of the encoder.

Setpoint	Description
0	No operation
1	Reset encoder fault
2	Reset encoder fault and multi-turn data

Note

The absolute position saved by the encoder changes abruptly after multi-turn data reset. In this case, perform mechanical homing.

2.12 Auxiliary/Application Functions

The servo drive provides the following auxiliary functions:

- Touch probe function
- Software position limit
- Position comparison
- EtherCAT-forced DO

2.12.1Touch Probe Function

Description

The touch probe function is used to latch the position (reference unit) when a DI signal or Z signal changes. The SV660N series servo drive offers two touch probes to save position values corresponding to the rising edge and falling edge of each touch probe signal, which means a total of four position values can be latched simultaneously.

Note

No specific DI logic is required when a DI is used to trigger the touch probe.

You can set the filter window for the touch probe signal in 200A-14h (H0A-19) and 200A-15h (H0A-20) when a DI is used to trigger the touch probe.

Related objects

Index (HEX)	Sub-index (HEX)	Name	Access	Data Type	Unit	Value Range	Default
2003	3	DI1 function	RW	Uint16	-	0 to 65535	14
...							
2003	0B	DI5 function	RW	Uint16	-	0 to 65535	39
60B8	0	Touch probe function	RW	Uint16	-	0 to 65535	0
60B9	0	Touch probe status	RO	Uint16	-	-	0
60BA	0	Touch probe 1 positive edge	RO	Int32	Reference unit	-	0
60BB	0	Touch probe 1 negative edge	RO	Int32	Reference unit	-	0
60BC	0	Touch probe 2 positive edge	RO	Int32	Reference unit	-	0
60BD	0	Touch probe 2 negative edge	RO	Int32	Reference unit	-	0
60D5	0	Touch probe 1 positive edge counter	RO	Uint16	-	-	0
60D6	0	Touch probe 1 negative edge counter	RO	Uint16	-	-	0
60D7	0	Touch probe 2 positive edge counter	RO	Uint16	-	-	0
60D8	0	Touch probe 2 negative edge counter	RO	Uint16	-	-	0

Operation procedure

Observe the following procedure when using DI5 to trigger the touch probe.

Background: touch probe 1 positive edge, continuous latching

1. Set 2003-0Bh (H03-10 (DI5 function)) to 38.
2. Set the touch probe function in 0x60B8.
   Assignment of each bit of the touch probe function (0x60B8) is shown in the following table.

<table>
<tr><td rowspan="2">Index 60B8h</td><td>Name</td><td colspan="3">Touch probe function</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the functions of touch probe 1 and touch probe 2.
For absolute encoders, Z signal refers to the zero point of the single-turn position feedback.</td></tr>
</table>

See the following table for descriptions of each bit of 60B8.

<table>
<tr><th>bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Touch probe 1 function selection
0: Switch off touch probe 1
1: Enable touch probe 1</td><td rowspan="6">bit0 to bit5: settings related to touch probe 1
When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled.
For absolute encoders, Z signal refers to the zero point of the single-turn position feedback.</td></tr>
<tr><td>1</td><td>Touch probe 1 trigger mode
0: Single trigger mode (Latches the position at the first trigger event.)
1: Continuous trigger mode</td></tr>
<tr><td>2</td><td>Touch probe 1 trigger signal selection
0: DI signal
1: Z signal</td></tr>
<tr><td>3</td><td>N/A</td></tr>
<tr><td>4</td><td>Touch probe 1 positive edge
0: Switch off latching at positive edge
1: Enable latching at positive edge</td></tr>
<tr><td>5</td><td>Touch probe 1 negative edge
0: Switch off latching at negative edge
1: Enable latching at negative edge</td></tr>
<tr><td>6 to 7</td><td>N/A</td><td>-</td></tr>
</table>

bit	Name	Description
8	Touch probe 2 function selection 0: Switch off touch probe 2 1: Enable touch probe 2	bit8 to bit13: settings related to touch probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 positive edge 0: Switch off latching at positive edge 1: Enable latching at positive edge	
13	Touch probe 2 negative edge 0: Switch off latching at negative edge 1: Enable latching at negative edge	
14 to 15	N/A	-

Set 0x60B8 to 0x0013 in this example.

3. Read the touch probe status in 0x60B9.
   Assignment of each bit of 0x60B9 is shown in the following table.

<table>
<tr><td rowspan="2">Index 60B9h</td><td>Name</td><td colspan="3">Touch probe status</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>-</td><td>Default</td><td>-</td></tr>
</table>

Defines the functions of touch probe 1 and touch probe 2.
See the following table for descriptions of each bit of 60B9.

bit	Name	Description
0	Touch probe 1 function selection 0: Switch off Touch probe 1 1: Enable touch probe 1	bit0 to bit2: status of touch probe 1
1	Touch probe 1 positive edge value 0: No positive edge value latched 1: Positive edge value latched	
2	Touch probe 1 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
3 to 7	N/A	-
8	Touch probe 2 function selection 0: Switch off Touch probe 1 1: Enable touch probe 1	bit8 to bit10: status of touch probe 2
9	Touch probe 2 positive edge value 0: No positive edge value latched 1: Positive edge value latched	
10	Touch probe 2 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
11 to 15	N/A	-

In this example, you can read bit1 of 0x60B9 to check whether the touch probe 1 positive edge value is latched.

4. Read the latch position of the touch probe. The four position values of the touch probe are saved to 0x60BA...0x60BD.
   In this example, if position latching at positive edge of touch probe 1 is executed, you can read the position value in 0x60BA (Touch probe 1 positive edge, reference unit). The latching times can be read in 0x60D5.

   Illustration

   The following figure shows the sequence of the touch probe function setting and status feedback in the preceding example, with DI5 used as the trigger signal and latching at positive edge enabled.

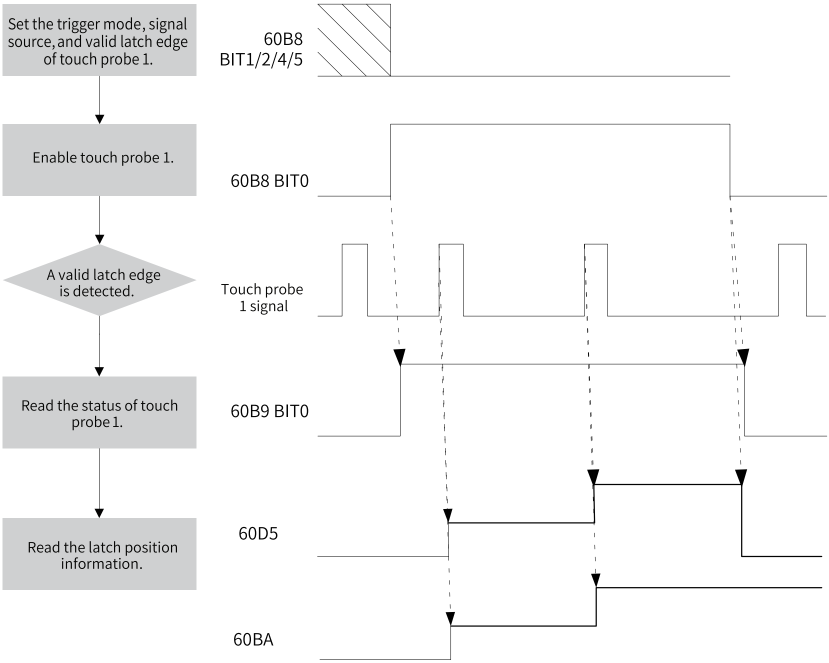


Figure 2-86 Procedure for use of the touch probe

2.12.2Software Position Limit

Description

In conventional drives, the position limit is defined by external sensor signals connected to CN1, which is known as hardware position limit.

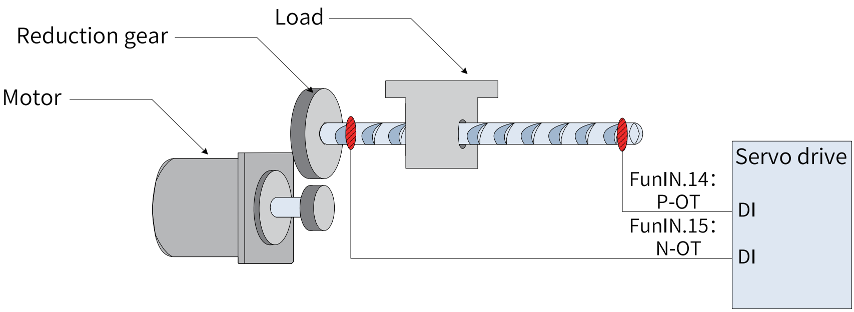


Figure 2-87 Installation of the limit switch

Table 2–3 Comparison between the hardware position limit and software position limit

Hardware Position Limit		Software Position Limit	
1	Restricted to linear motion and single-turn rotational motion.	1	Applicable to both the linear motion and the rotational motion.
2	Requires an external mechanical limit switch.	2	Removes the need for hardware wiring, preventing malfunction due to poor cable contact.
3	Suffered from the risk of mechanical slip.	3	Prevents malfunction due to mechanical slip through internal position comparison.
4	Unable to sense or detect an overtravel fault after power-off.		

The software position limit works by comparing the limit value with the internal feedback value. If the latter exceeds the former, a warning will be reported and the servo drive stops. This function applies to both the absolute position mode and the incremental position mode. In the incremental position mode, set 200A-02h to 2, which means the servo drive performs homing to find the mechanical home after power-on, and then enables the software position limit.

Related objects

Related index codes:

H0A-01	Name	Absolute position limit			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
200A-02h	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 2	Default	0

Defines whether the absolute position limit is active and the condition for activation.

Setpoint	Absolute Position Limit
0	Disabled
1	Enabled
2	Enabled after homing

If the absolute position limit is enabled, the servo drive stops in the mode defined by 2002-08h (H02–07) when the absolute position feedback reaches the limit value.

607D-01h	Name	Minimum software position limit			Setting Condition & Effective Time	During running & At stop	Data Structure	-	Data Type	Int32
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	-2^{31} to $(2^{31}-1)$ (reference unit)	Default	-2^{31}

Defines the minimum software position limit relative to the mechanical zero.

<table>
<tr><td rowspan="2">607D-02h</td><td>Name</td><td colspan="3">Maximum software position limit</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-2^{31} to (2^{31} - 1) (reference unit)</td><td>Default</td><td>2^{31} - 1</td></tr>
<tr><td colspan="11">Defines the maximum software position limit relative to the mechanical zero.</td></tr>
</table>

Caution

- Ensure the value of 607D-01h is lower than or equal to 607D-02h. If 607D-01h is set to a value higher than 607D-02h, EE09.0 (Software position limit setting error) will occur.
- In the absolute rotation mode or single-turn mode, ensure 607D-01 and 607D-02 are within the mechanical position limit. Otherwise, the servo drive reports EE09.0.
- Ensure the value of 607Ch (Home offset) is within the software position limit. Otherwise, the servo drive reports EE09.1.

2.12.3Position Comparison

Description

Position comparison works by comparing the instantaneous position data with the value pre-stored in the data array and, once available, outputting a DO signal with pulse width settable for future use in subsequent motion control.

Position comparison is applicable to high-speed motion axes as comparison actions are implemented by FPGA, removing the risk of software communication delay between processors.

For position comparison, you can select "active high" or "active low" for DOs. When "active high" is selected, the corresponding DO is activated when it is connected to the common terminal and deactivated when it is disconnected from the common terminal. When "active low" is selected, the corresponding DO is deactivated when it is connected to the common terminal and activated when it is disconnected from the common terminal. Three DOs are available for SV660N series servo drives.

Note

Position comparison is available only when the following conditions are fulfilled.

Preconditions for Position Comparison	
Control mode	All the control modes
Others	Motor rotating normally with critical elements (those besides control parameters) set properly

Related objects

When position comparison is enabled, you can assign DO function 25 (Position comparison) to any one of the three DOs, and the DO you select will be used as the position comparison output signal.

Parameters for position comparison

Para. No.		Name	Description
HEX	DEC		
Group H18: Position comparison output			
2018-01h	H18-00	Position comparison switch	1: Enable
2018-03h	H18-02	Position comparison resolution	Defines the number of pulses per revolution. For example, if H18-02 is set to 1, the number of pulses per revolution is 2^{22}. 0: 24-bit 1: 23-bit 2: 22-bit 3: 21-bit 4: 20-bit 5: 19-bit 6: 18-bit 7: 17-bit
2018-04h	H18-03	Position comparison mode	0: Single comparison 1: Cyclic comparison
2018-05h	H18-04	Current position as zero	1: Enable
2018-06h	H18-05	Position comparison pulse width	Defines the active pulse width of the DO when the comparison point is reached. The value range is 0 to 2047 (unit: 0.1 ms).
2018-08h	H18-07	Start point of position comparison	Activated when H18-00 is set to 1 again.

Para. No.		Name	Description
HEX	DEC		
Group H18: Position comparison output			
2018-09h	H18-08	End point of position comparison	Activated when H18-00 is set to 1 again.
2018-0Ah	H18-09	Current status of position comparison	0: No comparison; n: Waiting for the number N comparison point
2018-0Bh	H18-10	Real-time position feedback	Displays the current position value during position comparison. Value range: -2^{31} to 2^{31} - 1
2018-0Dh	H18-12	Zero offset of position comparison	Defines the offset value after current position is taken as the zero point. Value range: -2^{31} to $+2^{31}$-1
2019-01h	H19-00	Target value of position comparison 1	Defines the target value of position comparison 1. Value range: -2^{31} to 2^{31} - 1
2019-03h	H19-02	Attribute value of position comparison 1	Defines the attribute value of position comparison 1. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019-04h	H19-03	Target value of position comparison 2	Defines the target value of position comparison 2. Value range: -2^{31} to 2^{31} - 1
2019-06h	H19-05	Attribute value of position comparison 2	Defines the attribute value of position comparison 2. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019–07h	H19-06	Target value of position comparison 3	Defines the target value of position comparison 3. Value range: -2^{31} to 2^{31} - 1

Para. No.		Name	Description
HEX	DEC		
Group H18: Position comparison output			
2019-09h	H19-08	Attribute value of position comparison 3	Defines the attribute value of position comparison 3. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019-0Ah	H19-09	Target value of position comparison 4	Defines the target value of position comparison 4. Value range: -2^{31} to 2^{31} - 1
2019-0Ch	H19-11	Attribute value of position comparison 4	Defines the attribute value of position comparison 4. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019-0Dh	H19-12	Target value of position comparison 5	Defines the target value of position comparison 5. Value range: -2^{31} to 2^{31} - 1
2019-0Fh	H19-14	Attribute value of position comparison 5	Defines the attribute value of position comparison 5. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019-10h	H19-15	Target value of position comparison 6	Defines the target value of position comparison 6. Value range: -2^{31} to 2^{31} - 1

Para. No.		Name	Description
HEX	DEC		
Group H18: Position comparison output			
2019-12h	H19-17	Attribute value of position comparison 6	Defines the attribute value of position comparison 6. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019-13h	H19-18	Target value of position comparison 7	Defines the target value of position comparison 7. Value range: -2^{31} to 2^{31} - 1
2019-15h	H19-20	Attribute value of position comparison 7	Defines the attribute value of position comparison 7. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations
2019-16h	H19-21	Target value of position comparison 8	Defines the target value of position comparison 8. Value range: -2^{31} to 2^{31} - 1
2019-18h	H19-23	Attribute value of position comparison 8	Defines the attribute value of position comparison 8. 0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations

Run

1. Description

   Position comparison works by comparing the instantaneous position feedback with the value pre-saved in the data array and, once available, outputting a DO signal with pulse width settable for future use in subsequent motion control. Position comparison is applicable to high-speed motion axes as comparison actions are implemented by FPGA, removing the risk of software communication delay between processors.

- Position comparison switch:
  When the value of H18-00 (Position comparison switch) changes from 0 to 1, position comparison starts and the value of H18-09 (Current status of position comparison) is updated to the start point of position comparison. When the value of H18-00 changes to 0, position comparison stops and the current comparison status will be cleared.

- Position comparison resolution:
  The comparison resolution defines the number of pulses per revolution. Given the maximum and minimum limits on the target position defined by group H19, you can reset the resolution when the comparison value overflows. For example, when H18-02 is set to 7 (17-bit), the maximum value of the target position is 2^{31} - 1, and the motor rotates (2^{31} - 1)/2^{17} circles.

  The target position in group H19 is only related to the set resolution.

- Single comparison mode:
  In the single comparison mode, when comparison of the end point is done, the comparison function is switched off automatically and the current comparison value is cleared. Position comparison can be enabled again only when the position comparison switch is switched on again.

  The real-time position feedback in the single comparison mode is an absolute value, which means it is an accumulative value based on preceding comparison points, which cannot be cleared automatically.

- Cyclic comparison mode:
  In the cyclic comparison mode, position comparison will not be switched off when the comparison end point is reached, and current position comparison value will be reset as the start point for position comparison. After comparison of each point is done, the real-time position feedback (H18-10) will be cleared and counted again for cyclic comparison. In the cyclic comparison mode, the target position is a relative (incremental) value. Each time a comparison point is reached, the real-time position feedback is cleared and counted again for comparison with the new target.

- Position comparison output width:
  When the position comparison conditions are fulfilled, the servo drive outputs DO active level signal. The width of the active signal can be set by H18-05 (value range: 1 to (2047 x 0.1) ms).

  When position comparison DO is active, the comparison logic is suspended and no comparison will be performed. In this case, ensure the operating time between two target points is larger than the output width of DO.

- Target value of position comparison
  There are eight target values for position comparison. The target value is a 32-bit signed number. The target value and attribute value of position comparison must be updated to parameters in group H19 in advance.

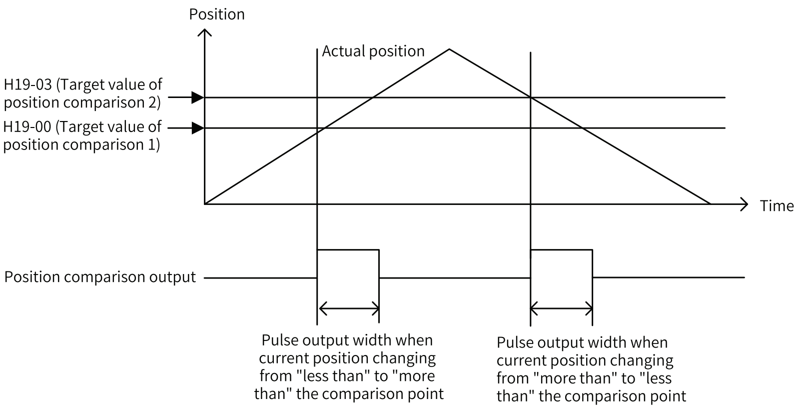
- Start point for comparison:
  The start point indicates the position of the first comparison point. For example, if the start point is set to 5, the comparison starts from position comparison 5.

- End point for comparison:
  The end point indicates the position of the last comparison point. For example, if the end point is set to 7, the comparison stops or restarts from the start point after position comparison 7 is reached.

- Zero offset of position comparison:
  The value of H18-10 (Real-time position feedback) will be changed to the offset value defined by H18-12 at the rising edge (0→1) of H18-04 (Current position as zero point).

2. Running

- When the position feedback of the encoder passes the target position comparison values (H19-00 to H19-21), the DO outputs the time width pulse defined by H18-05, as shown in the following figure.

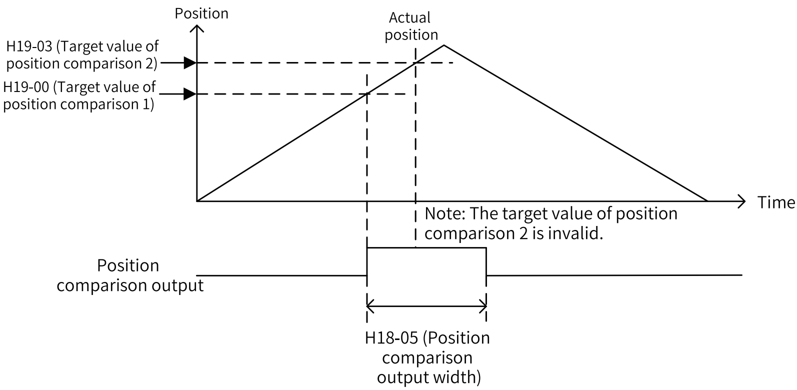


When the attribute of the comparison point is set to 1 (Output DO active signal if current position changes from "less than" to "more than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "less than" to "more than" the comparison point position.

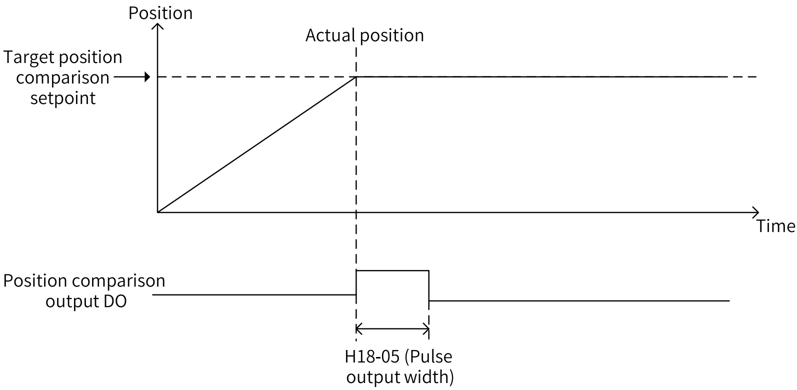
When the attribute of the comparison point is set to 2 (Output DO active signal if current position changing from "more than" to "less than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "more than" to "less than" the comparison point position.

When the attribute of the comparison point is set to 3 (Output DO active signal in both situations), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "more than" to "less than" the comparison point position in either direction.

- When the direction of action reverses and multiple position comparison values are set, no comparison will be performed once the position comparison DO is active. Therefore, ensure the operating time between two position comparison points is larger than the pulse output width. As the operating time between two comparison points is smaller than the pulse output width, position comparison is not performed when current position changes from "more than" to "less than" the comparison point.



- Only one pulse will be outputted when the stop position is the same with the target value of position comparison, as shown in the following figure.

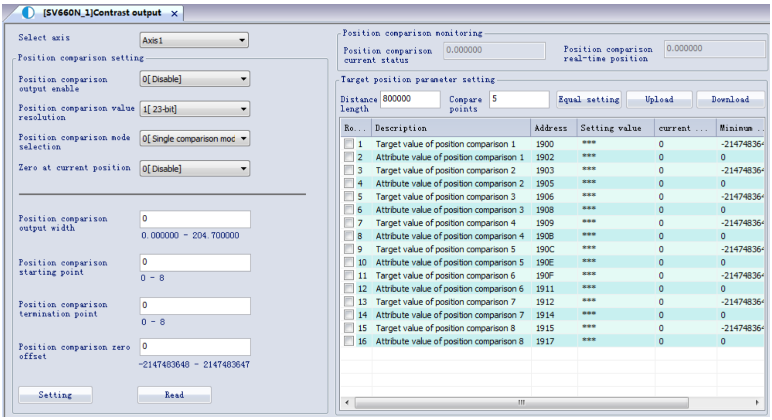


3. Interface of the software tool

The software tool supports division setting for users to set the target value of position comparison easily. Set a proper comparison mode, start point, and end point first.

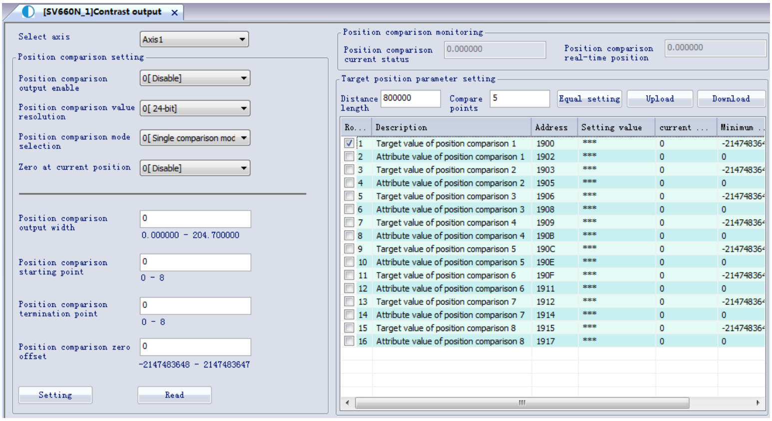
- Single comparison mode

a. Set **Position comparison mode selection** to **0 (Single position comparison mode)**.



b. **Target position parameter setting**: **Distance length** (total operating distance) and **Compare points**

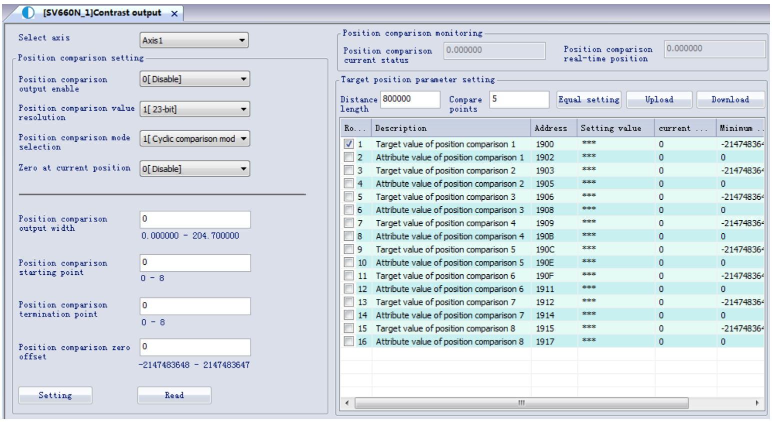
c. After clicking **Equal setting**, the target value of the first point is updated to "**Distance length** x 1/**Compare points**", the target value of the second point is updated to "**Distance length** x 2/**Compare points**", and the target value of the Nth point is updated to "**Distance length** x N/**Compare points**".



When H18-00 (Position comparison output selection) changes from 0 to 1 (Enable (rising edge-triggered)), H18-09 (Current state of position comparison) changes from 0 to 1 and the first target position value will be compared. When H18-10 (Real-time position feedback) reaches the value of the first target position, H18-09 changes from 1 to 2, and so on.

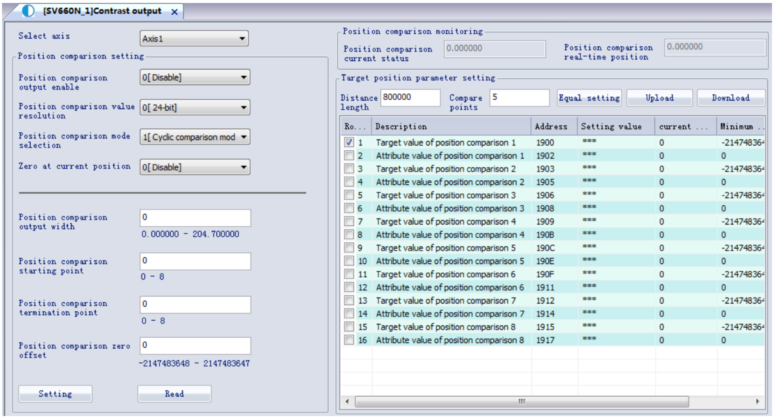
- Cyclic comparison mode

a. Set **Position comparison mode selection** to **1 (Cyclic comparison mode)**.



b. **Target position parameter setting**: **Distance length** (distance between two adjacent points) and **Compare points** (points to be compared cyclically)

c. After clicking **Equal setting**, the target values of the 1st point to the Nth point are updated to equal interval distance length.



When H18-00 (Position comparison output selection) changes from 0 to 1 (Enable (rising edge-triggered)), H18-09 (Current state of position comparison) changes from 0 to 1 and the first target position value will be compared. When H18-10 (Real-time position feedback) reaches the value of the firsta target position, H18-09 changes from 1 to 2, and so on.

2.12.4EtherCAT-forced DO Function

Description

Two DO options are available by default in the non-operational (non-OP) status (including network offline) for EtherCAT-forced DO status:

1. Status unchanged in the non-OP status: The servo status switches to the non-OP status and the forced DO status stays unchanged.
2. Initialization status: No forced DO is generated when the servo drive is in the non-OP status.
   When the network switches to the operational (OP) status, the forced DO is determined by 60FE-1 and 60FE-2.

Select the forced DO function by bits. You can select the DO to be used as EtherCAT-forced DO by bits, which means both the local functions and EtherCAT forced-DO function can be supported by the DO.

Related objects

See the following for related parameter settings.

H04-23	Name	EtherCAT-forced DO logic in non-OP status			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
2004-18h	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 7	Default	1
Descriptions for the setpoints are shown in the following table.										

Table 2–4 Description of setpoints

Setpoint	DO Function
0	Status of DO1, DO2, and DO3 unchanged in the non-OP status
1	No output in DO1 and status of others unchanged in the non-OP status
2	No output in DO2 and status of others unchanged in the non-OP status
3	No output in DO1 or DO2 and status of others unchanged in the non-OP status
4	No output in DO3 and status of others unchanged in the non-OP status
5	No output in DO1 or DO3 and status of others unchanged in the non-OP status
6	No output in DO2 or DO3 and status of others unchanged in the non-OP status
7	No output in DO1, DO2, or DO3 in the non-OP status

Setting method:

1. Assign DO function 31 (EtherCAT-forced DO) to the DO to be controlled forcibly by EtherCAT, and then set the bit of H04-23 as needed to select the forced DO status in the non-OP status.
2. Configure 60FE-1/60FE-2 as RPDO, and operate on bit16...bit18 to control the DO.

3 Safe Torque Off (STO)

3.1 STO Standards and Specifications

Terms	Description
Cat.	Classification of the safety-related parts of a control system, which are divided into B, 1, 2, 3, and 4 (ISO 13849-1)
CCF	Common cause failure
DC	Diagnostic coverage (%)
DTI	Diagnostic test interval time
SFF	Safe failure fraction
HFT	Hardware fault tolerance
PFH	Probability of dangerous hardware failure per hour
PL	Performance level
SC	Systematic capability
SIL	Safety integrity level
T1	Proof test interval
T2	Diagnostic test interval
DI	Digital input
DO	Digital outputs
PCB	Printed circuit board
MCU	Micro computer unit
FPGA	Field programmable gate array
Safe torque off	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start. If the motor is running at the moment when the STO function is activated, the motor will coast to stop.
Safe state	Disabling the PWM gating signal of the drive
System reset	Resetting the servo system through resetting the power supply or executing software reset
Proof test	Tests used to detect the failure of safety-related systems
Mission time	Specified cumulative operating time of the safety-related parts of the servo drive during its overall lifetime

Standards compliance

- North American standards (UL)
  UL 61800-5-1

  CSA C22.2 No. 274

- European directives and standards

Low Voltage Directive 2014/35/EU Standard EN 61800-5-1

Electromagnetic Compatibility Directive 2014/30/EU Standard EN 61800-3

Machinery Directive 2006/42/EC (functional safety) Standard IEC 61800-5-2

- Safety standard

Model	Safety Standard	Standard
SV660NXXX	Safety of machinery	ISO 13849-1: 2015 IEC 60204-1: 2016
	Functional safety	EN 61800-5-2: 2017 EN ISO 13849-1: 2015 EN 62061: 2005 + AC: 2010 + A1: 2013 + A2: 2015 EN 61508: 2010, parts 1-7
	EMC	IEC 61326-3-1

- Safety performance

Item	Performance Level
Safety integrity level	SIL3 SILCL3
Probability of Failure Per Hour (PFH)	PFH $\leqslant 0.1 \times 10^{-7}$ [1/h] (10% of SIL3)
Performance level	PLe (Category 3)
Mean time to dangerous failure of each channel	MTTFd: 5 years
Diagnostic coverage	DCave: Medium
Stop category	Stop category 0
Safety function	STO
Mission time	Same as the servo drive
Hardware fault tolerance	1
Systematic capability	3
Application mode	High demand or continuous mode

Specifications

- Electrical safety according to IEC 61800-5-1:2016, overvoltage category II
- Environment test requirement according to IEC 61800-5-1:2016
- Operating conditions are shown below.

Item	Description
Ambient/Storage temperature	0°C to 55°C/-20°C to +70°C
Ambient/Storage humidity	20% to 95% RH (without condensation)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Vibration</td><td>
<table>
<tr><th>Item</th><th>Test Condition</th></tr>
<tr><td>Test reference</td><td>IEC 60068-2-6 4.6</td></tr>
<tr><td>Condition</td><td>EUT powered on, operating normally</td></tr>
<tr><td>Motion mode</td><td>Sinusoidal</td></tr>
<tr><td>Vibration amplitude/ Acceleration</td><td>-</td></tr>
<tr><td>10 Hz ⩽ f ⩽ 57 Hz</td><td>Amplitude of 0.075 mm</td></tr>
<tr><td>57 Hz < f ⩽ 150 Hz</td><td>1 g</td></tr>
<tr><td>Duration of vibration</td><td>10 sweep cycles per axis on each of three mutually perpendicular axes</td></tr>
<tr><td>Axes</td><td>X, Y, Z</td></tr>
<tr><td>Details of mounting</td><td>According to manufacturer's specification</td></tr>
</table>
</td></tr>
<tr><td>Shock resistance</td><td>
<table>
<tr><th>Item</th><th>Test Condition</th></tr>
<tr><td>Test reference</td><td>Test Ea of IEC 60068-2-27: 2008 Table 17</td></tr>
<tr><td>Condition</td><td>EUT powered on, operating normally</td></tr>
<tr><td>Motion mode</td><td>Half-sine pulse</td></tr>
<tr><td>Shock amplitude/ Time</td><td>50 m/s² (5 g) 30 ms</td></tr>
<tr><td>Number of shocks</td><td>3 per axis on each of three mutually perpendicular axes</td></tr>
<tr><td>Axes</td><td>±X, ±Y, ±Z</td></tr>
<tr><td>Details of mounting</td><td>According to manufacturer's specification</td></tr>
</table>
</td></tr>
<tr><td>IP rating/Pollution degree</td><td>IP20;
PD2: free of corrosive or explosive gases; free of exposure to water, oil or chemicals; free of dust, salts or iron dust</td></tr>
<tr><td>Altitude</td><td>2000 m or below</td></tr>
<tr><td>Cooling method</td><td>Dry clean air (natural convection)</td></tr>
<tr><td>Others</td><td>Free of static electricity, strong electromagnetic fields, magnetic fields, or exposure to radioactivity</td></tr>
</table>

- The servo drive complies with EMC standards EN/IEC 61800-3:2017, IEC 61326-3-1, and IEC 61800-5-2.
- Others

Item	Description
Applicable servo drives	SV660NS1R6I-FS SV660NS2R8I-FS SV660NS5R5I-FS SV660NS7R6I-FS SV660NS012I-FS SV660NT3R5I-FS SV660NT5R4I-FS SV660NT8R4I-FS SV660NT012I-FS SV660NT017I-FS SV660NT021I-FS SV660NT026I-FS
Position	Integrated on the control board of the servo drive
Safety function - Inputs	Two channels: STO1/STO2

The STO subsystem elements must always be able to operate within the range of temperature, humidity, corrosion, dust, and vibration and other requirements specified above.

3.2 Commissioning, Operation, and Maintenance Requirements

Basic requirements

- Technical staff must be trained to understand the requirements and principles of designing and operating safety-related systems.
- Person performing the maintenance must be trained to understand the requirements and principles of designing and operating safety-related systems.
- Operators must be trained to understand the requirements and principles of designing and operating safety-related systems.
- The safety-related circuit on the control board that fails to operate must be replaced with a new one as it is not repairable.

Commissioning Checklist

- Start-up test and validation
  IEC 61508, EN/IEC 62061, and EN ISO 13849 require that the final assembler of the machine validates the operation of the safety function with an acceptance test. The acceptance tests for the standard safety functions of the drive are described in the guide. The tests for the optional safety functions are described in the appropriate guide.

  The acceptance test must be performed:

  - at initial start-up of the safety function
  - after any changes related to the safety function (wiring, components, settings and so on).
  - after any maintenance work related to the safety function.

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the test staff.

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance need to be logged into the logbook.

- Checklist

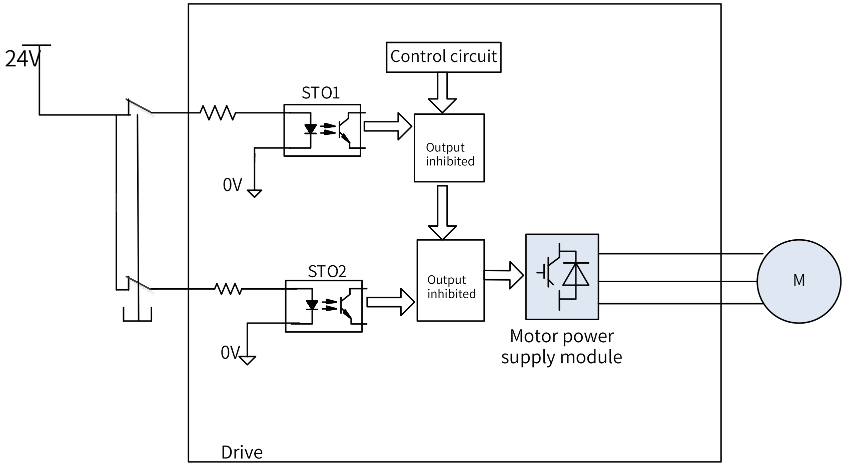
Step	Action	Result
1	Ensure that the drive runs and stops freely during commissioning.	
2	Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	
3	Check the STO circuit connections based on the circuit diagram.	
4	Check that the shield of the STO input cable is grounded to the drive frame.	
5	Close the disconnector and switch the power on.	
5.1	Test the STO signal #1 when the motor is stopped: Set STO1 and STO2 to "H". Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1 and send a start command to the drive. Ensure that the motor stays at standstill and the keypad of the drive displays "E150.1".	
5.2	Set STO1 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	
5.3	Test the STO signal #2 when the motor stops: Set STO1 and STO2 to "H". Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #2 and send a start command to the drive. Ensure that the motor stays at standstill and the keypad of the drive displays "E150.1".	
5.4	Set STO2 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	

Step	Action	Result
6.1	Test the STO channel #1 when the motor is running: Set STO1 and STO2 to "H". Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at standstill and the keypad of the drive displays "E150.1".	
6.2	Set STO1 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	
6.3	Test the STO channel #2 when the motor is running: Set STO1 and STO2 to "H". Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #2. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at standstill and the keypad of the drive displays "E150.1".	
6.4	Set STO2 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	
7	Document and sign the acceptance test report which verifies that the safety function is safe and acceptable for operation.	

Special requirements

To reach SIL 3 PL e (cat3), power cycling must be performed on the servo drive every 3 months for conducting power-on diagnostic.

3.3 STO Function



Switch off the power supply module of the motor to cut off the motor current and the motor torque.

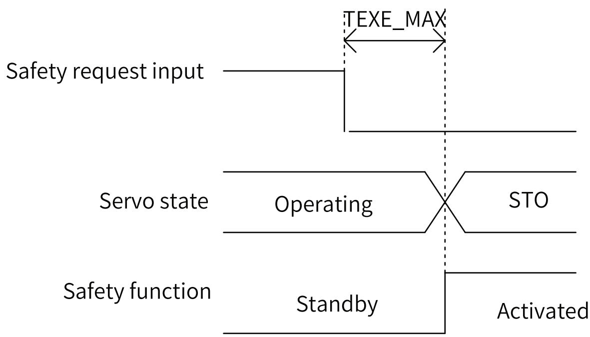
Figure 3-1 Schematics of the STO function

Safe Torque Off (STO) is a safety function that complies with IEC 61800-5-2:2016. It is built into Inovance SV660N series servo drives.

The STO function inhibits the control signal of the power semiconductors on the drive output end, preventing the drive from generating torque at the motor shaft end.

The STO function prevents movement of the motor by two redundant external hardware signals (STO1 and STO2) that block the PWM signals from being outputted to the power layer of the servo drive. These two +24 VDC signals must be active to allow the servo drive to operate normally.

If either one or both signals are set to "Low" level, the PWM signals will be blocked within 30 ms.



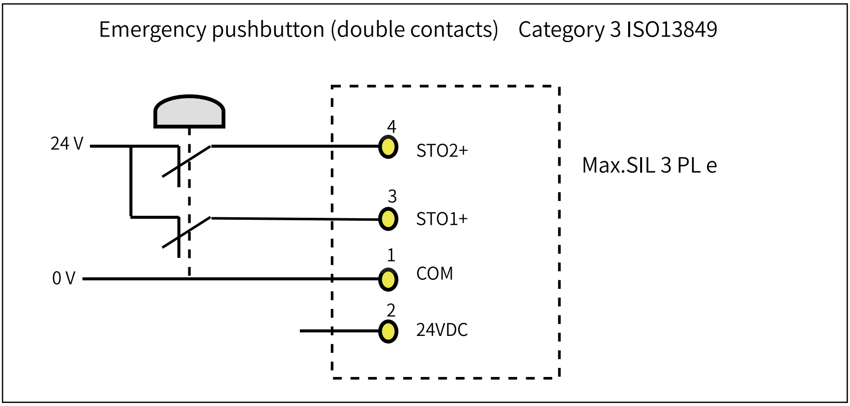
See the following table for the STO function.

STO1 Input	STO2 Input	PWM Signal
H	H	Normal
L	H	Inhibited
H	L	Inhibited
L	L	Inhibited

Safe Torque Off (STO)	
Assignment	Cuts off the power of the motor.
Description	The STO function brings the machine safely into a no-torque state and prevents it from unexpected start. If the motor is running at the moment when the STO function is activated, the motor will coast to stop.
Safe state	Disables the PWM gating signal of the drive.
Operating mode	High demand mode or continuous mode

3.4 Application Example of STO Function

Example: Direct stop, stop category 0, safe stop: STO



3.5 Monitoring on STO Function

The keypad displays the STO function state and fault information.

Fault codes related to the STO function are listed in the following table.

Fault Code	State	Description
E150.0	STO activated by external request	Both STO1 and STO2 in "Low" state, H0A-21 = 1
E150.1	Status of STO1 and STO2 inconsistent	Only one of STO1 and STO2 in "Low" state, status of STO1 and STO2 inconsistent
E150.2	STO activated by diagnosis	OV/UV of 5 V power supply detected
E150.3	STO activated by diagnosis	The input circuit of STO works improperly.
E150.4	STO activated by diagnosis	The buffer circuit of STO works improperly.

Note

- For a motor with brake, if either STO1 or STO2 closes, the drive will be disabled within 30 ms (STO response time).
- For a motor without brake, if either STO1 or STO2 closes, the drive will be disabled within 5 ms (STO response time).
- In the preceding two cases, if the 24V disconnection time difference between STO1 and STO2 is higher than 10 ms, the drive reports E150.1.

When H0A-21 is set to 0 and both STO1 and STO2 are in the "Low" state, the keypad displays the STO state as "Sto_".

When H0A-21 is set to 1 and both STO1 and STO2 are in the "Low" state, the keypad displays "E150.0".

3.6 STO Status in Exceptional Operations

The exceptional operation refers to the duration of power-on and initialization, and how to return from the STO state.

- The PWM buffer is disabled as the enable terminal is pulled up during power-on, so the PWM signal is inhibited.
- The PWM buffer is disabled as the enable terminal is pulled up during initialization of the MCU, so the PWM signal is inhibited. Such condition is relieved once initialization is done and servo drive operates normally.
- When all of the following conditions are met, the servo system that enters the safe state through the STO function can be back to normal, with the safe state cleared after auto-reset of the drive.

Note

- The input state of the STO request must be "high".
- The servo ON or servo RUN command must be inactive.
- No dangerous faults exist.

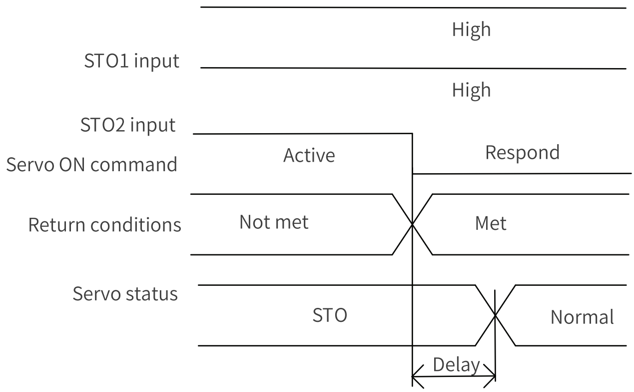


Figure 3-2 Return condition of servo ON/RUN command

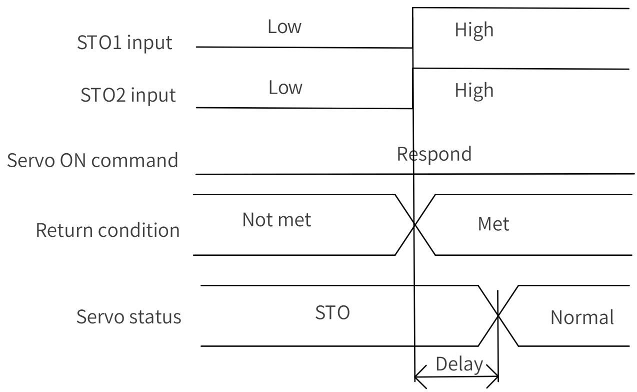


Figure 3-3 Return condition of external STO request state

3.7 Troubleshooting for STO Function

See the following table to identify the cause of a fault and the action to be taken. Contact Inovance technical support if the fault persists after corrective actions listed in the following table are taken. Fault codes related to the STO function are listed in the following table.

Error Code	Cause	Corrective Action
E150.0	Neither STO1 nor STO2 is connected to the 24 V signal.	Connect STO1 and STO2 to the 24 V signal.
E150.1	The input states of STO1 and STO2 are inconsistent.	1. Ensure the requests for disconnecting the voltage of STO1 and STO2 are triggered simultaneously. 2. The input circuit is abnormal and a certain STO input signal is still in the "High" state after the 24 V signal is disconnected. Contact Inovance for technical support.
E150.2	OV/UV of 5 V power supply detected	Repair the 5 V power supply. Contact Inovance for technical support.
E150.3	The input circuit of STO works improperly.	Fix the input circuit fault. Contact Inovance for technical support.
E150.4	The buffer circuit of STO works improperly.	Fix the buffer circuit fault. Contact Inovance for technical support.

3.8 Precautions

This section describes the information that needs to be read before starting operation. Read the following safety precautions, risk assessment information, and limitations before starting operation. Use the safety function STO after properly understanding all of the information.

Safety precautions

Carefully read the following important precautions and observe them when using the safety function STO.

- STO function is not intended as a replacement for the emergency stop function (E-stop). If only the STO function is triggered, with no extra measures taken, the power supply cannot be cut off in emergencies and high-current parts of the motor and drive are still energized, incurring the risk of electric shock or other risks result in electric energy. Therefore maintenance work on electrical parts of the drive or motor can only be carried out after isolating the drive system from the main supply.
- Depending on the standards and requirements for a particular application, it may be possible to use STO as an integral part of an E-stop system. However, its main purpose is for use in a dedicated safety control arrangement whose purpose is to prevent any hazard from occurring, without the use of an E-stop.
- An E-stop is often provided in a machine to allow for unexpected situations where an operator sees a hazard and can take action to prevent an accident.
- The design requirement for an E-stop differs from that of a safety interlock. Generally, the E-stop is required to be independent from any complex or "intelligent" control. It may use purely electromechanical devices to either

disconnect the power or initiate a controlled rapid stop using other means such as dynamic or regenerative braking.

Note

For use of permanent-magnet motors, reluctance motors, and salient-pole induction motors, in spite of the activation of the STO function, a possible failure mode that causes two power devices in the drive circuit to conduct incorrectly may exist (although highly unlikely). The drive system can produce an alignment torque which maximally rotates the motor shaft by 180° (electrical angle) for a permanent magnetic motor or 90° (electrical angle) for a salient pole induction motor or reluctance motor. This possible failure mode must be allowed for in the machine system design.

$$\text{Max. rotating angle of the motor shaft} = \frac{360^\circ \text{ electrical angle}}{\text{Number of motor pole pairs}}$$

- The design of safety-related systems requires specialist knowledge. To ensure that a complete control system is safe, it is necessary for the whole system to be designed according to recognized safety principles. The use of individual subsystems such as drives with STO function, which are intended for safety-related applications, does not in itself ensure that the complete system is safe.
- The STO function can be used to stop the drive in emergency stop situations.
- In normal operational mode, it is recommended not to stop the drive by using the STO function. If a drive running is stopped by using STO, the drive performs a coast-to-stop. If this is not acceptable, the system should be stopped using the correct mode instead of the STO function.
- This publication is a guide to the application of Inovance STO function, and also on the design of safety-related systems for machinery control.
- It is the responsibility of the designer of the end product or application to ensure that it is safe and in compliance with the relevant regulations.

Risk assessment

- When using the STO function, perform risk assessment on the servo system in advance. Make sure that the safety integrity level of the standards is met.
- The following residual risks can be present even when the safety functions operate. Therefore, safety must always be given consideration during risk assessment.
- If external forces (such as gravitational force with a vertical axis) are applied when the safety functions are operating, the motor will rotate due to the action of these external forces. Provide a separate mechanical brake to secure the motor.
- If the servo drive fails, the motor may operate within a range of 180 electrical degrees. Make sure that safety is ensured even in hazardous situations.
- The number of revolutions and movement distance for each type of motor are listed below.

- Rotational motor: 1/6 rotation max. (rotation angle at motor shaft conversion)
- Direct drive motor: 1/20 rotation max. (rotation angle at motor shaft conversion)

Note

The number of revolutions and the movement distance of the direct drive motor depend on the number of pole pairs.

- Linear servo motor: 30 mm max.

Note

The movement distance of the linear servo motor depends on pole pitch.

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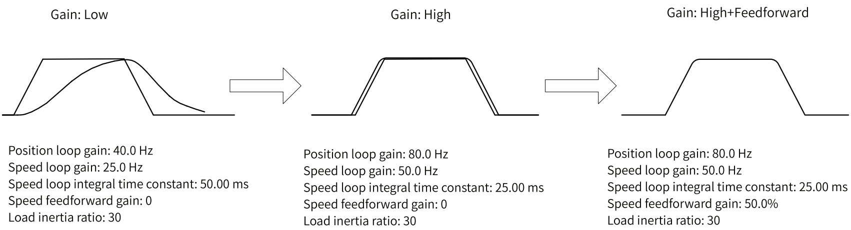
4 Adjustment

4.1 Overview

The servo drive must drive the motor as quick and accurate as possible to follow the commands from the host controller or internal setting. A proper gain tuning is required therefore.



Gains are defined by a combination of multiple parameters that affect each other, including the position loop gain, speed loop gain, filter, and load moment of inertia ratio. The setpoints of these parameters must be balanced during gain tuning.

Note

Before gain tuning, perform a trial run through jogging to ensure the motor operates properly.

The following figure shows the general flowchart for gain tuning.

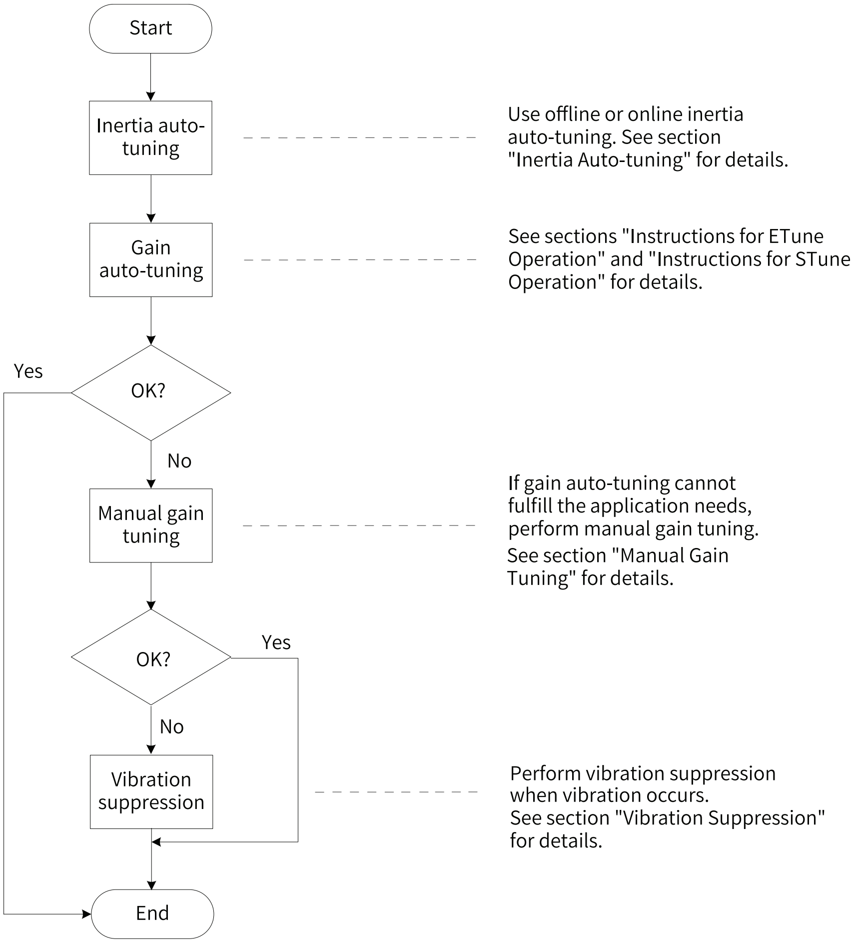


Figure 4-1 Flowchart of gain tuning

Table 4–1 Description of gain tuning

Step			Description	Reference
1	Inertia Auto-tuning	Offline	The servo drive calculates the load inertia ratio automatically through inertia auto-tuning.	*"4.2.1 Offline Inertia Auto-tuning" on page 189*
		Online	The host controller sends a command to make the motor rotate, and the servo drive calculates the load inertia ratio in real time.	*"4.2.2 Online Inertia Auto-tuning" on page 192*
2	Gain auto-tuning		The servo drive generates a group of gain parameters based on the correct inertia ratio.	*"4.3.1.1 Overview" on page 194* and *"4.3.2.1 Overview" on page 202*
3	Manual gain tuning	Basic gains	If the auto-tuned gain values fail to deliver desired performance, fine-tune the gains manually to improve the performance.	*"4.4.1 Basic Parameters" on page 210*
		Reference filter	Smoothens the position, speed, and torque references.	*"4.4.1 Basic Parameters" on page 210*
		Feedforward gain	Improves the follow-up behavior.	*"4.4.4 Feedforward Gain" on page 219*
		Pseudo differential regulator	Adjusts the speed loop control mode to improve the anti-interference capability at low frequency range.	*"4.4.5 PDFF Control" on page 222*
		Torque disturbance observer	Improves the resistance against torque disturbance.	*"4.4.6 Torque Disturbance Observer" on page 224*

Step			Description	Reference
4	Vibration suppression	Mechanical resonance	Enable the notch function to suppress the mechanical resonance.	*"4.6.1 Mechanical Resonance Suppression" on page 234*
		Low-frequency resonance	Activate the filter for suppressing low-frequency resonance.	*"4.6.2 Low-Frequency Resonance Suppression at the Mechanical End" on page 241*

4.2 Inertia Auto-tuning

The load inertia ratio (2008-10h(H08-15)) is calculated using the following formula.

$$\text{Load inertia ratio} = \frac{\text{Total moment of inertia of mechanical load}}{\text{Moment of inertia of the motor}}$$

The load inertia ratio is a critical parameter of the servo system. A correct load inertia ratio facilitates commissioning.

You can set the load inertia ratio manually or get the inertia ratio through inertia auto-tuning.

The following two inertia auto-tuning modes are available:

- Offline inertia auto-tuning
  Enable offline inertia auto-tuning (200D-03h (H0D-02)), and make the motor rotate by pressing the SET key on the keypad to perform inertia auto-tuning. Offline inertia auto-tuning does not involve the host controller.
- Online Inertia Auto-tuning
  Send a command to the servo drive through the host controller to make motor act accordingly to finish inertial auto-tuning. Online inertia auto-tuning involves the host controller.

Note

The following conditions must be fulfilled for an accurate calculation of the load inertia ratio during inertia auto-tuning:

1. The actual maximum speed of the motor is higher than 150 RPM.
2. The actual acceleration rate during acceleration/deceleration is higher than 3000 RPM/s.
3. The load torque is stable without dramatic changes.
4. The actual inertia ratio does not exceed 120.

If the actual inertia ratio is large but the gains are low, the motor may not be able to execute the maximum speed and acceleration rate needed as motor actions are slowed down. In this case, increase the speed loop gain (2008-01h (H08-00)) and perform auto-tuning again.

If vibration occurs during auto-tuning, stop inertia auto-tuning immediately and decrease the gains.

Inertia auto-tuning may also fail in case of a large backlash of the transmission mechanism.

4.2.1 Offline Inertia Auto-tuning

1. In the parameter display mode, switch to H0D-02 and press the SET key to enable offline inertia auto-tuning.
   ☆Related parameter:

<table>
<tr><td>H0D-02</td><td>Name</td><td colspan="3">Offline inertia auto-tuning</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>200D-03h</td><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Used to enable offline inertia auto-tuning through the keypad. In the parameter display mode, switch to H0D-02 and press the SET key to enable offline inertia auto-tuning.</td></tr>
</table>

   Check the following before performing offline inertia auto-tuning:

   The motor travel distance must meet the following requirements:

   - A travel distance of more than one revolutions in the forward/reverse direction is available between the limit switches.
     Before offline inertia auto-tuning, ensure limit switches are installed to the machine and a travel distance of more than one revolutions is reserved for the motor. This is to prevent overtravel during auto-tuning.
   - The required number of revolutions (H09-09) is fulfilled.
     View the value of H09-06 (Maximum speed of inertia auto-tuning), H09-07 (Time constant for accelerating to the maximum speed during inertia auto-tuning), and H09-09 (Number of revolutions per inertia auto-tuning) to ensure the motor

travel distance starting from the stop position is larger than the value of H09-09. If the motor travel distance is smaller than the value of H09-09, decrease the value of H09-06 or H09-07 until the requirement is met.

2. Press the UP/DOWN key to perform offline auto-tuning.
   To stop the servo drive, release the UP/DOWN key. To start auto-tuning again, press the UP/DOWN key again. The operating direction at start is determined by the UP/DOWN key. For applications requiring unidirectional movement, set H09-05 to 1.

   Increase the stiffness level (H09-01) of the servo drive properly so that the actual motor speed can reach the value defined by H09-06 (Maximum speed for inertia auto-tuning).

   The following figure is a general flowchart for offline inertia auto-tuning.

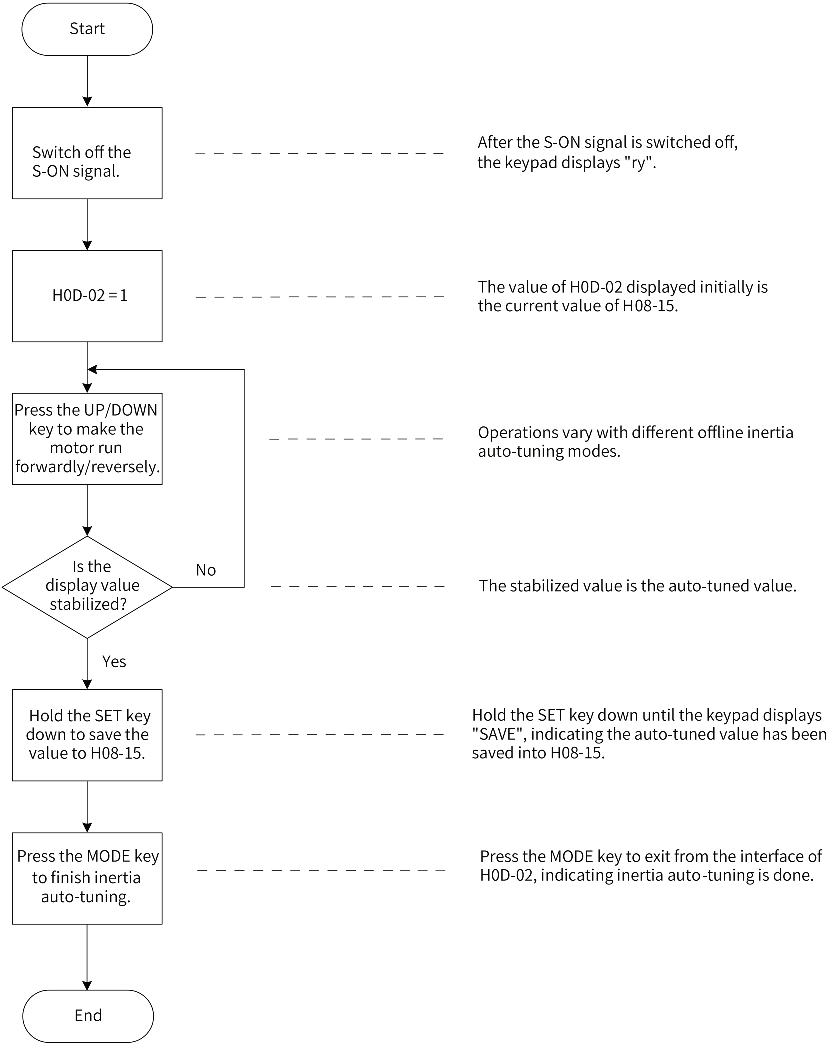


Figure 4-2 Offline inertia auto-tuning flowchart

☆Related parameters:

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-15	Gain switchover condition	0 to 10	-	Used to set the condition for gain switchover.	During running	At once	0
H09-05	Offline inertia auto-tuning mode	0: Bidirectional auto-tuning mode 1: Unidirectional auto-tuning mode	-	Defines the offline inertia auto-tuning mode.	At stop	At once	1
H09-06	Maximum speed of inertia auto-tuning	100 to 1000	RPM	Defines the maximum speed reference for offline inertia auto-tuning.	At stop	At once	500
H09-07	Time constant for accelerating to the max. speed during inertia auto-tuning	20 to 800	ms	Defined the time needed for the motor to accelerating from 0 RPM to 1000 RPM.	At stop	At once	125
H09-08	Waiting time after an individual inertia auto-tuning	50 to 10000	ms	Defines the time interval between two consecutive speed references.	At stop	At once	800
H09-09	Number of revolutions per inertia auto-tuning	15 to 10000	0.01 r	Defines the maximum number of revolutions.	-	-	100

4.2.2 Online Inertia Auto-tuning

The servo drive supports online inertia auto-tuning. The following figure shows the online inertia auto-tuning flowchart.

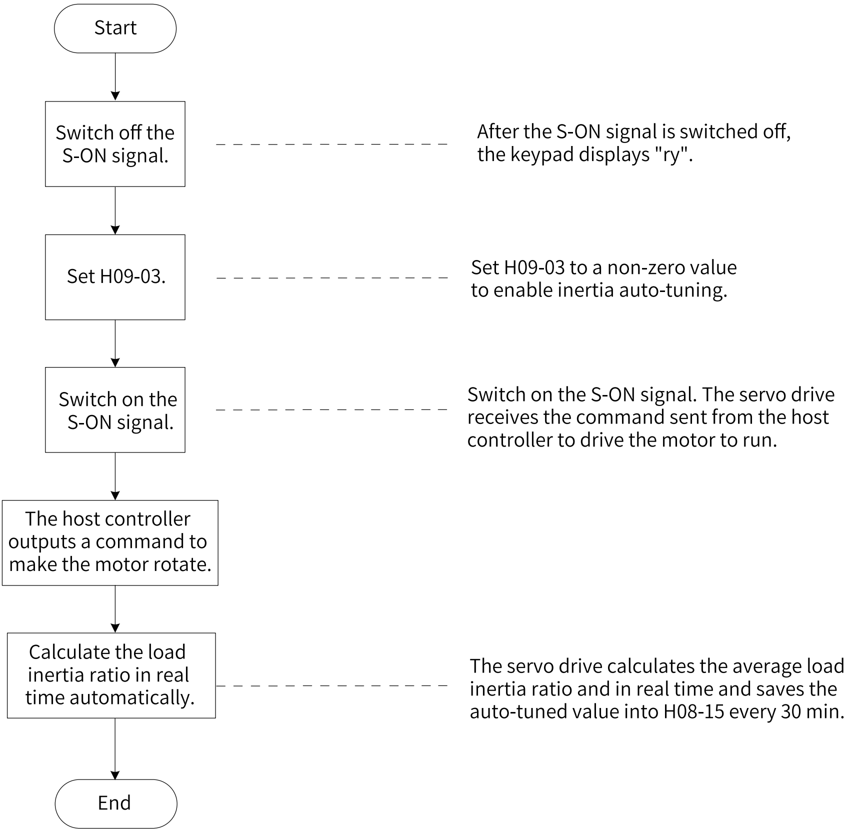


Figure 4-3 Online inertia auto-tuning flowchart

Note

H09-03 defines the real-time updating speed of the load moment of inertia ratio (H08-15).

1. H09-03 = 1: Applicable to cases where the actual load inertia ratio rarely changes, such as machine tools and wood carving machines
2. H09-03 = 2: Applicable to cases where the load inertia ratio changes slowly
3. H09-03 = 3: Applicable to cases where the actual inertia ratio changes rapidly, such as manipulators

Do not use online inertia auto-tuning in applications involving hitting against limit switches and press hitting.

☆Related parameter:

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-03	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	-	Defines the online inertia auto-tuning mode.	During running	At once	0

4.3 Gain Auto-tuning

4.3.1 ETune Function

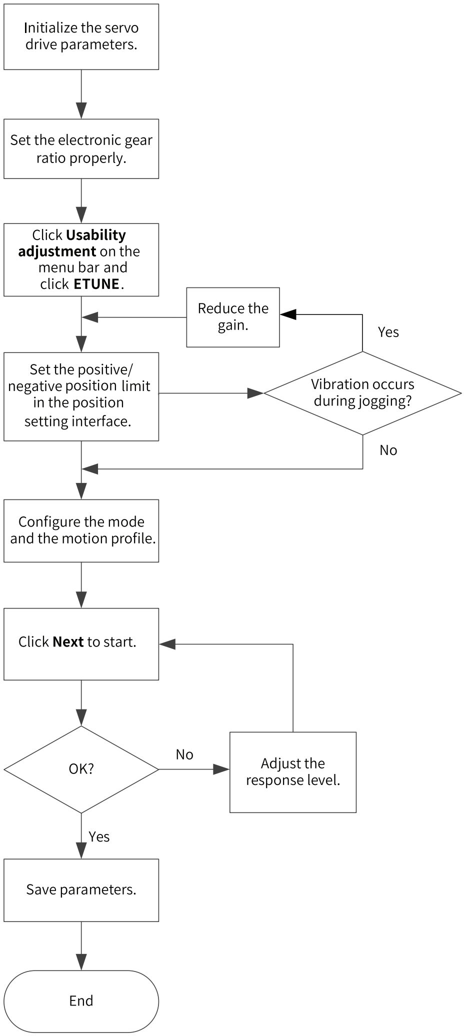
4.3.1.1 Overview

ETune is a wizard-type function designed to guide users to perform auto-tuning by setting the motion profile and the desired response level. After the motion profile and the response level are set, the servo drive generates the optimal gain parameters through auto-tuning. The auto-tuned parameters can be saved and exported as a recipe for use in other devices of the same model.

The ETune function is intended to be used in applications featuring slight load inertia changes.

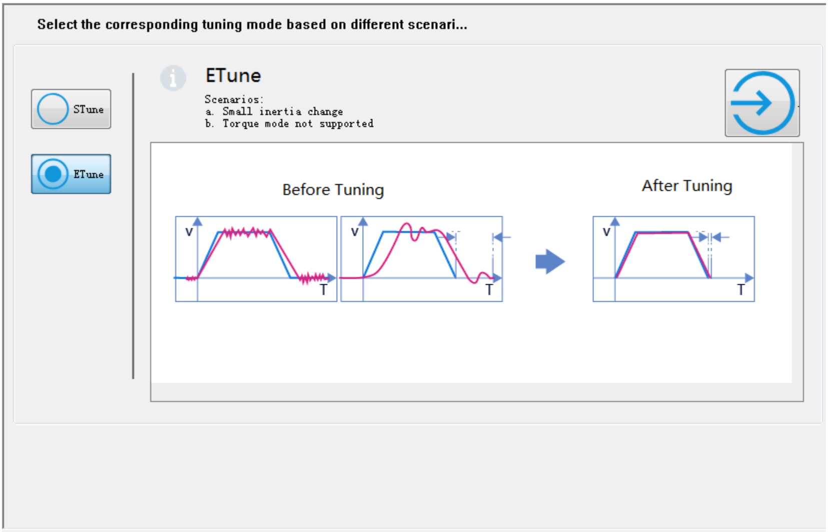
4.3.1.2 Instructions for ETune Operation

Operation flowchart

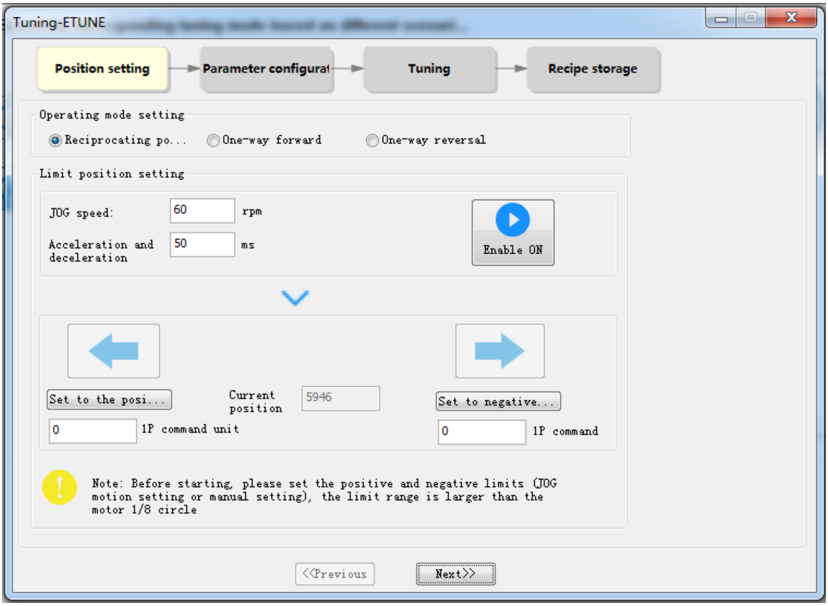


Description of the flowchart

1. Click **Usability adjustment** in the software tool, and then click **ETune**.



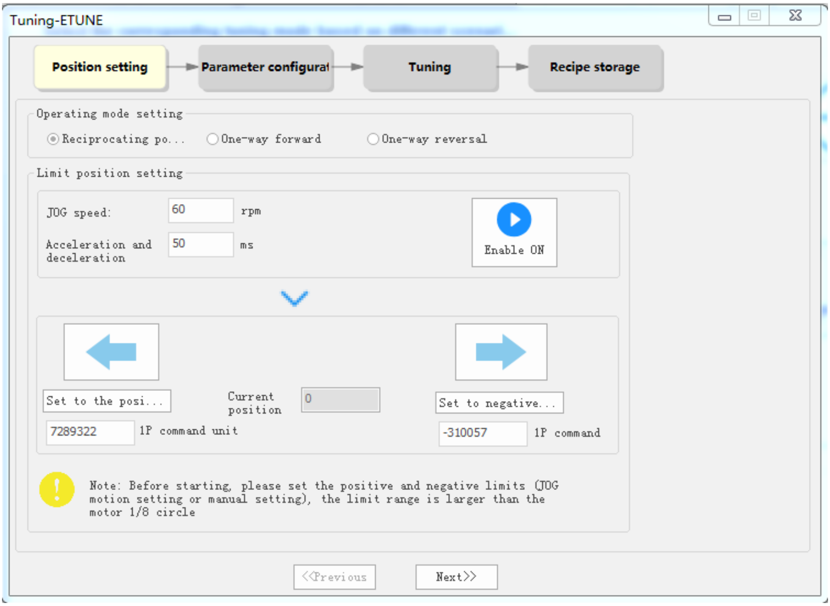
2. Select any of the following three operation modes based on the operating direction allowed by the machine.
   In the **Reciprocating po...** mode, the motor keeps reciprocating within the positive and negative position limits.
   In the **One-way forward** mode, the motor takes the difference between the positive and negative position limits as the maximum distance per action and keeps running in the forward direction.
   In the **One-way reversal** mode, the motor operates in the same way as that in the one-way forward mode, but in the opposite direction.



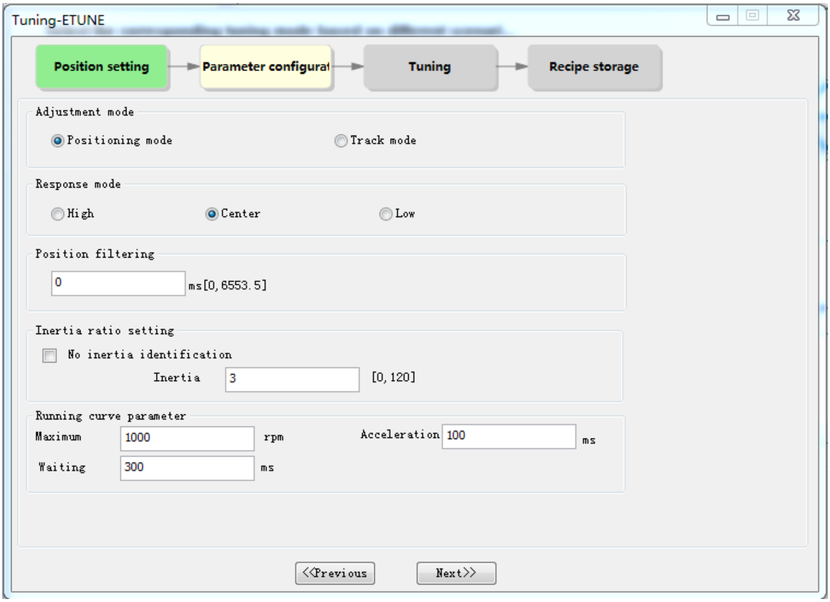
3. Enter the positive and negative position limits appropriate for the motor. The difference between the positive and negative limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio. You can set the position and negative position limits by the following two methods.

Method 1: Click **Enable ON**, and then click the left arrow to make the motor move to the positive position limit. Next, click **Set to the posi...**. Follow the same procedure for setting the negative position limit, and click **Enable OFF** (the **Enable ON** button turns to **Enable OFF** after a click).

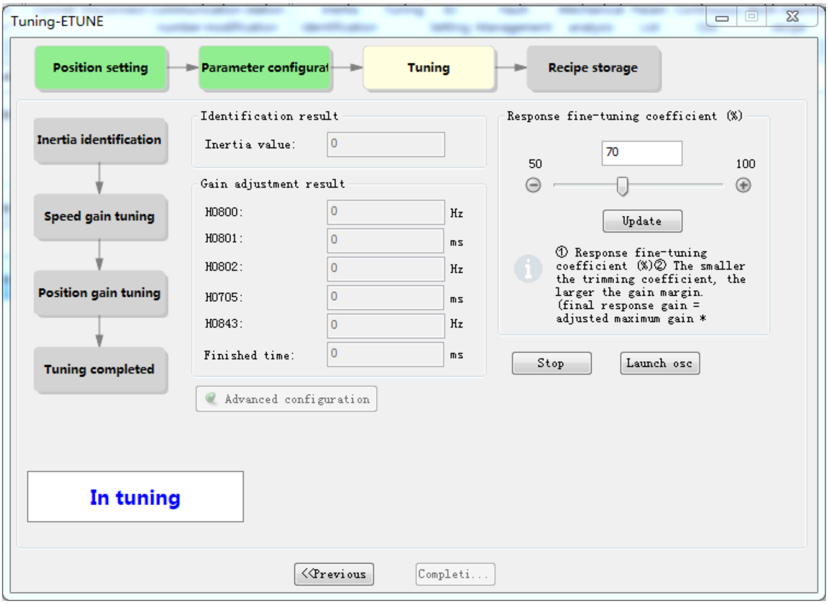
Method 2: Enter the positive and negative position limits directly. The difference between positive and negative position limits must be larger than 1/8 of one revolution. The larger the limit value, the better the adaptability of auto-tuned parameters, but the longer time will ETune operation take.



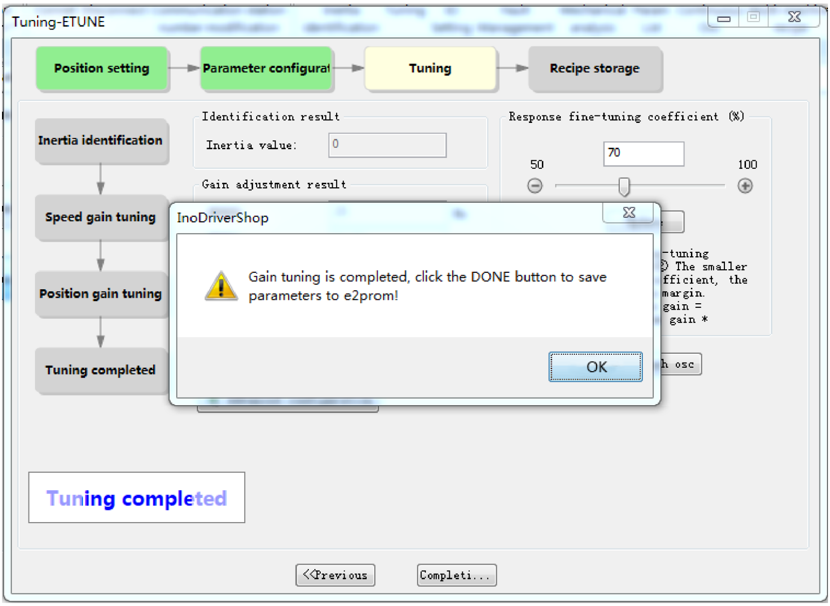
4. Click **Next** to switch to the mode parameter setting interface. The adjustment mode is divided into **Positioning mode** and **Track mode**. Inertia auto-tuning is optional. If you choose not to perform inertia auto-tuning, set the correct inertia ratio first (the value of the inertia ratio can be modified directly). You can adjust the response level and position filter time constant based on the responsiveness needed and the position reference noise generated during operation. Then configure the motion profile by setting the maximum speed, acceleration/deceleration time and time interval for auto-tuning.

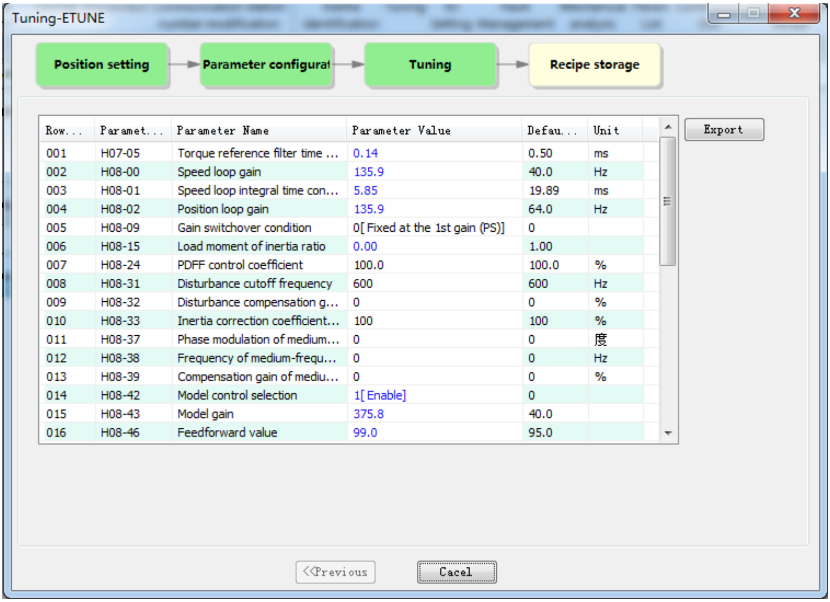


5. Click **Next** to start auto-tuning. If you choose to perform inertia auto-tuning, the servo drive starts inertia auto-tuning based on the set motion profile. After inertia auto-tuning is done, the servo drive starts gain tuning automatically. If you choose not to perform inertia auto-tuning on the start page, the servo drive starts gain tuning directly after start-up.



6. During gain tuning, if you modify the **Response fine-tuning coefficient** and click **Update**, gain tuning will be continued based on the fine-tuning coefficient entered. After gain tuning is done, you can click **DONE** to save the parameters to EEPROM and export parameters as a recipe file.





Row...	Paramet...	Parameter Name	Parameter Value	Defau...	Unit
001	H07-05	Torque reference filter time ...	0.14	0.50	ms
002	H08-00	Speed loop gain	135.9	40.0	Hz
003	H08-01	Speed loop integral time con...	5.85	19.89	ms
004	H08-02	Position loop gain	135.9	64.0	Hz
005	H08-09	Gain switchover condition	0[Fixed at the 1st gain (PS)]	0	
006	H08-15	Load moment of inertia ratio	0.00	1.00	
007	H08-24	PDFF control coefficient	100.0	100.0	%
008	H08-31	Disturbance cutoff frequency	600	600	Hz
009	H08-32	Disturbance compensation g...	0	0	%
010	H08-33	Inertia correction coefficient...	100	100	%
011	H08-37	Phase modulation of medium...	0	0	度
012	H08-38	Frequency of medium-frequ...	0	0	Hz
013	H08-39	Compensation gain of mediu...	0	0	%
014	H08-42	Model control selection	1[Enable]	0	
015	H08-43	Model gain	375.8	40.0	
016	H08-46	Feedforward value	99.0	95.0	

4.3.1.3 Precautions

- The maximum speed and acceleration/deceleration time of the motion profile can be set as needed. You can also increase the acceleration/deceleration time properly to enable quick positioning after auto-tuning is done.
- If the acceleration/deceleration time is too short, overload may occur. In this case, increase the acceleration/deceleration time properly.
- For vertical axes, take anti-drop measures beforehand and set the stop mode upon fault to "Stop at zero speed".
- For lead screw transmission, shorten the travel distance if the tuning duration is too long.

4.3.1.4 Solutions to Common Faults

Fault Symptom	Cause	Solution
E661: Gains too low	1. Vibration cannot be suppressed.	1. Enable the vibration suppression function manually.
	2. The positioning overshoot is too large.	2. Check whether the positioning threshold is too low. Increase the acceleration/deceleration time and reduce the response level.
	3. The reference is disturbed by noise.	3. Modify the electronic gear ratio to improve the reference resolution or increase the reference filter time constant in the "Parameter configuration" interface.
	4. The current fluctuates.	4. Check whether the current of the machine fluctuates regularly.
E600: Inertia auto-tuning failure	1. Vibration cannot be suppressed.	1. Enable the vibration suppression function manually and perform ETune again.
	2. The auto-tuned values fluctuate dramatically.	2. Increase the maximum operating speed and decrease the acceleration/deceleration time. For the lead screws, shorten the travel distance.
	3. Mechanical couplings of the load are loose or the mechanism is eccentric.	3. Rectify the mechanical fault.
	4. Interruption occurs due to a fault that occurs during auto-tuning.	4. Clear the fault and perform ETune again.
	5. The position reference filter time is set to an excessively high value.	5. Decrease the values of H05-04...H05-06 and perform ETune again.

4.3.2 STune Function

4.3.2.1 Overview

STune performs gain auto-tuning based on the set stiffness level. It aims to fulfill the requirements of rapidity and stability.

STune (mode 4) is turned on by default and will be turned off automatically after the servo drive operates as commanded for 10 min.

STune is intended to be used in applications featuring slight load inertia changes. For applications featuring dramatic inertia changes or where inertia auto-tuning is unavailable (due to low operating speed or low acceleration rate), turn off STune after initial power-on.

Note

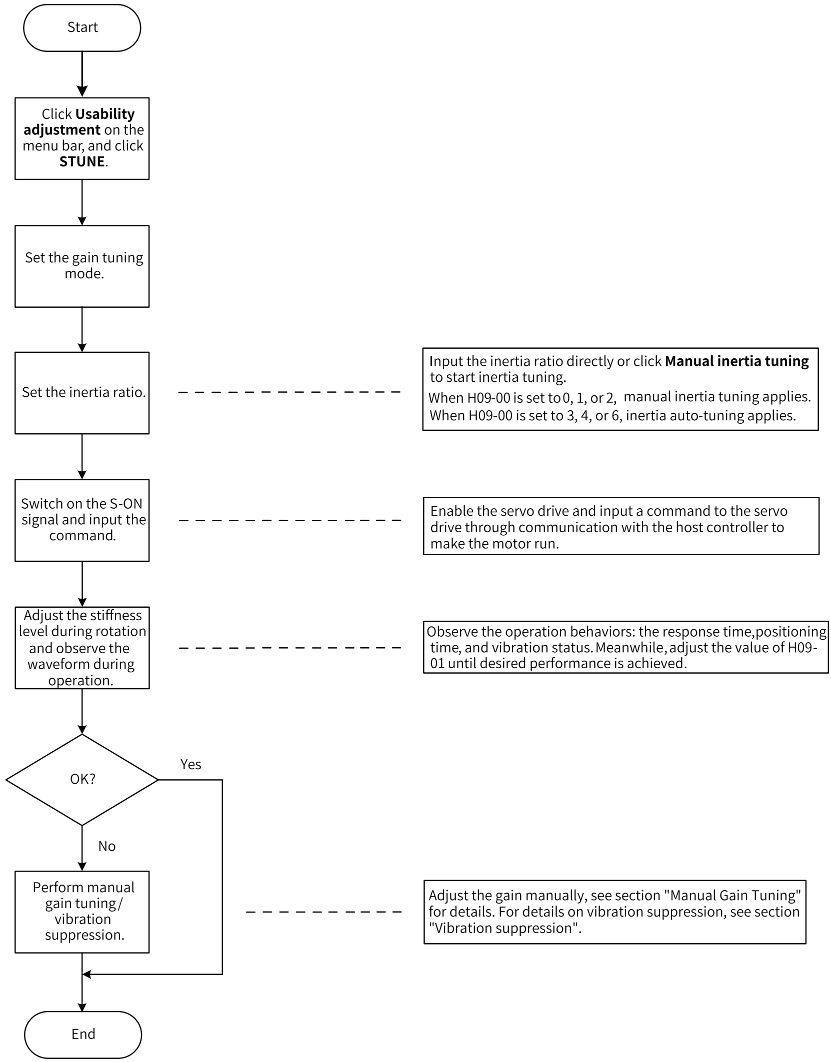
For STune modes 4 and 6, you need to perform load
inertia auto-tuning through online inertia auto-tuning and ensure the following conditions are met:

- The load inertia changes quickly.
- The load torque changes quickly.
- The motor is running at a speed lower than 120 r/min.
- Acceleration/Deceleration is slow (lower than 1000 r/min per second).
- The acceleration/deceleration torque is lower than the unbalanced load/viscous friction torque.

If the preceding conditions cannot be fulfilled, set the correct inertia ratio manually.

4.3.2.2 Instructions for ETune Operation

1. Operation flowchart



2. Description

You can set the gain auto-tuning mode through the keypad or the software tool.

a. Select the gain auto-tuning mode. In modes 0, 1 and 2 shown in the following table, you need to set the inertia ratio before stiffness tuning. If the inertia is unknown, perform inertia tuning manually. If vibration occurs on the machine, decrease the stiffness level before gain tuning. In modes 3, 4, and 6 shown in the following table, you can perform adjustment through the wizard-type interface directly, without the need for setting the inertia ratio.

Table 4–2

Mode	Name	Applicable Occasion
0	Invalid	The gains need to be adjusted manually.
1	Standard mode	Gains are set automatically based on the set stiffness level.
2	Positioning mode	Gains are set automatically based on the set stiffness level. This mode is applicable to occasions requiring quick positioning.
3	Interpolation mode + Inertia auto-tuning	Gains are set automatically based on the set stiffness level. The inertia is auto-tuned and vibration is suppressed automatically. This mode is applicable to multi-axis interpolation.
4	Normal mode + Inertia auto-tuning	Gains are set automatically based on the set stiffness level. The inertia is auto-tuned and vibration is suppressed automatically. This mode is applicable to trajectory tracking.
6	Quick positioning mode + Inertia auto-tuning	Gains are set automatically based on the set stiffness level. The inertia is auto-tuned and vibration is suppressed automatically. This mode is applicable to occasions requiring quick positioning.

b. Adjust the stiffness level gradually during operation of the load. The present stiffness level value will be written to the servo drive automatically. Keep monitoring the operating waveform after increasing the stiffness level (increase by one level at a time) until the desired performance is achieved.

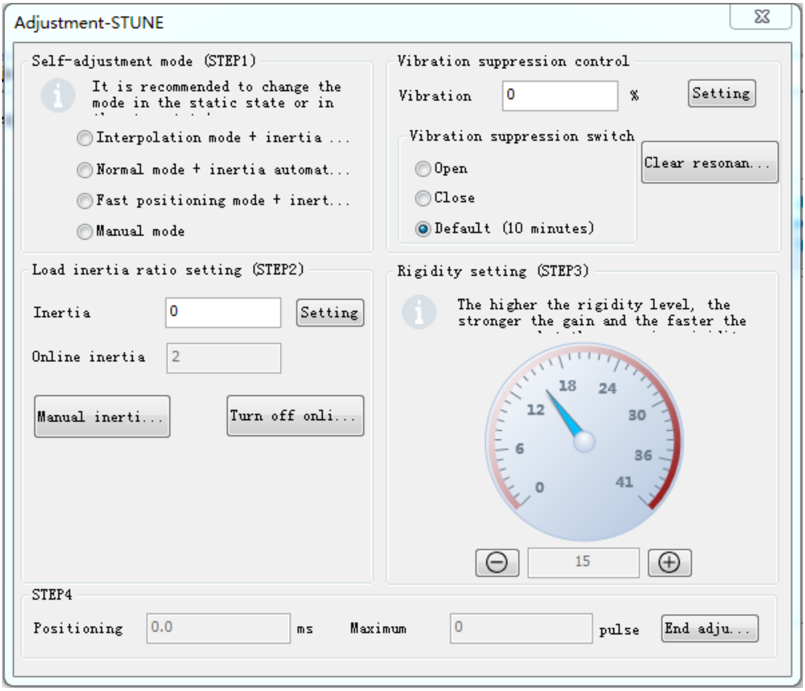
c. For STune modes 4 and 6, when the speed keeps higher than 100 r/min for more than 5 min, the value of H09-00 will be set to 0 automatically to exit from the STune mode.
If commissioning is done, you can set H09-00 to 0 to exit from STune mode in advance.

To modify the operating time of STune, set H09-37 (Vibration monitoring time) based on actual applications.

d. For STune modes 4 and 6, resonance suppression will be applied automatically. If resonance cannot be fully suppressed, set H09-58 to 1 to clear resonance suppression parameters. Reduce the stiffness level, and perform STune again.

e. For multi-axis trajectories, perform single-axis commissioning first to determine the highest response of each axis and modify the response of each axis manually to ensure position responses of different axes are consistent.

- STune mode 4: Determine the minimum value of H08-02 (Position loop gain). Then set H09-00 of each axis to 0 and set H08-02 of each axis to the same value.
- STune mode 6: Determine the minimum value of H08-43 (Model gain). Then set H09-00 of each axis to 0, and set H08-43 of each axis to the same value.



Note

To ensure a stable operation of STune mode 4 under default settings, gain parameters will be adjusted along with the inertia ratio when the inertia ratio is higher than 13. In multi-axis trajectories, responses may be inconsistent under the same stiffness level.

4.3.2.3 Precautions

The value range of H09-01 (Stiffness level) is 0 to 41. The level 0 indicates the weakest stiffness and lowest gain and level 41 indicates the strongest stiffness and highest gain. The following table lists the stiffness levels for different load types for your reference.

Table 4–3 Reference of stiffness levels

Recommended Stiffness Level	Type of Load Mechanisms
Level 4 to level 8	Large-scale machineries
Level 8 to level 15	Applications with low stiffness such as the conveyors
Level 15 to level 20	Applications with high stiffness such as the ball screws and direct-connected motors

The following five gain auto-tuning modes are available.

- Standard mode (H09-00 = 1)
  The 1st gain set (H08-00...H08-02, H07-05) are updated and saved automatically according to the stiffness level defined by H09-01.

Table 4–4 Parameters updated automatically in the standard mode

Para. No.	Name
H08-00	Speed loop gain
H08-01	Speed loop integral time constant
H08-02	Position loop gain
H07-05	Torque reference filter time constant

- Positioning mode (H09-00 = 2)
  On the basis of the preceding table, the 2nd gain set (H08-03...H08-05, H07-06) are also updated automatically according to the stiffness level defined by H09-01 and saved to the corresponding parameters. In addition, the position loop gain in the 2nd gain set should be higher than that in the 1st gain set by one stiffness level.

Table 4–5 Parameters updated automatically in the positioning mode

Para. No.	Name	Description
H08-03	2nd speed loop gain	-
H08-04	2nd speed loop integral time constant	If H08-04 is fixed to 512.00 ms, the 2nd speed loop integral action is invalid and only proportional control is used in the speed loop.
H08-05	2nd position loop gain	-
H07-06	2nd torque reference filter time constant	-

Values of parameters related to speed feedforward are fixed.

Table 4–6 Parameters with fixed values in the positioning mode

Para. No.	Name	Value
H08-19	Speed feedforward gain	30.00%
H08-18	Speed feedforward filter time constant	0.50 ms

Values of parameters related to gain switchover are fixed.

Gain switchover is enabled automatically in the positioning mode.

Para. No.	Name	Value	Description
H08-08	2nd gain mode setting	1	In the positioning mode, switchover between the 1st gain set (H08-00...H08-02, H07-05) and the 2nd gain set (H08-03...H08-05, H07-06) is active. In other modes, the original settings are used.
H08-09	Gain switchover condition	10	In the positioning mode, gain switchover is active only if H08-09 is set to 10. In other modes, the original settings are used.
H08-10	Gain switchover delay	5.0 ms	In the positioning mode, the gain switchover delay is 5.0 ms. In other modes, the original settings are used.
H08-11	Gain switchover level	50	In the positioning mode, the gain switchover level is 50. In other modes, the original settings are used.
H08-12	Gain switchover dead time	30	In the positioning mode, the gain switchover dead time is 30. In other modes, the original settings are used.

Note

In the gain auto-tuning mode, parameters updated along with H09-01 and those with fixed setpoints cannot be modified manually. To modify these parameters, set H09-00 (Gain auto-tuning mode) to 0 (Invalid) first.

- For STune mode 3/4/6, resonance suppression will be applied automatically. When the load changes or the mechanical structure is re-installed, the system resonance frequency changes accordingly. Set H09-58 to "Enable" and turn on the STune mode again after clearing resonance suppression parameters.

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-37	Phase modulation for medium-frequency jitter suppression 2	-90 to +90	°	Defines the phase of medium-frequency jitter suppression 2.	During running	At once	0
H08-38	Frequency of medium-frequency jitter suppression 2	100 to 1000	Hz	Defines the frequency of medium-frequency jitter suppression 2.	During running	At once	0
H08-39	Compensation gain of medium-frequency jitter suppression 2	0 to 300	0	Defines the compensation gain of medium-frequency jitter suppression 2.	During running	At once	0

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-18	Frequency of the 3rd notch	50 to 8000	Hz	Defines the frequency of the 3rd notch.	During running	At once	8000
H09-19	Width level of the 3rd notch	0 to 10	-	Defines the width level of the 3rd notch.	During running	At once	2
H09-20	Depth level of the 3rd notch	0 to 99	-	Defines the attenuation level of the 3rd notch.	During running	At once	0
H09-21	Frequency of the 4th notch	50 to 8000	Hz	Defines the frequency of the 4th notch.	During running	At once	8000
H09-22	Width level of the 4th notch	0 to 10	-	Defines the width level of the 4th notch.	During running	At once	2
H09-23	Depth level of the 4th notch	0 to 99	-	Defines the attenuation level of the 4th notch.	During running	At once	0
H09-58	STune resonance suppression reset selection	0 to 1	-	0: Disable 1: Enable After H09-58 is set to 1, H08-37...H08-39 and H09-18...H09-23 will be cleared automatically.	During running	At once	0

Note

If H09-00 (Gain auto-tuning mode) is set to 3, 4, or 6, the servo drive starts vibration suppression and inertia auto-tuning within 10 min (or other time defined by H09-37) after power-on. Then it exits from inertia auto-tuning automatically. If the function of inertia auto-tuning is turned off automatically, switching to modes 3, 4, or 6 does not activate inertia auto-tuning.

Do not set H09-00 to 3, 4, or 6 in applications with slow acceleration/deceleration, strong vibration, and unstable mechanical couplings.

In applications where the inertia does not change, set H09-03 (Online inertia auto-tuning mode) to 1 (Enabled, changing slowly). In applications where the inertia changes quickly, set H09-03 to 3 (Enabled, changing quickly).

4.3.2.4 Solutions to Common Faults

E661: Gain values too low

When the torque ripple detected by the servo drive exceeds the setpoint of H09-11 and becomes uncontrollable, the stiffness level will be reduced automatically until reaching level 10 where E661 is reported.

1. For uncontrollable vibration, enable vibration suppression manually.

2. For current fluctuation, check whether the current of the machine fluctuates regularly.

Para. No.	Name	Description	Value Range	Default	Unit	Data Type	Setting Condition	Effective Time
H08-37	Phase modulation for medium-frequency jitter suppression 2	-	-90 to +90	0	1°	16 bits	During running	At once
H08-38	Frequency of medium-frequency jitter suppression 2	-	100 to 1000	0	1 Hz	16 bits	During running	At once
H08-39	Compensation gain of medium-frequency jitter suppression 2	-	0 to 300	0	1	16 bits	During running	At once
H09-58	STune resonance suppression reset selection	0: Disable 1: Enable	0 to 1	0	1	16 bits	During running	At once

4.4 Manual Gain Tuning

4.4.1 Basic Parameters

When gain auto-tuning cannot deliver desired performance, fine-tune the gain manually to optimize the performance.

The servo system consists of three control loops, which are position loop, speed loop, and current loop from external to internal. The basic control diagram is shown in the following figure.

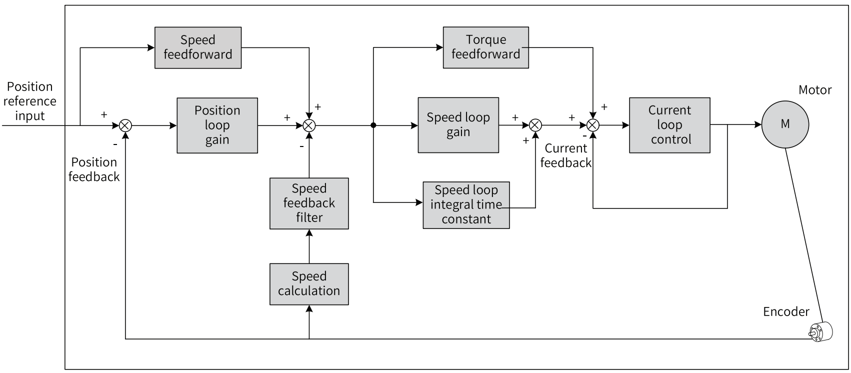


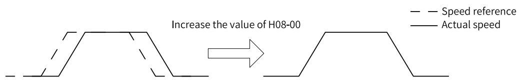
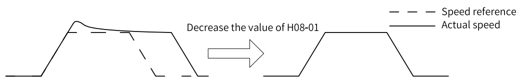
Figure 4-4 Basic control

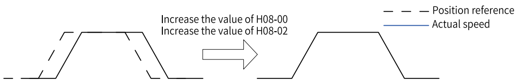
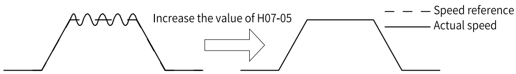
The responsiveness of the inner loop must be higher than that of the outer loop. Otherwise, the system may become unstable.

The current loop gain is set with the highest level of responsiveness by default, removing the need for further adjustment. You only need to adjust the position loop gain, speed loop gain, and other auxiliary gains. For gain tuning in the position control mode, the position loop gain must be increased together with the speed loop gain, and the responsiveness of the former must be lower than the latter.

The following table describes how to adjust the basic gain parameters.

Table 4–7

Step	Para. No.	Name	Description
1	H08-00	Speed loop gain	• Function: Determines the maximum frequency of a variable speed reference that can be followed up by the speed loop. If H08-15 (Load moment of inertia) is set correctly, the maximum frequency that can be followed up by the speed loop is the setpoint of H08-00.  • Note: Increasing the setpoint without incurring extra noise or vibration shortens the positioning time, stabilizes the speed, and improves the follow-up behavior. If noise occurs, decrease the setpoint. If mechanical vibration occurs, activate resonance suppression according to section *" Vibration Suppression" on page 233*.
2	H08-01	Speed loop integral time constant	• Function: Eliminates the speed loop deviation.  • Note: Set H08-01 according to the following formula: 500 ≤ H08-00 x H08-01 ≤ 1000 For example, if H08-00 is set to 40.0 Hz, the setpoint of H08-01 must meet the following requirement: 12.50 ms ≤ H08-01 ≤ 25.00 ms Decreasing the setpoint strengthens the integral action and shortens the positioning time. Note that an excessively low setpoint may easily lead to mechanical vibration and an excessively high setpoint prevents the speed loop deviation from being cleared. When H08-01 is set to 512.00 ms, integral action is invalid.

Step	Para. No.	Name	Description
3	H08-02	Position loop gain	• Function: Determines the maximum frequency of a variable position reference that can be followed up by the position loop. The maximum follow-up frequency of the position loop is the setpoint of H08-02  • Note: To ensure system stability, the maximum follow-up frequency of the speed loop must be 3 to 5 times higher than that of the position loop. Therefore, the following formula applies. $3 \leqslant \frac{2 \times \pi \times \text{H08-00}}{\text{H08-02}} \leqslant 5$ For example, when H08-00 is set to 40.0 Hz, H08-02 must meet the following requirement: 50.2 Hz ⩽ H08-02 ⩽ 83.7 Hz Adjust the setpoint based on the positioning time. Increasing the setpoint shortens the positioning time and improves the disturbance resistance capacity of the motor at a standstill. An excessively high setpoint may easily lead to system instability and oscillation.
4	H07-05	Torque reference filter time constant	• Function: Eliminates the high-frequency noise and suppresses mechanical resonance.  • Note: Ensure the cutoff frequency of the torque reference low-pass filter is 4 times higher than the maximum follow-up frequency of the speed loop. Therefore, the following formula applies. $\frac{1000}{2 \times \pi \times \text{H07-05}} \geqslant (\text{H08-00}) \times 4$ For example, when H08-00 is set to 40.0 Hz, the setpoint of H07-05 must be less than or equal to 1.00 ms. If increasing the setpoint of H08-00 incurs vibration, adjust the setpoint of H07-05 to suppress vibration. For details, see section *" Vibration Suppression" on page 233*. An excessively high setpoint weakens the responsiveness of the current loop. To suppress vibration upon stop, increase the setpoint of H08-00 and decrease the setpoint of H07-05. If strong vibration occurs upon stop, decrease the setpoint of H07-05.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-00	Speed loop gain	0.1 to 2000.0	Hz	Defines the proportional gain of the speed loop.	During running	At once	40
H08-01	Speed loop integral time constant	0.15 to 512.00	ms	Defines the integral time constant of the speed loop.	During running	At once	19.89
H08-02	Position loop gain	0.0 to 2000.0	Hz	Defines the proportional gain of the position loop.	During running	At once	64
H07-05	Torque reference filter time constant	0.00 to 30.00	ms	Defines the filter time constant of the torque reference.	During running	At once	0.79

4.4.2 Gain Switchover

Gain switchover, which is available only in the position control and speed control modes, can be triggered by the internal status of the servo drive. The following actions can be achieved through gain switchover.

- Switching to the lower gain when the motor is at a standstill (servo ON) to suppress vibration
- Switching to the higher gain when the motor is at a standstill to shorten the positioning time
- Switching to the higher gain when the motor is running to achieve better command tracking performance
- Switching between different gain settings through an external signal to fit different conditions of the load devices

H08-08 = 0

The first gain set (H08-00...H08-02, H07-05) are used, but proportional/proportional integral control switchover is available through bit26 (Gain switchover) of 60FE in the speed loop.

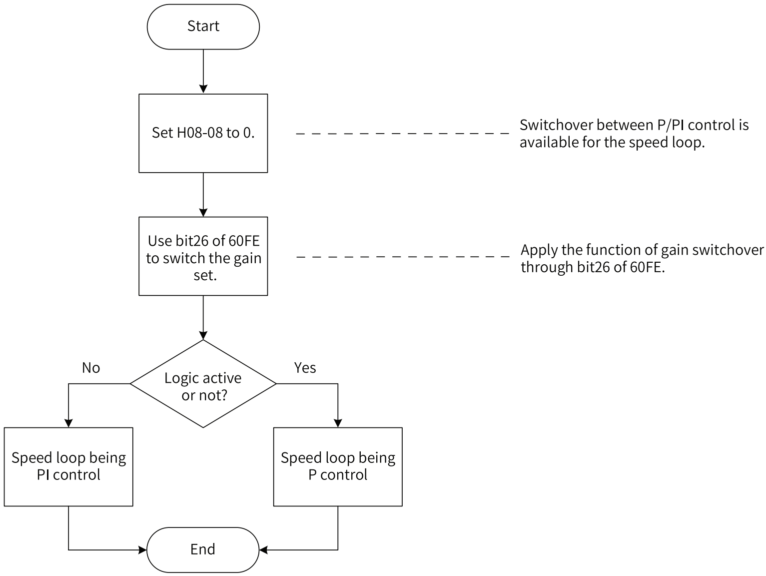


Figure 4-5 Gain switchover flowchart (H08-08 = 0)

H08-08 = 1

You can switch between the 1st gain set (H08-00...H08-02, H07-05) and 2nd gain set (H08-03...H08-05, H07-06) based on the condition defined by H08-09.

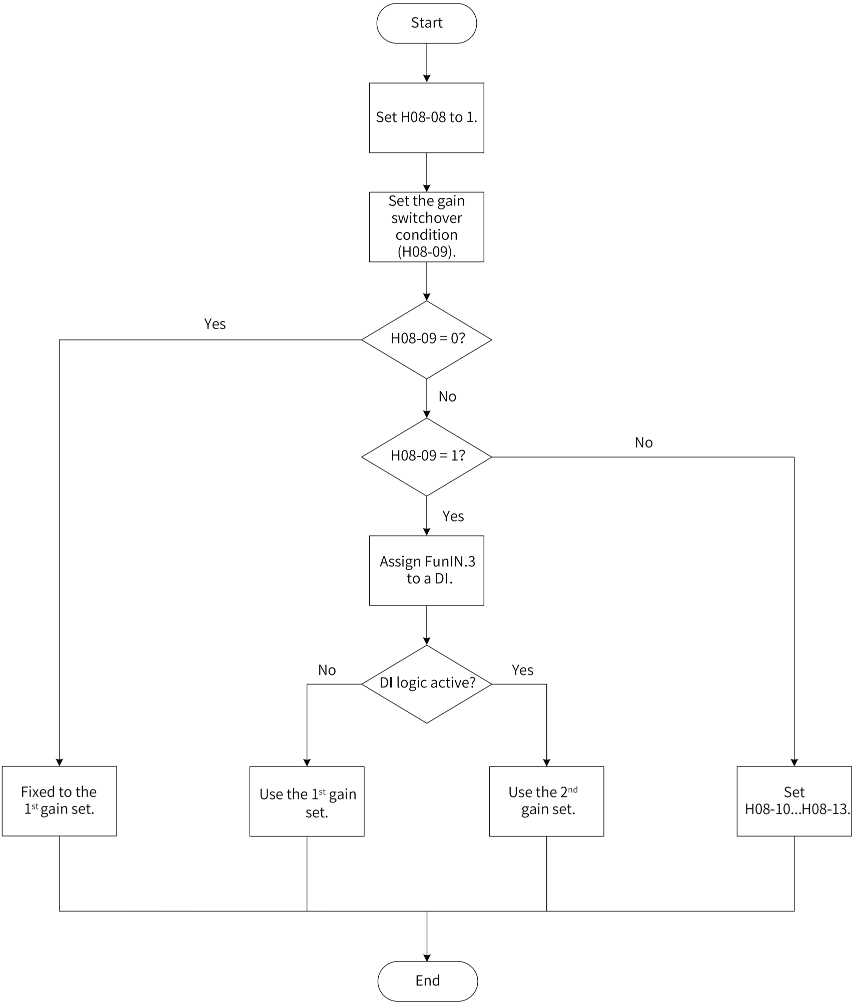
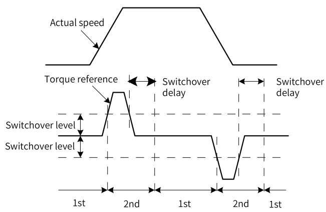
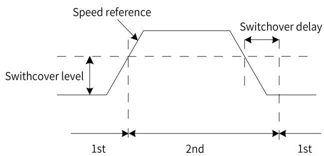
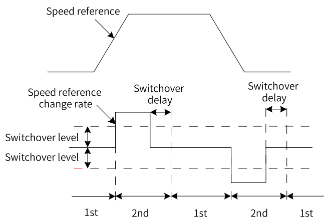
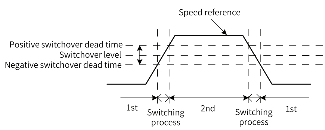
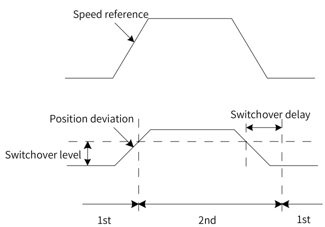
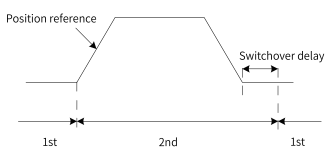
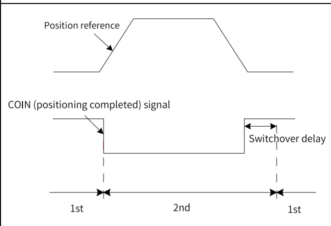
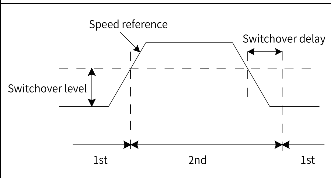


Figure 4-6 Gain switchover flowchart (H08-08 = 1)

There are 11 conditions for gain switchover. The following table describes diagrams and related parameters for different conditions.

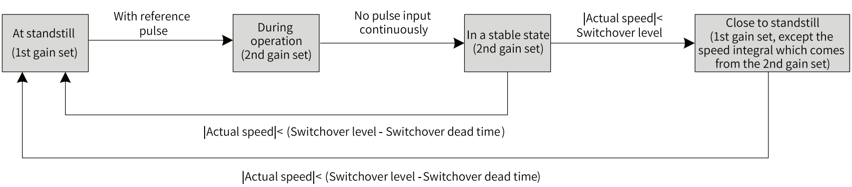
Table 4–8 Conditions for gain switchover

Gain Switchover Condition			Related Parameters		
H08-09	Condition	Diagram	Delay Time (H08-10)	Switchover Level (H08-11)	Switchover Dead Time (H08-12)
0	Fixed to the 1st gain set	-	Invalid	Invalid	Invalid
1	Switched by DI	-	Invalid	Invalid	Invalid
2	Torque reference		Valid	Valid (%)	Valid (%)
3	Speed reference		Valid	Valid	Valid
4	Speed reference change rate		Valid	Valid (10 RPM/s)	Valid (10 RPM/s)
5	Speed reference high-speed/low-speed threshold		Invalid	Valid (RPM)	Valid (RPM)
6	Position deviation		Valid	Valid (encoder unit)	Valid (encoder unit)

Gain Switchover Condition			Related Parameters		
H08-09	Condition	Diagram	Delay Time (H08-10)	Switchover Level (H08-11)	Switchover Dead Time (H08-12)
7	Position reference		Valid	Invalid	Invalid
8	Positioning completed		Valid	Invalid	Invalid
9	Actual speed		Valid	Valid (RPM)	Valid (RPM)
10	Position reference + Actual speed	See the following note for details.	Valid	Valid (RPM)	Valid (RPM)

Note

H08-10 (Gain switchover delay) is valid only during switching to the 1st gain set.



☆Related parameters:

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-08	2nd gain mode setting	0: Fixed to the 1st gain set, P/PI switched by DI 1: Switched between the 1st gain set and 2nd gain set as defined by H08-09	-	Defines the mode of the 2nd gain set.	During running	At once	1
H08-09	Gain switchover condition	0: Fixed to the 1st gain set 1: Switched by DI 2: Torque reference too high 3: Speed reference too high 4: Speed reference change rate too high 5: Speed reference high-speed/low-speed threshold 6: Position deviation too large 7: Position reference available 8: Positioning completed 9: Actual speed too high 10: Position reference + Actual speed	-	Defines the gain switchover condition.	During running	At once	0
H08-10	Gain switchover delay	0 to 10	-	Defines the gain switchover delay.	During running	At once	5
H08-11	Gain switchover level	1–1000	Based on switchover conditions	Defines the gain switchover level.	During running	At once	50
H08-12	Gain switchover dead time	0 to 20000	Based on switchover conditions	Defines the dead time of gain switchover.	During running	At once	30
H08-13	Position gain switchover time	0.0–100.0	ms	Defines the position loop gain switchover time.	During running	At once	3

4.4.3 Position Reference Filter

Name	Description	Applicable Occasion	Impact of Excessive Filtering
Position reference filter	Filters the position references (encoder unit) divided or multiplied by the electronic gear ratio to smoothen motor operation and reduce the shock on the machine.	The acceleration/ deceleration process is not performed on the position references sent from the host controller. The pulse frequency is low. The electronic gear ratio is higher than 10.	The response delay is prolonged.

4.4.4 Feedforward Gain

Speed feedforward

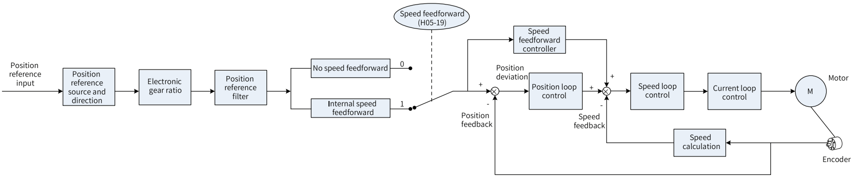


Figure 4-7 Block diagram of speed feedforward control

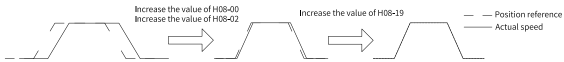
Speed feedforward can be applied to position control mode to improve the speed reference responsiveness and reduce the position deviation at fixed speed.

Operating procedure for speed feedforward:

1. Setting the speed feedforward signal source
   Set H05-19 to a non-zero value to enable the speed feedforward function. The corresponding signal source will be selected as well.

Para. No.	Name	Setpoint	Remarks
H05-19	Speed feedforward control	0: No speed feedforward	-
		1: Internal speed feedforward	Defines the speed corresponding to the position reference (encoder unit) as the speed feedforward signal source.
		2: 60B1 used as speed offset	-
		3: Zero phase control	-

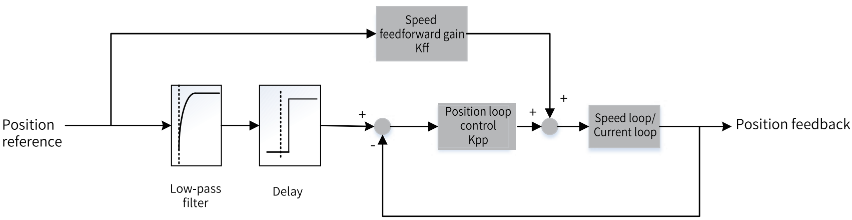
2. Setting speed feedforward parameters (including H08-19 and H08-18)

Para. No.	Name	Remarks
H08-18	Speed feedforward filter time constant	 Figure 4-8 Block diagram of speed feedforward control • Function: Increasing the value of H08-19 improves responsiveness but may cause speed overshoot during acceleration/deceleration. Decreasing the value of H08-18 suppresses speed overshoot during acceleration/deceleration. Increasing the value of H08-18 not only suppresses the noise generated in case of long position reference update/drive control period and uneven position reference pulse frequency, but also suppresses the positioning completed signal jitter. • Note: Set H08-18 to a fixed value first, and then increase the value of H08-19 gradually from 0 to a certain value at which speed feedforward achieves the required effect. Adjust H08-18 and H08-19 repeatedly until a balanced performance is reached.
H08-19	Speed feedforward gain	

Zero phase control

Zero phase control is used to compensate for the position deviation generated upon delay of position reference startup, reducing the position deviation upon start/stop of the position control mode.

The loop calculation model is shown in the following figure.



Setting parameters related to zero phase control

Para. No.	Name	Description	Value Range	Default	Min. Unit	Width	Change Condition	Effective Time
H05-19	Speed feedforward control	Setting H05-19 to 3 enables zero phase compensation feedforward. Normal speed feedforward applies when H08-17 is not involved. Zero phase control applies when H08-17 is involved.	0 to 3	1	1	16 bits	At stop	At once
H08-17	Zero phase delay	Indicates the advance time of speed feedforward calculation.	0 to 4.0	0	0.1 ms	16 bits	During running	At once
H05-04	Zero phase low-pass filter time	Defines the low-pass filter time of position references.	0 to 6553.5	0	0.1 ms	16 bits	At stop	At once

Torque feedforward

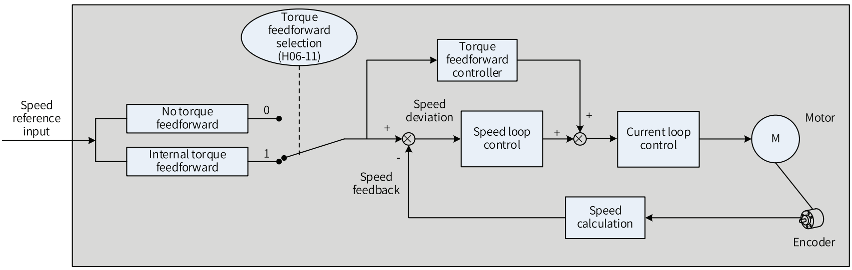


Figure 4-9 Torque feedforward control

Torque feedforward can be applied to the position control mode to improve torque reference responsiveness and reduce the position deviation during acceleration/ deceleration at a constant speed. Torque feedforward can also be applied to the speed control mode to improve torque reference responsiveness and reduce the speed deviation during operation at a constant speed.

The procedure for setting torque feedforward is as follows:

1. Setting the torque feedforward signal source
   Set H06-11 to 1 to enable speed feedforward. The corresponding signal source will be selected as well.

<table>
<tr><th>Para. No.</th><th>Name</th><th>Setpoint</th><th>Remarks</th></tr>
<tr><td rowspan="2">H06-11</td><td rowspan="2">Torque feedforward control</td><td>0: No torque feedforward</td><td>-</td></tr>
<tr><td>1: Internal torque feedforward</td><td>Defines the speed reference as the torque feedforward signal source.
In the position control mode, the speed reference is outputted from the position controller.</td></tr>
</table>

2. Setting torque feedforward parameters

<table>
<tr><th>Para. No.</th><th>Name</th><th>Description</th></tr>
<tr><td>H08-20</td><td>Torque feedforward filter time constant</td><td>• Function:
Increasing the value of H08-21 improves responsiveness but may cause overshoot during acceleration/ deceleration.
Decreasing the value of H08-20 suppresses overshoot during acceleration/deceleration. Increasing the value of H08-20 suppresses the noise.
• Note:
Keep H08-20 to the default value, and then gradually increase the value of H08-21 from 0 to a certain value at which torque feedforward achieves the required effect.
Adjust H08-20 and H08-21 repeatedly until a balanced performance is achieved.</td></tr>
<tr><td>H08-21</td><td>Torque feedforward gain</td><td>For details, see "4.4.4 Feedforward Gain" on page 219.</td></tr>
</table>

4.4.5 PDFF Control

The pseudo derivative feedback and feedforward (PDFF) control can be used to adjust speed loop control in the control modes other than torque control.

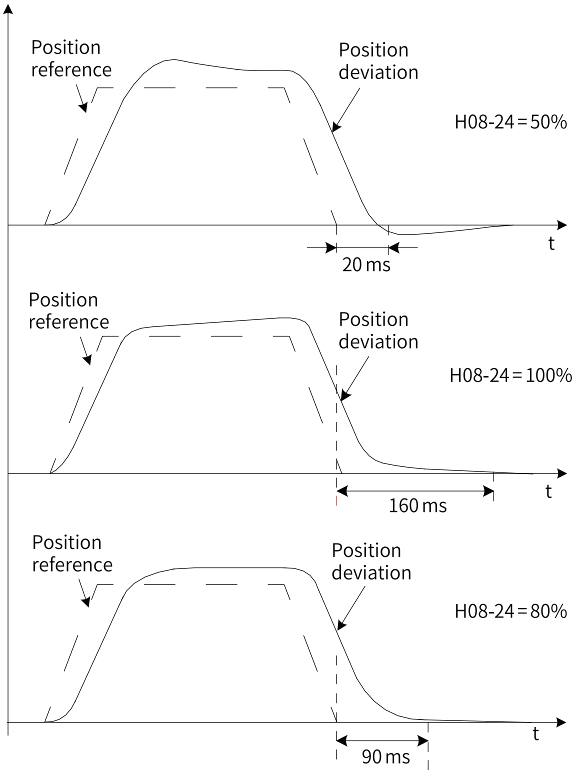


Figure 4-10 Example of PDFF control

Through adjusting the speed loop control method, PDFF control enhances the anti-disturbance capacity of the speed loop and improves the performance in following up speed references.

Para. No.	Name	Description
H08-24	PDFF control coefficient	• Function: Defines the control method of the speed loop in the control modes other than torque control. • Note: Setting H08-24 to an excessively low value slows down the responsiveness of the speed loop. When the speed feedback overshoots, decrease the setpoint of H08-24 gradually from 100.0 to a certain value at which the PDFF control achieves the desired effect. When H08-24 is set to 100.0, the speed loop control mode does not change and proportional integral control is applied by default.

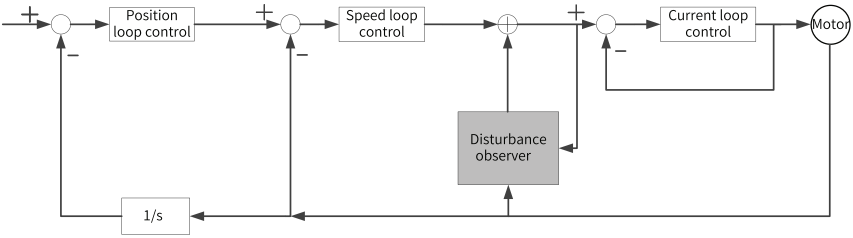
4.4.6 Torque Disturbance Observer

This function is intended to be used in the control modes other than torque control.

Disturbance observer

The disturbance observer observes the external disturbance. Disturbances within the frequency range can be observed and suppressed with different cutoff frequencies and compensation values.

The following figure depicts the control block diagram, showing the location of the disturbance observer in the control structure.



Note

1/s: Integral element

☆Related parameters:

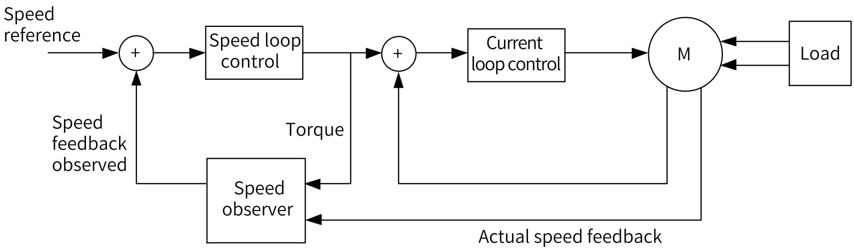
Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-31	Disturbance observer cutoff frequency	10 to 4000	1 Hz	The higher the cutoff frequency, the more easily will vibration occur.	During running	At once	600
H08-32	Disturbance observer compensation coefficient	0 to 100	1%	Defines the compensation percentage for observation.	During running	At once	0
H08-33	Disturbance observer inertia correction	0 to 1600	1%	H08-33 needs to be changed only when the inertia ratio does not reflect the actual condition. The acting inertia is the inertia setpoint multiplied by H08-33. It is recommended to use the default value of H08-33.	During running	At once	100

4.4.7 Speed Observer

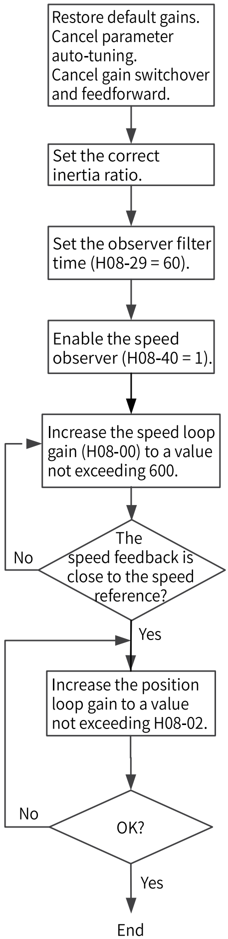
The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.

It improves the responsiveness and filters high frequencies automatically, thus improving the gains and shortening the positioning time without incurring high-frequency vibration.

The block diagram for the speed observer is shown as follows.



Commissioning procedure



Related parameters

Para. No.	Name	Min. unit	Value Range	Default	Setting Condition	Effective Time
H08-00	Speed loop gain	0.1 Hz	1 to 20000	40	During running	At once
H08-27	Cutoff frequency of speed observer	1 Hz	50 to 600	170	During running	At once
H08-28	Speed observer inertia correction coefficient	1%	1 to 1600	100	During running	At once
H08-29	Speed observer filter time	1 ms	0 to 10	0.8	During running	At once
H08-40	Speed observer selection	1	0 to 1	0	During running	At once

Note

Before using the speed observer, set H08-15 (Load inertia ratio) to a proper value or perform inertia auto-tuning. A wrong inertia ratio will cause vibration.

Setting H08-27, H08-28, or H08-29 to excessively low or high values will result in motor vibration.

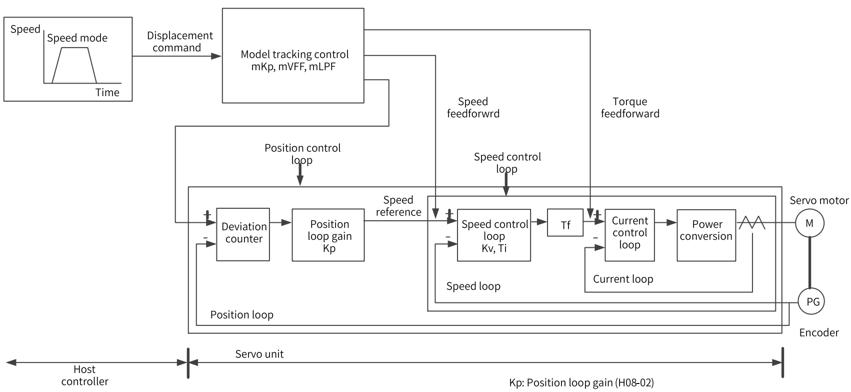
4.4.8 Model Tracking

The model tracking function, which is only available in the position control mode, can be used to improve the responsiveness and shorten the positioning time.

Parameters used by model tracking are normally set automatically through STune or ETune along with the gain parameters. However, manual tuning is needed in the following situations:

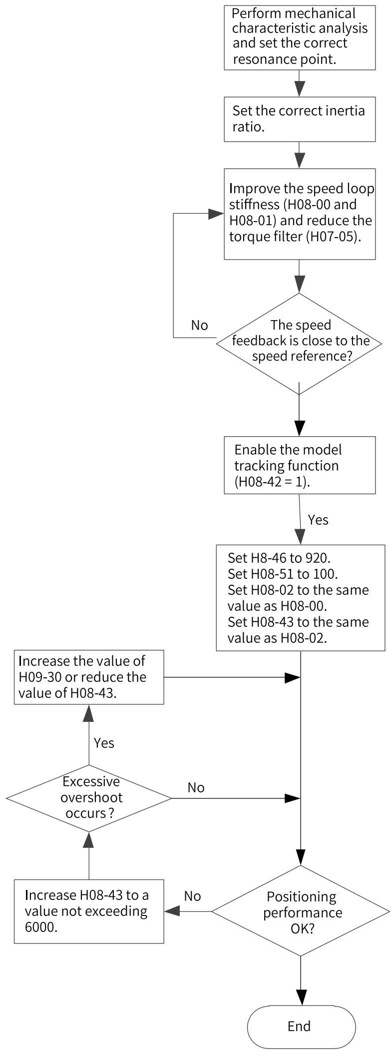
- The auto-tuned values cannot deliver desired performance.
- Improving the responsiveness takes priority over the auto-tuned values.
- User-defined gain parameters or model tracking control parameters are needed.

The block diagram for model tracking control is as follows.



Kp: Position loop gain (H08-02)
Kv: Speed loop gain (H08-00)
Ti: Speed loop integral time constant (H08-01)
Tf: Torque reference filter time constant (H07-05)
mKp: Model tracking control gain (H08-43)
mVFF: Model tracking control speed feedforward compensation (H08-46)
mLPF: Model filter time (H08-51)

Commissioning procedure



☆Related parameters

Para. No.	Name	Min. unit	Value Range	Default	Setting Condition	Effective Time
H07-05	Torque reference filter time constant	1 ms	0 to 30	0.2	During running	At once
H08-00	Speed loop gain	0.1 Hz	1 to 20000	400	During running	At once
H08-01	Speed loop integral time constant	0.01 ms	15 to 51200	1989	During running	At once

Para. No.	Name	Min. unit	Value Range	Default	Setting Condition	Effective Time
H08-02	Position loop gain	0.1 Hz	1 to 20000	640	During running	At once
H08-42	Model control selection	1	0 to 1	0	At stop	At once
H08-43	Model gain	1	0.1 to 2000	40	During running	At once
H08-46	Feedforward value	1	0 to 102.4	95	During running	At once
H08-51	Model filtering time 2	0.01 ms	0 to 2000	0	During running	At once

Note

Ensure the set inertia is accurate. Otherwise, motor vibration may occur.

4.4.9 Friction Compensation

Friction compensation is used to reduce the impact of the friction on the operating effect during mechanical transmission. Use different positive/negative compensation values according to the direction of operation.

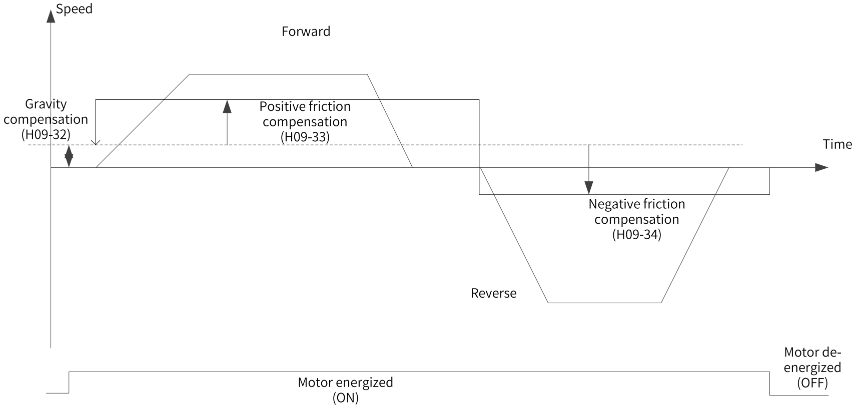
Note

Friction compensation is valid only in the position control mode.

☆Related parameters:

Para. No.	Name	Value Range	Description
H09-32	Gravity compensation value	0.0% to 100.0%	Defines the constant compensation torque for vertical gravity load.
H09-33	Positive friction compensation	0.0% to 100.0%	Defines the friction compensation for positive position references.
H09-34	Negative friction compensation	-100.0% to 0.0%	Defines the friction compensation for negative position references.
H09-35	Friction compensation speed threshold	0 RPM to 30.0 RPM	Defines the operating speed after the friction is neutralized.
H09-36	Friction compensation speed	0: Speed reference 1: Model speed (valid when the model function is enabled) 2: Speed feedback	Defines the source of speed threshold.

The diagram for friction compensation is as follows.



Note

When the speed is lower than the speed threshold, static friction applies. When the speed exceeds the speed threshold, dynamic friction applies. The compensation direction is determined by the direction of the position reference. Forward direction requires a positive compensation value. Reverse direction requires a negative compensation value.

4.5 Parameter Adjustment in Different Control Modes

Perform parameter adjustment in the sequence of "Inertia auto-tuning" => "Gain auto-tuning => "Manual gain tuning" in all the control modes.

4.5.1 Parameter Adjustment in the Position Control Mode

1. Get the value of H08-15 (Load moment of inertia ratio) through inertia auto-tuning.
2. Gain parameters in the position control mode are listed in the following tables.

- 1st gain set:

Para. No.	Name	Description	Default
H07-05	Torque reference filter time constant	Defines the torque reference filter time constant.	0.79 ms
H08-00	Speed loop gain	Defines the speed loop proportional gain.	40.0 Hz
H08-01	Speed loop integral time constant	Defines the integral time constant of the speed loop.	19.89 ms
H08-02	Position loop gain	Defines the position loop proportional gain.	64.0 Hz

- 2nd gain set

Para. No.	Name	Description	Default
H07-06	2nd torque reference filter time constant	Defines the torque reference filter time constant.	0.27 ms
H08-03	2nd speed loop gain	Defines the speed loop proportional gain.	75.0 Hz
H08-04	2nd speed loop integral time constant	Defines the integral time constant of the speed loop.	10.61 ms
H08-05	2nd position loop gain	Defines the position loop proportional gain.	120.0 ms
H08-08	2nd gain mode setting	Defines the mode of the 2nd gain set.	1
H08-09	Gain switchover condition	Defines the gain switchover condition.	0
H08–10	Gain switchover delay	Defines the gain switchover delay.	5.0 ms
H08-11	Gain switchover level	Defines the gain switchover level.	50
H08-12	Gain switchover dead time	Defines the dead time of gain switchover.	30
H08-13	Position gain switchover time	Defines the position loop gain switchover time.	3.0 ms

- Common gains

Para. No.	Name	Description	Default
H08-18	Speed feedforward filter time constant	Defines the filter time constant of the speed feedforward signal.	0.50 ms
H08-19	Speed feedforward gain	Defines the speed feedforward gain.	0.00%
H08-20	Torque feedforward filter time constant	Defines the filter time constant of the torque feedforward signal.	0.50 ms
H08-21	Torque feedforward gain	Defines the torque feedforward gain.	0.00%
H08-22	Speed feedback filtering option	Used to set the speed feedback filtering function.	0
H08-23	Cutoff frequency of speed feedback low-pass filter	Defines the cutoff frequency of the first-order low-pass filter for speed feedback.	8000 Hz
H08-24	PDFF control coefficient	Defines the coefficient of the PDFF controller.	100.00%
H09-30	Torque disturbance compensation gain	Defines the disturbance torque compensation gain.	0.00%
H09-31	Filter time constant of torque disturbance observer	Defines the filter time constant of the disturbance observer.	0.5 ms

Para. No.	Name	Description	Default
H09-04	Low-frequency resonance suppression mode	Defines the low-frequency resonance suppression mode.	0
H09-38	Frequency of low-frequency resonance	Defines the frequency of the low-frequency resonance suppression filter.	100.0 Hz
H09-39	Low-frequency resonance frequency filter setting	Defines the setting of low-frequency resonance suppression filter.	2
H0A-16	Threshold of low-frequency resonance position deviation	Defines the position fluctuation threshold (in pulses) which can be judged as low-frequency resonance.	0.0005 Rev

3. Perform gain auto-tuning to get the initial values of the 1st gain set (or 2nd gain set) and common gains.
   Fine-tune the following gains manually.

Para. No.	Name	Description	Default
H07-05	Torque reference filter time constant	Defines the torque reference filter time constant.	0.2 ms
H08-00	Speed loop gain	Defines the speed loop proportional gain.	39.0 Hz
H08-01	Speed loop integral time constant	Defines the integral time constant of the speed loop.	20.51 ms
H08-02	Position loop gain	Defines the position loop proportional gain.	55.7 ms
H08-19	Speed feedforward gain	Defines the speed feedforward gain.	0.0%

4.5.2 Parameter Adjustment in the Speed Control Mode

Parameter adjustment in the speed control mode is the same as that in the position control mode except the position loop gains (H08-02 and H08-05). See section *"4.5.1 Parameter Adjustment in the Position Control Mode" on page 230* for details.

4.5.3 Parameter Adjustment in the Torque Control Mode

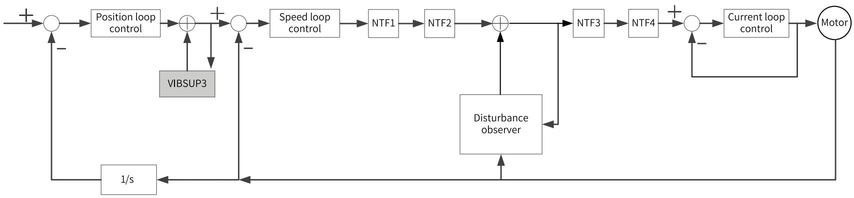
Parameter adjustment in the torque control mode is further differentiated based on the following conditions:

- If the actual speed reaches the speed limit, the adjustment method is the same as that described in *"4.5.2 Parameter Adjustment in the Speed Control Mode" on page 232*.
- If the actual speed does not reach the speed limit, the adjustment method is the same as that described in section *"4.5.2 Parameter Adjustment in the Speed*

Control Mode" on page 232, except the position/speed loop gain and speed loop integral time constant.

4.6 Vibration Suppression

The block diagram for vibration suppression is as follows.



- NTF1–4: 1st notch to 4th notch
- VIBSUP3: Medium- and low-frequency vibration suppression, reduction applied at a carrier frequency lower than 8 K under 300 Hz
- 1/s: Integral element

☆Related parameters:

Para. No.	Name	Default	Unit	Min. Value	Max. Value	Setting Condition	Effective Time
H08-53	Medium- and low-frequency jitter suppression frequency 3	0	0.1 Hz	0	6000	During running	At once
H08-54	Medium- and low-frequency jitter suppression compensation 3	0	1%	0	200	During running	At once
H08-56	Medium- and low-frequency jitter suppression phase modulation 3	300	1%	0	1600	During running	At once
H08-59	Medium- and low-frequency jitter suppression frequency 4	0	0.1 Hz	0	3000	During running	At once
H08-60	Medium- and low-frequency jitter suppression compensation 4	0	1%	0	200	During running	At once
H08-61	Medium- and low-frequency jitter suppression phase modulation 4	100	1%	0	600	During running	At once

Note

Jitter suppression phase modulation: Refers to synchronous phase adjustment of the compensation value and jitter. It is recommended to use the default value. Adjustment is needed only when the phase of compensation deviates sharply from the phase of vibration.

Jitter suppression frequency: Defines the jitter frequency to be suppressed.

Jitter suppression compensation: Defines the compensation magnitude for jitter suppression.

4.6.1 Mechanical Resonance Suppression

Resonance frequency is present in the mechanical system. When gains are increased, resonance may occur near the resonance frequency, disabling further increase of the gain.

- Mechanical resonance can be suppressed in the following two methods:
  - Torque reference filter (H07-05, H07-06)
    To suppress mechanical resonance, set the filter time constant to enable the torque reference to be attenuated in the frequency range above the cutoff frequency.

    Filter cutoff frequency fc (Hz) = 1/[2π x H07-05 (ms) x 0.001]
  - Notch
    The notch reduces the gains at certain frequencies to suppress mechanical resonance. After resonance is suppressed by the notch, you can increase the gains. The operating principle of the notch is shown in the following figure.

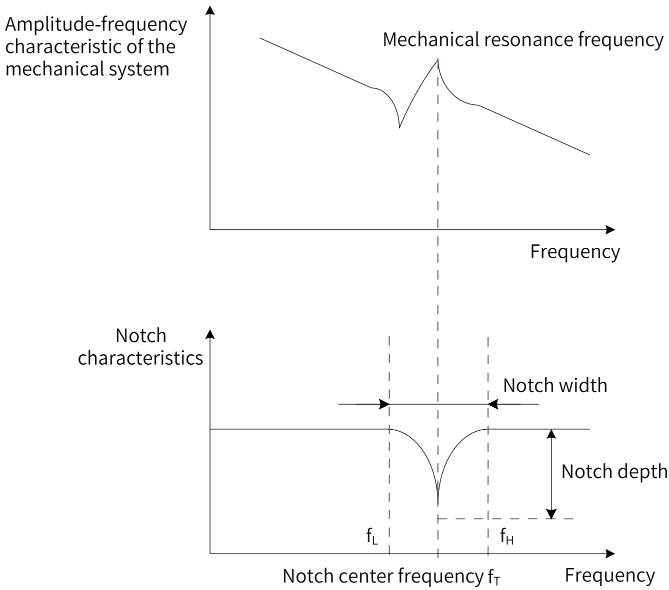


Figure 4-11 Operating principle of the notch

A total of four notches can be used, and each is defined by three parameters: frequency, width level, and depth level. The 1st and 2nd notches are manual notches, whose parameters needs to be set by users. Parameters of the 3rd and 4th notches can be either set manually or set automatically after being configured as adaptive notches (H09-02 =1 or 2).

Table 4–9 Description of notch parameters

Item	Manual Notch		Manual/Adaptive Notch	
	1st Notch	2nd Notch	3rd Notch	4th Notch
Frequency	H09-12	H09-15	H09-18	H09-21
Width level	H09-13	H09-16	H09-19	H09-22
Depth level	H09-14	H09-17	H09-20	H09-23

Note

When the frequency is 8000 Hz (default), the notch is invalid.

The adaptive notch is preferred for resonance suppression. The manual notch can be used in cases where the adaptive notch cannot deliver desired performance.

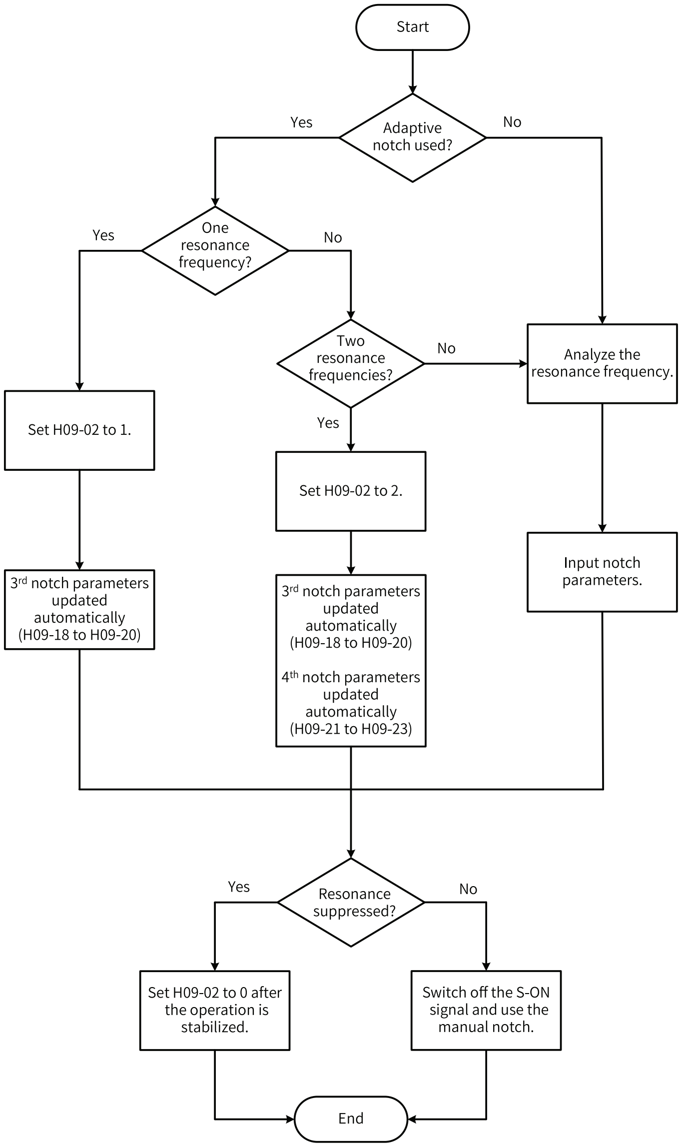


Figure 4-12 Procedure for setting the notch

- Procedure for setting the adaptive notch:

1. Set H09-02 (Adaptive notch mode) to 1 or 2 based on the number of resonance points.

2. When resonance occurs, set H09-02 to 1 first to enable one adaptive notch. If resonance occurs again after gain tuning, set H09-02 to 2 to enable two adaptive notches.
3. Parameters of the 3rd or 4th notches are updated automatically during operation, and parameter values are saved automatically to the corresponding parameters in group H09 every 30 min.
4. If resonance is suppressed, the adaptive notch functions well. After the servo drive operates stably for a period of time, set H09-02 to 0. Parameters of the adaptive notch are fixed to the values updated the last time. This is to prevent notch parameters from being updated to wrong values due to misoperation. Wrong values will intensify resonance.
5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.
6. If there are more than two resonance frequencies, use both the adaptive notch and the manual notch to suppress resonance or use the four notches as manual notches (H09-02 = 0).

Note

When the adaptive notch is used, if the S-ON signal is switched off within 30 min, notch parameters will not be saved into corresponding parameters.

When the resonance frequency is lower than 300 Hz, the suppression effect of the adaptive notch will be affected.

- Procedure for setting the manual notch:

1. Analyze the resonance frequency.
2. When using the manual notch, set the notch frequency to same value as the actual resonance frequency obtained in the following ways:

   a. Use the "Mechanical characteristic analysis" function in Inovance software tool.
   b. Calculate the resonance frequency based on the motor phase current displayed on the oscilloscope interface of the software tool.
   c. Set H09-02 (Adaptive notch mode) to 3. The servo drive detects the resonance frequency and saves the detected value to H09-24 automatically after start.

3. Input the resonance frequency obtained in step 1 into the parameter of the selected notch, and input the width level and depth level of this notch.
4. If the resonance is suppressed, it indicates the notch functions well and you can continue adjusting the gain. If new resonance occurs, repeat steps 1 and 2.
5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.

- Width level of the notch
  The width level indicates the ratio of the notch width to the center frequency of the notch.

$$\text{Notch width level} = \frac{f_H - f_L}{f_T}$$

  In which:

  f_T: Center frequency of the notch, which is also the mechanical resonance frequency

  $f_H - f_L$: notch width, indicating the frequency bandwidth whose amplitude attenuation rate is -3 dB relative to the notch center frequency

  The default value 2 applies to general applications.

- Depth level of the notch
  The notch depth level indicates the ratio of the input to the output at the center frequency.

  When the depth level is 0, the input is completely suppressed at the center frequency. When the depth level is 100, the input can be fully passed at the center frequency. Therefore, the lower the depth level is, the higher the notch depth is, and the stronger the suppression effect will be. Note that an excessively low depth level may lead to system oscillation.

Note

If the amplitude-frequency characteristic curve obtained by the mechanical characteristic analysis tool does not have obvious spikes but vibration does occur in actual operations, it indicates the gain limit of the servo drive may be reached, which causes the vibration. Such vibration, which is not mechanical resonance that normally suppressed by a notch, can be suppressed only by reducing the gains or the torque reference filter time.

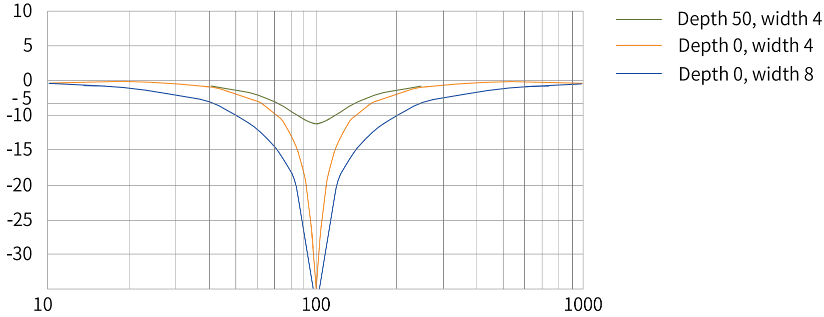


Figure 4-13 Notch frequency characteristics

☆Related parameters:

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-02	Adaptive notch mode	0: Parameters of the 3rd and 4th adaptive notches no longer updated 1: Only one adaptive notch (3rd notch) activated, parameters updated in real time based on the vibration condition 2: Two adaptive notches (3rd and 4th notches) activated, parameters updated in real time based on the vibration condition 3: Resonance frequency detected only (displayed in H09-24) 4: Adaptive notch cleared, values of the 3rd and 4th notches restored to default	-	Defines the adaptive notch mode.	During running	At once	0
H09-12	Frequency of the 1st notch	50 to 8000	Hz	Defines the frequency of the 1st notch.	During running	At once	4000
H09-13	Width level of the 1st notch	0 to 10	-	Defines the width level of the 1st notch.	During running	At once	2
H09-14	Depth level of the 1st notch	0 to 99	-	Defines the attenuation level of the 1st notch.	During running	At once	0

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-15	Frequency of the 2nd notch	50 to 8000	Hz	Defines the frequency of the 2nd notch.	During running	At once	4000
H09-16	Width level of the 2nd notch	0 to 10	-	Defines the width level of the 2nd notch.	During running	At once	2
H09-17	Depth level of the 2nd notch	0 to 99	-	Defines the attenuation level of the 2nd notch.	During running	At once	0
H09-18	Frequency of the 3rd notch	50 to 8000	Hz	Defines the frequency of the 3rd notch.	During running	At once	4000
H09-19	Width level of the 3rd notch	0 to 10	-	Defines the width level of the 3rd notch.	During running	At once	2
H09-20	Depth level of the 3rd notch	0 to 99	-	Defines the attenuation level of the 3rd notch.	During running	At once	0
H09-21	Frequency of the 4th notch	50 to 8000	Hz	Defines the frequency of the 4th notch.	During running	At once	4000
H09-22	Width level of the 4th notch	0 to 10	-	Defines the width level of the 4th notch.	During running	At once	2
H09-23	Depth level of the 4th notch	0 to 99	-	Defines the attenuation level of the 4th notch.	During running	At once	0
H09-24	Auto-tuned resonance frequency	0 to 5000	Hz	Indicates the auto-tuned resonance frequency when H09-02 is set to 3.	-	-	0

4.6.2 Low-Frequency Resonance Suppression at the Mechanical End

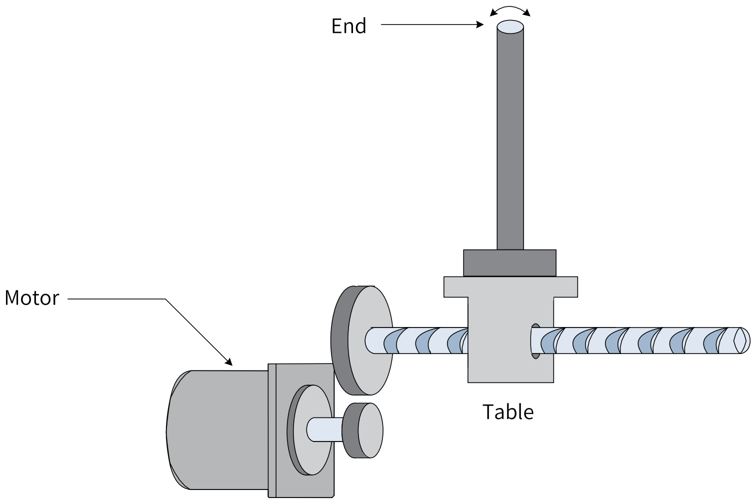


Figure 4-14 Low-frequency vibration at the mechanical end

If the mechanical load end is long and heavy, vibration may easily occur in this part at emergency stop, affecting the positioning effect. Such vibration is called low-frequency resonance as its frequency is generally within 100 Hz, which is lower than the mechanical resonance frequency mentioned in section "Mechanical Resonance Suppression". Use the low-frequency resonance suppression function to reduce such vibration.

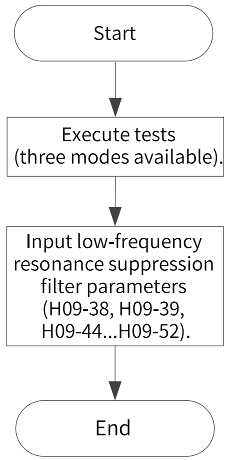


Figure 4-15 Procedure for setting low-frequency resonance suppression filter

First, collect the position deviation waveform in the motor positioning state through the oscilloscope function in the software tool and calculate the position deviation fluctuation frequency, which is the low-frequency resonance frequency. Then, input the values of H09-38 (or H09-44) and H09-49 manually and keep the values of other parameters to the default values. Observe the resonance suppression effect after using the low-frequency resonance suppression filter.

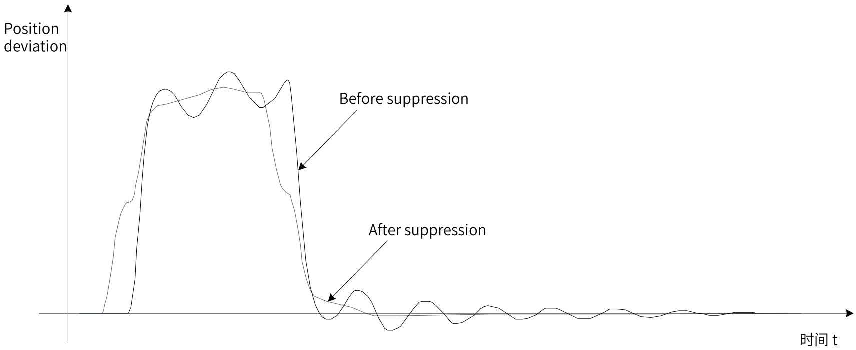


Figure 4-16 Low-frequency resonance suppression effect

☆Related parameters:

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-38	Low-frequency resonance suppression frequency at the mechanical end	1.0 to 100.0	Hz	Defines the low-frequency resonance suppression frequency.	During running	At once	100
H09-39	Low-frequency resonance suppression at the mechanical end	0 to 3	–	Defines the low-frequency resonance suppression level.	During running	At once	2
H09-44	Frequency of low-frequency resonance suppression 2 at mechanical load end	0.0 to 200.0	Hz	Defines the frequency of the 2nd group of low-frequency resonance suppression. The setpoint 0 indicates this function is disabled.	During running	At once	0

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-45	Responsiveness of low-frequency resonance suppression 2 at mechanical load end	0.01 to 10.00	Hz	Defines the responsiveness of the 2nd group of low frequency resonance suppression. Increasing the setpoint reduces the delay caused by suppression and improves the responsiveness. Note that an excessively high setpoint may cause vibration.	During running	At once	1
H09-47	Width of low-frequency resonance suppression 2 at mechanical load end	0.00 to 2.00	Hz	Defines the width of the 2nd group of low frequency resonance suppression. Increase the setpoint when the vibration frequency changes during operation.	During running	At once	1
H09-49	Frequency of low-frequency resonance suppression 3 at mechanical load end	0.0 to 200.0	Hz	Defines the frequency of the 3rd group of low frequency resonance suppression. The setpoint 0 indicates this function is disabled.	During running	At once	0
H09-50	Responsiveness of low-frequency resonance suppression 3 at mechanical load end	0.01 to 10.00	Hz	Defines the responsiveness of the 3rd group of low frequency resonance suppression. Increasing the setpoint reduces the delay caused by suppression and improves the responsiveness. Note that an excessively high setpoint may cause vibration.	During running	At once	1
H09-52	Width of low-frequency resonance suppression 3 at mechanical load end	0.00 to 2.00	Hz	Defines the width of the 3rd group of low frequency resonance suppression. Increase the setpoint when the vibration frequency changes during operation.	During running	At once	1

4.7 Mechanical Characteristic Analysis

4.7.1 Overview

Mechanical characteristic analysis is used to determine the mechanical resonance point and system bandwidth. A maximum of 8 kHz response characteristic analysis is available and three modes including mechanical characteristic, speed open loop and speed closed loop are supported.

4.7.2 Operation Flowchart

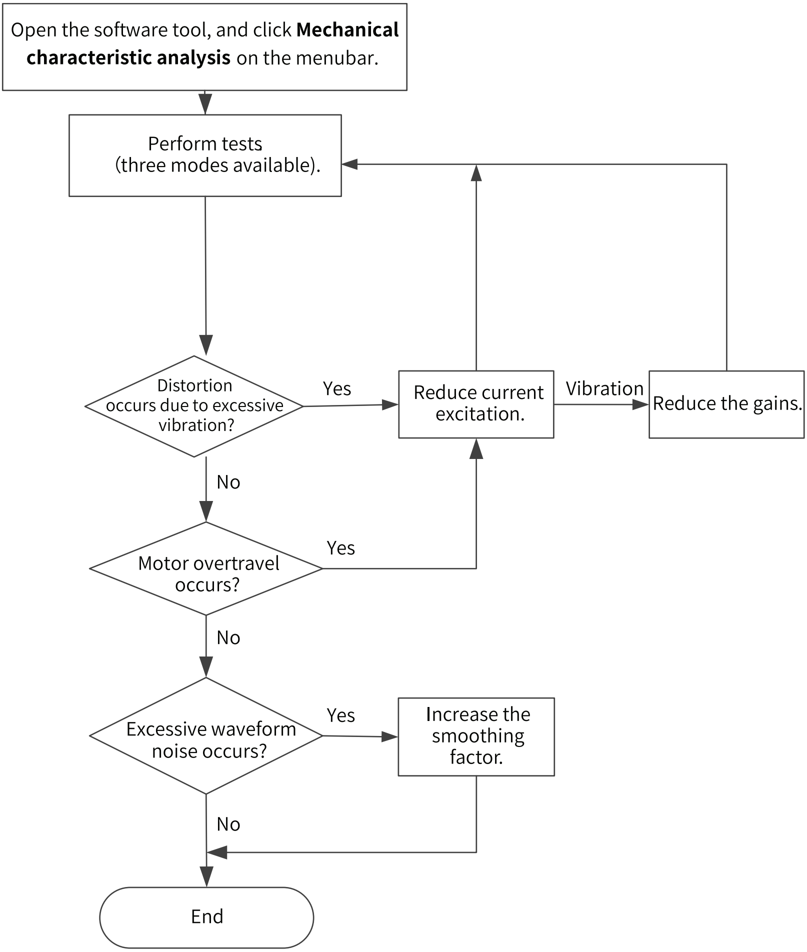


Figure 4-17 Operating procedure for mechanical characteristic analysis

Note

To avoid strong vibration during testing, set the initial current excitation to 10%.

The analysis waveform may be distorted if the current excitation is too low.

If the vibration generated during test cannot be suppressed after reducing the current excitation, the possible causes and solutions may be: 1) The gain is too high, reduce the speed gain or set the notch based on the auto-tuned resonance point. 2) The set inertia is too high, set the correct inertia.

In the mechanical characteristic test mode, waveforms before and after notch settings are consistent. In the speed closed loop and speed open loop modes, waveforms are attenuated after notch settings.

An example of the waveform obtained with the mechanical characteristic analysis is shown in the following figure.

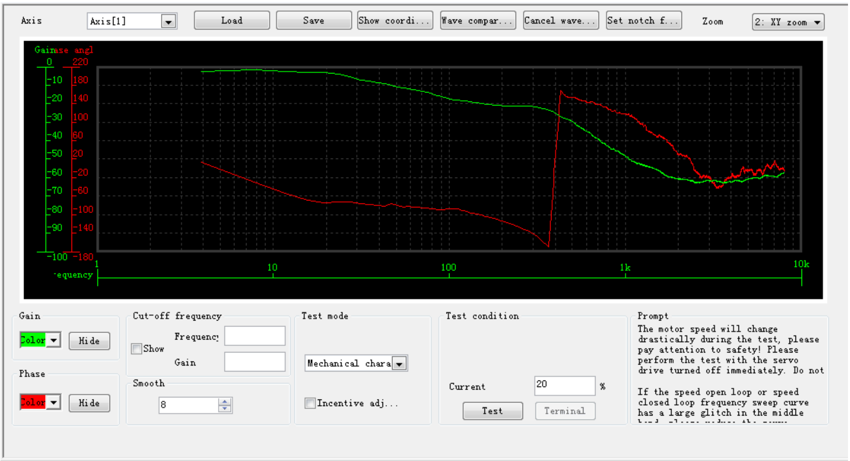


Figure 4-18 Example of the waveform obtained

5 Multi-Machine Recipe Management

In EtherCAT multi-axis applications, parameters of each axis are usually written or read separately, which is time-consuming and error-prone. Therefore, EtherCAT network devices need a PC software capable of writing/reading parameters of all the servo axes at a time, with the complete device recipe saved.

Function

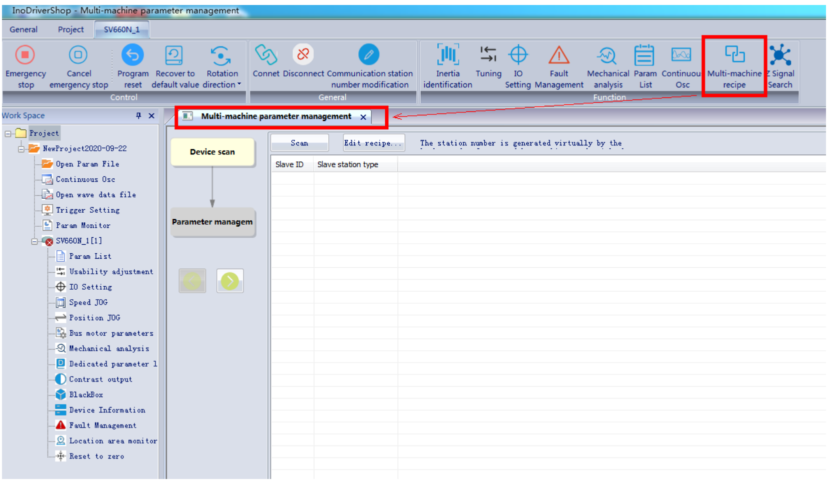
- Identification and scanning of axis drives: The software identifies Inovance EtherCAT devices (SV660N series servo drives) based on the configuration of the network card.
- Uploading and downloading of all the cascaded axis drive parameters
- Saving and downloading of drive recipes
- Comparison and copy of axis drive parameters
- Comparison of device parameters and recipe parameters

Operating environment

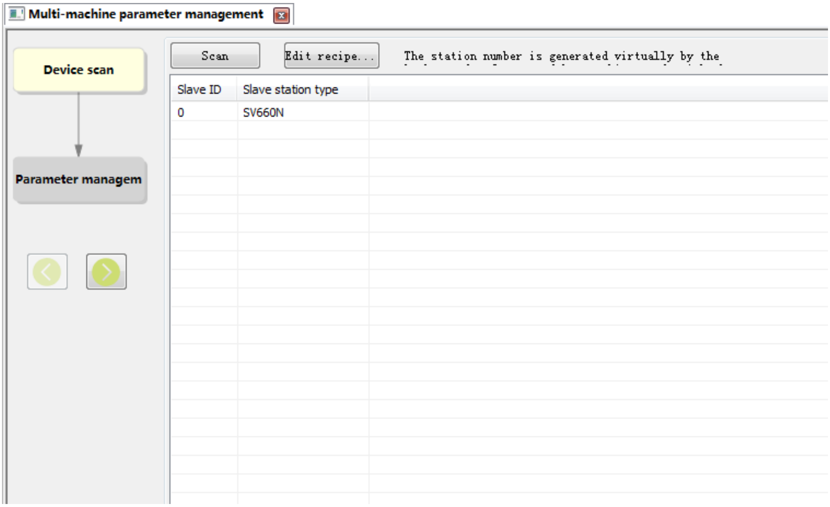
- Hardware: PC
- Software supported:
  Operating system: WIN7 32-bit/64-bit systems and WIN 10 32-bit/64-bit systems

Instructions for use

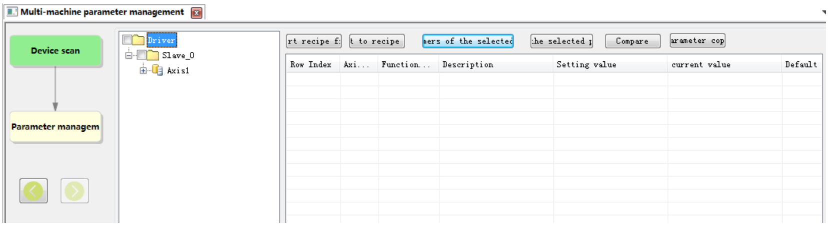
1. Click the **Multi-machine recipe** button under **SV660N** to start the multi-machine recipe function, as shown below.



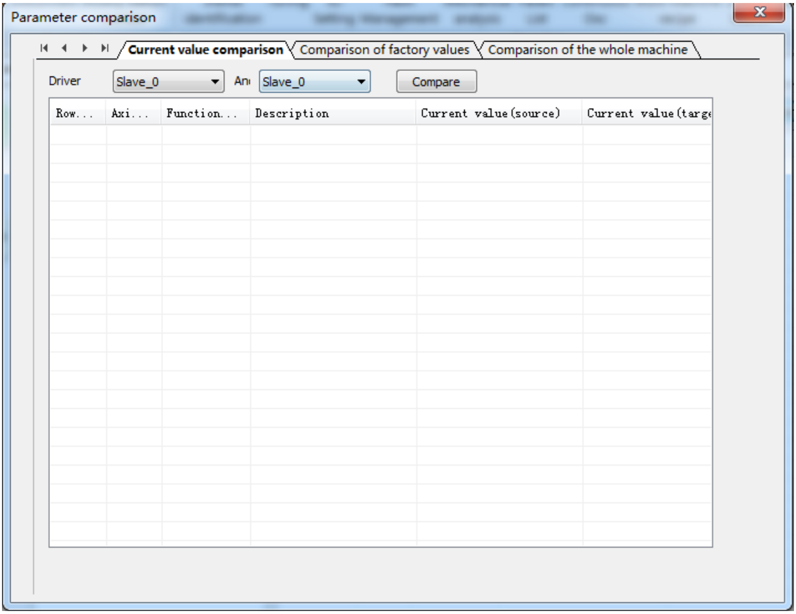
2. Scanning: Click the **Scan** button, and all the EtherCAT slaves cascaded will be scanned and displayed. The scanning time is directly proportional to the number of cascaded slaves, so you may wait a few minutes in case of large numbers of cascaded slaves. (Non-Inovance slaves are displayed as "Non-Inovance device".)



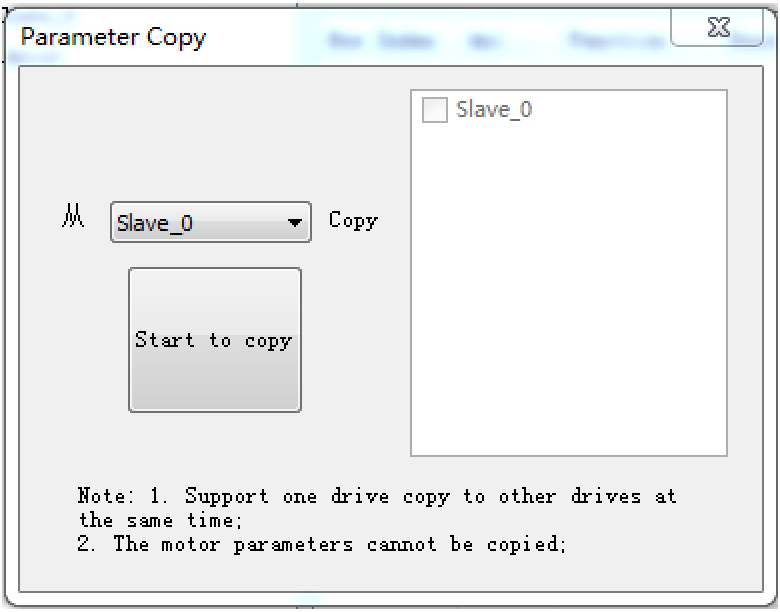
3. Click the ">" button to enter the parameter management interface.



- **Import recipe files**: Import the machine recipe saved in the local to the current device.
- **Export to recipe files**: Upload all the slave parameters and save them as a recipe file (the recipe file does not contain parameters in groups H00 or H01).
- **Upload the parameters of the selected slave stations**: You can choose to upload parameters of all slaves, part of the slaves or an individual slave.
- **Compare**: You can compare 1) current parameter values among slaves; 2) default values of slaves; and 3) machine recipes.



- **Parameter copy**: You can copy parameters from slave to slave.



6 Troubleshooting

6.1 Fault and Warning Levels

Faults and warnings of the servo drive are divided into three levels based on severity: No. 1 > No. 2 > No. 3, as shown below.

- No. 1 non-resettable fault
- No. 1 resettable fault
- No. 2 resettable fault
- No. 3 resettable warning

Note

"Resettable" means the keypad stops displaying the fault/warning once a "Reset signal" is input.

To reset a fault/warning, use one of the following two methods:

- Set H0D-01 (200D-02h) to 1 (Fault reset).
- Set the rising edge of bit7 of the control word 0x6040 through the host controller.

To reset No. 1 and No. 2 faults, switch off the S-ON signal first and then send the fault reset signal.

For No.3 warnings, the servo drive resets the warning automatically after the warning source is cleared.

☆Related parameter

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
200Dh-02h	Fault reset	0: No operation 1: Enable	Used to stop the keypad from displaying the fault/warning when a resettable fault/warning occurs. 200Dh-02h is set to 0 immediately after reset.	At stop	Immediately	0

Troubleshooting during startup:

<table>
<tr><th>Start Process</th><th>Fault Symptom</th><th>Cause</th><th>Confirming Method</th></tr>
<tr><td rowspan="6">Switching on the control circuit power supply (L1C, L2C) and main power supply (L1, L2, L3).</td><td rowspan="4">The LED neither lights up nor displays "ry".</td><td>1. The voltage of the control circuit power supply is abnormal.</td><td>Check whether the value of H0B-63 is 1.
Measure the AC voltage between L1C and L2C.</td></tr>
<tr><td>2: Phase loss occurs on the input power supply.</td><td>Check whether the value of H0B-63 is 2.
Voltage must be present in all the phases of a three-phase 380 V power supply.</td></tr>
<tr><td>3. The voltage of the main circuit power supply is abnormal.</td><td>Check whether the value of H0B-63 is 3.
● For single-phase 220 V models, measure the AC voltage between L1 and L2. When the DC bus voltage amplitude (voltage between P⊕ and N⊖) is lower than 200 V, the keypad displays "nr".
● For three-phase 220 V/ 380 V models, measure the AC voltage among L1, L2, L3/R, S, T. When the DC bus voltage amplitude (voltage between P⊕ and N⊖) is lower than 200 V/460 V, the keypad displays "nr".</td></tr>
<tr><td>4. The servo drive is faulty.</td><td>-</td></tr>
<tr><td>The keypad displays "Exxx.x".</td><td colspan="2">Rectify the fault according to "6.3 Solutions to Faults" on page 256, "6.4 Solutions to Warnings" on page 298, and "6.5 Solutions to Communication Faults" on page 309.</td></tr>
<tr><td colspan="3">The keypad displays "ry" after preceding faults are cleared.</td></tr>
</table>

6.2 List of Fault and Warning Codes

List of fault codes

Fault Code	Display	Fault Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
E101	E101.0	System parameter error	No. 1	No	Servo drive fault	0x6320	0x01010101
	E101.1	Parameter error in group 2000h/2001h	No. 1	No	Servo drive fault	0x6320	0x11010101
	E101.2	Address error in read/write after total number of parameters changes	No. 1	No	Servo drive fault	0x6320	0x21010101
E102	E102.0	Logic configuration fault	No. 1	No	Servo drive fault	0x7500	0x01020102
	E102.8	Software version mismatch	No. 1	No	Servo drive fault	0x7500	0x81020102
E104	E104.1	MCU operation timeout	No. 1	No	Servo drive fault	0x7500	0x11040104
	E104.2	Current loop operation timeout	No. 1	No	Servo drive fault	0x7500	0x21040104
	E104.4	Command update timeout	No. 1	No	Servo drive fault	0x7500	0x41040104
E108	E108.0	Parameter write error	No. 2	Yes	Servo drive fault	0x5530	0x01080108
	E108.1	Parameter read error	No. 2	Yes	Servo drive fault	0x5530	0x11080108
	E108.2	Invalid check on data written in EEPROM	No. 2	Yes	Servo drive fault	0x5530	0x21080108
	E108.3	Invalid check on data read in EEPROM	No. 2	Yes	Servo drive fault	0x5530	0x31080108
E120	E120.0	Unknown encoder type	No. 1	No	Axis fault	0x7122	0x01200120
	E120.1	Unknown motor model	No. 1	No	Axis fault	0x7122	0x11200120
	E120.2	Unknown drive model	No. 1	No	Axis fault	0x7122	0x21200120
	E120.5	Motor and drive current mismatch	No. 1	No	Axis fault	0x7122	0x51200120
	E120.6	FPGA and motor model mismatch	No. 1	No	Axis fault	0x7122	0x61200120

Fault Code	Display	Fault Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
E122	E122.0	Multi-turn absolute encoder setting error	No. 2	Yes	Axis fault	0x6320	0x01220122
	E122.1	Different DIs assigned with the same function	No. 2	Yes	Axis fault	0x6320	0x11220122
	E122.2	Different DOs assigned with the same function	No. 2	Yes	Servo drive fault	0x6320	0x21220122
	E122.3	Upper limit in the rotation mode invalid	No. 2	Yes	Axis fault	0x6320	0x31220122
E136	E136.0	Encoder parameter error	No. 1	No	Axis fault	0x7305	0x01360136
	E136.1	Encoder communication error	No. 1	No	Axis fault	0x7305	0x11360136
E140	E140.0	Encryption chip check fault	No. 1	No	Servo drive fault	0x0140	0x01400140
	E140.1	Encryption chip check failure	No. 1	No	Servo drive fault	-	-
E150	E150.0	STO signal input protection	No. 1	Yes	Servo drive fault	0x0150	0x01500150
	E150.1	STO signal input error	No. 1	Yes	Servo drive fault	0x0150	0x11500150
	E150.2	Buffer 5 V supply voltage error	No. 1	Yes	Servo drive fault	0x0150	0x21500150
	E150.3	STO upstream optocoupler detection failure	No. 1	Yes	Servo drive fault	0x0150	0x31500150
	E150.4	PWM Buffer detection failure	No. 1	Yes	Servo drive fault	0x0150	0x41500150
E201	E201.0	Phase-P overcurrent	No. 1	No	Servo drive fault	0x2312	0x02010201
	E201.1	Phase-U overcurrent	No. 1	No	Axis fault	0x2312	0x12010201
	E201.2	Phase-V overcurrent	No. 1	No	Axis fault	0x2312	0x22010201
	E201.4	Phase-N overcurrent	No. 1	No	Servo drive fault	0x2312	0x42010201

Fault Code	Display	Fault Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
E208	E208.0	MCU position reference updated frequently	No. 1	Yes	Axis fault	0x0208	0x02080208
	E208.2	Encoder communication timeout	No. 1	Yes	Axis fault	0x0208	0x22080208
	E208.3	Current sampling fault	No. 1	Yes	Axis fault	0x0208	0x32080208
	E208.4	FPGA current loop operation timeout	No. 1	Yes	Axis fault	0x0208	0x42080208
E210	E210.0	Output short-circuited to ground	No. 1	No	Axis fault	0x2330	0x02100210
E234	E234.0	Runaway protection	No. 1	No	Axis fault	0x0234	0x02340234
E400	E400.0	Main circuit overvoltage	No. 1	Yes	Servo drive fault	0x3210	0x04000400
E410	E410.0	Main circuit undervoltage	No. 1	Yes	Servo drive fault	0x3220	0x04100410
E420	E420.0	Phase loss	No. 2	Yes	Servo drive fault	0x3130	0x04200420
E430	E430.0	Control power supply undervoltage	No. 2	Yes	Servo drive fault	0x3120	0x04300430
E500	E500.0	Motor overspeed	No. 1	Yes	Axis fault	0x8400	0x05000500
	E500.1	Speed feedback overflow	No. 1	Yes	Axis fault	0x8400	0x15000500
	E500.2	FPGA position feedback pulse overspeed	No. 1	Yes	Axis fault	-	0x25000500
E602	E602.0	Angle auto-tuning error	No. 1	Yes	Axis fault	0x0602	0x06020602
	E602.2	Wrong U/V/W phase sequence detected in angle auto-tuning	No. 1	Yes	Axis fault	0x0602	0x26020602
E605	E605.0	Motor speed upon S-ON too high	No. 1	Yes	Axis fault	0x8400	0x06050605
E620	E620.0	Motor overload	No. 1	Yes	Axis fault	0x3230	0x06200620
E630	E630.0	Motor stalled	No. 1	Yes	Axis fault	0x7121	0x06300630
E640	E640.0	IGBT over-temperature	No. 1	Yes	Axis fault	0x4210	0x06400640
	E640.1	Flywheel diode over-temperature	No. 1	Yes	Axis fault	-	0x06050605
E650	E650.0	Heatsink over-temperature	No. 1	Yes	Axis fault	0x4210	0x06500650
E660	E660.0	Air-cooled motor over-temperature	No. 1	Yes	Axis fault	0x4210	0x06600660

Fault Code	Display	Fault Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
E661	E661.0	Auto-tuned gains too low	No. 2	Yes	Axis fault	0x4210	0x06610661
E731	E731.0	Encoder battery failure	No. 2	Yes	Axis fault	0x0661	0x07310731
E733	E733.0	Encoder multi-turn counting error	No. 2	Yes	Axis fault	0x7305	0x07330733
E735	E735.0	Encoder multi-turn counting overflow	No. 2	Yes	Axis fault	0x7305	0x07350735
E740	E740.2	Absolute encoder error	No. 1	No	Axis fault	0x7305	0x27400740
	E740.3	Absolute encoder single-turn calculation error	No. 1	No	Axis fault	0x7305	0x37400740
	E740.6	Encoder write error	No. 1	No	Axis fault	0x7305	0x67400740
E755	E755.0	Nikon encoder communication fault	No. 1	No	Axis fault	-	0x07550755
E765	E765.0	Nikon encoder out of limit	No. 1	No	Axis fault	-	0x07650765
E760	E760.0	Encoder over-temperature	No. 2	Yes	Axis fault	0x4210	0x07600760
EA33	EA33.0	Encoder read/write check error	No. 1	No	Axis fault	0x7305	0x0A330A33
EB00	EB00.0	Position deviation too large	No. 2	Yes	Axis fault	0x8611	0x0B000B00
	EB00.1	Position deviation overflow	No. 2	Yes	Axis fault	0x8611	0x1B000B00
EB01	EB01.1	Individual position reference increment too large	No. 2	Yes	Axis fault	0x6320	0x1B010B01
	EB01.2	Position reference increment too large continuously	No. 2	Yes	Axis fault	0x6320	0x2B010B01
	EB01.3	Command overflow	No. 2	Yes	Axis fault	0x6320	0x3B010B01
	EB01.4	Target position beyond upper/lower limit	No. 2	Yes	Axis fault	0x6320	0x4B010B01

Fault Code	Display	Fault Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
EE08	EE08.0	Synchronization (SYNC) signal loss	No. 2	Yes	Axis fault	0x0FFF	0x0E080E08
	EE08.1	Status switchover error	No. 2	Yes	Axis fault	0x0FFF	0x1E080E08
	EE08.2	IRQ loss	No. 2	Yes	Axis fault	0x0FFF	0x2E080E08
	EE08.3	Network cable connected improperly	No. 2	Yes	Axis fault	0x0FFF	0x3E080E08
	EE08.4	Data frame loss protection error	No. 2	Yes	Axis fault	0x0FFF	0x4E080E08
	EE08.5	Data frame transfer error	No. 2	Yes	Axis fault	0x0FFF	0x5E080E08
	EE08.6	Data update timeout	No. 2	Yes	Axis fault	0x0FFF	0x6E080E08
EE09	EE09.0	Software position limit setting error	No. 2	Yes	Axis fault	0x6320	0x0E090E09
	EE09.1	Home setting error	No. 2	Yes	Axis fault	0x6320	0x1E090E09
	EE09.2	Gear ratio beyond the limit	No. 2	Yes	Axis fault	0x6320	0x2E090E09
	EE09.3	No synchronization signal	No. 2	Yes	Axis fault	0x6320	0x3E090E09
	EE09.5	PDO mapping beyond the limit	No. 2	Yes	Axis fault	0x6320	0x5E090E09
EE11	EE11.0	ESI check error	No. 2	Yes	Servo drive fault	0x5530	0x0E110E11
	EE11.1	EEPROM read error	No. 2	Yes	Servo drive fault	0x5530	0x1E110E11
	EE11.2	EEPROM update failure	No. 2	Yes	Servo drive fault	0x5530	0x2E110E11
EE12	EE12.0	EtherCAT external device error	No. 1	No	Servo drive fault	0x0E12	0x0E120E12
EE13	EE13.0	Synchronization cycle setting error	No. 2	Yes	Servo drive fault	0x6320	0x0E130E13
EE15	EE15.0	Synchronization cycle error too large	No. 2	Yes	Servo drive fault	0x0E15	0x0E150E15

List of warning codes

Warning Code	Display	Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
E121	E121.0	S-ON command invalid	No. 3	Yes	Warning	0x0121	0x01210121
E600	E600.0	Inertia auto-tuning failure	No. 3	Yes	Warning	0x0600	0x06000600

Warning Code	Display	Name	Fault Type	Resettable	Fault Range	Error Code (603Fh)	Aux. Code (203Fh)
E601	E601.0	Homing warning	No. 3	Yes	Warning	0x0601	0x06010601
	E601.1	Homing switch error	No. 3	Yes	Warning	0x0601	0x16010601
	E601.2	Homing method setting error	No. 3	Yes	Warning	0x6320	0x2601E602
E730	E730.0	Encoder battery warning	No. 3	Yes	Warning	0x7305	0x07300730
E900	E900.0	Emergency stop	No. 3	Yes	Warning	0x0900	0x09000900
E902	E902.0	DI setting invalid	No. 3	Yes	Warning	0x6320	0x09020902
	E902.1	DO setting invalid	No. 3	Yes	Warning	0x0902	0x19020902
	E902.2	Invalid setting for torque reach	No. 3	Yes	Warning	0x0902	0x29020902
E908	E908.0	Model identification failure	No. 3	Yes	Warning	0x0908	0x09080908
E909	E909.0	Motor overload	No. 3	Yes	Warning	0x3230	0x09090909
E920	E920.0	Regenerative resistor overload	No. 3	Yes	Warning	0x3210	0x09200920
E922	E922.0	Resistance of external regenerative resistor too small	No. 3	Yes	Warning	0x6320	0x09220922
E924	E924.0	Regenerative transistor over-temperature	No. 3	Yes	Warning	0x3230	0x09240924
E941	E941.0	Parameter modifications activated at next power-on	No. 3	Yes	Warning	0x6320	0x09410941
E942	E942.0	Parameters saved frequently	No. 3	Yes	Warning	0x7600	0x09420942
E950	E950.0	Forward overtravel	No. 3	Yes	Warning	0x5443	0x09500950
E952	E952.0	Reverse overtravel	No. 3	Yes	Warning	0x5444	0x09520952
EA41	EA41.0	Torque fluctuation compensation failure	No. 3	Yes	Warning	0x0A41	0x0A410A41
E902	E902.3	Homing method setting error	No. 3	Yes	Warning	0x6320	0x4E090E09

6.3 Solutions to Faults

- E101.0: System parameter error

  Cause:

The total number of parameters changes, which generally occurs after software update.

Values of parameters in groups 2002h and above exceed the limit, which generally occurs after software update.

Cause	Confirming Method	Solution
1. The voltage of the control circuit power supply drops instantaneously.	1. Check whether the control circuit (L1C, L2C) is in the process of power-off or instantaneous power failure occurs.	Restore system parameters to default values (2002-20h (H02-31) = 1) and write parameters again.
	2. Measure whether the input voltage of the control circuit cable on the non-drive side is within the following range: 220 V servo drive: Effective value: 220 V to 240 V Allowable deviation: -10% to +10% (198 V to 264 V) 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: -10% to +10% (342 V to 484 V)	Enlarge the capacity of the power supply or replace with a power supply of higher capacity. Restore system parameters to default values (2002-20h (H02-31) = 1) and write parameters again.
2. Instantaneous power failure occurs when saving parameters.	Check whether instantaneous power failure occurs when saving parameters.	Power on the servo drive again, restore system parameters to default values (2002-20h (H02-31) = 1) and write parameters again.
3. The number of write operations within a certain period of time exceeds the limit.	Check whether parameters are updated frequently through the host controller.	1. If the servo drive is faulty, replace the servo drive. 2. Change the write mode and write parameters again.
4. The software is updated.	Check whether the software is updated.	Reset the servo drive model and the motor model, and restore system parameters to default values (2002-20h (H02-31) = 1).
5. The servo drive is faulty.	If the fault persists though parameters are restored to default settings and the servo drive is powered off and on several times, the servo drive is faulty.	Replace the servo drive.

- E101.1: Parameter error in group 2000h/2001h

Cause:

The total number of parameters changes, which generally occurs after software update.

Values of parameters in groups 2000 or 2001 exceed the limit, which generally occurs after software update.

Cause	Confirming Method	Solution
1. Instantaneous power failure occurs when saving parameters.	Check whether instantaneous power failure occurs when saving parameters.	Set the servo drive model (2001-0Bh (H01-10)) to a wrong value first and perform a power cycle, and then set the servo drive model to the correct value and perform a power cycle.
2. Instantaneous power failure occurs during writing serial-type motor parameters.	Check whether instantaneous power failure occurs during writing serial-type motor parameters.	Write the serial-type motor parameters again using the software tool.
3. The software is updated.	Check whether the software is updated.	Set the servo drive model (2001-0Bh (H01-10)) to a wrong value first and perform a power cycle, and then set the servo drive model to the correct value and perform a power cycle.
4. The servo drive is faulty.	If the fault persists even though the servo drive is powered off and on several times and steps 1 and 2 are executed repeatedly, it indicates the servo drive is faulty.	Replace the servo drive.

- E101.2: Address error in read/write after total number of parameters changes

Cause	Confirming Method	Solution
The total number of parameters changes after software update, leading to address error in read/write operations.	Check whether the parameter access address exceeds the limit.	Restore default settings.

- E102.0: Logic configuration fault
  Cause:

  The FPGA- or MCU-related hardware is damaged, leading to communication failure between MCU and FPGA.

Cause	Confirming Method	Solution
1. The FPGA is faulty. 2. The communication between MCU and FPGA fails.	The fault persists after the servo drive is powered off and on several times.	Check whether FPGA has been upgraded. If yes, make sure FPGA is programmed successfully. Replace the servo drive.

- E102.8: Software version mismatch

  Cause:

  The software version of MCU or FPGA is wrong.

Cause	Confirming Method	Solution
The software version of MCU or FPGA is wrong.	1. Check whether the MCU version (H01-00) is 9xx.x (the fourth digit displayed on the keypad is 9). 2. Check whether the FPGA version (H01-01) is 9xx.x (the fourth digit displayed on the keypad is 9).	Contact Inovance for technical support. Update the FPGA or MCU software to make them match.

- E104.1: MCU operation timeout

  Cause:

  The access to MCU times out.

Cause	Confirming Method	Solution
1. The FPGA is faulty.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.
2. The communication handshake between FPGA and HOST is abnormal.		
3. Access timeout occurs between HOST and the coprocessor.		

- E104.2: Current loop operation timeout

  Cause:

  The MCU torque interrupt scheduling time is detected to be abnormal. This fault is reported only in the commissioning stage.

Cause	Confirming Method	Solution
The time interval of MCU torque interrupt scheduling is abnormal.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- E104.4: Command update timeout

Take the moment of entering the interrupt as the starting time, if the time when commands are written to MCU is larger than the time when position and speed regulators are started by FPGA, a warning will be reported.

Cause	Confirming Method	Solution
The system reports that the encoder communication time is set improperly or the command calculation time is too long.	The fault persists after the servo drive is powered off and on several times.	1. Hide unnecessary functions. 2. Replace the servo drive.

- E108.0: Parameter write error

  Cause:

  Parameter values cannot be written to EEPROM.

Cause	Confirming Method	Solution
An error occurs when writing parameters.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on several times, replace the servo drive.

- E108.1: Parameter read error

  Cause:

  Parameter values cannot be read in EEPROM.

Cause	Confirming Method	Solution
An error occurs when reading parameters.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on several times, replace the servo drive.

- E108.2: Invalid check on data written in EEPROM

  Cause:

  The check on the data written in EEPROM fails.

Cause	Confirming Method	Solution
The check on the data written in EEPROM fails.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on several times, replace the servo drive.

- E108.3: Invalid check on data read in EEPROM

  Cause:

The check on the data read in EEPROM fails.

Cause	Confirming Method	Solution
The check on the data read in EEPROM fails.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on several times, replace the servo drive.

- E120.0: Unknown encoder type
  Cause:

  The servo drive detects the encoder type during initialization upon power-on. If the encoder type does not comply with the requirement, E120.0 occurs.

Cause	Confirming Method	Solution
1. The encoder model does not match.	Check whether the encoder model is correct.	Replace the encoder.
2. An ISMH1 series motor and a 20-bit encoder are used.	Check whether H00-00 (Motor code) is set properly.	Set H00-00 to 14000.

- E120.1: Unknown motor model
  Cause:

  The servo drive detects the motor model defined by H00-00 during initialization upon power-on. If the motor model does not exist, E120.1 occurs.

Cause	Confirming Method	Solution
The motor model is set improperly.	Check whether H00-00 (Motor code) is set properly.	Set H00-00 properly.

- E120.2: Unknown drive model
  Cause:

  The servo drive detects the servo drive model defined by H01-10 during initialization upon power-on. If the servo drive model does not exist, E120.2 occurs.

Cause	Confirming Method	Solution
The servo drive model is set improperly.	Check whether H01-10 (Servo drive model) is set properly.	Set H01-10 properly.

- E120.5: Motor and drive current mismatch
  Cause:

  The rated output of the servo drive is far higher than the rated current of the motor. Replace with a servo drive of lower rated output or a motor with higher rated current.

Cause	Confirming Method	Solution
The internal scaling value is abnormal.	Check whether the servo drive model is correct. If the set current sampling coefficient is too large, calculation overflow will occur.	Replace the servo drive.

- E120.6: FPGA and motor model mismatch
  Cause:
  - The motor model is set improperly, causing mismatch and malfunction of the servo drive.
  - The motor model is set properly, but the motor encoder is not supported by the servo drive.

Cause	Confirming Method	Solution
The motor encoder is not supported by FPGA.	Check whether the motor encoder is supported by the FPGA version (H01-01).	Update the program or replace the motor.

- E122.0: Multi-turn absolute encoder setting error
  Cause:

  The motor does not match in the absolute position mode or the motor code is set improperly.

Cause	Confirming Method	Solution
The motor does not match in the absolute position mode or the motor code is set incorrectly.	1. Check the motor nameplate to see whether the motor is configured with a multi-turn absolute encoder. 2. Check whether the motor code is set correctly in 2000-01h (H00-00).	Reset 2000-01h (H00-00) according to the motor nameplate or replace with a matching motor.

- E122.1: Different DIs assigned with the same function
  Cause:

  The same function is assigned to different DIs.

  The DI function No. exceeds the maximum setting number allowed for DI functions.

Cause	Confirming Method	Solution
1. Different DIs are assigned with the same function.	View 2003-03h (H03-02)/ 2003-05h (H03-04)...2003-15h (H03-20) and 2017-01h (H17-00)/2017-03h (H17-02)...2017-1Fh(H17-30) to check whether they are assigned with the same DI function No..	Assign different DI functions to parameters that have been assigned with the same DI function in groups 2003h and 2017h. To enable such assignments, restart the control circuit power supply or switch off the S-ON signal and send a "RESET" signal.
2. The DI function No. exceeds the number of DI functions.	Check whether the MCU program is updated.	Restore system parameters to default values (2002-20h (H02-31) = 1) and power on the servo drive again.

- E122.2: Different DOs assigned with the same function

Cause	Confirming Method	Solution
The DO function No. exceeds the maximum setting number allowed for DO functions.	Check whether DO function numbers defined by 2004-01h (H04-00), 2004-03h (H04-02), and 2004-05h (H04-04) are improper.	Set the correct DO function No..

- E122.3: Upper limit in the rotation mode invalid
  Cause:

  The upper limit (reference range) of the mechanical single-turn position exceeds 2^{31} in the absolute position rotation mode.

Cause	Confirming Method	Solution
The upper limit of the mechanical single-turn position exceeds 2^{31} in the absolute position rotation mode.	Check the set mechanical gear ratio, upper limit of the mechanical single-turn position and electronic gear ratio in the absolute position rotation mode (H02-01 (2002–02h) = 2).	Reset the mechanical gear ratio, the upper limit of mechanical single-turn position and the electronic gear ratio to ensure the upper limit of the mechanical single-turn position (reference range) does not exceed 2^{31}.

- E136.0: Encoder parameter error
  Cause:

  When the servo drive reads parameters in the encoder ROM, no parameters are saved there or parameter values are inconsistent with the parameter setpoints.

Cause	Confirming Method	Solution
1. The motor model does not match the servo drive model.	View the servo drive and servo motor nameplates to check whether they are Inovance SV660N series servo drive and servo motor.	Replace with the mutually-matching servo drive and servo motor.
2. A parameter check error occurs or no parameter is saved in the ROM of the serial incremental encoder.	1. Check whether the encoder cable provided by Inovance is used. For cable specifications, see SV660N Series Servo Drive Selection Guide. The cable must be connected securely without scratching, breaking or poor contact. 2. Measure signals PS+, PS-, +5V and GND on both ends of the encoder cable and observe whether signals at both ends are consistent. For signal assignment, see Chapter "Wiring" in SV660N Series Servo Drive Hardware Guide.	1. Use the encoder cable provided by Inovance. Ensure motor terminals and servo drive screws are connected securely. Use a new encoder cable if necessary. 2. Route encoder cables and power cables (R/S/T, U/V/W) through different routes.
3. The servo drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

- E136.1: Encoder communication error

  Cause:

  - The encoder cable is disconnected.
  - A communication error occurs on the encoder due to interference.

Cause	Confirming Method	Solution
A fault occurs on the communication between FPGA and the encoder during initialization upon power-on.	Observe the value of H0B-28 to see whether it is not 0.	1. Check whether encoder cables are connected properly. 2. Check whether the motor model is set properly. 3. Check whether H01-00 (MCU software version) and H01-01 (FPGA software version) are set properly.

- E140.1: Encryption chip check failure

Cause	Confirming Method	Solution
The key of the encryption chip is incorrect, causing failure in decrypting the Renesas chip.	1. Check the software version. Check whether the encryption program is programmed in the servo drive. 2. Check whether the encryption chip works properly.	Power off and on the servo drive again, if the fault persists, contact Inovance for maintenance.

- E150.0: STO signal input protection
  Cause:

  The STO input protection applies (safety state).

Cause	Confirming Method	Solution
The STO function is active.	1. Check whether the STO function is activated.	There is no need to take any corrective actions. After the STO terminal is back to normal, clear the fault using the fault reset function.
	2. Check whether the STO power supply is normal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
	3. The fault persists after preceding causes are rectified.	Replace the servo drive.

- E150.1: STO signal input error
  Cause:

The single-channel input of STO is invalid.

Cause	Confirming Method	Solution
1. The STO power supply is abnormal.	Check whether the STO power supply is normal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
2. The STO input resistor is abnormal.	After STO is triggered, only one STO signal is sent to MCU after the 24 V power supply is cut off due to input resistor drift.	Replace the servo drive.
3: The STO function fails.	The fault persists after preceding causes are rectified.	Replace the servo drive.

- E150.2: Buffer 5 V supply voltage error
  Cause:

  The MCU monitors the 5 V power supply of the PWM Buffer to detect whether overvoltage or undervoltage occurs. If the voltage is abnormal, E150.2 occurs.

Cause	Confirming Method	Solution
The 5 V power supply of the Buffer is abnormal.	Check the 5 V power supply.	Replace the servo drive.

- E150.3: STO upstream optocoupler detection failure
  Cause:

  Short circuit occurs on the optocoupler of the upstream hardware circuit of STO.

Cause	Confirming Method	Solution
Short circuit occurs on the upstream optocoupler of STO1 or STO2.	Switch off the 24 V power supply and power on the servo drive again, E150.0 is not reported.	Replace the servo drive.

- E150.4: PWM Buffer detection failure
  Cause:

  An error occurs on the PWM Buffer integrated circuit during initialization detection upon power-on (the PWM signal cannot be blocked).

Cause	Confirming Method	Solution
The Buffer fails to block the PWM waves.	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- E201.0: Phase-P overcurrent
  Cause:

An excessively high current flows through the positive pole of the DC-AC circuit.

Cause	Confirming Method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	1. Motor parameters are set improperly, modify motor parameter values. 2. Current loop parameters are set improperly, modify current loop parameter values. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. If the servo drive operates improperly, replace it.
2. The encoder is wired improperly, aging, or connected loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely.	Re-solder, tighten or replace the encoder cable.
3. The servo drive is faulty.	1. Switch off the S-ON signal, rotate the motor shaft manually, and check whether the value of 200B-12h (H0B-17) changes as the motor shaft rotates. 2. Disconnect the motor cable but the fault persists after the servo drive is powered off and on again. 3. Check whether resistance of the external regenerative resistor is too small or the regenerative resistor is short-circuited (between terminals P⊕ and C).	1. Replace with a regenerative resistor with matching resistance and model and perform wiring again. 2. Replace the servo drive.

- E201.1: Phase-U overcurrent

  Cause:

A current higher than the threshold is collected in the phase-U current.

Cause	Confirming Method	Solution
1. Motor cables are in poor contact. 2. Motor cables are grounded. 3. U/V/W cables of the motor are short-circuited.	1. Check whether the servo drive power cables and motor cables on the U, V, and W side of the servo drive are loose. 2. After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	1. Tighten the cables that are loose or disconnected. 2. Replace the motor in case of poor insulation.
4. The motor is damaged due to over-temperature.	1. Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring. 2. Disconnect the motor cables and measure whether the resistance among U, V, and W phases of motor cables is balanced.	1. Connect the motor cables correctly. 2. Replace the motor if the resistance is unbalanced.

- E201.2: Phase-V overcurrent
  Cause:

  A current higher than the threshold is collected in the phase-V current.

Cause	Confirming Method	Solution
1. Motor cables are in poor contact. 2. Motor cables are grounded. 3. U/V/W cables of the motor are short-circuited.	1. Check whether the servo drive power cables and motor cables on the U, V, and W side of the servo drive are loose. 2. After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	1. Tighten the cables that are loose or disconnected. 2. Replace the motor in case of poor insulation.
4. The motor is damaged due to over-temperature.	1. Disconnect the motor cables and check whether short circuit occurs among U, V, and W phases and whether burrs exist in the wiring. 2. Disconnect the motor cables and measure whether the resistance among U, V, and W phases of motor cables is balanced.	1. Connect the motor cables correctly. 2. Replace the motor if the resistance is unbalanced.

- E201.4: Phase-N overcurrent
  Cause:

  An excessively high current flows through the negative pole of the DC-AC circuit.

Cause	Confirming Method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	Adjust the gains.
2. The encoder is wired improperly, aging, or connected loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely.	Re-solder, tighten or replace the encoder cable.

Cause	Confirming Method	Solution
3. Overcurrent occurs on the regenerative resistor.	Check whether resistance of the external regenerative resistor is too small or the regenerative resistor is short-circuited (between terminals P⊕ and C).	Replace with a regenerative resistor of matching resistance and model. Perform wiring again.
4. The servo drive is faulty.	Switch off the S-ON signal, rotate the motor shaft manually, and check whether the value of 200B-12h (H0B-17) changes as the motor shaft rotates. Disconnect the motor cable and power on the servo drive again, but the fault persist.	Replace the servo drive.

- E208.0: MCU position reference updated frequently
  Cause: Locate the fault cause through the internal fault code (200B-2Eh).

Cause	Confirming Method	Solution
1. MCU communication times out.	Internal fault code 200B-2Eh (H0B-45) = 1208: The internal integrated circuit is damaged.	Replace the servo drive.
2. The FPGA operation times out.	Internal fault code 200B-2Eh (H0B-45) = 0208: Figure out the cause based on cause 1.	

- E208.2: Encoder communication timeout
  Cause:

  The servo drive fails to receive the data fed back by the encoder in three consecutive cycles.

Cause	Confirming Method	Solution
The servo drive fails to receive the data fed back by the encoder in three consecutive cycles.	1. Check bit12 of H0B-30. 2. The encoder cable is connected improperly. 3. The encoder cable is connected loosely. 4. The encoder cable is too long. 5. The encoder communication suffers from interference. 6. The encoder is faulty.	1. Check whether the motor model is correct. 2. Check whether the encoder cable is proper. 3. Check whether the encoder version (H00-04) is set properly. 4. If servo drive operates improperly, replace it.

- E208.3: Current sampling fault
  Cause:

  Phase-U and phase-V current sampling is abnormal.

Cause	Confirming Method	Solution
Phase-U and phase-V current sampling is abnormal.	1. Check whether ambient devices are generating disturbance and whether multiple disturbance sources such as variable-frequency devices are inside the cabinet. 2. The internal current sampling integrated circuit is damaged.	1. Check whether the servo drive and motor are grounded and shielded properly. 2. Install magnetic ring on the motor power cables and encoder cable. 3. Replace the servo drive.

- E208.4: FPGA current loop operation timeout
  Cause:

  The operating time of the current loop exceeds the interval threshold.

Cause	Confirming Method	Solution
The FPGA operation times out.	Internal fault code 200B-2Eh (H0B-45) = 4208: Current loop operation timeout	Disable some unnecessary functions to reduce the operating load of the current loop.

- E210.0: Output short-circuited to ground
  Cause:

  An abnormal motor phase current or bus voltage is detected during auto-inspection upon power-on.

Cause	Confirming Method	Solution
1. The servo drive power cables (U/V/W) are short-circuited to ground.	Disconnect the motor cables and measure whether the servo drive power cables (U/V/W) are short-circuited to ground (PE).	Re-connect or replace the servo drive power cables.
2. The motor is short-circuited to ground.	After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	Replace the motor.
3. The servo drive is faulty.	Disconnect the power cables from the servo drive, but the fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- E234.0: Runaway Protection
  Cause:

  The torque reference direction is opposite to the speed feedback direction in the torque control mode.

  The speed feedback direction is opposite to the speed reference direction in the position or speed control mode.

Cause	Confirming Method	Solution
1. The U/V/W cables are connected in the wrong phase sequence.	Check whether the U/V/W phase sequence on the drive side is consistent with that on the motor side.	Connect the U/V/W cables in the correct phase sequence.
2. An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on.	The U/V/W phase sequence is correct. But E234.0 occurs when the servo drive is enabled.	Power off and on the servo drive again.
3. The encoder model is wrong or the wiring is incorrect.	View the servo drive and servo motor nameplates to check whether they are Inovance SV660N series servo drive and servo motor equipped with a 20-bit encoder.	Replace with the mutually-matching servo drive and servo motor. If you use Inovance SV660N series servo drive and servo motor equipped with a 20-bit encoder, ensure 2000-01h (H00-00) is set to 14000. Check the motor model, encoder type, and encoder cable connection again.

Cause	Confirming Method	Solution
4. The encoder is wired improperly, aging, or connected loosely.	1. Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. 2. Switch off the S-ON signal, rotate the motor shaft manually, and check whether the value of 200B-0Bh (H0B-10) changes as the motor shaft rotates.	Re-solder, tighten or replace the encoder cable.
5. The gravity load in vertical axis applications is too large.	Check whether the load of the vertical axis is too large. Adjust brake parameters 2002-0Ah (H02-09)...2002-0Dh (H02-12) to check whether the fault can be cleared.	Reduce the load of the vertical axis, increase the stiffness level, or hide this fault without affecting the safety performance and normal use.
6. Improper parameter settings lead to excessive vibration.	The stiffness level is set to an excessively high value, leading to excessive vibration.	Set a proper stiffness level to avoid excessive vibration.

- E400.0: Main circuit overvoltage
  Cause:

  The DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold.

  220 V servo drive: Normal value: 310 V; Overvoltage threshold: 420 V

  380 V servo drive: Normal value: 540 V; Overvoltage threshold: 760 V

Cause	Confirming Method	Solution
1. The voltage input to the main circuit is too high.	Check the power input specifications of the servo drive and measure whether the voltage input to main circuit cables (R/S/T) on the drive side is within the following range: 220 V servo drive: Effective value: 220 V to 240 V Allowable deviation: –10% to +10% (198 V to 264 V) 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: –10% to +10% (342 V to 484 V)	Replace or adjust the power supply according to the specified range.
2. The power supply is unstable or affected by lightning.	Check whether the power supply is unstable, affected by lightning, or complies with the preceding range.	Connect a surge protection device and then switch on the main circuit and control circuit power supplies again. If the fault persists, replace the servo drive.

Cause	Confirming Method	Solution
3. The regenerative resistor fails.	If the built-in regenerative resistor is used (2002-1Ah (H02-25) = 0), check whether P⊕ and D are jumpered properly. If yes, measure the resistance between terminals C and D. If an external regenerative resistor is used (2002-1Ah (H02-25) = 1 or 2), measure the resistance between P⊕ and C. For details, See section "Specifications of the regenerative resistor" in SV660P Series Servo Drive Commissioning Guide.	1. If the resistance is "∞" (infinite), the regenerative resistor is disconnected internally. 2. If the built-in regenerative resistor is used, turn to using an external regenerative resistor (2002-1Ah (H02-25) = 1 or 2) instead of the built-in one, and remove the jumper between P⊕ and D. Note that the external regenerative resistor used must carry the same resistance and equal or higher power than the built-in one. 3. If an external regenerative resistor is used, replace with a new one and connect it between P⊕ and C. 4. Set 2002-1Bh (H02-26) (Power of external regenerative resistor) and 2002-1Ch (H02-27) (Resistance of external regenerative resistor) properly according to the specifications of the external regenerative resistor used.

Cause	Confirming Method	Solution
4. The resistance of the external regenerative resistor is too large, resulting in insufficient energy absorption during braking.	Measure the resistance of the external regenerative resistor connected between terminals P⊕ and C, and compare the measured value with the recommended value.	1. Replace with a new external regenerative resistor that carries the recommended resistance, and connect it between P⊕ and C. 2. Set 2002-1Bh (H02-26) (Power of external regenerative resistor) and 2002-1Ch (H02-27) (Resistance of external regenerative resistor) properly according to the specifications of the external regenerative resistor used.
5. The motor is in abrupt acceleration/ deceleration status and the maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/ deceleration time during operation and measure whether the DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold during deceleration.	After confirming the input voltage of the main circuit is within the specified range, increase the acceleration/deceleration time if the operating conditions allow.
6. The bus voltage sampling value deviates greatly from the measured value.	Check whether the bus voltage 200B-1Bh (H0B-26) detected is within the following range: 220 V servo drive: 200B-1Bh (H0B-26) > 420 V 380 V servo drive: 200B-1Bh (H0B-26) ＞ 760 V Measure whether the DC bus voltage detected between P⊕ and N⊖ is close to the value displayed in 200B-1Bh (H0B-26).	Contact Inovance for technical support.
7. The servo drive is faulty.	The fault persists after the main circuit is powered off and on several times.	Replace the servo drive.

- E410.0: Main circuit undervoltage
  Cause:

  The DC bus voltage between P⊕ and N⊖ is lower than the undervoltage threshold.

  220 V servo drive: Normal value: 310 V; Undervoltage threshold: 200 V (180 V for S5R5 models)

  380 V servo drive: Normal value: 540 V; Undervoltage threshold: 380 V

Cause	Confirming Method	Solution
1. The power supply of the main circuit is unstable or power failure occurs.	Check the specifications of the power supply. Measure whether the input voltages of the main circuit on the power supply side and the drive side (L1, L2) are within the following range: 220 V servo drive: Effective value: 220 V to 240 V Allowable deviation: –10% to +10% (198 V to 264 V) Measure the voltages of all the three phases.	Increase the capacity of the power supply.
2. Instantaneous power failure occurs.		
3. The power supply voltage drops during operation.	Monitor the power supply voltage and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and voltage drop.	
4. A three-phase servo drive is connected to a single-phase power supply, leading to phase loss.	Check whether the main circuit is wired properly and whether the phase loss detection (200A-01h (H0A-00)) is disabled.	Replace the cables and connect the main circuit cables correctly. Three-phase: R, S, T
5. The servo drive is faulty.	Check whether the bus voltage 200B-1Bh (H0B-26) detected is within the following range: 220 V servo drive: 200B-1Bh (H0B-26) < 200 V 380 V servo drive: 200B-1Bh (H0B-26) < 380 V The fault persists after the main circuit (L1, L2) is powered off and on several times.	Replace the servo drive.

- E420.0: Phase loss

  Cause:

  Phase loss occurs on the three-phase servo drive.

<table>
<tr><th>Cause</th><th>Confirming Method</th><th>Solution</th></tr>
<tr><td>1. The three-phase input cables are connected improperly.</td><td>Check whether the cables between the power supply side and R/S/T terminals of the servo drive are connected properly.</td><td>Replace the cables and connect the main circuit cables correctly.</td></tr>
<tr><td>2. A single-phase power supply is used for a three-phase servo drive.</td><td rowspan="2">Check the specifications of power supply and measure whether the voltage input to the main circuit is within the following range:
220 V servo drive:
Effective value:
220 V to 240 V
Allowable deviation: -10% to +10% (198 V to 264 V)
380 V servo drive:
Effective value:
380 V to 440 V
Allowable deviation: -10% to +10% (342 V to 484 V)
Measure the voltages of all the three phases.</td><td rowspan="2">A three-phase servo drive of 0.75 kW (2001-03h (H01-02) = 5) is allowed to run under a single-phase power supply.
If the input voltage is within specified range, set 200A-01h (H0A-00) to 2 (Inhibit phase loss fault and warning).
If the input voltage is outside the specified range, replace or adjust the power supply.</td></tr>
<tr><td>3. The three-phase power supply is unbalanced or the voltages of the three phases are too low.</td></tr>
<tr><td>4. The servo drive is faulty.</td><td>The fault persists after the main circuit (R/S/T) is powered off and on several times.</td><td>Replace the servo drive.</td></tr>
</table>

- E430.0: Control circuit power supply undervoltage
  Cause:

  220 V servo drive: Normal value 310 V; Undervoltage threshold 190 V

  380 V servo drive: Normal value 540 V; Undervoltage threshold 350 V

Cause	Confirming Method	Solution
1. The control circuit power supply is unstable or power failure occurs.	Check whether the control circuit (L1C, L2C) is in the process of power-off or instantaneous power failure occurs.	Power off and on the servo drive again. If unexpected power failure occurs, ensure the power supply is stable.
	Check whether the input voltage of the control circuit cables on the drive side is within the following range: 220 V servo drive: Effective value: 220 V to 240 V Allowable deviation: –10% to +10% (198 V to 264 V) 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: –10% to +10% (342 V to 484 V)	Increase the power supply capacity.
2. The control circuit cables are in poor contact.	Check whether control cables are well connected and whether the voltage of control circuit cables (L1C, L2C) is within the specified range.	Re-connect or replace the cables.

- E500.0: Motor overspeed
  Cause: The actual speed of the motor exceeds the overspeed threshold.

Cause	Confirming Method	Solution
1. The U/V/W phase sequence of motor cables is wrong.	Check whether U/V/W phase sequence on the drive side is consistent with that on the motor side.	Connect the U/V/W cables in the correct phase sequence.
2. Parameter 200A-09h (H0A-08) is set improperly.	Check whether the overspeed threshold is lower than the maximum speed needed: Overspeed threshold = 1.2 x Maximum motor speed (when 200A-09h (H0A-08) = 0). Overspeed threshold = H0A-08 (when H0A-08 $\neq$ 0, and H0A-08 < 1.2 x Maximum motor speed)	Reset the overspeed threshold according to the mechanical requirements.

Cause	Confirming Method	Solution
3. The input reference exceeds the overspeed threshold.	Check whether the motor speed corresponding to the input reference exceeds the overspeed threshold. • Position control mode: In CSP mode, view the gear ratio 6091-01h/6091-02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. In PP mode, view the gear ratio 6091-01h/6091-02h and determine the value of 6081h (Profile velocity). In HM mode, view the gear ratio 6091-01h/6091-02h and determine the value of 6099-01h and 6099-02h. • Speed control mode: View the values of 6091h (Gear ratio), 60FFh (Target velocity), H06-06...H06-09, and 607Fh (Max. profile velocity). • Torque control mode: View the speed limits defined by H07-19 and H07-20 and check the corresponding speed limits.	• Position control mode: In CSP mode, decrease the position reference increment for an individual synchronization cycle. The host controller should handle the position ramp when generating references. In PP mode, decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the values of 6099-01h and 6099-02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions. • Speed control mode: Decrease the target speed, speed limit, and gear ratio. In PV mode, increase the speed ramp (6083h , 6084h). In CSV mode, the host controller should handle the speed ramp. • Torque control mode: Set the speed limit to a value lower than the overspeed threshold.
4. The motor speed overshoots.	Check in the software tool whether the speed feedback exceeds the overspeed threshold.	Adjust the gains or mechanical operating conditions.
5. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

- E500.1: Speed feedback overflow
  Cause:

  The FPGA speed measurement overflows.

Cause	Confirming Method	Solution
The FPGA speed measurement is abnormal.	Check whether bit9 of H0B-30 is 1.	1. The speed feedback is abnormal, check whether the encoder version (H00-04) is proper. 2. The encoder cable is abnormal, replace the encoder cable. 3. The encoder cable is being disturbed. Re-connect the grounding cable and the shielded cable or install a magnetic ring.

- E500.2: FPGA position feedback pulse overspeed

Cause	Confirming Method	Solution
The MCU detects excessive pulse increment fed back by FPGA.	1. Check whether the value of H0B-17 changes abruptly. 2. Check whether the communication between the servo drive and the encoder is being disturbed.	Modify the value of H0A-70 (Overspeed threshold). The default value of H0A-70 is 0. Take the maximum speed of the motor as the threshold for excessive pulse increment.

- E602.0: Angle auto-tuning error
  Cause:

  Unusual jitter occurs on the encoder feedback during angle auto-tuning.

Cause	Confirming Method	Solution
The data fed back by the encoder is abnormal.	Check if the encoder communication is being disturbed.	Check the wiring of the encoder.

- E602.2: Wrong U/V/W phase sequence detected in angle auto-tuning
  Cause:

  A wrong U/V/W phase sequence is detected in angle auto-tuning.

Cause	Confirming Method	Solution
U/V/W cables are connected reversely, which is detected during angle auto-tuning.	Check whether U/V/W phases are wired correctly.	Exchange cables of any two phases among U/V/W and perform auto-tuning again.

- E605.0: Motor speed too high upon S-ON
  Cause:

  The motor speed exceeds the rated speed when the servo drive in size A/B is switched on.

Cause	Confirming Method	Solution
The motor speed exceeds the rated speed when the servo drive is switched on.	Check whether the motor is in the power generating state when the servo drive is switched on.	Reduce the motor speed before switching on the servo drive.

- E620.0: Motor overload
  Cause:

  The accumulative heat of the motor reaches the fault threshold.

Cause	Confirming Method	Solution
1. The motor and encoder cables are connected improperly or in poor contact.	Check the wiring among the servo drive, motor and encoder according to the correct wiring diagram.	Connect cables according to the correct wiring diagram. It is recommended to use the cables provided by Inovance. When customized cables are used, prepare and connect the customized cables according to the wiring instructions.
2. The load is so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load rate (200B-0DH (H0B-12)) of the servo drive keeps exceeding 100.0%.	Replace with a servo drive of higher capacity and a matching servo motor. Reduce the load and increase the acceleration/ deceleration time.
3. Acceleration/deceleration is too frequent or the load inertia is too large.	Calculate the mechanical inertia ratio or perform inertia auto-tuning, and view the inertia ratio in 2008-10h (H08-00). Confirm the individual operation cycle when the servo motor operates cyclically.	Increase the acceleration/ deceleration time in an individual operation cycle.
4. The gains are improper or the stiffness level is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust the gains again.

Cause	Confirming Method	Solution
5. The model of the servo drive or motor is set incorrectly.	View the servo drive model (2001-0Bh (H01-10)) and motor model (2000-06h (H0D-05)) saved in the serial encoder.	Read the servo drive nameplate and set the servo drive model (2001-0Bh (H01-10)) and motor model properly according to section "Servo Drive Model and Nameplate" in SV660N Series Servo Drive Hardware Guide.
6. The motor is stalled due to mechanical factors, resulting in overload during operation.	Check the reference and the motor speed (200B-01h (H0B-00)) through the software tool or keypad. • References in the position control mode: 200B-0Eh (H0B-13) (Input position reference counter) • References in the speed control mode: 200B-02h (H0B-01) (Speed reference) • References in the torque control mode: 200B-03h (H0B-02) (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 RPM in the corresponding mode.	Eliminate the mechanical factors.
7. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

Note

When this fault occurs, stop for at least 30s before further operations.

- E630.0: Motor stalled
  Cause:

  The actual motor speed is lower than 10 RPM but the torque reference reaches the limit, and such status persists for the time defined by 200A-21h (H0A-32).

Cause	Confirming Method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform motor trial run without load and check cable connections and the phase sequence.	Connect cables again according to the correct wiring diagram or replace the cables.
2. The motor parameters (especially the number of pole pairs) are set improperly and motor angle auto-tuning is not performed.	Read parameters in group H00 to check whether the number of pole pairs are set properly. Perform several angle auto-tunings on the motor and check whether the value of H00-28 is consistent upon each angle auto-tuning.	Modify the motor parameter values.
3. The communication commands are being disturbed.	Check whether jitter occurs on the commands sent from the host controller and whether EtherCAT communication is being disturbed.	Check whether the communication line between the host controller and the servo drive is being disturbed.
4. The motor is stalled due to mechanical factors.	Check the reference and the motor speed (H0B-00) through the software tool or keypad. • References in the position control mode: H0B-13 (Input position reference counter) • References in the speed control mode: H0B-01 (Speed reference) • References in the torque control mode: H0B-02 (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 RPM in the corresponding mode. Check the current feedback (torque reference) waveform.	Check whether any mechanical part gets stuck or eccentric.

Note

When this fault occurs, stop for at least 30s before further operations.

- E640.0: IGBT over-temperature

Cause: The IGBT temperature reaches the fault threshold defined by H0A-18.

Cause	Confirming Method	Solution
1. The ambient temperature is too high. 2. The servo drive is restarted several times to reset the overload fault.	Measure the ambient temperature, view the fault records (set 200B-22h (H0B-33) and 200B-23h (H0B-34)) to check whether an overload fault or warning (E620, E630, E650, E909, E920, E922) occurs.	• Improve the cooling conditions of the servo drive to lower down the ambient temperature. • Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists even though the servo drive is restarted five minutes after power-off.	Replace the servo drive.

Note

When this fault occurs, stop for at least 30s before further operations.

- E640.1: Flywheel diode over-temperature
  Cause:

  The temperature of the flywheel diode reaches the fault threshold defined by H0A-18.

Cause	Confirming Method	Solution
1. The ambient temperature is too high. 2. The servo drive is restarted several times to reset the overload fault.	Measure the ambient temperature, view the fault records (set 200B-22h (H0B-33) and 200B-23h (H0B-34)) to check whether an overload fault or warning (E620, E630, E650, E909, E920, E922) occurs.	• Improve the cooling conditions of the servo drive to lower down the ambient temperature. • Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists even though the servo drive is restarted five minutes after power-off.	Replace the servo drive.

Note

When this fault occurs, stop for at least 30s before further operations.

- E650.0: Heatsink over-temperature
  Cause:

  The temperature of the servo drive power module is higher than the over-temperature threshold.

Cause	Confirming Method	Solution
1. The ambient temperature is too high.	Measure the ambient temperature.	Improve the cooling conditions of the servo drive to lower down the ambient temperature.
2. The servo drive is restarted several times to reset the overload fault.	View the fault records (set 200B-22h (H0B-33) and 200B-23h (H0B-34)) to check whether an overload fault or warning (E620.0, E630.0, E650.5, E909.0, E920.0, E922.0) occurs.	Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists even though the servo drive is restarted five minutes after power-off.	Replace the servo drive.

Note

When this fault occurs, stop for at least 30s before further operations.

- E660.0: Air-cooled motor over-temperature
  Cause:

  The temperature of the air-cooled motor is too high.

Cause	Confirming Method	Solution
The temperature of the air-cooled motor is too high.	Measure whether the temperature of the air-cooled motor is too high.	Cool the motor down.

- E661.0: Auto-tuned gains too low

Cause	Confirming Method	Solution
1. The auto-tuned gain values are wrong. 2. The internal gains reach the lower limit (5 for position loop and 10 for speed loop). 3. Excessive overshoot occurs during positioning.	• Check whether the machine suffers from periodic fluctuation. • Check whether the positioning threshold is too low.	1. Set the notch manually when vibration cannot be suppressed automatically. 2. Check whether the positioning threshold is too low. Increase the reference acceleration/ deceleration time. 3. Modify the electronic gear ratio to improve the reference resolution, or increase the reference filter time constant in the Parameter configuration interface. Check whether the machine suffers from periodic vibration.

- E731.0: Encoder battery failure
  Cause:

  The voltage of the absolute encoder battery is lower than 2.8 V.

Cause	Confirming Method	Solution
The battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set 200D-15h (H0D-20) to 1 to clear the fault.
The encoder battery voltage is too low.	Measure the battery voltage.	Use a new battery with the matching voltage.

- E733.0: Encoder multi-turn counting error
  Cause:

  An encoder multi-turn counting error occurs.

Cause	Confirming Method	Solution
The encoder is faulty.	Set 200D-15h (H0D-20) to 2 to clear the fault. E733.0 persists after the servo drive is powered on again.	Replace the motor.

- E735.0: Encoder multi-turn counting overflow
  Cause:

  A multi-turn counting overflow occurs on the absolute encoder.

Cause	Confirming Method	Solution
The number of forward revolutions exceeds 32767 or the number of reverse revolutions exceeds 32768.	Check whether the value of H0B-70 is 32767 or 32768 when the servo drive works in the absolute position linear mode (H02-01 = 1).	Set H0D-20 to 2 and power on again. Perform homing if necessary.

- E740.2: Absolute encoder error

  Cause:

  Communication timeout occurs on the absolute encoder.

Cause	Confirming Method	Solution
The communication between the servo drive and the encoder is abnormal.	Check whether the value of H0B-28 is not 0.	1. Check whether H00-00 (Motor code) is set properly. 2. Check whether the encoder cable is connected properly. 3. Check whether the servo drive and motor are grounded properly. You can install a magnetic ring on the encoder cable to reduce interference.

- E740.3: Absolute encoder single-turn calculation error

  Cause:

  An encoder fault occurs.

Cause	Confirming Method	Solution
An encoder fault occurs.	Check whether bit7 of H0B-28 is 1.	1. Check whether the encoder version (H00-04) is proper. 2. Check whether the encoder cable is proper. 3. Replace the motor.

- E740.6: Encoder data write error

  Cause:

  The attempt to write the encoder data fails.

Cause	Confirming Method	Solution
An error occurs when writing the position offset after angle auto-tuning.	Replace with a new encoder cable. If the fault no longer occurs after cable replacement, it indicates the original encoder cable is damaged. Keep the motor in a fixed place, power on the servo drive several times and check the electrical angle changes in 200B-12h (H0B-17). The electrical angle change should be within ±30°.	Replace with a new encoder cable. If the fault persists after the encoder cable is replaced, the encoder may be faulty. In this case, replace the servo motor.

- E755.0: Nikon encoder communication fault

Cause	Confirming Method	Solution
1. An encoder communication error or encoder fault is detected after servo drive initialization is done upon power-on. 2. E755.0 will be reported when a Nikon encoder that has been idled for a long time is powered on again.	1. Check whether the encoder cable is connected properly. 2. Check whether strong interference sources are present and whether connectors are loose or cables are broken.	1. Ensure the encoder cable is connected properly. 2. Take proper shielding measures in case of strong interference sources.

- E765.0: Nikon encoder out of limit

Cause	Confirming Method	Solution
Over-temperature, overspeed, or EEPROM access error is detected in the encoder.	The error is detected by the Nikon encoder. The servo drive only displays the error.	Set H0D-21 to 1 to clear the fault.

- E902.2: Torque reach setting invalid

Cause	Confirming Method	Solution
The DO parameters set for torque reach in the torque control mode are invalid.	Check whether the value of 2007-17h (H07-22) is equal to or less than the setpoint (unit: 0.1%) of 2007-18h (H07-23).	Set 2007-17h (H07-22) to a value higher than 2007-18h (H07-23).

- EA33.0: Encoder read/write check error

Cause:

Encoder parameters are abnormal.

Cause	Confirming Method	Solution
1. The serial incremental encoder cable is disconnected or loose.	Check the wiring.	Check for wrong connection, disconnection and poor contact of the encoder cable. Route the motor cable and encoder cable through different routes.
2. An error occurs when reading/writing the serial incremental encoder parameters.	If the fault persists after the servo drive is powered off and on several times, the encoder is faulty.	Replace the servo motor.

- EB00.0: Position deviation too large
  Cause:

  The position deviation is larger than the setpoint of 6065h in the position control mode.

Cause	Confirming Method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Connect cables again according to the correct wiring diagram or replace the cables.
2. The servo drive U/V/W cables or the encoder cable is disconnected.	Check the wiring.	Connect the cables again. The U/V/W phase sequence on the drive side must be consistent with that on the motor side. Replace with new cables if necessary and ensure cables are connected properly.

Cause	Confirming Method	Solution
3. The motor is stalled due to mechanical factors.	Check the reference and the motor speed (200B-01h (H0B-00)) through the software tool or keypad. • References in the position control mode: 200B-0Eh (H0B-13) (Input position reference counter) • References in the speed control mode: 200B-02h (H0B-01) (Speed reference) • References in the torque control mode: 200B-03h (H0B-02) (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 RPM in the corresponding mode.	Eliminate the mechanical factors.
4. The gain values are too low.	Check the position loop gain and speed loop gain of the servo drive. 1st gain set: H08-00...H08-02 2nd gain set: H08-03...H08-05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is too large.	Position control mode: • In CSP mode, view the gear ratio 6091-01h/6091-02h and determine the position reference increment for an individual synchronization cycle and convert it to the speed information. • In PP mode, view the gear ratio 6091-01h/6091-02h and determine the value of 6081h (Profile velocity). • In HM mode, view the gear ratio 6091-01h/6091-02h and determine the value of 6099-01h and 6099-02h.	• CSP: Decrease the position reference increment for an individual synchronization cycle. The host controller should handle the position ramp when generating references. • PP: Decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). • HM: Decrease the value of 6099-01h and 6099-02h or increase the acceleration/deceleration ramp (609Ah). • Decrease the gear ratio according to actual conditions.

Cause	Confirming Method	Solution
6. Given the operating condition, the value of 6065h (Following error window) is too low.	Check whether the setpoint of 6065h is too low.	Increase the setpoint of 6065h.
7. The servo drive/motor is faulty.	Monitor the operating waveforms using the oscilloscope function in the software tool: position reference, position feedback, speed reference, torque reference	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

- EB00.1: Position deviation overflow

  Cause:

  The position deviation is too large.

Cause	Confirming Method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Connect cables again according to the correct wiring diagram or replace the cables.
2. The servo drive U/V/W cables or the encoder cable is disconnected.	Check the wiring.	Connect the cables again. The U/V/W phase sequence on the drive side must be consistent with that on the motor side. Replace with new cables if necessary and ensure cables are connected properly.
3. The motor is stalled due to mechanical factors.	Check the reference and motor speed (H0B-00) through the software tool or keypad. • References in the position control mode: H0B-13(Input position reference counter) • References in the speed control mode: H0B-01(Speed reference) • References in the torque control mode: H0B-02(Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 RPM in the corresponding mode.	Eliminate the mechanical factors.

Cause	Confirming Method	Solution
4. The gain values are too low.	Check the position loop gain and speed loop gain of the servo drive. • 1st gain set: H08-00...H08-02 • 2nd gain set: H08-03...H08-05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is too large.	Position control mode: • In CSP mode, view the gear ratio 6091-01h/6091-02h and determine the position reference increment for an individual synchronization cycle and convert it to the speed information. • In PP mode, view the gear ratio 6091-01h/6091-02h and determine the value of 6081h (Profile velocity). • In HM mode, view the gear ratio 6091-01h/6091-02h and determine the value of 6099-01h and 6099-02h.	• CSP: Decrease the position reference increment for an individual synchronization cycle. The host controller should handle the position ramp when generating references. • PP: Decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). • HM: Decrease the value of 6099-01h and 6099-02h or increase the acceleration/ deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. Given the operating condition, the value of 6065h (Following error window) is too low.	Check whether the setpoint of 6065h is too low.	Increase the setpoint of 6065h.
7. The servo drive/motor is faulty.	Monitor the operating waveforms using the oscilloscope function in the software tool: position reference, position feedback, speed reference, torque reference	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

- EB01.1: Individual position reference increment too large

  Cause:

  The target position increment is too large.

Cause	Confirming Method	Solution
The target position increment is too large.	Check the variation between two adjacent target positions using the software tool.	1. Check whether the maximum speed of the motor fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profile reference speed. If not, replace the servo motor. 2. Before switching the mode or enabling the servo drive, check whether the target position is aligned with current position feedback. 3. The communication sequence of the host controller is abnormal, leading to slave data error. Check the communication sequence of the host controller.

- EB01.2: Position reference increment too large continuously

  Cause:

  The target position increment exceeds the limit value N times consecutively.

Cause	Confirming Method	Solution
The target position increment is too large.	Check the variation between two adjacent target positions using the software tool.	1. Check whether the maximum speed of the motor fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profile reference speed. If not, replace the servo motor. 2. Before switching the mode or enabling the servo drive, check whether the target position is aligned with current position feedback. 3. The communication sequence of the host controller is abnormal, leading to slave data error. Check the communication sequence of the host controller.

- EB01.3: Command overflow

  Cause:

The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.

Cause	Confirming Method	Solution
The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.	Check whether the host controller continues sending commands after overtravel warning is reported by the servo drive.	1. Detect the servo limit signal (bit0 and bit1 of 60FD recommended) through the host controller. 2. Stop sending limit direction commands when an active servo limit signal is detected by the host controller.

- EB01.4: Target position beyond upper/lower limit
  Cause:

  The target position exceeds the upper/lower limit of the unit position in the single-turn absolute mode.

Cause	Confirming Method	Solution
The target position exceeds the upper/lower limit of the unit position in the single-turn absolute mode.	Check whether the set target position is within the single-turn upper/lower limit.	Set the target position to a value within the upper/lower limit.

- EE09.0: Software position limit setting error
  Cause:

  The lower limit of the software position limit is equal to or higher than the upper limit.

Cause	Confirming Method	Solution
The lower limit of the software position limit is equal to or larger than the upper limit.	Check the values of 607D-01h and 607D-02h.	Set 607D-01h to a value lower than 607D-02h.

- EE09.1: Home setting error
  Cause:

  The home offset exceeds the upper/lower limit.

Cause	Confirming Method	Solution
1. The home offset is outside the software position limit.	The home offset is outside the software position limit when the encoder works in the incremental mode, absolute linear mode, and single-turn absolute mode.	Set the home offset to a value within the software position limit.
2. The home offset is beyond the upper/lower limit in the rotation mode.	The home offset is outside the mechanical single-turn upper/lower limit when the encoder works in the rotation mode.	Set the home offset to a value within the mechanical single-turn upper/lower limit.

- EE09.2: Gear ratio beyond the limit

  Cause:

  The electronic gear ratio exceeds the limit: (0.001, 4000 x Encoder resolution/ 10000).

Cause	Confirming Method	Solution
The set electronic gear ratio exceeds the preceding range.	Check whether the ratio of 6091-01h to 6091-02h exceeds the preceding range.	Set the gear ratio according to the preceding range.

- EE09.3: No synchronization signal

  Cause:

  The MCU does not receive the synchronization signal when the servo communication is switched to OP status.

Cause	Confirming Method	Solution
1. The communication synchronization clock is configured improperly.	Replace with another master (such as Beckhoff or Omron PLC) and perform tests to compare between different masters.	Rectify improper configurations.
2. The IN/OUT port of EtherCAT communication is connected reversely.	Check whether the IN/OUT port is connected reversely.	Connect the IN and OUT ports in the correct sequence.

Cause	Confirming Method	Solution
3. The slave controller integrated circuit is damaged.	If the fault persists after the master is replaced, measure the synchronization signal generated by the slave controller integrated circuit with an oscilloscope. If there is no signal, the slave controller integrated circuit is damaged.	Contact Inovance for replacing the slave controller integrated circuit.
4. The MCU pins are damaged.	Test the synchronization signal generated by the slave controller integrated circuit with an oscilloscope. If there is a signal, the pins of the MCU integrated circuit are damaged.	Contact Inovance for replacing the MCU integrated circuit.

- EE09.5: PDO mapping beyond the limit
  Cause:

  The number of the mapping objects in TPDO or RPDO exceeds 10.

Cause	Confirming Method	Solution
The number of mapping objects in TPDO or RPDO exceeds 10.	Check the number of self-indexes configured in 1600h or 1A00h.	The number of mapping objects in TPDO or RPDO cannot exceed 10.

6.4 Solutions to Warnings

- E121.0: S-ON command invalid
  Cause:

  The S-ON signal is set repeatedly.

Cause	Confirming Method	Solution
1. The servo drive is enabled internally at the same time when the S-ON signal is activated through communication.	Check whether an S-ON signal is sent from the host controller when auxiliary functions (200D-03h (H0D-02), 200D-04h (H0D-03), and 200D-0Ch (H0D-11)) are used.	Switch off the S-ON signal sent from the host controller.
2. The S-ON signal is sent from the DI and the software tool simultaneously.	Check whether the S-ON signal is sent from the DI and the software tool simultaneously.	Switch off the redundant S-ON signal.

- E600.0: Inertia auto-tuning failure
  Cause:
  - The vibration cannot be suppressed. Enable vibration suppression manually to dampen the vibration.
  - The auto-tuned values fluctuate dramatically. Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation.
  - Mechanical couplings of the load are loose or eccentric. Rectify the mechanical faults.
  - A warning occurs during auto-tuning and causes interruption. Rectify the fault causes and perform inertia auto-tuning again.
  - The vibration cannot be suppressed if the load carries a large inertia. In this case, increase the acceleration/deceleration time first to ensure the motor current is unsaturated.

Cause	Confirming Method	Solution
1. Continuous vibration occurs during auto-tuning. 2. The auto-tuned values fluctuate dramatically. 3. Mechanical couplings of the load are loose or the mechanism is eccentric. 4. A warning occurs during auto-tuning and causes interruption. 5. The vibration cannot be suppressed if the load carries large inertia. In this case, increase the acceleration/deceleration time to ensure the motor current is unsaturated.	Perform internal inspection to check whether the torque jitters upon stop (not FFT).	1. Rectify the fault and perform inertia auto-tuning again. 2. For vibration that cannot be suppressed, enable vibration suppression function. 3. Ensure mechanical couplings are connected securely. 4. Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation.

- E601.0: Homing warning
  Cause:

  When using the homing function, the home is not found within the time defined by 2005-24h.

Cause	Confirming Method	Solution
1. The home switch is faulty.	There is only high-speed searching but no low-speed searching during homing. After high-speed searching, low-speed searching in the reverse direction applies .	• If Z signal is used as the home signal, a hardware DI is used as the deceleration point, check whether DI functions (FunIN.14 for positive position limit; FunIN.15 for negative position limit; FunIN.31 for home switch) are set properly in group 2003h and then check the wiring of the DI. Change the DI logic manually and observe the value of 200B-04h (H0B-03) to see whether the servo drive receives the corresponding DI level change. If not, the DI is wired improperly. If yes, a fault occurs during homing. Perform the homing operation correctly. • The preceding process also applies when the home switch is used as the home signal.
2. The time limit for homing is too short.	Check whether the value of 2005-24h (H05-35) is too small.	Increase the value of 2005-24h (H05-35).
3. The speed in high-speed searching for the home switch signal is too low.	Check the distance between the initial position of homing and the home switch. Then check whether the value of 6099-01h is too small, resulting in a long homing process.	Increase the value of 6099-01h.

- E601.1: Homing switch error

  Cause:

  The homing switch is set improperly.

Cause	Confirming Method	Solution
The home switch is set improperly.	Check whether the limit signals at both sides are both activated. Check whether the limit signal and the deceleration point signal/home signal are both activated.	Set the hardware switch position properly.

- E601.2: Homing method setting error

  Cause:

  The homing method (0x6098h) is set improperly.

Cause	Confirming Method	Solution
The homing method (0x6098) is set to a value outside [-2 to +14] when the absolute position single-turn mode is used (H02-01 = 4).	Check the setpoint of 0x6098.	Set 0x6098 to a value within the specified range.
The homing method (0x6098) is set to a value outside [-2, 14], [17, 30], and [33,35] in modes other than absolute position single-turn mode.	Check the setpoint of 0x6098.	Set 0x6098 to a value within the specified range.

- E730.0: Encoder battery warning

  Cause:

  The voltage of the absolute encoder battery is lower than 3.0 V.

Cause	Confirming Method	Solution
The voltage of the absolute encoder battery is lower than 3.0 V.	Measure the battery voltage.	Use a new battery with the matching voltage.

- E900.0: Emergency stop

  Cause:

  The logic of the DI (hardware DI or virtual DI) assigned with FunIN.34 (EmergencyStop) is active.

Cause	Confirming Method	Solution
FunIN.34 (EmergencyStop) is triggered.	Check whether the logic of the DI assigned with FunIN.34 (EmergencyStop) is active.	Check the operating mode and clear the active DI braking signal without affecting the safety performance.

- E902.0: DI setting invalid

  Cause:

  DI function parameters are set to invalid values.

Cause	Confirming Method	Solution
DI (DI1...DI5) function parameters are set to invalid values.	Check whether H03-02, H03-04, H03-06, H03-08, and H03-10 are set to invalid values.	Set DI function parameters to valid values.

- E902.1: DO setting invalid

  Cause:

  DO function parameters are set to invalid values.

Cause	Confirming Method	Solution
DO (DO1...DO3) function parameters are set to invalid values.	Check whether H04-00, H04-02, and H04-04 are set to invalid values.	Set DO function parameters to valid values.

- E902.2: Invalid setting for torque reach
  Cause:

  The DO parameters set for torque reach in the torque control mode are invalid.

Cause	Confirming Method	Solution
The DO parameters set for torque reach in the torque control mode are invalid.	Check whether the value of H07-22 is lower than or equal to the value of H07-23 (unit: 0.1%).	Set H07-22 to a value higher than that of H07-23.

- E908.0: Model identification failure
  Cause:

  The first two check bytes of model identification are incorrect, indicating the attempt to read model identification parameter fails.

Cause	Confirming Method	Solution
1. The model identification parameter is not written. 2. The check bytes of model identification are incorrect.	The warning persists after restart.	1. Write the model identification parameter again. 2. Set H01-72 to 1 to hide the model identification function.

- E909.0: Motor overload warning
  Cause:

  The accumulative heat of the motor reaches the warning threshold (90% of the maximum allowable heat).

Cause	Confirming Method	Solution
1. The motor cables and encoder cable are connected improperly or in poor contact.	Check the wiring among the servo drive, servo motor and the encoder according to the correct wiring diagram.	Connect cables according to the correct wiring diagram. It is recommended to use the cables provided by Inovance. When customized cables are used, prepare and connect the customized cables according to the wiring instructions.
2. The load is so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load rate (H0B-12) keeps exceeding 100.0%.	Replace with a servo drive of higher capacity and a matching servo motor. Reduce the load and increase the acceleration/ deceleration time.
3. Acceleration/ Deceleration is too frequent or the load inertia is too large.	Check the mechanical inertia ratio or perform inertia auto-tuning. View the value of H08-15 (Load moment of inertia ratio). Confirm the individual operation cycle when the servo motor operates cyclically.	Increase the acceleration/ deceleration time.
4. The gain values are improper or the stiffness level is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust the gains again.
5. The model of the servo drive or motor is set improperly.	View the serial-type motor model in H00-05 and the servo drive model in H01-10.	Read the servo drive nameplate and set the servo drive model (H01-10) and motor model properly.

Cause	Confirming Method	Solution
6. The motor is stalled due to mechanical factors, resulting in overload during operation.	Check the reference and the motor speed (H0B-00) through the software tool or the keypad. • References in the position control mode: H0B-13 (Input position reference counter) • References in the speed control mode: H0B-01 (Speed reference) • References in the torque control mode: H0B-02 (Internal torque reference) Check whether the reference value is not 0 or is very large but the motor speed is 0 RPM in the corresponding mode.	Eliminate the mechanical factors.
7. The servo drive is faulty.	Power off and on the servo drive again.	Replace the servo drive if the fault persists after the servo drive is powered off and on again.

- E920.0: Regenerative resistor overload

  Cause:

  The accumulative heat of the regenerative resistor is too high and reaches the warning threshold (90% of the maximum allowable heat).

Cause	Confirming Method	Solution
1. The cable connected to the external regenerative resistor is in poor contact, disconnected or broken.	Remove the external regenerative resistor and measure whether its resistance is "∞" (infinite). Measure whether the resistance between terminals P⊕ and C is "∞" (infinite).	Replace with a new external regenerative resistor. After confirming the resistance measured is the same as the nominal value, connect it between terminals P⊕ and C.
		Connect the external regenerative resistor between terminals P⊕ and C with a proper cable.
2. The jumper between terminals P⊕ and D is shorted or disconnected when the built-in regenerative resistor is used.	Measure whether the resistance between terminals P⊕ and D is "∞" (infinite).	Ensure terminals P⊕ and D are jumpered.

Cause	Confirming Method	Solution
3. 2002-1Ah (H02-25) is set improperly when an external regenerative resistor is used.	• View the setpoint of H02-25. • Measure the resistance of the external regenerative resistor connected between P⊕ and C. Check whether the resistance measured is too large by comparing it with the value listed in Table "Specifications of the regenerative resistor". • Check whether the value of H02-27 is larger than the resistance of the external regenerative resistor connected between terminals P⊕ and C.	Set H02-25 (Regenerative resistor type) based on section "Wiring and Setting of the Regenerative Resistor" in SV660N Series Servo Drive Hardware Guide. H02-25 = 1 (external, naturally ventilated) H02-25 = 2 (external, forced-air cooling)
4. The resistance of the external regenerative resistor is too large.		Select a proper regenerative resistor according to Table "Specifications of the Regenerative Resistor" in SV660N Series Servo Drive Commissioning Guide.
5. The value of 2002-1Ch (H02-27) (Resistance of external regenerative resistor) is larger than the resistance of the external regenerative resistor used.		Set H02-27 according to the resistance of the external regenerative resistor used.
6. The input voltage of the main circuit is beyond the specified range.	Check whether the input voltage of the main circuit cable on the drive side is within the following range: • 220 V servo drive: Effective value: 220 V to 240 VAllowable deviation: -10% to +10% (198 V to 264 V) • 380 V servo drive: Effective value: 380 V to 440 VAllowable deviation: -10% to +10% (342 V to 484 V)	Replace or adjust the power supply according to the specified range.

Cause	Confirming Method	Solution
7. The load moment of inertia ratio is too large.	Perform moment of inertia auto-tuning according to section "Inertia auto-tuning" in SV660N Series Servo Drive Function Guide or calculate the total mechanical inertia based on mechanical parameters. Check whether the actual load inertia ratio exceeds 30.	• Select an external regenerative resistor with large capacity and set H02-26 (Power of the external regenerative resistor) to a value consistent with the actual power. • Select a servo drive with large capacity. • Reduce the load if allowed. • Increase the acceleration/ deceleration time if allowed. • Increase the motor operation cycle if allowed.
8. The motor speed is excessively high and deceleration is not done within the set time. The motor is in the continuous deceleration status during cyclic operation.	View the motor speed curve during cyclic operation and check whether the motor is in the deceleration status continuously.	
9. The capacity of the servo drive or the regenerative resistor is insufficient.	View the motor speed curve in an individual cycle and calculate whether the maximum braking energy can be absorbed completely.	
10. The servo drive is faulty.	-	Replace with a new servo drive.

- E922.0: Resistance of the external regenerative resistor too small

  Cause:

  The value of 2002-1Ch (H02-27) (Resistance of external regenerative resistor) is smaller than the value of 2002-16h (H02-21) (Permissible minimum resistance of regenerative resistor).

Cause	Confirming Method	Solution
When an external regenerative resistor (2002-1Ah (H02-25) = 1 or 2) is used, the resistance of the external regenerative resistor is lower than the minimum permissible resistance.	Measure the resistance of the external regenerative resistor between P⊕ and C and check whether it is lower than the value of 2002-16h (H02-21).	• If yes, replace with an external regenerative resistor that matches the servo drive, then set 2002-1Ch (H02-27) according to the resistance of the resistor used. Finally, connect the new resistor between P⊕ and C. • If not, set 2002-1Ch (H02-27) according to the resistance of the external regenerative resistor used.

- E924.0: Regenerative transistor over-temperature

  Cause:

The estimated temperature of the regenerative transistor is higher than H0A-49 (Regenerative transistor over-temperature threshold).

Cause	Confirming Method	Solution
1. The temperature of the regenerative transistor is too high. 2. The regenerative transistor will be turned off automatically after overload occurs.	The regenerative transistor temperature exceeds the threshold defined by H0A-49.	Control the usage of the regenerative transistor based on actual conditions.

- E941.0: Parameter modifications activated at next power-on
  Cause:

  The parameters modified are those whose "Effective time" is "Next power-on".

Cause	Confirming Method	Solution
The parameters modified are those whose "Effective time" is "Next power-on".	Check whether parameters you modified are those whose "Effective Time" is "Next power-on".	Power off and on the servo drive again.

- E942.0: Parameter saved frequently
  Cause:

  The number of parameters modified at a time exceeds 200.

Cause	Confirming Method	Solution
A large number of parameters are modified and saved frequently to EEPROM (200E-02h = 1 or 3).	Check whether the host controller executes parameter modifications at a brief interval.	Check the operation mode. For parameters that need not be saved in EEPROM, set 200E-02h (H0E-01) to 0.

- E950.0: Forward overtravel warning
  Cause:

  The logic of DI assigned with FunIN.14 (P-OT, positive limit switch) is active.

Cause	Confirming Method	Solution
1. The logic of the DI assigned with FunIN.14 (P-OT, positive limit switch) is active.	• Check whether a DI in group 2003h is assigned with FunIN.14. • Check whether the DI logic of the corresponding bit of 200E-04h (H0E-03) (Monitored DI status) is active.	Check the operation mode and on the prerequisite of ensuring safety, send a reverse run command or rotate the motor to deactivate the logic of the DI assigned with FunIN.14.
2. The servo drive position feedback reaches the positive software position limit.	Check whether the position feedback (0x6064) is close to the value of 0x607D-02.	Ensure the servo drive references are proper, allowing the load travel range to be within the software position limit.

- E952.0: Reverse overtravel warning
  Cause:

  The logic of the DI assigned with FunIN.15 (N-OT, negative limit switch) is active.

Cause	Confirming Method	Solution
1. The logic of the DI assigned with FunIN.15 (N-OT, negative limit switch) is active.	• Check whether a DI in group 2003h is assigned with FunIN.15. • Check whether the DI logic of the corresponding bit of 200E-04h (H0E-03) (Monitored DI status) is active.	Check the operation mode. On the prerequisite of ensuring safety, send a forward run command or rotate the motor to deactivate the logic of DI assigned with FunIN.15.
2. The servo drive position feedback reaches the negative software position limit	Check whether the position feedback (0x6064) is close to the value of 0x607D-02.	Ensure the servo drive references are proper, allowing the load travel range to be within the software position limit.

- EA41.0 Torque fluctuation compensation failure
  Cause:

  The attempt to write torque fluctuation compensation parameter to the encoder fails.

Cause	Confirming Method	Solution
The attempt to write torque fluctuation compensation parameter to the encoder fails. An encoder data read/ write error occurs.	Check the wiring of the encoder.	If the fault persists after several attempts, contact Inovance for technical support.

6.5 Solutions to Communication Faults

This section describes solutions to communication faults. For solutions to the servo drive faults, see the preceding sections.

- EE08.0: Synchronization (SYNC) signal loss
  Cause:

  The SYNC signal is turned off when the EtherCAT network is in the OP state.

Cause	Confirming Method	Solution
The SYNC signal is not generated due to hardware errors.	Check whether the SYNC signal cycle is 0 using the oscilloscope in the software tool.	Replace the servo drive. Contact Inovance for maintenance.

- EE08.1: Network status switchover error
  Cause:

  When the servo drive is enabled, the EtherCAT network status switches from OP to other status.

Cause	Confirming Method	Solution
This fault is caused by mal-operation of the master or the operator.	Check whether the master switches the network status when the servo drive is enabled.	Check the network status switchover program of the host controller.

- EE08.2: IRQ loss
  Cause:
  - For servo drives with H01-00 (MCU software version) = 902.0 or earlier, causes for IRQ loss include all the causes for EE08.0...EE08.6 without differentiation.
  - For servo drives with H01-00 (MCU software version) = 902.1 or later, causes for IRQ loss are further differentiated and categorized into different faults, which means EE08.2 will no longer be reported.
- EE08.3: Network cable connected improperly
  Cause:

  The network cable of the servo drive is connected improperly. (The low 16 bits of H0E-29 represent the number of IN port loss events. The high 16 bits of H0E-29 represent the number of OUT port loss events.)

Cause	Confirming Method	Solution
The physical connection of the data link is unstable or the process data is lost due to plug-in/ plug-out of the network cable.	Check: 1) whether the network cable of the servo drive is connected securely. 2) whether strong vibration occurs on site. 3) whether the network cable is plugged in or out. 4) whether the network cable provided by Inovance is used.	Check the connection of the network port through the value change of H0E-29. Replace with a new network cable.

- EE08.4 Data frame loss protection error

  Cause:

  The PDO data is corrupted due to EMC interference or inferior network cable.

Cause	Confirming Method	Solution
The data is lost due to EMC interference, poor quality of the network cable or improper connection.	Check whether the high 16 bits of H0E-25 have values that are increased.	• Check whether the servo drive is grounded properly and rectify the EMC problem. • Check whether the network cable used is the one designated by Inovance. • Check whether the network cable is connected properly.

- EE08.5: Data frame transfer error

  Cause:

  As error data frames are generated from the upstream slave, the downstream slave receives invalid data frames.

Cause	Confirming Method	Solution
The upstream slave detects that the data frame has been corrupted and marked, which is then transferred to the downstream slave, leading to a warning event.	Check whether a processing unit error occurs due to transfer error (H0E-27) or invalid frames (H0E-28) upon occurrence of the fault, and check whether no counting is performed in RX-ERR of Port0.	Check the upstream slave to locate the fault cause.

- EE08.6: Data update timeout

  Cause:

  The slave is in the OP status and does not receive the data frame in a long time.

Cause	Confirming Method	Solution
The data frame is lost or aborted in the upstream slave or the master performance is not up to standard.	Check through the software tool whether the phase difference between SYNC and IRQ exceeds the value of H0E-22 multiplied by the communication cycle.	• Check whether the operating load of the master CPU is excessive. Increase the communication time or set H0E-22 to a high value. • Check whether link loss occurs on the upstream slave.

- EE11.0: ESI check error

  Cause:

  The attempt to load the XML file fails during EtherCAT communication.

Cause	Confirming Method	Solution
1. The XML file is programmed in the EEPROM. 2. The XML file in the EEPROM is modified unexpectedly.	Check whether the XML version displayed in H0E-96 is normal.	Program the XML file.

- EE11.1: EEPROM read failure

  Cause:

  The EEPROM communication of external EtherCAT devices fails.

Cause	Confirming Method	Solution
The EtherCAT data in the EEPROM cannot be read	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- EE11.2: EEPROM update failure

  Cause:

  The communication is normal but the message in the EEPROM is wrong or lost.

Cause	Confirming Method	Solution
The EtherCAT data in the EEPROM cannot be updated.	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- EE12.0: EtherCAT external device error

  Cause:

  The EtherCAT network cannot be initialized.

Cause	Confirming Method	Solution
1. The FPGA firmware is not programmed.	Check whether 2001-02h is 09xx.Y.	Program the FPGA firmware.
2. The servo drive is faulty.	The servo drive is faulty.	Replace the servo drive.

- EE13.0: Synchronization cycle setting error
  Cause:

  The synchronization cycle is not an integer multiple of 125 µs or 250 µs after the network switches to the OP mode.

Cause	Confirming Method	Solution
The synchronization cycle is not an integer multiple of 125 µs or 250 µs.	Check the setting of the synchronization cycle in the controller.	Set the synchronization cycle to an integer multiple of 125 µs or 250 µs.

- EE15.0: Synchronization cycle error too large
  Cause:

  The synchronization cycle error exceeds the threshold.

Cause	Confirming Method	Solution
The synchronization cycle error of the controller is too large.	• Measure the synchronization cycle of the controller using a digital oscilloscope or the oscilloscope tool in the software tool.	Increase the value of 200E-21h.

7 Description of Parameters

7.1 Classification of Object Dictionary

The object dictionary is the most important part in device specifications. It is an ordered set of parameters and variables that include device descriptions and all parameters of device network status. A group of objects can be accessed in an ordered and pre-defined way through the network.

The CANopen protocol adopts the object dictionary with 16-bit indexes and 8-bit sub-indexes. The structure of the object dictionary is shown in the following table.

Index	Object
0	Not used
0001h–001Fh	Static data types (standard data types, such as Boolean and Integer16)
0020h–003Fh	Complex data types (predefined structure consisting of simple types, such as PDOCommPar and SDOParmeter)
0040h–005Fh	Manufacturer-specific complex data types
0060h–007Fh	Device profile-specific static data types
0080h–009Fh	Device profile-specific complex data types
00A0h–0FFFh	Reserved
1000h–1FFFh	Communication profile area (such as the device type, error register, and number of supported PDOs)
2000h–5FFFh	Manufacturer-specific profile area (such as parameter mapping)
6000h–9FFFh	Standardized device profile area (for example, CiA402 protocol)
A000h–FFFFh	Reserved

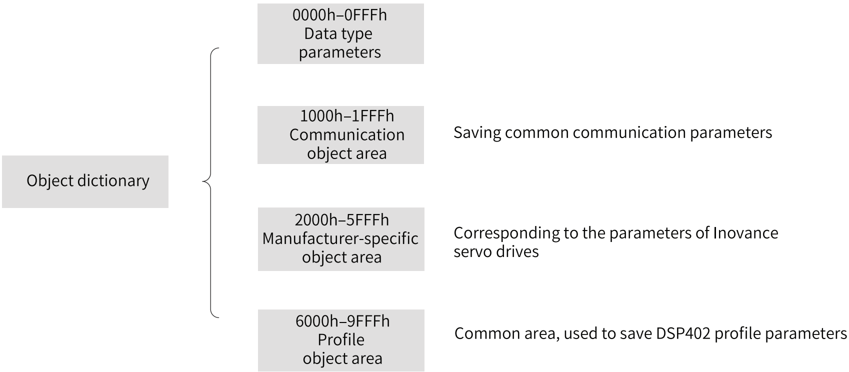


Figure 7-1 Structure of CANopen object dictionary

Objects in SV660N include the following attributes: index, sub-index, data structure, data type, access, mapping, setting condition & effective time, related mode, data range, and default

★Definitions of terms

Position of the object dictionary in the parameter list is specified by the "Index" and "Sub-index".

- "Index": This field (in hexadecimal) specifies the position of the same type of objects in the object dictionary.
- "Sub-index": This field specifies the offset of each object under the same index.

The mapping relation between the parameter and the object dictionary is as follows:

- Object dictionary index = 0x2000 + Parameter group number
- Object dictionary sub-index = Hexadecimal offset within the parameter group + 1

For example, parameter H02-10 is mapped to object 2002-0Bh (H02-07).

Objects in the object dictionary are described based on types.

For example, 607Dh, which limits the software position, describes the minimum and maximum position limits as defined below:

Index	Sub-index	Name	Meaning
607Dh	00h	Number of entries	Defines the number of object data (exclusive of the sub-index 00h).
607Dh	01h	Min. position limit	Defines the minimum position limit (absolute position mode).
607Dh	02h	Max. position limit	Defines the maximum position limit (absolute position mode).

"Data Structure": See the following table for details.

Table 7–1 Description for "Data Structure"

Type	Meaning	DS301 Value
VAR	Single simple value, including data types Int8, Uint16, and String	7
ARR	Data block of the same type	8
REC	Data block of different types	9

"Data Type": See the following table for details.

Table 7–2 Description for "Data Type"

Data Type	Value Range	Data Length	DS301 Value
Int8	-128 to +127	1 byte	2
Int16	-32768 to +32767	2 bytes	3
Int32	-2147483648 to +2147483647	4 bytes	4
Uint8	0 to 255	1 byte	5
Uint16	0 to 65535	2 bytes	6
Uint32	0 to 4294967295	4 bytes	7
String	ASCII	-	9

"Access": See the following table for details.

Table 7–3 Description for "Access"

Access	Description
RW	Read/Write
WO	Write-only
RO	Read-only
CONST	Constant, read-only

"Mapping": See the following table for details.

Table 7–4 Description for "Mapping"

Mapping	Description
No	Cannot be mapped to PDO
RPDO	Can be used as RPDO
TPDO	Can be used as TPDO

"Setting Condition & Effective Time": See the following table for details.

Table 7–5 Description for "Setting Condition & Effective Time"

Setting Condition	Description
At stop	The parameter can be edited only when the servo drive is not in the operational state.
During running	The parameter can be edited when the servo drive is in any state.
At once	The change in the parameter value is activated at once.
At stop	The change in the parameter value is activated after the servo drive is not in the operational state.
Next power-on	The change in the parameter value is activated at next power-on. Note: The servo drive reports E941 when the value of the parameter whose "Effective Time" is "Next power-on" is changed.

"Related Mode": See the following table for details.

Table 7–6 Description for "Related Mode"

Related Mode	Description
-	The parameter is not related to the control mode.
All	The parameter is related to all the control modes.
PP/PV/PT/HM/CSP/CSV/CST	The parameter is related to specific control modes.

"Data Range": Indicates the upper and lower limits of writable parameters.

If the value of a parameter modified through SDO exceeds the data range, the servo drive returns a SDO transmission abort code to deactivate the modification.

If the value of a parameter is modified through PDO, the servo drive does not check the validity of the value.

"Default": Indicates the default value of the parameter.

7.2 Communication Parameters (Group 1000h)

Index 1000h	Name	Device type					Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0x00020192
Defines the CoE device profile type.										

Index 1008h	Name	Manufacturer device name					Data Structure	-	Data Type	-
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	SV660-ECAT
Defines the manufacturer device name.										

Index 1009h	Name	Manufacturer hardware version					Data Structure	-	Data Type	-
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	Dependent on the hardware version of the drive.
Defines the hardware version of the manufacturer device.										

Index 100Ah	Name	Manufacturer software version					Data Structure	-	Data Type	-
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	Dependent on the software version of the drive.
Defines the software version of the manufacturer device.										

Index 1018h	Name	Identity object					Data Structure	REC	Data Type	OD data type
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the device information.										

Sub-index 00h	Name	Number of entries					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	4	Default	4

Sub-index 01h	Name	Vendor ID					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0x00100000
Defines the series number of the drive.										

Sub-index 02h	Name	Product code					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	786696
Defines the internal code of the drive.										

Sub-index 03h	Name	Revision number					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	65537
Defines the software update record number of the drive.										

Index 1C00h	Name	Sync Manager communication type					Data Structure	REC	Data Type	OD data type
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the communication type of the Sync Manager.										

Sub-index 00h	Name	Number of Sync Manger channels					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	4	Default	4

Sub-index 01h	Name	SM0 communication type					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0x01
SM0 communication type : mailbox write										

Sub-index 02h	Name	SM1 communication type					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0x02
SM1 communication type : mailbox read										

Sub-index 03h	Name	SM2 communication type				Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0x03
SM2 Communication type: process data output										

Sub-index 04h	Name	SM3 communication type				Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0x04
SM3 communication type: process data input										

Index 1600h	Name	1st Receive PDO mapping				Data Structure	REC	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped objects of RPDO1.										

Sub-index 00h	Name	Number of mapped objects in RPDO1				Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 10	Default	3

Sub-index 01h	Name	1st mapped object				Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object				Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607A0020

Sub-index 03h	Name	3rd mapped object				Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B80020

Sub-index 04h to 0Ah	Name	4th to 10th mapped objects				Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	All	Data Range	0 to 4294967295	Default	-

Index 1701h	Name	258th Receive PDO mapping				Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of RPDO258										

Sub-index 00h	Name	Number of mapped objects in RPDO258					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	4

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607A0020

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B80010

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FE0120

Index 1702h	Name	259th Receive PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of RPDO259.										

Sub-index 00h	Name	Number of mapped objects in RPDO259					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	7

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607A0020

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FF0020

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	All	Data Range	0 to 4294967295	Default	60710010

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60600008

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B80010

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607F0020

Index 1703h	Name	260th Receive PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of RPDO260.										

Sub-index 00h	Name	Number of mapped objects in RPDO260				Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	7

Sub-index 01h	Name	1st mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607A0020

Sub-index 03h	Name	3rd mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FF0020

Sub-index 04h	Name	4th mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60600008

Sub-index 05h	Name	5th mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B80010

Sub-index 06h	Name	6th mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60E00010

Sub-index 07h	Name	7th mapped object				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60E10010

Index 1704h	Name	261st Receive PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of RPDO261.										

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object					Data Struc ture	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607A0020

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FF0020

Sub-index 04h	Name	4th mapped object					Data Struc ture	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60710010

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60600008

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B80010

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607F0020

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60E00010

Sub-index 09h	Name	9th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60E10010

Index 1705h	Name	262nd Receive PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of RPDO262.										

Sub-index 00h	Name	Number of mapped objects in RPDO262					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	8

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	607A0020

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FF0020

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60600008

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B80010

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60E00010

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60E10010

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B20010

Index 1A00h	Name	1st Transmit PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of TPDO1.										

Sub-index 00h	Name	Number of mapped objects in TPDO1					Data Structure	-	Data Type	Uint8
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 10	Default	7

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60400010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60640020

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B90010

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BA0020

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BC0020

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	603F0010

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Map ping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FD0020

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	-

Sub-index 09h	Name	9th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	-

Sub-index 10h	Name	10th mapped object					Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	-

Index 1B01h	Name	258th Transmit PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of TPDO258.										

Sub-index 00h	Name	Number of mapped objects in TPDO258					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	8

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	603F0010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60410010

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60640020

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60770010

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60F40020

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B90010

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BA0020

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FD0020

Index 1B02h	Name	259th Transmit PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of TPDO259.										

Sub-index 00h	Name	Number of mapped objects in TPDO259					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	9

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	603F0010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60410010

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60640020

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60770010

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60610008

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B90010

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BA0020

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BC0020

Sub-index 09h	Name	9th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	,· 60FD0020

Index 1B03h	Name	260th Transmit PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of TPDO260.										

Sub-index 00h	Name	Number of mapped objects in TPDO260					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	10

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	603F0010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60410010

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60640020

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60770010

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60F40020

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60610008

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B90010

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B A0020

Sub-index 09h	Name	9th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BC0020

Sub-index 0Ah	Name	10th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60FD0020

Index 1B04h	Name	261st Transmit PDO mapping					Data Structure	REC	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the mapped object of TPDO261.										

Sub-index 00h	Name	Number of mapped objects in TPDO261					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0

Sub-index 01h	Name	1st mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	603F0010

Sub-index 02h	Name	2nd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60410010

Sub-index 03h	Name	3rd mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60640020

Sub-index 04h	Name	4th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60770010

Sub-index 05h	Name	5th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60610008

Sub-index 06h	Name	6th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60F40020

Sub-index 07h	Name	7th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B90010

Sub-index 08h	Name	8th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Map ping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60B A0020

Sub-index 09h	Name	9th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Map ping	No	Related Mode	-	Data Range	0 to 4294967295	Default	60BC0020

Sub-index 0Ah	Name	10th mapped object					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 4294967295	Default	606C0020

Index 1C12h	Name	Sync Manager 2 RPDO assignment					Data Structure	ARR	Data Type	Uint16
	Access	RW	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the index of the object assigned.										

Sub-index 00h	Name	Number of assigned RPDOs					Data Structure	-	Data Type	Uint8
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 1	Default	1

<table>
<tr><td rowspan="2">Sub-index 01h</td><td>Name</td><td colspan="4">Index of assigned RPDO</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>5889</td></tr>
<tr><td colspan="11">Defines the index of the object assigned.
Observe the following procedure:
1. Perform conofiguration only when the EtherCAT state machine is in the pre-operational ("P" displayed on the keypad) state.
2. There is no need to set 1C12h in cases where the assigned RPDO is selected through the twinCAT host controller software. In other cases, assign the PDO according to the following procedure.
• Step 1: Write 0 to 1C12-00h.
• Step 2: Write RPDOx (1600/1701...1705) to be used to 1C12-01h.
• Step 3: If an index among 1701...1705 is used as RPDO and the mapped object cannot be modified, go to step 5. If 1600 is used as RPDO, write the value 0 to the sub-index 00h of RPDOx, and write mapped objects to 01h...0Ah. Then, go to step 4.
• Step 4: After the mapped objects in 1600 are written, write the number of mapped objects to 1600-00h.
• Step 5. Write 1 to 1C12-00h.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 1C13h</td><td>Name</td><td colspan="4">Sync Manager 2 TPDO assignment</td><td>Data Structure</td><td>ARR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>OD data range</td><td>Default</td><td>OD default value</td></tr>
<tr><td colspan="11">Defines the index of the object assigned.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 00h</td><td>Name</td><td colspan="4">Number of assigned TPDOs</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>1</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 01h</td><td>Name</td><td colspan="4">Index of assigned TPDO</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>5889</td></tr>
<tr><td colspan="11">Defines the index of the object assigned.
Observe the following procedure:
1. Perform configuration only when the EtherCAT state machine is in the pre-operational ("P" displayed on the keypad) state.
2. There is no need to set 1C12h in cases where the assigned TPDO is selected through the twinCAT host controller software. In other cases, assign the PDO according to the following procedure.
• Step 1: Write 0 to 1C13-00h.
• Step 2: Write the TPDOx (1A00/1B01...1B04) to be used to 1C13-01h.
• Step 3: If an index among 1B01...1B04 is used as TPDO and the mapped object cannot be modified, go to step 5. If 1A00 is used as TPDO, write the value 0 to the sub-index 00h of 1A00, and write mapped objects to 01h...0Ah. Then, go to step 4.
• Step 4: After the mapped objects in 1A00h are written, write the number of mapped objects to 1A00-00h.
• Step 5: Write 1 to 1C13-00h.</td></tr>
</table>

Index 1C32h	Name	Sync Manager 2 output parameters				Data Structure	REC	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the output parameters of Sync Manager 2.										

Sub-index 00h	Name	Number of synchronization parameters				Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	32

Sub-index 01h	Name	Synchronization type				Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	2
"0x0002" indicates the distributed clock synchronization mode 0 (DC Sync mode 0).										

Sub-index 02h	Name	Cycle time (unit: ns)				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	0
Defines the cycle of DC Sync 0.										

Sub-index 04h	Name	Synchronization types supported				Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	4
Defines the type of the distributed clock. "0x0004" indicates the distributed clock synchronization mode 0 (DC Sync mode 0).										

Sub-index 05h	Name	Minimum cycle time				Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	125000
Defines the minimum synchronization cycle (unit: ns) supported by the slave.										

Note

The minimum cycle time supported by SV660N is 125000 ns. The network cannot enter the OP state if the actual cycle time is less than 125000 ns.

Sub-index 06h	Name	Calc and copy time (unit: ns)					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-
Defines the time for the microprocessor to copy data from Sync Manager to local.										

Sub-index 09h	Name	Delay time (unit: ns)					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-

Sub-index 20h	Name	Sync error					Data Structure	-	Data Type	BOOL
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-
Indicates whether the synchronization error occurs. True: Synchronization active and synchronization error not occurred False: Synchronization inactive and synchronization error occurred										

Index 1C33h	Name	Sync Manager 2 input parameters					Data Structure	REC	Data Type	OD data type
	Access	RO	Mapping	No	Related Mode	-	Data Range	OD data range	Default	OD default value
Defines the input parameters of Sync Manager 2.										

Sub-index 00h	Name	Number of synchronization parameters					Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	32

Sub-index 01h	Name	Synchronization type					Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	2
"0x0002" indicates the distributed clock synchronization mode 0 (DC Sync mode 0).										

Sub-index 02h	Name	Cycle time (unit: ns)					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-
Defines the synchronization cycle of DC Sync 0.										

Sub-index 04h	Name	Synchronization types supported					Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	4
Defines the type of the distributed clock. "0x0004" indicates the distributed clock synchronization mode 0 (DC Sync mode 0).										

Sub-index 05h	Name	Minimum cycle time					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	125000
Defines the minimum synchronization cycle (unit: ns) supported by the slave.										

Note

The minimum cycle time supported by SV660N is 125000 ns. The network cannot enter the OP state if the actual cycle time is less than 125000 ns.

Sub-index 06h	Name	Calc and copy time (unit: ns)					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-
Defines the time for the microprocessor to copy data from Sync Manager to local.										

Sub-index 09h	Name	Delay time (unit: ns)					Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-

Sub-index 20h	Name	Sync error					Data Structure	-	Data Type	BOOL
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	-
Indicates whether the synchronization error occurs. True: Synchronization active and synchronization error not occurred False: Synchronization inactive and synchronization error occurred										

7.3 Manufacturer-specific Parameters (Group 2000h)

7.3.1 Group 2000h: Servo Motor Parameters

Index 2000h	Name	Servo motor parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Defines servo motor parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	6

Sub-index 01h	Name	Motor code			Setting Condition & Effective Time	At stop Next power-on	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	14101

Defines the code of the servo motor.
The SV660N series servo drive is intended to be used with a serial-type motor. The motor code is fixed to "14XXX". See 2000-06h for details on serial-type motor models.

Setpoint	Motor code	Remarks
14000	Inovance motor equipped with a 20-bit encoder	-
14101	Inovance motor equipped with a 23-bit absolute encoder	For details on the absolute encoder, See section "Introduction to the Absolute Encoder System" in SV660N Series Servo Drive Function Guide.

Setting the motor code to a wrong value will lead to E120.1 (Unknown motor model).

Sub-index 03h	Name	Customized No.			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to (2^{32} - 1)	Default	0

Displays customized software No. in hexadecimal (XXX.YY).
XXX: Fixed No. for customized software
YY: Upgrade record No. for customized software

Sub-index 05h	Name	Encoder version			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 6553.5	Default	0
Displays the encoder software version in the format of 2XXX.Y, with one decimal place.										

Sub-index 06h	Name	Serial-type motor model			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0
Displays the code of the serial-type motor, which is determined by the motor model and unmodifiable.										

Sub-index 07h	Name	FPGA customized No.			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 655.35	Default	0

Sub-index 08h	Name	STO version			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 655.35	Default	0

Sub-index 09h	Name	Serial encoder type			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

7.3.2 Group 2001h: Servo Drive Parameters

Index 2001h	Name	Servo drive parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Defines parameters of the servo drive.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	32

Sub-index 01h	Name	MCU software version			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0
Displays the MCU software version. The display format is XXXX.Y, with one decimal place.										

Sub-index 02h	Name	FPGA software version			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0
Displays the FPGA software version. The display format is XXXX.Y, with one decimal place.										

<table>
<tr><td rowspan="2">Sub-index 0Bh</td><td>Name</td><td colspan="3">Servo drive model</td><td>Setting Condition & Effective Time</td><td>At stop Next power-on</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
</table>

Defines the servo drive model.

SV660N series servo drive models are listed in the following table.

Setpoint	Servo Drive Model	Remarks
2	S1R6	Rated power of the servo drive: 0.2 kW Power supply of the main circuit: Single-phase 220 V
3	S2R8	Rated power of the servo drive: 0.4 kW Power supply of the main circuit: Single-phase 220 V
5	S5R5	Rated power of the servo drive: 0.75 kW Power supply of the main circuit: Single-phase 220 V
6	S7R6	Rated power of the servo drive: 1.0 kW Power supply of the main circuit: Single-phase/Three-phase 220 V [1]
7	S012	Rated power of the servo drive: 1.5 kW Power supply of the main circuit: Single-phase/Three-phase 220 V [1]
10001	T3R5	Rated power of the servo drive: 1.0 kW Power supply of the main circuit: Three-phase 380 V
10002	T5R4	Rated power of the servo drive: 1.5 kW Power supply of the main circuit: Three-phase 380 V
10003	T8R4	Rated power of the servo drive: 2.0 kW Power supply of the main circuit: Three-phase 380 V
10004	T012	Rated power of the servo drive: 3.0 kW Power supply of the main circuit: Three-phase 380 V
10005	T017	Rated power of the servo drive: 5.0 kW Power supply of the main circuit: Three-phase 380 V
10006	T021	Rated power of the servo drive: 6.0 kW Power supply of the main circuit: Three-phase 380 V
10007	T026	Rated power of the servo drive: 7.5 kW Power supply of the main circuit: Three-phase 380 V

If the voltage input to the main circuit of the servo drive does not comply with the preceding specifications, E420.0 (Main circuit phase loss) occurs.

[1]: The main circuit of the servo drive supports single-phase 220 V power supplies without derating.

<table>
<tr><td rowspan="2">Sub-index 0Ch</td><td>Name</td><td colspan="3">DC-AC voltage class</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>220</td></tr>
</table>

Sub-index 0Dh	Name	Rated power of the servo drive			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1073741824	Default	0.4

Sub-index 0Fh	Name	Max. output power of the servo drive			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1073741824	Default	0.4

Sub-index 11h	Name	Rated output current of the servo drive			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1073741824	Default	2.8

Sub-index 13h	Name	Max. output current of the servo drive			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1073741824	Default	10.1

Sub-index 29h	Name	DC bus overvoltage protection threshold			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 2000	Default	420

7.3.3 Group 2002h: Basic Control Parameters

Index 2002h	Name	Basic control parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Defines basic control parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	36

Sub-index 01h	Name	Control mode			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 9	Default	9

Defines the control mode of the servo drive.
When the servo drive is in the EtherCAT bus control mode, bit 9 of the status word 6041h is set to 1.
For the operation modes of the servo drive, see Chapter "Basic Functions" in SV660N Series Servo Drive Function Guide.

Setpoint	Description
0	Speed control mode
1	Position control mode
2	Torque control mode
9	EtherCAT mode

Sub-index 02h	Name	Absolute encoder system selection			Setting Condition & Effective Time	At stop & Next power-on	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 4	Default	0

Defines the mode of the absolute encoder system.

Setpoint	Absolute encoder system selection	Remarks
0	Incremental position mode	The encoder is used as a serial incremental encoder without power-off memory.
1	Absolute position linear mode	The encoder is used as an absolute encoder with power-off memory. This mode is applicable to applications where the load travel range is fixed and multi-turn data does not overflow.
2	Absolute position rotation mode	The encoder is used as an absolute encoder with power-off memory. This mode applies to applications where the load travel range is not limited and the number of unidirectional revolutions is lower than 32767.
3	Absolute position linear mode (encoder overflow not detected)	Encoder overflow will not be detected in this mode.
4	Absolute position single-turn mode	-

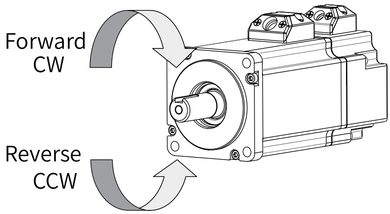
Note

In the absolute position mode, the system automatically detects the motor code to check whether an absolute encoder is used. If not, E122.0 (Multi-turn absolute encoder setting error) will be reported.

For details on the absolute position mode, see section "Introduction to the Absolute Encoder System" in SV660N Series Servo Drive Function Guide.

<table>
<tr><td rowspan="2">Sub-index 03h</td><td>Name</td><td colspan="3">Direction of rotation</td><td>Setting Condition & Effective Time</td><td>At stop & Next power-on</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the forward direction of the motor when viewed from the motor shaft side.</td></tr>
</table>

Setpoint	Direction of rotation	Remarks
0	Counterclockwise (CCW) as forward direction	Defines the CCW direction as the forward direction when a forward run command is received, indicating the motor rotates in the CCW direction when viewed from the motor shaft side.
1	Clockwise (CW) as forward direction	Defines the CW direction as the forward direction when a forward run command is received, indicating the motor rotates in the CW direction when viewed from motor shaft side.



<table>
<tr><td rowspan="2">Sub-index 06h</td><td>Name</td><td colspan="3">Stop mode at S-ON OFF</td><td>Setting Condition & Effective Time</td><td>At stop & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>int16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-3 to +1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.</td></tr>
</table>

Setpoint	Stop Mode
-3	Stop at zero speed, keeping dynamic braking status
-2	Ramp to stop as defined by 6084h/609Ah, keeping dynamic braking status
-1	Dynamic braking stop, keeping dynamic braking status
0	Coast to stop, keeping de-energized status
1	Ramp to stop as defined by 6084h/609Ah, keeping de-energized status

Set a proper stop mode according to the mechanical status and operation requirements.
For comparison of stop modes, see section "Servo OFF" in SV660N Series Servo Drive Commissioning Guide.
After the brake output function is enabled, the stop mode upon S-ON OFF is forcibly set to "Ramp to stop as defined by 6085h, keeping dynamic braking status".

Sub-index 07h	Name	Stop mode at No. 2 fault			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	int16
	Access	RW	Mapping	-	Related Mode	All	Data Range	-5 to +3	Default	2

Defines the deceleration mode of the motor for stopping rotating upon occurrence of a No. 2 fault and the motor status after stop.

Setpoint	Stop Mode
-5	Stop at zero speed, keeping dynamic braking status
-4	Stop at emergency-stop torque, keeping dynamic braking status
-3	Ramp to stop as defined by 6085h, keeping dynamic braking status
-2	Ramp to stop as defined by 6084h/609Ah, keeping dynamic braking status
-1	Dynamic braking stop, keeping dynamic braking status
0	Coast to stop, keeping de-energized status
1	Ramp to stop as defined by 6084h/609Ah, keeping de-energized status
2	Ramp to stop as defined by 6085h, keeping de-energized status
3	Stop at emergency-stop torque, keeping de-energized status

After the brake (BK) output function is enabled, the stop mode at No. 2 fault is forcibly set to "Ramp to stop as defined by 6085h, keeping dynamic braking status".

Sub-index 08h	Name	Stop mode at overtravel			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 7	Default	1

Defines the deceleration mode of the motor for stopping rotating upon overtravel and the motor status after stop.

Setpoint	Stop Mode
0	Coast to stop, keeping de-energized status
1	Stop at zero speed, keeping position lock status
2	Stop at zero speed, keeping de-energized status
3	Ramp to stop as defined by 6085h, keeping de-energized status
4	Ramp to stop as defined by 6085h, keeping position lock status
5	Dynamic braking stop, keeping de-energized status
6	Dynamic braking stop, keeping dynamic braking status
7	Not responding to overtravel

When the servo motor drives a vertical axis, set 2002-08h (H02-07) to 1 or 4 to allow the motor shaft to stay locked upon overtravel.

For comparison of stop modes, see section "Servo OFF" in SV660N Series Servo Drive Commissioning Guide.

After the brake output function is enabled, the stop mode at S-ON OFF is forcibly set to "Ramp to stop as defined by 6085h, keeping position lock status".

Sub-index 09h	Name	Stop mode at No. 1 fault			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 2	Default	2

Defines the deceleration mode of the motor for stopping rotating when a No. 1 fault occurs and the motor status after stop.

Setpoint	Stop Mode
0	Coast to stop, keeping de-energized state
1	Dynamic braking stop, keeping de-energized status
2	Dynamic braking stop, keeping dynamic braking status

For details on No. 1 fault and comparison of stop modes, see Chapter "Troubleshooting" and section "Servo OFF" in SV660N Series Servo Drive Commissioning Guide.
After the brake output function is enabled, the stop mode at No. 1 fault is forcibly set to "Dynamic braking stop, keeping dynamic braking status".

Sub-index 0Ah	Name	Delay from brake output ON to command received			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 500 (ms)	Default	250

Defines the delay from the moment the brake (BK) output signal is ON to the moment the servo drive starts to receive commands after power-on.
Within the time defined by 2002-0Ah (H02–09), the servo drive does not receive position/speed/torque references.
See section "Brake Settings" in SV660N Series Servo Drive Commissioning Guide to check the brake sequence for the motor at standstill.

Sub-index 0Bh	Name	Delay from brake (BK) output OFF to motor de-energized in the stop state			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	50 to 1000 (ms)	Default	150

Defines the delay from the moment brake (BK) output is OFF to the moment when the motor at standstill enters the de-energized status.
See section "Brake Settings" in SV660N Series Servo Drive Commissioning Guide to check the brake sequence for the motor at standstill.

<table>
<tr><td rowspan="2">Sub-index 0Ch</td><td>Name</td><td colspan="3">Motor speed threshold at brake (BK) output OFF in the rotation state</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>20 to 3000 (ms)</td><td>Default</td><td>30</td></tr>
<tr><td colspan="11">Defines the motor speed threshold when brake (BK) output is OFF in the rotation state.
See section "Brake Settings" in SV660N Series Servo Drive Commissioning Guide to check the brake sequence for a rotating motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 0Dh</td><td>Name</td><td colspan="3">Delay from S-ON OFF to brake (BK) output OFF in the rotation state</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Map ping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>1 to 1000 (ms)</td><td>Default</td><td>500</td></tr>
<tr><td colspan="11">Defines the delay from the moment the S-ON signal is OFF to the moment the brake (BK) output is OFF in the rotation state.
See section "Brake Settings" in SV660N Series Servo Drive Commissioning Guide to check the brake sequence for a rotating motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 10h</td><td>Name</td><td colspan="3">Warning display on the keypad</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Map ping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines whether to switch the keypad to the fault display mode when a No. 3 fault occurs.
For details on No.3 warnings, see Chapter "Troubleshooting" in SV660N Series Servo Drive Commissioning Guide.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 11h</td><td>Name</td><td colspan="3">Brake enable switch</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Map ping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>1</td></tr>
</table>

Setpoint	Description
0	Inhibited
1	Enable

<table>
<tr><td rowspan="2">Sub-index 15h</td><td>Name</td><td colspan="3">Dynamic brake relay coil ON delay</td><td>Setting Condition & Effective Time</td><td>During running At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Map ping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>30 to 30000</td><td>Default</td><td>30</td></tr>
</table>

Sub-index 16h	Name	Permissible minimum resistance of regenerative resistor			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	1 to 1000	Default	40
The permissible minimum resistance of the regenerative resistor is only related to the servo drive model.										

Sub-index 17h	Name	Power of built-in regenerative resistor			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0
The power of the built-in regenerative resistor is only related to the servo drive model, which is unmodifiable.										

Sub-index 18h	Name	Resistance of built-in regenerative resistor			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

The resistance of the built-in regenerative resistor is only related to the servo drive model, which is unmodifiable.
The built-in regenerative resistor comes into rescue when the maximum braking energy calculated exceeds the absorption capacity of the capacitor.
When using the built-in regenerative resistor, connect a jumper bar between terminals P⊕ and D.
When the value of 2001-0Bh (Servo drive model) is 2 or 3, the built-in regenerative resistor is not installed in the servo drive.

Servo Drive Model		Specifications of Built-in Regenerative Resistor	
		Resistance (Ω)	Power (W)
Single-phase 220 V	SV660NS1R6I	-	-
	SV660NS2R8I	-	-
	SV660NS5R5I	50	50
Three-phase 220 V	SV660NS7R6I	25	80
	SV660NS012I		
Three-phase 380 V	SV660NT3R5I	100	80
	SV660NT5R4I	100	80
	SV660NT8R4I	50	80
	SV660NT012I		
	SV660NT017I	35	100
	SV660NT021I		
	SV660NT026I		

Sub-index 19h	Name	Resistor heat dissipation coefficient			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	10 to 100 (%)	Default	30

Defines the heat dissipation coefficient of the regenerative resistor, which is applicable to both external and built-in regenerative resistors.
Set the heat dissipation coefficient 2002-19h (H02-24) based on actual cooling conditions of the resistor.
Recommendations:
Set 2002-19h (H02-24) to a value lower than or equal to 30% in case of natural ventilation.
Set 2002-19h (H02-24) to a value lower than or equal to 50% in case of forced-air cooling.

Sub-index 1Ah	Name	Regenerative resistor type			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	3

Defines the regenerative resistor type and the mode of absorbing and releasing the braking energy.
Select the regenerative resistor type based on section "Wiring and Setting of Regenerative Resistor" in SV660N Series Servo Drive Hardware Guide.

Sub-index 1Bh	Name	Power of external regenerative resistor			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	1 to 65535 (W)	Default	40

Defines the power of the external regenerative resistor.
Note: The value of 2002-1Bh (H02-26) cannot be lower than the calculated value.

Sub-index 1Ch	Name	Resistance of external regenerative resistor			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	15 to 1000 (W)	Default	50

Defines the resistance of the external regenerative resistor.
Note: The value of 2002-1Ch (H02-27) cannot be lower than the calculated value.

Sub-index 1Fh	Name	User password			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 20h	Name	System parameter initialization			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 2	Default	0

Used to restore default values or clear fault records.

Setpoint	Description	Remarks
0	No operation	-
1	Restore default setting	Restore parameters to default values except parameters in groups 2000h and 2001h.
2	Clear fault records	Clear the latest 10 faults and warnings.

If necessary, use Inovance software tool to back up parameters except those in groups 2000h and 2001h.

Sub-index 21h	Name	Default keypad display			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 99	Default	50

The keypad can switch to the monitored value display mode (group 200Bh) based on settings. 2002-21h is used to set the offset of the parameter within group 200Bh.
If a parameter not in group 200Bh is set, the keypad does not switch to the monitored value display mode.

Sub-index 24h	Name	Keypad data update frequency			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 20	Default	0

Sub-index 2Ah	Name	Manufacturer password			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

7.3.4 Group 2003h: Input Terminal Parameters

Index 2003h	Name	Terminal input parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value

Used to set terminal input parameters.

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	65

Sub-index 03h	Name	DI1 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 40	Default	14

Defines the function of DI1.

Descriptions for the setpoints are shown in the following table.

Setpoint	DI Function
0	No assignment
1	Servo ON
2	Fault reset
14	Positive limit switch
15	Negative limit switch
31	Home switch
34	Emergency stop
38	Touch probe 1
39	Touch probe 2

Note

1. Set 2003-03h to a value listed in the preceding table. Otherwise, E122.1 will occur.
2. Do not assign the same function to different DIs. Otherwise, E122.1 will occur.
3. If a certain function is assigned to a DI and the logic of this DI is activated, this DI function will remain active even if you cancel the function assignment.
4. DI1...DI4 are normal DIs, requiring the input signal width to be larger than 1 ms.
5. DI5 is a high-speed DI, requiring the input signal width to be larger than 0.25 ms.
6. When the touch probe function is enabled, DI5 and DI4 are assigned with touch probe 1 and touch probe 2 respectively by default.

Sub-index 04h	Name	DI1 logic			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Used to set the level logic of DI1 when the function assigned to DI1 is active.
DI1 to DI4 are normal DIs, requiring the input signal width to be larger than 1 ms. Set active level logic correctly according to the host controller and peripheral circuits. The width of the input signal is shown in the following table for your reference.

Setpoint	DI Logic Upon Active DI Function	Remarks
0	Low level	Low level must remain active for more than 1 ms.
1	High level	High level must remain active for more than 1 ms.

Sub-index 05h	Name	DI2 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 40	Default	15

Sub-index 06h	Name	DI2 logic			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 07h	Name	DI3 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 40	Default	31

Sub-index 08h	Name	DI3 logic			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 09h	Name	DI4 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 40	Default	39

Sub-index 0Ah	Name	DI4 logic			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 0Bh	Name	DI5 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 40	Default	38

Sub-index 0Ch	Name	DI5 logic			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 3Dh	Name	DI1 filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 500 (ms)	Default	0.5

Sub-index 3Eh	Name	DI2 filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 500 (ms)	Default	0.5

Sub-index 3Fh	Name	DI3 filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 500 (ms)	Default	0.5

Sub-index 40h	Name	DI4 filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 500 (ms)	Default	0.5

<table>
<tr><td rowspan="2">Sub-index 41h</td><td>Name</td><td colspan="3">DI5 filter time</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 500 (ms)</td><td>Default</td><td>0.5</td></tr>
</table>

7.3.5 Group 2004h: Output Terminal Parameters

<table>
<tr><td rowspan="2">Index 2004h</td><td>Name</td><td colspan="3">Output terminal parameters</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>ARR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>-</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>OD Data Range</td><td>Default</td><td>OD Default Value</td></tr>
<tr><td colspan="11">Used to set output terminal parameters.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 00h</td><td>Name</td><td colspan="3">Number of entries</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>-</td><td>Default</td><td>6</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 01h</td><td>Name</td><td colspan="3">DO1 function</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 32</td><td>Default</td><td>1</td></tr>
<tr><td colspan="11">Defines the function of DO1.
Descriptions for the setpoints are shown in the following table.</td></tr>
</table>

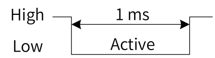
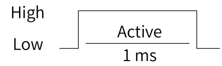
Setpoint	DO Function
0	No assignment
1	Servo ready
2	Motor rotation
9	Brake
10	Warning
11	Fault
25	Comparison output
31	EtherCAT-forced output
32	EDM safety state output

Set 2004-01h to a value listed in the preceding table.
Different DOs can be assigned with the same function.

Sub-index 02h	Name	DO1 logic level			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Defines the level logic of DO1 when the function assigned to DO1 is active.

DO1 to DO3 are normal DOs, requiring the minimum output signal width to be 1 ms. The host controller must be able to receive valid DO logic changes.

Setpoint	DO1 Logic Upon Active DO Function	Transistor Status	Minimum Signal Width
0	Low level	ON	
1	High level	OFF	

Before receiving DO logic changes, view the setpoint of 200D-12h (Forced DI/DO selection) to check whether the DO level is determined by the actual operating status of the servo drive or by forced DO (200D-14h or 60FEh).

Sub-index 03h	Name	DO2 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 32	Default	11

Sub-index 04h	Name	DO2 logic level			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 05h	Name	DO3 function			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 32	Default	9

Sub-index 06h	Name	DO3 logic level			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 18h	Name	EtherCAT-forced DO logic in non-OP status			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 7	Default	1

Descriptions for the setpoints are shown in the following table.

Setpoint	DO Function
0	Status of DO1, DO2, and DO3 unchanged in the non-OP status
1	No output in DO1 and status of others unchanged in the non-OP status
2	No output in DO2 and status of others unchanged in the non-OP status
3	No output in DO1 or DO2 and status of others unchanged in the non-OP status
4	No output in DO3 and status of others unchanged in the non-OP status
5	No output in DO1 or DO3 and status of others unchanged in the non-OP status
6	No output in DO2 or DO3 and status of others unchanged in the non-OP status
7	No output in DO1, DO2, or DO3 in the non-OP status

7.3.6 Group 2005h: Position Control Parameters

Index 2005h	Name	Position control parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value

Used to set position control parameters.

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	55

Sub-index 05h	Name	First-order low-pass filter time constant			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	PP/HM/CSP	Data Range	0 to 6553.5 (ms)	Default	0

Sub-index 06h	Name	Moving average filter time constant 1			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	PP/HM/CSP	Data Range	0 to 1000 (ms)	Default	0

Sub-index 07h	Name	Moving average filter time constant 2			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	PP/HM/CSP	Data Range	0 to 128.0 (ms)	Default	0

Sub-index 08h	Name	Numerator of electronic gear ratio			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	Yes	Related Mode	PP/HM/CSP	Data Range	0 to (2^{32} - 1)	Default	1

Sub-index 0Ah	Name	Denominator of electronic gear ratio			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	Yes	Related Mode	PP/HM/CSP/CSV/PV	Data Range	0 to (2^{32} - 1)	Default	1

Sub-index 14h	Name	Speed feedforward control selection			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	PP/HM/CSP	Data Range	0 to 3	Default	1

Defines the source of the speed loop feedforward signal.
In the position control mode, speed feedforward can be used to improve the position reference response speed.

Setpoint	Speed feedforward source	Remarks
0	No speed feedforward	-
1	Internal speed feedforward	The speed information corresponding to the position reference (encoder unit) is used as the speed loop feedforward source.
2	60B1 used as speed feedforward	60B1h is used as the source of external speed feedforward signal in the CSP mode. The polarity of 60B1h can be set in bit6 of 607Eh.
3	Zero phase control	Zero phase control can be used together with H8-17 (Zero phase delay) to reduce the position follow-up deviation during startup.

Speed feedforward control parameters include 2008-13h (Speed feedforward filter time constant) and 2008-14h (Speed feedforward gain). See section "Feedforward Gain" in SV660N Series Servo Drive Function Guide for details.

Sub-index 15h	Name	Condition for COIN (positioning completed) signal output			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	0

Sub-index 1Fh	Name	Local homing mode			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0, 6	Default	0

Setpoint	Description
0	0: Disable
6	6: Current position as the home

Used to execute local homing when the homing method defined in CiA402 profile cannot be called by the host controller through operating bit4 of the control word.

Note

Use this function in the Servo OFF state only. Failure to comply may result in malfunction of the motor due to sudden change in the position feedback. After homing is done successfully, the present position feedback will be cleared.

Sub-index 24h	Name	Homing time limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	HM	Data Range	0 to 6553.5 (s)	Default	5000.0

Defines the maximum homing time.
If 2005-24h is set to an excessively low value or if the home is not found within the time defined by 2005-24h, E601.0 (Homing timeout) occurs.

Sub-index 25h	Name	Local home offset			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int32
	Access	RW	Mapping	-	Related Mode	HM	Data Range	-1073741824 to +1073741824	Default	0

2005-25h is used together with 2005-1Fh. After homing is done, the present position feedback is the value of 2005-25h.

Sub-index 2Fh	Name	Position offset in absolute position linear mode (low 32 bits)			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Int32
	Access	RW	Mapping	-	Related Mode	All	Data Range	-2^{31} to $(2^{31} - 1)$ (encoder unit)	Default	0

<table>
<tr><td rowspan="2">Sub-index 31h</td><td>Name</td><td colspan="3">Position offset in absolute position linear mode (high 32 bits)</td><td>Setting Condition & Effective Time</td><td>At stop & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-2^{31} to $(2^{31} - 1)$ (encoder unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">These two parameters define the offset of the mechanical absolute position (encoder unit) relative to the motor absolute position (encoder unit) when the absolute encoder system works in the linear mode (2002-02 = 1).
Position offset in the absolute position linear mode = Motor absolute position - Mechanical absolute position</td></tr>
</table>

Note

Default values of 2005-2Fh and 2005-31h are 0 in the absolute position linear mode. After homing is done, the servo drive calculates the difference between the absolute position fed back by the encoder and the mechanical absolute position first. Then, the servo drive assigns the difference to 2005-2Fh and 2005-31h and saves it to EEPROM.

<table>
<tr><td rowspan="2">Sub-index 33h</td><td>Name</td><td colspan="3">Mechanical gear ratio (numerator) in the absolute position rotation mode</td><td>Setting Condition & Effective Time</td><td>At stop & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>1 to 65535</td><td>Default</td><td>1</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 34h</td><td>Name</td><td colspan="3">Mechanical gear ratio (denominator) in absolute position rotation mode</td><td>Setting Condition & Effective Time</td><td>At stop & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>1 to 65535</td><td>Default</td><td>1</td></tr>
<tr><td colspan="11">Defines the ratio of the feedback pulses (encoder unit) per load revolution to the absolute position fed back by the encoder when the absolute encoder system works in the rotation mode (2002-02 = 2).
Assume that the encoder resolution is R_E , the encoder pulses per load revolution is R_M , and 2005-35h and 2005-37h are 0, then the following formula applies: $R_M = R_E$ x 2005-33h/2005-34h</td></tr>
</table>

Note

The servo drive calculates the upper limit of mechanical absolute position based on 2005-35h and 2005-37h first. If 2005-35h and 2005-37h are set to 0, the servo drive turns to calculating the upper limit based on 2005-33h and 2005-34h.

Sub-index 35h	Name	Pulses per load revolution in absolute position rotation mode (low 32 bits)			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to (2^{32} - 1) (encoder unit)	Default	0

Sub-index 37h	Name	Pulses per load revolution in absolute position rotation mode (high 32 bits)			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to (2^{32} - 1) (encoder unit)	Default	0
Defines the feedback pulses (encoder unit) per load revolution when the absolute encoder system works in the rotation mode (2002-02 (H02–01)= 2). Assume the encoder pulses per load revolution is R_M and 2005-35h or 2005-37h is not 0, the following formula applies: P_M = 2005-37h x 2^{32} + 2005-35h										

Note

The servo drive calculates the upper limit of mechanical absolute position based on 2005-35h and 2005-37h first. If 2005-35h and 2005-37h are set to 0, the servo drive turns to calculating the upper limit based on 2005-33h and 2005-34h.

7.3.7 Group 2006h: Speed Control Parameters

Index 2006h	Name	Speed control parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set speed control parameters										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	16

Sub-index 04h	Name	Speed reference			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	-	Related Mode	Local speed mode	Data Range	-6000 to +6000 (RPM)	Default	200
2006-04h is valid in the local speed mode and invalid in the EtherCAT mode.										

Sub-index 06h	Name	Acceleration ramp time of speed reference			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	Local speed mode	Data Range	0 to 65535 (ms)	Default	0
2006-06h is valid in the local speed mode and invalid in the EtherCAT mode.										

Sub-index 07h	Name	Deceleration ramp time of speed reference			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	Local speed mode	Data Range	0 to 65535 (ms)	Default	0
2006-07h is valid in the local speed mode and invalid in the EtherCAT mode.										

Sub-index 09h	Name	Positive speed limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	Local speed mode	Data Range	0 to 6000 (RPM)	Default	6000
2006-09h is valid in the local speed mode and invalid in the EtherCAT mode.										

Sub-index 0Ah	Name	Negative speed limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	Local speed mode	Data Range	0 to 6000 (RPM)	Default	6000
2006-0Ah is valid in the local speed mode and invalid in the EtherCAT mode.										

<table>
<tr><td rowspan="2">Sub-index 0Bh</td><td>Name</td><td colspan="3">Quick declaration coefficient</td><td>Setting Condition & Effective Time</td><td>At stop & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0–2</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">The default value is 0. When 6085h (Quick stop deceleration) is set to the maximum value but the ramp time still exceeds the expected value, enlarge the value of 6085h through 2006-0Bh to reduce the stop time.</td></tr>
</table>

Setpoint	Name
0	x 1
1	x 10
2	x 100

Note

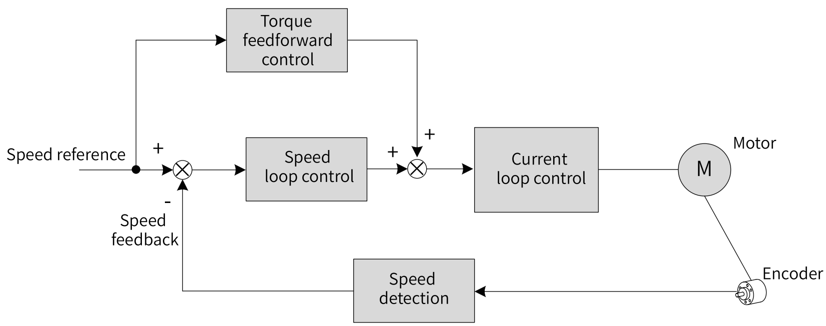
When the brake function is enabled and the stop mode at S-ON OFF is set to "Ramp to stop", the maximum time of ramp-to-stop is Min (H02-12, stop time defined by 6085h).

Sub-index 0Ch	Name	Torque feedforward control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0–2	Default	1

Defines whether to enable internal torque feedforward in the control modes other than torque control.
Torque feedforward can be used to improve the torque reference response speed and reduce the position deviation during acceleration/deceleration at constant speed.

Setpoint	Torque feedforward control	Remarks
0	/	-
1	Internal torque feedforward	The speed reference is used as the torque feedforward signal source, which is further divided into the following two situations: In the position control mode, the speed reference refers to that output from the position controller. In the speed control mode, the speed reference refers to that set by the user.
2	60B2h used as external torque feedforward source	60B2h is used as the external torque feedforward signal source in the CSP and CSV modes. The polarity of the torque feedforward signal can be set in bit5 of 607Eh. Note: When 60B2h is used as the torque feedforward signal, you can adjust 2008-16h (H08-21) and 2008-15h (H08-20) to achieve the desired performance.

Torque feedforward parameters include 2008-16h (Torque feedforward gain) and 2008-15h (Torque feedforward filter time constant). For details, see section "Feedforward Gain" in SV660N Series Servo Drive Function Guide.
The block diagram for torque feedforward control in control modes other than torque control is as follows:



Sub-index 0Dh	Name	Acceleration/ Deceleration ramp time of jog speed			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	-	Data Range	0 to 65535 (ms)	Default	10

Defines the acceleration/deceleration time in the jog mode set through H0D-11 or the software tool.

Sub-index 0Eh	Name	Speed feedforward smoothing filter			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	-	Data Range	0 to 2000 (us)	Default	0
Defines the speed feedforward filter time constant.										

Sub-index 11h	Name	Threshold of TGON (motor rotation) signal			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1000	Default	20

Sub-index 1Dh	Name	Cogging torque compensation selection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	1

7.3.8 Group 2007h: Torque Control Parameters

Index 2007h	Name	Torque control parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set torque control parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	40

Sub-index 04h	Name	Torque reference value set through keypad			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	-	Related Mode	Local torque mode	Data Range	-400.0 to +400.0 (unit: %)	Default	0

Sub-index 06h	Name	Torque reference filter time constant 1			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0.00 to 30.00 (ms)	Default	0.20

Sub-index 07h	Name	Torque reference filter time constant 2			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0.00 to 30.00 (ms)	Default	0.27
Defines the torque reference filter time constant. Low-pass filtering of torque references helps smoothen torque references and reduce vibration. Pay attention to the responsiveness during setting as an excessively high setpoint lowers down the responsiveness.										

Note

The servo drive offers two low-pass filters, in which the low-pass filter 1 is used by default.

Gain switchover can be used in the position or speed control mode. Once certain conditions are satisfied, the servo drive can switch to filter 2. For details on gain switchover, see section "Gain Switchover".

Sub-index 0Ah	Name	Positive internal torque limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	Local torque mode	Data Range	0.0 to 400.0 (%)	Default	350

Sub-index 0Bh	Name	Negative internal torque limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	Local torque mode	Data Range	0.0 to 400.0 (%)	Default	350

Note

2007-0Ah and 2007-0Bh are valid only in the local torque mode (H02-00 = 2). For torque limit in the EtherCAT mode, use 60E0h/60E1h/6072h. Use the torque limit with caution as an excessively low limit value may lead to insufficient motor torque output.

If the setpoint exceeds the maximum torque of the servo drive and motor, the actual torque will be limited to a value within the maximum torque of the servo drive and motor.

<table>
<tr><td rowspan="2">Sub-index 10h</td><td>Name</td><td colspan="3">Emergency-stop torque</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0.0 to 400.0 (%)</td><td>Default</td><td>100</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 14h</td><td>Name</td><td colspan="3">Positive internal speed limit in torque control</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>Local torque mode</td><td>Data Range</td><td>0 to 6000 (RPM)</td><td>Default</td><td>3000</td></tr>
</table>

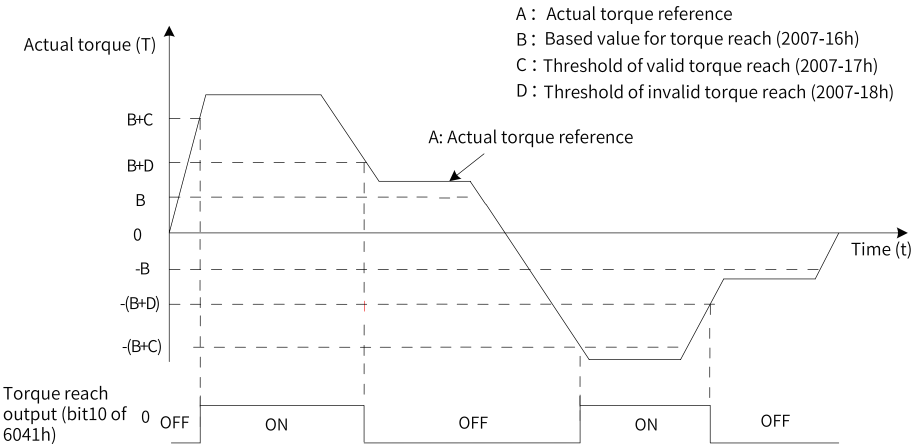
<table>
<tr><td rowspan="2">Sub-index 15h</td><td>Name</td><td colspan="3">Negative internal speed limit in torque control</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>Local torque mode</td><td>Data Range</td><td>0 to 6000 (RPM)</td><td>Default</td><td>3000</td></tr>
<tr><td colspan="11">2007-14h and 2007-15h are valid in the local torque mode only (H02-00 = 2). Use 607F for speed limit in the EtherCAT, CST, and PT modes.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 16h</td><td>Name</td><td colspan="3">Base value for torque reach</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PT</td><td>Data Range</td><td>0.0 to 400.0 (%)</td><td>Default</td><td>0.0</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 17h</td><td>Name</td><td colspan="3">Threshold for valid torque reach</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PT</td><td>Data Range</td><td>0.0 to 400.0 (%)</td><td>Default</td><td>20</td></tr>
</table>

Sub-index 18h	Name	Threshold for invalid torque reach			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PT	Data Range	0.0 to 400.0 (%)	Default	10

The torque reach function is used to judge whether the actual torque reference reaches the range of valid torque reach. If yes, the servo drive outputs the corresponding flag (bit10 of status word) to the host controller.



Actual torque reference (viewed in 200B-03h): A
Base value for torque reach (2007-16h): B
Threshold of valid torque reach (2007-17h): C
Threshold of invalid torque reach (2007-18h): D
C and D are the offset based on B.
The torque reach signal is activated only when the actual torque reference meets the following condition: |A| ⩾ B + C
Otherwise, the torque reach signal remains inactive.
The torque reach signal is deactivated only when the actual torque reference meets the following condition: |A| < B + D

Sub-index 19h	Name	Depth of field-weakening			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	60 to 115 (%)	Default	115

Use the default value in general cases. Reducing the field-weakening depth improves the dynamic performance of the field-weakening area and reduces current ripple, but also leads to load rate rise.

Sub-index 1Ah	Name	Max. permissible demagnetizing current		Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	1 to 200 (unit: %)	Default	100

Use the default value in general cases. Increasing the demagnetizing current extends the motor speed range, but also poses a greater challenge on the bearing capacity of the motor. If you need to increase the setpoint of 2007-1Ah, contact Inovance first.

Sub-index 1Bh	Name	Field-weakening selection		Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

0: Disable; 1: Enable

Sub-index 1Ch	Name	Field-weakening gain		Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.001 to 1.000	Default	0.030

Sub-index 25h	Name	Time constant of low-pass filter 2		Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.00 to 10.00 (ms)	Default	0.00

Sub-index 26h	Name	Torque reference filter selection		Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

0: First-order filter
1: Biquad filter

Sub-index 27h	Name	Biquad filter attenuation ratio		Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 50	Default	16

7.3.9 Group 2008h: Gain Parameters

Index 2008h	Name	Gain parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set gain parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	65

Sub-index 01h	Name	Speed loop gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0.1 to 2000 (Hz)	Default	39
Defines the proportional gain of the speed loop. 2008-01h determines the responsiveness of the speed loop. The higher the setpoint, the higher the responsiveness. Note that an excessively high setpoint may cause vibration. In the position control mode, the position loop gain must be increased together with the speed loop gain.										

Sub-index 02h	Name	Speed loop integral time constant			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0.15 to 512 (ms)	Default	20.51
Defines the integral time constant of the speed loop. The lower the setpoint, the better the integral action, and the quicker will the deviation value be close to 0. Note: There is no integral action when 2008-02h is set to 512.00.										

Sub-index 03h	Name	Position loop gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/HM/CSP	Data Range	0.1 to 2000 (Hz)	Default	55.7
Defines the proportional gain of the position loop. 2008-03h determines the responsiveness of the position loop. A high setpoint shortens the positioning time. Note that an excessively high setpoint may cause vibration. The first gain set include parameters 2008-01h, 2008-02h, 2008-03h, and 2007-07h.										

Sub-index 04h	Name	2nd speed loop gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0.1 to 2000 (Hz)	Default	75

Sub-index 05h	Name	2nd speed loop integral time constant			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0.15 to 512.00 (ms)	Default	10.61

Sub-index 06h	Name	2nd position loop gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/HM/CSP	Data Range	0.1 to 2000.0 (Hz)	Default	120

Defines the second gain of the position loop and speed loop. The second gain set include parameters 2008-04h, 2008-05h, 2008-06h and 2007-07h. For details on gain switchover, see section "Gain Switchover".

Sub-index 09h	Name	2nd gain mode setting			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 1	Default	1

Defines the switchover mode of the 2nd gain set.

Setpoint	Mode
0	0: Fixed to the 1st gain set, P/PI switched by bit26 of 60FE (switched to P when bit26 of 60FE is set to 1)
1	1: Switched between the 1st gain set (2008-01h...2008-03h, 2007-06h) and the 2nd gain set (2008-04h...2008-06h, 2007-07h) as defined by 2008-0Ah

<table>
<tr><td rowspan="2">Sub-index 0Ah</td><td>Name</td><td colspan="3">Gain switchover condition</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PP/PV/HM/ CSP/CSV</td><td>Data Range</td><td>0 to 10</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">See the following table for gain switchover conditions.</td></tr>
</table>

Table 7–7 Conditions for gain switchover

Setpoint	Gain switchover condition	Remarks
0	Fixed to the 1st gain set	The 1st gain set applies.
1	DI	Gains are switched through bit26 of 60FE. bit26 signal inactive: 1st gain set (2008-01h...2008-03h, 2007-06h) bit26 signal active: 2nd gain set (2008-04h...2008-06h, 2007-07h) If the bit26 signal cannot be assigned to DI, the 1st gain set applies.
2	Torque reference too large	If the torque reference absolute value exceeds (Level + Dead time) [%] in the last 1st gain set, the servo drive switches to the 2nd gain set. If the torque reference absolute value is lower than (level – dead time) [%] and such status lasts within the delay defined by 2008- 0Bh (Gain switchover delay) in the last 2nd gain set, the servo drive switches to the 1st gain set.
3	Speed reference too large	If the speed reference absolute value exceeds (Level + Dead time) [RPM] in the last 1st gain set, the servo drive switches to the 2nd gain set. If the speed reference absolute value keeps lower than (Level + Dead time) [RPM] within the delay defined by 2008-0Bh in the last 2nd gain set, the servo drive switches to the 1st gain set.
4	Speed reference too large	Active in the control modes other than speed control If the absolute value of the change rate in the speed reference exceeds (Level + Dead time) [10 RPM/s] in the last 1st gain set, the servo drive switches to the 2nd gain set. If the absolute value of the change rate in the speed reference keeps lower than (Level - Dead time) [10 RPM/s] within the delay defined by 2008-0Bh in the last 2nd gain set, the servo drive switches to the 1st gain set. In the speed control mode, the 1st gain set always applies.
5	Speed reference high-speed/low-speed threshold	If the speed reference absolute value exceeds (Level - Dead time) [RPM] in the last 1st gain set, the servo drive starts switching to the 2nd gain set, with gains changed gradually. When the speed reference absolute value reaches (Level + Dead time) [RPM], the 2nd gain set applies. If the speed reference absolute value is lower than (Level + Dead time) [RPM] in the last 2nd gain set, the servo drive starts reverting to the 1st gain set, with gains changed gradually. When the speed reference absolute value reaches (Level - Dead time) [RPM], the 1st gain set applies.

Setpoint	Gain switchover condition	Remarks
6	Position deviation too large	Active only in the position control mode If the position deviation absolute value exceeds (Level + Dead time) [encoder unit] in the last 1st gain set, the servo drive switches to the 2nd gain set. If the position deviation absolute value keeps lower than (Level - Dead time) [encoder unit] within the delay defined by 2008-0Bh in the last 2nd gain set, the servo drive switches to the 1st gain set. The 1st gain set applies in control modes other than position control.
7	Position reference available	Active only in the position control mode If the position reference is not 0 in the last 1st gain set, the servo drive switches to the 2nd gain set. If the position reference keeps being 0 within the delay defined by 2008-0Bh in the last 2nd gain set, the servo drive switches to the 1st gain set. The 1st gain set applies in control modes other than position control.
8	Positioning completed	Active only in the position control mode If positioning has been completed in the last 1st gain set, the servo drive switches to the 2nd gain set. If positioning has been completed within the delay defined by 2008-0Bh in the last 2nd gain set, the servo drive switches to the 1st gain set. The 1st gain set applies in control modes other than position control.
9	Actual speed too high	Active only in the position control mode If the absolute value of actual speed exceeds (Level + Dead time) [RPM] in the last 1st gain set, the servo drive switches to the 2nd gain set. If the absolute value of actual speed exceeds (Level - Dead time) [RPM] within the delay defined by 2008-0Bh in the last 2nd gain set, the servo drive switches to the 1st gain set. The 1st gain set applies in control modes other than position control.
10	Position reference + Actual speed	Active only in the position control mode If the position reference is not 0 in the last 1st gain set, the servo drive switches to the 2nd gain set. If the position reference keeps being 0 within the delay defined by 2008-0Bh in the last 2nd gain set, the 2nd gain set applies. When the position reference keeps being 0 after the time defined by 2008-0Bh elapses, if the absolute value of actual speed does not reach (Level) [RPM], the servo drive switches to the 1st gain set (except the speed integral time constant which is fixed to 2008-05h (2nd speed loop integral time constant)); if the absolute value of the actual speed is lower than (Level - Dead time) [RPM], the servo drive switches to the 1st gain set without any exception. The 1st gain set applies in control modes other than position control.

<table>
<tr><td rowspan="2">Sub-index 0Bh</td><td>Name</td><td colspan="3">Gain switchover delay</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PP/PV/HM/ CSP/CSV</td><td>Data Range</td><td>0 to 1000 (ms)</td><td>Default</td><td>5</td></tr>
<tr><td colspan="11">Defines the delay when the servo drive switches from the 2nd gain set to the 1st gain set.</td></tr>
</table>

Sub-index 0Ch	Name	Gain switchover level			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 20000	Default	50

Defines the gain switchover level. Gain switchover is affected by both the level and the dead time. For details, see descriptions of 2008-0Ah. The unit of gain switchover level varies with the switchover condition.

Sub-index 0Dh	Name	Gain switchover dead time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 20000	Default	30

Defines the dead time for gain switchover.
Gain switchover is affected by both the level and the dead time. For details, see descriptions of 2008-0Ah. The unit of gain switchover dead time varies with the switchover condition.

Note

Set 2008-0Ch to a value higher than 2008-0Dh. If 2008-0Ch is set to a value lower than 2008-0Dh, the servo drive sets 2008-0Ch to the same value as 2008-0Dh.

Sub-index 0Eh	Name	Position gain switchover time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 1000 (ms)	Default	3

In the position control mode, if 2008-06h (2nd position loop gain) is set to a value far higher than 2008-03h (Position loop gain), set the time for switching from 2008-03h to 2008-06h.
2008-0Eh can be used to reduce the impact caused by an increase in the position loop gain.
2008-06h is invalid if it is set to a value lower than or equal to 2008-03h. In this case, the servo drive switches to the 2nd gain set immediately.

Sub-index 10h	Name	Load moment of inertia ratio			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 120 (multiplier)	Default	3

Defines the mechanical load inertia ratio relative to the motor moment of inertia.
The setpoint 0 indicates the motor is disconnected from the load. The setpoint 1.00 indicates the mechanical load inertia equals the motor moment of inertia.
In inertial auto-tuning (offline and online), the servo drive automatically calculates and updates the value of 2008-10h.
When online inertia auto-tuning (2009-04h ≠ 0) is used, the servo drive sets 2008-10h automatically. To set 2008-10h manually, disable online inertia auto-tuning (2009- 04h = 0).

Note

When the value of 2008-10h is the same as the actual inertia ratio, the value of speed loop gain (2008-01h/2008-04h) indicates the actual maximum follow-up frequency of the speed loop.

<table>
<tr><td rowspan="2">Sub-index 12h</td><td>Name</td><td colspan="3">Zero phase delay</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to 4 (ms)</td><td>Default</td><td>0</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 13h</td><td>Name</td><td colspan="3">Speed feedforward filter time constant</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to 64 (ms)</td><td>Default</td><td>0.5</td></tr>
<tr><td colspan="11">Defines the filter time constant of speed feedforward.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 14h</td><td>Name</td><td colspan="3">Speed feedforward gain</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>0 to 1000 (%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">In the position control mode, speed feedforward is the value of 2008-14h multiplied by the speed feedforward signal, which is part of the speed reference.
Increasing the value of 2008-14h improves the responsiveness of position references and reduces the position deviation during operation at a constant speed.
Set 2008-13h to a fixed value first, and then gradually increase the value of 2008-14h from 0 to a certain setpoint at which speed feedforward achieves the desired effect.
Adjust 2008-13h and 2008-14h repeatedly until a balanced setting is achieved.</td></tr>
</table>

Note

For the speed feedforward function and speed feedforward signal selection, see 2005-14h (Speed feedforward control selection).

Sub-index 15h	Name	Torque feedforward filter time constant			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 64 (ms)	Default	0.5

Defines the filter time constant of torque feedforward.

Sub-index 16h	Name	Torque feedforward gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 300 (%)	Default	0

In the non-torque control mode, torque feedforward is the value of 2008-16h multiplied by the torque feedforward signal, which is part of the torque reference.
Increasing the value of 2008-16h improves the responsiveness to variable speed references.
Increasing the value of 2008-16h improves the responsiveness to position references and reduces the position deviation during operation at a constant speed.
When adjusting torque feedforward parameters, use the default value of 2008-15h first and gradually increase the value of 2008-16h to enhance the torque feedforward effect. When speed overshoot occurs, keep the value of 2008-16h unchanged and increase the value of 2008-20h. Adjust 2008-15h and 2008-16h repeatedly until a balanced setting is achieved.

Note

For the torque feedforward function and torque feedforward signal selection, see 2006-0Ch (Torque feedforward control selection).

Sub-index 17h	Name	Speed feedback filtering option			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Map ping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 4	Default	0

Defines the moving average filtering times for speed feedback.
The higher the setpoint, the weaker the speed feedback fluctuation, but the longer the feedback delay will be.

Note

When 2008-17h is set to a value higher than 0, 2008-18h (Cutoff frequency of speed feedback low-pass filter) is invalid.

Sub-index 18h	Name	Cutoff frequency of speed feedback low-pass filter			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 8000 (Hz)	Default	8000
Defines the cutoff frequency for first-order low-pass filtering on the speed feedback.										

Note

The lower the setpoint, the weaker the speed feedback fluctuation, and the longer the feedback delay will be.

Setting 2008-18h to 8000 negates the filtering effect.

Sub-index 19h	Name	Pseudo derivative feedback and feedforward control coefficient			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 200 (%)	Default	100
Defines the control mode of the speed loop. When 2008-19h is set to 200.0, PI control (default control mode of the speed loop) is applied to the speed loop, which features fast dynamic response. When 2008-19h is set to 0.0, speed loop integral action is enhanced, which filters out low-frequency interferences but also slows down the dynamic response. 2008-19h can be used to keep a good responsiveness of the speed loop, with the anti-interference capacity in low-frequency bands improved and the speed feedback overshoot not increased.										

Sub-index 1Ch	Name	Speed observer cutoff frequency			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	50 to 600 (Hz)	Default	170

Sub-index 1Dh	Name	Speed observer inertia correction coefficient			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	1 to 1600 (%)	Default	100

Sub-index 1Eh	Name	Speed observer filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 10 (ms)	Default	0.8

Sub-index 1Fh	Name	Disturbance compensation time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100 (ms)	Default	0.2

Sub-index 20h	Name	Disturbance cutoff frequency			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uin t16
	Access	RW	Mapping	-	Related Mode	-	Data Range	10 to 4000 (Hz)	Default	600

Sub-index 21h	Name	Disturbance compensation gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uin t16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100 (%)	Default	0

Sub-index 22h	Name	Disturbance observer inertia correction coefficient			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uin t16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1600 (%)	Default	100

Sub-index 26h	Name	Phase modulation for medium-frequency jitter suppression 2			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uin t16
	Access	RW	Mapping	-	Related Mode	-	Data Range	-90 to +90 (%)	Default	0

Sub-index 27h	Name	Frequency of medium-frequency jitter suppression 2			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1000 (Hz)	Default	0

Sub-index 28h	Name	Compensation gain of medium-frequency jitter suppression 2			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 300 (%)	Default	0

Sub-index 29h	Name	Speed observer selection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 2Bh	Name	Model control selection			Setting Condition & Effective Time	During running &At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 2Ch	Name	Model gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.1 to 2000	Default	40

Sub-index 2Fh	Name	Feedforward value			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 102.4	Default	95

Sub-index 36h	Name	Medium- and low-frequency jitter suppression frequency 3			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 300 (Hz)	Default	0

Sub-index 37h	Name	Medium- and low-frequency jitter suppression compensation 3			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 200 (%)	Default	0

Sub-index 39h	Name	Medium- and low-frequency jitter suppression phase modulation 3			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 600 (%)	Default	100

Sub-index 3Ch	Name	Medium- and low-frequency jitter suppression frequency 4			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 300 (Hz)	Default	0

Sub-index 3Dh	Name	Medium- and low-frequency jitter suppression compensation 4			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 200 (%)	Default	0

Sub-index 3Eh	Name	Medium- and low-frequency jitter suppression phase modulation 4			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 600 (%)	Default	100

Sub-index 3Fh	Name	Position loop integral time constant			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.15 to 512	Default	512

Sub-index 40h	Name	2nd position loop integral time constant			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.15 to 512	Default	512

Sub-index 41h	Name	Speed observer feedback source			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 49h	Name	Viscous friction of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100	Default	0

Sub-index 4Ah	Name	Forward coulomb friction of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100	Default	0

Sub-index 4Bh	Name	Reverse coulomb friction of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	-	Related Mode	-	Data Range	-100 to 0	Default	0

Sub-index 4Ch	Name	Friction compensation selection of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 4Dh	Name	Acceleration compensation factor of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 900	Default	0

Sub-index 4Eh	Name	Static friction of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100	Default	0

Sub-index 4Fh	Name	Transition speed between coulomb friction and viscous friction of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100	Default	0

Sub-index 50h	Name	Initial torque shock of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100	Default	0

Sub-index 51h	Name	Friction compensation delay of zero deviation control			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1000	Default	20

7.3.10Group 2009h: Gain Auto-tuning Parameters

Index 2009h	Name	Gain auto-tuning parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set gain auto-tuning parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	60

Sub-index 01h	Name	Gain auto-tuning mode			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 7	Default	4
2009-01h is set to 4 by default.										

Sub-index 02h	Name	Stiffness level in the 1st gain set			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 41	Default	15
Defines the stiffness level of the servo system. The higher the stiffness level, the stronger the gains and the quicker the response will be. But an excessively high stiffness level will cause vibration. The setpoint 0 indicates the weakest stiffness and 41 indicates the strongest stiffness.										

Sub-index 03h	Name	Adaptive notch mode			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 4	Default	3
Defines the working mode of the adaptive notch.										

Sub-index 04h	Name	Online inertia auto-tuning mode			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 3	Default	2
Defines whether to enable online inertia auto-tuning and the inertia ratio update speed during online inertia auto-tuning.										

Sub-index 06h	Name	Offline inertia auto-tuning mode			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 1	Default	1
Defines the offline inertia auto-tuning mode. The offline inertia auto-tuning function can be enabled through 200D-03h. For details on offline inertia auto-tuning, see section "Inertia Auto-tuning" in SV660N Series Servo Drive Function Guide.										

Sub-index 07h	Name	Maximum speed in inertia auto-tuning			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	100 to 1000 (RPM)	Default	500
Defines the maximum permissible speed reference value in offline inertia auto-tuning mode. During inertia auto-tuning, the higher the speed, the more accurate the auto-tuned values. Use the default value of 2009-07h in general cases.										

Sub-index 08h	Name	Time constant for accelerating to the maximum speed during inertia auto-tuning			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	20 to 800 (ms)	Default	125
Defines the time for the motor to accelerate from 0 RPM to the speed defined by 2009-07h during offline inertia auto-tuning.										

Sub-index 09h	Name	Interval after an individual inertia auto-tuning			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	50 to 10000 (ms)	Default	800
Defines the time interval between two consecutive speed references when 2009-06h (Offline inertia auto-tuning mode) is set to 0 (Bidirectional).										

Sub-index 0Ah	Name	Number of motor revolutions per inertia auto-tuning			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	All	Data Range	0 to 100 (r)	Default	1
Defines the number of motor revolutions needed when 2009-06h (Offline inertia auto-tuning mode) is set to 0 (Bidirectional).										

Note

In offline inertia auto-tuning, check whether the travel distance of the motor at the stop position is larger than the setpoint of 2009-0Ah. If not, decrease the setpoint of 2009-07h or 2009-08h until the travel distance at the stop position is larger than the setpoint of 2009-0Ah.

Sub-index 0Ch	Name	Vibration threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0 to 100 (%)	Default	5
Defines the threshold of vibration detected by the notch. When the current feedback exceeds the threshold, the notch starts working.										

Sub-index 0Dh	Name	Frequency of the 1st notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	50 to 8000 (Hz)	Default	8000
Defines the center frequency of the notch, which is the mechanical resonance frequency. In the torque control mode, setting 2009-0Dh to 8000 deactivates the notch function.										

Sub-index 0Eh	Name	Width level of the 1st notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 20	Default	2
Defines the width level of the notch. Use the default value of 2009-0Eh in general cases. Width level is the ratio of the notch width to the notch center frequency.										

Sub-index 0Fh	Name	Depth level of the 1st notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 99	Default	0
Defines the depth level of the notch. The depth level of the notch is the ratio between the input to the output at the notch center frequency. The higher the setpoint, the lower the notch depth and the weaker the mechanical resonance suppression will be. Note that an excessively high setpoint may cause system instability. For use of notches, see section "Vibration Suppression" in SV660N Series Servo Drive Function Guide.										

Sub-index 10h	Name	Frequency of the 2nd notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	50 to 8000 (Hz)	Default	8000

Sub-index 11h	Name	Width level of the 2nd notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 20	Default	2

Sub-index 12h	Name	Depth level of the 2nd notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	0 to 99	Default	0
Descriptions for parameters of the 2nd notch are the same as that of the 1st notch (2009-0Dh, 2009-0Eh, 2009-0Fh).										

Sub-index 13h	Name	Frequency of the 3rd notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	50 to 8000 (Hz)	Default	8000

Sub-index 14h	Name	Width level of the 3rd notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0 to 20	Default	2

Sub-index 15h	Name	Depth level of the 3rd notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0 to 99	Default	0
Descriptions for parameters of the 3rd notch are the same as that of the 1st notch (2009-0Dh, 2009-0Eh, 2009-0Fh).										

Note

The 3rd notch can be configured as an adaptive notch (2009-03h = 1 or 2). In this case, notch parameters are updated automatically and cannot be modified manually. If the notch frequency is 8000 Hz, the notch function is disabled.

Sub-index 16h	Name	Frequency of the 4th notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	50 to 8000 (Hz)	Default	8000

Sub-index 17h	Name	Width level of the 4th notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0 to 20	Default	2

Sub-index 18h	Name	Depth level of the 4th notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0 to 99	Default	0
Descriptions for parameters of the 4th notch are the same as that of the 1st notch (2009-0Dh, 2009-0Eh, 2009-0Fh).										

Note

The 4th notch can be configured as an adaptive notch (2009-03h = 1 or 2). In this case, parameters are updated automatically by the servo drive and cannot be modified manually. If the notch frequency is 8000 Hz, the notch function is disabled.

Sub-index 19h	Name	Auto-tuned resonance frequency			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	PP/PV/HM/CSP/CSV	Data Range	0 to 5000	Default	0
When 2009-03h (Adaptive notch mode) is set to 3, the present mechanical resonance frequency will be displayed.										

Sub-index 1Fh	Name	Tension fluctuation compensation gain			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	-	Related Mode	-	Data Range	-100 to +100	Default	0

Sub-index 20h	Name	Tension fluctuation compensation filter time			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 25	Default	0.5

Sub-index 21h	Name	Gravity compensation value			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100 (%)	Default	0

Sub-index 22h	Name	Positive friction compensation value			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 100 (%)	Default	0

Sub-index 23h	Name	Negative friction compensation value			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	-	Related Mode	-	Data Range	-100 to 0 (%)	Default	0

Sub-index 24h	Name	Friction compensation speed			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 20	Default	2

Sub-index 25h	Name	Friction compensation speed selection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 19	Default	0

Description

Setpoint	Description
0	Slow speed mode + Speed reference
1	Slow speed mode + Model speed
2	Slow-speed mode + Speed feedback
16	High-speed mode + Speed reference
17	High-speed mode + Model speed
18	High-speed mode + Speed feedback

Sub-index 26h	Name	Vibration monitoring time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	1200

Sub-index 27h	Name	Frequency of low-frequency resonance suppression 1 at the mechanical end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	1 to 100 (Hz)	Default	100

Sub-index 28h	Name	Low-frequency resonance suppression 1 at the mechanical end			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	2

Sub-index 2Ah	Name	Frequency of the 5th notch			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	50 to 8000 (Hz)	Default	8000

Sub-index 2Bh	Name	Width level of the 5th notch			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 20	Default	2

Sub-index 2Ch	Name	Depth level of the 5th notch			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 99	Default	0

Sub-index 2Dh	Name	Frequency of low-frequency resonance suppression 2 at mechanical load end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 200	Default	0

Sub-index 2Eh	Name	Responsiveness of low-frequency resonance suppression 2 at mechanical load end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.01 to 10	Default	1

Sub-index 30h	Name	Width of low-frequency resonance suppression 2 at mechanical load end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 2	Default	100

Sub-index 32h	Name	Frequency of low-frequency resonance suppression 3 at mechanical load end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 2000	Default	0

Sub-index 33h	Name	Responsiveness of low-frequency resonance suppression 3 at mechanical load end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0.01 to 10	Default	1

Sub-index 35h	Name	Width of low-frequency resonance suppression 3 at mechanical load end			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 2	Default	100

Sub-index 39h	Name	STune mode setting			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 4	Default	4

Sub-index 3Ah	Name	STune resonance suppression switchover frequency			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 4000	Default	900

Sub-index 3Bh	Name	STune resonance suppression reset selection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

7.3.11Group 200Ah: Fault and Protection Parameters

Index 200Ah	Name	Fault and protection parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set the fault and protection parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	60

Sub-index 01h	Name	Power input phase loss protection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	0
SV660N series servo drives support single-phase/three-phase 220 V and three-phase 380 V power supplies. When voltage fluctuation or phase loss occurs on the power supply, power input phase loss protection will be triggered by the servo drive based on the setting of 200A-01h.										

Note

200A-01h = 0: The servo drive reports E420.0 (Phase loss fault) when H01-10 (Servo drive model) is set to 60005 (850 W).

200A-01h = 1: The servo drive does not report E420.0 (Phase loss fault). When H01-10 (Servo drive model) is set to 60005 (850 W), derate 80%.

Three-phase 220 V servo drives (S7R6, S012) need no derating in case of single-phase power input. Three-phase 380 V servo drives enter the NRD status in case of a phase loss fault. In this case, you cannot operate the servo drive by hiding the phase loss fault.

Sub-index 02h	Name	Absolute position limit			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 2	Default	0
Defines whether the absolute position limit is active and the condition for activating the position limit. After the absolute position limit is enabled, when the target position reference exceeds the position limit in the position control mode, the servo drive takes the position limit as the target and stops after reaching the limit; when the absolute position feedback reaches the position limit in other control modes, the servo drive reports an overtravel warning and stops in the mode defined by 2002-08h (Stop mode at overtravel).										

Sub-index 05h	Name	Motor overload protection gain			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	50 to 300 (%)	Default	100

Defines the motor overload duration before E620.0 (Motor overload) is reported.
You can change the setpoint of 200A-05h based on motor temperature to reduce or prolong the time to trigger overload protection. The setpoint 50% indicates the trigger time is reduced by 50%. The setpoint 150% indicates the trigger time is prolonged by 50%.
Set 200A-05h based on the actual temperature of the motor.

Sub-index 09h	Name	Overspeed threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 20000 (RPM)	Default	0

Defines the overspeed threshold of the motor.

Sub-index 0Bh	Name	Threshold of excessive local position deviation			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to (2^{32} - 1)	Default	25185824

Defines the threshold for reporting EB00.0 (Position deviation too large). The function of 200A-0Bh is the same as 6065h (Following error window), both of which are active.

Sub-index 0Dh	Name	Runaway protection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 1	Default	1

Used to enable runaway protection.

Sub-index 13h	Name	IGBT over-temperature threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	120 to 175 (°C)	Default	135

Defines the over-temperature protection threshold of the power module.

Sub-index 14h	Name	Filter time constant of touch probe 1			Setting Condition & Effective Time	During running & Next power-on	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 6.3 (us)	Default	2

Sub-index 15h	Name	Filter time constant of touch probe 2			Setting Condition & Effective Time	During running & Next power-on	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 6.3 (us)	Default	2

Touch probe 1 and touch probe 2 are high-speed DIs. When external input signals suffer from spike interference, set 200A-14h or 200A-15h to filter the out spike interference.

Note: The oscilloscope in the software tool displays the unfiltered signals of touch probe 1 and touch probe 2. Signals with width lower than 0.25 ms will not be displayed.

Sub-index 16h	Name	STO function display			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Defines whether to display the STO status or report E150.0 after the STO function is triggered.

0: Displays the STO status. The keypad displays "sto_" after the STO function is triggered. In this case, no fault is reported and no output is generated from the fault DO.

1: Displays the STO fault. The keypad displays "E150.0" after the STO function is triggered. In this case, the servo drive reports E150.0 and the fault DO generates output.

Sub-index 18h	Name	TZ signal filter time			Setting Condition & Effective Time	At stop & Next power-on	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 31 (unit: 25 ns)	Default	15

Sub-index 1Ah	Name	Filter time constant of speed feedback display value			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uin t16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 5000 (ms)	Default	50

Defines the filter time constant of the speed feedback display value to smoothen the speed feedback.

200Ah-1Ah applies to the monitoring parameter 200B-01h (Motor speed actual value) and the speed display value monitored through the software tool.

<table>
<tr><td rowspan="2">Sub-index 1Bh</td><td>Name</td><td colspan="3">Motor overload detection</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines whether to enable motor overload detection.</td></tr>
</table>

Caution

Take caution when hiding the motor overload fault as such operation may damage the motor.

<table>
<tr><td rowspan="2">Sub-index 1Ch</td><td>Name</td><td colspan="3">Motor rotation DO speed filter time</td><td>Setting Condition & Effective Time</td><td>At stop & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 5000 (ms)</td><td>Default</td><td>50</td></tr>
<tr><td colspan="11">Defines the low-pass filter time constant of speed feedback signals.
200A-1Ch is active only when the speed feedback signals are used to judge the speed-related DO signals.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 21h</td><td>Name</td><td colspan="3">Over-temperature protection time window for stalled motor</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>-</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535 (ms)</td><td>Default</td><td>200</td></tr>
<tr><td colspan="11">Defines the over-temperature duration before E630.0 (Motor stalled) is detected by the servo drive.
You can adjust the sensitivity for detecting E630.0 by changing the setpoint of 200A-21h.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 22h</td><td>Name</td><td colspan="3">Over-temperature protection for stalled motor</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>1</td></tr>
<tr><td colspan="11">Defines whether to enable the over-temperature protection detection on E630.0 (Motor stalled).</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 25h</td><td>Name</td><td colspan="3">Absolute encoder multi-turn overflow fault selection</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 1</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">200A-25h sets whether to hide the detection on E735.0 (Encoder multi-turn counting overflow) in the absolute position linear mode.</td></tr>
</table>

Sub-index 29h	Name	Overtravel compensation selection			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 1	Default	0
0: Enabled, used to handle the position reference loss caused by disturbed position limit signals in CSP mode										

Sub-index 32h	Name	Regenerative transistor over-temperature threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	100 to 175 (°C)	Default	115

Sub-index 33h	Name	Encoder communication error tolerance threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 31	Default	3

Sub-index 34h	Name	Phase loss detection filter times			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	3 to 36	Default	20

Sub-index 35h	Name	Encoder temperature protection threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 175	Default	0
0: Disable										

Sub-index 38h	Name	Runaway current threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	100 to 400 (%)	Default	200

Sub-index 39h	Name	Reset delay			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 60000 (ms)	Default	10000
Faults E620.0, E630.0, E640.0, E640.1, and E650.0 can be reset only after the time defined by 200A-39h elapses.										

Sub-index 3Ah	Name	Runaway speed threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	1 to 1000 (RPM)	Default	50

Sub-index 3Bh	Name	Runaway speed filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0.1 to 100.0 (ms)	Default	2

Sub-index 3Ch	Name	Runaway protection detection time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	10 to 1000 (ms)	Default	30

Sub-index 47h	Name	Overspeed threshold			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 20000	Default	0

Sub-index 48h	Name	MS1 motor overload curve switchover			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 3	Default	0

Sub-index 49h	Name	Maximum time of ramp-to-stop			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 65535 (ms)	Default	10000
Defines the maximum time taken by the motor in decelerating from 6000 RPM to 0 RPM when the stop mode is set to "Ramp to stop as defined by 6084h/609Ah (HM)" or "Ramp to stop as defined by 6085h".										

Sub-index 4Ah	Name	STO 24 V disconnection filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 5 (ms)	Default	5
Defines the filter time from the moment when STO1 and STO2 are disconnected from the 24 V power supply to the moment when the STO status is displayed or E150.0 is reported.										

Sub-index 4Bh	Name	STO fault tolerance filter time			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 10 (ms)	Default	10
Defines the filter time from the moment when STO1 and STO2 are input with different voltages to the moment when E150.1 is reported.										

Sub-index 4Ch	Name	Servo OFF delay after STO triggered			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	Yes	Related Mode	All	Data Range	0 to 25 (ms)	Default	20
Defines filter time from the moment when the STO status is displayed or E150.0/E150.1 is reported to the moment when the S-ON signal is switched off.										

7.3.12Group 200Bh: Monitoring Parameters

Index 200Bh	Name	Monitoring parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	Yes	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set monitoring parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	65

Sub-index 01h	Name	Motor speed actual value			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-32767 to +32767 (RPM)	Default	0

Indicates the actual motor speed after round-off, which is accurate to 1 RPM.
You can set the filter time constant for 200B-01h in 200A-1Ah (Filter time constant of speed feedback display value).

Sub-index 02h	Name	Speed reference			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	PP/PV/HM/ CSP/CSV	Data Range	-32767 to +32767 (RPM)	Default	0

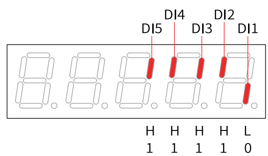
Indicates the present speed reference (accurate to 1 RPM) of the servo drive in the position and speed control modes.

Sub-index 03h	Name	Internal torque reference			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-500 to +500 (%)	Default	0

Indicates present torque reference which is accurate to 0.1%. The value 100.0% corresponds to the rated torque of the motor.

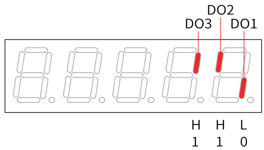
Sub-index 04h	Name	Monitored DI status			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Indicates the level status of DI1 to DI5 without filtering.
Upper LED segments ON: high level (indicated by "1")
Lower LED segments ON: low level (indicated by "0")
In cases where DI1 is low level and DI2 to DI5 are high level, the corresponding binary value is 11110, the value of 200B-04h read in the software tool is 30, and the corresponding keypad display is as follows.



Sub-index 06h	Name	Monitored DO status			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Indicates the level status of DO1 to DO3 without filtering.
Upper LED segments ON: high level (indicated by "1")
Lower LED segments ON: low level (indicated by "0")
In cases where DO1 is low level and DO2 to DO3 are high level, the corresponding binary value is "110", the value of 200B-06h read in the software tool is 6, and the corresponding keypad display is as follows.



Sub-index 08h	Name	Absolute position counter			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-2^{31} to 2^{31} - 1 (reference unit)	Default	0

Indicates present absolute position (reference unit) of the motor in the position control mode.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

Sub-index 0Ah	Name	Mechanical angle			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 360 (°)	Default	0

Indicates present mechanical angle (encoder unit) of the motor. The value 0 indicates that the mechanical angle is 0°.

Sub-index 0Bh	Name	Electrical angle			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 360 (°)	Default	0

Indicates the present electrical angle of the motor, which is accurate to 0.1°.
The electrical angle variation range is ±360.0° when the motor rotates. If the motor has four pairs of poles, each revolution generates four rounds of angle changes from 0° to 359.9°.
Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle changes from 0° to 359.9°.

<table>
<tr><td rowspan="2">Sub-index 0Dh</td><td>Name</td><td colspan="3">Average load rate</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 800 (%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the percentage of the average load torque to the rated torque of the motor, which is accurate to 0.1%. The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 10h</td><td>Name</td><td colspan="3">Position following deviation (encoder unit)</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>PP/ HM/ CSP</td><td>Data Range</td><td>-2^{31} to 2^{31} - 1 (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Counts the position pulses fed back by the encoder in any control mode.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.</td></tr>
</table>

Note

When the motor is equipped with an absolute encoder, 200B-12 displays only the low 32 bits of the motor position feedback. The actual motor position feedback can be obtained in 200B-4E (Absolute position (low 32 bits) of absolute encoder) and 200B-50 (Absolute position (high 32 bits) of absolute encoder).

<table>
<tr><td rowspan="2">Sub-index 12h</td><td>Name</td><td colspan="3">Feedback pulse counter</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>ARR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>-2^{31} to +(2^{31} - 1) (p)</td><td>Default</td><td>0</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 14h</td><td>Name</td><td colspan="3">Total power-on time</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>- (s)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the total operating time of the servo drive.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.</td></tr>
</table>

Note

If the servo drive is switched on and off continuously within a short period of time, a deviation within 1 h may be present in the total power-on record.

Sub-index 19h	Name	RMS value of phase current			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 6553.5 (A)	Default	-
Indicates the RMS value of the phase current of the servo motor, which is accurate to 0.1 A.										

Sub-index 1Bh	Name	Bus voltage			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 6553.5 (V)	Default	-
Indicates the DC bus voltage of the main circuit after rectification, which is accurate to 0.1 V.										

Sub-index 1Ch	Name	Module temperature			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-20 to +200 (°C)	Default	-
Indicates the temperature of the module inside the servo drive, which can be used as a reference for estimating the actual temperature of the servo drive.										

Sub-index 1Dh	Name	Absolute encoder fault information given by FPGA			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 1Eh	Name	Axis status information given by FPGA			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 1Fh	Name	Axis fault information given by FPGA			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 20h	Name	Encoder fault information			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 22h	Name	Fault log			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 9	Default	-
Used to view any one of the latest 10 faults that occurred on the servo drive.										

Sub-index 23h	Name	Fault code of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-	Default	-

Sub-index 24h	Name	Time stamp of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	(s)	Default	-

Sub-index 26h	Name	Motor speed upon occurrence of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	(RPM)	Default	-

Sub-index 27h	Name	Motor phase-U current upon occurrence of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	(A)	Default	-

Sub-index 28h	Name	Motor phase-V current upon occurrence of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	(A)	Default	-

Sub-index 29h	Name	Bus voltage upon occurrence of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	(V)	Default	-

Sub-index 2Ah	Name	DI status upon occurrence of the selected fault		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	(V)	Default	-

Sub-index 2Ch	Name	DO status upon occurrence of the selected fault		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-	Default	-
200B-23h...200B-2Bh display corresponding parameter values when the fault displayed in 200B-23h occurs.										

Sub-index 2Eh	Name	Internal fault code		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 2Fh	Name	Absolute encoder fault information given by FPGA upon occurrence of the selected fault		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 30h	Name	System status information given by FPGA upon occurrence of the selected fault		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 31h	Name	System fault information given by FPGA upon occurrence of the selected fault		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 32h	Name	Encoder fault information upon occurrence of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 34h	Name	Internal fault code upon occurrence of the selected fault			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 36h	Name	Position deviation counter			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	PP/HM/CSP	Data Range	-2^{31} to $(2^{31}-1)$ (reference unit)	Default	0

Indicates the position deviation value which has not been divided or multiplied by the electronic gear ratio in the position control mode.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
Note: Position deviation (reference unit) refers to the value converted with encoder position deviation, so the precision may be compromised.

Sub-index 38h	Name	Motor speed actual value			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-6000 to +6000 (RPM)	Default	0

Indicates the actual value of the motor speed, which is accurate to 0.1 RPM.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
You can set the filter time constant for speed feedback in 200A-1Ah.

Sub-index 3Ah	Name	Bus voltage of the control circuit			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to 6553.5	Default	0

Indicates the DC bus voltage of the control circuit after rectification.

Sub-index 3Bh	Name	Mechanical absolute position (low 32 bits)			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 2^{32} (reference unit)	Default	0

Indicates the low 32-bit value (encoder unit) of the mechanical position feedback when an absolute encoder is used.

<table>
<tr><td rowspan="2">Sub-index 3Dh</td><td>Name</td><td colspan="3">Mechanical absolute position (high 32 bits)</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-2^{31} to $(2^{31} - 1)$ (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the high 32-bit value (encoder unit) of the mechanical position feedback when an absolute encoder is used.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 40h</td><td>Name</td><td colspan="3">Notrdy (Not ready) state</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 5</td><td>Default</td><td>0</td></tr>
</table>

Display Value	Meaning
0	None
1	Control circuit power supply error (H0B-57)
2	Phase loss detection error
3	Main circuit power supply error (including short-circuited-to-ground error)
4	Other servo drive faults
5	Short-circuited-to-ground detection not done

<table>
<tr><td rowspan="2">Sub-index 43h</td><td>Name</td><td colspan="3">Encoder temperature</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-100 to +200</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the encoder temperature value.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 44h</td><td>Name</td><td colspan="3">Brake load rate</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 200 (%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the brake load rate. When the load rate exceeds 100%, the servo drive stops braking.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 47h</td><td>Name</td><td colspan="3">Number of revolutions of the absolute encoder</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 65535</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the number of revolutions of the absolute encoder.</td></tr>
</table>

Sub-index 48h	Name	Single-turn position feedback of absolute encoder			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to (2^{31} - 1) (encoder unit)	Default	0
Indicates the single-turn position feedback of the encoder.										

Sub-index 4Eh	Name	Absolute position (low 32 bits) feedback of the absolute encoder			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (encoder unit)	Default	0
Indicates the low 32-bit value of the position feedback of the absolute encoder.										

Sub-index 50h	Name	Absolute position (high 32 bits) feedback of the absolute encoder			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (encoder unit)	Default	0
Indicates the high 32-bit value of the position feedback of the absolute encoder.										

Sub-index 52h	Name	Single-turn position (low 32 bits) of the rotating load			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to (2^{32} - 1) (encoder unit)	Default	0
Indicates the low 32-bit value (encoder unit) of the position feedback of the load when the absolute encoder system works in the rotation mode (2002-02h = 2).										

Sub-index 54h	Name	Single-turn position (high 32 bits) of the rotating load			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-2^{31} to (2^{31} - 1) (encoder unit)	Default	0
Indicates the high 32-bit value (encoder unit) of the position feedback of the load when the absolute encoder system works in the rotation mode (2002-02h = 2).										

Sub-index 56h	Name	Single-turn position of the rotating load			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-2 to (2^{31} - 1) (reference unit)	Default	0
Indicates the position feedback of the load when the absolute encoder system works in the rotation mode (2002-02h = 2).										

Sub-index 5Bh	Name	Group number of the abnormal parameter			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 65535	Default	0
Indicates the group number of the abnormal parameter when E101 occurs.										

Sub-index 5Ch	Name	Offset of abnormal parameter within the group			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 65535	Default	0
Indicates the offset of the abnormal parameter within the parameter group when E101 occurs.										

7.3.13Group 200Dh: Auxiliary Function Parameters

Index 200Dh	Name	Auxiliary functions			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	-	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value
Used to set monitoring parameters.										

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	21

Sub-index 01h	Name	Software reset			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Defines whether to enable software reset.

Setpoint	Description	Remarks
0	No operation	-
1	Enable	Programs in the servo drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.

Software reset is available in the following conditions:
The servo drive is in the S-OFF state.
No. 1 non-resettable faults do not occur.
No operation is performed on EEPROM (the software reset function is invalid when 200A-04h is set to 1).

Sub-index 02h	Name	Fault reset			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Defines whether to enable fault reset.

Setpoint	Description	Remarks
0	No operation	-
1	Enable	When a No. 1 or No. 2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause, stopping the keypad from displaying the fault. When a No. 3 warning occurs, you can enable the fault reset function directly, regardless of the servo drive status.

For fault classification, see Chapter "Troubleshooting".
The fault reset function, once enabled, stops the keypad from displaying the fault only. It does not activate modifications made on parameters.
This function is not applicable to non-resettable faults. Use this function with caution in cases where the fault causes are not rectified.

Sub-index 03h	Name	Offline inertia auto-tuning			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Used to enable offline inertia auto-tuning through the keypad.
In the parameter display mode, switch to "200D-03h", and press the SET key to enable offline inertia auto-tuning. For details, see section "Inertia Auto-tuning".

Sub-index 04h	Name	Encoder initial angle auto-tuning			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Setpoint	Description
0	No operation
1	Enable

Sub-index 05h	Name	Read/write in encoder ROM			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 2	Default	0

Setpoint	Description
0	No operation
1	Write ROM
2	Read ROM

Sub-index 06h	Name	Emergency stop			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Defines whether to enable emergency stop.

Setpoint	Description
0	No operation
1	Enable

When emergency stop is enabled, the servo drive stops immediately in the stop mode defined by 605Ch regardless of the operating status.

Sub-index 0Ch	Name	Jog function			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	-	Default	-

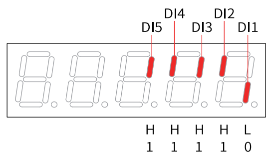
Used to enable the jog function through the keypad.
The jog function can be set through the keypad. For details, see Section "Jogging" in SV660N Series Servo Drive Commissioning Guide.
This function is not related to the control mode of the servo drive.

Sub-index 12h	Name	Forced DI/DO selection			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	0

Defines whether to enable forced DI/DO.

Sub-index 13h	Name	Forced DI setting			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 31	Default	31

Used to set the level logic of the DI functions assigned in group 2003h when forced DI function is enabled (200D-12h = 1 or 3).
The value of 200D-13h is displayed as a hexadecimal on the keypad, when it is converted to a binary value, bit(n) = 1 indicates the DI function logic is high level; bit(n) = 0 indicates the DI function logic is low level.
Example:
The value of 200D-13h is 0x1E, which corresponds to the binary value "11110", indicating DI1 is low level, and DI2 to DI5 are high level. You can also monitor the status of DI1 to DI5 through 200B-04h.



Whether the DI function is active depends not only on 200D-13h but also on the DI logic set in group 2003h.

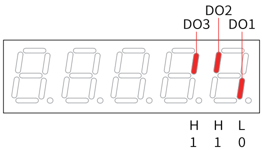
Sub-index 14h	Name	Forced DO setting			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 7	Default	0

Defines whether the DO functions assigned in group 2004h are active when the forced DO function is enabled (200D-12h = 2 or 3).

The value of 200D-14h is displayed as a hexadecimal on the keypad. When it is converted to a binary value, bit(n) = 1 indicates the DO function is active; bit(n) = 0 indicates the DO function is inactive.

Example:

The value of 200D-14h is 6, which corresponds to the binary value "110", indicating the function assigned to DO1 is active, and functions assigned to DO2 and DO3 are inactive. Assume DO1...DO3 in group 2004h are "active low", then 200B-06h is displayed as follows:



Sub-index 15h	Name	Absolute encoder reset			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	All	Data Range	0 to 2	Default	0

Defines whether to reset the encoder fault or the multi-turn data of the encoder.

Setpoint	Description
0	No operation
1	Reset encoder fault
2	Reset encoder fault and multi-turn data

Note

The absolute position of the encoder changes abruptly after multi-turn data reset. In this case, perform mechanical homing.

7.3.14Group 200Eh: Communication Function Parameters

Index 200Eh	Name	Communication parameters			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	-	Mapping	-	Related Mode	-	Data Range	OD Data Range	Default	OD Default Value

Defines servo motor parameters.

Sub-index 00h	Name	Number of entries			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	97

Sub-index 01h	Name	Node address			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	1 to 127	Default	1
Defines the servo drive axis address during RS232 communication. 0: Broadcast address. The host controller performs the write operation on all the servo drives through the broadcast address. The servo drives acts accordingly after receiving the broadcast address frames, without responding. 1 to 127: Each of the servo drive networked must have a unique address. Otherwise, communication error or failure will occur.										

Sub-index 02h	Name	Update parameter values written through communication to EEPROM			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	3
Defines whether to save parameters written through RS232 and EtherCAT (writing with SDO only) communication to EEPROM.										

Note

The value of 200E-02h will always be updated and saved to EEPROM.

If the parameters modified need not be saved after power off, set 200E-02h to 0. This is to prevent EEPROM from being damaged by frequent parameter saving, leading to E108.0 (Parameter write error).

Sub-index 15h	Name	EtherCAT slave name			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	0 to 65535	Default	-
Indicates the station number assigned to the slave by the master during EtherCAT communication.										

Sub-index 16h	Name	EtherCAT slave alias			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	No	Related Mode	-	Data Range	0 to 65535	Default	-

For masters that fail to assign the station numbers, set the slave station numbers through 200Eh-16h during EtherCAT communication.
200E-16h = 0: The master assigns the station numbers by default.
200E-16h ≠ 0: The set station number applies by default, with the one assigned by master deactivated.

Sub-index 17h	Name	Sync loss window			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	1 to 20	Default	8

Defines the maximum number of master signal loss events allowed by the slave. The slave reports EE08.2 (IRQ loss) if the value of 200E-17h is exceeded.

Sub-index 18h	Name	EtherCAT station alias from EEPROM			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 19h	Name	Sync loss counter			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 1Ah	Name	Port 0 invalid frame counter			Setting Condition & Effective Time	At display	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

Indicates CRC error of Port0. If there is a counting value, the frames received by Port0 are damaged. The possible cause may lie in the cable or PHY port, including 0x301 RX-ER. Normally, 0x300 = 0x301, if 0x300 > 0x301, CRC errors occur in the network.

Sub-index 1Bh	Name	Port 1 invalid frame counter			Setting Condition & Effective Time	At display	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

Indicates CRC error of Port1. If there is a counting value, the frames received by Port0 are damaged. The possible cause may lie in the cable or PHY port, including 0x301 RX-ER. Normally, 0x300 = 0x301, if 0x300 > 0x301, CRC errors occur in the network.

Sub-index 1Ch	Name	Port 0/1 transfer error counter			Setting Condition & Effective Time	At display	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

If the received data is wrong and ended with an extra error flag, it indicates the data has already been processed by other stations.

Sub-index 1Dh	Name	Process unit and PDI error counter			Setting Condition & Effective Time	At display	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

If data exchange error occurs between ESC and internal MCU, keep the setpoint to 0. If the counting value increases, the internal anti-disturbance performance of the board is abnormal.

Sub-index 1Eh	Name	Port 0/1 loss counter			Setting Condition & Effective Time	At display	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

If data link loss is detected by the ESC port, the counting value of the corresponding link loss counter increases. This may be caused by poor contact or broken cables.

Sub-index 20h	Name	Sync mode setting			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 2	Default	1

Defines the synchronization mode.

Setpoint	Operation mode	Description
0	Manufacturer function	Manufacturer function
1	Synchronization mode 1	Applicable to host controllers with a jitter of 1 us during synchronization.
2	Synchronization mode 2	Applicable to host controllers with a jitter above 1 us during synchronization.

Note

In synchronization mode, the synchronization cycle must be an integer multiple of 125 us. Otherwise, the servo drive reports EE13.0 (Synchronization cycle setting error).

Sub-index 21h	Name	Sync error window			Setting Condition & Effective Time	At stop & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	100 to 4000 (ns)	Default	3000
Defines the permissible jitter range of synchronization signals when the servo drive works in synchronization mode 1 (200E-20h = 1).										

Note

In synchronization mode 1 (200E-20h = 1), if the jitter range of synchronization signals exceeds the value of 200E-21h after ESM enters the OP state, the servo drive reports EE15.0 (Synchronization cycle error too large).

Sub-index 22h	Name	EtherCAT network state and link state			Setting Condition & Effective Time	At display	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0
Indicates the connection status of the state machine and EtherCAT network ports.										

Sub-index 23h	Name	CSP excessive position increment counter			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0
Defines the counting value when the position reference increment exceeds the maximum position reference increment threshold. When the counting value exceeds the threshold, EB01.0 or EB01.1 occurs.										

Sub-index 24h	Name	AL fault code			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 65535	Default	0

Sub-index 25h	Name	Enhanced link detection enable			Setting Condition & Effective Time	During running & Next power-on	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1	Default	0

Sub-index 26h	Name	EtherCAT XML reset selection			Setting Condition & Effective Time	During running & Next power-on	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 1	De fault	0

Sub-index 51h	Name	Serial port baud rate			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 10	Default	9

Defines the communication rate between the servo drive and the host controller.

Setpoint	Baud rate (bps)
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600
9	115200
10	230400

The baud rate set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.

Sub-index 52h	Name	Modbus data format			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 3	Default	3

Defines the data check mode between the servo drive and the host controller during communication.
The data format set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.

Sub-index 53h	Name	Modbus response delay			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 20	Default	0

Sub-index 54h	Name	Modbus communication timeout			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 600	Default	0

Sub-index 5Bh	Name	Modbus version			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 655.35	Default	0

Sub-index 5Eh	Name	EtherCAT COE version			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	-	Related Mode	-	Data Range	0 to 655.35	Default	0

Sub-index 61h	Name	XML file version			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint16
	Access	RW	Mapping	-	Related Mode	-	Data Range	0 to 655.35	Default	0

7.3.15Group 203Fh: Manufacturer Fault Codes

Index 203Fh	Name	Manufacturer fault code			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	0 to (2^{32} - 1)	Default	-
Indicates the fault code of the highest level. The value of 203Fh is a hexadecimal, in which the high 16 bits indicate the manufacturer internal fault code, and the low 16 bits indicate the manufacturer external fault code.										

7.4 Parameters Defined by the Device Profile (Group 6000h)

Index 603Fh	Name	Error code			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 65535	Default	-
When an error described in CiA402 profile occurs on the drive, 603Fh is the same as that described in CiA402. For details, see *"6.2 List of Fault and Warning Codes" on page 251*. The value of 603F is a hexadecimal. 203Fh displays the auxiliary byte of the error code in hexadecimal. The data type of 203Fh is Uint32, in which the high 16 bits represent the internal error code of the manufacturer, and the low 16 bits represent the external error code of the manufacturer.										

Index 6040h	Name	Control word			Setting Condition & Effective Time	At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 65535	Default	0

Defines the control command.

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
4 to 6	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault reset	0: Inactive 0 -> 1: Fault reset is available only for faults and warnings that can be reset. 1: Other control commands are invalid. 1->0: Invalid
8	Halt	1: Active, 0: Inactive
9	Operation mode specific	Related to the operation mode of the servo drive.
10	Reserved	Undefined
11 to 15	Manufacturer-specific	Manufacturer-specific

Note:

- All bits in the control word constitute a control command.
- The meanings of bit0...bit3 and bit7 are the same in each mode. The servo drive switches to the preset status according to the CiA402 state machine switchover process only when commands are sent in sequence. Each command corresponds to a certain status.
- bit4...bit6 are related to each mode (see the control commands in different modes for details).
- bit9 is not defined.

Index 6041h	Name	Status word			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	0 to 65535	Default	0

Indicates the servo drive status.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms		oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso

MSB LSB

Note：ms=manufacturer-specific；oms=operation mode specific；ila =internal limit active；tr=target reached；rm=remote；w=warning；sod=switch on disabled；qs=quick stop；ve=voltage enabled；f=fault；oe=operation enabled；so=switch on；rtso=ready to switch on

Table 7–8 Description of each bit of 6041h

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	Switch on	1: Active, 0: Inactive
2	Operation enabled	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reached	1: Active, 0: Inactive
11	Internal limit active	1: Active, 0: Inactive
12 to 13	Operation mode specific	Related to the servo drive operation mode.
14	Manufacturer-specific	Undefined
15	Home found	1: Active, 0: Inactive

Table 7–9 Descriptions of setpoints of 6041h

Binary Value	Description
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switched on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Note

- Meanings of bit0 to bit9 are the same in each mode of operation. After commands are sent in sequence by the control word 6040h, the servo drive feeds back the acknowledged status.
- Meanings of bit12 and bit13 vary with the mode of operation. For details, see parameters related to each mode.
- Meanings of bit10, bit11, and bit15 are the same in each mode of operation and indicate the servo drive status after a certain mode of operation is implemented.

605Ah	Name	Quick stop option code			Setting Condition & Effective Time	Any condition & At stop	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	No	Related Mode	All	Data Range	0 to 7	Default	2

Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor status after stop.

Setpoint	Stop Mode
0	Coast to stop, keeping de-energized status
1	Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized status
2	Ramp to stop as defined by 6085h, keeping de-energized status
3	Stop at emergency-stop torque, keeping de-energized status
4	N/A
5	Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock status
6	Ramp to stop as defined by 6085h, keeping position lock status
7	Stop at emergency-stop torque, keeping position lock status

When the brake function is enabled and the value of 605Ah is lower than 4, the stop mode is forcibly set to "Ramp to stop as defined by 6085h, keeping de-energized state".

605Ch	Name	Disable operation option code			Setting Condition & Effective Time	Any condition & At stop	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	No	Related Mode	All	Data Range	-4 to +1	Default	0

Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.

Setpoint	Stop Mode
-4	Ramp to stop as defined by 6085h, keeping dynamic braking status
-3	Stop at zero speed, keeping dynamic braking status
-2	Ramp to stop under all modes, keeping dynamic braking status
-1	Dynamic braking stop, keeping dynamic braking status
0	Coast to stop, keeping de-energized status
1	Ramp to stop under all modes, keeping de-energized status

Set a proper stop mode according to the mechanical status and operation requirements.
After the brake output (BK) function is enabled, the stop mode upon S-ON OFF is forcibly set to "Ramp to stop as defined by 6085h, keeping dynamic braking status".

605Dh	Name	Stop option code			Setting Condition & Effective Time	Any condition & At stop	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	No	Related Mode	All	Data Range	1 to 3	Default	1

Defines the deceleration mode of the motor for stopping rotating upon halt and the motor status after stop.

PP/PV/HM mode:

Setpoint	Stop Mode
1	Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock status
2	Ramp to stop as defined by 6085h, keeping position lock status
3	Stop at emergency-stop torque, keeping position lock status

PT mode:

Setpoint	Stop Mode
1/2/3	Ramp to stop as defined by 6087h, keeping position lock status

605Eh	Name	Fault reaction option code			Setting Condition & Effective Time	Any condition & At stop	Data Structure	-	Data Type	Int16
	Access	RW	Mapping	No	Related Mode	All	Data Range	-5 to +3	Default	0

Defines the deceleration mode of the motor for stopping rotating upon occurrence of a No. 2 fault and the motor status after stop.

Setpoint	Stop Mode
-5	Stop at zero speed, keeping dynamic braking status
-4	Stop at emergency-stop torque, keeping dynamic braking status
-3	Ramp to stop as defined by 6085h, keeping dynamic braking status
-2	Ramp to stop as defined by 6084h/609Ah, keeping dynamic braking status
-1	Dynamic braking stop, keeping dynamic braking status
0	Coast to stop, keeping de-energized status
1	Ramp to stop as defined by 6084h/609Ah, keeping de-energized status
2	Ramp to stop as defined by 6085h, keeping de-energized status
3	Stop at emergency-stop torque, keeping de-energized status

After the brake (BK) output function is enabled, the stop mode at No. 2 fault is forcibly set to "Ramp to stop as defined by 6085h, keeping dynamic braking status".

<table>
<tr><td rowspan="2">Index
6060h</td><td>Name</td><td colspan="3">Modes of operation</td><td>Setting Condition & Effective Time</td><td>At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 10</td><td>Default</td><td>0</td></tr>
</table>

Defines the servo drive operation mode.

Setpoint	Modes of Operation	
0	N/A	Reserved
1	Profile position (PP) mode	See section "Profile Position Mode" in SV660N Series Servo Drive Function Guide.
2	N/A	Reserved
3	Profile velocity (PV) mode	See section "Profile Velocity Mode" in SV660N Series Servo Drive Function Guide.
4	Profile torque (PT) mode	See section "Profile Torque Mode" in SV660N Series Servo Drive Function Guide.
5	N/A	Reserved
6	Homing (HM) mode	See section "Homing Mode" in SV660N Series Servo Drive Function Guide.
7	Interpolated position (IP) mode	Not supported
8	Cyclic synchronous position (CSP) mode	See section "Cyclic Synchronous Position Mode" in SV660N Series Servo Drive Function Guide.
9	Cyclic synchronous velocity (CSV) mode	See section "Cyclic Synchronous Velocity Mode" in SV660N Series Servo Drive Function Guide.
10	Cyclic synchronous torque (CST) mode	See section "Cyclic Synchronous Torque Mode" in SV660N Series Servo Drive Function Guide.

If an unsupported operation mode is set through SDO, a SDO error will be returned. For details, see *"8.5 SDO Transfer Abort Code" on page 500*.

If an operation mode not supported is set through PDO, this operation mode is invalid.

<table>
<tr><td rowspan="2">Index 6061h</td><td>Name</td><td colspan="3">Modes of operation display</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int8</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 10</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Displays the current operation mode of the servo drive.</td></tr>
</table>

<table>
<tr><th>Setpoint</th><th colspan="2">Modes of Operation</th></tr>
<tr><td>0</td><td>N/A</td><td>Reserved</td></tr>
<tr><td>1</td><td>Profile position (PP) mode</td><td>See section "Profile Position Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
<tr><td>2</td><td>N/A</td><td>Reserved</td></tr>
<tr><td>3</td><td>Profile velocity (PV) mode</td><td>See section "Profile Velocity Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
<tr><td>4</td><td>Profile torque (PT) mode</td><td>See section "Profile Torque Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
<tr><td>5</td><td>N/A</td><td>Reserved</td></tr>
<tr><td>6</td><td>Homing (HM) mode</td><td>See section "Homing Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
<tr><td>7</td><td>Interpolated position (IP) mode</td><td>Not supported</td></tr>
<tr><td>8</td><td>Cyclic synchronous position (CSP) mode</td><td>See section "Cyclic Synchronous Position Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
<tr><td>9</td><td>Cyclic synchronous velocity (CSV) mode</td><td>See section "Cyclic Synchronous Velocity Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
<tr><td>10</td><td>Cyclic synchronous torque (CST) mode</td><td>See section "Cyclic Synchronous Torque Mode" in SV660N Series Servo Drive Function Guide.</td></tr>
</table>

<table>
<tr><td rowspan="2">6062h</td><td>Name</td><td colspan="3">Position demand value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>PP/HM/ CSP</td><td>Data Range</td><td>(reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the input position reference (reference unit) in the S-ON state.</td></tr>
</table>

<table>
<tr><td rowspan="2">6063h</td><td>Name</td><td colspan="3">Position actual value*</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>(encoder unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates the input position reference (encoder unit) in the S-ON state.</td></tr>
</table>

<table>
<tr><td rowspan="2">6064h</td><td>Name</td><td colspan="3">Position actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-(reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Represents the single-turn absolute position feedback of the rotating load in real time in user-defined unit. This value is equal to 200B-08h in the absolute position mode.
Position actual value (6064h) x Gear ratio (6091h) = Position actual value* (6063h)</td></tr>
</table>

Index 6065h	Name	Following error window			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/HM/ CSP	Data Range	0 to (2^{32} - 1) (reference unit)	Default	3145728

Defines the threshold of excessive position deviation (reference unit).
For 6065h, setpoints beyond 2147483647 will be forcibly changed to 2147483647.

Index 6066h	Name	Following error time out			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PP/HM/ CSP	Data Range	0 to 65535 (ms)	Default	0

Defines the time lapse to trigger excessive position deviation (EB00.0).
When the position deviation (reference unit) exceeds ±6065h and such status persists after the time defined by 6066h elapses, EB00.0 (Excessive position deviation) will occur.

Index 6067h	Name	Position window			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP	Data Range	0 to (2^{32} - 1) (reference unit)	Default	734

Defines the threshold for position reach.
When the position deviation is within ±6067h and the time reaches the value defined by 6068h, the position is reached and bit10 of 6041h is set to 1.
This flag bit is valid only when the S-ON signal is active in the PP mode.

Index 6068h	Name	Position window time			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	PP	Data Range	0 to 65535 (ms)	Default	0

Defines the time window for position reach.

Index 606Ch	Name	Velocity actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	All	Data Range	-	Default	0

Indicates the speed actual value (reference unit/s).

<table>
<tr><td rowspan="2">Index 606Dh</td><td>Name</td><td colspan="3">Velocity window</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PV</td><td>Data Range</td><td>0 to 65535 (RPM)</td><td>Default</td><td>10</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 606Eh</td><td>Name</td><td colspan="3">Velocity window time</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PV</td><td>Data Range</td><td>0 to 65535 (ms)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">606Dh is used to set the threshold for speed reach. 606Eh is used to set the window time for speed reach.
If the difference between the speed reference and speed feedback is within ±606D and such status persists for the time defined by 606E, the speed is reached, and bit10 (Target reached) of 6041h is set to 1.
This flag bit is valid only when the servo drive is enabled in PV mode.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 606Fh</td><td>Name</td><td colspan="3">Velocity threshold</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PV</td><td>Data Range</td><td>0 to 65535 (RPM)</td><td>Default</td><td>10</td></tr>
<tr><td colspan="11">Defines the threshold for zero speed.
When the speed feedback is within ±606F and the time defined by 6070 elapses, the motor speed is acknowledged to be 0 and bit12 of 6041 is set to 1.
This flag bit is valid only in PV mode.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6070h</td><td>Name</td><td colspan="3">Velocity threshold time</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PV</td><td>Data Range</td><td>0 to 65535 (ms)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the threshold for zero speed.
When the speed feedback is within ±606F and the time defined by 6070 elapses, the motor speed is acknowledged to be 0 and bit12 of 6041 is set to 1.
This flag bit is valid only in PV mode.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6071h</td><td>Name</td><td colspan="3">Target torque</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PT/CST</td><td>Data Range</td><td>-4000.0 to +4000.0 (%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the target torque in PT and CST modes.
The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6072h</td><td>Name</td><td colspan="3">Max. torque</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 4000.0 (%)</td><td>Default</td><td>3500</td></tr>
<tr><td colspan="11">Defines the maximum torque limit of the servo drive in forward/reverse direction.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6074h</td><td>Name</td><td colspan="3">Torque demand value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-(%)</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the torque reference output value during operation.
The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6077h</td><td>Name</td><td colspan="3">Torque actual value</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>-(%)</td><td>Default</td><td>-</td></tr>
<tr><td colspan="11">Indicates the actual torque output of the servo drive.
The value 100.0% corresponds to the rated torque of the motor.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 607Ah</td><td>Name</td><td colspan="3">Target position</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/CSP</td><td>Data Range</td><td>-2 to (2^{31} - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the target position in PP mode and CSP mode.
In CSP mode, 607Ah represents the absolute target position. In PP mode, 607Ah represents either incremental position or absolute position as defined by the control word.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 607Ch</td><td>Name</td><td colspan="3">Home offset</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>-2 to (2^{31} - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the physical distance between the mechanical zero and the motor home in the homing mode.
The home offset is activated only after homing is done upon power-on and bit15 of 6041h is set to 1.
Home offset is used in the following cases:
● Determines the present position according to 60E6h after homing is done.
● If 607Ch is outside the value of 607Dh (Software position limit), EE09.1 (Home setting error) will occur.</td></tr>
</table>

Index 607Dh	Name	Software position limit			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint32
	Access	-	Mapping	Yes	Related Mode	All	Data Range	OD Data Range	Default	OD Default Value

Defines the minimum and maximum software position limits.

- Minimum absolute software position limit = (607D-1h)
- Maximum absolute software position limit = (607D-2h)

The software position limit is used to judge the absolute position. When homing is not performed, the internal software position limit is invalid.

The condition for activating the absolute software position limit is set in the object dictionary 0x200A-02h.

- 0: No limit
- 1: Absolute software position limit activated
- 2: Absolute software position limit activated after homing

The absolute software position limit takes effect once the following conditions are met: The device is powered on, the homing operation is done, and bit15 of 6041h is set to 1. If the minimum software position limit is higher than the maximum software position limit, EE09.0 (Software position limit setting error) will occur.

When the position reference or position feedback reaches the internal software position limit, the servo drive takes the position limit as the target position in the position control mode and stops upon reaching the limit, with an overtravel fault being reported. If a reverse displacement command is input, the motor exits from the overtravel state and this bit is zeroed out.

When both the DI limit switch and internal software position limit are activated, the overtravel status is determined by the DI limit switch.

Sub-index 0h	Name	Highest sub-index supported			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	2

Sub-index 1h	Name	Min. position limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int32
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	-2 to $(2^{31} - 1)$ (reference unit/s)	Default	-2^{31}

Sub-index 2h	Name	Max. position limit			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Int32
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	-2 to $(2^{31} - 1)$ (reference unit/s)	Default	$2^{31} - 1$

Defines the maximum software position limit relative to the mechanical zero.

Maximum software position limit = (607D-2h)

<table>
<tr><td rowspan="2">Index 607Eh</td><td>Name</td><td colspan="3">Polarity</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>All</td><td>Data Range</td><td>0 to 255</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the polarity of position, speed, and torque references.</td></tr>
</table>

bit	Description
0 to 4	Undefined
5	Torque reference polarity 0: Multiply by 1 1: Multiply by -1 PT: Inverts the target torque (6071h). CSP/CSV: Inverts the torque offset (60B2h). CST: Inverts the torque reference (6071h + 60B2h).
6	Speed reference polarity 0: Multiply by 1 1: Multiply by -1 PT: Inverts the target torque (6071h). CSP: Inverts the velocity offset (60B1h) CSV: Inverts the speed reference (60FFh + 60B1h).
7	Position reference polarity 0: Multiply by 1 1: Multiply by -1 PP: Inverts the target position (607Ah) CSP: Inverts the position reference (607Ah + 60B0h).

<table>
<tr><td rowspan="2">Index 607Fh</td><td>Name</td><td colspan="3">Max. profile velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Struc ture</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP/PV/PT/ HM/CST</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s)</td><td>Default</td><td>10485 7600</td></tr>
<tr><td colspan="11">Defines the speed limit in PP, PV, PT, CST, and HM modes.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6081h</td><td>Name</td><td colspan="3">Profile velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>PP</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s)</td><td>Default</td><td>174762</td></tr>
<tr><td colspan="11">Defines the constant operating speed of the target position in PP mode.</td></tr>
</table>

Index 6083h	Name	Profile acceleration			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/PV	Data Range	0 to (2^{31} - 1) (reference unit/s^2)	Default	17476266667
Defines the position reference acceleration in PP mode. In PP mode, if the value of 6083h exceeds that of 60C5h, the value of 60C5h will be used. For 6083h, the setpoint 0 will be forcibly changed to 1.										

Index 6084h	Name	Profile deceleration			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PP/PV	Data Range	0 to (2^{31} - 1) (reference unit/s^2)	Default	17476266667
Defines the position reference deceleration in PP mode. In PP mode, if the value of 6084h exceeds that of 60C6h, the value of 60C6h will be used. For 6084h, the setpoint 0 will be forcibly changed to 1.										

Index 6085h	Name	Quick stop deceleration			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	Yes	Related Mode	PP/PV/ HM/CSP/ CSV	Data Range	0 to 2^{32} - 1 (reference unit/s^2)	Default	2^{31} - 1
Defines the deceleration rate during ramp-to-stop when the quick stop command is active in the PP, CSV, PV, and HM modes, with 605Ah (Quick stop option code) set to 2 or 6. Defines the deceleration rate during ramp-to-stop when the halt command is active in the PP, CSV, PV, and HM modes, with 605Dh (Stop option code) set to 2. For 6085h, the setpoint 0 will be forcibly changed to 1.										

Index 6087h	Name	Torque slope			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	PT/CST	Data Range	0 to 2^{32} - 1 (%/s)	Default	2^{32} - 1
Defines the acceleration rate (torque reference increment per second) of the torque reference in PT and CST modes. In PT and CST modes, if 605A (Quick stop option code) is set to 1, 2, 5, or 6, or 605D (Stop option code) is set to 1 or 2, the servo drive decelerates to stop as defined by 6087h. If the value of 6087h exceeds the torque reference limit, the limit value will be used. For 6087h, the setpoint 0 will be forcibly changed to 1.										

Index 6091h	Name	Gear ratio			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint32
	Access	-	Mapping	Yes	Related Mode	All	Data Range	OD Data Range	De fault	OD Default Value

Defines the proportional relation between the load shaft displacement designated by the user and the motor shaft displacement.

The relation between the motor position feedback (encoder unit) and the load shaft position feedback (reference unit) is as follows.

Motor position feedback = Load shaft position feedback x Gear ratio

The relation between the motor speed (RPM) and the load shaft speed (reference unit/s) is as follows.

$$\text{Motor speed (RPM)} = \frac{\text{Load shaft speed x Gear ratio (6091h)}}{\text{Motor revolutions}} \times 60$$

The relation between the motor acceleration (RPM/ms) and the load shaft acceleration (reference unit/s^2) is as follows.

$$\text{Motor acceleration} = \frac{\text{Load shaft acceleration x Gear ratio (6091h)}}{\text{Motor revolutions}} \times \frac{1000}{60}$$

Sub-index 00h	Name	Highest sub-index supported			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	2

Sub-index 01h	Name	Motor revolutions			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	-	Data Range	1 to (2^{32} - 1)	Default	Encoder resolution

Sub-index 02h	Name	Shaft revolutions			Setting Condition & Effective Time	During running & At once	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	-	Data Range	1 to (2^{32} - 1)	De fault	1

<table>
<tr><td rowspan="2">Index 6098h</td><td>Name</td><td colspan="3">Homing method</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int8</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>-2 to +35</td><td>De fault</td><td>0</td></tr>
<tr><td colspan="11">Indicates the servo drive status.</td></tr>
</table>

Mode	Description
-2	Forward, positive mechanical limit as deceleration point and Z signal as home
-1	Reverse, negative mechanical limit as deceleration point and Z signal as home
1	Reverse, negative limit switch as deceleration point and Z signal as home, falling edge of the negative limit switch signal must be reached before Z signal
2	Forward, positive limit switch as deceleration point and Z signal as home, falling edge of positive limit switch signal must be reached before Z signal
3	Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
4	Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
5	Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
6	Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
7	Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
8	Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
9	Forward, home switch as deceleration point and Z signal as home, rising edge on the other side of the home switch signal must be reached before Z signal
10	Forward, home switch as deceleration point and Z signal as home, falling edge on the other side of the home switch signal must be reached before Z signal
11	Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
12	Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
13	Reverse, home switch as deceleration point and Z signal on the other side of the home switch signal as home, rising edge on the other side of the home switch signal must be reached before Z signal
14	Reverse, home switch as deceleration point and Z signal on the other side of the home switch signal as home, falling edge on the other side of the home switch signal must be reached before Z signal
15 to 16	N/A
17 to 32	Similar to setpoints 1...14 except that the deceleration point coincide with the home
33	Reverse, Z signal as home
34	Forward, Z signal as home
35	Current position as home

Index 6099h	Name	Homing speeds		Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint32
	Access	-	Mapping	Yes	Related Mode	HM	Data Range	OD Data Range	Default	OD Default Value

Defines the two speed values used in the homing mode.

- Speed during search for switch
- Speed during search for zero

Sub-index 0h	Name	Highest sub-index supported		Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	2	Default	2

Sub-index 1h	Name	Speed during search for switch		Setting Condition & Effective Time	During running & At stop	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	HM	Data Range	0 to (2^{32} - 1) (reference unit/s)	De fault	1747627

Defines the speed in searching for the deceleration point signal. A high setpoint prevents occurrence of E601.0 (Homing timeout).

Note: After finding the deceleration point, the slave decelerates and blocks the change of the home signal during deceleration. To prevent the slave from encountering the home signal during deceleration, set the switch position of the deceleration point signal properly to leave sufficient deceleration distance or increase the homing acceleration rate to shorten the deceleration time.

Sub-index 2h	Name	Speed during search for zero		Setting Condition & Effective Time	During running & At stop	Data Structure	-	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	HM	Data Range	10 to (2^{32} - 1) (reference unit/s)	Default	174763

Defines the speed in searching for the home signal. Set this sub-index to a low value to avoid overshoot during stop at high speed, preventing excessive deviation between the stop position and the preset mechanical home.

<table>
<tr><td rowspan="2">Index 609A</td><td>Name</td><td colspan="3">Homing acceleration</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>HM</td><td>Data Range</td><td>0 to (2^{32} - 1) (reference unit/s^2)</td><td>Default</td><td>100</td></tr>
<tr><td colspan="11">Defines the acceleration rate in the homing mode.
The setpoint is activated after homing is started.
In the HM mode, if 605Dh (Stop option code) is set to 2, the servo drive decelerates to stop as defined by 609Ah.
609A indicates the position reference (reference unit) increment per second. For 609A, the setpoint 0 will be forcibly changed to 1.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60B0h</td><td>Name</td><td colspan="3">Position offset</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>CSP</td><td>Data Range</td><td>-2 to (2^{31} - 1) (reference unit)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the position reference offset in CSP mode.
The sum of 607Ah and 60B0h determines the target position of the servo drive.
Target position = 607Ah + 60B0h</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60B1h</td><td>Name</td><td colspan="3">Velocity offset</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>CSP/CSV</td><td>Data Range</td><td>-2 to (2^{31} - 1) (reference unit/s)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the external speed feedforward signal of EtherCAT in CSP mode (activated when 2005-14h is set to 2). 60B1h can be used to reduce the position deviation during positioning. After positioning is done, set the velocity offset to 0. Failure to comply will result in deviation between the target position and the position feedback.
60B1h also defines the speed reference offset in CSV mode.</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 60B2h</td><td>Name</td><td colspan="3">Torque offset</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>CSP/CSV/ CST</td><td>Data Range</td><td>-4000.0 to +4000.0 (%)</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Defines the external torque feedforward signal of EtherCAT in CSV mode (activated when 2006-0Ch is set to 2).
Defines the torque reference offset in CST mode. After offset, the following formula applies:
Target torque = 6071h + 60B2h</td></tr>
</table>

Index 60B8h	Name	Touch probe function			Setting Condition & Effective Time	During running & At stop	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	RPDO	Related Mode	-	Data Range	0 to 65535	Default	0

Defines the functions of touch probe 1 and touch probe 2.
See the following table for descriptions of each bit of 60B8.

bit	Function	Description
0	Touch probe 1 function selection 0: Switch off touch probe 1 1: Enable touch probe 1	bit0 to bit5: settings related to touch probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 positive edge 0: Switch off latching at positive edge 1: Enable latching at positive edge	
5	Touch probe 1 negative edge 0: Switch off latching at negative edge 1: Enable latching at negative edge	
6 to 7	N/A	bit8 to bit13: settings related to touch probe 2
8	Touch probe 2 function selection 0: Switch off touch probe 2 1: Enable touch probe 2	
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 positive edge 0: Switch off latching at positive edge 1: Enable latching at positive edge	
13	Touch probe 2 negative edge 0: Switch off latching at negative edge 1: Enable latching at negative edge	
14 to 15	N/A	-

For absolute encoders, Z signal refers to the zero position of the single-turn position feedback.

Index 60B9h	Name	Touch probe status			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-	Default	-

Indicates the status of touch probe 1 and touch probe 2.

bit	Function	Description
0	Touch probe 1 function selection 0: Switch off touch probe 1 1: Enable touch probe 1	bit0 to bit7: status of touch probe 1
1	Touch probe 1 positive edge value 0: No positive edge value latched 1: Positive edge value latched	
2	Touch probe 1 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
3 to 7	N/A	bit8 to bit15: status of touch probe 2
8	Touch probe 2 function selection 0: Switch off Touch probe 2 1: Enable touch probe 2	
9	Touch probe 2 positive edge value 0: No positive edge value latched 1: Positive edge value latched	
10	Touch probe 2 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
11 to 15	N/A	

Index 60BAh	Name	Touch probe 1 positive edge			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-(reference unit)	Default	-

Indicates the position value of touch probe 1 at positive edge (reference unit).

Index 60BBh	Name	Touch probe 1 negative edge			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-(reference unit)	Default	-

Indicates the position value of touch probe 1 at negative edge (reference unit).

Index 60BCh	Name	Touch probe 2 positive edge			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-(reference unit)	Default	-
Indicates the position value of touch probe 2 at positive edge (reference unit).										

Index 60BDh	Name	Touch probe 2 negative edge			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	-	Data Range	-(reference unit)	Default	-
Indicates the position value of touch probe 2 at negative edge (reference unit).										

Index 60C5h	Name	Max. acceleration			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to (2^{32} - 1) (reference unit/s^2)	Default	2^{31} - 1
Defines the maximum limit of acceleration. In the HM mode, if the value of 609Ah exceeds that of 60C5h, the value of 60C5h will be used. For 60C5h, the setpoint 0 will be forcibly changed to 1.										

Index 60E0h	Name	Positive torque limit value			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 4000.0 (%)	Default	3500
Defines the maximum torque limit of the servo drive in the forward direction.										

Index 60E1h	Name	Negative torque limit value			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Related Mode	All	Data Range	0 to 4000.0 (%)	Default	3500
Defines the maximum torque limit of the servo drive in the reverse direction.										

Index 60E3h	Name	Supported homing methods			Setting Condition & Effective Time	-	Data Structure	ARR	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	HM	Data Range	OD Data Range	Default	OD Default Value
Indicates the supported homing methods.										

Sub-index 00h	Name	Highest sub-index supported			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	31

Sub-index 01h	Name	1st supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint8
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	769

Meaning:

bit0 to bit7	The low 8 bits indicate the supported homing method. Set 6098h to the corresponding value.
bit8	Relative position homing 0: Not supported 1: Supported
bit9	Absolute position homing 0: Not supported 1: Supported
bit10 to bit15	N/A

Defines whether to use relative or absolute position homing through 60E6h.

Sub-index 02h	Name	2nd supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	770

The low 8 bits indicate the supported homing method.

Sub-index 03h	Name	3rd supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	771

The low 8 bits indicate the supported homing method.

Sub-index 04h	Name	4th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	772

The low 8 bits indicate the supported homing method.

Sub-index 05h	Name	5th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	773
The low 8 bits indicate the supported homing method.										

Sub-index 06h	Name	6th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	774
The low 8 bits indicate the supported homing method.										

Sub-index 07h	Name	7th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	775
The low 8 bits indicate the supported homing method.										

Sub-index 08h	Name	8th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	776
The low 8 bits indicate the supported homing method.										

Sub-index 09h	Name	9th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	777
The low 8 bits indicate the supported homing method.										

Sub-index 0Ah	Name	10th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	778
The low 8 bits indicate the supported homing method.										

Sub-index 0Bh	Name	11th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	779
The low 8 bits indicate the supported homing method.										

Sub-index 0Ch	Name	12th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	780
The low 8 bits indicate the supported homing method.										

Sub-index 0Dh	Name	13th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	781
The low 8 bits indicate the supported homing method.										

Sub-index 0Eh	Name	14th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	782
The low 8 bits indicate the supported homing method.										

Sub-index 0Fh	Name	15th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	783
The low 8 bits indicate the supported homing method.										

Sub-index 10h	Name	16th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	784
The low 8 bits indicate the supported homing method.										

Sub-index 11h	Name	17th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	785
The low 8 bits indicate the supported homing method.										

Sub-index 12h	Name	18th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	786
The low 8 bits indicate the supported homing method.										

Sub-index 13h	Name	19th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	787
The low 8 bits indicate the supported homing method.										

Sub-index 14h	Name	20th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	788
The low 8 bits indicate the supported homing method.										

Sub-index 15h	Name	21st supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	789
The low 8 bits indicate the supported homing method.										

Sub-index 16h	Name	22nd supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	790
The low 8 bits indicate the supported homing method.										

Sub-index 17h	Name	23rd supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	791
The low 8 bits indicate the supported homing method.										

Sub-index 18h	Name	24th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	792
The low 8 bits indicate the supported homing method.										

Sub-index 19h	Name	25th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	793
The low 8 bits indicate the supported homing method.										

Sub-index 1Ah	Name	26th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	794
The low 8 bits indicate the supported homing method.										

Sub-index 1Bh	Name	27th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	795
The low 8 bits indicate the supported homing method.										

Sub-index 1Ch	Name	28th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	796
The low 8 bits indicate the supported homing method.										

Sub-index 1Dh	Name	29th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	797
The low 8 bits indicate the supported homing method.										

Sub-index 1Eh	Name	30th supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	798
The low 8 bits indicate the supported homing method.										

Sub-index 1Fh	Name	31st supported homing method			Setting Condition & Effective Time	-	Data Structure	-	Data Type	Uint16
	Access	RO	Mapping	No	Related Mode	-	Data Range	-	Default	799
The low 8 bits indicate the supported homing method.										

Index 60E6h	Name	Actual position calculation method			Setting Condition & Effective Time	During running & At once	Data Structure	VAR	Data Type	Uint8
	Access	RW	Mapping	No	Related Mode	HM	Data Range	0 to 1	Default	0

Defines the method for calculating the mechanical position after homing is done.

Setpoint	Actual position calculation method
0	Absolute position homing After homing is done, the following formula applies: 6064h (Position actual value) = 607Ch (Home offset)
1	Relative position homing After homing is done, the following formula applies: 6064h (Position actual value) = Present position feedback + 607Ch (Home offset)

After homing is triggered, changes in 60E6h will be blocked.

Index 60F4h	Name	Following error actual value			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	PP/HM/CSP	Data Range	-	Default	0
Indicates the position deviation (reference unit).										

Index 60FCh	Name	Position demand value*			Setting Condition & Effective Time	-	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Related Mode	PP/HM/CSP	Data Range	-(Encoder unit)	Default	-

Indicates the position reference (encoder unit).
If no warning is detected when the S-ON signal is active, the relation between the position reference in reference unit and that in encoder unit is as follows:
60FCh (encoder unit) = 6062h (reference unit) x 6091h

<table>
<tr><td rowspan="2">Index 60FDh</td><td>Name</td><td colspan="3">Digital inputs</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Related Mode</td><td>PP/HM/CSP</td><td>Data Range</td><td>-</td><td>Default</td><td>0</td></tr>
<tr><td colspan="11">Indicates current DI logic of the drive.
0: Inactive
1: Active
The DI signal indicated by each bit is described as follows:</td></tr>
</table>

Bit	Signal
0	1: Reverse overtravel active
1	1: Forward overtravel active
2	1: Home signal active
3 to 15	N/A
16	1: DI1 input active
17	1: DI2 input active
18	1: DI3 input active
19	1: DI4 input active
20	1: DI5 input active
21 to 26	N/A
27	1: STO1 signal input
28	1: STO2 signal input
29	1: EDM output active
30 to 31	N/A

<table>
<tr><td rowspan="2">Index 60FEh</td><td>Name</td><td colspan="3">Digital outputs</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>ARR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>-</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>OD Data Range</td><td>Default</td><td>OD Default Value</td></tr>
<tr><td colspan="11">Indicates the current DO logic of the servo drive.</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 0h</td><td>Name</td><td colspan="3">Highest sub-index supported</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>-</td><td>Default</td><td>2</td></tr>
</table>

<table>
<tr><td rowspan="2">Sub-index 1h</td><td>Name</td><td colspan="3">Physical outputs</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to (2^{32} - 1)</td><td>Default</td><td>0</td></tr>
</table>

Indicates the DO logic.
The signal indicated by each bit is described as follows:

Bit	Related Signal	Description
0 to 15	N/A	-
16	DO1	Forced output (0: OFF; 1: ON), only when H0D-17 is set to 4 and bit16 of 60FE-02 is set to 1
17	DO2	Forced output (0: OFF; 1: ON), only when H0D-17 is set to 4 and bit17 of 60FE-02 is set to 1
18	DO3	Forced output (0: OFF; 1: ON), only when H0D-17 is set to 4 and bit18 of 60FE-02 is set to 1
19 to 25	N/A	-
26	Gain switchover	Switched between P and PI, only when bit26 of 60FE-02 is set to 1
27 to 31	N/A	-

<table>
<tr><td rowspan="2">Sub-index 2h</td><td>Name</td><td colspan="3">Bit mask</td><td>Setting Condition & Effective Time</td><td>During running & At stop</td><td>Data Structure</td><td>-</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>0 to (2^{32} - 1)</td><td>Default</td><td>0</td></tr>
</table>

Defines whether to enable the forced DO function.
The signal indicated by each bit is described as follows:

Bit	Related DO	Description
0 to 15	N/A	-
16	DO1	H0D-17 = 4, forced DO1 output enabled
17	DO2	H0D-17 = 4, forced DO2 output enabled
18	DO3	H0D-17 = 4, forced DO3 output enabled
19 to 25	N/A	-
26	Gain switchover	Switchover between P and PI enabled
27 to 31	N/A	-

<table>
<tr><td rowspan="2">Index 60FFh</td><td>Name</td><td colspan="3">Target velocity</td><td>Setting Condition & Effective Time</td><td>During running & At once</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>Yes</td><td>Related Mode</td><td>PV/CSV</td><td>Data Range</td><td>-2^{31} to +(2^{31} - 1)</td><td>Default</td><td>0</td></tr>
</table>

Defines the target velocity in PV and CSV modes.
The maximum operating speed of the motor in CSV mode is determined by the maximum motor speed.

<table>
<tr><td rowspan="2">Index 6502h</td><td>Name</td><td colspan="3">Supported drive modes</td><td>Setting Condition & Effective Time</td><td>-</td><td>Data Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>No</td><td>Related Mode</td><td>-</td><td>Data Range</td><td>-</td><td>Default</td><td>941</td></tr>
</table>

Indicates the operation modes supported by the servo drive.

bit	Description	Supported or Not 0: No 1: Yes
0	Profile position (PP) mode	1
1	Velocity (VL) mode	0
2	Profile velocity (PV) mode	1
3	Profile torque (PT) mode	1
4	N/A	0
5	Homing (HM) mode	1
6	Interpolated position (IP) mode	0
7	Cyclic synchronous position (CSP) mode	1
8	Cyclic synchronous velocity (CSV) mode	1
9	Cyclic synchronous torque (CST) mode	1
10 to 31	Manufacturer-specific	Reserved and undefined

If 6502h is supported, you can obtain the supported drive modes through 6502h.

8 List of Parameters

8.1 Parameter Groups

Parameter access address: index+subindex, both of which are in hexadecimal.

The CiA402 protocol establishes the following restrictions on the parameter address:

Index (Hex)	Description
0001h–0FFFh	Data type description
1000h–1FFFh	CoE communication object
2000h–5FFFh	Manufacturer-specific object
6000h–9FFFh	Profile object
A000h–FFFFh	Reserved

8.2 Parameter Group 1000h

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1000	0	Device type	RO	No	Uint32	-	-	0x00020192
1008	0	Manufacturer device name	RO	No	-	-	-	SV660N-ECAT
1009	0	Manufacturer hardware version	RO	No	-	-	-	Software version dependent
100A	0	Manufacturer software version	RO	No	-	-	-	Hardware version dependent
1018	Identity object							
	0	Number of entries	RO	No	Uint8	-	-	0x04
	1	Vendor ID	RO	No	Uint32	-	-	0x00100000
	2	Product code	RO	No	Uint32	-	-	0x000C010D
	3	Revision number	RO	No	Uint32	-	-	0x00010001
	4	Serial number	RO	No	Uint32	-	-	0x00000000

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1C00	Sync Manager communication type							
	0	Number of SYNC Manager channels	RO	No	Uint8	-	-	0x04
	1	SM0 communication type	RO	No	Uint8	-	-	0x01
	2	SM1 communication type	RO	No	Uint8	-	-	0x02
	3	SM2 communication type	RO	No	Uint8	-	-	0x03
	4	SM3 communication type	RO	No	Uint8	-	-	0x04
1600	1st Receive PDO mapping							
	0	Number of mapped objects in RPDO1	RW	No	Uint8	-	0 to 0x0A	0x03
	1	1st mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60400010
	2	2nd mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60600008
	3	3rd mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60 B80010
	4	4th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	5	5th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	6	6th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	7	7th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	8	8th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	9	9th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	0A	10th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1701	258th Receive PDO mapping							
	0	Number of mapped objects in RPDO258	RO	No	Uint8	-	-	0x04
	1	1st mapped object	RO	No	Uint32	-	-	0x60400010
	2	2nd mapped object	RO	No	Uint32	-	-	0x607 A0020
	3	3rd mapped object	RO	No	Uint32	-	-	0x60 B80010
	4	4th mapped object	RO	No	Uint32	-	-	0x60F E0120
1702	259th Receive PDO mapping							
	0	Number of mapped objects in RPDO259	RO	No	Uint8	-	-	0x07
	1	1st mapped object	RO	No	Uint32	-	-	0x60400010
	2	2nd mapped object	RO	No	Uint32	-	-	0x607 A0020
	3	3rd mapped object	RO	No	Uint32	-	-	0x60FF0020
	4	4th mapped object	RO	No	Uint32	-	-	0x60710010
	5	5th mapped object	RO	No	Uint32	-	-	0x60600008
	6	6th mapped object	RO	No	Uint32	-	-	0x60 B80010
	7	7th mapped object	RO	No	Uint32	-	-	0x607F0020

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1703	260th Receive PDO mapping							
	0	Number of mapped objects in RPDO260	RO	No	Uint8	-	-	0x07
	1	1st mapped object	RO	No	Uint32	-	-	0x60400010
	2	2nd mapped object	RO	No	Uint32	-	-	0x607 A0020
	3	3rd mapped object	RO	No	Uint32	-	-	0x60FF0020
	4	4th mapped object	RO	No	Uint32	-	-	0x60600008
	5	5th mapped object	RO	No	Uint32	-	-	0x60 B80010
	6	6th mapped object	RO	No	Uint32	-	-	0x60 E00010
	7	7th mapped object	RO	No	Uint32	-	-	0x60 E10010
1704	261st Receive PDO mapping							
	0	Number of mapped objects in RPDO261	RO	No	Uint8	-	-	0x09
	1	1st mapped object	RO	No	Uint32	-	-	0x60400010
	2	2nd mapped object	RO	No	Uint32	-	-	0x607 A0020
	3	3rd mapped object	RO	No	Uint32	-	-	0x60FF0020
	4	4th mapped object	RO	No	Uint32	-	-	0x60710010
	5	5th mapped object	RO	No	Uint32	-	-	0x60600008
	6	6th mapped object	RO	No	Uint32	-	-	0x60 B80010
	7	7th mapped object	RO	No	Uint32	-	-	0x607F0020
	8	8th mapped object	RO	No	Uint32	-	-	0x60 E00010
	9	9th mapped object	RO	No	Uint32	-	-	0x60 E10010

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1705	262nd Receive PDO mapping							
	0	Number of mapped objects in RPDO262	RW	No	Uint8	-	-	0x08
	1	1st mapped object	RW	No	Uint32	-	-	0x60400010
	2	2nd mapped object	RW	No	Uint32	-	-	0x607 A0020
	3	3rd mapped object	RW	No	Uint32	-	-	0x60FF0020
	4	4th mapped object	RW	No	Uint32	-	-	0x60600008
	5	5th mapped object	RW	No	Uint32	-	-	0x60 B80010
	6	6th mapped object	RW	No	Uint32	-	-	0x60 E00010
	7	7th mapped object	RW	No	Uint32	-	-	0x60 E10010
	8	8th mapped object	RW	No	Uint32	-	-	0x60 B20010

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1A00	1st Transmit PDO mapping							
	0	Number of mapped objects in TPDO1	RW	No	Uint8	-	0 to 0x0A	0x07
	1	1st mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60410010
	2	2nd mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60640020
	3	3rd mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60 B90010
	4	4th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60B A0020
	5	5th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60B C0020
	6	6th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x603F0010
	7	7th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	0x60F D0010
	8	8th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	9	9th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-
	0A	10th mapped object	RW	No	Uint32	-	0 to 0xFFFFFFFF	-

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1B01	258th Transmit PDO mapping							
	0	Number of mapped objects in TPDO258	RO	No	Uint8	-	-	0x09
	1	1st mapped object	RO	No	Uint32	-	-	0x603F0010
	2	2nd mapped object	RO	No	Uint32	-	-	0x60410010
	3	3rd mapped object	RO	No	Uint32	-	-	0x60640020
	4	4th mapped object	RO	No	Uint32	-	-	0x60770010
	5	5th mapped object	RO	No	Uint32	-	-	0x60F40020
	6	6th mapped object	RO	No	Uint32	-	-	0x60 B90010
	7	7th mapped object	RO	No	Uint32	-	-	0x60B A0020
	8	8th mapped object	RO	No	Uint32	-	-	0x60B C0020
	9	9th mapped object	RO	No	Uint32	-	-	0x60F D0010

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1B02	259th Transmit PDO mapping							
	0	Number of mapped objects in TPDO259	RO	No	Uint8	-	-	0x09
	1	1st mapped object	RO	No	Uint32	-	-	0x603F0010
	2	2nd mapped object	RO	No	Uint32	-	-	0x60410010
	3	3rd mapped object	RO	No	Uint32	-	-	0x60640020
	4	4th mapped object	RO	No	Uint32	-	-	0x60770010
	5	5th mapped object	RO	No	Uint32	-	-	0x60610008
	6	6th mapped object	RO	No	Uint32	-	-	0x60 B90010
	7	7th mapped object	RO	No	Uint32	-	-	0x60B A0020
	8	8th mapped object	RO	No	Uint32	-	-	0x60B C0020
	9	9th mapped object	RO	No	Uint32	-	-	0x60F D0010

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1B03	260th Transmit PDO mapping							
	0	Number of mapped objects in TPDO260	RO	No	Uint8	-	-	0x0A
	1	1st mapped object	RO	No	Uint32	-	-	0x603F0010
	2	2nd mapped object	RO	No	Uint32	-	-	0x60410010
	3	3rd mapped object	RO	No	Uint32	-	-	0x60640020
	4	4th mapped object	RO	No	Uint32	-	-	0x60770010
	5	5th mapped object	RO	No	Uint32	-	-	0x60F40020
	6	6th mapped object	RO	No	Uint32	-	-	0x60610008
	7	7th mapped object	RO	No	Uint32	-	-	0x60 B90010
	8	8th mapped object	RO	No	Uint32	-	-	0x60B A0020
	9	9th mapped object	RO	No	Uint32	-	-	0x60B C0020
	0A	10th mapped object	RO	No	Uint32	-	-	0x60F D0010

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1B04	261st Transmit PDO mapping							
	0	Number of mapped objects in TPDO261	RO	No	Uint8	-	-	0x0A
	1	1st mapped object	RO	No	Uint32	-	-	0x603F0010
	2	2nd mapped object	RO	No	Uint32	-	-	0x60410010
	3	3rd mapped object	RO	No	Uint32	-	-	0x60640020
	4	4th mapped object	RO	No	Uint32	-	-	0x60770010
	5	5th mapped object	RO	No	Uint32	-	-	0x60610008
	6	6th mapped object	RO	No	Uint32	-	-	0x60F40020
	7	7th mapped object	RO	No	Uint32	-	-	0x60 B90010
	8	8th mapped object	RO	No	Uint32	-	-	0x60B A0020
	9	9th mapped object	RO	No	Uint32	-	-	0x60B C0020
	0A	10th mapped object	RO	No	Uint32	-	-	0x606 C0020
1C12	Sync Manager 2_RPDO assignment							
	0	Number of assigned RPDOs	RW	No	Uint8	-	0 to 0x1	0x01
	1	Index of assigned RPDO	RW	Yes	Uint16	-	0 to 0xFFFF	0x1701
1C13	Sync Manager 2_TPDO assignment							
	0	Number of assigned TPDOs	RW	No	Uint8	-	0 to 0x1	0x01
	1	Index of assigned TPDO	RW	Yes	Uint16	-	0 to 0xFFFF	0x1B01

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1C32	Sync Manager 2 output parameters							
	0	Number of synchronization parameters	RO	No	Uint8	-	-	0x20
	1	Synchronization type	RO	No	Uint16	-	-	0x0002
	2	Cycle time	RO	No	Uint32	ns	-	0
	4	Synchronization types supported	RO	No	Uint16	-	-	0x0004
	5	Minimum cycle time	RO	No	Uint32	ns	-	0x0003 D090
	6	Calc and copy time	RO	No	Uint32	ns	-	-
	9	Delay time	RO	No	Uint32	ns	-	-
	20	Sync error	RO	No	BOOL	-	-	-
1C33	Sync Manager 2 input parameters							
	0	Number of synchronization parameters	RO	No	Uint8	-	-	0x20
	1	Synchronization type	RO	No	Uint16		-	0x0002
	2	Cycle time	RO	No	Uint32	ns	-	0
	4	Synchronization types supported	RO	No	Uint16	-	-	0x0004
	5	Minimum cycle time	RO	No	Uint32	ns	-	0x0003 D090
	6	Calc and copy time	RO	No	Uint32	ns	-	-
	9	Delay time	RO	No	Uint32	ns	-	-
	20	Sync error	RO	No	BOOL	-	-	-

8.3 Parameter Group 2000h

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
2000h/H00: Servo motor parameters									
01h	H00-00	Motor code	-	0 to 65535	14101	-	16 bits	At stop	Next power-on

Para. Group HEX Index	DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
03h	H00-02	Customized no.	-	0 to (2^{32} - 1)	0	-	32 bits	-	-
05h	H00-04	Encoder version	-	0 to 6553.5	0	-	16 bits	-	-
06h	H00-05	Serial-type motor code	-	0 to 65535	0	-	16 bits	-	-
07h	H00-06	FPGA customized No.	-	0 to 655.35	0	-	16 bits	-	-
08h	H00-07	STO version	-	0 to 655.35	0	-	16 bits	-	-
09h	H00-08	Serial encoder type	-	0 to 65535	0	-	16 bits	-	-
2001h/H01: Servo drive parameters									
01h	H01-00	MCU software version	-	0 to 6553.5	0	-	16 bits	-	-
02h	H01-01	FPGA software version	-	0 to 6553.5	0	-	16 bits	-	-
0Bh	H01-10	Servo drive model	2: 1R6 3: S2R8 5: S5R5 60005: S6R6 6: S7R6 7: S012 10001: T3R5 10002: T5R4 10003: T8R4 10004: T012 10005: T017 10006: T021 10007: T026	0 to 65535	3	-	16 bits	At stop	Next power-on
0Ch	H01-11	DC-AC voltage class	-	0 to 65535	220	V	16 bits	-	-
0Dh	H01-12	Rated power of the servo drive	-	0 to 1073741824	0.4	kW	32 bits	-	-
0Fh	H01-14	Max. output power of the servo drive	-	0 to 1073741824	0.4	kW	32 bits	-	-
11h	H01-16	Rated output current of the servo drive	-	0 to 1073741824	2.8	A	32 bits	-	-
13h	H01-18	Max. output current of the servo drive	-	0 to 1073741824	10.1	A	32 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
29h	H01-40	DC bus overvoltage protection threshold	-	0 to 2000	420	V	16 bits	-	-
2002h/H02: Basic control parameters									
01h	H02-00	Control mode	0: Speed control mode 1: Position control mode 2: Torque control mode 9: EtherCAT mode	0 to 9	9	-	16 bits	At stop	At once
02h	H02-01	Absolute system selection	0: Incremental mode 1: Absolute position linear mode 2: Absolute position rotation mode 3: Absolute position linear mode (encoder overflow not detected) 4: Absolute position single-turn mode	0 to 4	0	-	16 bits	At stop	Next power-on
03h	H02-02	Direction of rotation	0: CCW as the forward direction 1: CW as the forward direction	0 to 1	0	-	16 bits	At stop	Next power-on
06h	H02-05	Stop mode at S-ON OFF	-3: Stop at zero speed, keeping dynamic braking status -2: Ramp to stop as defined by 6084h/ 609Ah, keeping dynamic braking status -1: Dynamic braking stop, keeping dynamic braking status 0: Coast to stop, keeping de-energized status 1: Ramp to stop as defined by 6084h/ 609Ah, keeping de-energized status	-3 to +1	0	-	16 bits	At stop	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
07h	H02-06	Stop mode at No. 2 fault	-5: Stop at zero speed, keeping dynamic braking status -4: Stop at the emergency-stop torque, keeping dynamic braking status -3: Ramp to stop as defined by 6085h, keeping dynamic braking status -2: Ramp to stop as defined by 6084h/ 609Ah, keeping dynamic braking status -1: Dynamic braking stop, keeping dynamic braking status 0: Coast to stop, keeping de-energized status 1: Ramp to stop as defined by 6084h/ 609Ah, keeping de-energized status 2: Ramp to stop as defined by 6085h, keeping de-energized status 3: Stop at emergency-stop torque, keeping de-energized status	-5 to +3	2	-	16 bits	At stop	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
08h	H02-07	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized status 3: Ramp to stop as defined by 6085h, keeping de-energized status 4: Ramp to stop as defined by 6085h, keeping position lock status 5: Dynamic braking stop, keeping de-energized status 6: Dynamic braking stop, keeping dynamic braking status 7: Not responding to overtravel (with warning displayed only)	0 to 7	1	-	16 bits	At stop	At once
09h	H02-08	Stop mode at No. 1 fault	0: Coast to stop, keeping de-energized state 1: Dynamic braking stop, keeping de-energized status 2: Dynamic braking stop, keeping dynamic braking status	0 to 2	2	-	16 bits	At stop	At once
0Ah	H02-09	Delay from brake (BK) output ON to command received	-	0 to 500	250	ms	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
0Bh	H02-10	Delay from brake (BK) output OFF to motor de-energized	-	50 to 1000	150	ms	16 bits	During running	At once
0Ch	H02-11	Speed threshold at brake (BK) output OFF in the rotation state	-	20 to 3000	30	RPM	16 bits	During running	At once
0Dh	H02-12	Delay from S-ON OFF to brake (BK) output OFF in the rotation state	-	1 to 1000	500	ms	16 bits	During running	At once
10h	H02-15	Warning display on the keypad	0: Warning information outputted immediately 1: Warning information not outputted	0 to 1	0	-	16 bits	During running	At once
11h	H02-16	Brake enable switch	0: Disable 1: Enable	0 to 1	1	-	16 bits	During running	At once
15h	H02-20	Dynamic brake relay coil ON delay	-	30 to 30000	30	ms	16 bits	During running	At once
16h	H02-21	Permissible minimum resistance of the regenerative resistor	-	1 to 1000	40	Ω	16 bits	-	-
17h	H02-22	Power of built-in regenerative resistor	-	0 to 65535	0	W	16 bits	-	-
18h	H02-23	Resistance of built-in regenerative resistor	-	0 to 65535	0	Ω	16 bits	-	-
19h	H02-24	Resistor heat dissipation coefficient	-	10 to 100	30	%	16 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
1Ah	H02-25	Regenerative resistor type	0: Built-in 1: External, natural cooling 2: External, forced air cooling 3: No resistor needed, braking energy absorbed by the capacitor	0 to 3	3	-	16 bits	During running	At once
1Bh	H02-26	Power of external regenerative resistor	-	1 to 65535	40	W	16 bits	During running	At once
1Ch	H02-27	Resistance of external regenerative resistor	-	15 to 1000	50	Ω	16 bits	During running	At once
1Fh	H02-30	User password	-	0 to 65535	0	-	16 bits	During running	At once
20h	H02-31	System parameter initialization	0: No operation 1: Restore default settings 2: Clear fault log	0 to 2	0	-	16 bits	At stop	At once
21h	H02-32	Selection of parameters in group H0B	-	0 to 99	50	-	16 bits	During running	At once
24h	H02-35	Keypad data update frequency	-	0 to 20	0	Hz	16 bits	During running	At once
2Ah	H02-41	Factory password	-	0 to 65535	0	-	16 bits	During running	At once
2003h/H03: Terminal input parameters									
03h	H03-02	DI1 function	0: No assignment 1: Servo ON 2: Fault reset 14: Positive limit switch 15: Negative limit switch 31: Home switch 34: Emergency stop 38: Touch probe 1 39: Touch probe 2	0 to 40	14	-	16 bits	During running	At once
04h	H03-03	DI1 logic	0: NO 1: NC	0 to 1	0	-	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
05h	H03-04	DI2 function	0 to 39 See the description of H03-02 for details.	0 to 40	15	-	16 bits	During running	At once
06h	H03-05	DI2 logic	0 to 1 See the description of H03-03 for details.	0 to 1	0	-	16 bits	During running	At once
07h	H03-06	DI3 function	0 to 39 See the description of H03-02 for details.	0 to 40	31	-	16 bits	During running	At once
08h	H03-07	DI3 logic	0 to 1 See the description of H03-03 for details.	0 to 1	0	-	16 bits	During running	At once
09h	H03-08	DI4 function	0 to 39 See the description of H03-02 for details.	0 to 40	39	-	16 bits	During running	At once
0Ah	H03-09	DI4 logic	0 to 1 See the description of H03-03 for details.	0 to 1	0	-	16 bits	During running	At once
0Bh	H03-10	DI5 function	0 to 39 See the description of H03-02 for details.	0 to 40	38	-	16 bits	During running	At once
0Ch	H03-11	DI5 logic	0 to 1 See the description of H03-03 for details.	0 to 1	0	-	16 bits	During running	At once
3Dh	H03-60	DI1 filter time		0 to 500	0.5	ms	16 bits	During running	At once
3Eh	H03-61	DI2 filter time		0 to 500	0.5	ms	16 bits	During running	At once
3Fh	H03-62	DI3 filter time		0 to 500	0.5	ms	16 bits	During running	At once
40h	H03-63	DI4 filter time		0 to 500	0.5	ms	16 bits	During running	At once
41h	H03-64	DI5 filter time		0 to 500	0.5	ms	16 bits	During running	At once
2004h/H04: Terminal output parameters									

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
01h	H04-00	DO1 function	0: No assignment 1: Servo ready 2: Motor rotating 9: Brake (BK) output 10: Warning 11: Fault 25: Comparison output 31: EtherCAT forced output 32: EDM safety state	0 to 32	1	-	16 bits	During running	At once
02h	H04-01	DO1 logic	0: NO 1: NC	0 to 1	0	-	16 bits	During running	At once
03h	H04-02	DO2 function	0 to 32 See the description of H04-00 for details.	0 to 32	11	-	16 bits	During running	At once
04h	H04-03	DO2 logic	0 to 1 See the description of H04-01 for details.	0 to 1	0	-	16 bits	During running	At once
05h	H04-04	DO3 function	0 to 32 See the description of H04-00 for details.	0 to 32	9	-	16 bits	During running	At once
06h	H04-05	DO3 logic	0 to 1 See the description of H04-01 for details.	0 to 1	0	-	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
18h	H04-23	EtherCAT forced DO logic in non-OP status	0: Status of DO1, DO2, and DO3 unchanged in the non-OP status 1: No output in DO1 and status of others unchanged in the non-OP status 2: No output in DO2 and status of others unchanged in the non-OP status 3: No output in DO1 or DO2 and status of others unchanged in the non-OP status 4: No output in DO3 and status of others unchanged in the non-OP status 5: No output in DO1 or DO3 and status of others unchanged in the non-OP status 6: No output in DO2 or DO3 and status of others unchanged in the non-OP status 7: No output in DO1, DO2, or DO3 in the non-OP status	0 to 7	0	-	16 bits	During running	At once
2005h/H05: Position control parameters									
05h	H05-04	First-order low-pass filter time constant	-	0 to 6553.5	0	ms	16 bits	At stop	At once
06h	H05-05	Moving average filter time constant 1	-	0 to 1000	0	ms	16 bits	At stop	At once
07h	H05-06	Moving average filter time constant 2	-	0 to 128	0	ms	16 bits	At stop	At once
08h	H05-07	Numerator of electronic gear ratio	-	0 to 4294967295	1	1	32 bits	During running	At once
0Ah	H05-09	Denominator of electronic gear ratio	-	0 to 4294967295	1	1	32 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
14h	H05-19	Speed feedforward control	0: No speed feedforward 1: Internal speed feedforward 2: 60B1 used as speed feedforward 3: Zero phase control	0 to 3	1	-	16 bits	At stop	At once
15h	H05-20	Condition for COIN (positioning completed) signal output	0: Position deviation = Filtered position reference - Position feedback	0 to 3	0	-	16 bits	At stop	At once
1F	H05-30	Homing function	0: Disable 6: Current position as the home	0, 6	0	-	16 bits	During running	At once
24h	H05-35	Homing time limit	-	0 to 6553.5	5000	s	16 bits	During running	At once
25h	H05-36	Local home offset	-	-1073741824 to +1073741824	0	-	32 bits	During running	At once
2Fh	H05-46	Position deviation in absolute position linear mode (low 32 bits)	-	-2^{31} to $+(2^{31} - 1)$	0	-	32 bits	At stop	Next power-on
31h	H05-48	Position deviation in absolute position linear mode (high 32 bits)	-	-2^{31} to $+(2^{31} - 1)$	0	-	32 bits	At stop	Next power-on
33h	H05-50	Numerator of mechanical gear ratio	-	1 to 65535	1	-	16 bits	At stop	At once
34h	H05-51	Denominator of mechanical gear ratio	-	1 to 65535	1	-	16 bits	At stop	At once
35h	H05-52	Pulses per load revolution in absolute position rotation mode (low 32 bits)	-	0 to $(2^{32} - 1)$	0	1 p	32 bits	At stop	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
37h	H05-54	Pulses per load revolution in absolute position rotation mode (high 32 bits)	-	0 to (2^{32} - 1)	0	1 p	32 bits	At stop	At once
2006h/H06: Speed control parameters									
04h	H06-03	Speed reference	-	-6000 to +6000	200	RPM	16 bits	During running	At once
06h	H06-05	Acceleration ramp time of speed reference	-	0 to 65535	0	RPM	16 bits	During running	At once
07h	H06-06	Deceleration ramp time of speed reference	-	0 to 65535	0	RPM	16 bits	During running	At once
09h	H06-08	Forward speed limit	-	0 to 6000	6000	RPM	16 bits	During running	At once
0Ah	H06-09	Reverse speed limit	-	0 to 6000	6000	RPM	16 bits	During running	At once
0Bh	H06-10	Deceleration unit in emergency stop	0: x 1 1: x 10 2: x 100	0 to 2	0	-	16 bits	At stop	At once
0Ch	H06-11	Torque feedforward control	0: No torque feedforward 1: Internal torque feedforward 2: 60B2h used as external torque feedforward	0 to 2	1	-	16 bits	During running	At once
0Dh	H06-12	Acceleration ramp time of jog speed	-	0 to 65535	10	ms	16 bits	During running	At once
0Eh	H06-13	Speed feedforward smoothing filter	-	0 to 2000	0	us	16 bits	During running	At once
11h	H06-16	Threshold of TGON (motor rotation) signal	-	0 to 1000	20	RPM	16 bits	During running	At once
1Dh	H06-28	Cogging torque compensation selection	0: No 1: Yes	0 to 1	1	-	16 bits	During running	At once
2007h/H07: Torque control parameters									

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
04h	H07-03	Torque reference set through keypad	-	-400.0 to +400.0	0	%	16 bits	During running	At once
06h	H07-05	Torque reference filter time constant 1	-	0 to 30.00	0.2	ms	16 bits	During running	At once
07h	H07-06	Torque reference filter time constant 2	-	0 to 30.00	0.27	ms	16 bits	During running	At once
0Ah	H07-09	Forward internal torque limit	-	0 to 400.0	350	%	16 bits	During running	At once
0Bh	H07-10	Reverse internal torque limit	-	0 to 400.0	350	%	16 bits	During running	At once
10h	H07-15	Emergency-stop torque	-	0 to 400.0	100	%	16 bits	During running	At once
14h	H07-19	Internal speed limit in torque control	-	0 to 6000	3000	RPM	16 bits	During running	At once
15h	H07-20	Negative internal speed limit in torque control	-	0 to 6000	3000	RPM	16 bits	During running	At once
16h	H07-21	Reference value for torque reach	-	0 to 400.0	0	%	16 bits	During running	At once
17h	H07-22	Torque output value when DO signal for torque reach turned on	-	0 to 400.0	20	%	16 bits	During running	At once
18h	H07-23	Torque output value when DO signal for torque reach turned off	-	0 to 400.0	10	%	16 bits	During running	At once
19h	H07-24	Depth of field-weakening	-	60 to 115	115	%	16 bits	During running	At once
1Ah	H07-25	Max. permissible demagnetizing current	-	1 to 200	100	%	16 bits	During running	At once
1Bh	H07-26	Field-weakening selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	At stop	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
1Ch	H07-27	Field-weakening gain	-	0.001 to 1.000	0.03	-	16 bits	During running	At once
25h	H07-36	Time constant of low-pass filter 2	-	0 to 10.00	0	ms	16 bits	During running	At once
26h	H07-37	Torque reference filter selection	0: First-order filter 1: Biquad filter	0 to 1	0	-	16 bits	During running	At once
27h	H07-38	Biquad filter attenuation ratio	-	0 to 50	16	-	16 bits	At stop	At once
2008h/H08: Gain parameters									
01h	H08-00	Speed loop gain	-	0.1 to 2000	39	Hz	16 bits	During running	At once
02h	H08-01	Speed loop integral time constant	-	0.15 to 512	20.51	ms	16 bits	During running	At once
03h	H08-02	Position loop gain	-	0.1 to 2000	55.7	Hz	16 bits	During running	At once
04h	H08-03	2nd speed loop gain	-	0.1 to 2000	75	Hz	16 bits	During running	At once
05h	H08-04	2nd speed loop integral time constant	-	0.15 to 512	10.61	ms	16 bits	During running	At once
06h	H08-05	2nd position loop gain	-	0.1 to 2000	120	Hz	16 bits	During running	At once
09h	H08-08	2nd gain mode setting	0: Fixed to the 1st gain set, P/PI switched by bit26 of 60FE 1:Switched between the 1st gain set and 2nd gain set as defined by H08-09	0 to 1	1	-	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
0Ah	H08-09	Gain switchover condition	0: Fixed to the 1st gain set (PS) 1: Switched by bit26 of 60FE 2: Torque reference too large (PS) 3: Speed reference too large (PS) 4: Speed reference change rate too large (PS) 5: Speed reference high/low-speed threshold (PS) 6: Position deviation too large (P) 7: Position reference available (P) 8: Positioning completed (P) 9: Actual speed (P) 10: Position reference+Actual speed (P)	0 to 10	0	-	16 bits	During running	At once
0Bh	H08-10	Gain switchover delay	-	0 to 1000	5	ms	16 bits	During running	At once
0Ch	H08-11	Gain switchover level	-	0 to 20000	50	-	16 bits	During running	At once
0Dh	H08-12	Gain switchover dead time	-	0 to 20000	30	-	16 bits	During running	At once
0Eh	H08-13	Position gain switchover time	-	0 to 1000	3	ms	16 bits	During running	At once
10h	H08-15	Load moment of inertia ratio	-	0 to 120	3	-	16 bits	During running	At once
12h	H08-17	Zero phase delay	-	0 to 4	0	ms	16 bits	During running	At once
13h	H08-18	Speed feedforward filter time constant	-	0 to 64	0.5	ms	16 bits	During running	At once
14h	H08-19	Speed feedforward gain	-	0 to 100	0	%	16 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
15h	H08-20	Torque feedforward filter time constant	-	0 to 64	0.5	ms	16 bits	During running	At once
16h	H08-21	Torque feedforward gain	-	0 to 300	0	%	16 bits	During running	At once
17h	H08-22	Speed feedback filtering option	0: Inhibited 1: Two times 2: Four times 3: Eight times 4: Sixteen times	0 to 4	0	-	16 bits	At stop	At once
18h	H08-23	Cutoff frequency of speed feedback low-pass filter	-	100 to 8000	8000	Hz	16 bits	During running	At once
19h	H08-24	PDFF control coefficient	-	0 to 200	100	%	16 bits	During running	At once
1Ch	H08-27	Speed observer cutoff frequency	-	50 to 600	170	Hz	16 bits	During running	At once
1Dh	H08-28	Speed observer inertia correction coefficient	-	1 to 1600	100	%	16 bits	During running	At once
1Eh	H08-29	Speed observer filter time	-	0 to 10	0.8	ms	16 bits	During running	At once
1Fh	H08-30	Disturbance compensation time	-	0 to 100	0.2	ms	16 bits	During running	At once
20h	H08-31	Disturbance cutoff frequency	-	10 to 4000	600	Hz	16 bits	During running	At once
21h	H08-32	Disturbance compensation gain	-	0 to 100	0	%	16 bits	During running	At once
22h	H08-33	Disturbance observer inertia correction coefficient	-	0 to 1600	100	%	16 bits	During running	At once
26h	H08-37	Phase modulation for medium-frequency jitter suppression 2	-	-90 to +90	0	°	16 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
27h	H08-38	Frequency of medium-frequency jitter suppression 2	-	0 to 1000	0	Hz	16 bits	During running	At once
28h	H08-39	Compensation gain of medium-frequency jitter suppression 2	-	0 to 300	0	%	16 bits	During running	At once
29h	H08-40	Speed observer selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	At once
2Bh	H08-42	Model control selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	At once
2Ch	H08-43	Model gain	-	0.1 to 2000	40	-	16 bits	During running	At once
2Fh	H08-46	Feedforward value	-	0 to 102.4	95	-	16 bits	During running	At once
36h	H08-53	Medium- and low-frequency jitter suppression frequency 3	-	0 to 300	0	Hz	16 bits	During running	At once
37h	H08-54	Medium- and low-frequency jitter suppression compensation 3	-	0 to 200	0	%	16 bits	During running	At once
39h	H08-56	Medium- and low-frequency jitter suppression phase modulation 3	-	0 to 600	100	%	16 bits	During running	At once
3Ch	H08-59	Medium- and low-frequency jitter suppression frequency 4	-	0 to 300	0	Hz	16 bits	During running	At once
3Dh	H08-60	Medium- and low-frequency jitter suppression compensation 4	-	0 to 200	0	%	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
3Eh	H08-61	Medium- and low-frequency jitter suppression phase modulation 4	-	0 to 600	100	%	16 bits	During running	At once
3Fh	H08-62	Position loop integral time constant	-	0.15 to 512	512	-	16 bits	During running	At once
40h	H08-63	2nd position loop integral time constant	-	0.15 to 512	512	-	16 bits	During running	At once
41h	H08-64	Speed observer feedback source	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	At once
49h	H08-72	Viscous friction of zero deviation control	-	0 to 100	0	-	16 bits	During running	At once
4Ah	H08-73	Forward coulomb friction of zero deviation control	-	0 to 100	0	-	16 bits	During running	At once
4Bh	H08-74	Reverse coulomb friction of zero deviation control	-	-100 to 0	0	-	16 bits	During running	At once
4Ch	H08-75	Friction compensation selection of zero deviation control	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	At once
4Dh	H08-76	Acceleration compensation factor of zero deviation control	-	0 to 900	0	-	16 bits	During running	At once
4Eh	H08-77	Static friction of zero deviation control	-	0 to 100	0	-	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
4Fh	H08-78	Transition speed between coulomb friction and viscous friction of zero deviation control	-	0 to 100	0	-	16 bits	During running	At once
50h	H08-79	Initial torque shock of zero deviation control	-	0 to 100	0	-	16 bits	During running	At once
51h	H08-80	Friction compensation delay of zero deviation control	-	0 to 1000	20	-	16 bits	During running	At once
2009h/H09: Gain auto-tuning parameters									
01h	H09-00	Gain auto-tuning mode	0: Invalid, gain parameters tuned manually 1: Valid, gain parameters tuned automatically based on the stiffness level 2: Positioning mode, gain parameters tuned automatically based on the stiffness level 3: Interpolation mode + Inertia auto-tuning 4: Normal mode + Inertia auto-tuning 6: Quick positioning mode + Inertia auto-tuning	0 to 7	4	-	16 bits	During running	At once
02h	H09-01	Stiffness level	-	0 to 41	15	-	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
03h	H09-02	Adaptive notch mode	0: Adaptive notch not updated 1: One adaptive notch activated (3rd notch) 2: Two adaptive notches activated (3rd and 4th notches) 3: Resonance point tested only, displayed in H09-24 4: Adaptive notch cleared, values of the 3rd and 4th notches restored to default settings	0 to 4	3	-	16 bits	During running	At once
04h	H09-03	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowing 2: Enabled, changing normally 3: Enabled, changing quickly	0 to 3	2	-	16 bits	During running	At once
06h	H09-05	Offline inertia auto-tuning mode	0: Bidirectional 1: Unidirectional	0 to 1	0	-	16 bits	At stop	At once
07h	H09-06	Maximum speed of inertia auto-tuning	-	100 to 1000	500	RPM	16 bits	At stop	At once
08h	H09-07	Time constant for accelerating to the max. speed during inertia auto-tuning	-	20 to 800	125	ms	16 bits	At stop	At once
09h	H09-08	Waiting time after an individual inertia auto-tuning	-	50 to 10000	800	ms	16 bits	At stop	At once
0Ah	H09-09	Number of motor revolutions per inertia auto-tuning	-	0 to 100	1	-	16 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
0Ch	H09-11	Vibration threshold	-	0 to 100	5	%	16 bits	During running	At once
0Dh	H09-12	Frequency of the 1st notch	-	50 to 8000	8000	Hz	16 bits	During running	At once
0Eh	H09-13	Width level of the 1st notch	-	0 to 20	2	-	16 bits	During running	At once
0Fh	H09-14	Depth level of the 1st notch	-	0 to 99	0	-	16 bits	During running	At once
10h	H09-15	Frequency of the 2nd notch	-	50 to 8000	8000	Hz	16 bits	During running	At once
11h	H09-16	Width level of the 2nd notch	-	0 to 20	2	-	16 bits	During running	At once
12h	H09-17	Depth level of the 2nd notch	-	0 to 99	0	-	16 bits	During running	At once
13h	H09-18	Frequency of the 3rd notch	-	50 to 8000	8000	1 Hz	16 bits	During running	At once
14h	H09-19	Width level of the 3rd notch	-	0 to 20	2	-	16 bits	During running	At once
15h	H09-20	Depth level of the 3rd notch	-	0 to 99	0	-	16 bits	During running	At once
16h	H09-21	Frequency of the 4th notch	-	50 to 8000	8000	1 Hz	16 bits	During running	At once
17h	H09-22	Width level of the 4th notch	-	0 to 20	2	-	16 bits	During running	At once
18h	H09-23	Depth level of the 4th notch	-	0 to 99	0	-	16 bits	During running	At once
19h	H09-24	Auto-tuned resonance frequency	-	0 to 5000	0	Hz	16 bits	-	-
1Fh	H09-30	Tension fluctuation compensation gain	-	-100 to +100	0	-	16 bits	-	-
20h	H09-31	Tension fluctuation compensation filter time	-	0 to 25	0.5	-	16 bits	-	-
21h	H09-32	Gravity compensation value	-	0 to 100	0	%	16 bits	During running	At once
22h	H09-33	Forward friction compensation value	-	0 to 100	0	%	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
23h	H09-34	Reverse friction compensation value	-	-100 to 0	0	%	16 bits	During running	At once
24h	H09-35	Friction compensation speed	-	0 to 20	2	-	16 bits	During running	At once
25h	H09-36	Friction compensation speed	0x00: Slow mode + Speed reference 0x01: Slow mode + Model speed 0x02: Slow mode + Speed feedback 0x10: Quick mode + Speed reference 0x11: Quick mode + Model speed 0x12: Quick mode + Speed feedback	0 to 19	0	-	16 bits	During running	At once
26h	H09-37	Vibration monitoring time	-	0 to 65535	1200	-	16	During running	At once
27h	H09-38	Frequency of low-frequency resonance suppression 1 at the mechanical end	-	1 to 100	100	Hz	16 bits	During running	At once
28h	H09-39	Low-frequency resonance suppression 1 at the mechanical end	-	0 to 3	2	-	16 bits	At stop	At once
2Ah	H09-41	Frequency of the 5th notch	-	50 to 8000	8000	Hz	16 bits	During running	At once
2Bh	H09-42	Width level of the 5th notch	-	0 to 20	2	-	16 bits	At stop	At once
2Ch	H09-43	Depth level of the 5th notch	-	0 to 99	0	-	16 bits	At stop	At once
2Dh	H09-44	Frequency of low-frequency resonance suppression 2 at mechanical load end	-	0 to 200	0	-	16 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
2Eh	H09-45	Responsiveness of low-frequency resonance suppression 2 at the mechanical load end	-	0.01 to 10	1	-	16 bits	During running	At once
30h	H09-47	Width of low-frequency resonance suppression 2 at mechanical load end	-	0 to 2	100	-	16 bits	During running	At once
32h	H09-49	Frequency of low-frequency resonance suppression 3 at mechanical load end	-	0 to 2000	0	-	16 bits	During running	At once
33h	H09-50	Responsiveness of low-frequency resonance suppression 3 at mechanical load end	-	0.01 to 10	1	-	16 bits	During running	At once
35h	H09-52	Width of low-frequency resonance suppression 3 at mechanical load end	-	0 to 2	1	-	16 bits	During running	At once
39h	H09-56	STune mode setting	-	0 to 4	4	-	16 bits	During running	At once
3Ah	H09-57	STune resonance suppression switchover frequency	-	0 to 4000	900	Hz	16 bits	During running	At once
3Bh	H09-58	STune resonance suppression reset selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	At once
200Ah/H0A: Fault and protection parameters									

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
01h	H0A-00	Power input phase loss protection	0: Phase loss fault detected 1: Phase loss fault not detected 3: Power loss detection enabled Note: In the common bus mode, set 200A-01h to 1. Otherwise, the servo drive cannot enter "rdy" state after power-on.	0 to 3	0	-	16 bits	During running	At once
02h	H0A-01	Absolute position limit	0: Disable 1: Enable 2: Enabled after homing	0 to 2	0	-	16 bits	At stop	At once
05h	H0A-04	Motor overload protection gain	-	50 to 300	100	-	16 bits	At stop	At once
09h	H0A-08	Overspeed threshold	-	0 to 20000	0	RPM	16 bits	During running	At once
0Bh	H0A-10	Threshold of excessive local position deviation	-	0 to (2^{32} - 1)	25185824	-	16 bits	During running	At once
0Dh	H0A-12	Runaway protection	0: Disable 1: Enable	0 to 1	1	-	16 bits	During running	At once
13h	H0A-18	IGBT over-temperature threshold	-	120 to 175	135	°C	16 bits	During running	At once
14h	H0A-19	Filter time constant of touch probe 1	-	0 to 6.3	2	us	16 bits	During running	At once
15h	H0A-20	Filter time constant of touch probe 2	-	0 to 6.3	2	us	16 bits	During running	At once
16h	H0A-21	STO function display selection	0: Display STO status 1: Display STO fault	0 to 1	0	-	16 bits	During running	At once
18h	H0A-23	TZ signal filter time	-	0 to 31	15	25 ns	16 bits	At stop	Next power-on
1Ah	H0A-25	Filter time constant of speed feedback display value	-	0 to 5000	50	ms	16 bits	At stop	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
1Bh	H0A-26	Motor overload detection	0: Enable 1: Hide motor overload warning (E909.0) and motor overload fault (E620.0)	0 to 1	0	-	16 bits	At stop	At once
1Ch	H0A-27	Motor rotation DO speed filter time	-	0 to 5000	50	ms	16 bits	During running	At once
21h	H0A-32	Motor stall over-temperature protection time window	-	10 to 65535	200	ms	16 bits	During running	At once
22h	H0A-33	Motor stall over-temperature detection	0: Hide 1: Enable	0 to 1	1	-	16 bits	During running	At once
25h	H0A-36	Encoder multi-turn overflow fault selection	0: Not hide 1: Hide	0 to 1	0	-	16 bits	During running	At once
29h	H0A-40	Overtravel compensation switch	0: Enable 1: Disable	0 to 1	0	-	16 bits	At stop	At once
32h	H0A-49	Regenerative transistor over-temperature threshold	-	100 to 175	115	°C	16 bits	During running	At once
33h	H0A-50	Encoder communication fault tolerance threshold	-	0 to 31	3	-	16 bits	During running	At once
34h	H0A-51	Phase loss detection filter times	-	3 to 36	20	55 ms	16 bits	During running	At once
35h	H0A-52	Encoder over-temperature threshold	-	0 to 175	0	°C	16 bits	During running	At once
38h	H0A-55	Runaway current threshold	-	100 to 400	200	%	16 bits	During running	At once
39h	H0A-56	Overload fault reset delay	-	0 to 60000	10000	ms	16 bits	During running	At once
3Ah	H0A-57	Runaway speed threshold	-	1 to 1000	50	RPM	16 bits	During running	At once

Para. Group HEX Index	DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
3Bh	H0A-58	Runaway speed filter time	-	0.1 to 100	2	ms	16 bits	During running	Next power-on
3Ch	H0A-59	Runaway protection detection time	-	10 to 1000	30	ms	16 bits	During running	At once
47h	H0A-70	Overspeed threshold 2	-	0 to 20000	0	RPM	16 bits	During running	At once
48h	H0A-71	MS1 motor overload curve switchover	0: New overload curve 1: Old overload curve 2: Disable voltage discharge upon power failure 3: Old overload curve and disable voltage discharge upon power failure	0 to 3	0		16 bits	During running	At once
49h	H0A-72	Maximum stop time of ramp-to-stop	-	0 to 65535	10000	ms	16 bits	At stop	At once
4Ah	H0A-73	STO 24 V disconnection filter time	-	0 to 5	5	ms	16 bits	During running	At once
4Bh	H0A-74	Fault tolerance filter time of two STO channels	-	0 to 10	10	ms	16 bits	During running	At once
4Ch	H0A-75	Servo OFF delay after STO triggered	-	0 to 25	20	ms	16 bits	During running	At once
200Bh/H0B: Monitoring parameters									
01h	H0B-00	Motor speed actual value	-	-32767 to +32767	0	RPM	16 bits	-	-
02h	H0B-01	Speed reference	-	-32767 to +32767	0	RPM	16 bits	-	-
03h	H0B-02	Internal torque reference	-	-500 to +500	0	%	16 bits	-	-
04h	H0B-03	Monitored DI status	-	0 to 65535	0	-	16 bits	-	-
06h	H0B-05	Monitored DO status	-	0 to 65535	0	-	16 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
08h	H0B-07	Absolute position counter	-	-2^{31} to $+(2^{31} - 1)$	0	1 p	32 bits	-	-
0Ah	H0B-09	Mechanical angle	-	0 to 360	0	°	16 bits	-	-
0Bh	H0B-10	Electrical angle	-	0 to 360	0	°	16 bits	-	-
0Dh	H0B-12	Average load rate	-	0 to 800	0	%	16 bits	-	-
10h	H0B-15	Position following error (encoder unit)	-	-2147483648 to +2147483647	0	p	32 bits	-	-
12h	H0B-17	Feedback pulse counter	-	-2147483648 to +2147483647	0	p	32 bits	-	-
14h	H0B-19	Total power-on time	-	0 to 429496729.5	0	s	32 bits	-	-
19h	H0B-24	RMS value of phase current	-	0 to 6553.5	0	A	32 bits	-	-
1Bh	H0B-26	Bus voltage	-	0 to 6553.5	0	V	16 bits	-	-
1Ch	H0B-27	Power module temperature	-	-20 to +200	0	°C	16 bits	-	-
1Dh	H0B-28	Absolute encoder fault information given by FPGA	-	0 to 65535	0	-	16 bits	-	-
1Eh	H0B-29	Axis status information given by FPGA	-	0 to 65535	0	-	16 bits	-	-
1Fh	H0B-30	Axis fault information given by FPGA	-	0 to 65535	0	-	16 bits	-	-
20h	H0B-31	Encoder fault information	-	0 to 65535	0	-	16 bits	-	-
22h	H0B-33	Fault log	0: Present fault 1: Last fault 2: 2nd to last fault 3: 3rd to last fault 4: 4th to last fault 5: 5th to last fault 6: 6th to last fault 7: 7th to last fault 8: 8th to last fault 9: 9th to last fault	0 to 9	0	-	16 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
23h	H0B-34	Fault code of the selected fault	-	0 to 65535	0	-	16 bits	-	-
24h	H0B-35	Time stamp upon occurrence of the selected fault	-	0 to 429496729.5	0	s	32 bits	-	-
26h	H0B-37	Motor speed upon occurrence of the selected fault	-	-32767 to +32767	0	RPM	16 bits	-	-
27h	H0B-38	Motor phase U current upon occurrence of the selected fault	-	-3276.7 to +3276.7	0	A	16 bits	-	-
28h	H0B-39	Motor phase V current upon occurrence of the selected fault	-	-3276.7 to +3276.7	0	A	16 bits	-	-
29h	H0B-40	Bus voltage upon occurrence of the selected fault	-	0 to 6553.5	0	V	16 bits	-	-
2Ah	H0B-41	DI status upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-
2Ch	H0B-43	DO status upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-
2Eh	H0B-45	Internal fault code	-	0 to 65535	0	-	16 bits	-	-
2Fh	H0B-46	Absolute encoder fault information given by FPGA upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
30h	H0B-47	System status information given by FPGA upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-
31h	H0B-48	System fault information given by FPGA upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-
32h	H0B-49	Encoder fault information upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-
34h	H0B-51	Internal fault code upon occurrence of the selected fault	-	0 to 65535	0	-	16 bits	-	-
36h	H0B-53	Position following error (reference unit)	-	-2^{31} to $+(2^{31}-1)$	0	p	32 bits	-	-
38h	H0B-55	Motor speed actual value	-	-6000 to +6000	0	RPM	32 bits	-	-
3Ah	H0B-57	Bus voltage of the control circuit	-	0 to 6553.5	0	V	16 bits	-	-
3Bh	H0B-58	Mechanical absolute position (low 32 bits)	-	0 to 2^{32}	0	p	32 bits	-	-
3Dh	H0B-60	Mechanical absolute position (high 32 bits)	-	-2^{31} to $+(2^{31}-1)$	0	p	32 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
40h	H0B-63	NotRdy state	0: None 1: Control circuit power supply error (H0B-57) 2: Phase loss detection error 3: Main circuit power supply detection error (including short-circuited to ground error) 4: Other servo faults 5: Short-circuited to ground detection not done	0 to 5	0	-	16 bits	-	-
43h	H0B-66	Encoder temperature	-	-100 to +200	0	°C	16 bits	-	-
44h	H0B-67	Load rate of regenerative transistor	-	0 to 200	0	%	16 bits	-	-
47h	H0B-70	Number of revolutions fed back by the absolute encoder	-	0 to 65535	0	Rev	16 bits	-	-
48h	H0B-71	Single-turn position feedback of the absolute encoder	-	0 to (2^{31} - 1)	0	p	32 bits	-	-
4Bh	H0B-74	System fault information given by FPGA	-	0 to 65535	0	-	16 bits	-	-
4Eh	H0B-77	Position feedback of the absolute encoder (low 32 bits)	-	-2^{31} to +(2^{31} - 1)	0	p	32 bits	-	-
50h	H0B-79	Position feedback of the absolute encoder (high 32 bits)	-	-2^{31} to +(2^{31} - 1)	0	p	32 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
52h	H0B-81	Single-turn position of the rotating load (low 32 bits)	-	0 to (2^{32} - 1)	0	p	32 bits	-	-
54h	H0B-83	Single-turn position of the rotating load (high 32 bits)	-	-2^{31} to +(2^{31} - 1)	0	p	32 bits	-	-
56h	H0B-85	Single-turn position of the rotating load (reference unit)	-	-2^{31} to +(2^{31} - 1)	0	p	32 bits	-	-
5Bh	H0B-90	Group No. of the abnormal parameter	-	0 to 65535	0	-	16 bits	-	-
5Ch	H0B-91	Offset of the abnormal parameter within the parameter group	-	0 to 65535	0	-	16 bits	-	-
200Dh/H0D: Auxiliary function parameters									
01h	H0D-00	Software reset	0: No operation 1: Enable	0 to 1	0	-	16 bits	At stop	At once
02h	H0D-01	Fault reset	0: No operation 1: Enable	0 to 1	0	-	16 bits	At stop	At once
03h	H0D-02	Offline inertia auto-tuning selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	At stop	At once
04h	H0D-03	Encoder initial angle auto-tuning	0: No operation 1: Enable	0 to 1	0	-	16 bits	At stop	At once
05h	H0D-04	Read/write in encoder ROM	0: No operation 1: Write ROM 2: Read ROM	0 to 2	0	-	16 bits	At stop	At once
06h	H0D-05	Emergency stop	0: No operation 1: Enable	0 to 1	0	-	16 bits	During running	At once
0Ch	H0D-12	Phase U/V current balance correction	0: Disable 1: Enable	0 to 1	0	-	16 bits	At stop	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
12h	H0D-17	Forced DI/DO enable switch	0: No operation 1: Forced DI enabled, forced DO disabled 2: Forced DI disabled, forced DO enabled 3: Forced DI and DO enabled 4: EtherCAT forced DO enabled	0 to 4	0	-	16 bits	During running	At once
13h	H0D-18	Forced DI value	-	0 to 31	0	-	16 bits	During running	At once
14h	H0D-19	Forced DO value	-	0 to 7	0	-	16 bits	During running	At once
15h	H0D-20	Absolute encoder reset selection	0: No operation 1: Reset encoder fault 2: Reset encoder fault and multi-turn data	0 to 2	0	-	16 bits	At stop	At once
200Eh/H0E: Auxiliary function parameters									
01h	H0E-00	Node address	-	0 to 127	1	-	16 bits	During running	At once
02h	H0E-01	Save objects written through communication to EEPROM	0: Parameters and object dictionaries written through communication not saved to EEPROM 1: Only parameters written through communication saved to EEPROM 2: Only object dictionaries written through communication saved to EEPROM 3: Parameters and object dictionaries written through communication saved to EEPROM	0 to 3	3	-	16 bits	During running	At once
15h	H0E-20	EtherCAT slave name	-	0 to 65535	0	-	16 bits	-	-
16h	H0E-21	EtherCAT slave alias	-	0 to 65535	0	-	16 bits	At stop	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
17h	H0E-22	Number of synchronous loss events allowed by EtherCAT	-	1 to 20	8	-	16 bits	During running	At once
18h	H0E-23	EtherCAT station alias from EEPROM	-	0 to 65535	0	-	16 bits	During running	At once
19h	H0E-24	Number of SYNC loss events	-	0 to 65535	0	-	16 bits	-	-
1Ah	H0E-25	Max. error value and invalid frames of EtherCAT port 0 per unit time	-	0 to 65535	0	-	16 bits	-	-
1Bh	H0E-26	Max. error value and invalid frames of EtherCAT port 1 per unit time	-	0 to 65535	0	-	16 bits	-	-
1Ch	H0E-27	Max. transfer error of EtherCAT port per unit time	-	0 to 65535	0	-	16 bits	-	-
1Dh	H0E-28	Max. EtherCAT data frame processing unit error per unit time	-	0–255	0	-	16 bits	-	-
1Eh	H0E-29	Max. link loss value of EtherCAT port 0 per unit time	-	0 to 65535	0	-	16 bits	-	-
20h	H0E-31	EtherCAT synchronization mode setting	-	0 to 2	1	-	16 bits	At stop	Next power-on
21h	H0E-32	EtherCAT synchronization error threshold	-	0 to 4000	3000	us	16 bits	At stop	At once
22h	H0E-33	EtherCAT state machine status and port connection status	-	0 to 65535	0	-	16 bits	-	-

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
23h	H0E-34	Number of excessive position reference increment events in CSP mode	-	0 to 7	1	-	16 bits	During running	At once
24h	H0E-35	AL fault code	-	0 to 65535	0	-	16 bits	-	-
25h	H0E-36	EtherCAT AL enhanced link selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	Next power-on
26h	H0E-37	EtherCAT XML reset selection	0: Disable 1: Enable	0 to 1	0	-	16 bits	During running	Next power-on
51h	H0E-80	Modbus baud rate	9: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps 10: 230400 bps	0 to 10	9	-	16 bits	During running	At once
52h	H0E-81	Modbus data format	0: No parity, 2 stop bits (8-N-2) 1: Even parity, 1 stop bit (8-E-1) 2: Odd parity, 1 stop bit (8-O-1) 3: No parity, 1 stop bit (8-N-1)	0 to 3	3	-	16 bits	During running	At once
53h	H0E-82	Modbus response delay	-	0 to 20	0	ms	16 bits	During running	At once
54h	H0E-83	Modbus communication timeout	-	0 to 600	0	ms	16 bits	During running	At once
5Bh	H0E-90	Modbus version	-	0 to 655.35	0	-	16 bits	-	-
5Eh	H0E-93	EtherCAT COE version	-	0 to 655.35	0	-	16 bits	-	-
61h	H0E-96	XML version	-	0 to 655.35	0	-	16 bits	-	-
2018h/H18: Position comparison output									

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
01h	H18-00	Position comparison output selection	0: Disable 1: Enable (rising edge-triggered)	-	0	-	16 bits	During running	At once
03h	H18-02	Position comparison resolution	0: 24-bit 1: 23-bit 2: 22-bit 3: 21-bit 4: 20-bit 5: 19-bit 6: 18-bit 7: 17-bit	-	1	-	16 bits	During running	At once
04h	H18-03	Position comparison mode	0: Individual comparison 1: Cyclic comparison	-	0	-	16 bits	During running	At once
05h	H18-04	Current position as zero	0: Disable 1: Enable (rising edge-triggered)	-	0	-	16 bits	During running	At once
06h	H18-05	Position comparison output width	-	-	0	0.1 ms	16 bits	During running	At once
08h	H18-07	Start point of position comparison	-	-	0	-	16 bits	During running	At once
09h	H18-08	End point of position comparison	-	-	0	-	16 bits	During running	At once
0Ah	H18-09	Current status of position comparison	-	-	0	-	16 bits	Unedita ble	At once
0Bh	H18-10	Real-time position of position comparison	-	-	0	-	32 bits	Unedita ble	At once
0Dh	H18-12	Zero offset of position comparison	-	-	0	-	32 bits	During running	At once
2019h/H19: Target position parameters									
01h	H19-00	Target value of position comparison 1	-	-	0	-	32 bits	During running	At once

Para. Group		Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
HEX	DEC								
Index	Para.								
03h	H19-02	Attribute value of position comparison 1	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
04h	H19-03	Target value of position comparison 2	-	-	0	-	32 bits	During running	At once
06h	H19-05	Attribute value of position comparison 2	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
07h	H19-06	Target value of position comparison 3	-	-	0	-	32 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
09h	H19-08	Attribute value of position comparison 3	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
0Ah	H19-09	Target value of position comparison 4	-	-	0	-	32 bits	During running	At once
0Ch	H19-11	Attribute value of position comparison 4	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
0Dh	H19-12	Target value of position comparison 5	-	-	0	-	32 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
0Fh	H19-14	Attribute value of position comparison 5	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
10h	H19-15	Target value of position comparison 6	-	-	0	-	32 bits	During running	At once
12h	H19-17	Attribute value of position comparison 6	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
13h	H19-18	Target value of position comparison 7	-	-	0	-	32 bits	During running	At once

Para. Group HEX Index	Para. Group DEC Para.	Name	Description	Value Range	Default	Unit	Data Type	Change Condition	Effective Time
15h	H19-20	Attribute value of position comparison 7	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once
16h	H19-21	Target value of position comparison 8	-	-	0	-	32 bits	During running	At once
18h	H19-23	Attribute value of position comparison 8	0: Skip this point 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 2: Output DO active signal if current position changes from "more than" to "less than" the comparison point 3: Output DO active signal in both situations	-	0	-	16 bits	During running	At once

8.4 Parameter Group 6000h

The parameter group 6000h contains objects supported by the servo drive in DSP402 device profile.

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
603Fh	0	Error code	RO	TPDO	Uint 16	-	-	-	-	-
6040h	0	Control word	RW	RPDO	Uint 16	-	0 to 65535	0	During running	At once
6041h	0	Status word	RO	TPDO	Uint 16	-	-	-	-	-
605Ah	0	Quick stop option code	RW	No	int 16	-	0 to 7	2	During running	At stop
605Ch	0	Disable operation option code	RW	No	int 16	-	-4 to +1	0	During running	At stop
605Dh	0	Stop option code	RW	No	int 16	-	1 to 3	1	During running	At stop
605Eh	0	Fault reaction option code	RW	No	int 16	-	-5 to +3	2	During running	At stop
6060h	0	Modes of operation	RW	RPDO	int 8	-	0 to 10	0	During running	At once
6061h	0	Modes of operation display	RO	TPDO	int 8	-	-	-	-	-
6062h	0	Position demand value	RO	TPDO	int 32	Reference unit	-	-	-	-
6063h	0	Position actual value*	RO	TPDO	int 32	Encoder unit	-	-	-	-
6064h	0	Position actual value	RO	TPDO	int 32	Reference unit	-	-	-	-
6065h	0	Following error window	RW	RPDO	Uint 32	Reference unit	0 to $(2^{32} - 1)$	0	During running	At once
6066h	0	Following error time out	RW	RPDO	Uint 16	ms	0 to 65535	0	During running	At once
6067h	0	Position window	RW	RPDO	Uint 32	Reference unit	0 to $(2^{32} - 1)$	734	During running	At once
6068h	0	Position window time	RW	RPDO	Uint 16	ms	0 to 65535	0	During running	At once
606Ch	0	Velocity actual value	RO	TPDO	int 32	Reference unit/s	-	-	-	-
606Dh	0	Velocity window	RW	RPDO	Uint 16	RPM	0 to 65535	10	During running	At once

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
606Eh	0	Velocity window time	RW	RPDO	Uint 16	ms	0 to 65535	0	During running	At once
606Fh	0	Velocity threshold	RW	RPDO	Uint 16	RPM	0 to 65535	10	During running	At once
6070h	0	Velocity threshold time	RW	RPDO	Uint 16	ms	0 to 65535	0	During running	At once
6071h	0	Target torque	RW	RPDO	int 16	0.1%	-4000 to +4000	0	During running	At once
6072h	0	Max. torque	RW	RPDO	Uint 16	0.1%	0 to 4000	3500	During running	At once
6074h	0	Torque demand value	RO	TPDO	int 16	0.1%	-	0	-	-
6077h	0	Torque actual value	RO	TPDO	int 16	0.1%	-	0	-	-
607Ah	0	Target position	RW	RPDO	int 32	Reference unit	-2^{31} to $+(2^{31}-1)$	0	During running	At once
607Ch	0	Home offset	RW	RPDO	int 32	Reference unit	-2^{31} to $+(2^{31}-1)$	0	During running	At once
607D	Software position limit									
	0	Highest sub-index supported	RO	No	Uint 8	-	-	0x02	-	-
	1	Min. position limit	RW	RPDO	int 32	Reference unit	-2^{31} to $+(2^{31}-1)$	-2^{31}	During running	At once
	2	Max. position limit	RW	RPDO	int 32	Reference unit	-2^{31} to $+(2^{31}-1)$	$2^{31}-1$	During running	At once
607Eh	0	Polarity	RW	RPDO	Uint 8	-	0–255	0	During running	At once
607Fh	0	Max. profile velocity	RW	RPDO	Uint 32	Reference unit/s	0 to $(2^{32}-1)$	104857600	During running	At once
6081h	0	Profile velocity	RW	RPDO	Uint 32	User-defined velocity unit	0 to $(2^{32}-1)$	1747627	During running	At once
6083h	0	Profile acceleration	RW	RPDO	Uint 32	Reference unit/s^2	0 to $(2^{32}-1)$	174762666	During running	At once
6084h	0	Profile deceleration	RW	RPDO	Uint 32	Reference unit/s^2	0 to $(2^{32}-1)$	174762666	During running	At once
6085h	0	Quick stop deceleration	RW	RPDO	Uint 32	Reference unit/s^2	0 to $(2^{32}-1)$	$2^{31}-1$	During running	At once

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
6086h	0	Motion profile type	RW	RPDO	int 16	-	-32767 to +32767	0	During running	At once
6087h	0	Torque slope	RW	RPDO	Uint 32	0.1%/s	0 to $(2^{32} - 1)$	$2^{32} - 1$	During running	At once
6091h		Gear ratio								
	0	Highest sub-index supported	RO	No	Uint 8	Uint 8	-	0x02	-	-
	1	Motor revolutions	RW	RPDO	Uint 32	-	0 to $(2^{32} - 1)$	1	During running	At once
	2	Shaft revolutions	RW	RPDO	Uint 32	-	1 to $(2^{32} - 1)$	1	During running	At once
6098h	0	Homing method	RW	RPDO	int 8	-	-2 to +35	1	During running	At once
6099h		Homing speeds								
	0	Highest sub-index supported	RO	No	Uint 8	-	-	2	-	-
	1	Speed during search for switch	RW	RPDO	Uint 32	Reference unit/s	0 to $(2^{32} - 1)$	1747627	During running	At once
	2	Speed during search for zero	RW	RPDO	Uint 32	Reference unit/s	10 to $(2^{32} - 1)$	174763	During running	At once
609Ah	0	Homing acceleration	RW	RPDO	Uint 32	Reference unit/s^2	0 to $(2^{32} - 1)$	1747626667	During running	At once
60B0h	0	Position offset	RW	RPDO	int 32	Reference unit	-2^{31} to $+(2^{31} - 1)$	0	During running	At once
60B1h	0	Velocity offset	RW	RPDO	int 32	Reference unit/s	-2^{31} to $+(2^{31} - 1)$	0	During running	At once
60B2h	0	Torque offset	RW	RPDO	int 16	0.10%	-4000 to +4000	0	During running	At once
60B8h	0	Touch probe function	RW	RPDO	Uint 16	-	0 to 65535	0	During running	At once
60B9h	0	Touch probe status	RW	TPDO	Uint 16	-	-	0	-	-
60BAh	0	Touch probe 1 positive edge	RW	TPDO	int 32	Reference unit	-	0	-	-
60BBh	0	Touch probe 1 negative edge	RW	TPDO	int 32	Reference unit	-	0	-	-

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
60BCh	0	Touch probe 2 positive edge	RW	TPDO	int 32	Reference unit	-	0	-	-
60BDh	0	Touch probe 2 negative edge	RW	TPDO	int 32	Reference unit	-	0	-	-
60C5h	0	Max. acceleration	RW	RPDO	Uint 32	User-defined acceleration unit	0 to 2^{32} - 1	2^{31} - 1	During running	At once
60C6h	0	Max. deceleration	RW	RPDO	Uint 32	User-defined acceleration unit	0 to 2^{32} - 1	2^{31} - 1	During running	At once
60D5h	0	Touch probe 1 positive edge counter	RO	TPDO	Uint 16	-	-	0	-	-
60D6h	0	Touch probe 1 negative edge counter	RO	TPDO	Uint 16	-	-	0	-	-
60D7h	0	Touch probe 2 positive edge counter	RO	TPDO	Uint 16	-	-	0	-	-
60D8h	0	Touch probe 2 negative edge counter	RO	TPDO	Uint 16	-	-	0	-	-
60E0h	0	Positive torque limit value	RW	RPDO	Uint 16	0.1%	0 to 4000	3500	During running	At once
60E1h	0	Negative torque limit value	RW	RPDO	Uint 16	0.1%	0 to 4000	3500	During running	At once

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
60E3h	Supported homing method									
	0	Highest sub-index supported	RO	No	Uint 8	-	-	31	-	-
	1	1st supported homing method	RO	No	Uint 16	-	-	769	-	-
	2	2nd supported homing method	RO	No	Uint 16	-	-	770	-	-
	3	3rd supported homing method	RO	No	Uint 16	-	-	771	-	-
	4	4th supported homing method	RO	No	Uint 16	-	-	772	-	-

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
60E3h	5	5th supported homing method	RO	No	Uint 16	-	-	773	-	-
	6	6th supported homing method	RO	No	Uint 16	-	-	774	-	-
	7	7th supported homing method	RO	No	Uint 16	-	-	775	-	-
	8	8th supported homing method	RO	No	Uint 16	-	-	776	-	-
	9	9th supported homing method	RO	No	Uint 16	-	-	777	-	-
	A	10th supported homing method	RO	No	Uint 16	-	-	778	-	-
	B	11th supported homing method	RO	No	Uint 16	-	-	779	-	-
	C	12th supported homing method	RO	No	Uint 16	-	-	780	-	-
	D	13th supported homing method	RO	No	Uint 16	-	-	781	-	-
	E	14th supported homing method	RO	No	Uint 16	-	-	782	-	-

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
60E3h	F	15th supported homing method	RO	No	Uint 16	-	-	783	-	-
	10	16th supported homing method	RO	No	Uint 16	-	-	784	-	-
	11	17th supported homing method	RO	No	Uint 16	-	-	785	-	-
	12	18th supported homing method	RO	No	Uint 16	-	-	786	-	-
	13	19th supported homing method	RO	No	Uint 16	-	-	787	-	-
	14	20th supported homing method	RO	No	Uint 16	-	-	788	-	-
	15	21th supported homing method	RO	No	Uint 16	-	-	789	-	-
	16	22th supported homing method	RO	No	Uint 16	-	-	790	-	-
	17	23th supported homing method	RO	No	Uint 16	-	-	791	-	-
	18	24th supported homing method	RO	No	Uint 16	-	-	792	-	-

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
60E3h	19	25th supported homing method	RO	No	Uint 16	-	-	793	-	-
	1A	26th supported homing method	RO	No	Uint 16	-	-	794	-	-
	1B	27th supported homing method	RO	No	Uint 16	-	-	795	-	-
	1C	28th supported homing method	RO	No	Uint 16	-	-	796	-	-
	1D	29th supported homing method	RO	No	Uint 16	-	-	797	-	-
	1E	30th supported homing method	RO	No	Uint 16	-	-	798	-	-
	1F	31th supported homing method	RO	No	Uint 16	-	-	799	-	-
60E6h	0	Actual position calculation mode	RW	No	Uint 16	-	0 to 1	0	During running	At once
60F4h	0	Following error actual value	RO	TPDO	int 32	Reference unit	-	-	-	-
60FCh	0	Position demand value*	RO	TPDO	int 32	Encoder unit	-	-	-	-
60FDh	0	Digital inputs	RO	TPDO	Uint 32	-	-	-	-	-
60FEh	Digital outputs									
	0	DO state	RO	No	Uint 8	-	-	2	-	-
	1	Physical outputs	RW	RPDO	Uint 32	-	0 to 2^{32} - 1	0	During running	At once
	2	Bitmask	RW	No	Uint 32	-	0 to 2^{32} - 1	0	During running	At once

Index (HEX)	Sub-index (HEX)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	Change Condition	Effective Time
60FFh	0	Target velocity	RW	RPDO	int 32	Reference unit/s	$-2^{31}-1$ to $+(2^{31}-1)$	0	During running	At once
6502h	0	Supported drive modes	RO	No	Uint 32	-	-	941	-	-

8.5 SDO Transfer Abort Code

Abort Code	Function
0503 0000	Toggle bit not altered
0504 0000	SDO protocol timed out
0504 0001	Client/Server command specifier not valid or unknown
0504 0005	Out of memory
0601 0000	Unsupported access to an object
0601 0001	Attempt to read a write only object
0601 0002	Attempt to write a read only object
0602 0000	Object does not exist in the object dictionary
0604 0041	Object cannot be mapped to the PDO
0604 0042	The number and length of the objects to be mapped would exceed PDO length
0604 0043	General parameter incompatibility reason
0604 0047	General internal incompatibility in the device
0606 0000	Access failed due to an hardware error
0607 0010	Data type does not match, length of service parameter does not match
0607 0012	Data type does not match, length of service parameter too high
0607 0013	Data type does not match, length of service parameter too low
0609 0011	Sub-index does not exist
0609 0030	Invalid value for parameter
0609 0031	Value of parameter written too high
0609 0032	Value of parameter written too low
0609 0036	Maximum value is less than minimum value
0800 0000	General error
0800 0020	Data cannot be transferred or stored to the application
0800 0021	Data cannot be transferred or stored to the application because of local control

Abort Code	Function
0800 0022	Data cannot be transferred or stored to the application because of the present device state
0800 0023	Object dictionary dynamic generation fails or no object dictionary is present
0800 0024	No data available

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