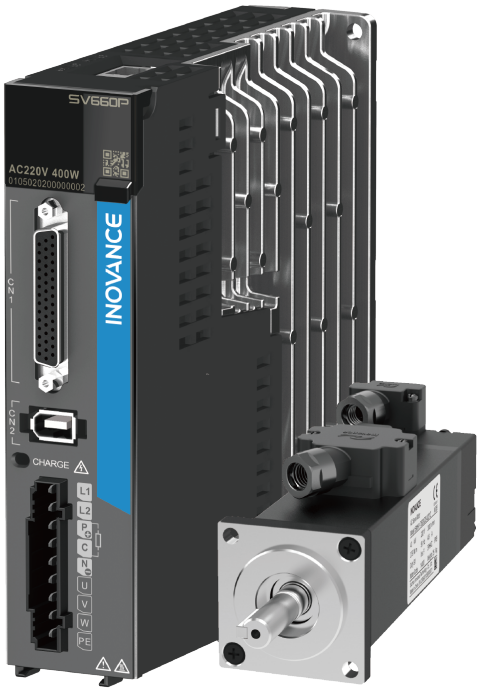
INOVANCE

SV660P Series Servo Drive

Function Guide



Data code 19011393 A03

Preface

Overview

The SV660P series high-performance AC servo drive covers a power range from 50 W to 7.5 kW. It supports Modbus, CANopen and CANlink communication protocols and carries necessary communication interfaces to work with the host controller for a networked operation of multiple servo drives.

The SV660P series servo drive supports adaptive 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 high inertia and a 23-bit single-turn/multi-turn absolute encoder.

The SV660P series servo drive serves to achieve quick and accurate position control, speed control, and torque control in automation equipment such as electronic manufacturing devices, manipulators, packing devices, and machine tools.

This function guide presents product functions and parameters, including function overview, basic servo drive functions, adjustment and parameter list.

More Documents

Name	Data Code
SV660P series servo drive selection guide	19011390
SV660P series servo drive hardware guide	19011391
SV660P series servo drive commissioning guide	19011392

Revision History

Date of Revision	Version	Revision
August 2020	A00	First release
November 2020	A01	Minor corrections
January 2021	A02	• Updated the descriptions for parameters including H02-06, H02-08, H03-65, H03-66, H05-16, H05-31, H05-41, H06-01, H07-17, H0A-26, H0C-02, and H0C-08. • Updated the descriptions for Er.136 and Er.210. • Added Appendix: CANlink Enhanced Axis Control Parameters.
May 2021	A03	• Updated descriptions for H05-16. • Updated descriptions for Er.510.

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 user 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 user 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 user 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 user 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 user 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, with no screws, washers, or exposed cables 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

The following table describes the servo drive functions. Detailed function descriptions are provided in the corresponding chapters.

Name	Function
Position control mode	Operating in the position control mode
Speed control mode	Operating in the speed control mode
Torque control mode	Operating in the torque control mode
Position/Speed control switchover mode	Switching between position control and speed control through external DI signals
Speed/Torque control switchover mode	Switching between speed control and torque control through external DI signals
Torque/Position control switchover mode	Switching between torque control and position control through external DI signals
Torque/Speed/Position control switchover mode	Switching among torque control, speed control and position control through external DI signals
High-resolution encoder	Featuring a resolution of 8388608 PPR
Mechanical characteristic analysis	Analyzing the resonance frequency and characteristic of the mechanical system through a PC installed with Inovance software tool
Gain auto-tuning	Generating a group of gain values automatically to match present working conditions through setting just one parameter
Gain switchover	Switching to different gains upon stop or switching gains through external terminals during operation
Torque disturbance observer	Estimating the disturbance torque suffered by the system to make compensation and reduce vibration
Resonance suppression	Setting filter characteristics automatically to suppress mechanical system vibration after detecting the resonance point
Torque reference filter	Suppressing the mechanical resonance generated in case of excessively high response speed
Electronic gear ratio	Decreasing or increasing the pulse input by 0.001 x encoder resolution to 4000 x encoder resolution
Position ramp	Accelerating smoothly to respond to the position reference
Position first-order low-pass filter	Enabling smooth acceleration and deceleration
Homing	Searching for the mechanical home automatically to locate the relative position between the mechanical home and mechanical zero
Interrupt positioning	Interrupting present position reference and executing the set displacement
Zero clamp	Keeping the motor speed below a certain value in the speed mode to keep the position locked
Reference pulse selection	Offering four types of pulse train
External regenerative resistor	Intending to be used when the braking capacity of the built-in regenerative resistor is insufficient
Input signal selection	Assigning functions such as S-ON to corresponding pins
Fault log	Recording or clearing the latest ten faults/warnings
Status display	Displaying servo drive status through the LED on the keypad
External I/O display	Displaying ON/OFF status of external I/O signals
Forced output of output signals	Outputting signals unrelated to the servo drive status forcibly, which can be used to check the wiring of the output signals
Trial run mode	Making the servo motor run through the keypad without a start signal

Name	Function
Inovance software tool	Supporting parameter settings, trial run and status display through a PC
Warning code output	Outputting a three-digit warning code upon a warning event

2 Basic Functions of the Servo Drive

2.1 Position Control Mode

2.1.1 Position Control Mode

Definition of terms:

- Reference unit: Refers to the minimum identifiable value input from the host controller to the servo drive.
- Encoder unit: Refers to the value of the input reference multiplied by the electronic gear ratio.

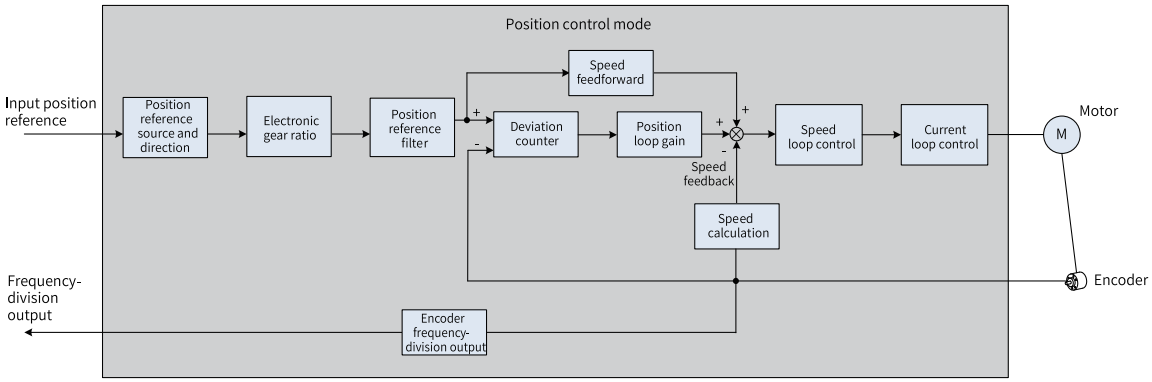


Figure 2-1 Position control diagram

Set H02-00 (Control mode selection) to 1 (Position control mode) through the keypad or Inovance software tool to make the servo drive operate in the position control mode. Set the servo drive parameters based on the mechanical structure and technical indicators.

The following describes the position control mode.

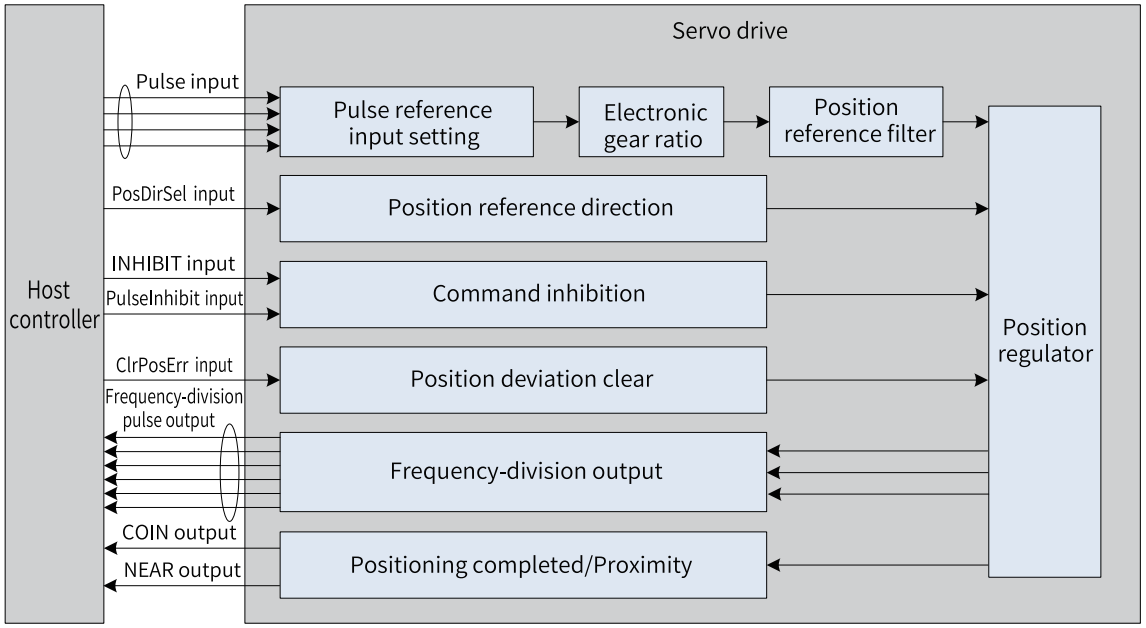


Figure 2-2 Signal exchange between the servo drive and the host controller

2.1.2 Position Reference Input Setting

The position reference input setting includes the position reference source, position reference direction, and position reference inhibition.

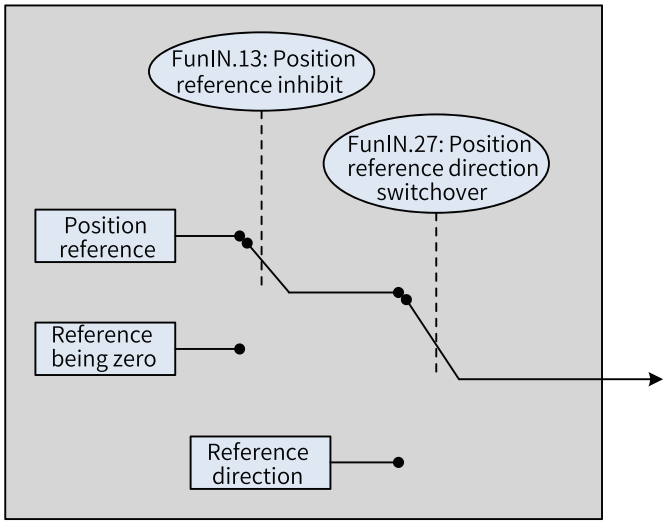


Figure 2-3 Position reference input setting

Position reference source

In the position control mode, set the position reference source in H05-00 first.

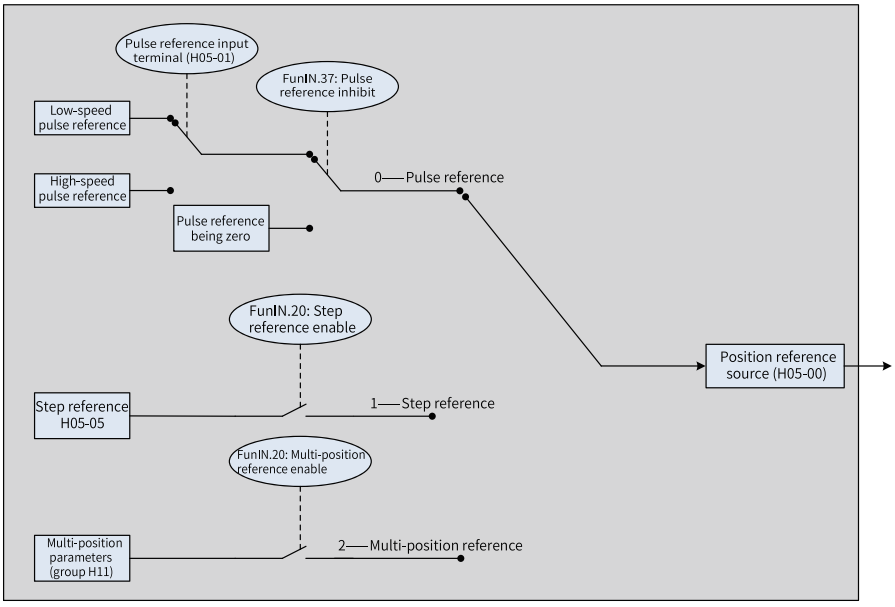


Figure 2-4 Setting the position reference source

☆Related parameters

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H05–00	Position reference source	0: Pulse reference 1: Step reference 2: Multi-position reference	Defines the position reference source. Pulse references are external position references. Step references and multi-position references are internal position references.	At stop	At once	0

- Pulse reference (H05-00 = 0)
  Perform the following operations to obtain the correct pulse reference format.

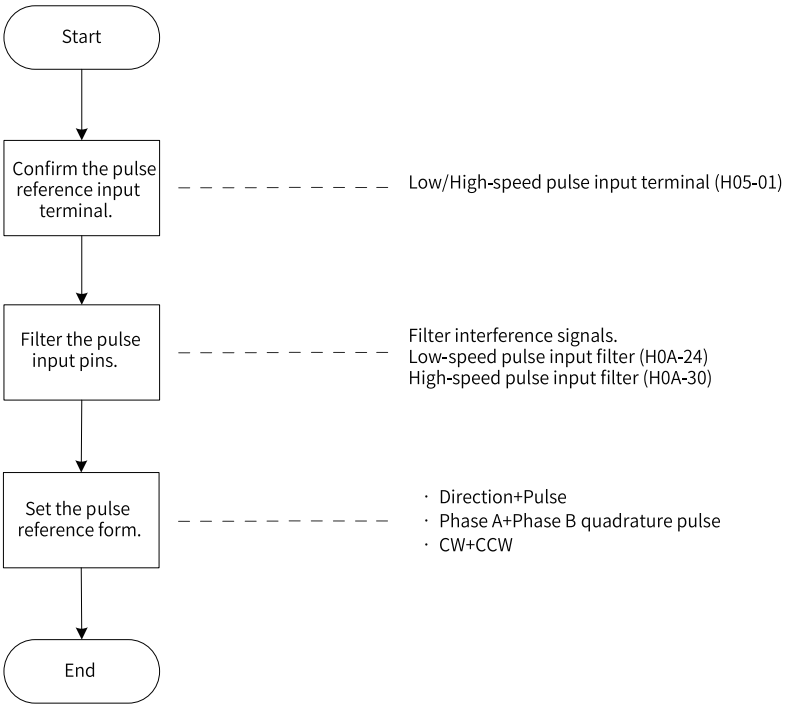
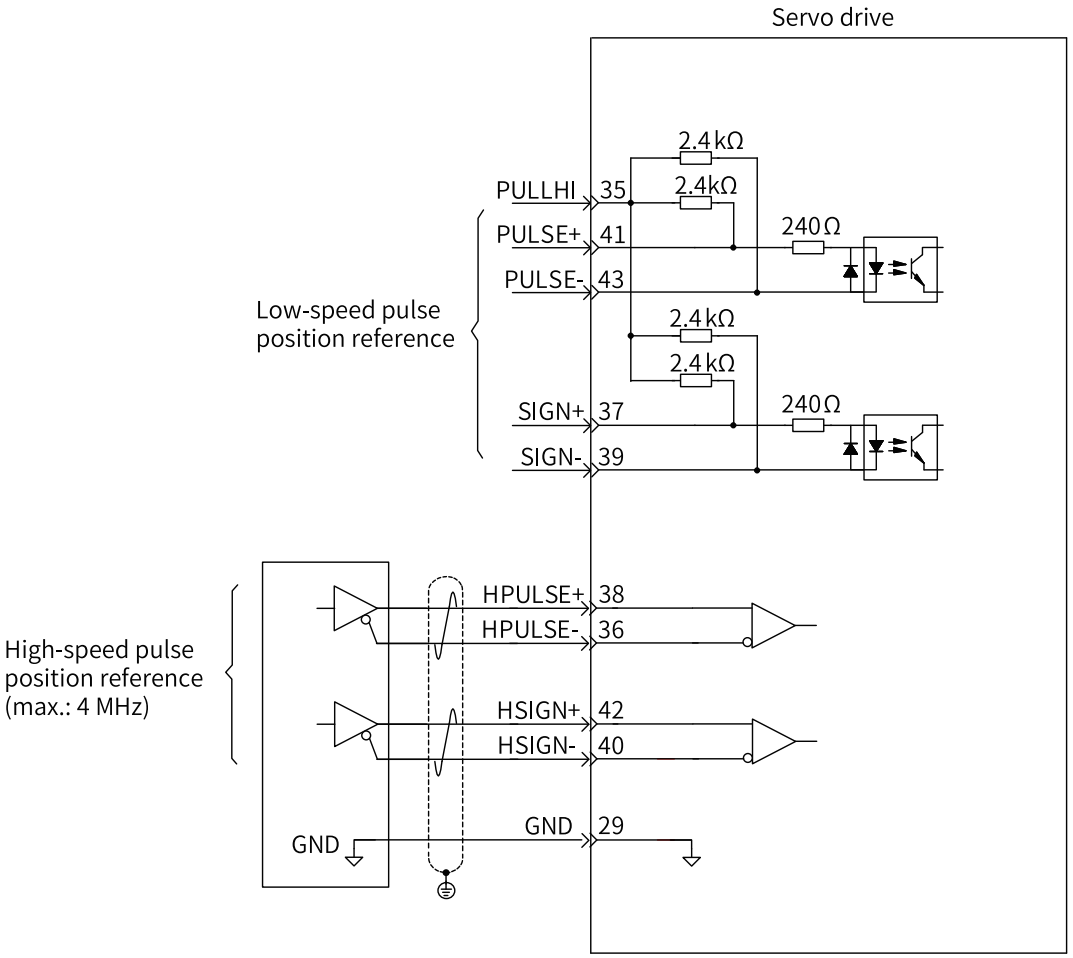


Figure 2-5 Flowchart for setting the pulse reference as the source

  - Pulse reference input terminals
    The servo drive provides two groups of pulse input terminals.



The low-speed pulse input terminals (PULSE+, PULSE-, SIGN+, SIGN-) receive differential input (maximum frequency up to 200 kpps) and open-collector input (maximum frequency up to 200 kpps).

The high-speed pulse input terminals (HPULSE+, HPULSE-, HSIGN+, HSIGN-) receive differential input (maximum frequency up to 4 Mpps) only.

☆Related parameters

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H05–01	Pulse reference input terminal selection	0: Low-speed terminals 1: High-speed terminals	Defines the hardware input terminal of pulse references.	At stop	At once	0

For details on the terminal circuit, see SV660P Series Servo Drive Hardware Guide.

Table 2–1 Specifications of pulse input

Pulse Type		Maximum Input Frequency	Voltage	Forward Current
High-speed pulse	Differential signal	4 M	5 V	< 25 mA
Low-speed pulse	Differential signal	200 k	5 V	< 15 mA
	Open collector signal	200 k	24 V	< 15 mA

- Pulse input pin filter

Set the pin filter time for input terminals of low-speed and high-seed pulses. This is to prevent motor malfunction caused by interference signals.

☆Related parameters

Para. No.	Name	Value Range	Unit	Function	Setting Condition	Effective Time	Default
H0A-24	Filter time constant of low-speed pulse input pin	0 to 255	25ns	Defines the filter time constant for low-speed pulses.	At stop	Next power-on	30
H0A-30	Filter time constant of high-speed pulse input pin	0 to 255	25ns	Defines the filter time constant for high-speed pulses.	At stop	Next power-on	3

If the filter time constant for pulse input pins is t_F, the minimum width of input signals is t_{min}, then the input signals before and after filtering are as follows. The filtered input signal will be delayed for t_F over the unfiltered one.

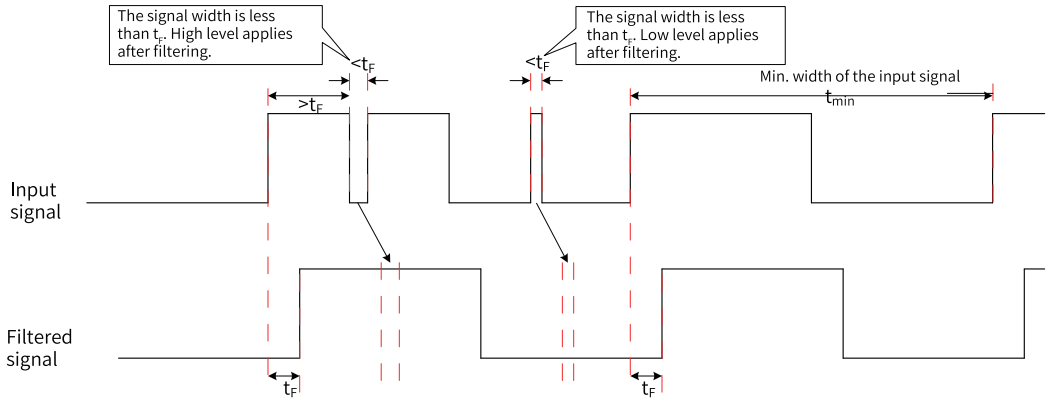


Figure 2-6 Example of filtered signal waveform

The pulse input pin filter time t_F must meet the following requirement: $t_F \leqslant$ (20% to 25%) t_{min}

The following table lists the recommended filter time constant based on the maximum frequency (or minimum pulse width) of input pulses.

Table 2–2 Recommended filter time constant

Pulse Input Terminal	Para. No.	Maximum Frequency of Input Pulses	Recommended Filter Time Constant (25 ns)
Low-speed pulse input terminal	H0A-24	< 167 k	30
Low-speed pulse input terminal	H0A-24	167 k to 200 k	20
High-speed pulse input terminal	H0A-30	200 k to 1 M	5
High-speed pulse input terminal	H0A-30	> 1 M	3

For example, if the filter time constant is set to 30, the actual filter time is 30 x 25 = 750 ns.

- Pulse reference form

  The servo drive supports the following three types of pulse references:

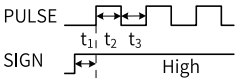
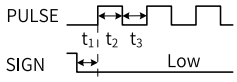
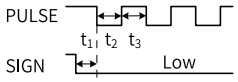
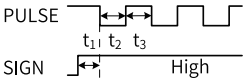
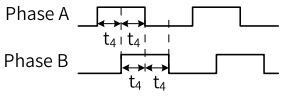
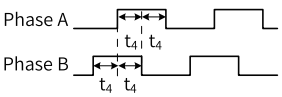
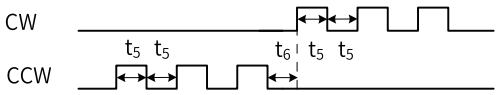
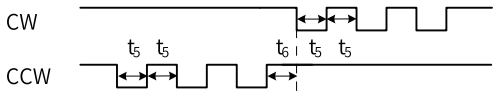
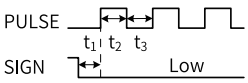
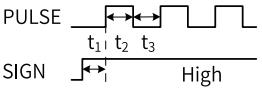
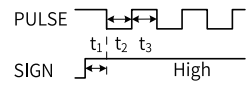
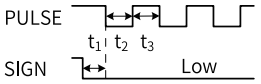
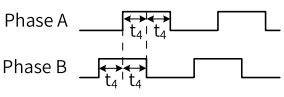
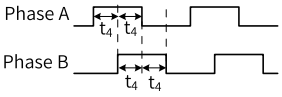
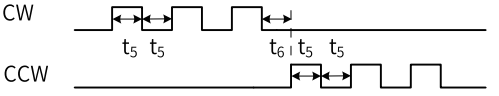
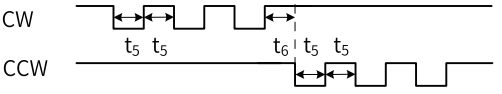
  - Direction + Pulse (positive or negative logic)
  - Phase A + Phase B quadrature pulse, quadrupled frequency
  - CW + CCW

Select a pulse reference form appropriate for the host controller or other pulse generators.

☆Related parameters

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H05–15	Pulse reference form	0: Direction + Pulse, positive logic 1: Direction + Pulse, negative logic 2: Phase A + Phase B quadrature pulse, quadrupled frequency 3: CW + CCW	Defines the pulse reference form.	At stop	Next power-on	0

Table 2–3 Descriptions of the pulse form

H02-02 Direction of Rotation	H05-15 Reference Form	Pulse Form	Signal	Diagram of Forward Pulses	Diagram of Reverse Pulses
0	0	Pulse + Direction Positive Logic	PULSE SIGN		
	1	Pulse + Direction Negative Logic	PULSE SIGN		
	2	Phase A + Phase B Quadrature pulse Quadrupled frequency	PULSE (phase A) SIGN (phase B)	Phase A leads phase B by 90°. 	Phase B leads phase A by 90°. 
	3	CW+CCW	PULSE (CW) SIGN (CCW)		
					
1	0	Pulse + Direction Positive Logic	PULSE SIGN		
	1	Pulse + Direction Negative Logic	PULSE SIGN		
	2	Phase A + Phase B Quadrature pulse Quadrupled frequency	PULSE (phase A) SIGN (phase B)	Phase B leads phase A by 90°. 	Phase A leads phase B by 90°. 
	3	CW+CCW	PULSE (CW) SIGN (CCW)		
					

The following table describes the maximum frequencies and minimum time widths of position pulse references corresponding to different input terminals.

Table 2–4 Specifications of the pulse reference

Input Terminal		Max. Frequency	Min. Time Width (unit: us)					
			t1	t2	t3	t4	t5	t6
High-speed pulse input terminal		4 Mpps	0.125	0.125	0.125	0.25	0.125	0.125
Low-speed pulse input terminal	Differential input	200 kpps	2.5	2.5	2.5	5	2.5	2.5
	Open collector input	200 kpps	2.5	2.5	2.5	5	2.5	2.5

The rise time and fall time of position pulse references must be lower than 0.1 us.

- Pulse reference frequency

  You can set the maximum position pulse frequency in H0A-09. If the actual input pulse frequency is higher than H0A-09, Er.B01 (Pulse input error) will occur.

  ☆Related parameters

Para. No.	Name	Value Range	Unit	Function	Setting Condition	Effective Time	Default
H0A-09	Maximum position pulse frequency	100 to 4000	kHz	Defines the maximum frequency of external pulse references.	At stop	Next power-on	4000

- Step reference as position reference source (H05-00 = 1)

Caution

When the S-ON (Servo ON) signal is active, the motor is in the locked state when the step reference is disabled or in the rotational state when the step reference is enabled. After H05-05 (Step reference) is done executing, the motor stays in the locked state when no step reference is triggered again.

The servo drive supports step operation, which means the servo drive operates at a fixed speed until the set displacement is reached. The setting flowchart is shown below.

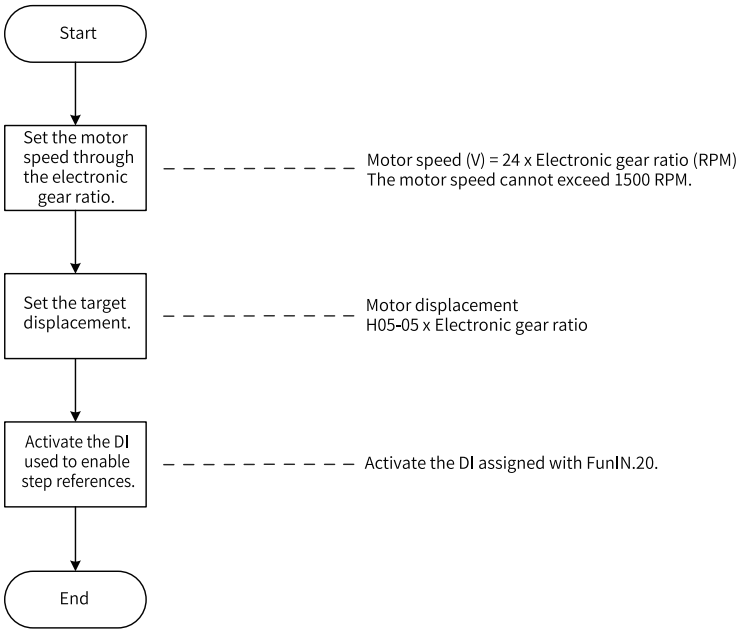


Figure 2-7 Flowchart for setting step reference

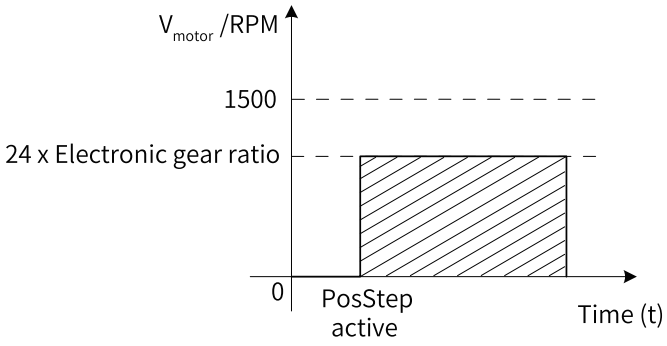


Figure 2-8 Motor operating curve (H05-00 = 1)

The hatched area in the preceding figure indicates the motor displacement: H05-05 x Electronic gear ratio (encoder unit).

- Relation between the motor speed and electronic gear ratio
  When the step reference is used as the position reference source, the set motor speed will be converted based on the following formula. The motor speed in this case cannot exceed 1500 RPM.

  $$V_{motor} = 24 \times \text{Electronic gear ratio (RPM)}$$

- Motor displacement
  When the step reference is used as the position reference source, the sum of position references (reference unit) is set in H05-05. The sign of the setpoint of H05-05 determines whether the motor speed is a positive or a negative value.

  ☆Related parameters

Para. No.	Name	Value Range	Unit	Function	Setting Condition	Effective Time	Default
H05–05	Step reference	-9999 to +9999	Reference unit	Defines the position reference sum when H05-00 (Position reference source) is set to 1 (Step reference). The sign of the setpoint determines whether the motor speed is a positive or a negative value.	At stop	At once	50

- Step reference enable

  To use the step reference as the position reference source, assign FunIN.20 (PosStep, step reference enable) to a certain DI of the servo drive, and set the active logic of this DI.

  ☆Related function No.

Function No.	Name	Function Name	Description
FunIN.20	PosStep	Step reference enable	S-ON: Active: The position reference defined by H05-05 is input to the servo drive, driving the motor to run. Inactive: The motor stays locked.

FunIN.20 (Step reference enable) is edge-triggered. The motor is locked after the step reference is done executing. When FunIN.20 is triggered again, the motor executes the step reference defined by H05-05 again.

- Multi-position reference as position reference source (H05-00 = 2)

  The servo drive supports multi-position operation, in which 16 displacement references can be saved in the servo drive. The maximum operating speed and acceleration/deceleration time of each displacement can be set separately. The waiting time and linkage mode among these 16 displacements can also be set as needed. The setting flowchart is shown below.

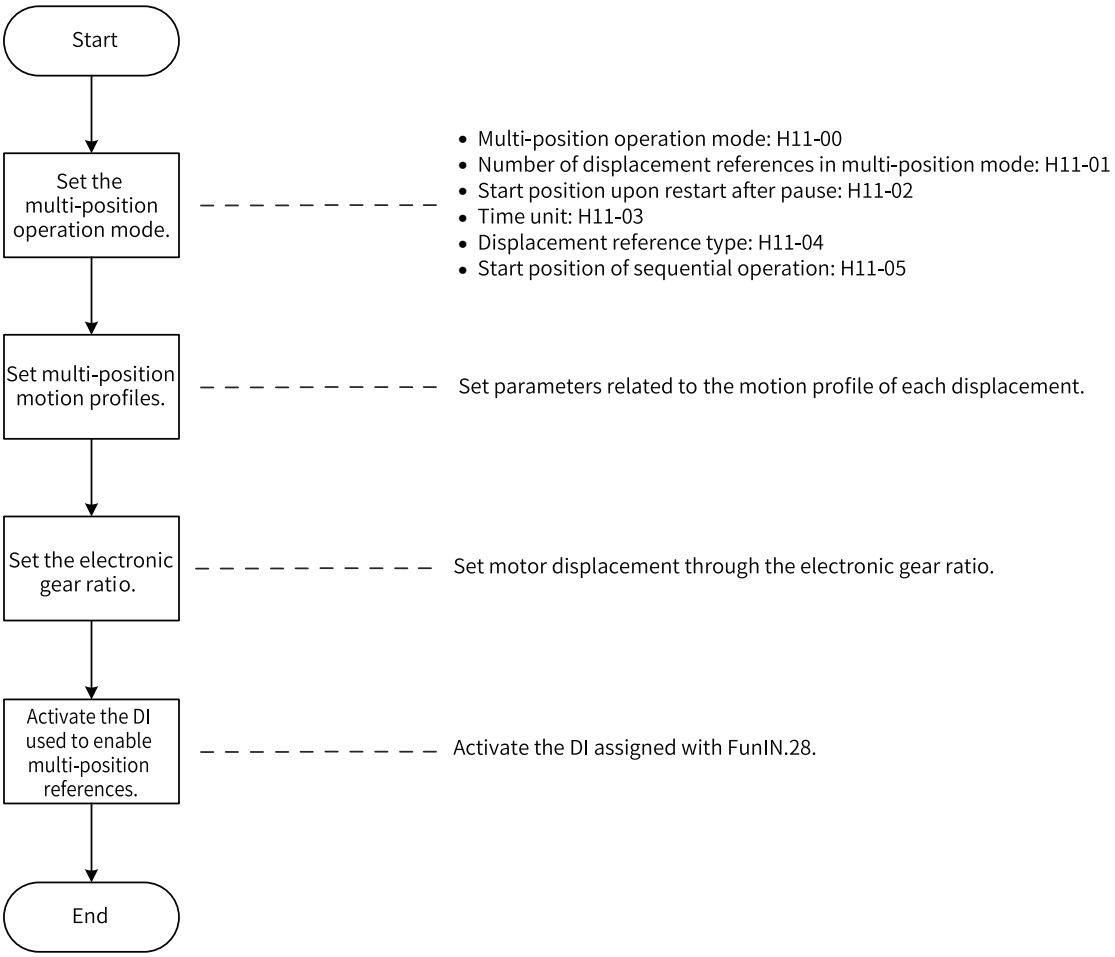


Figure 2-9 Flowchart for setting multi-position reference as the source

- Setting the multi-position operation mode

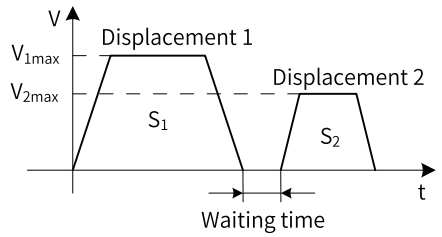
  ☆Related parameters

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H11-00	Multi-position operation mode	0: Individual operation 1: Cyclic operation 2: DI-based operation 3: Sequential operation 5: Axis-controlled continuous operation	Defines the linkage mode between displacements.	At stop	At once	1
H11-01	Number of multi-position references	1 to 16	Defines the total number of displacements in multi-position operation.	At stop	At once	1
H11-02	Start displacement no. after pause	0: Continue to execute the remaining positions 1: Start from displacement 1	Defines the start displacement no. when multi-position operation recovers from a pause upon S-ON. **Note:** H11-02 is active only when H11-00 is not set to 2.	At stop	At once	1

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H11-03	Waiting time unit	0: ms 1: s	Defines the acceleration/ deceleration time and waiting time unit. **Note:** The waiting time is active only when H11-00 is set 0 or 1.	At stop	At once	0
H11-04	Displacement reference type	0: Relative position reference 1: Absolute position reference	Defines the displacement reference type.	During running	At once	0
H11-05	Start displacement no. in sequential operation	0 to 16	Defines the start displacement no. after the first cycle of operation is done in the sequential operation mode (H11-00 = 3). **Note:** • H11-05 = 0, or H11-05 > H11-01: Cyclic operation does not apply. • When H11-05 > 1, the start position No. is the setpoint of H11-05.	At stop	At once	0

(1) Individual operation (H11-00 = 0)

Table 2–5 Description of individual operation

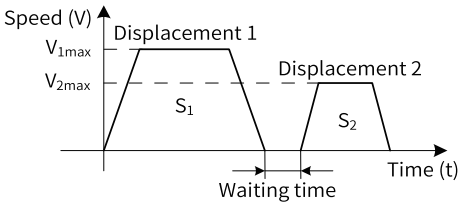
Description	Operating Curve
• The servo drive stops after an individual operation. • The servo drive switches to the next displacement no. automatically. • The time interval between displacements can be set as needed. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max}, V_{2max}: maximum operating speeds in displacement 1 and displacement 2 S_1, S_2: displacement 1 and displacement 2 • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the servo drive abandons the unexecuted displacements and stops. The COIN (positioning completed) signal is activated after the servo drive stops. • Switch on the PosInsen signal again. The servo drive operates as defined by H11-02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02-05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

★Definitions of terms:

A complete operation cycle covers all the displacement references defined by H11-01.

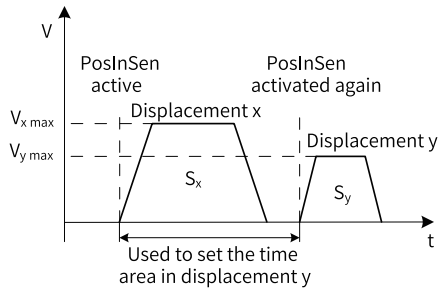
(2) Cyclic operation (H11-00 = 1)

Table 2–6 Descriptions of cyclic operation

Description	Operating Curve
• The servo drive starts from displacement 1 again after each cycle of operation. • The servo drive switches to the next displacement no. automatically. • The time interval between displacements can be set as needed. • The cyclic operation mode is kept when the FunIN.28 (Multi-position reference enable) is active. • The PosInSen (multi-position reference enable) signal is level-triggered.	 V_{1max}, V_{2max}: maximum operating speeds in displacement 1 and displacement 2 S_1, S_2: displacement 1 and displacement 2 • The positioning completed signal is active after each displacement is reached. • If PosInsen (multi-position reference enable) signal is switched off during operation, the servo drive abandons unexecuted displacements and stops. The COIN (positioning completed) signal is activated after the servo drive stops. • Switch on the PosInsen signal again. The servo drive operates as defined by H11-02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02-05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

(3) DI-based operation (H11-00 = 2)

Table 2–7 Descriptions of DI-based operation

Description	Operating Curve
• The next displacement No. can be set when the current displacement is in progress. The motor stops after current displacement reference is done executing. After the PosInsen (multi-position reference enable) signal is switched on again, the displacement No. at this moment will be executed. The displacement No. is determined by the DI logic. • • The time interval between displacements is determined by the command delay of the host controller. • The PosInsen (multi-position reference enable) signal is edge-triggered.	 V_{xmax} , V_{ymax} : maximum operating speeds in displacement x and displacement y S_x , S_y : displacement x and displacement y • The positioning completed signal is active after each displacement is reached. • If the PosInsen (multi-position reference enable) signal switched off during operation, the servo drive continues to execute the unexecuted displacements and outputs the COIN (positioning completed) signal. • The position No. must be switched in the following sequence: 1. Wait until displacement x is done executing before switching the displacement no.. 2. When displacement x is in progress or done, switch off the PosInsen (multi-position reference enable) signal first, and then change the displacement no. from x to y (if x = y, the servo drive executes displacement x again). 3. After displacement x is done executing, switch on the PosInsen (multi-position reference enable) signal again to make the servo drive execute displacement y. • If the S-ON signal is switched off during operation, the motor stops as defined by H02-05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

In multi-position operation mode, assign four DIs with FunIN.6 to FunIN.9 respectively, and set the active logic of these DIs.

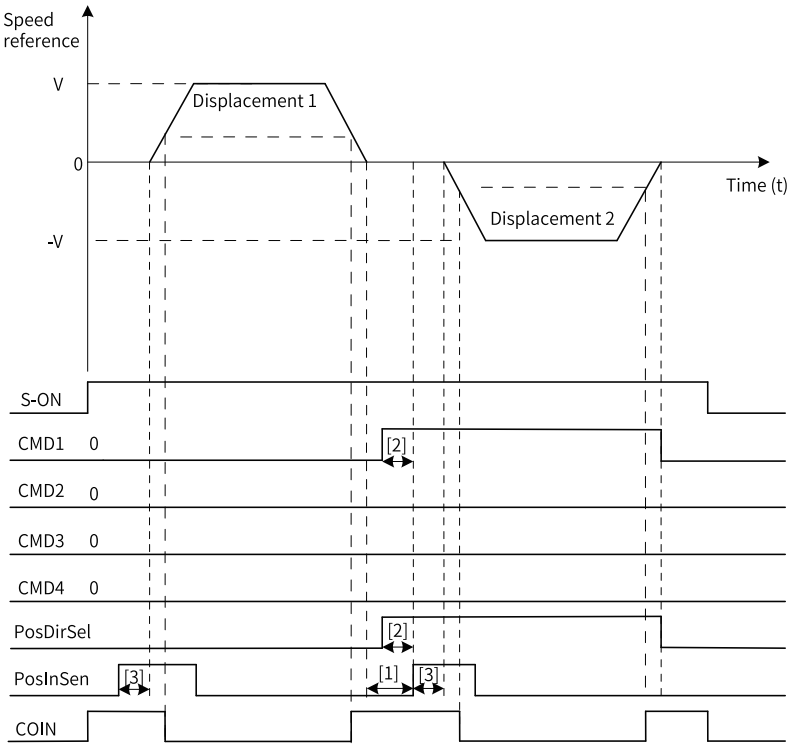


Figure 2-10 Multi-position sequence diagram

Note

- [1] Area for switchover of displacement no.: Refers to the interval starting from the moment the last position reference is done transmitting to the moment the next PosInsen (multi-position reference enable) is activated again.
- [2] When a low-speed DI is used, an effective signal width of 3 ms must be kept.
- [3] The PosInSen signal is edge-triggered. The minimum signal widths required by the low-speed DI and high-speed DI are 3 ms and 0.25 ms respectively.

☆Related function No.

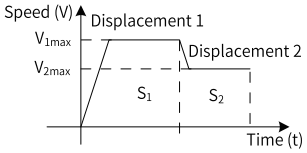
Function No.	Name	Function Name	Function
FunIN.6	CMD1	Multi-reference switchover 1	The displacement no. is a 4-bit binary value. The relation between the displacement no. and CMD1 to CMD4 is shown in *"Table 2–8" on page 28*. The DI logic is level-triggered. The CMD value is 1 upon active level input or 0 upon inactive level input.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 2–8 Relation between the displacement no. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Displacement No.
0	0	0	0	1
0	0	0	1	2
…				
1	1	1	1	16

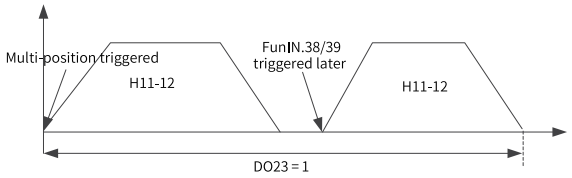
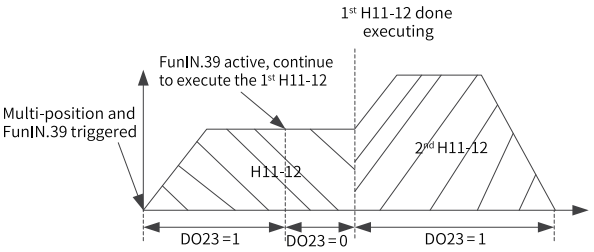
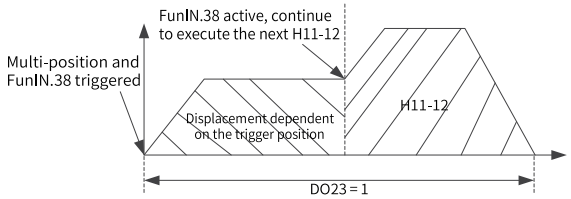
Sequential operation (H11-00 = 3)

Table 2–9 Descriptions of sequential operation

Description	Operating Curve
• The servo drive stops after one cycle of operation (H11-05 = 0 or H11-05 > H11-01). • • Cyclic operation is available, which starts from the position No. defined by H11-05 (Start position No. of sequential operation) after the first cycle of operation. • The servo drive switches to the next displacement no. automatically. • There is no time interval between displacements. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max}, V_{2max}: maximum operating speeds in displacement 1 and displacement 2 S_1, S_2: displacement 1 and displacement 2 • The positioning completed signal is active after each displacement is reached. • If the PosInsen (multi-position reference enable) signal is switched off when the operation is in progress, the servo drive abandons the unexecuted position and stops. The positioning completed signal is activated after the servo drive stops. • Switch on the PosInsen signal again. The servo drive operates as defined by H11-02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02-05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

Axis-controlled continuous operation (H11-00 = 5)

Table 2–10 Description of axis-controlled continuous operation

Description	Operating Curve
• The servo drives executes one displacement only. • The individual operation mode, sequential operation mode, and interrupted operation mode are included. • The PoslnSen (multi-position reference enable) signal is level-triggered.	• Individual operation  • The PoslnSen (multi-position reference enable) signal is triggered only once (FunIN.38/39 triggered later). The servo drive stops after executing the distance defined by H11-12 (Displacement 1). • Sequential operation  • The PoslnSen (Multi-position reference enable) signal is triggered only once. Write H11-12 again and activate FunIN.39 when the first H11-12 (Displacement 1) is still in progress. After receiving the new distance (or speed), which is the second H11-12, the servo drive continues executing the first H11-12 until the distance defined by the first H11-12 is reached. Then it starts to execute the second H11-12 directly. The travel distance therefore is the sum of the first H11-12 and the second H11-12.• • Interrupted operation  • The PoslnSen (Multi-position reference enable) signal is triggered only once. Write H11-12 (such as 1000000) again and activate FunIN.38 when the first H11-12 (such as 9000000) is still in progress. After receiving the new distance (or speed), which is the second H11-12, the servo drive stops executing the first H11-12 and turns to executing the second H11-12.

☆Related function No.

Function No.	Name	Function Name	Function
FunIN.38	MultiBlockTrig	Write interrupt-trigger signal	Active: Newly written command activated immediately Inactive: Newly written command not activated
FunIN.39	MultiBlockWr	Write non-interrupt-trigger signal	Active: Newly written command activated after current displacement is done executing Inactive: Newly written command not activated
FunOUT.23	WrNextBlockEn	Next command input enable	Active: Next command input allowed Inactive: Next command input inhibited

- Setting multi-position operating curve

  A total of 16 displacement references can be set during multi-position operation. The displacement, maximum operating speed, acceleration/deceleration time, and waiting time between displacements can be set separately. The following table takes displacement 1 as an example.

  ☆Related parameters

Para. No.	Name	Value Range	Unit	Function	Setting Condition	Effective Time	Default
H11-12	Displacement 1	-1073741824 to +1073741824	Reference unit	Defines the position reference sum of displacement 1.	During running	At once	10000
H11-14	Maximum speed of displacement 1	1 to 6000	RPM	Defines the maximum operating speed of displacement 1.	During running	At once	200
H11-15	Acceleration/ Deceleration time of displacement 1	0 to 65535	ms (s)	Defines the time for the motor to change from 0 RPM to 1000 RPM in the 1st displacement.	During running	At once	10
H11-16	Waiting time after displacement 1	0 to 10000	ms (s)	Defines the waiting time after displacement 1 is done executing.	During running	At once	10

The actual operating curve of the motor based on preceding settings is shown in the following figure.

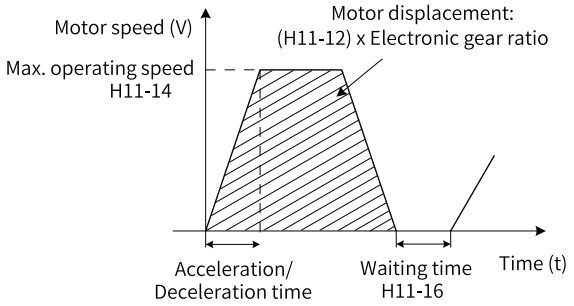


Figure 2-11 Motor operating curve in displacement 1

Actual time (t) taken to accelerate to H11-14:

$$t = \frac{(H11\text{-}14)}{1000} \times (H11\text{-}15)$$

For parameter settings of other 15 displacements, see Chapter "Parameter List".

- Setting multi-position reference enable mode
  To use the multi-position reference as the position reference source, assign FunIN.28 (PosInSen, multi-position reference enable) to a certain DI of the servo drive, and set the active logic of this DI.

  ☆ Related function No.

Function No.	Name	Function Name	Function
FunIN.28	PosInSen	Multi-position reference enable	Active: The motor executes the multi-position reference. Inactive: The motor stays locked. **Note:** • When H11-00 = 0, 1, 3, the logic of the DI assigned with the PosInSen signal is level-triggered. • When H11-00 = 2, the logic of the DI assigned with the PosInSen signal is edge-triggered.

Position reference direction

A DI can be used to change the position reference direction, thus changing the motor direction of rotation. Assign FunIN.27 (PosDirSel, position reference direction) to a DI of the servo drive, and set the active logic of this DI.

☆Related function No.

Function No.	Name	Function Name	Function
FunIN.27	PosDirSel	Position reference direction	Inactive: Actual position reference direction same as the set direction Active: Actual position reference direction opposite to the set direction

The actual direction of rotation is related to the setting of H02-02 (Direction of rotation), the sign (+/-) of the position reference value, and FunIN.27.

Table 2–11 Motor direction of rotation

H02-02	Sign of the Position Reference Value	FunIN.27	Actual Direction of Rotation
0	+	Inactive	CCW
0	+	Active	CW
0	-	Inactive	CW
0	-	Active	CCW
1	+	Inactive	CW
1	+	Active	CCW
1	-	Inactive	CCW
1	-	Active	CW

Position reference inhibition

FunIN.13 (Inhibit) and FunIN.37 (PulseInhibit) are used to inhibit position references and pulse references.

- Position reference inhibit (FunIN.13)
  The servo drive sets all the position references to 0, which means it does not respond to any internal or external position references, and the motor is in the locked state in the position control mode. In this case, the servo drive can switch to other control mode to continue operating.

  When FunIN.13 is activated, the input position reference counter (H0B-13) continues counting the position references in the position control mode, but the references counted in this case are not responded to by the servo drive after FunIN.13 is deactivated.

  To use FunIN.13 (Inhibit, position reference inhibit), assign FunIN.13 to a certain DI and set the active logic of this DI. It is recommended to use the high-speed DI (DI8 or DI9).

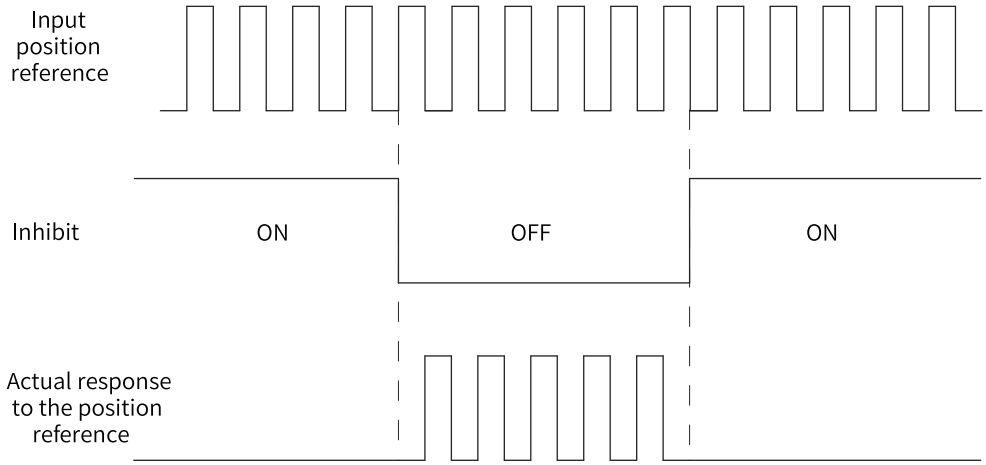


Figure 2-12 Example of position reference inhibition waveform

☆ Related function No.

Function No.	Name	Function Name	Function
FunIN.13	Inhibit	Position reference inhibit	Inactive: The servo drive responds to position references in the position control mode. Active: The servo drive does not respond to any internal or external position references in the position control modes.

- Pulse reference inhibit
  The servo drive sets all the pulse references to 0, which means it does not respond to any pulse references inputted from the pulse input terminal but it can respond to position references in other forms in the position control mode. In this case, you can switch to other control modes.

  When FunIN.37 is activated in the position control mode and no other forms of position references are used, the input position reference counter (H0B-13) continues counting the pulse references inputted from the pulse input terminal, but the pulse references counted in this case are not responded to by the servo drive after FunIN.37 is deactivated.

  If position references in other forms are used in the position control mode, the input position reference counter (H0B-13) continues counting the these position references, and these references will be executed.

To use FunIN.37 (PulseInhibit, pulse reference inhibit), assign FunIN.37 to a certain DI and set the active logic of this DI. It is recommended to use the high-speed DI (DI8 or DI9).

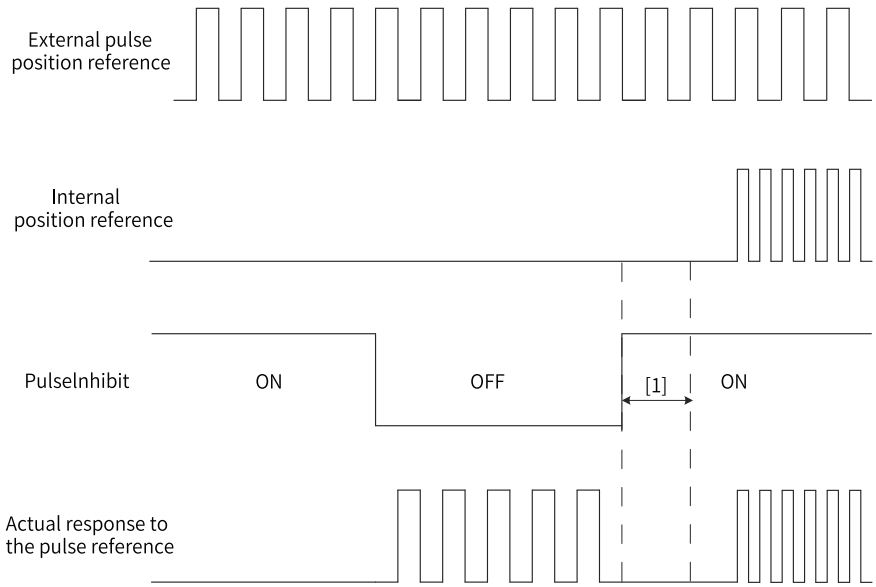


Figure 2-13 Waveform example for pulse reference inhibit

Note

- [1] When using a low-speed DI, keep an interval of at least 3 ms from the moment the DI logic is deactivated to the moment the internal position reference is inputted.
- When using a high-speed DI, keep an interval of at least 0.25 ms from the moment the DI signal is inputted to the moment the response is generated.

☆ Related function No.

Function No.	Name	Function Name	Function
FunIN.37	PulseInhibit	Pulse reference inhibit	When the position reference source is pulse reference (H05-00 = 0) in the position control mode: Inactive: The servo drive responds to pulse references. Active: The servo drive does not respond to pulse references.

2.1.3 Reference Frequency Division/Multiplication Function (Electronic Gear Ratio)

Caution

- The electronic gear ratio must be within the following range:

$$\frac{0.001 \times \text{Encoder resolution}}{10000} \leq B/A \leq \frac{4000 \times \text{Encoder resolution}}{10000}$$

  Otherwise, Er.B03 (Electronic gear ratio beyond the limit) will occur.
- In cases where an operation error occurs due to an improper electronic gear ratio, it is recommended to reset the electronic gear ratio after the servo drive stops.

Definition of the electronic gear ratio

In the position control mode, the input position reference (reference unit) defines the load displacement; the motor position reference (encoder unit) defines the motor displacement. The electronic gear ratio is used to establish a proportional relation between the input position reference and motor position reference.

The electronic gear ratio, which allows frequency division (electronic gear ratio < 1) or frequency multiplication (electronic gear ratio > 1), can be used to set the actual displacement corresponding to the input position reference per reference unit, or used to increase the position reference frequency when the motor speed needed cannot be fulfilled due to limited pulse output frequency of the host controller or limited parameter value range.

★Definitions of terms:

- Reference unit: Refers to the minimum identifiable value input from the host controller to the servo drive.
- Encoder unit: Refers to the value of the input reference multiplied/divided by the electronic gear ratio.

Procedure for setting the electronic gear ratio

The electronic gear ratio varies according to the mechanical structure. Set the electronic gear ratio according to the following procedure.

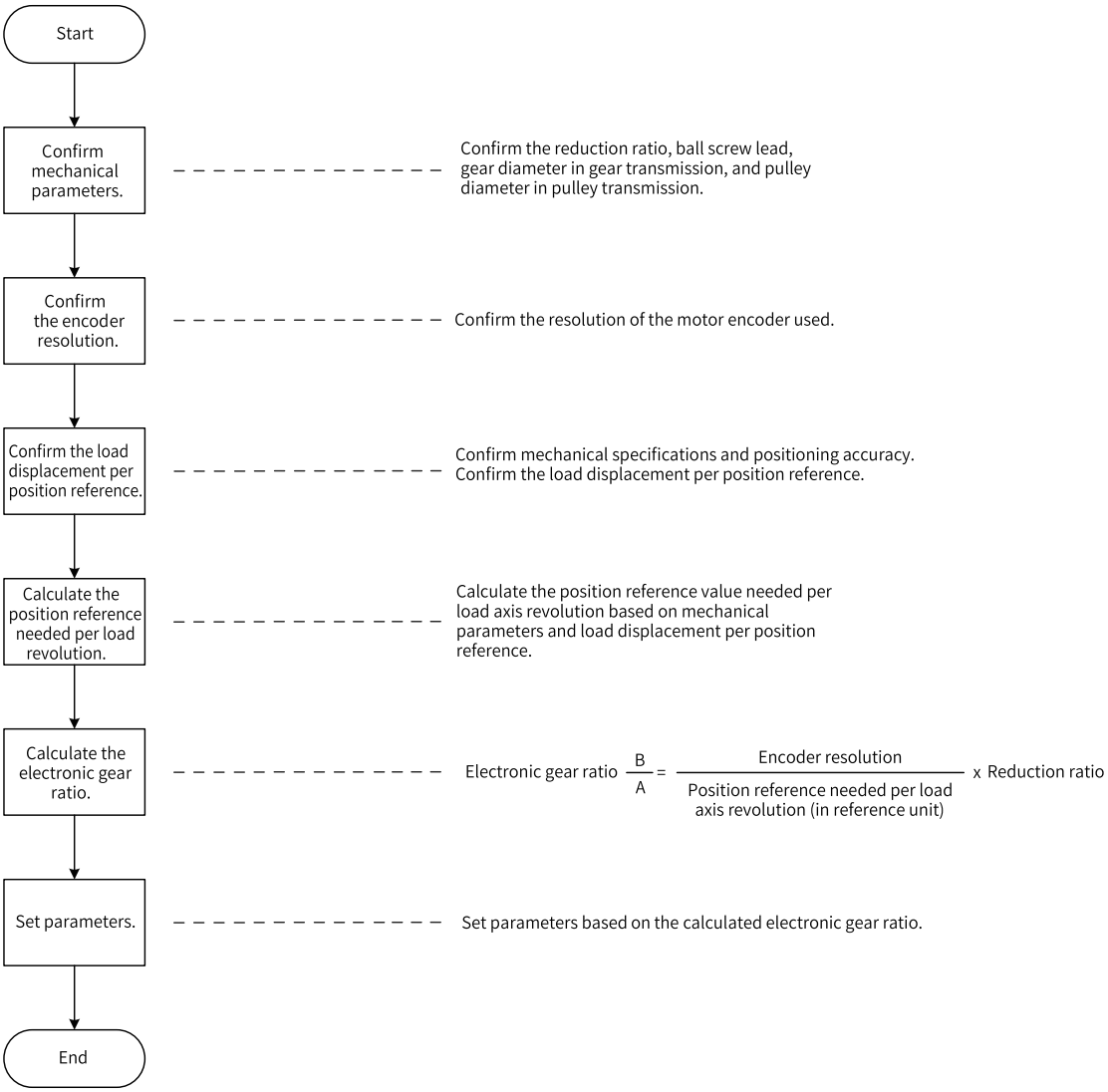


Figure 2-14 Procedure for setting the electronic gear ratio

See the following figure for how to set parameters.

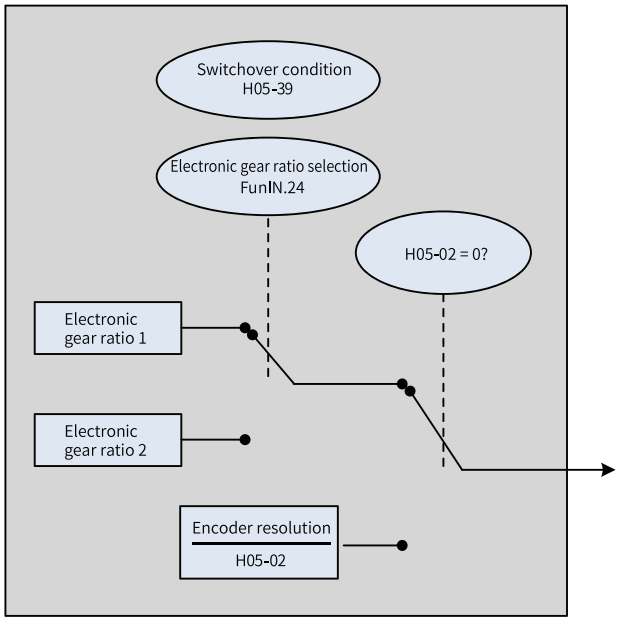


Figure 2-15 Procedure for setting the electronic gear ratio

Note

When the setpoint of H05-02 (Pulses per revolution) is not 0, the following formula applies:

Electronic gear ratio $\frac{B}{A} = \frac{\text{Encoder resolution}}{\text{H05.02}}$. In this case, electronic gear ratios 1 and 2 are invalid.

Related parameters

- Setting the electronic gear ratio

  ☆Related parameters

Para. No.	Name	Value Range	Unit	Function	Setting Condition	Effective Time	Default
H05-02	Pulses per revolution	0 to 1048576	PPR	Defines the number of pulses required for one motor revolution.	At once	Next power-on	0
H05-07	Electronic gear ratio 1 (numerator)	1 to 1073741824	-	Defines the numerator of electronic gear ratio 1.	During running	At once	8388608
H05-09	Electronic gear ratio 1 (denomina-tor)	1 to 1073741824	-	Defines the denominator of electronic gear ratio 1.	During running	At once	10000
H05-11	Electronic gear ratio 2 (numerator)	1 to 1073741824	-	Defines the numerator of electronic gear ratio 2.	During running	At once	8388608
H05-13	Electronic gear ratio 2 (denomina-tor)	1 to 1073741824	-	Defines the denominator of electronic gear ratio 2.	During running	At once	10000

- Switching the electronic gear ratio

Caution

The motor speed may fluctuate significantly if the electronic gear ratio changes sharply in real time or electronic gear ratio 1 differs greatly from electronic gear ratio 2. In this case, set H05-04 (First-order low-pass filter time constant) properly to allow smooth switchover of the position reference.

- The electronic gear ratio can be switched when H05-02 (Pulses per revolution) is set to 0. Determine whether to switch between electronic gear ratios 1 and 2 based on mechanical conditions. Set the condition for switching the electronic gear ratio.
- Only one electronic gear ratio is effective at any moment.
- The effective time of real-time change in the electronic gear ratio is also restricted by the switchover condition.

☆Related parameter

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H05-39	Electronic gear ratio switchover condition	0: Switching after the position reference kept 0 (H05-02 = 0) for 2.5 ms 1: Switching in real time	Defines the condition for switching the electronic gear ratio.	At stop	At once	0

Assign FunIN.24 (GEAR-SEL, electronic gear ratio selection) to a certain DI and set the active logic of this DI.

☆Related function No.

Function No.	Name	Function	Function
FunIN.24	GEAR_SEL	Electronic gear ratio selection	Inactive: Using electronic gear ratio 1 in the position control mode Active: Using electronic gear ratio 2 in the position control mode

See the following table for the electronic gear ratio used by the servo drive.

H05-02	H05-39	Level of the DI Assigned with FunIN.24	Electronic Gear Ratio
0	0	Inactive	$\frac{\text{H05-07}}{\text{H05-09}}$
		Active	$\frac{\text{H05-11}}{\text{H05-13}}$
	1	Inactive	$\frac{\text{H05-07}}{\text{H05-09}}$
		Active	$\frac{\text{H05-11}}{\text{H05-13}}$
1 to 1048576	-		-

The resolution of the serial encoder is 2^n PPR, where "n" is the number of bits of the serial encoder.

For example, the resolution of 20-bit serial encoder is 2^{20} PPR, which is 1048576 PPR.

- Calculating the electronic gear ratio
  The following figure shows the relation among the position reference (reference unit), load displacement, and electronic gear ratio.

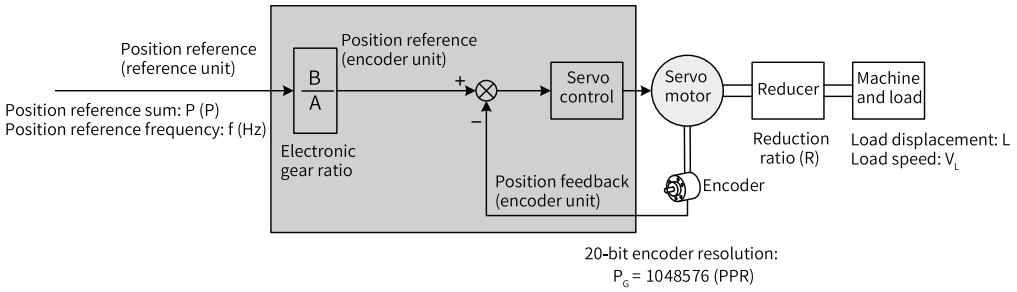


Figure 2-16 Relation among the position reference (reference unit), load displacement, and electronic gear ratio

Take a ball screw in linear motion as an example, with P_B (mm) as the screw lead, P_G as the encoder resolution, and R as the reduction ratio of the reducer.

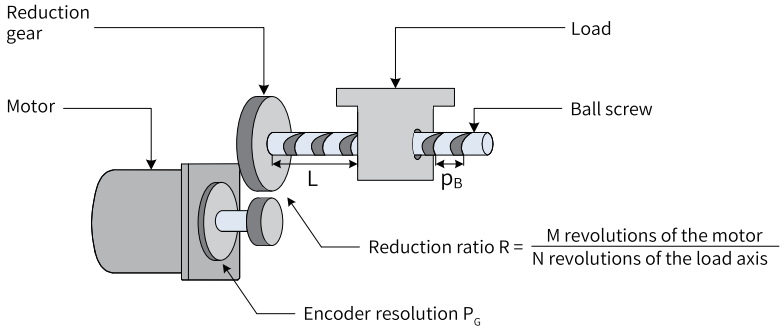


Figure 2-17 Ball screw

- When the load displacement per pulse ΔL (mm) is known:

  The load shaft rotates $\frac{\Delta L}{p_B}$ circles and the motor shaft rotates $\frac{\Delta L}{p_B} \times R$ circles when the mechanical displacement is ΔL. Then the following formula applies:

  $$1 \times \frac{B}{A} = \frac{\Delta L}{p_B} \times R \times P_G$$

  Therefore, the electronic gear ratio is as follows.

  $$\frac{B}{A} = \frac{\Delta L}{p_B} \times R \times P_G$$

- When the load displacement L (mm) and position reference sum P (P) are known:

  The load shaft rotates $\frac{L}{p_B}$ circles, and the motor shaft rotates $\frac{L}{p_B} \times R$ circles when the mechanical displacement is L. Then the following formula applies:

  $$P \times \frac{B}{A} = \frac{L}{p_B} \times R \times P_G$$

  Therefore, the electronic gear ratio is as follows.

  $$\frac{B}{A} = \frac{L}{p_B} \times R \times P_G \times \frac{1}{P}$$

- When the load moving speed VL (mm/s) and position reference frequency f (Hz) are known:

  Load shaft speed: $\frac{v_L}{p_B}$ (r/s)

  Motor speed: $v_M = \frac{v_L}{p_B} \times R$ (r/s)

  The relation among the position reference frequency, electronic gear ratio, and motor speed is as follows:

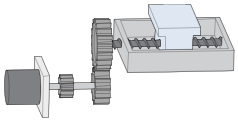
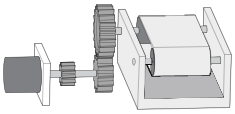
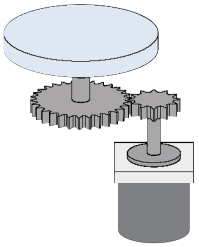
$$f \times \frac{B}{A} = v_M \times P_G$$

Therefore, the electronic gear ratio is as follows.

$$\frac{B}{A} = \frac{v_M \times P_G}{f}$$

- Example for setting the electronic gear ratio

Table 2–12 Example for setting electronic gear ratio

Step	Name	Mechanical Structure		
		Transmission With Ball Screw	Transmission With Belt Pulley	Rotating Load
	-			
1	Mechanical parameters	Reduction ratio (R): 1/1 Screw lead: 0.01 m	Reduction ratio (R): 5/1 Diameter of belt pulley: 0.2 m (Circumference of belt pulley): 0.628 m	Reduction ratio (R): 10/1 Load angle of rotation per revolution of the load shaft: 360°
2	Encoder resolution	20-bit = 1048576 PPR	20-bit = 1048576 PPR	20-bit = 1048576 PPR
3	Load displacement per position reference (reference unit)	0.0001 m	0.000005 m	0.01°
4	Position references per revolution of the load shaft (reference unit)	$\frac{0.01}{0.0001} = 100$	$\frac{0.628}{0.000005} = 125600$	$\frac{360}{0.01} = 36000$
5	Calculation	$\frac{B}{A} = \frac{1048576}{100} \times \frac{1}{1}$	$\frac{B}{A} = \frac{1048576}{125600} \times \frac{5}{1}$	$\frac{B}{A} = \frac{1048576}{36000} \times \frac{10}{1}$
6	Setting	H05-07 = 1048576 H05-09 = 100	H05-07 = 5242880 H05-09 = 125600	H05-07 = 10485760 H05-09 = 36000

2.1.4 Position Reference Filter Function

This function serves to filter the position references (encoder unit) multiplied or divided by the electronic gear ratio, which includes first-order low-pass filter and moving average filter.

Use this function in the following cases:

- The acceleration/deceleration process is not performed on the position references sent from the host controller.
- The pulse reference frequency is low.
- The electronic gear ratio is higher than 10.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H05-04	First-order low-pass filter time constant	0–6553.5	ms	Defines the time constant of the first-order low-pass filter used for position references (encoder unit).	At stop	Immediately	0.0
H05-06	Moving average filter time constant	0–128.0	ms	Defines the time constant of the moving average filter used for position references (encoder unit).	At stop	Immediately	0.0

This function does not affect the displacement value (position reference sum).

A large setpoint delays the responsiveness, so set a proper filter time constant based on actual conditions.

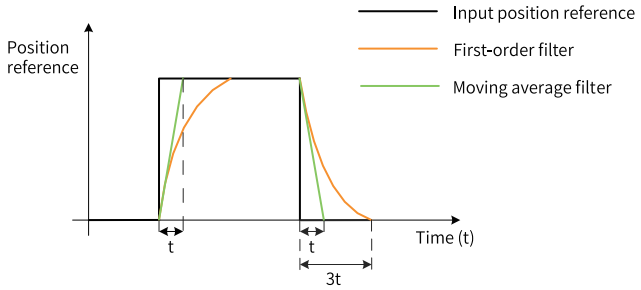


Figure 2-18 First-order filter and moving average filter of rectangular position references

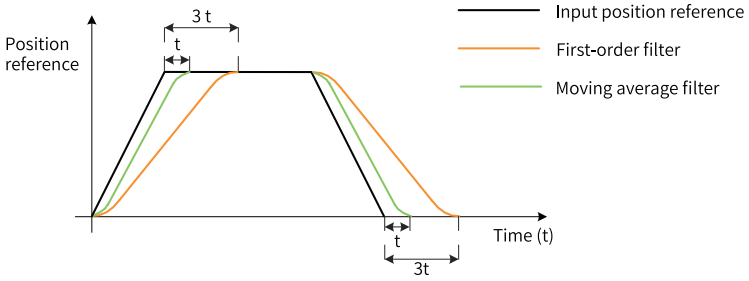


Figure 2-19 First-order filter and moving average filter of trapezoid position references

2.1.5 Position Deviation Clear

Position deviation = Position reference sum – Position feedback sum

This function serves to clear the position deviation when the condition defined by H05-16 (Clear action selection) is met.

☆Related parameters

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H05-16	Clear action	0: Position deviation cleared upon S-ON OFF or fault 1: Position deviation cleared upon S-ON OFF or stop at fault 2: Position deviation cleared upon S-ON OFF or stop at fault; position deviation cleared upon ClrPosErr signal inputted from DI when the servo drive is in RUN state	Defines the condition for clearing the position deviation.	At stop	At once	0

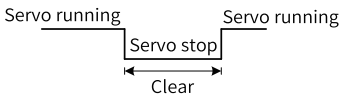
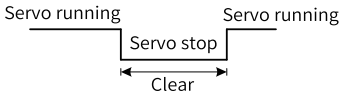
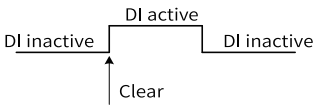
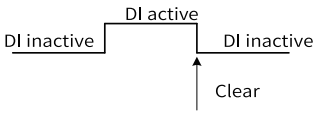
When H05-16 is set to 2, assign FunIN.35 (ClrPosErr, clear position deviation) to a certain DI and set the active logic of this DI.

☆Related function No.

Function No.	Name	Function Name	Function
FunIN.35	ClrPosErr	Position deviation clear	Active: Position deviation cleared Inactive: Position deviation not cleared

See the following table for the setting method.

Table 2–13 Position deviation clear

Setpoint	Clear Conditions	Clear Time
H05-16 = 0	Clear the position deviation when the S-ON signal is switched off or when a fault occurs.	
H05-16 = 1	Clear the position deviation when the S-ON signal is switched off or when the servo drive stops upon a fault event.	
H05-16 = 2	Clear the position deviation cleared when the S-ON signal is switched off or when a fault occurs. Clear the position deviation when ClrPosErr signal is inputted through a DI when the servo drive is in the RUN state.	 (Rising edge-triggered)  (Falling edge-triggered)

2.1.6 Frequency-Division Output

Caution

It is recommended to use the active edge outputted by Z signal when a high precision frequency-division output of Z signal is required.

- H05-41 = 0: Rising-edge triggered
- H05-41 = 1: Falling-edge triggered

In frequency-division output, the position reference pulses or the position pulses fed back by the encoder is outputted in the form of phase A/phase B quadrature pulses.

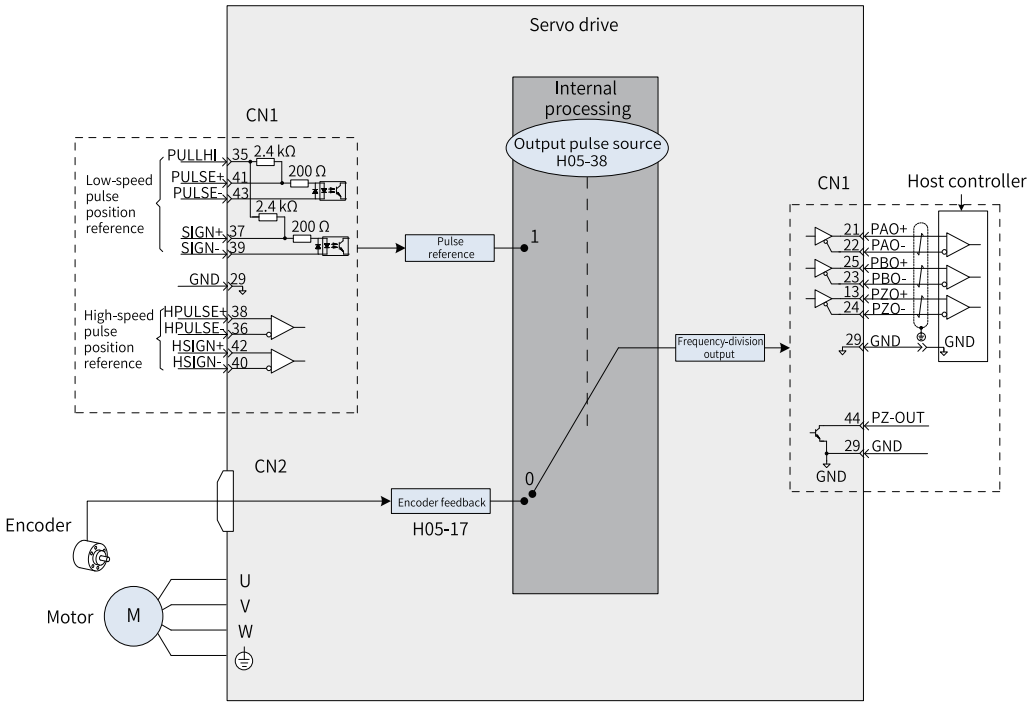


Figure 2-20 Schematic diagram of frequency-division output

It is recommended to use pulse reference synchronous output (H05-38 = 1) during synchronous tracing of multi-axis servo pulses. When the host controller is used for closed-loop feedback, it is recommended to use encoder frequency-division output (H05-38 = 0).

The servo drive offers one group of frequency-division terminals, as described below:

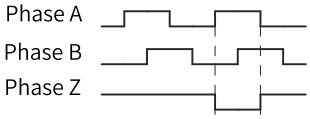
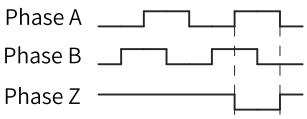
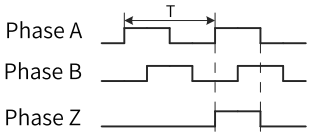
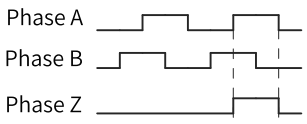
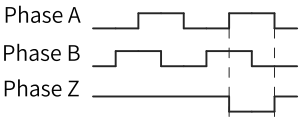
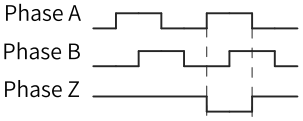
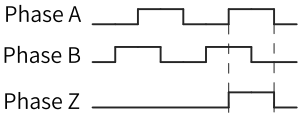
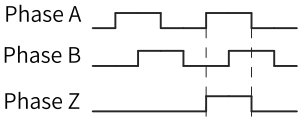
- Phase A pulses: PAO+ and PAO-, differential output, maximum output pulse frequency: 2 Mpps
- Phase B pulses: PBO+ and PBO-, differential output, maximum output pulse frequency: 2 Mpps
- Phase Z pulses: PZO+ and PZO-, differential output, maximum output pulse frequency: 2 Mpps
- PZ-OUT, GND, and open-collector output, maximum output pulse frequency: 100 kpps

Set H05-38 (Pulse output source), H02-03 (Pulse output phase), H05-17 (Number of encoder frequency-division pulses), and H05-41 (Z pulse output polarity) as needed when using frequency-division output.

When encoder feedback pulse is used as the pulse output source (H05-38 = 0), the number of output pulses of phase A/B per motor revolution is determined by H05-17 (Number of encoder frequency-division pulses) and H05-61 (Number of encoder frequency-division pulses (32-bit)). The pulse width (T)

of phase A/B is determined by the motor speed. Phase Z synchronizes with phase A with a width of T. Phase Z outputs signal only once per motor revolution.

Table 2–14 Diagrams of encoder frequency-division output pulses (H05-38 = 0)

H02-03 (Pulse output phase)	H05-41 (Z pulse output polarity)	Pulse Output Diagram in Forward Run	Pulse Output Diagram in Reverse Run
0	0	 Phase A leads phase B by 90°.	 Phase B leads phase A by 90°.
	1	 Phase A leads phase B by 90°.	 Phase B leads phase A by 90°.
1	0	 Phase B leads phase A by 90°.	 Phase A leads phase B by 90°.
	1	 Phase B leads phase A by 90°.	 Phase A leads phase B by 90°.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H02-03	Output pulse phase	0: Phase A leading phase B 1: Phase A lagging behind phase B	-	Defines the relation between phase A and phase B.	At stop	Next power-on	0
H05-17	Number of encoder frequency-division pulses	35–32767	PPR	Defines the number of pulses outputted by PAO or PBO (before frequency quadrupled) per motor revolution when the setpoint of H05-61 (Encoder frequency-division pulses (32-bit)) is lower than 35.	At stop	Next power-on	2500

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H05-38	Servo pulse output source	0: Encoder frequency-division output 1: Pulse reference synchronous output 2: Frequency-division or synchronous output inhibited	-	Defines the servo pulse output source.	At stop	Next power-on	0
H05-41	Z pulse output polarity	0: Negative (Z pulse being low level) 1: Positive (Z pulse being high level)	-	Defines the output level when the phase Z pulse is active.	At stop	Next power-on	1
H05-61	Number of encoder frequency-division pulses (32-bit)	0 to 262143	PPR	Defines the number of pulses outputted by PAO or PBO (before frequency quadrupled) per motor revolution when the setpoint of H05-61 is higher than or equal to 35.	At stop	Next power-on	0

2.1.7 Motion Control/Internal Command/Positioning Completed/Proximity Function

- "Motion control completed" refers to the completion of command transmission and positioning in the position control mode. The servo drive therefore outputs an McOK (motion control completed) signal, and the host controller, upon receiving the signal, acknowledges the motion control is done.
- "Internal command completed" refers to the completion of command transmission, upon which the internal multi-position reference is zero. The servo drive therefore outputs a CmdOk (internal command completed) signal, and the host controller, upon receiving the signal, acknowledges the internal command transmission is done.
- "Positioning completed" refers to the completion of the positioning process in the position control mode, which requires the position deviation to meet the condition defined by H05-20. The servo drive therefore outputs a COIN (positioning completed) signal, and the host controller, upon receiving the signal, acknowledges the positioning is done.

The schematic diagram is shown below.

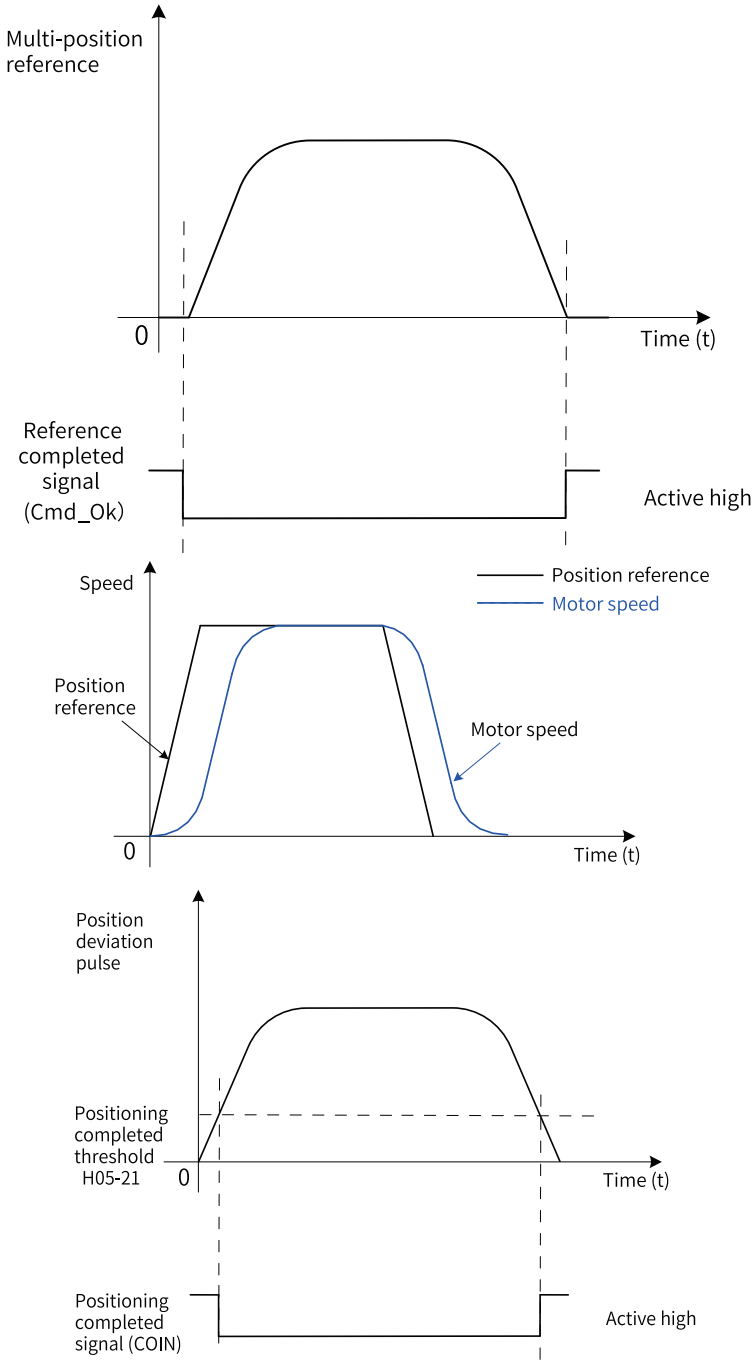


Figure 2-21 Description of positioning completed/proximity

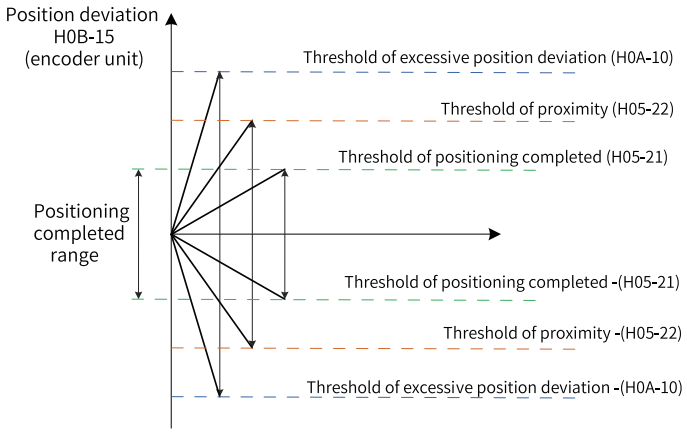
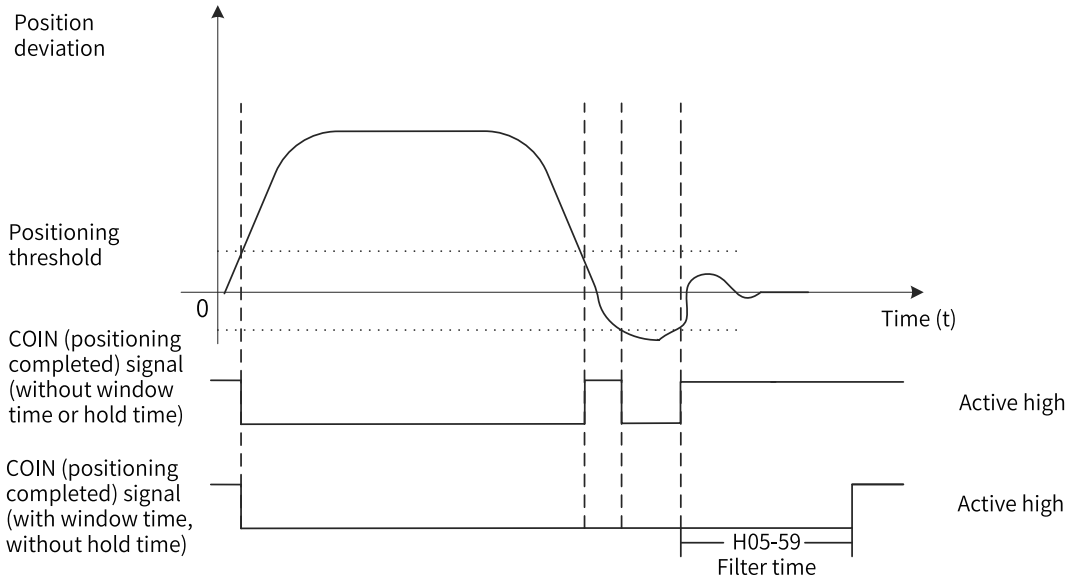


Figure 2-22 Signals related to position deviation

You can set the unit for positioning completed, proximity, and excessive position deviation in H0A-17. When position deviation meets the condition defined by H05-20, the servo drive outputs a NEAR (proximity) signal to prepare the host controller for positioning completion.

Before applying the positioning completed/proximity function, set H05-20, H05-21, H05-22, H05-59, and H05-60 first. The schematic diagram for the window time (H05-59) and hold time (H05-60) of COIN (positioning completed) signal is as follows.



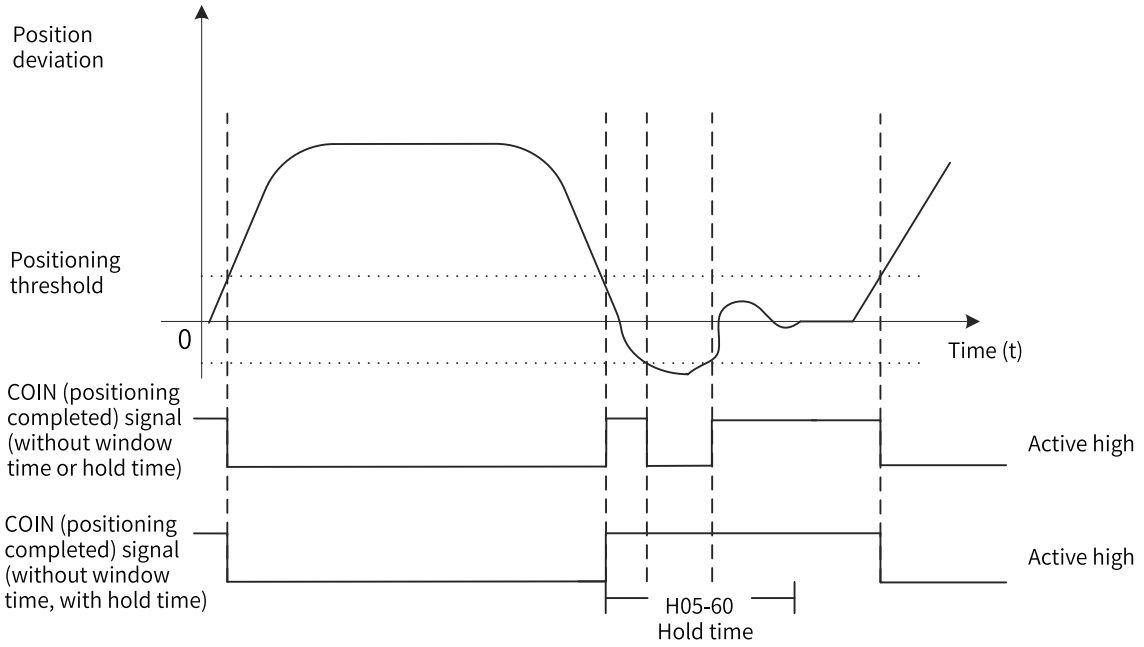


Figure 2-23 Schematic diagram for the window time (H05-59) and hold time (H05-60) of positioning completion

When the COIN (positioning completed) signal has a hold time of 0, it remains active until the next position reference is received.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0A-17	Position setting unit	0–1	-	Unit selection: 0: Encoder unit 1: Reference unit	At stop	Immediately	0
H05-20	Condition for COIN (positioning completed) signal output	0: Absolute value of position deviation lower than H05-21 1: Absolute value of position deviation lower than H05-21 and filtered position reference being 0 2: Absolute value of position deviation lower than H05-21 and position reference being 0 3: Absolute value of position deviation kept lower than H05-21 within the time defined by H05-60 and unfiltered position reference being 0	-	Defines the condition for outputting the COIN (positioning completed) signal.	During running	Immediately	0

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H05-21	Threshold of positioning completed	1–65535	Encoder/ Reference unit	Defines the threshold of position deviation absolute value when the COIN (positioning completed) signal is active.	During running	Immediately	5872
H05-22	Threshold of proximity	1–65535	Encoder/ Reference unit	Defines the threshold of position deviation absolute value when the NEAR (proximity) signal is active.	During running	Immediately	65535
H05-59	Window time of COIN (positioning completed) signal	0-30000	ms	Defines the filter time of the COIN (positioning completed) signal. After filtering, an active level will be output.	During running	Immediately	0
H05-60	Hold time of COIN (positioning completed) signal	0-30000	ms	Defines the hold time of an active COIN (positioning completed) signal.	During running	Immediately	0

Caution

- Set H05-22 to a value higher than the setpoint of H05-21.
- H05-21 only reflects the threshold of position deviation absolute value for positioning completion. It is not related to the positioning accuracy.
- A large speed feedforward gain (H08-19) or a low-speed operation reduces the position deviation absolute value. In this case, the COIN (positioning completed) signal may keep active if H05-21 is set to a large value. To improve the positioning accuracy, decrease the setpoint of H05-21.
- If H05-21 is set to a small value and the position deviation is also small, you can change the condition for outputting the COIN (positioning completed) signal in H05-20.
- An inactive S-ON signal deactivates the COIN (positioning completed) signal and NEAR (proximity) signal output.

To use the motion control/internal command/positioning completed/proximity function, assign FunOUT.24 (McOk, motion control completed), FunOUT.22 (CmdOk, internal command completed), FunOUT.5 (COIN, positioning completed), and FunOUT.6 (NEAR, proximity) to four DOs respectively, and set the active logic of these DOs.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.5	COIN	Positioning completed	Active: The position deviation absolute value meets the threshold defined by H05-21 in the position control mode, indicating the positioning is done. Inactive: The servo drive is in the process of positioning.
FunOUT.6	NEAR	Proximity	Active: The position deviation absolute value meets the threshold defined by H05-22, indicating the positioning is nearly done. Inactive: The servo drive is in the process of proximity in the position control mode.
FunOUT.22	CmdOk	Internal command completed	Active: The transmission of the multi-position reference or interrupt positioning reference is done in the position control mode. Inactive: The transmission of the multi-position reference or interrupt positioning reference is in progress in the position control mode.
FunOUT.24	McOk	Motion control completed	Active: The transmission of the multi-position reference or interrupt positioning reference and the positioning process are done in the position control mode Inactive: The transmission of the multi-position reference or interrupt positioning reference or positioning is in progress in the position control mode.

2.1.8 Interrupt Positioning

Caution

The interrupt positioning signal cannot be triggered during homing.

Description

In the position control mode, if interrupt positioning is triggered when the S-ON signal is active, the servo drive aborts current operation and turns to executing the preset position reference, which is to say, after interrupt positioning is triggered, the motor executes the position reference triggered by interrupt positioning, with motor direction unchanged.

When interrupt positioning is in progress, the servo drive does not respond to any other internal/ external position references (including another interrupt positioning command). In this case, the input position reference counter (H0B-13) counts the interrupt positioning reference only. After interrupt positioning is done, the servo drive may or may not respond to other position references depending on the setpoint of H05-29 (Interrupt positioning cancel signal). The position references received during interrupt positioning will be abandoned.

After interrupt positioning is done, the servo drive outputs the interrupt positioning completed (FunOUT.15: XintCoin) signal and positioning completed (FunOUT.5: COIN) signal, while the host controller, upon receiving XintCoin signal, acknowledges interrupt positioning is done. The XintCoin signal output is not related to the S-ON signal or the logic of DI9.

Interrupt positioning is effective only when the following conditions are met:

- The motor speed is higher than or equal to 10 RPM before interrupt positioning is triggered, or the setpoints of H05-26 (Constant operating speed in interrupt positioning) and H05-24 (Displacement of interrupt positioning) are not 0.
- The DI assigned with FunIN.33 (Interrupt positioning inhibited) is not used or the logic of this DI is inactive.

Note

The moving average filter is inactive when interrupt positioning is in progress.

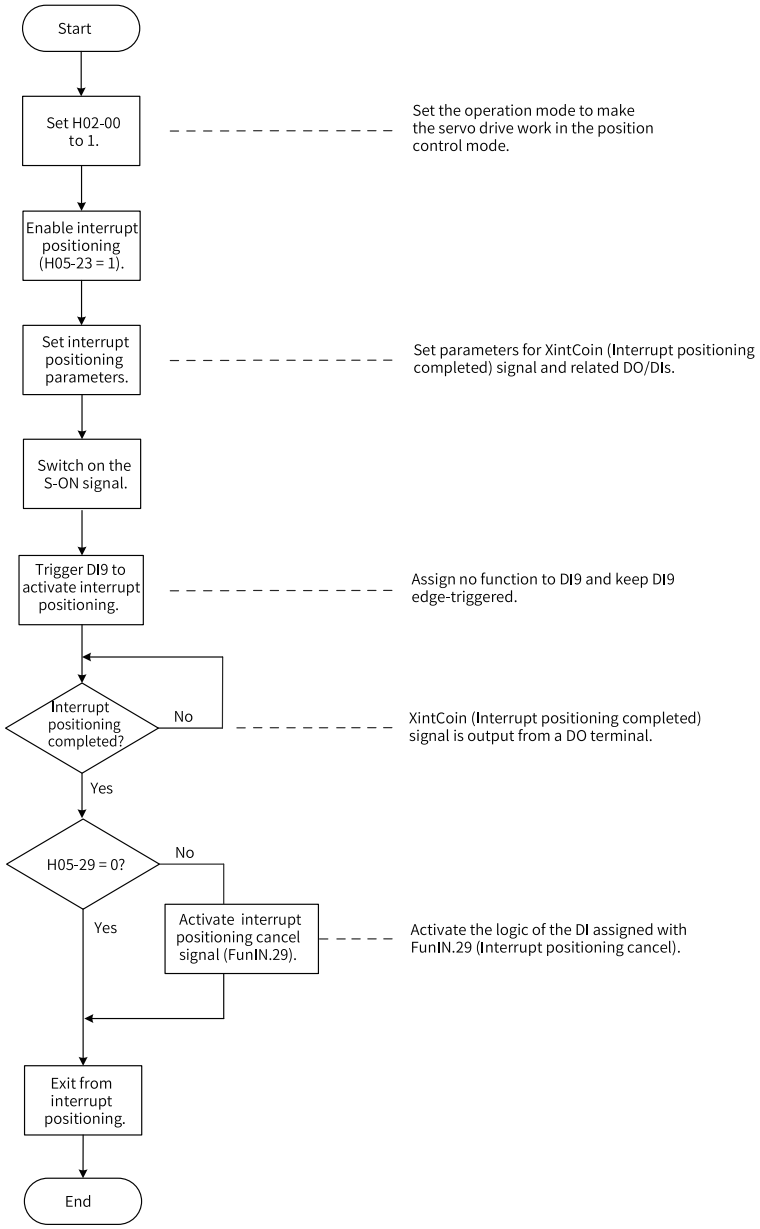


Figure 2-24 Flowchart of interrupt positioning signal

Setting parameters

☆Related parameters

Para. No.	Name	Value Range	Unit	Function	Setting Condition	Effective Time	Default
H05-23	Interrupt positioning selection	0: Disable 1: Enabled	-	Used to enable/disable interrupt positioning.	At stop	Next power-on	0
H05-24	Displacement of interrupt positioning	0 to 1073741824	Reference unit	Defines the displacement of interrupt positioning.	During running	At once	10000
H05-26	Constant operating speed in interrupt positioning	0 to 6000	RPM	Defines the maximum motor speed in interrupt positioning, which is unrelated to the electronic gear ratio.	During running	At once	200
H05-27	Acceleration/ Deceleration time of interrupt positioning	0 to 1000	ms	Defines the time for the motor to accelerate from 0 RPM to 1000 RPM.	During running	At once	10
H05-29	Interrupt positioning cancel signal Enable	0: Disable 1: Enable	-	Defines the condition for responding to other position references after interrupt positioning is done. When H05-29 is set to 1, interrupt positioning must be canceled by a DI assigned with FunIN.29 (Interrupt positioning cancel).	During running	At once	1

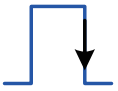
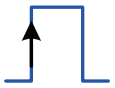
☆Related Function No.

Function No.	Name	Function	Function
FunIN.29	XintFree	Interrupt positioning cancel	Active: The interrupt positioning state is unlocked, which means the servo drive can respond to other position references. Inactive: The interrupt positioning state is locked, which means the servo drive cannot respond to other position references.
FunIN.33	XintInHibit	Interrupt positioning inhibit	Active: Interrupt positioning inhibited Inactive: Interrupt positioning permitted
FunOUT.15	XintCoin	Interrupt positioning completed	Active: Interrupt positioning completed during position control Inactive: Interrupt positioning not completed during position control

Caution

During interrupt positioning, DI9 is used to trigger interrupt positioning only, which means no other functions can be assigned to DI9 through H03-18 (DI9 function selection) and no other DIs can trigger interrupt positioning. The logic of DI9 (H03-19) is edge-triggered.

Table 2–15 Active logic of DI9 during interrupt positioning

H03-19	Active Logic of DI9	Waveform
0	Active low	
1	Active high	

The constant operating speed for interrupt positioning is shown in the following figure.

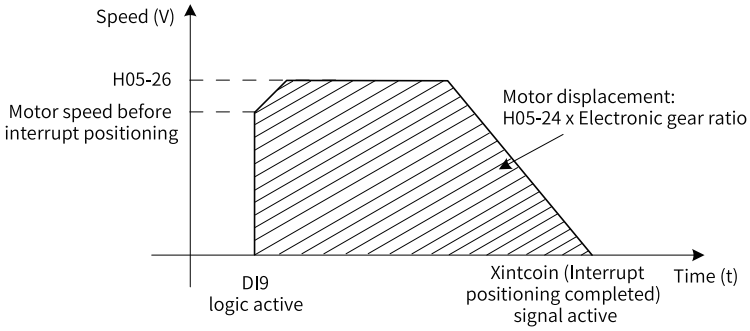


Figure 2-25 Motor operating curve during interrupt positioning

Table 2–16 Motor speed during interrupt positioning

H05-26	Motor Speed before Triggering Interrupt Positioning	Interrupt Positioning	Constant Operating Speed in Interrupt Positioning
0	< 10	Active	-
	⩾ 10	Active	Motor Speed before Triggering Interrupt Positioning
1 to 6000	-	Active	H05-26

2.1.9 Homing

Caution

- The homing trigger signal is disabled when interrupt positioning or multi-position reference is in progress.
- Ensure H11-00 is not set to 5 when using local homing function. When H11-00 is set to 5 (Axis-controlled continuous operation), the local homing function will be disabled.

Description of the homing function

- Home (or mechanical home): Indicates the position of the home switch or motor Z signal depending on the setting of H05-31 (Homing mode).
- Zero position (or target point): Indicates the sum of the home plus the offset (defined by H05-36). When H05-36 (Home offset) is set to 0, zero position shares the same position with the home.

In the position control mode, when homing is triggered after the S-ON signal is activated, the motor starts searching for the zero point.

When homing is in progress, the servo drive does not respond to other position references (including another homing trigger signal) until homing is done.

The homing function comes in two modes: homing mode and electrical homing mode.

- Homing: The servo drive, upon receiving the homing trigger signal, locates the relative position of the motor shaft and the mechanical home based on the pre-set mechanical home and starts searching for the home first. Then the servo drive executes the offset based on the home, after which it reaches the zero point. The homing mode usually applies in initial search of the zero point.
- Electrical homing: After determining the absolute zero position through homing, the servo drive takes current position as the start position to execute a relative displacement.

After the homing function (both homing and electrical homing) is done executing, the motor position absolute value (H0B-07) is consistent with the home offset (H05-36).

After homing is done, the servo drive outputs the homing completed signal (FunOUT.16: HomeAttain) or electrical homing completed signal (FunOUT.17: ElecHomeAttain). The host controller, upon receiving the signal, acknowledges the homing is done. HomeAttain and ElecHomeAttain signals are independent of the control mode or the operating state of the servo drive.

Table 2–17 Comparison between homing and electrical homing

<table>
<tr><th>Mode</th><th>Homing trigger mode (H05-30)</th><th>Homing Direction, Deceleration Point, Home</th><th>Trigger Signal</th><th>Total Motor Displacement</th></tr>
<tr><td rowspan="5">Homing</td><td>0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td rowspan="3">Determined by H05-31 (Homing mode)</td><td>HomingStart signal</td><td rowspan="3">Determined by the home coordinate and offset displacement.</td></tr>
<tr><td>3</td><td>S-ON</td></tr>
<tr><td>4</td><td>S-ON</td></tr>
<tr><td>6</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>8</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Electrical homing</td><td>2</td><td rowspan="2">The homing direction is consistent with the motor displacement sign (+/-), needless of the deceleration point or home signal.</td><td>HomingStart signal</td><td rowspan="2">(H05-36 – H0B-07) x Electronic gear ratio</td></tr>
<tr><td>5</td><td>S-ON</td></tr>
</table>

Note

The moving average filter and the low-pass filter are inactive during homing.

Homing

Caution

- Set mechanical limit switches before enabling homing. For homing upon hit-and-stop, set the offset to a value within the travel range to prevent the machine from collision due to high-speed operation during homing.
- When the motor hits the limit switch during homing, the servo drive reports Er.950 (Forward overtravel) or Er.952 (Reverse overtravel), and the motor, if H05-40 is set to 0 or 1, stops based on the stop mode defined by H02-07.

See the following examples for the homing mode:

- H05-31 = 0: Forward homing, home switch as the deceleration point and the home
- H05-31 = 2: Forward homing, motor Z signal as the deceleration point and the home
- H05-31 = 4: Forward homing, home switch as the deceleration point and motor Z signal as the home
- H05-31 = 6: Forward homing, positive limit switch as the deceleration point and the home
- H05-31 = 8: Forward homing, positive limit switch as the deceleration point and motor Z signal as the home
- H05-31 = 10: Forward homing, mechanical limit as the deceleration point and the home (H05-31 = 10)
- H05-31 = 12: Forward homing, mechanical limit as the deceleration point and motor Z signal as the home (H05-31 = 12)

The other homing modes are the same as above, except the initial homing mode, which is contrary to the above.

- H05-31 = 0: Forward homing, home switch as the deceleration point and the home
  - The home switch (deceleration point) signal is inactive (0: inactive, 1: active) when the motor starts running. The positive limit switch is not triggered during the whole process.
    The motor starts searching for the deceleration point signal in the forward direction at the speed defined by H05-32. After reaching the rising edge of the deceleration point signal, it decelerates as defined by H05-34 to the setpoint of "-(H05-33)". After that, it starts searching for the falling edge of the deceleration point signal in the reverse direction at the speed defined by "-(H05-33)" After reaching this falling edge, it changes to search for the rising edge of the home signal at the same speed but in the opposite direction. Finally it stops immediately after reaching the rising edge of the home signal during forward acceleration or forward operation at a constant speed.

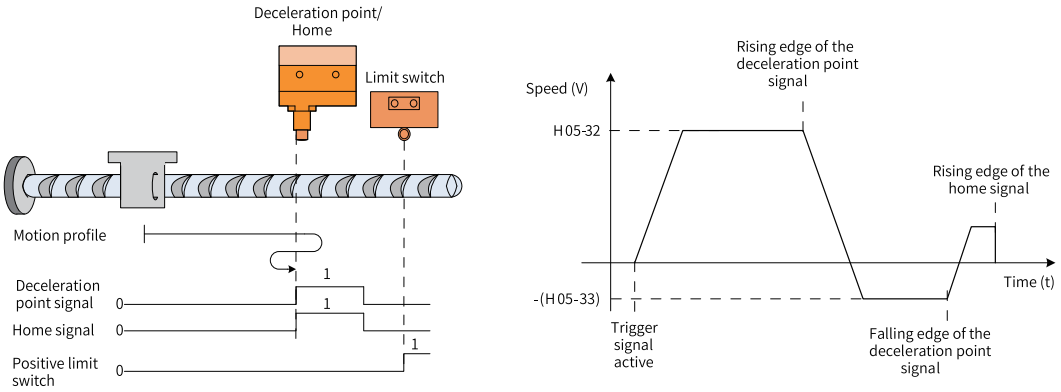


Figure 2-26 Motor operating curve and speeds in Mode 0

- The home switch (deceleration point) signal is active when the motor starts running, and the positive limit switch is not triggered during the whole process.
  The motor starts searching for the falling edge of the deceleration point in the reverse direction at the speed defined by "-(H05-33)". After reaching this falling edge, it changes to operate in the forward direction and search for the rising edge of the home signal at the same speed. Finally, it stops immediately after reaching the rising edge of the home signal during forward acceleration or forward operation at a constant speed.

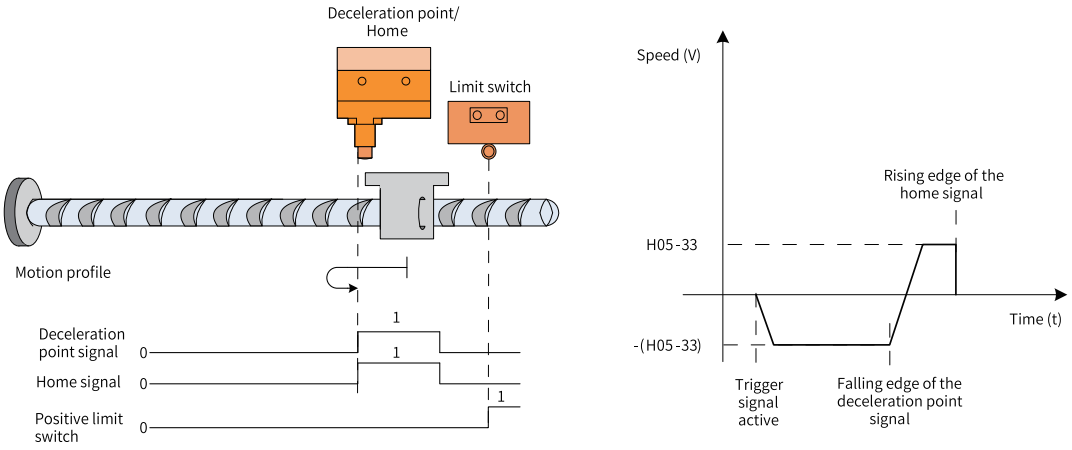


Figure 2-27 Motor operating curve and speeds in Mode 0

- The home switch (deceleration point) signal is inactive when the motor starts running, and the positive limit switch is triggered.
  The motor starts searching for the deceleration point signal in the forward direction at the speed defined by H05-32. After reaching the positive limit switch, it changes to execute reverse homing (H05-40 = 2 or 3) or stops and waits for another homing trigger signal (H05-40 = 0 or 1). After receiving the signal, it starts searching for the falling edge of the deceleration point signal in the reverse direction at the speed defined by "-H05-32". After reaching this falling edge, it decelerates as defined by H05-34 and changes to search for the rising edge of the home signal in the forward direction as defined by H05-33. Finally, it stops immediately after reaching the rising edge of the home signal during forward acceleration or forward operation at a constant speed.

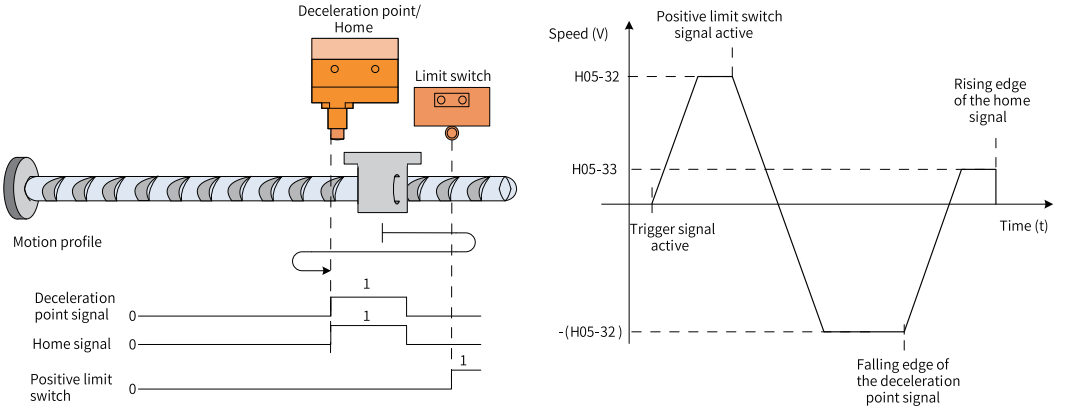


Figure 2-28 Motor operating curve and speeds in Mode 0

- Mode 2: Forward homing, motor Z signal as the deceleration point and the home (H05-31 = 2)

Caution

Note: In Mode 2 and Mode 3 where the motor Z signal acts as the home and deceleration point, the actual stop position of the motor may not be on the rising edge that on the same side of motor Z signal. A deviation of ± 1 pulse (in encoder unit) may be present in the stop position.

- The motor Z signal is inactive (0: inactive, 1: active) when the motor starts running, and the positive limit switch is not triggered during the whole process.
  The motor starts searching for the Z signal in the forward direction at the speed defined by H05-32. After reaching the rising edge of the Z signal, the motor decelerates as defined by H05-34 and changes to run in the reverse direction. Then it accelerates to the speed defined by "-(H05-33)" and stops immediately after reaching the rising edge of the Z signal on the other side during reverse acceleration or reverse operation at a constant speed.

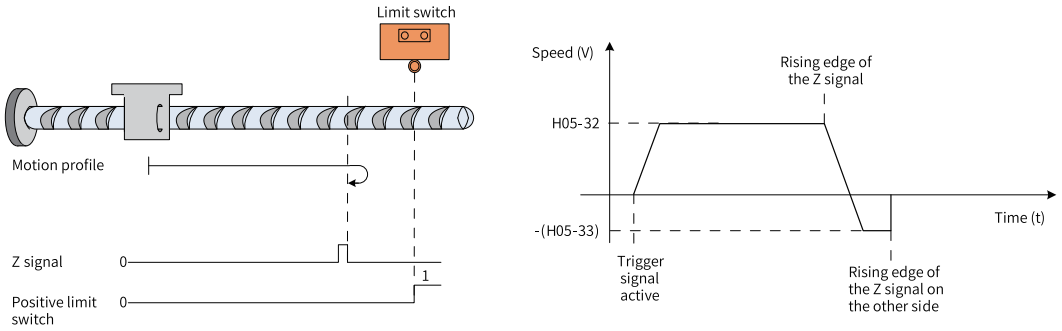


Figure 2-29 Motor operating curve and speeds in Mode 2

- The motor Z signal is active when the motor starts running, and the positive limit switch is not triggered during the whole process.
  The motor starts searching for the falling edge of the Z signal in the forward direction at the speed defined by H05-33. After reaching this falling edge, it changes to search for the rising edge of the Z signal in the reverse direction at the speed defined by "-(H05-33)". Finally, it stops immediately after reaching the rising edge of the Z signal during reverse acceleration or reverse operation at a constant speed.

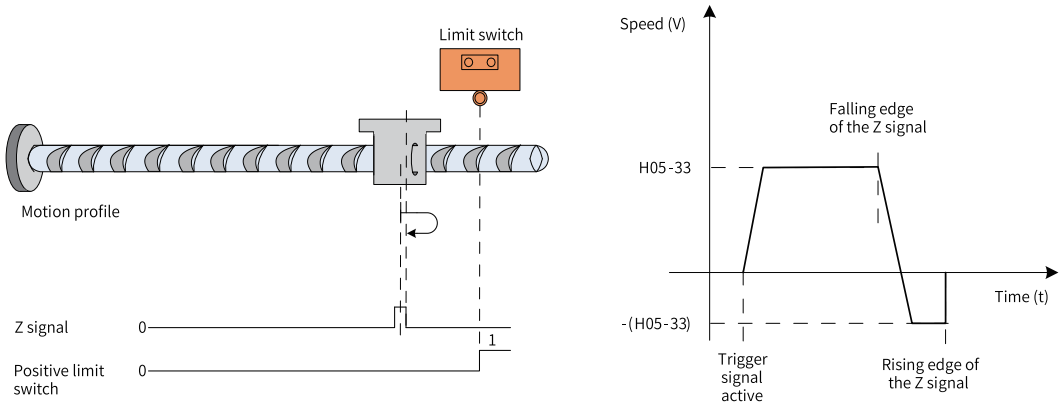


Figure 2-30 Motor operating curve and speeds in Mode 2

- The motor Z signal is inactive when the motor starts running, and the positive limit switch is triggered.
  The motor starts searching for the Z signal in the forward direction at the speed defined by H05-32. After hitting the positive limit switch, the motor changes to execute reverse homing (H05-40 = 2 or 3) or stops and waits for another homing trigger signal (H05-40 = 0 or 1). After receiving the signal, it starts searching for the Z signal in the reverse direction at the speed defined by "-(H05-32)" until reaching the rising edge of the Z signal, where it decelerates as defined by H05-34 and changes to search for the rising edge of the Z signal on the other side at the speed defined by H05-33 in the forward direction. Finally, it stops immediately after reaching the rising edge of the Z signal on the other side during forward acceleration or forward operation at a constant speed.

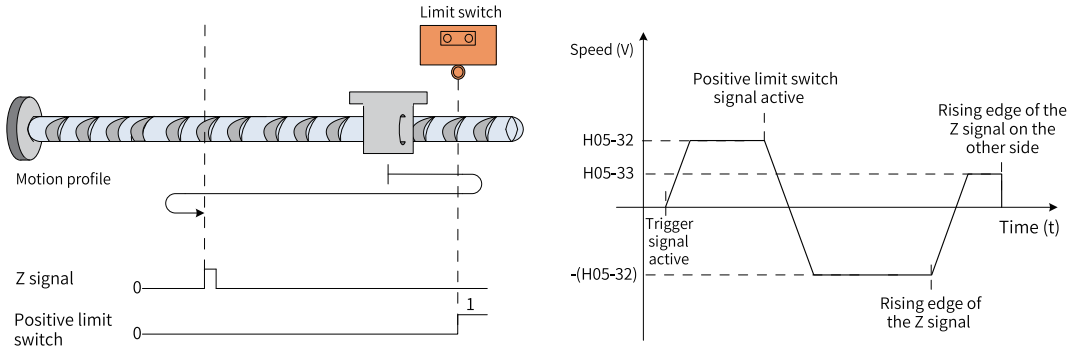


Figure 2-31 Motor operating curve and speeds in Mode 2

- Mode 4: Forward homing, home switch as the deceleration point and motor Z signal as the home (H05-31 = 4)

  - The home switch signal is inactive (0: inactive, 1: active) when the motor starts running and the positive limit switch is not triggered during the whole process.
    The motor starts searching for the home switch signal in the forward direction at the speed defined by H05-32. After reaching the rising edge of the home switch signal, it decelerates as defined by H05-34 and changes to search for the falling edge of the home switch signal at the speed defined by "-(H05-33)". After reaching this falling edge, it decelerates and changes to search for the rising edge of the home switch signal in the forward direction at the speed defined by "H05-33". After reaching this rising edge, it continues running and stops after reaching the first Z signal.

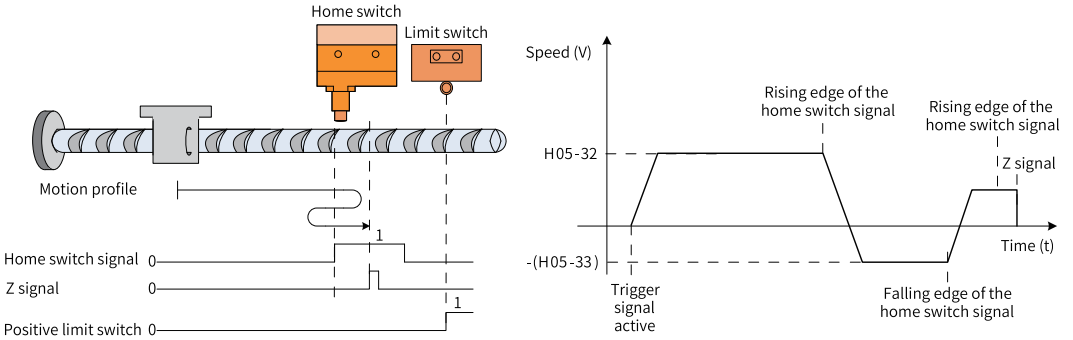


Figure 2-32 Motor operating curve and speeds in Mode 4

  - The home switch signal is active when the motor starts running and the positive limit switch is not triggered during the whole process.

The motor starts searching for the falling edge of the home switch signal in the reverse direction at the speed defined by "-(H05-33)". After reaching this falling edge, it decelerates and changes to search for the rising edge of the home switch signal in the forward direction at the speed defined by "H05-33". After reaching this rising edge, it continues running and stops after reaching the rising edge of the first Z signal.

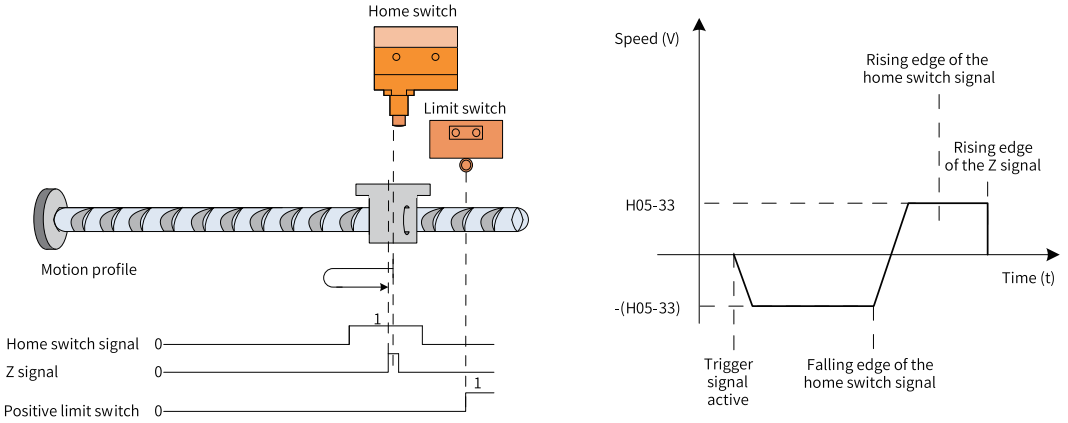


Figure 2-33 Motor operating curve and speeds in Mode 4

- The home switch signal is inactive when the motor starts running and the positive limit switch is triggered.
  The motor starts searching for the home switch in the forward direction at the speed defined by H05-32. After hitting the positive limit switch, the motor executes reverse homing (H05-40 = 2 or 3) as defined by H05-40 or stops and waits for another homing trigger signal (H05-40 = 0 or 1). After receiving this signal, it starts searching for the deceleration point in the reverse direction at the speed defined by "-(H05-32)" until reaching the falling edge of the home switch signal, where it decelerates as defined by H05-34 and changes to search for the rising edge of the home switch signal in the forward direction at the speed defined by H05-33. After reaching this rising edge, it continues running and stops after reaching the first Z signal.

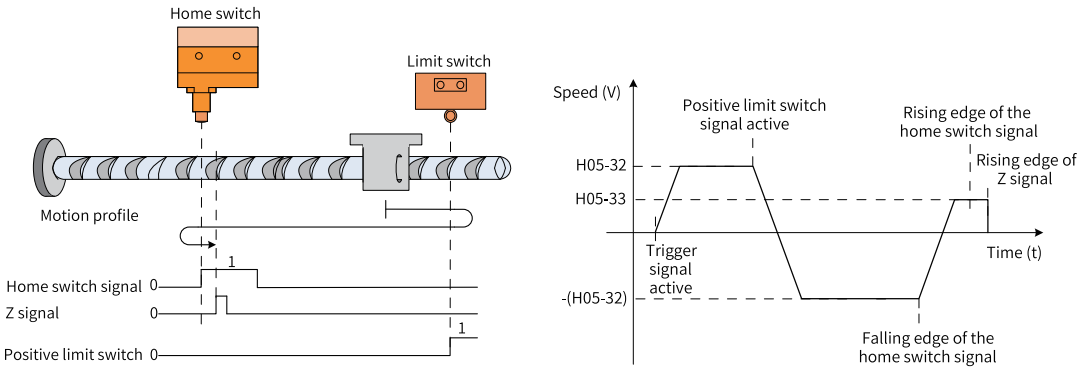


Figure 2-34 Motor operating curve and speeds in Mode 4

- Mode 6: Forward homing, positive limit switch as the deceleration point and the home (H05-31 = 6)
  - The positive limit switch signal is inactive (0: inactive, 1: active) when the motor starts running. The motor starts searching for the positive limit switch in the forward direction at the speed defined by H05-32. After reaching the rising edge of the positive limit switch signal, it decelerates as defined by H05-34 and changes to search for the falling edge of the positive limit switch signal

in the reverse direction at the speed defined by "-(H05-33)". After reaching this falling edge, it decelerates and changes to search for the rising edge of the positive limit switch signal in the forward direction at the speed defined by H05-33. Finally, it stops after reaching the rising edge of the positive limit switch signal during forward acceleration or forward operation at a constant speed.

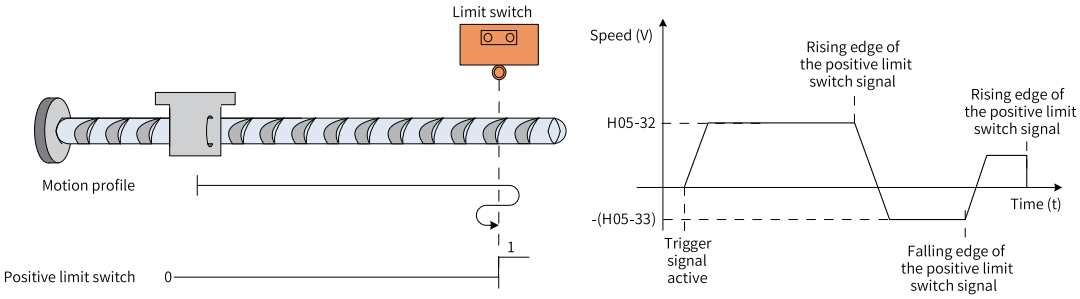


Figure 2-35 Motor operating curve and speeds in Mode 6

- The positive limit switch signal is active when the motor starts running.
  The motor starts searching for the falling edge of the positive limit switch signal in the reverse direction at the speed defined by "-(H05-33)". After reaching this falling edge, it decelerates and changes to search for the rising edge of the positive limit switch signal in the forward direction at the speed defined by H05-33. Finally, it stops immediately after reaching the rising edge of the positive limit switch signal during forward acceleration or forward operation at a constant speed.

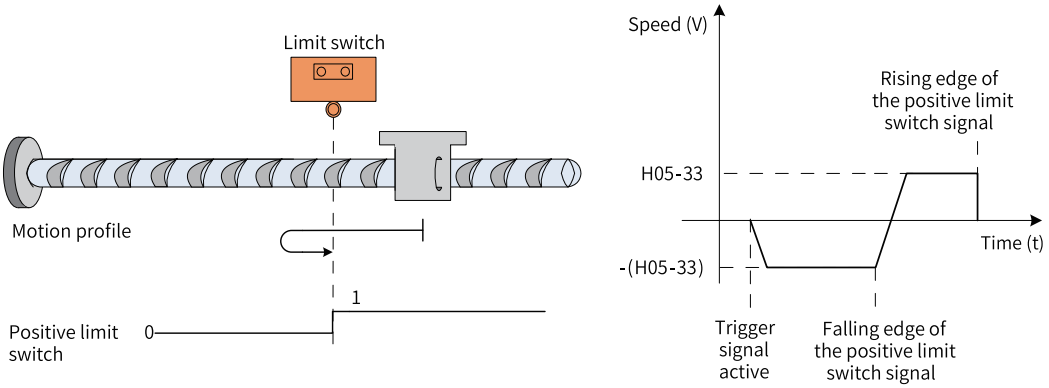


Figure 2-36 Motor operating curve and speeds in Mode 6

- Mode 8: Forward homing, positive limit switch as the deceleration point and motor Z signal as the home (H05-31 = 8)
  - The positive limit switch signal is inactive (0: inactive, 1: active) when the motor starts running. The motor starts searching for the positive limit switch in the forward direction at the speed defined by H05-32. After reaching the rising edge of the positive limit switch signal, it decelerates as defined by H05-34 and changes to search for the falling edge of the positive limit switch signal in the reverse direction at the speed defined by "-(H05-33)". After reaching this falling edge, the motor continues running and stops after reaching the first Z signal.

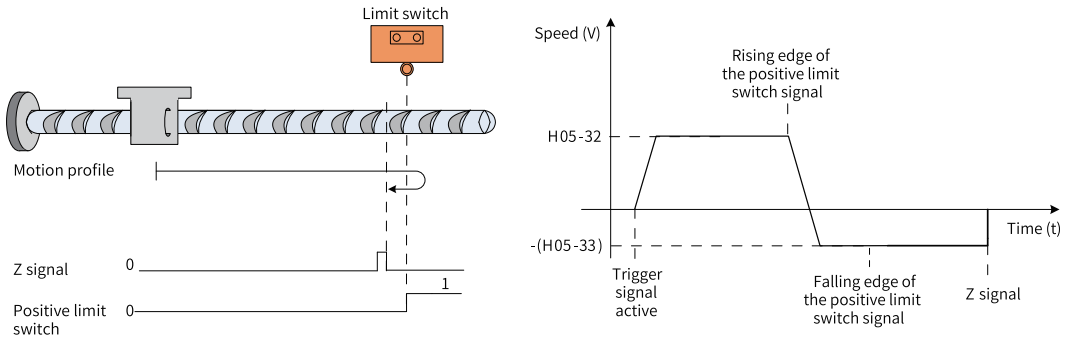


Figure 2-37 Motor operating curve and speeds in Mode 8

- The positive limit switch signal is active when the motor starts running.
  The motor starts searching for the falling edge of the positive limit switch signal in the reverse direction at the speed defined by "-(H05-33)". After reaching this falling edge, it continues running. After reaching the rising edge of the first Z signal, it stops.

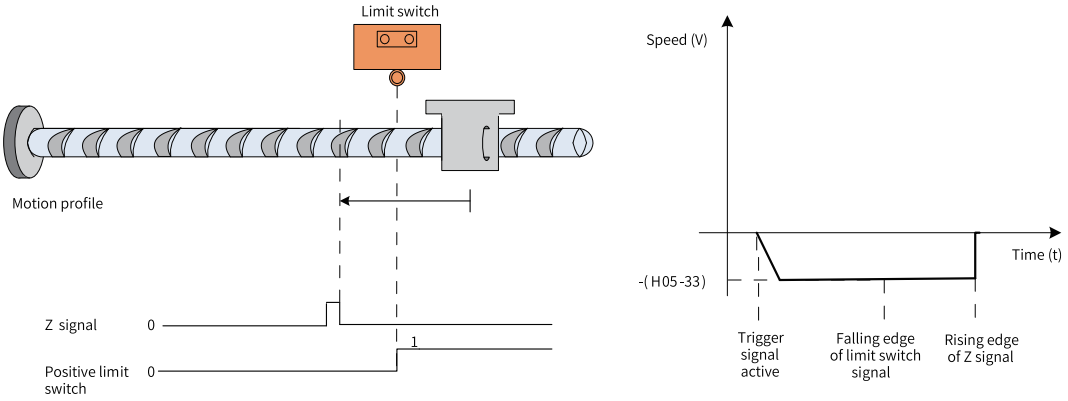


Figure 2-38 Motor operating curve and speeds in Mode 8

- Mode 10: Forward homing, forward mechanical limit as the deceleration point and the home (H05-31 = 10)
  The motor starts running in the forward direction at the speed defined by H05-33. After hitting the mechanical limit, if the torque keeps reaching the upper limit (H05-58) and the speed keeps lower than H05-56 for a period of time, it indicates the mechanical limit is reached. In this case, the motor stops immediately.

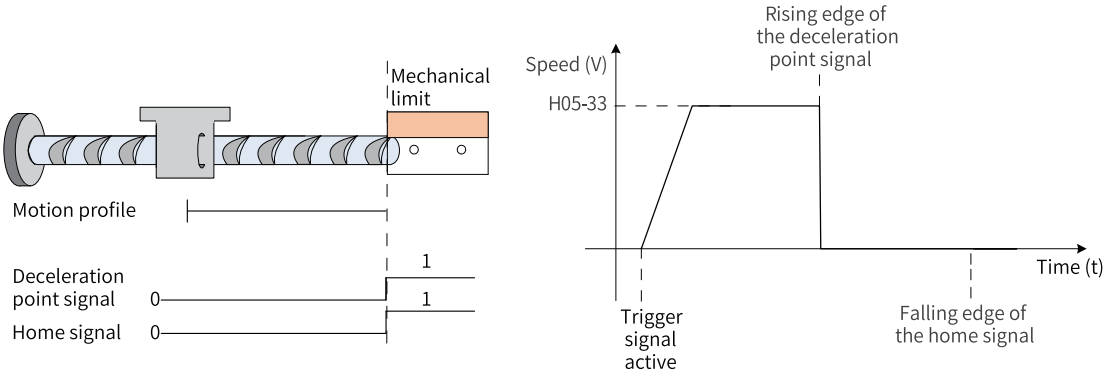


Figure 2-39 Motor operating curve and speeds in Mode 10

- Mode 12: Forward homing, forward mechanical limit as the deceleration point and motor Z signal as the home (H05-31 = 12)
  The motor starts running in the forward direction at the speed defined by H05-33. After hitting the mechanical limit, if the torque keeps reaching the upper limit (H05-58) and the speed keeps lower than H05-56 for a period of time, it indicates the mechanical limit is reached. In this case, the motor changes to run in the reverse direction at the speed defined by H05-33 and stops after reaching the rising edge of the first Z signal.

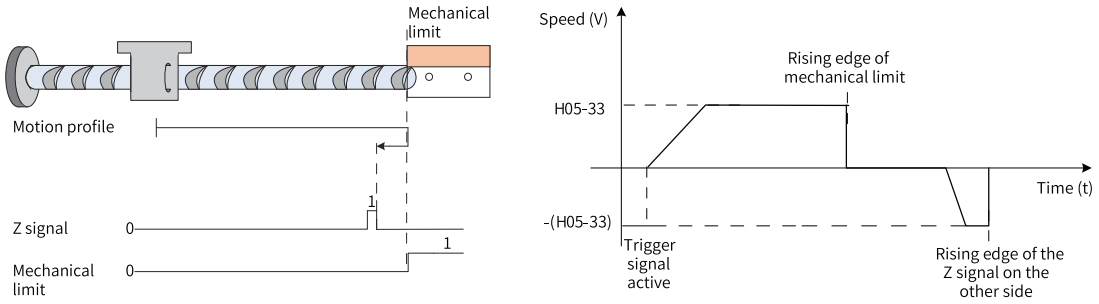


Figure 2-40 Motor running curve and speeds in Mode 12

Electrical homing: starting electrical homing (H05-30 = 5)

The mechanical zero position is known after homing is done. In this case, you can make the motor move from current absolute position (H0B-07) to the designated position (H05-36) by setting H05-36 (Mechanical home offset).

In the electrical homing mode, the motor runs at the speed defined by H05-32 in the direction determined by the sign (+/-) of the total displacement value. The total displacement is determined by the difference between H05-36 and H0B-07. The motor stops immediately after the displacement reference is done executing.

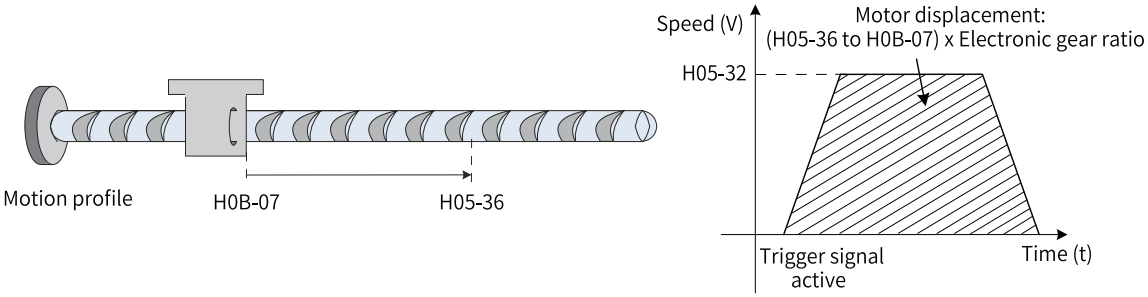
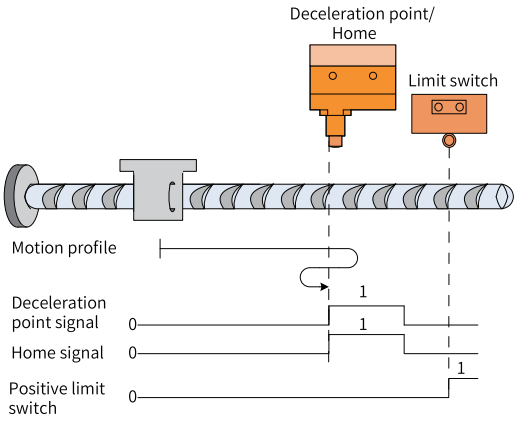
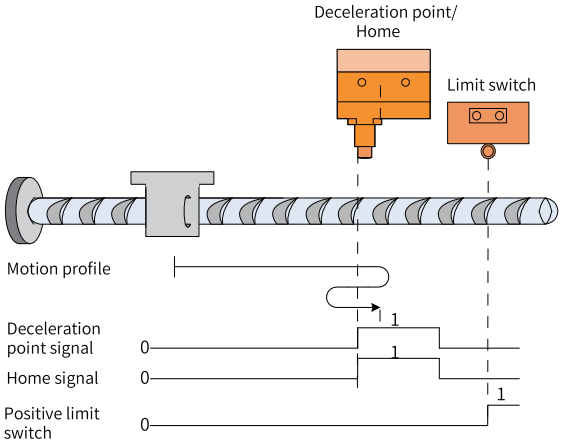
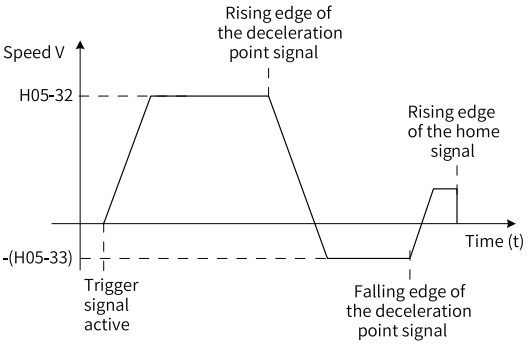
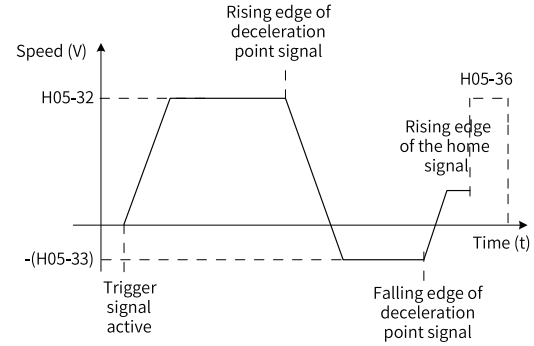


Figure 2-41 Motor operating curve and speeds in electrical homing

Mechanical home and mechanical zero

The following table describes the difference between mechanical home and mechanical zero in cases where H05-30 (Homing selection) is set to 0 (Disabled).

Table 2–18 Description of mechanical home and mechanical zero

Mechanical Zero Different From Mechanical Home	Mechanical Zero Same As Mechanical Home
If home offset is present (H05-36 ≠ 0) and the mechanical home differs from the mechanical zero (H05-40 = 0 or 2), the motor stops immediately after reaching the rising edge of the home signal during acceleration or constant-speed operation in the forward direction. After stop, the motor position absolute value (H0B-07) is changed to the value of H05-36 (Mechanical home offset) forcibly.	If home offset is present (H05-36 ≠ 0) and the mechanical zero is the same as the mechanical home (H05-40 = 1 or 3), the motor continues running after reaching the rising edge of the home switch signal during forward acceleration or forward operation at a constant speed until the motor position absolute value (H0B-07) reaches the value of H05-36 (Mechanical home offset).
	
	

Parameter Settings

- Setting the homing mode
  ☆Related parameters

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H05-30	Homing selection	0: Disabled 1: Homing enabled by the HomingStart signal input from DI 2: Electrical homing enabled by the HomingStart signal input from DI 3: Homing enabled immediately upon power-on 4: Homing performed immediately 5: Electrical homing started 6: Current position as the home 8: DI-triggered point as the home	Defines the homing mode and the source for triggering the homing signal.	During running	Immediately	0

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H05-31	Homing mode	0: Forward, home switch as deceleration point and home 1: Reverse, home switch as deceleration point and home 2: Forward, motor Z signal as deceleration point and home 3: Reverse, motor Z signal as deceleration point and home 4: Forward, home switch as deceleration point and Z signal as home 5: Reverse, home switch as deceleration point and Z signal as home 6: Forward, positive limit switch as deceleration point and home 7: Reverse, negative limit switch as deceleration point and home 8: Forward, positive limit switch as deceleration point and Z signal as home 9: Reverse, negative limit switch as deceleration point and Z signal as home 10: Forward, mechanical limit as deceleration point and home 11: Reverse, mechanical limit as deceleration point and home 12: Forward, mechanical limit as deceleration point and Z signal as home 13: Reverse, mechanical limit as deceleration point and Z signal as home 14: Forward single-turn homing (electrical homing mode, H05-69 needs to be used) 15: Reverse single-turn homing (electrical homing mode, H05-69 needs to be used) 16: Nearby single-turn homing (electrical homing mode, H05-69 needs to be used)	Defines the direction, deceleration point, and the home during homing.	During running	Immediately	0

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H05-40	Home offset and action upon overtravel	0: H05-36 as the coordinate after homing, reverse homing applied after homing triggered again upon overtravel 1: H05-36 as the relative offset after homing, reverse homing applied after homing triggered again upon overtravel 2: H05-36 as the coordinate after homing, reverse homing applied automatically upon overtravel 3: H05-36 as the relative offset after homing, reverse homing applied automatically upon overtravel	Defines the mechanical home offset during homing, extra travel distance after homing, and the action upon overtravel.	At stop	Immediately	0
H05-69	Auxiliary homing function	0: Disabled 1: Single-turn homing enabled 2: Current position as the single-turn home (position of the Z signal) 3: A new searching for Z signal (homing) started 4: Single-turn home offset cleared	Defines the auxiliary homing functions. To use these functions, install an Inovance 23-bit absolute encoder.	At stop	Next power-on	0

- Setting the homing curve

  The final positioning may be unstable if the home signal is activated without sufficient deceleration after the deceleration point signal is activated. Therefore, take the displacement required by deceleration into account when setting the input positions of the deceleration point and home signal. The acceleration/deceleration time during homing (H05-34) also needs to be taken into account as it affects the positioning stability.

  ☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H05-32	Speed in high-speed searching for the home switch signal	0 to 3000	RPM	Defines the speed in high-speed searching for the deceleration point during homing. During electrical homing, the motor always runs at the speed defined by H05-32.	During running	Immediately	100
H05-33	Speed in low-speed searching for the home switch signal	0 to 1000	RPM	Defines the speed in low-speed searching for the home during homing. The setpoint must be low enough to prevent mechanical shock at stop.	During running	Immediately	10

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H05-34	Acceleration/ Deceleration time during homing	0 to 1000	ms	Defines the time needed for the motor to change from 0 RPM to 1000 RPM at a constant speed during homing.	During running	Immediately	1000
H05-35	Homing time limit	0 to 65535	ms	Defines the time taken by homing. Once the time limit is exceeded, Er.601 (Homing timeout) will occur.	During running	Immediately	10000
H05-36	Mechanical home offset	-1073741824 to +107374182-4	Refer-ence unit	Defines the absolute value of the motor position (H0B-07) after homing.	During running	Immediately	0

☆Related function No.

Function No.	Name	Function	Description
FunIN.31	HomeSwitch	Home switch	Active: Current position as the home Set the logic of the DI assigned with FunIN.31 to "active high" or "active low" based on the output of the host controller. See the following table for details.
FunIN.32	HomingStart	Homing function	Active: Homing enabled (The HomingStart signal cannot be triggered repeatedly during homing.) Inactive: Homing disabled
FunIN.41	HomingRecord	DI-triggered position as the home	The edge-triggered position is taken as the home.
FunOut.16	HomeAttain	Homing completed	Active: Homing completed in the position control mode Inactive: Homing not completed
FunOut.17	ElecHomeAttain	Electrical homing completed	Active: Electrical homing completed in the position control mode Inactive: Electrical homing not completed

DI Terminal Logic Set by HomeSwitch	Actual Active Level
0 (Low level)	Low level
1 (High level)	High level
3 (Rising edge)	High level
4 (Falling edge)	Low level
5 (Edge-triggered)	Low level

Operation sequence

- H05-30 (Homing selection) = 1 or 2

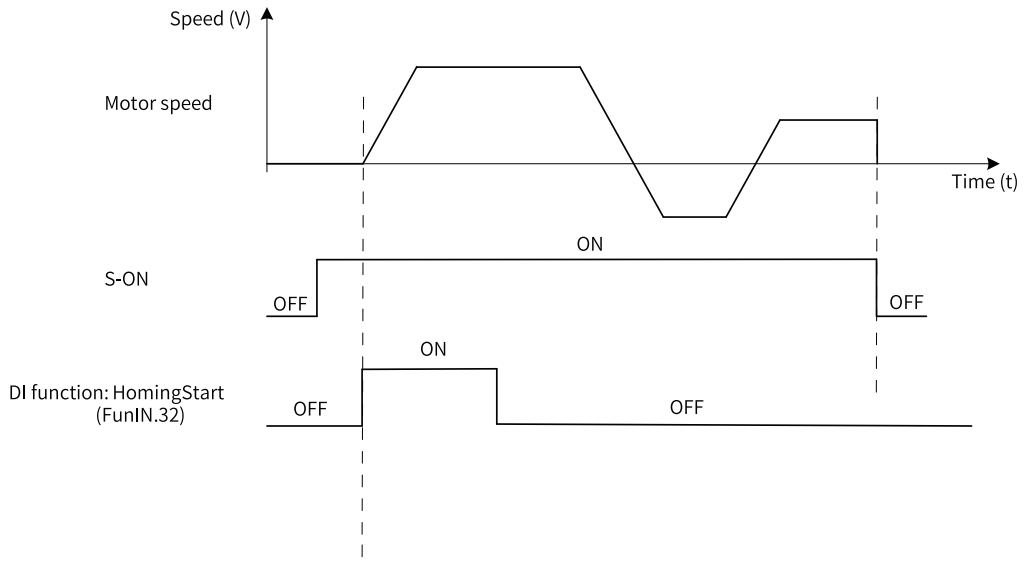


Figure 2-42 Example of timing diagram

- Switch on the S-ON signal first and then the HomingStart signal.
- During homing, the S-ON signal remains active and the change of the HomingStart signal is shielded.
- During homing, the servo motor stops if the S-ON signal is switched off. To enable homing again, switch on the S-ON signal first and then the HomingStart signal.
- If Er.601 (Homing timeout) occurs, the servo motor stops, but the S-ON signal remains active. In this case, trigger the HomingStart signal again to reset Er.601, and execute homing again.
- The homing operation can be triggered repeatedly.

- H05-30 = 3
  - The homing operation is executed only when the S-ON signal is switched on for the first time after power-on.
  - The motor stops when Er.601 (Homing timeout) occurs. To reset Er.601, deactivate the S-ON signal.
  - The homing operation can only be triggered again at next power-on.
- H05-30 (Homing selection) = 4 or 5
  - The homing operation is executed immediately after the S-ON signal is activated upon power-on.
  - If the S-ON signal is switched off during homing, the motor stops immediately. To trigger homing again, switch on the S-ON signal again.
  - When Er.601 (Homing timeout) occurs, H05-30 is set to 0 and the motor stops. To reset Er.601, deactivate the S-ON signal. To perform homing again, reset H05-30. After homing is done, H05-30 is set to 0.
- H05-30 = 6
  - To take the current position as the home and implement the home offset (H05-40 = 0 or 2, H05-36 ≠ 0), set H05-36 and H05-40 first, and then set H05-30 to 6. Failing to do so will cause H0B-07 to keep the previous value of H05-36 rather than the one set currently.

- After homing is done, H05-30 is set to 0. To perform homing again, write H05-36 again and set H05-30 to 6.

- H05-30 = 8
  - To take the DI-triggered position as the home, assign FunIN.41 to a DI first and set the current position as the home.
  - To implement home offset (H05-40 = 0 or 2, H05-36 ≠ 0), set H05-36 and H05-40 first, and then set H05-30 to 6. Failing to do so will cause H0B-07 to keep the previous value of H05-36 rather than the one set currently.

2.1.10 Block Diagram of Position Control Parameters

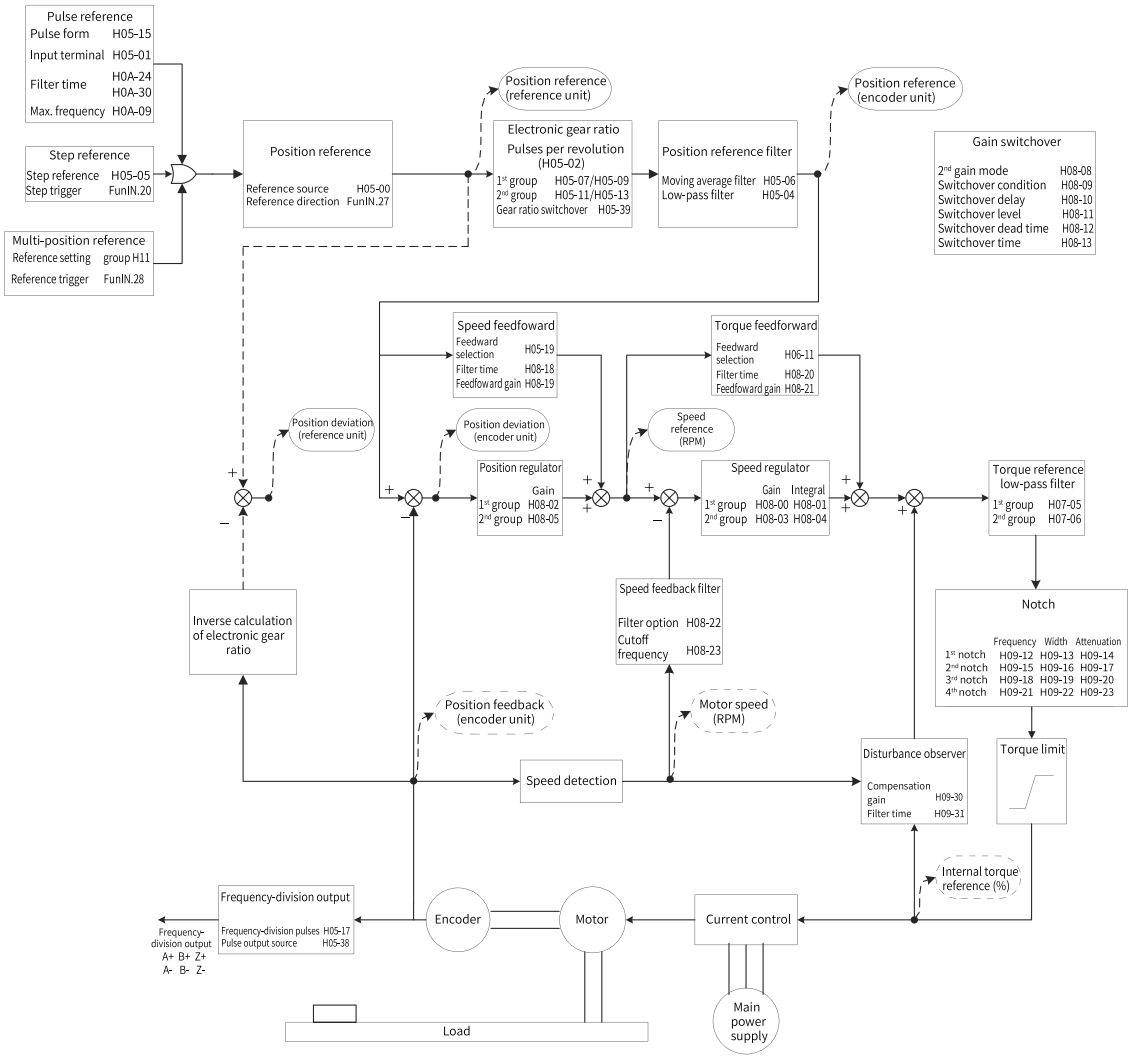


Figure 2-43 Block diagram of position control parameters

2.2 Speed Control Mode

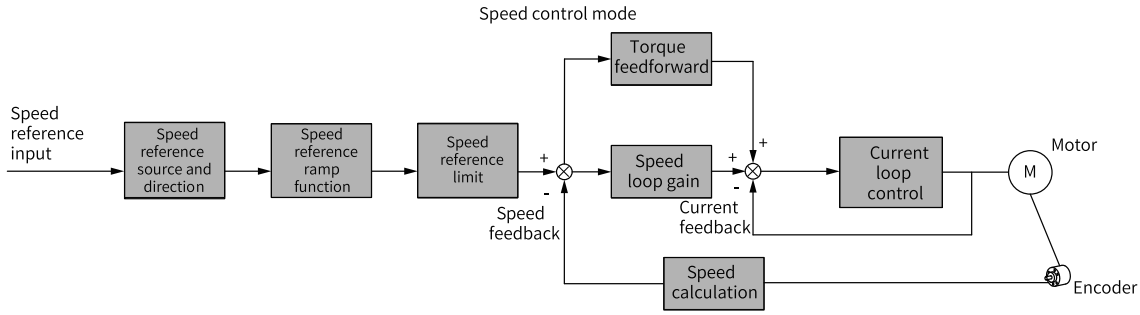


Figure 2-44 Speed control mode

Set H02.00 to 0 through Inovance software tool or the keypad, which enables the servo drive to operate in the speed control mode. Set servo drive parameters based on the mechanical structure and technical indicators. The following describes parameter settings in the speed control mode.

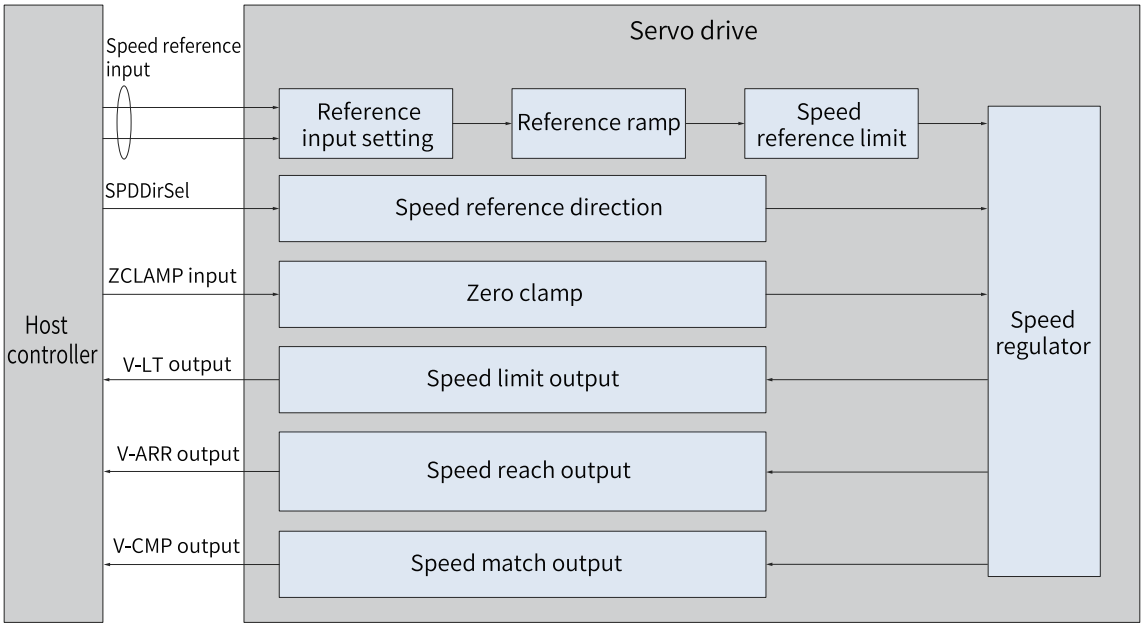


Figure 2-45 Signal exchange between the servo drive and host controller

2.2.1 Speed Reference Input Setting

Speed reference source

The following five speed reference sources are available in the speed control mode, which can be set in H06-02.

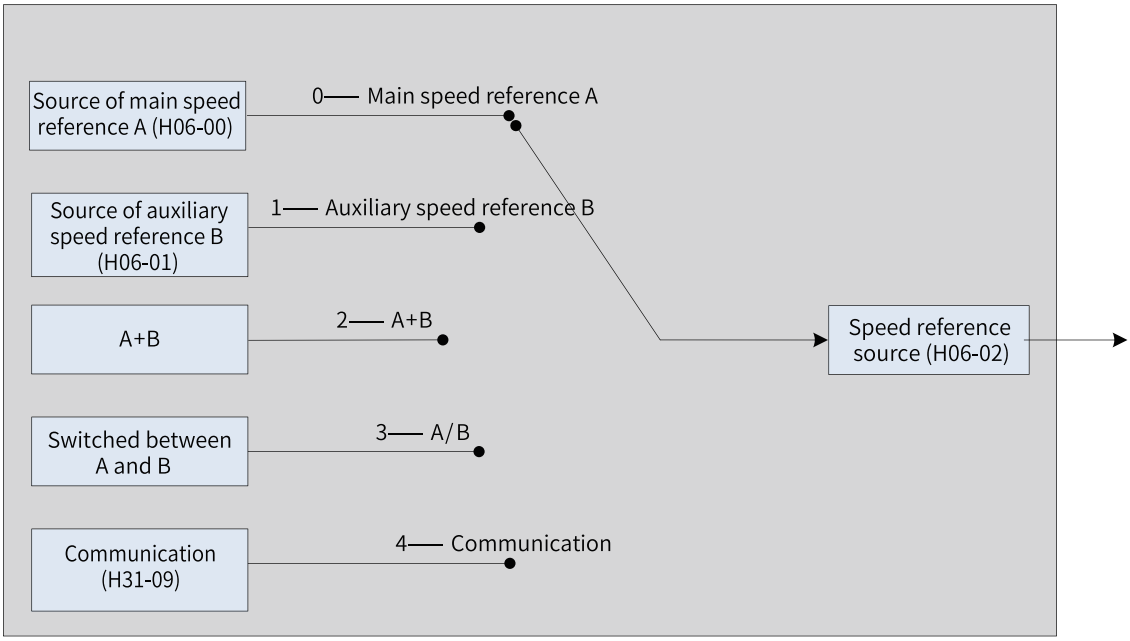


Figure 2-46 Speed reference source

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-02	Speed reference source	0: Source of main speed reference A 1: Source of auxiliary speed reference B 2: A+B 3: Switched between A and B 4: Communication	-	Defines the speed reference source.	At stop	Immediately	0

- Source of main speed reference A

  The main speed reference A is an internal speed reference that can be set through digital setting.

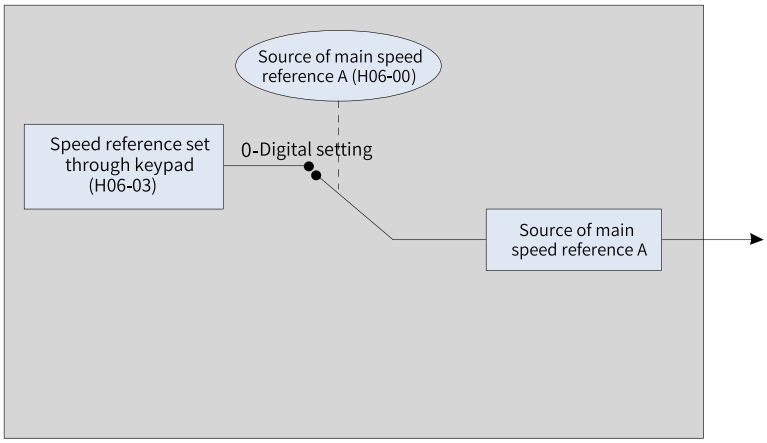


Figure 2-47 Source of main speed reference A

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-00	Source of main speed reference A	0: Digital setting (H06-03)	-	Defines the source of main speed reference A.	At stop	Immediately	0

Digital setting: The setpoint of H06-03 (Speed reference set through keypad) is used as the speed reference value.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-03	Speed reference set through keypad	-6000 to +6000	RPM	Defines the value of the internal speed reference, which is accurate to 1 RPM.	During running	Immediately	200

- Source of auxiliary speed reference B

  The auxiliary speed reference B is an internal speed reference that can be set through digital setting or multi-speed references.

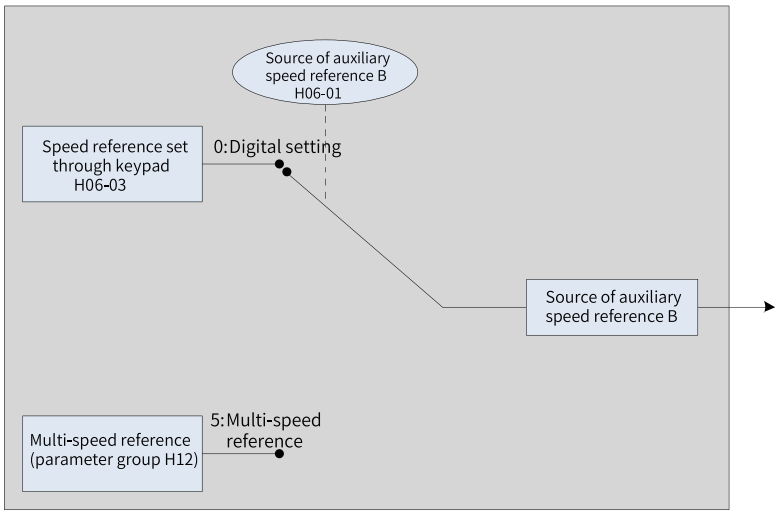


Figure 2-48 Source of auxiliary speed reference B

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-01	Source of auxiliary speed reference B	0: Digital setting (H06-03) 5: Multi-speed reference	-	Defines the source of auxiliary speed reference B.	At stop	Immediately	5

The digital setting mode is the same as H06-00. The following describes multi-speed references.

The servo drive supports multi-speed operation, in which 16 speed references can be saved in the servo drive. The maximum operating speed, operating time and acceleration/deceleration time (four groups) can be set separately for each speed reference. Four groups of acceleration/ deceleration times are available. The setting flowchart is shown below.

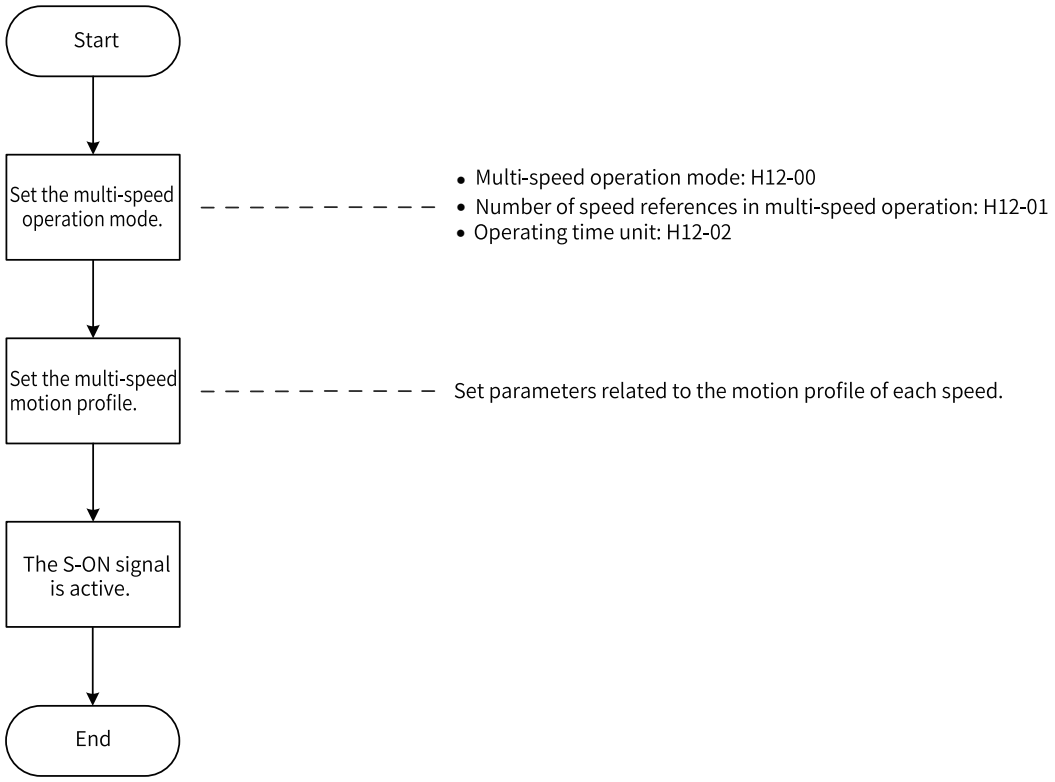


Figure 2-49 Flowchart for setting multi-speed reference

1. Setting the multi-speed operation mode

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H12-00	Multi-speed operation mode	0: Individual operation (number of speeds defined by H12-01) 1: Cyclic operation (number of speeds defined by H12-01) 2: DI-based operation	-	Defines the multi-speed operation mode.	At stop	Immediately	1
H12-01	Number of speed references in multi-speed operation	1 to 16	-	Defines the number of speed references during multi-speed operation.	At stop	Immediately	1
H12-02	Operating time unit	0: Sec 1: Min	-	Defines the operating time unit of speed references during multi-speed operation.	During running	Immediately	1

You can assign FunIN.5 (DIR-SEL) to an external DI to select the reference direction in multi-speed operation.

☆Related function No.

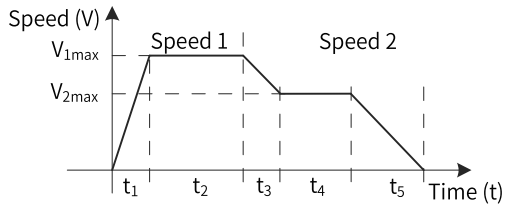
Function No.	Name	Function	Description
FunIN.5	DIR-SEL	Reference direction in multi-speed operation	Inactive: Default reference direction Active: Opposite to the reference direction

The following describes different multi-speed operation modes when H12-01 is set to 2.

- Individual operation (H12-00 = 0)
  Set H12-00 to 0 to select the individual operation mode.

  Set H12-01 and H12-02 as needed. Then set the reference value, operating time, and acceleration/deceleration time of each speed. The servo drive executes speed references in a sequence from speed 1 to the speed N (last speed). After all the speed references are executed, the servo drive stops.

Table 2–19 Description of individual operation

Description	Operating Curve
• The servo drive operates for one cycle only. • The servo drive switches to the next displacement no. automatically.	 • V_{1max}, V_{2max}: reference speeds of speed 1 and speed 2 • t_1: actual acceleration/deceleration time of speed 1 • t_3, t_5: acceleration/deceleration time of speed 2 • Operating time = Time taken in switching from the last speed no. to this speed no. + Duration of constant-speed operation in this speed no. For example, the operating time of speed 1 is the sum of t_1 and t_2; the operating time of speed 2 is the sum of t_3 and t_4. • Do not set the operating time of a certain speed to 0. Otherwise, the servo drive skips this speed no. and switches to the next speed no. directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed no.. • If the S-ON signal is switched off during operation, the motor stops in the mode defined by H02-05 (Stop mode at S-ON OFF).

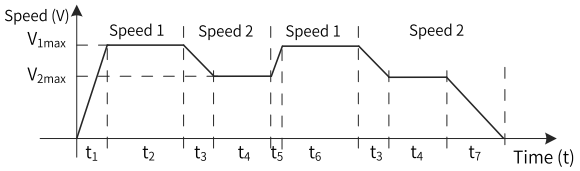
Definition of terms:

A complete operation cycle covers all the speed references defined by H12-01.

- Cyclic operation (H12-00 = 1)
  Select the cyclic operation mode by setting H12-00 to 1.

Set H12-01 and H12-02 as needed. Then set the reference value, operating time and acceleration/deceleration time for each speed no.. The servo drive executes speed references in a sequence from speed 1 to speed N (last speed). After all the speeds are executed, the servo drive jumps to speed 1 and repeats the preceding process.

Table 2–20 Descriptions of cyclic operation

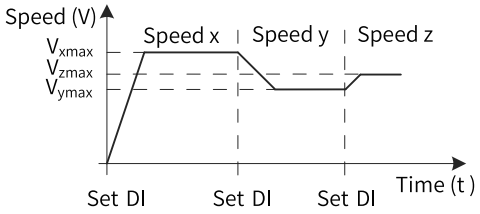
Description	Operating Curve
• The servo drive starts from speed 1 again after each cycle of operation. • The servo drive switches to the next displacement no. automatically. • The cyclic operation state remains active if the S-ON signal is active.	 • V_{1max}, V_{2max}: maximum operating speeds of speed 1 and speed 2 • Operating time = Time taken in switching from the last speed no. to this speed no. + Duration of constant-speed operation in this speed no. For example, the operating time of speed 1 is the sum of t_1 and t_2; the operating time of speed 2 is the sum of t_3 and t_4. • Do not set the operating time of a certain speed to 0. Otherwise, the servo drive skips this speed no. and switches to the next speed no. directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed no.. • If the S-ON signal is switched off during operation, the motor stops in the mode defined by H02-05 (Stop mode at S-ON OFF).

- DI-based operation (H12-00 = 2)

  Set H12-00 to 2 to select DI-based operation.

  Set H12-01 and H12-02 as needed. Then set the reference value, operating time and acceleration/deceleration time for each speed no.. The servo drive executes the speed references according to ON/OFF combination of the external DIs (CMDx).

Table 2–21 Descriptions of DI-based operation

Description	Operating Curve
• This mode remains active if the S-ON signal is active. • The speed no. is determined by the DI logic. • The time interval between multi-speed references is determined by the command delay of the host controller. • Multi-speed references are edge-triggered.	 • x, y: speed no. The relation between the speed no. and the DI logic is described below. • The operating time is independent of the parameter setpoint. If the speed no. changes during operation, the servo drive switches to the new speed no. immediately. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed no.. • If the S-ON signal is switched off during operation, the motor stops in the mode defined by H02-05 (Stop mode at S-ON OFF).

When H11-00 is set to 2, assign FunIN.6 (CMD1), FunIN.7 (CMD2), FunIN.8 (CMD3), and FunIN9 (CMD4) to four DIs, and set the active logic of these DIs. You can also assign FunIN.5 (DIR-SEL) to a DI to switch the speed reference direction.

☆Related function No.

Function No.	Name	Function	Description
FunIN.5	DIR-SEL	DI-based multi-speed operation direction	Defines the speed reference direction in the DI-based multi-speed operation mode. Inactive: Reference direction Active: Opposite to the reference direction
FunIN.6	CMD1	Multi-reference switchover 1	The speed no. is a 4-bit binary value. The relation between the speed no. and CMD1 to CMD4 is shown in *"Table 2–22" on page 76*. The CMD value is 1 when the level input from DI is active or is 0 when the level input from DI is inactive.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 2–22 Relation between the speed no. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Speed No.
0	0	0	0	1
0	0	0	1	2
…				
1	1	1	1	16

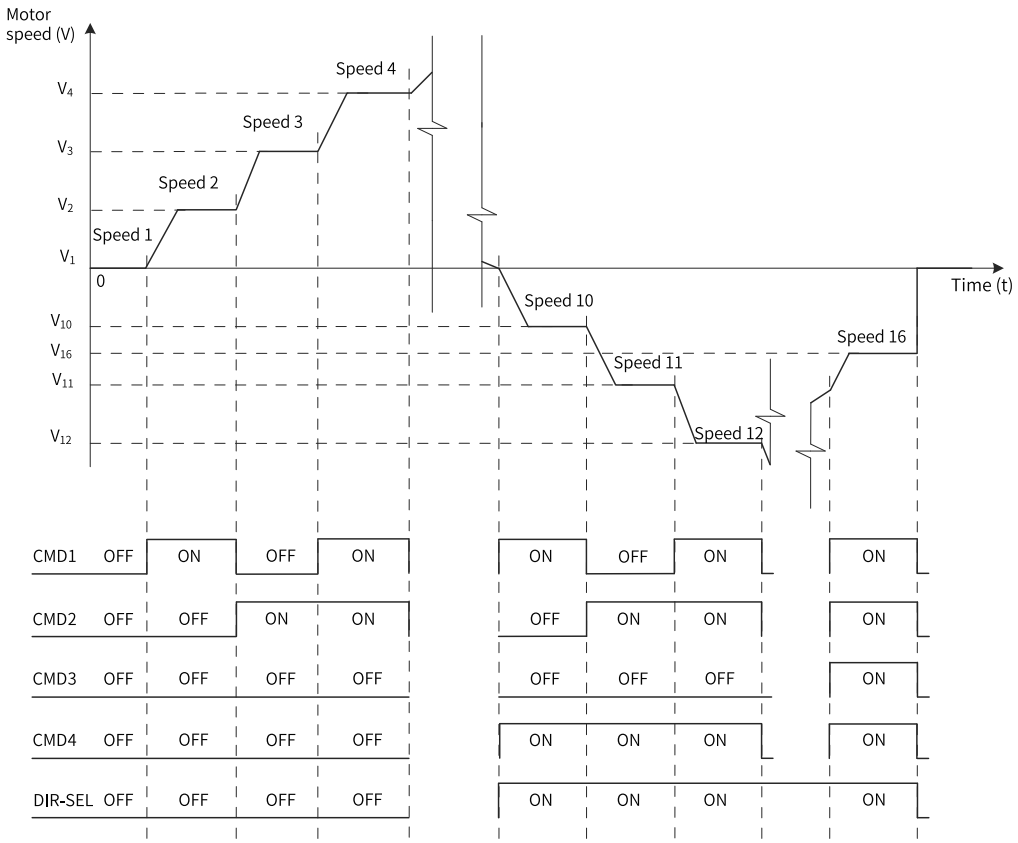


Figure 2-50 Example of multi-speed operation curve

2. Setting the multi-speed operating curve

The following takes speed 1 as an example.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H12-03	Acceleration time 1	0 to 65535	ms	Defines the 1st group of acceleration/ deceleration time.	At stop	Immediately	10
H12-04	Deceleration time 1	0 to 65535	ms		At stop	Immediately	10
H12-09	Acceleration time 4	0 to 65535	ms	Defines the 4th group of acceleration/ deceleration time.	At stop	Immediately	150
H12-10	Deceleration time 4	0 to 65535	ms		At stop	Immediately	150
H12-20	Speed of speed 1	-6000 to +6000	RPM	Defines the speed of speed 1.	At stop	Immediately	0

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H12-21	Operating time of speed 1	0 to 6553.5	s (min)	Defines the operating time of speed 1.	At stop	Immediately	5
H12-22	Acceleration/ Deceleration time of speed 1	0: Zero acceleration/ deceleration time 1: Acceleration/ Deceleration time 1 2: Acceleration/ Deceleration time 2 3: Acceleration/ Deceleration time 3 4: Acceleration/ Deceleration time 4	-	Defines the acceleration/ deceleration time of speed 1	At stop	Immediately	0

For speed references in the multi-speed operation mode, besides the reference value and operating time, four groups of acceleration/deceleration time options are also available. The default value of H12-22 is 0.

The following describes the actual acceleration/deceleration time and the operating time when H12-00 (Multi-speed operation mode) is set to 1 (Individual operation).

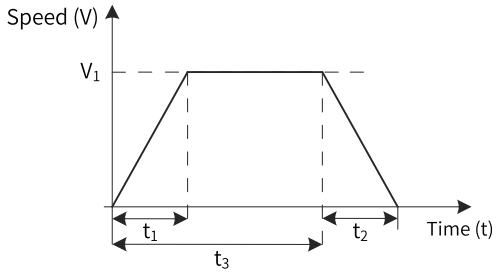


Figure 2-51 Example of multi-speed operation curve

As shown in the preceding figure, the speed reference is V_1 and the actual acceleration time t_1 is as follows.

$$t_1 = \frac{V_1}{1000} \times \text{Acceleration time set for this speed}$$

The actual deceleration time t_2 is as follows.

$$t_2 = \frac{V_1}{1000} \times \text{Deceleration time set for this speed}$$

Operating time = Time taken in switching from the last speed no. to this speed no. + Duration of constant-speed operation in this speed no. (as shown by t_3 in the preceding figure)

- Switchover between A and B

When setting H06-02 (Speed reference source) to 3 (Switched between A and B), you need to assign FunIN.4 (CMD-SEL) to the corresponding DI. The input signal of this DI determines which source (A or B) is active.

☆Related function No.

Function No.	Name	Function	Description
FunIN.4	CMD-SEL	Main reference (A)/Auxiliary reference (B) switchover	Inactive: Current reference being A Active: Current reference being B

- Communication

  When H06-02 (Speed reference source) is set to 4 (Communication), the speed reference is the setpoint of H31-09. Parameter H31-09, which is not displayed on the keypad, can be set through communication only.

  ☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H31-09	Speed reference set through communica-tion	-6000.000 to +6000.000	RPM	Used to set the speed reference value through communication. The setpoint is accurate to 0.001 RPM.	During running	Immediately	-

Speed reference direction

Assign FunIN.26 to a DI so that you can switch the speed reference direction directly through the DI. The input signal of this DI determines the speed reference direction.

☆Related function No.

Function No.	Name	Function	Description
FunIN.26	SPDDirSel	Speed reference direction	Inactive: Forward Active: Reverse

The actual direction of rotation is related to the setting of H02-02 (Direction of rotation), the sign (+/-) of the speed reference value, and the logic of FunIN.26.

Table 2–23 Actual direction of rotation in the speed control mode

H02-02	Sign of the Speed Reference Value	FunIN.26	Actual Direction of Rotation
0	+	Inactive	CCW
0	+	Active	CW
0	-	Inactive	CW
0	-	Active	CCW
1	+	Inactive	CW
1	+	Active	CCW
1	-	Inactive	CCW
1	-	Active	CW

2.2.2 Ramp Function Setting

The ramp function is used to smooth the acceleration rate of speed references through acceleration/deceleration time setting.

In the speed control mode, a high acceleration rate easily leads to motor jerk or intense vibration. In this case, increasing the acceleration/deceleration time smoothens the motor speed change, preventing mechanical damage caused by jerk or vibration.

Caution

- When the speed reference is defined by the keypad or the jog speed, you can set the acceleration time and deceleration time in H06-05 and H06-06.
- When the speed reference is defined by multi-speed references, you can set the acceleration/deceleration time in parameter group H12. For details, see Chapter "Parameter List".

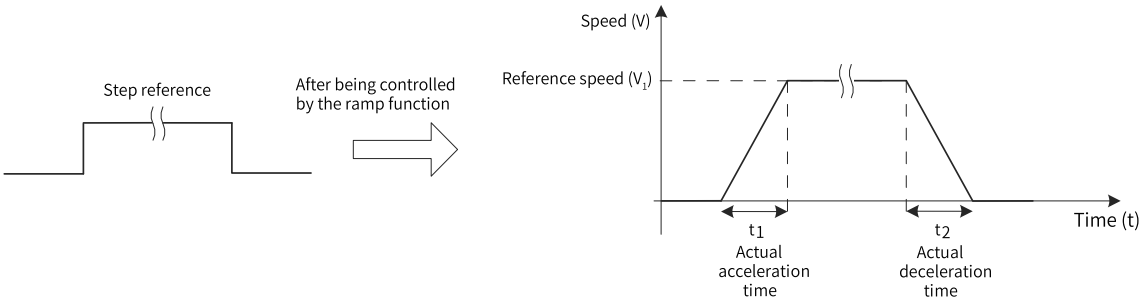


Figure 2-52 Definition of the ramp function

- H06-05: Defines the time taken in accelerating from 0 RPM to 1000 RPM.
- H06-06: Defines the time taken in decelerating from 1000 RPM to 0 RPM.

The formulas for calculating the actual acceleration time and deceleration time are as follows:

$$\text{Actual acceleration time } t_1 = \frac{\text{Speed reference}}{1000} \times \text{Speed reference acceleration ramp time}$$

$$\text{Actual deceleration time } t_2 = \frac{\text{Speed reference}}{1000} \times \text{Speed reference deceleration ramp time}$$

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-05	Acceleration ramp time constant of speed reference	0–65535	ms	Defines the acceleration/deceleration time of speed references (excluding multi-speed references) in the speed control mode.	During running	Immediately	0
H06-06	Deceleration ramp time constant of speed reference	0–65535	ms		During running	Immediately	-

2.2.3 Zero Clamp

Caution

- Zero clamp is used in systems where position loop is unavailable in the speed control mode.
- If the motor oscillates in the zero clamp state, adjust the position loop gain.

Zero clamp refers to the zero position lock state that applies when the speed reference amplitude, in cases where the ZCLAMP (FunIN.12) signal is active, is less than or equal to H06-15 in the speed control mode. In this case, an internal position loop is built in the servo drive, which deactivates the speed references.

The motor is locked to the zero clamp position with a deviation of ± 1 pulse, unaffected by external force.

When the speed reference amplitude exceeds the setpoint of H06-15 (Speed threshold for zero clamp), the motor exits from the zero clamp state and continues running according to the input speed reference. Zero clamp is deactivated when the ZCLAMP (FunIN.12) signal is inactive.

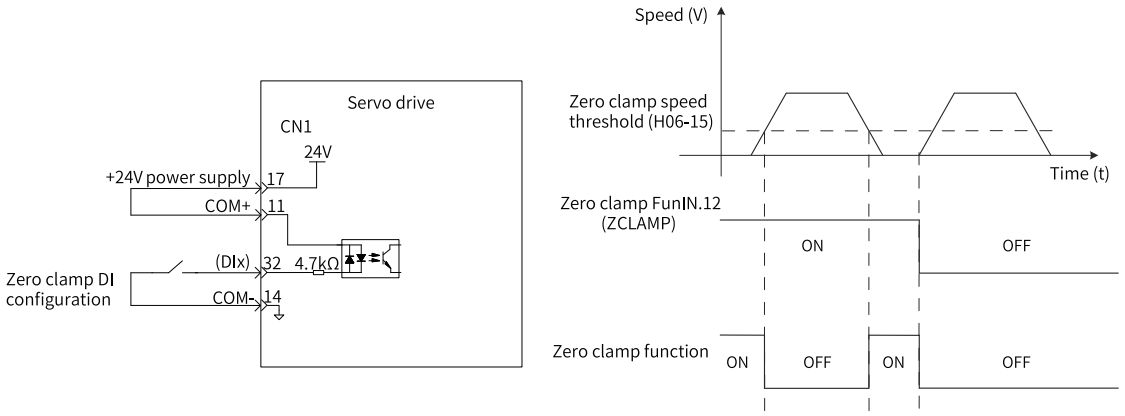


Figure 2-53 Wiring and waveform of zero clamp

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-15	Zero clamp speed threshold	0–6000	RPM	Defines the speed threshold for zero clamp.	During running	Immediately	10

☆Related function No.

Function No.	Name	Function	Description
FunIN.12	ZCLAMP	Zero clamp	Inactive: Zero clamp disabled Active: Zero clamp enabled

2.2.4 Speed Reference Limit

Caution

When the actual speed of the motor exceeds H0A-08 (Overspeed threshold), Er.500 (Motor overspeed) occurs. For details of H0A-08, see Chapter "List of Parameters". The speed reference limit must be lower than H0A-08.

The speed references in the speed control mode is limited by the following factors:

- H06-07 (Maximum speed limit): Defines the speed reference limit in both directions. The limit value applies when speed references exceed it.
- H06-08 (Forward speed limit): Defines the speed limit in the forward direction. The limit value applies when forward speed references exceed it.
- H06-09 (Reverse speed limit): Defines the speed limit in the reverse direction.The limit value applies when reverse speed references exceed it.
- Maximum motor speed (default limit): Depends on the motor model.

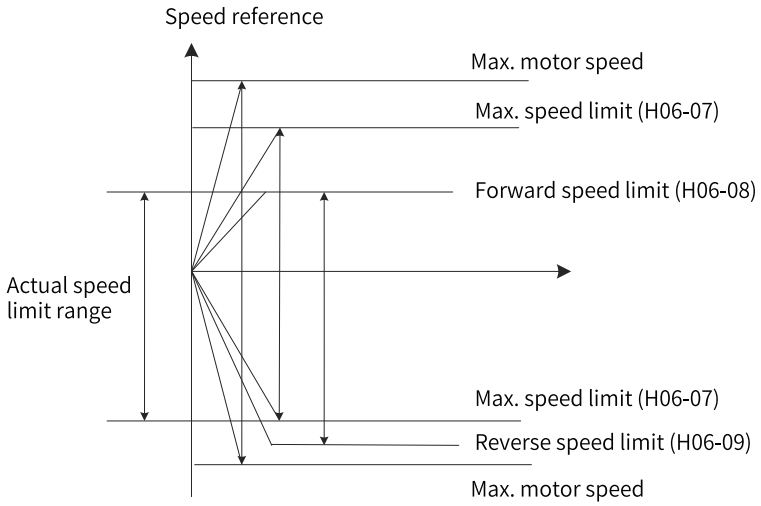


Figure 2-54 Example of speed reference limit

The actual motor speed limit is within the following range:

- |Amplitude of forward speed reference| ⩽ min {maximum motor speed, H06-07, H06-08}
- |Amplitude of reverse speed reference| ⩽ min {maximum motor speed, H06-07, H06-09}

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-07	Maximum speed limit	0 to 6000	RPM	Defines the maximum speed limit.	During running	Immediately	6000
H06-08	Forward speed limit	0 to 6000	RPM	Defines the speed limit in the forward direction.	During running	Immediately	6000
H06-09	Reverse speed limit	0 to 6000	RPM	Defines the speed limit in the reverse direction.	During running	Immediately	6000

2.2.5 Speed-Related DO Functions

By comparing filtered speed feedback with different thresholds, DO signals can be output for use by the host controller. The filter time constant is set in H0A-27 (Speed DO filter time constant).

TGON signal output

Only when the absolute value of filtered motor speed reaches H06-16 (Motor speed threshold) will the servo drive output the TGON (FunOUT.2: motor rotation) signal to acknowledge the rotation state.

Acknowledgment of the TGON signal is not affected by the operating state or the control mode of the servo drive.

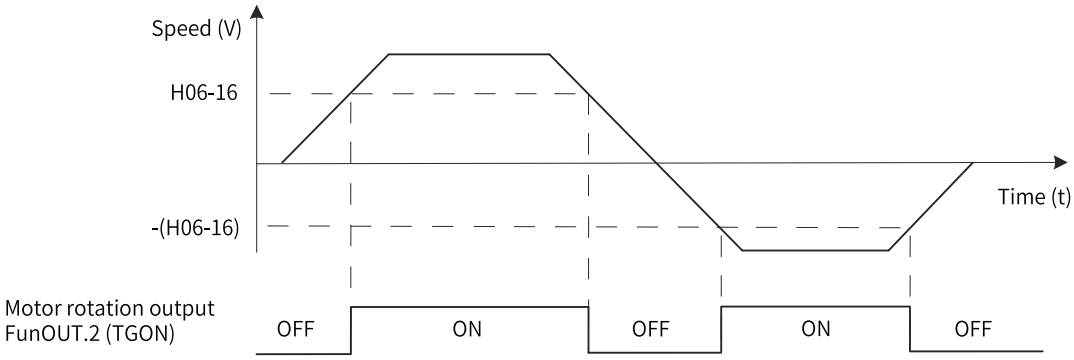


Figure 2-55 TGON signal waveform

Note

In the preceding figure, "ON" indicates the TGON (motor rotation) signal is active. "OFF" indicates the TGON (motor rotation) signal is inactive.

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-16	Threshold of TGON signal	0–1000	RPM	Defines the speed threshold at which the TGON (motor rotation) signal is active.	During running	Immediately	20

To use the TGON signal, assign FunOUT.2 (TGON, motor rotation) to a DO and set the active logic of this DO.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.2	TGon	Motor rotation	Inactive: Absolute value of filtered motor speed less than H06-16 Active: Absolute value of filtered motor speed reaching H06-16

V-Cmp signal output

In the speed control mode, the servo drive outputs the speed matching (FunOUT.4: V-Cmp) signal only when the difference between the filtered motor speed and speed reference is within the threshold defined by H06-17. If the difference exceeds H06-17, the T-Cmp signal is inactive.

If the servo drive is neither in the operation state nor the speed control mode, the V-Cmp signal is inactive.

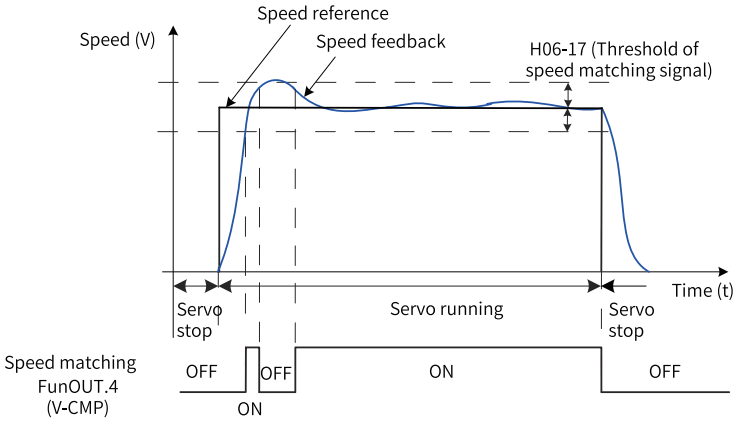


Figure 2-56 V-Cmp signal waveform

Note

In the preceding figure, "ON" indicates the V-Cmp signal is active. "OFF" indicates the V-Cmp signal is inactive.

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-17	Threshold of V-Cmp signal	0–100	RPM	Defines the threshold at which the V-Cmp (speed matching) signal is active.	During running	Immediately	10

To use the V-Cmp signal, assign FunOUT.4 (V-Cmp, speed matching) to a certain DO and set the active logic of this DO.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.4	V-CMP	Speed matching	Inactive: The absolute value of the difference between filtered motor speed and speed reference exceeds the threshold defined by H06-17. Active: The absolute value of the difference between filtered motor speed and speed reference is within the threshold defined by H06-17.

V-Arr signal output

The servo drive outputs the V-Arr (FunOUT.19: speed reach) signal only when the filtered motor speed exceeds the threshold defined by H06-18.

Acknowledgment of the V-Arr signal is not affected by the operation state or control mode of the servo drive.

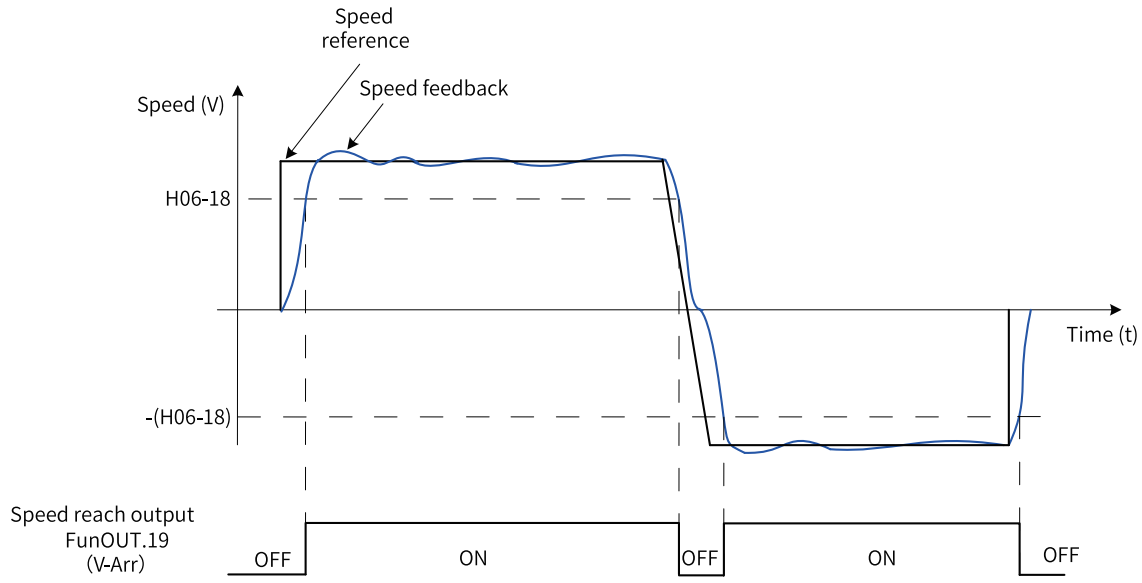


Figure 2-57 V-Arr signal waveform

Note

In the preceding figure, "ON" indicates the V-Arr (speed reached) signal is active. "OFF" indicates the V-Arr (speed reached) signal is inactive.

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-18	Threshold of V-Arr signal	10–6000	RPM	Defines the threshold at which the V-Arr (speed reach) signal is active.	During running	Immediately	1000

To use the V-Arr signal, assign FunOUT.19 (V-Arr, speed reach) to a DO and set the active logic of this DO.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.19	V-Arr	Speed reach	Inactive: The absolute value of filtered motor speed feedback exceeds the threshold defined by H06-18. Active: The absolute value of filtered motor speed feedback is within the threshold defined by H06-18.

V-Zero signal output

The servo drive outputs the V-Zero (FunOUT.3: zero speed) signal only when the absolute value of actual motor speed is lower than the threshold defined by H06-19.

Acknowledgment of the V-Zero signal is not affected by the operation state or the control mode of the servo drive.

Interferences in the speed feedback can be filtered by the speed feedback DO filter. You can set the corresponding filter time constant in H0A-27.

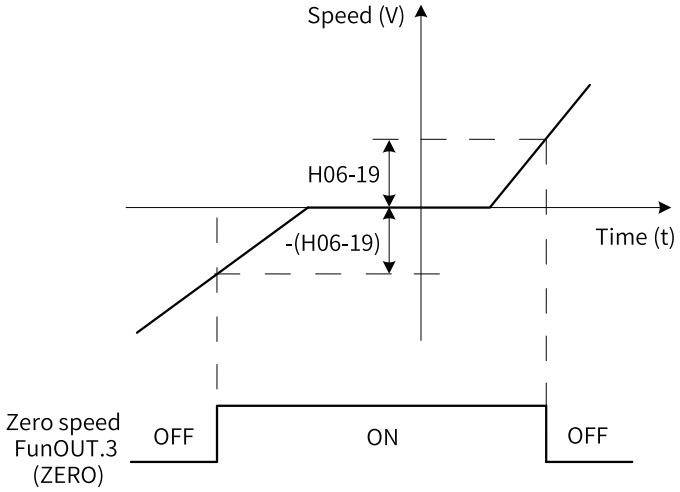


Figure 2-58 V-Zero signal waveform

Note

In the preceding figure, "ON" indicates the V-Zero signal is active. "OFF" indicates the V-Zero signal is inactive.

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H06-19	Threshold of zero speed output signal	1–6000	RPM	Defines the threshold at which the V-Zero (zero speed) signal is active.	During running	Immediately	10

To use the V-Zero signal, assign FunOUT.3 (V-Zero, zero speed) to a DO and set the active logic of this DO.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.3	V-Zero	Zero speed	Inactive: The difference between the motor speed feedback and the reference value exceeds the threshold defined by H06-19. Active: The difference between the motor speed feedback and the reference value does not exceed the threshold defined by H06-19.

2.2.6 Block Diagram of Speed Control Parameters

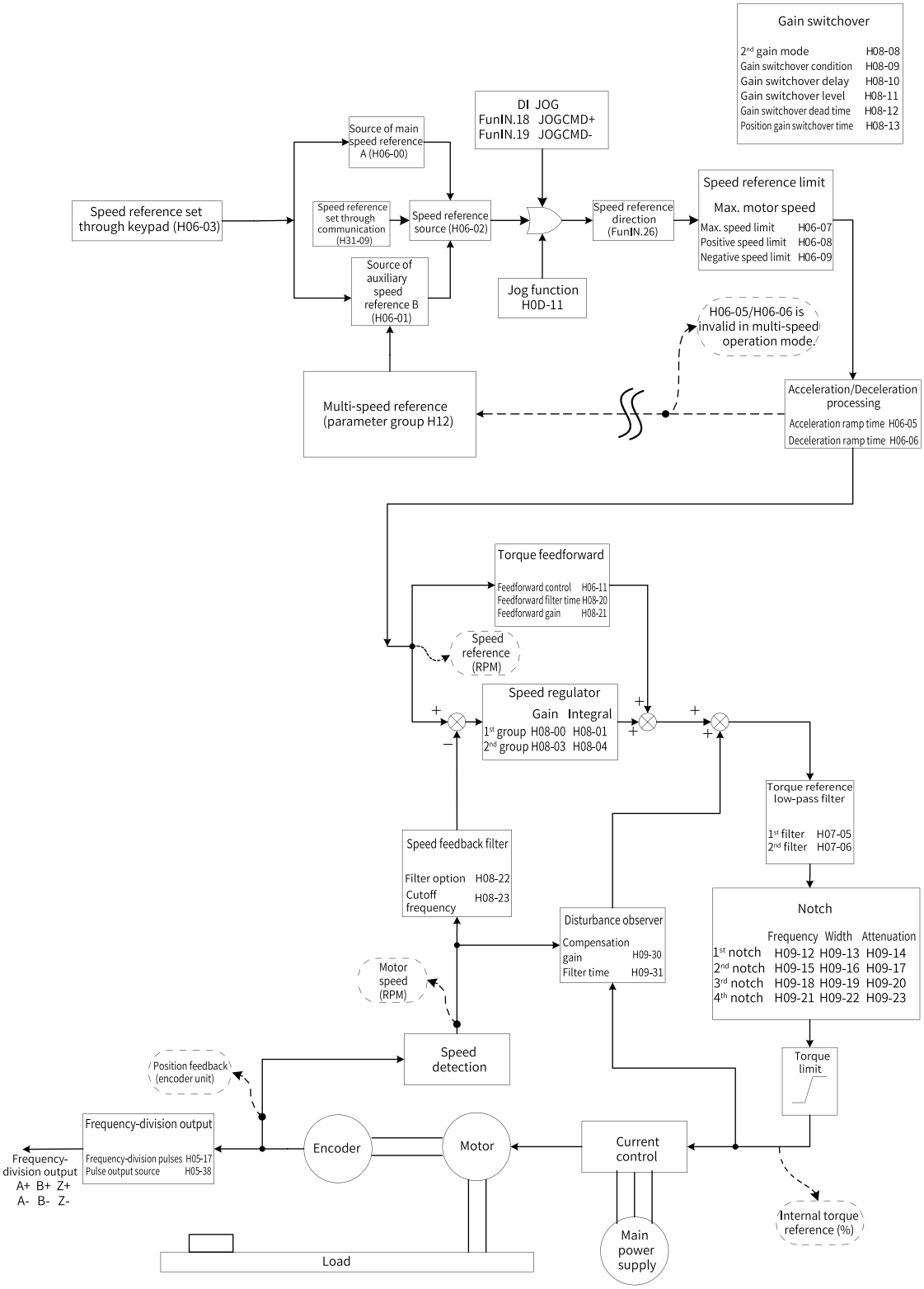


Figure 2-59 Block diagram of speed control parameters

2.3 Torque Control Mode

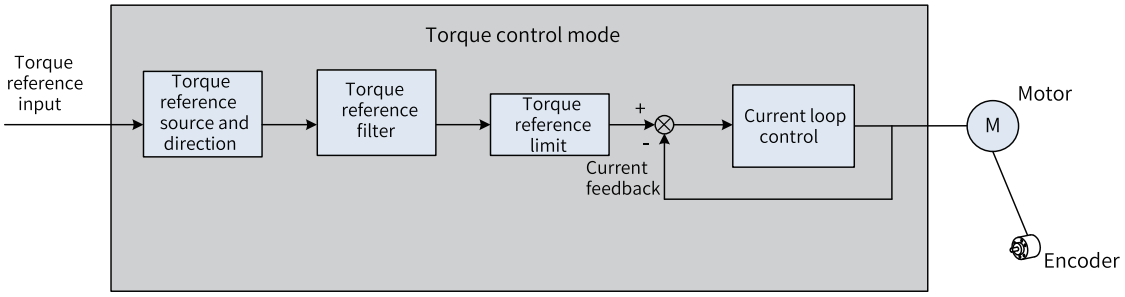


Figure 2-60 Block diagram of torque control mode

Set H02-00 (Control mode selection) to 2 (Torque control mode) through the keypad or the software tool to make the servo drive operate in the torque control mode. Set the servo drive parameters based on the mechanical structure and technical indicators. The following describes basic parameter settings in the torque control mode.

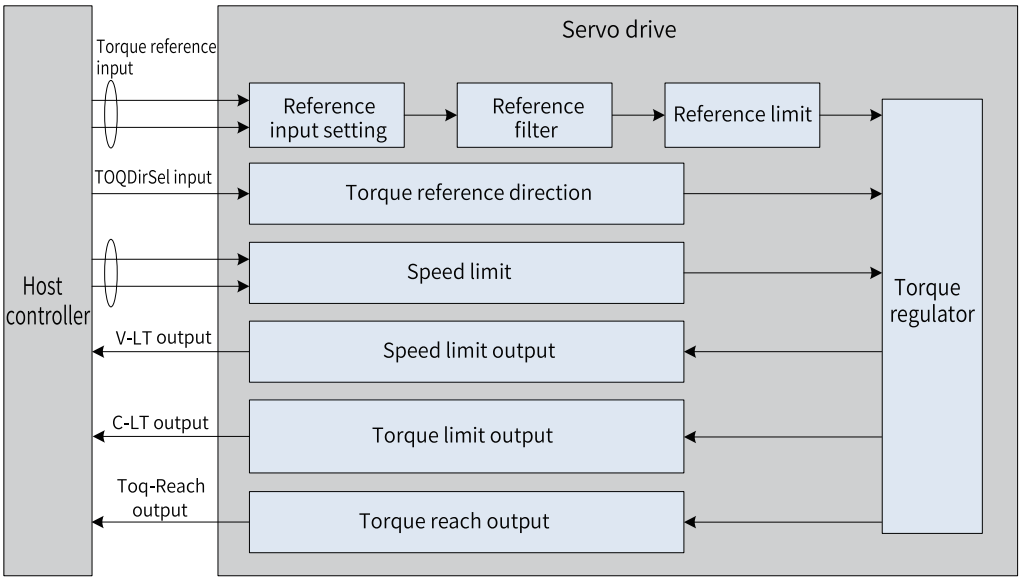


Figure 2-61 Signal exchange between the servo drive and the host controller

2.3.1 Torque Reference Input Setting

Torque reference sources

Five torque reference sources are available in the torque control mode, which can be set in H07-02.

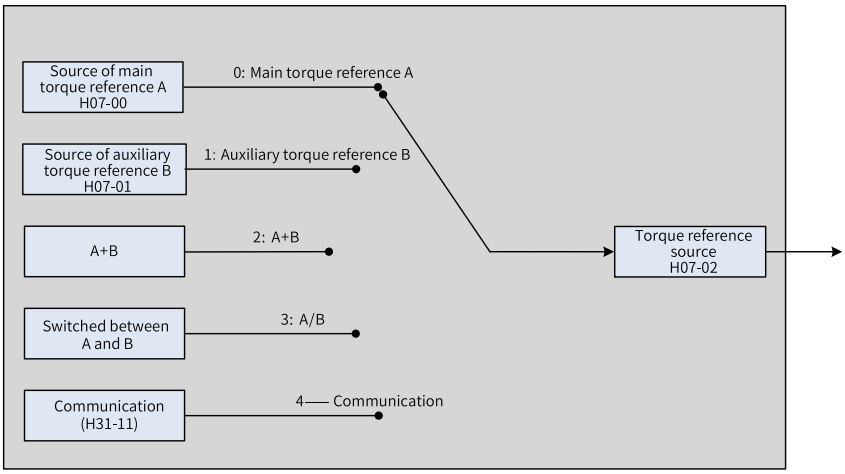


Figure 2-62 Torque reference sources

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-02	Torque reference source	0: Source of main torque reference A 1: Source of auxiliary torque reference B 2: A+B 3: Switched between A and B 4: Communication	-	Defines the torque reference source.	At stop	Immediately	0

- Source of main torque reference A

  The main speed reference A is an internal speed reference that can be set through digital setting.

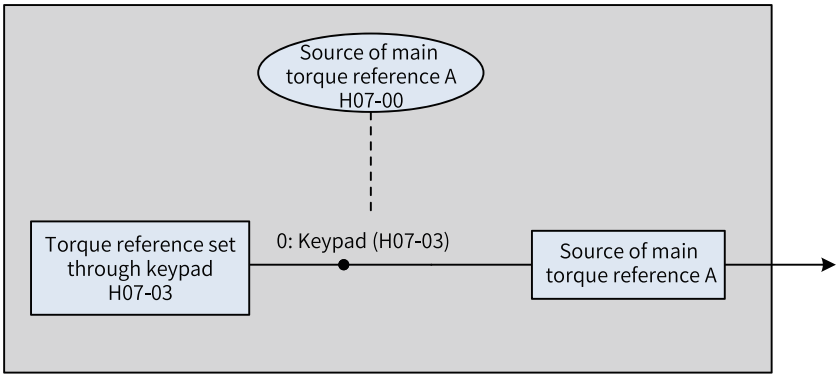


Figure 2-63 Source of main torque reference A

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-00	Source of main torque reference A	0: Digital setting (H07-03)	-	Defines the source of main torque reference A.	At stop	Immediately	0

Digital setting

The torque reference is set in H07-03, which defines the percentage of the reference torque to the rated torque of the motor.

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-03	Torque reference set through keypad	-400.0 to +400.0	%	Defines the internal torque reference value, which is accurate to 0.1%.	During running	Immediately	0

- Source of auxiliary torque reference B
  The source of auxiliary torque reference B is set in the same way as the main torque reference A. For descriptions of related parameters, see group H07 in Chapter "Parameter List".
- Switchover between A and B
  When setting H07-02 (Torque reference source selection) to 3 (Switched between A and B), you need to assign FunIN.4 (CMD-SEL) to a DI and the input signal of this DI determines which source (A or B) is active.

  ☆Related function No.

Function No.	Name	Function	Description
FunIN.4	CMD-SEL	Reference switchover	OFF: Current reference being A ON: Current reference being B

- Communication
  When H07-02 (Torque reference source) is set to 4 (Communication), the torque reference is the setpoint of H31-11. Parameter H31-11, which is not displayed on the keypad, can be set through communication only.

  ☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H31-11	Torque reference set through communication	-100.000 to +100.000	%	Defines the torque reference value set through communication, which is accurate to 0.001%.	During running	Immediately	-

Torque reference direction

To switch the torque reference direction through a DI, assign FunIN.25 (TorDirSel, torque reference direction) to a DI. The input signal of this DI determines the torque reference direction.

☆Related function No.

Function No.	Name	Function	Description
FunIN.25	ToqDirSel	Torque reference direction	Inactive: Actual direction same as the reference direction Active: Actual direction opposite to the reference direction

The actual direction of rotation is related to the setting of H02-02 (Direction of rotation), the sign (+/-) of the torque reference value, and the logic of FunIN.25.

Table 2–24 Actual direction of rotation in the torque control mode

H02-02	Sign (+/-) of Torque Reference Value	Logic of FunIN.25	Actual Direction of Rotation
0	+	Inactive	CCW
0	+	Active	CW
0	-	Inactive	CW
0	-	Active	CCW
1	+	Inactive	CW
1	+	Active	CCW
1	-	Inactive	CCW
1	-	Active	CW

2.3.2 Torque Reference Filter

Caution

If the filter time constant is set to an excessively high value, the responsiveness will be degraded, so pay attention to the responsiveness when setting the filter time constant.

The servo drive smoothens torque references and reduces vibration through the low-pass filter in all the control modes.

The servo drive offers two low-pass filters for torque references, in which the low-pass filter 1 is used by default.

The servo drive switches to low-pass filter 2 when gain switchover is enabled (H08-08 = 1) and the condition defined by H08-09 (H08-09 ≠ 0) is met.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-05	Torque reference filter time constant	0–30.00	ms	Defines the low-pass filter time constant for the 1st group of torque references.	During running	Immediately	0.79
H07-06	2nd torque reference filter time constant	0–30.00	ms	Defines the low-pass filter time constant for the 2nd group of torque references.	During running	Immediately	0.79

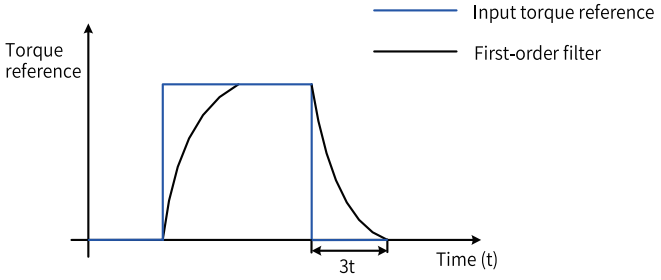


Figure 2-64 First-order filtering of rectangular torque references

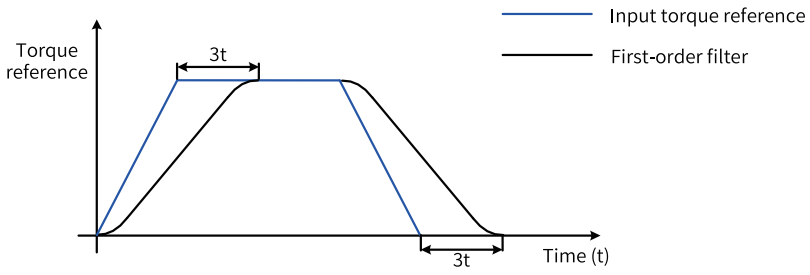


Figure 2-65 First-order filtering of trapezoid torque references

2.3.3 Torque Reference Limit

Caution

Torque reference limit is needed and active in all the control modes.

The torque reference limit is used to protect the servo drive and the motor.

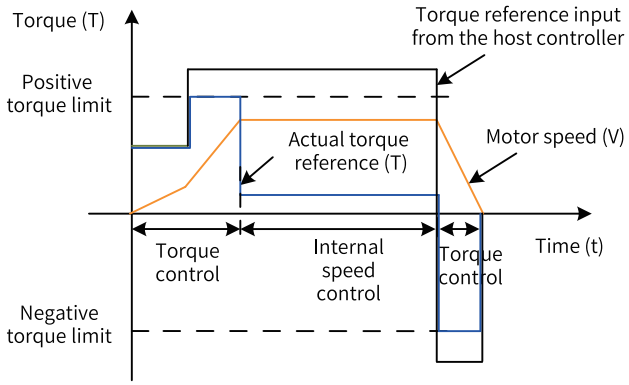


Figure 2-66 Torque reference and torque limit

If the absolute value of the torque reference input from the host controller or output from the speed regulator exceeds the absolute value of the torque reference limit, the torque reference limit applies. If the contrary happens, the torque reference input from the host controller or output from the speed regulator applies.

Only one torque reference limit is active at any moment. The positive/negative torque limit cannot exceed the maximum torque and ±300.0% rated torque of the servo drive and motor.

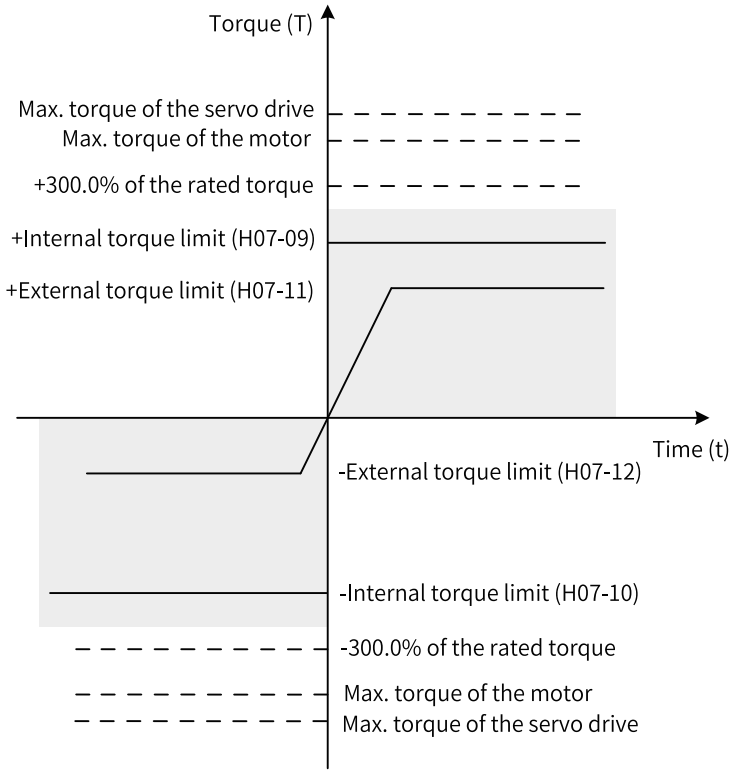


Figure 2-67 Example of torque limit

Setting the torque limit source

You can set the torque limit source in H07-07.

The torque limit applies when the torque reference exceeds the torque limit. Set the torque limit based on the operating requirements of the load. An excessively low limit may weaken the acceleration/ deceleration capacity of the motor, causing the actual motor speed to fall below the demand value during operation at a constant torque.

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-07	Torque limit source	0: Positive/Negative internal torque limit 1: Positive/Negative external torque limit	-	Defines the torque limit source.	At stop	Immediately	0

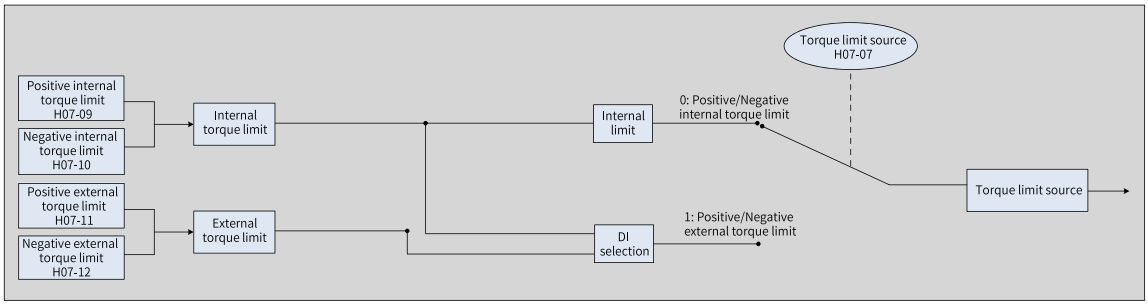


Figure 2-68 Torque limit source

The following figures show examples in which absolute values of torque references input from the host controller exceed the absolute value of torque limit in the torque control mode.

- H07-07 = 0 (Positive/Negative internal torque limit)
  The torque reference limit is determined only by H07-09 (Positive internal torque limit) and H07-10 (Negative internal torque limit).

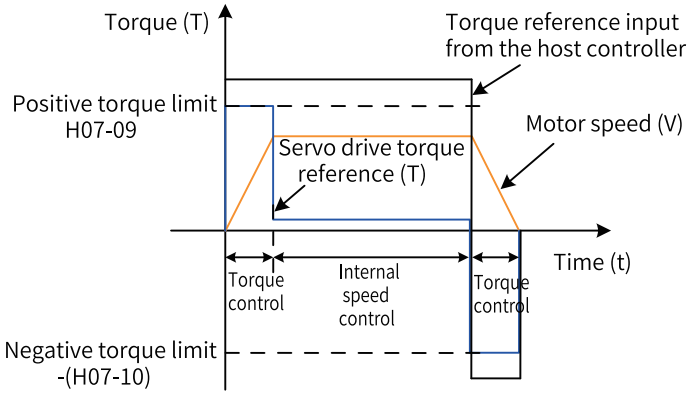


Figure 2-69 Torque limit curve (H07-07 = 0)

- H07-07 = 1 (Positive/Negative external torque limit)
  The torque reference limit is determined by the logic of the external DI signal. The positive torque limit is selected between H07-09 (Positive internal torque limit) and H07-11 (Positive external torque limit). The negative torque limit is selected between H07-10 (Negative internal torque limit) and H07-12 (Negative external torque limit).

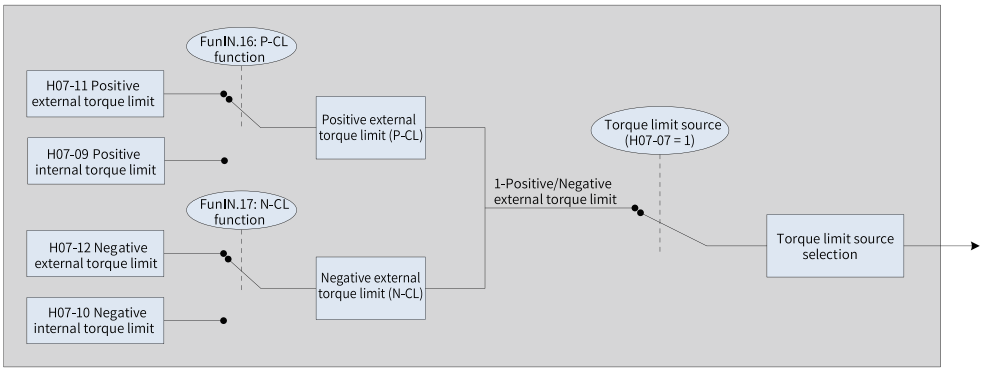
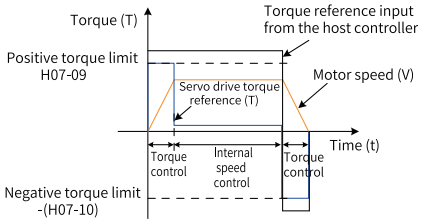
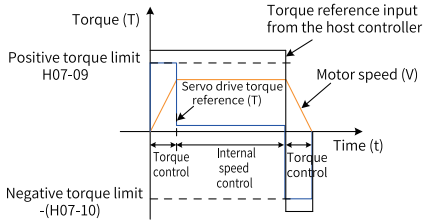
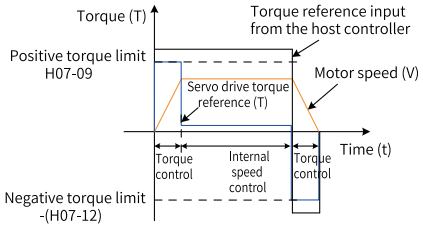
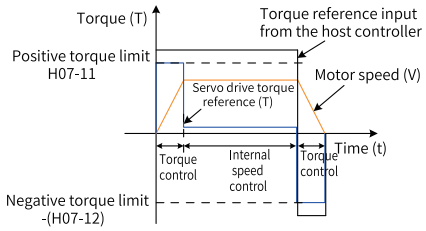


Figure 2-70 Torque limit source (H07-07 = 1)

Table 2–25 Descriptions of H07-07 = 1

<table>
<tr><th colspan="2" rowspan="2">DI Status</th><th colspan="2">P-CL</th></tr>
<tr><th>OFF</th><th>ON</th></tr>
<tr><td rowspan="2">N-CL</td><td>OFF</td><td> 
</td><td> 
</td></tr>
<tr><td>ON</td><td> 
</td><td> 
</td></tr>
</table>

Assign FunIN.16 (P-CL: Positive external torque limit) and FunIN.17 (N-CL: Negative external torque limit) to two DIs and set the active logic of these two DIs.

☆Related function No.

Function No.	Name	Function	Description
FunIN.16	P-CL	Positive external torque limit	The torque limit source is switched based on H07-07 (Torque limit source). H07-07 = 1: Active: Positive external torque limit activated Inactive: Positive internal torque limit activated
FunIN.17	N-CL	Negative external torque limit	The torque limit source is switched based on H07-07 (Torque limit source). H07-07 = 1: Active: Negative external torque limit activated Inactive: Negative internal torque limit activated

☆Related parameter

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-09	Positive internal torque limit	0 to 400.0	%	Defines the positive/ negative internal torque limit (the value 100% corresponds to the rated torque).	During running	Immediately	300
H07-10	Negative internal torque limit	0 to 400.0	%		During running	Immediately	300
H07-11	Positive external torque limit	0 to 400.0	%	Defines the positive/ negative external torque limit (the value 100% corresponds to the rated torque).	During running	Immediately	300
H07-12	Negative external torque limit	0 to 400.0	%		During running	Immediately	300

Setting torque limit DO signal

The servo drive outputs C-LT (FunOUT.7: torque limit) signal to the host controller when the torque reference reaches the limit value. To use the C-LT signal, assign FunOUT.7 to a DO and set the active logic of this DO.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.7	C-LT	Torque limit signal	Active: The torque reference reaches the limit value and the limit value applies. Inactive: The torque reference does not reach the limit value.

2.3.4 Speed Limit in the Torque Control Mode

In the torque control mode, the motor accelerates continuously if the torque reference is higher than the load torque on the machine side, which may cause overspeed and damage the machine. A speed limit therefore must be set to protect the machine.

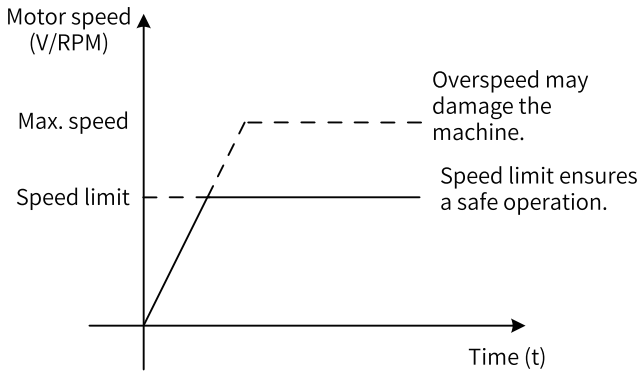


Figure 2-71 Speed limit in the torque control mode

Setting the speed limit source

You can set the speed limit source in the torque control mode through H07-17. The set speed limit applies when the motor speed exceeds the limit. Set the speed limit based on the operating requirements of the load.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-17	Speed limit source	0: Internal speed limit 1: Reserved 2: H07-19 or H07-20 as defined by DI	-	Defines the speed limit source in the torque control mode.	During running	Immediately	0

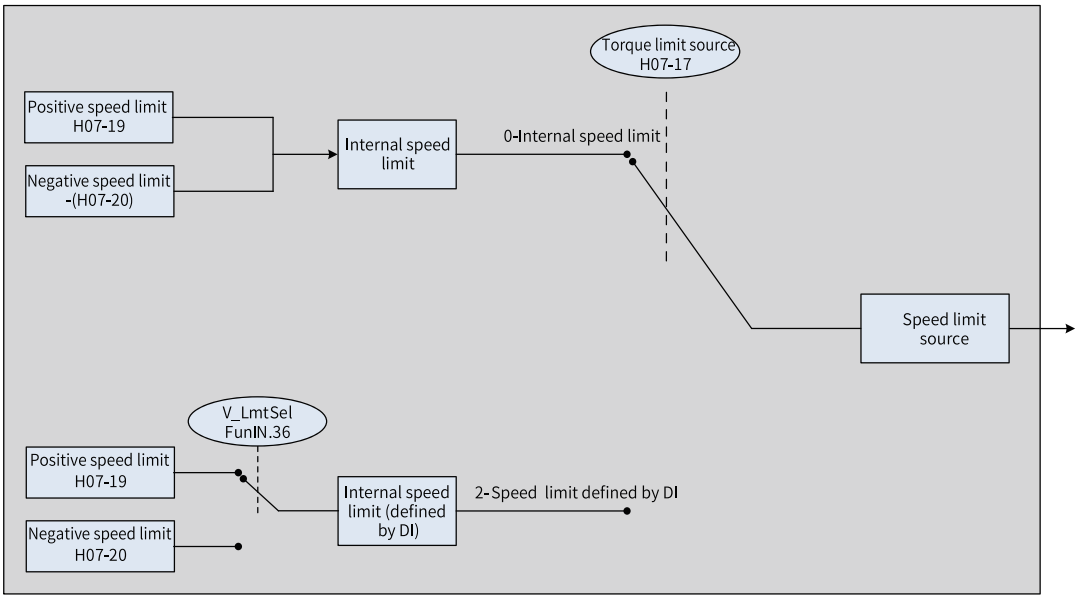


Figure 2-72 Speed limit source

- H07-17 = 0 (Internal speed limit)
  The speed limit in different directions of rotation is determined only by H07-19 (Positive speed limit) and H07-20 (Negative speed limit)

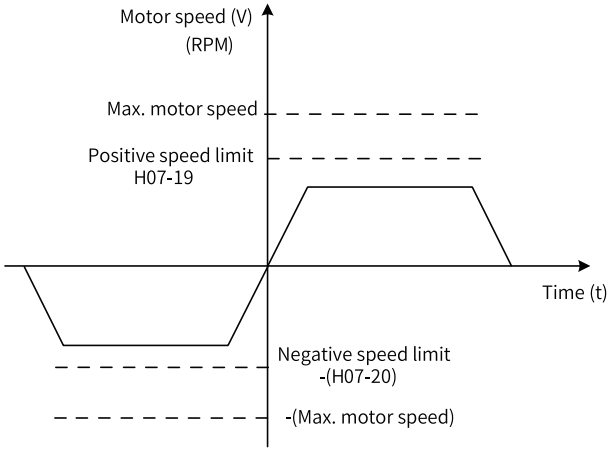


Figure 2-73 Speed limit curve (H07-17 = 0)

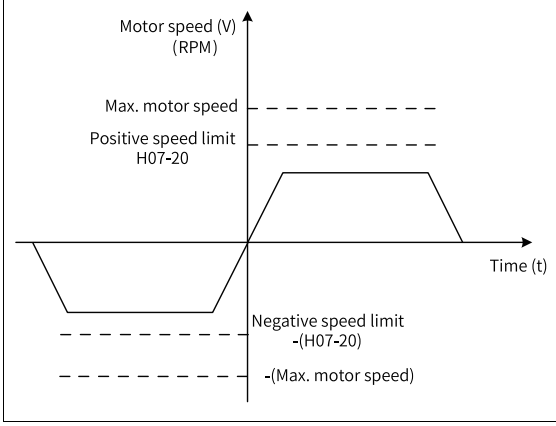
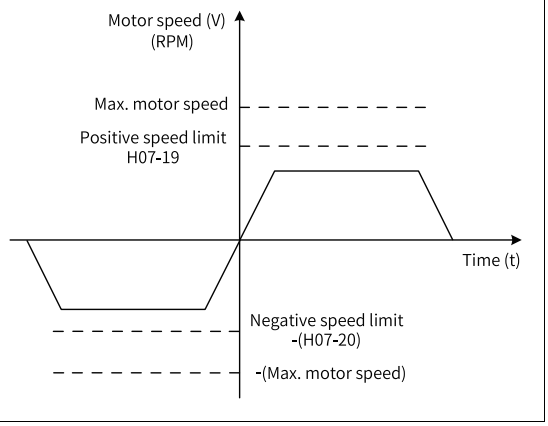
- H07-17 = 2 (H07-19 or H07-20 as defined by DI)
  H07-19 or H07-20 is used as the speed limit based on the logic of the DI signal.

  Before setting H07-17 to 2, assign FunIN.36 (V-LmtSel: internal speed limit source) to a DI first, and set the active logic of this DI.

  ☆Related function No.

Function No.	Name	Function	Description
FunIN.36	V_LmtSel	Internal speed limit source	Inactive: H07-19 as internal speed limit Active: H07-20 as internal speed limit

Table 2–26 Descriptions of speed limit

<table>
<tr><th colspan="2">V_LmtSel</th></tr>
<tr><th>ON</th><th>OFF</th></tr>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
</table>

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-19	Positive speed limit/ Speed limit 1 in torque control	0–6000	RPM	Defines the positive speed limit/speed limit 1 in the torque control mode.	During running	Immediately	3000
H07-20	Negative speed limit/Speed limit 2 in torque control	0–6000	RPM	Defines the negative speed limit/speed limit 2 in the torque control mode.	During running	Immediately	3000

Setting speed limit DO signal

In the torque control mode, the servo drive outputs V-LT (FunOUT.8: speed limited) signal to the host controller when the motor speed absolute value keeps exceeding the speed limit for the time defined by H07-40.

Acknowledgment of the V-LT signal is executed only during operation in the torque control mode.

To use the V-LT signal, assign FunOUT.8 to a DO and set the active logic of this DO.

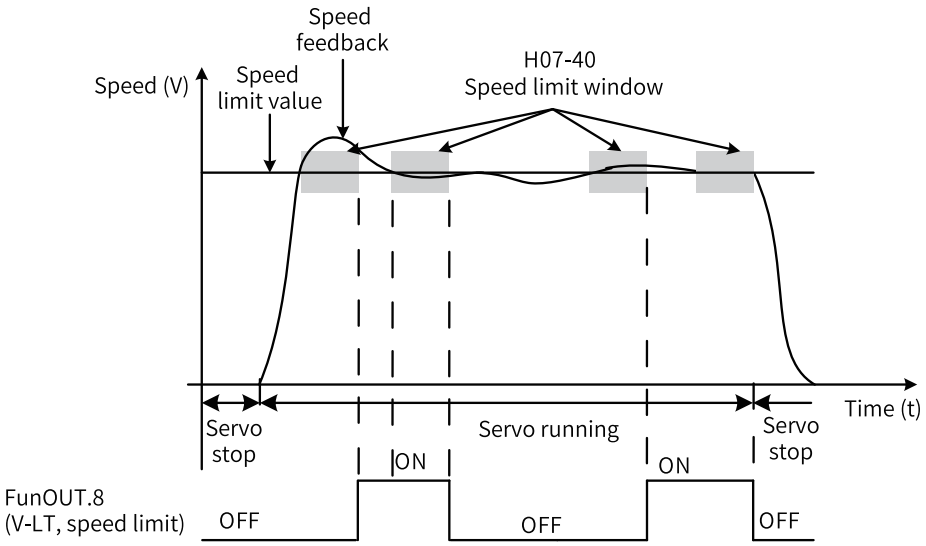


Figure 2-74 Example of speed limit DO waveform

☆Related function No.

Function No.	Name	Function	Description
FunOUT.8	V-LT	Speed limited	Inactive: Motor speed not reaching the speed limit Active: Motor speed reaching the speed limit and speed loop built based on this limit

2.3.5 Torque Reach Output

The servo drive outputs TorReach (FunOUT.18: torque reach) signal to the host controller when the actual torque reference reaches the torque reference threshold. This signal is used to check whether the actual torque reference reaches the set range.

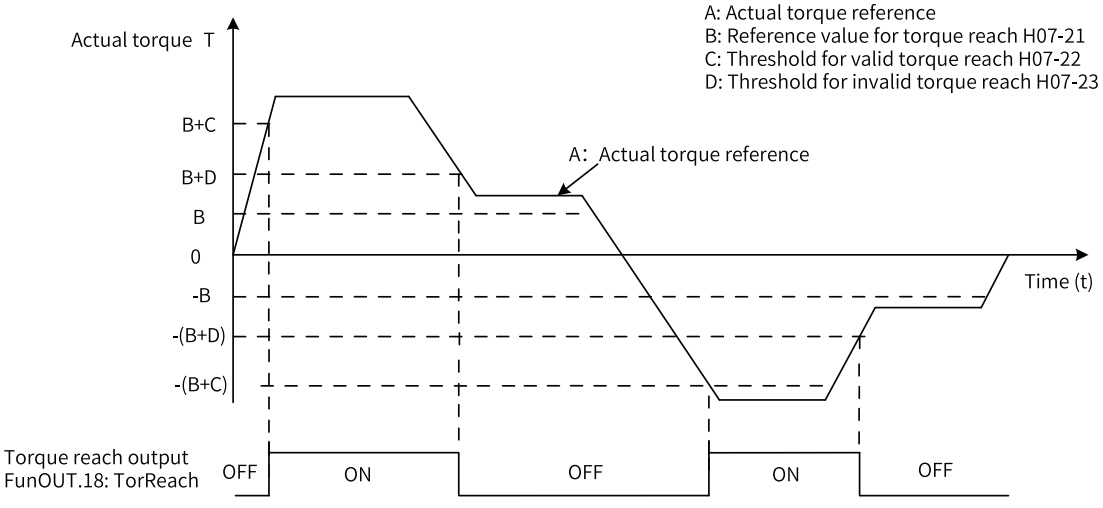


Figure 2-75 Example of torque reach output waveform

- Actual torque reference (viewed in H0B-02): A
- Reference value for torque reach (H07-21): B
- Threshold of valid torque reach (H07-22): C

- Threshold of invalid torque reach (H07-23): D

C and D are the offset based on B.

Therefore, the TorReach signal is active only when |A| ⩾ B + C and inactive only when |A| < B + D.

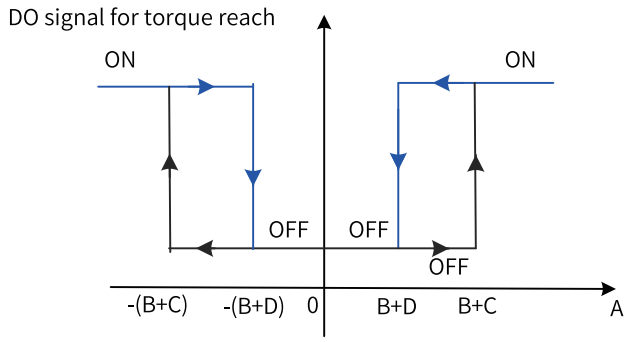


Figure 2-76 Active TorReach signal

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H07-21	Reference value for torque reach	0–300.0	%	Defines the reference value for torque reach (the value 100% corresponds to the rated torque).	During running	Immediately	0
H07-22	Threshold of valid torque reach	0–300.0	%	Defines the offset threshold for valid torque reach (the value 100% corresponds to the rated torque).	During running	Immediately	20.0
H07-23	Threshold of invalid torque reach	0–300.0	%	Defines the offset threshold for invalid torque reach (the value 100% corresponds to the rated torque).	During running	Immediately	10.0

To use the TorReach signal, assign FunOUT.18 (ToqReach, torque reach) to a DO of the servo drive and set the active logic of this DO.

☆Related function No.

Function No.	Name	Function	Description
FunOUT.18	ToqReach	Torque reach	Valid: Torque reference absolute value reaching the setpoint Invalid: Torque reference absolute value lower than the setpoint

2.3.6 Block Diagram of Torque Control Parameters

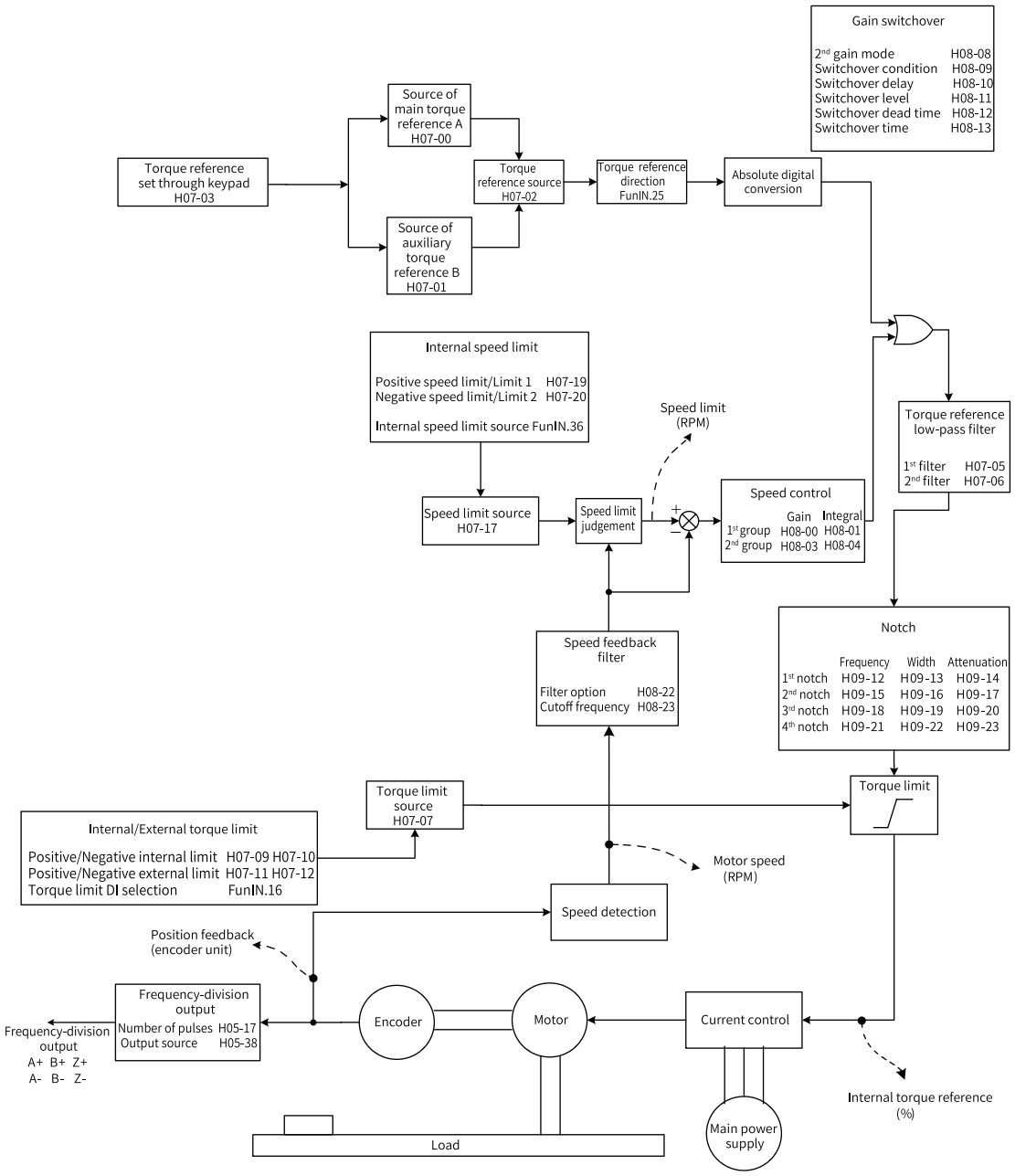


Figure 2-77 Block diagram of torque control parameters

2.4 Compound Control Mode

In the compound control mode, the control mode can be switched when the S-ON signal is active and the servo drive is in the "run" state. The following four compound control modes are available:

- Torque control mode ↔ Speed control mode
- Speed control mode ↔ Position control mode
- Torque control mode ↔ Position control mode
- Speed control mode ↔ Position control mode ↔ Torque control mode

You can enable the compound control mode by setting H02-00 through the keypad or the software tool.

☆Related parameter

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H02-00	Control mode selection	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Torque control mode ↔ Speed control mode 4: Speed control mode ↔ Position control mode 5: Torque control mode ↔ Position control mode 6: Torque control mode ↔ Speed control mode ↔ Position control mode	Defines the control mode of the servo drive.	At stop	Immediately	1

Set the parameters for different control modes based on the mechanical structure and technical indicators. For details, see descriptions of H02-00 in Chapter "Parameter List".

Before setting H02-00 to 3, 4, or 5, assign FunIN.10 (M1_SEL, mode selection 1) to a DI first and set the active logic of this DI. Before setting H02-00 to 6, assign FunIN.10 and FunIN.11 (M2_SEL, mode selection 2) to two DIs first and set the active logic of these two DIs.

☆Related function No.

Function No.	Name	Function	Description
FunIN.10	M1_SEL	Mode switchover 1	Defines the present control mode during compound control when the servo drive is in the "run" state, as shown in *"Table 2–27" on page 102*.
FunIN.11	M2_SEL	Mode switchover 2	Defines the present control mode during compound control when the servo drive is in the "run" state, as shown in *"Table 2–28" on page 103*.

Table 2–27 Servo drive control mode

H02-00	Logic of the DI Assigned with M1_SEL	Control Mode
3	Inactive	Torque control mode
	Active	Speed control mode
4	Inactive	Speed control mode
	Active	Position control mode
5	Inactive	Torque control mode
	Active	Position control mode

Table 2–28 Servo drive control mode

H02-00	Logic of the DI Assigned with M2_SEL	Logic of the DI Assigned with M1_SEL	Control Mode
6	-	Active	Position control mode
	Active	Inactive	Speed control mode
	Inactive	Inactive	Torque control mode

2.5 Absolute Encoder System

2.5.1 Overview

The absolute encoder, which features a single-turn resolution of 8388608 (2^{23}), is used to detect the motor position within one turn and count the number of motor revolutions, with 16-bit multi-turn data recorded. The absolute encoder can be used to build an absolute system that works in the absolute position linear mode or absolute position rotation mode, both of which can be applied in the position control, speed control, and torque control modes. In the absolute system, the absolute encoder is powered up by a battery to back up the data upon power-off. These data are used by the servo drive for calculating the mechanical absolute position upon power-on, removing the need for a homing operation.

To match the absolute encoder with the SV660P series servo drive, set H00-00 (Motor code) to 14101 (Inovance 23-bit absolute encoder). Then set H02-01 (Absolute system selection) based on actual applications. Er.731 (Encoder battery failure) will occur at initial operation of the battery. Set H0D-20 (Absolute encoder reset function) to 1 to reset Er.731 before performing the homing operation.

Note

When you change the value of H02-02 (Direction of rotation) or H0D-20 (Absolute encoder reset selection), the absolute position recorded by the encoder changes abruptly, causing the absolute position reference of the machine to change. In this case, a homing operation is needed. After homing is done, the deviation between the mechanical absolute position and that recorded in the encoder is calculated automatically and saved in the EEPROM of the servo drive.

2.5.2 Related Parameter Settings

Absolute encoder system settings

Set H00-00 (Motor code) to 14101 (Motor with 23-bit absolute encoder). Then set H02-01 to select the absolute position mode.

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H00-00	Motor code	14000: Inovance motor with 20-bit incremental encoder 14101: Inovance motor with 23-bit absolute encoder	Defines the type of the motor used. Select Inovance motor equipped with a 23-bit absolute encoder.	At stop	Next power-on	14101
H00-08	Absolute encoder type	14100: Multi-turn absolute encoder Others: Single-turn absolute encoder	Defines the absolute encoder type.	At stop	Next power-on	0
H02-01	Absolute system selection	0: Incremental position mode 1: Absolute position linear mode 2: Absolute position rotation mode	Defines the absolute position mode.	At stop	Next power-on	0

Note

In the absolute position mode, the system detects the motor code automatically to check whether the motor used is equipped with an absolute encoder. If not, Er.122 (Product mismatch in the absolute position mode) will occur.

Absolute position linear mode

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H0B-07	Absolute position counter	-	Displays present absolute position (in reference unit) of the motor in the position mode.	At display	-	0
H0B-58	Mechanical absolute position (low 32 bits)	-	Displays the position of the load converted to the motor end in the absolute position linear mode or absolute position rotation mode.	At display	-	0
H0B-60	Mechanical absolute position (high 32 bits)	-		At display	-	0
H0B-77	Absolute position fed back by the absolute encoder (low 32 bits)	-	Displays the absolute position fed back by the absolute encoder.	At display	-	0
H0B-79	Absolute position fed back by the absolute encoder (high 32 bits)	-		At display	-	0

The absolute position rotation mode applies when the load travel range is fixed and the encoder multi-turn data does not overflow, such as the ball screw transmission mechanism shown below.

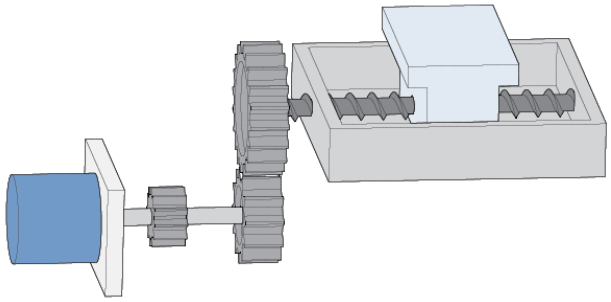


Figure 2-78 Ball screw transmission mechanism

In the formula $P_M = P_E - P_O$:
P_M: mechanical absolute position (H0B-58 and H0B-60)
P_E [range: -2^{38} to $(2^{38}-1)$]: absolute position fed back by the encoder
P_O: position offset in the absolute position linear mode (H05-46 and H05-48)

If the electronic gear ratio is B/A, then the following formula applies: H0B-07 (Absolute position counter) = $P_M/(B/A)$ H0B-07 indicates present mechanical absolute position (in reference unit).

Position offset in the absolute position linear mode (H05-46 and H05-48) is 0 by default. After homing is done, the servo drive calculates the difference between the mechanical absolute position and that fed back by the encoder, assigns the difference to H05-46 and H05-48 and saves the difference to EEPROM.

The encoder multi-turn data range in the absolute position linear mode is -32768 to +32767. If the number of forward revolutions exceeds 32767 or the number of reverse revolutions is lower than -32768, Er.735 (Encoder multi-turn count overflow) occurs. You can hide Er.735 by setting H0A-36 (Encoder multi-turn overflow fault) to 1 (Hide).

Absolute position rotation mode

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H05-50	Absolute position rotation mode Mechanical gear ratio (numerator)	1–65535	1	Defines the mechanical transmission gear ratio between the load and the motor in the absolute position rotation mode. The gear ratio is active only when H05-52 and H05-54 are set to 0.	At stop	Immediately	65535
H05-51	Mechanical gear ratio (denominator) in absolute position rotation mode	1–65535	1		At stop	Immediately	1
H05-52	Pulses per load revolution in absolute position rotation mode (low 32 bits in encoder unit)	0 to 4294967295	Encoder unit	Defines the pulses at the motor end per load revolution in the absolute position rotation mode.	At stop	Immediately	0
H05-54	Pulses per load revolution in absolute position rotation mode (high 32 bits in encoder unit)	0 to 4294967295	Encoder unit		At stop	Immediately	0

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0B-58	Mechanical absolute position (low 32 bits)	-	Encoder unit	Displays the position of the load converted to the motor end in the absolute position linear mode or absolute position rotation mode.	At display	-	0
H0B-60	Mechanical absolute position (high 32 bits)	-	Encoder unit		At display	-	0
H0B-77	Absolute position fed back by the absolute encoder (low 32 bits)	-	Encoder unit	Displays the absolute position fed back by the absolute encoder.	At display	-	0
H0B-79	Absolute position fed back by the absolute encoder (high 32 bits)	-	Encoder unit		At display	-	0
H0B-81	Single-turn position of the rotating load (low 32 bits)	-	Encoder unit	Defines the motor position converted from the rotating load single-turn position to the motor end in the absolute position rotation mode.	At display	-	0
H0B-83	Single-turn position of the rotating load (high 32 bits)	-	Encoder unit		At display	-	0
H0B-85	Single-turn position of the rotating load	-	Refer-ence unit	Defines single-turn position of the rotating load in the absolute position rotation mode.	At display	-	0

This mode applies when the load travel range is unlimited and the number of revolutions in one direction is lower than 32767. The rotating load is shown below.

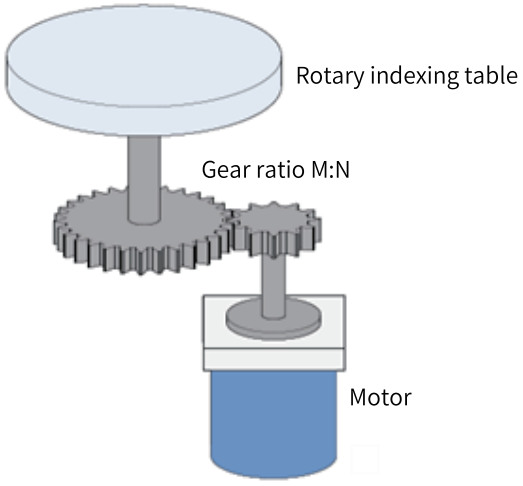


Figure 2-79 Rotating load

The servo drive calculates the upper limit of the mechanical absolute position based on H05-52 and H05-54 first. If H05-52 and H05-54 are 0, the servo drive turns to H05-50 and H05-51. When the encoder resolution (R_E) is 2^{23}, and the encoder pulses per load revolution is represented by R_M, the following formula applies: H05-52 or H05-54 ≠ 0: R_M = H05-54 x 2^{32} + H05-52 H05-52 and H05-54 = 0: $R_M = R_E$

If the electronic gear ratio is B/A, then the following formula applies: H0B-07 (Absolute position counter) = R_M/(B/A) H0B-07 indicates present mechanical absolute position in reference unit.

The following figure shows the relation between single-turn position of the rotating load and position of the rotary indexing table.

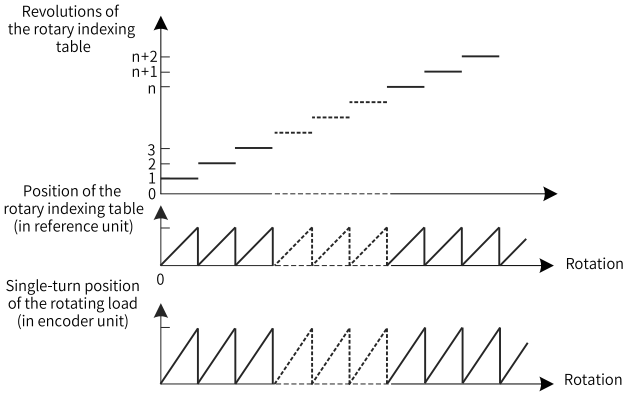


Figure 2-80 Relation between single-turn position of the rotating load and the position of the rotary indexing table

The following figure shows the relation between the position fed back by the encoder and the single-turn position of the rotating load.

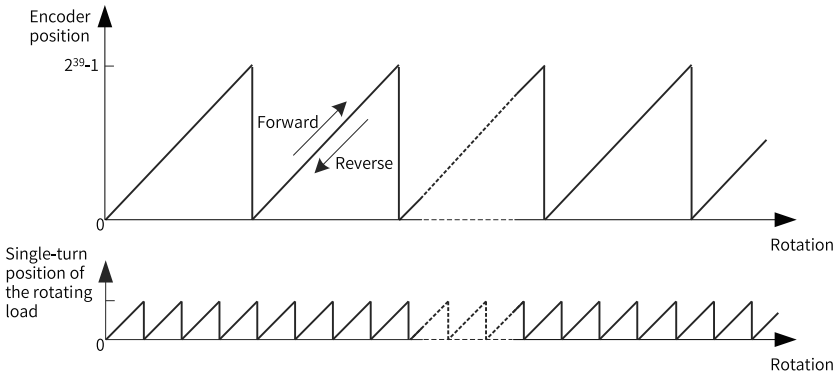


Figure 2-81 Relation between the position fed back by the encoder and single-turn position of the rotating load

The multi-turn data range is unlimited in the absolute position rotation mode, so you can hide Er.735 (Encoder multi-turn count overflow).

Encoder feedback data

The encoder feedback data is divided into the number of revolutions and the single-turn position. For the incremental position mode, the number of revolutions is not recorded.

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0B-70	Number of revolutions fed back by the absolute encoder	-	r	Displays the number of revolutions fed back by the absolute encoder.	At display	-	0
H0B-71	Single-turn position fed back by the absolute encoder	-	Encoder unit	Displays the single-turn absolute position fed back by the absolute encoder.	At display	-	0

Encoder multi-turn overflow fault

In the absolute position linear mode, you can hide the encoder multi-turn overflow fault by setting H0A-36.

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0A-36	Encoder multi-turn overflow fault	0: Not hide 1: Hide	-	In the absolute position linear mode, you can hide the encoder multi-turn overflow fault by setting H0A-36.	At stop	Immediately	0

Absolute encoder reset

You can reset the encoder fault or reset the multi-turn data fed back by the encoder by setting H0D-20.

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0D-20	Absolute encoder reset selection	0: No operation 1: Reset encoder fault 2: Reset encoder fault and multi-turn data	-	You can reset the encoder fault or reset the multi-turn data fed back by the encoder by setting H0D-20.	At stop	Immediately	0

Note

The absolute position recorded by the encoder changes abruptly after multi-turn data reset. In this case, a homing operation is needed.

2.5.3 Precautions for Use of the Battery Box

Er.731 (Encoder battery failure) will occur at initial operation of the battery. Set H0D-20 (Absolute encoder reset selection) to 1 to reset Er.731 before further operations.

When the battery voltage detected is lower than 3.0 V, Er.730 (Encoder battery warning) occurs. In this case, replace the battery according to the following steps.

1. Step 1: Power on the servo drive and make it stay in the non-operating state.
2. Step 2: Replace the battery.

3. Step 3: If no other warning occurs after Er.730 is cleared, the servo drive is ready to run.

- If you replace the battery after powering off the servo drive, Er.731 (Encoder battery failure) will occur at next power-on, leading to an abrupt change in the multi-turn data. In this case, set H0D-20 to 1 to reset the encoder fault. Then perform the homing operation again.
- Ensure the maximum motor speed does not exceed 6000 RPM upon power-down of the servo drive. This is to enable the encoder to record the position accurately.
- Keep the battery in environments within the required ambient temperature range and ensure the battery is in reliable contact and carries sufficient power capacity. Otherwise, encoder data loss may occur.

2.6 Auxiliary Functions

The servo drive offers the following auxiliary functions to ensure a proper operation of the servo system.

2.6.1 Software Position Limit

Hardware position limit is implemented by inputting external sensor signals to CN1 of the servo drive.

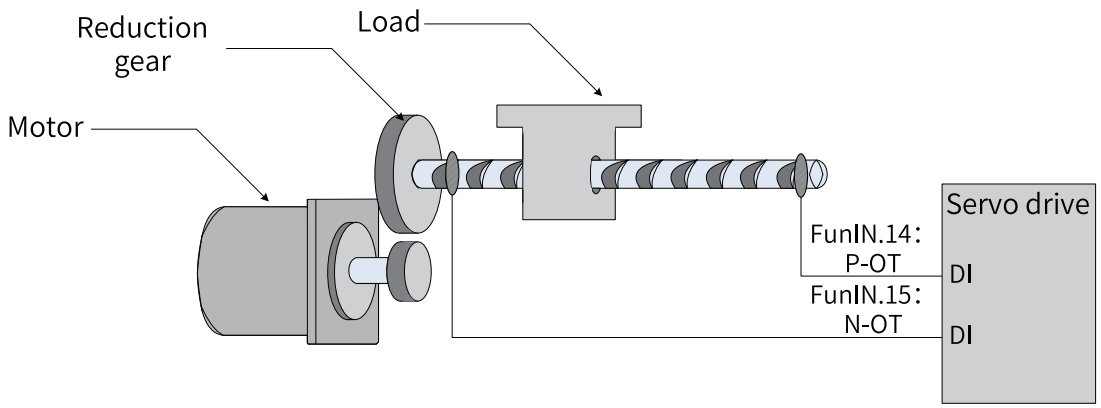


Figure 2-82 Installation of limit switches

Software position limit is implemented through a comparison between the internal position feedback and the set limit. If the set limit is exceeded, the servo drive reports a warning and stops immediately. Software position limit is available in both the absolute position mode and incremental position mode. Before enabling software position limit in the incremental position mode, set H0A-40 (Software position limit) to 2 (Enabled after homing) first, and then perform homing operation upon power-on.

Table 2–29 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 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 caused by mechanical slip through internal position comparison.
4	Unable to sense or detect overtravel after power-off.		

Table 2–30 Related parameters of software position limit

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0A-40	Software position limit	0: Disabled 1: Enabled immediately upon power-on 2: Enabled after homing	1	Defines whether or how to enable the software position limit.	At stop	Immediately	0
H0A-41	Maximum value of absolute position limit	-2147483648 to +2147483647	Reference unit	Defines the maximum absolute position limit in software position limit.	At stop	Immediately	2147483647
H0A-43	Minimum value of absolute position limit	-2147483648 to +2147483647	Reference unit	Defines the minimum absolute position limit in software position limit.	At stop	Immediately	-2147483648

- When H0A-40 is set to 0, software position limit is disabled.
- When H0A-40 is set to 1, software position limit is enabled immediately upon power-on. When the value of the absolute position counter (H0B-07) is higher than the value of H0A-41, Er.950 (Forward overtravel warning) occurs and the servo drive stops.
  When the value of the absolute position counter (H0B-07) is lower than the value of H0A-43, Er.952 (Reverse overtravel warning) occurs and the servo drive stops.
- If H0A-40 is set to 2, software position limit is enabled after homing upon power-on. When the value of the absolute position counter (H0B-07) is higher than the value of H0A-41 after homing, Er.950 (Forward overtravel warning) occurs and the servo drive stops. When the value of the absolute position counter (H0B-07) is lower than the value of H0A-43 after homing, Er.952 (Reverse overtravel warning) occurs and the servo drive stops.

2.6.2 Software Reset

When a No. 1 non-resettable fault does not occur and a restart is not allowed on site, you can use the software reset function to restart a non-operating servo drive.

☆Related parameter

Parameter No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H0D-00	Software reset	0: No operation 1: Enable	After the software reset function is enabled, the servo drive executes program reset (similar to that upon power-on) automatically, without the need for power-off.	At stop	Immediate-ly	0

2.6.3 Motor Protection

Motor overload protection

The motor, after being energized, generates heat continuously due to thermal effect of the current. The heat is then dissipated to the surrounding. When the heat generated exceeds the heat dissipated, the motor temperature may rise to a point that could damage the motor. To prevent such risks, the servo drive offers the motor overload protection function to prevent the motor from being damaged due to over-temperature.

The SV660P series servo drive offers motor overload and over-temperature protection functions that compliant with NEC and CEC requirements.

You can adjust the time for reporting Er.620 (Motor overload fault) by setting the motor overload protection gain (H0A-04). Use the default value of H0A-04 in general conditions, however, when one of the following condition occurs, adjust H0A-04 based on the actual heating condition.

- The motor works in environments with high temperature.
- The motor works in a cyclic motion featuring a short cycle and frequent acceleration/deceleration.

You can also disable motor overload detection (H0A-26 = 1) when you are sure that the motor will not be damaged due to over-temperature.

Caution

Take caution when disabling motor stall over-temperature protection as such operation may damage the motor.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0A-04	Motor overload protection gain	50–300	%	Defines the motor overload duration before Er.620 (Motor overload fault) is reported.	At stop	Immediately	100
H0A-26	Motor overload detection	0: Enable 1: Disable 2: No meaning 3: Enable a new motor overload detection	-	Defines whether to hide the motor overload fault (Er.620) and warning (Er.909).	At stop	Immediately	3

Motor stall over-temperature protection

A stalled motor is overheated significantly as the motor speed is nearly 0 RPM under a high current, so a stalled motor can operate within an allowable period of time only, exceeding of which will lead to over-temperature and damage the motor. To prevent such risks, the servo drive offers motor over-temperature protection to prevent a stalled motor from being damaged due to over-temperature.

You can set the time for reporting Er.630 (Motor stall over-temperature fault) by setting the time threshold for motor over-temperature protection (H0A-32). The motor over-temperature protection function is enabled by default (H0A-33 = 1).

Caution

Take caution when disabling motor stall over-temperature protection as such operation may damage the motor.

Use a dedicated motor for the SV660P series servo drive. Failure to comply will result in the risk of short circuit due to insulation deterioration.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0A-32	Time window of motor stall over-temperature protection	10 to 65535	ms	Defines the motor stall over-temperature duration before Er.630 (Motor stall over-temperature fault) is reported.	During running	Immediately	200
H0A-33	Motor stall over-temperature detection	0: Disable 1: Enable	-	Defines whether to hide Er.630 (Motor stall over-temperature fault).	During running	Immediately	1

Motor overspeed protection

An excessively high speed may damage the motor or the machine. The SV660P series servo drive therefore offers the motor overspeed protection function to provide thermal protection for the motor.

$$\text{Overspeed threshold} = \begin{cases} \text{Max. motor speed} \times 1.2 & \text{H0A-08} = 0 \text{ or H0A-08} > \text{Max. motor speed} \times 1.2 \\ \text{H0A-08} & \text{H0A-08} \neq 0 \text{ and H0A-08} < \text{Max. motor speed} \times 1.2 \end{cases}$$

Caution

- The servo drive also offers motor runaway protection to prevent motor stall caused by loss of control.
- In applications where the motor drives a vertical axis or is driven by the load, set H0A-12 to 0 to disable the runaway fault detection. Use this function with caution.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H0A-08	Overspeed threshold	0 to 10000	RPM	Defines the motor speed threshold at which the overspeed fault (Er.500) is reported.	During running	Immediately	0
H0A-12	Runaway protection	0: Disable 1: Enable	-	Defines whether to enable runway protection.	During running	Immediately	1

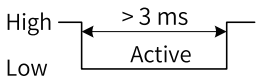
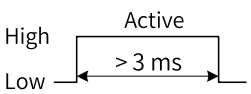
Besides runaway protection, the servo drive allows you to set the speed limit in the speed control and torque control modes to protect the motor and the machine.

2.6.4 DI Filter Time

The servo drive provides seven DIs, in which DI1 to DI5 are normal low-speed DIs, and DI8 and DI9 are high-speed DIs.

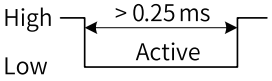
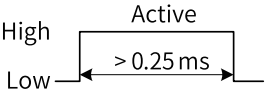
The following table describes the logic of low-speed DIs.

Table 2–31 Logic of low-speed DIs

Setpoint	Logic Upon Active DI Function	Remarks
0	Low level	
1	High level	

The following table describes the logic of high-speed DIs.

Table 2–32 Logic of high-speed DIs

Setpoint	Logic Upon Active DI Function	Remarks
0	Low level	
1	High level	

S-ON signal filter setting

Caution

To use the servo drive, you need to assign FunIN.1 (S-ON, servo ON) to a DI or VDI.

Check whether interference exists in the S-ON signal when FunIN.1 is assigned to a DI. If yes, set H02-18 to filter the signal. Note that the effective time width of the S-ON signal must be larger than the sum of the setpoint of H02-18 plus 3 ms. Otherwise, the S-ON signal is inactive.

High-speed DI filter setting

The servo drive offers two high-speed DIs with an input signal frequency up to 4 kHz. You can set H0A-19 and H0A-20 to filter the signal interference.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H02-18	S-ON filter time constant	0–64	ms	Defines the filter time constant of the S-ON signal.	At stop	Immediately	0
H0A-19	DI8 filter time constant	0–255	25 ns	Defines the filter time constant of DI8.	At stop	Next power-on	80
H0A-20	DI9 filter time constant	0–255	25 ns	Defines the filter time constant of DI9.	At stop	Next power-on	80

3 Adjustment

3.1 Overview

The servo drive must drive the motor as quick and accurate as possible to follow the commands sent from the host controller or internal setting, which requires a proper setting of gain values.

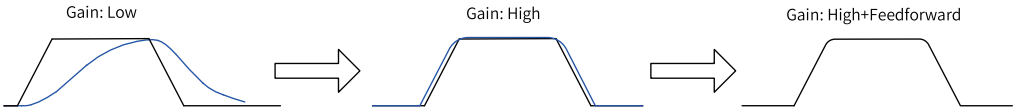


Figure 3-1 Example of gain setting

Position loop gain: 40.0 Hz	Position loop gain: 200.0 Hz	Position loop gain: 200.0 Hz
Speed loop gain: 200.0 Hz	Speed loop gain: 25.0 Hz	Speed loop gain: 25.0 Hz
Speed loop integral time constant: 100.00 ms	Speed loop integral time constant: 50.00 ms	Speed loop integral time constant: 50.00 ms
Speed feedforward gain: 0	Speed feedforward gain: 0	Speed feedforward gain: 50.0%
Load inertia ratio: 30	Load inertia ratio: 30	Load inertia ratio: 30

The gain is 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. Take the relation of these parameters into consideration to keep a balanced setting.

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.

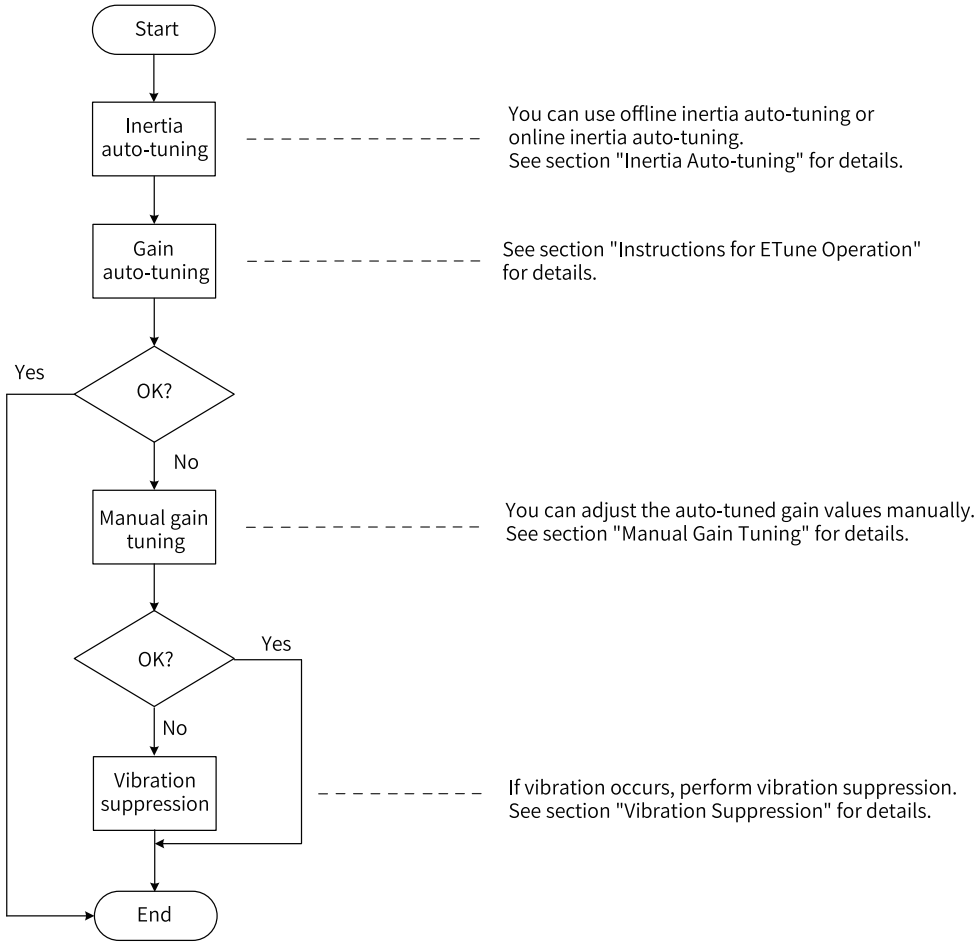


Figure 3-2 Flowchart of gain tuning

Table 3–1 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.	*"3.2.1 Offline Inertia Auto-tuning" on page 118*
		Online	The host controller sends a command to make the motor rotate, and the servo drive calculates the load inertia ratio in real time.	*"3.2.2 Online Inertia Auto-tuning" on page 121*
2	Gain auto-tuning		The servo drive generates a group of gain values on the premise that the inertia ratio is set correctly.	Chapter "Instructions for ETune Operation" and Chapter "Instructions for STune Operations"

Step			Description	Reference
3	Manual gain tuning	Basic gain values	If the auto-tuned gain values cannot deliver desired performance, fine-tune gain values manually to improve the performance.	"3.5.1 Basic Parameters" on page 132
		Reference filter	Filters the position, speed, and torque references.	"3.5.3 Comparison of Filters" on page 141
		Feedforward gain	Improves the follow-up behavior.	"3.5.4 Feedforward Gain" on page 141
		Pseudo differential regulator	Adjusts the speed loop control mode to improve the anti-interference capability in the low-frequency band.	"3.5.5 PDFF control" on page 143
		Torque disturbance observer	Improves the resistance against torque disturbance.	"3.5.6 Torque Disturbance Observer" on page 144
4	Vibration suppression	Mechanical resonance	Suppresses mechanical resonance through the notch.	"3.7.1 Mechanical Resonance Suppression" on page 155
		Low-frequency resonance	Suppresses low-frequency resonance through the low-frequency resonance suppression filter.	"3.7.2 Low-frequency Resonance Suppression at the Mechanical Load End" on page 161

3.2 Inertia Auto-tuning

The load inertia ratio (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 obtain the inertia ratio through inertia auto-tuning.

The following two inertia auto-tuning modes are available:

- Offline inertia auto-tuning
  To enable offline inertia auto-tuning, use H0D-02 (Offline inertia auto-tuning) and make the motor rotate and execute inertia auto-tuning through the keypad. Offline inertia auto-tuning does not involve the host controller.
- Online Inertia Auto-tuning
  To enable online inertia auto-tuning, send a command to the host controller, and the motor executes inertia auto-tuning as commanded.

Note

- The following conditions must be fulfilled for an accurate calculation of the load inertia ratio during inertia auto-tuning:
  - The actual maximum speed of the motor is higher than 150 RPM.
  - The actual acceleration rate during acceleration/deceleration is higher than 3000 RPM/s.
  - The load torque is stable.
  - The actual inertia ratio does not exceed 120.
- If the actual load inertia ratio is large but the gain is low, the motor may not be able to achieve the maximum speed and acceleration requirements as motor actions are slowed down. In this case, increase the speed loop gain (H08-00) and perform inertia auto-tuning again.
- If vibration occurs during auto-tuning, stop inertia auto-tuning immediately and decrease the gain.
- Inertia auto-tuning may also fail in case of a large backlash of the transmission mechanism.

3.2.1 Offline Inertia Auto-tuning

The following two offline inertia auto-tuning methods are available: Method 1: H09-05 = 0 or 1: The setpoint of H08-15 is taken as the initial inertia ratio for inertia auto-tuning. Method 2: H09-05 = 2 or 3: No initial inertia ratio is required for inertia auto-tuning.

Method 1

Set H09-05 (Offline inertia auto-tuning mode) to 0 or 1 , switch to "H0D-02" in the parameter display mode, and press the SET key to enable offline inertia auto-tuning.

☆Related parameter

<table>
<tr><td rowspan="2">H0D-02</td><td>Name</td><td colspan="3">Offline inertia auto-tuning</td><td>Setting Condition</td><td>During running</td><td>Related Mode</td><td>-</td></tr>
<tr><td>Value Range</td><td>-</td><td>Unit</td><td>-</td><td>Effective Time</td><td>Immediate-ly</td><td>Default</td><td>-</td></tr>
<tr><td colspan="9">Used to select offline inertia auto-tuning. 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 travel distance of the motor meets the following requirements:
  - A travel distance of more than one revolutions in the forward/reverse direction is available between the mechanical limit switches.
    Limit switches are installed to the machine. A travel distance as described above is reserved to prevent overtravel during inertia auto-tuning.
  - The revolutions defined by H09-09 (Motor revolutions per inertia auto-tuning) is fulfilled.
    View H09-06 (Maximum speed of inertia auto-tuning), H09-07 (Time constant of accelerating to the max. speed during inertia auto-tuning), and H09-09 (Motor revolutions per inertia auto-tuning) to check whether the travel distance at the stop position is larger than the setpoint of H09-09. If not, decrease the setpoint of H09-06 or H09-07 until the requirement is met.
- Estimate the value of H08-15 (Load moment of inertia ratio).
  If the default value (1.00) of H08-15 is used but the actual inertia ratio is higher than 30.00, the motor may run slowly, resulting in auto-tuning failure. In this case, take the following two measures:

- Set H08-15 to a large value first.
  It is recommended to set H08-15 to a large value first, such as 5.00. Then increase the value gradually until the value displayed on the keypad changes with it.
- Increase the stiffness level (H09-01) properly so that the actual motor speed can reach H09-06 (Maximum speed of inertia auto-tuning).

The following figure shows the general flowchart for offline inertia auto-tuning.

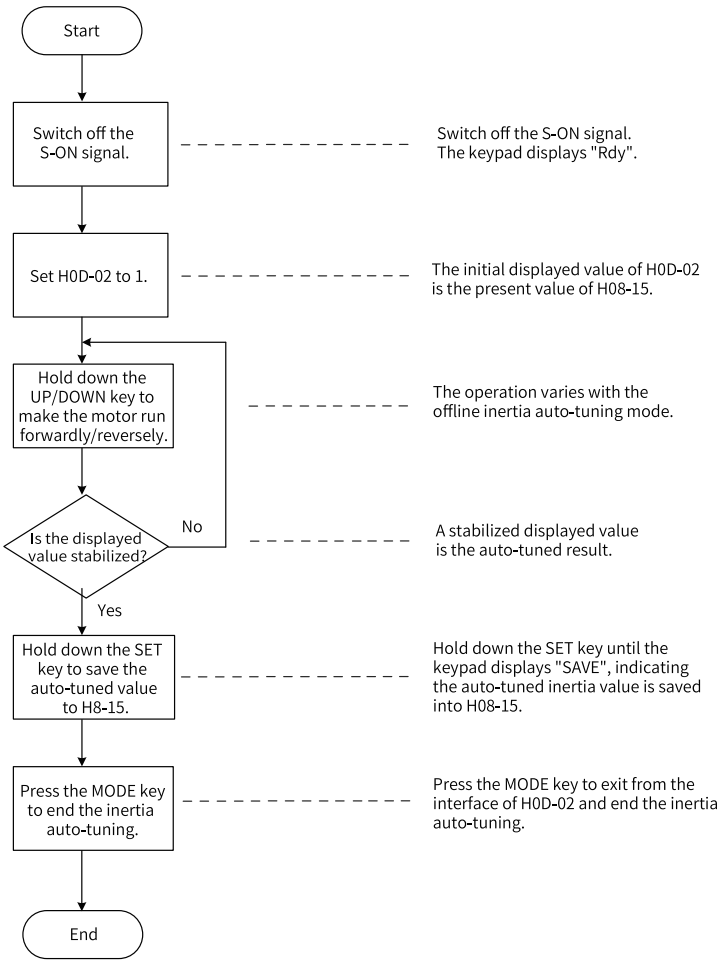
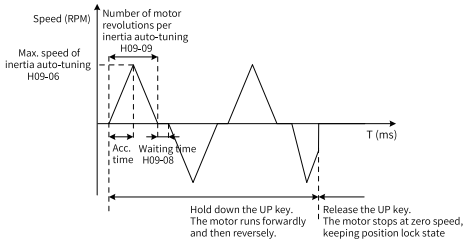
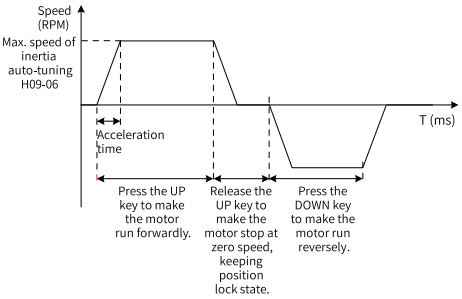


Figure 3-3 Offline inertia auto-tuning flowchart

Offline inertia auto-tuning is divided into two modes: positive/negative triangle wave mode and jog mode. The command forms for these two modes are different, as shown below.

Table 3–2 Descriptions of offline inertia auto-tuning modes

Item	Positive and Negative Triangular Wave Mode (H09-05 = 0)	Jog Mode (H09-05 = 1)
Command form	Symmetric triangular wave 	Trapezoidal wave 
Maximum speed	H09-06	H09-06
Acceleration/ Deceleration time	H09-07	H09-07
Keys	UP key held down: The motor rotates forwardly and then reversely. DOWN key held down: The motor rotates reversely and then forwardly. UP/DOWN key released: The motor stops at zero speed, keeping position lock state.	UP key pressed: The motor rotates forwardly. DOWN key pressed: The motor rotates reversely. UP/DOWN key released: The motor stops at zero speed, keeping position lock state.
Time interval	H09-08	Time interval between two key operations
Motor revolutions	⩽ H09-09	Controlled manually
Applicable occasion	Occasions where the motor travel distance is short	Occasions where the motor travel distance is long and manual control is allowed

Method 2

Set H9-05 to 2 or 3 and perform inertia auto-tuning based on the same flowchart for Method 1. To make the motor stop at zero speed, release the UP/DOWN key. Pressing the UP/DOWN key again starts a new inertia auto-tuning. The initial direction of operation is determined by the UP/DOWN key. For applications allowing operations in one direction only, set H09-05 to 3.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-05	Offline inertia auto-tuning mode	0: Positive/ Negative triangular wave mode 1: Jog mode 2: Dual-direction auto-tuning mode 3: Single-direction auto-tuning mode	-	Defines the offline inertia auto-tuning mode.	At stop	Immediately	0
H09-06	Maximum speed of inertia auto-tuning	100–1000	RPM	Defines the maximum speed for offline inertia auto-tuning.	At stop	Immediately	500
H09-07	Time constant for accelerating to the max. speed during inertia auto-tuning	20–800	ms	Defines the time needed for the motor to accelerate from 0 RPM to the setpoint of H09-06 in Method 1. Defines the time needed for the motor to accelerate from 0 RPM to 1000 RPM in Method 2.	At stop	Immediately	125
H09-08	Waiting time after an individual inertia auto-tuning	50–10000	ms	Defines the time interval between two consecutive speed references.	At stop	Immediately	800
H09-09	Number of motor revolutions per inertia auto-tuning	15–10000	0.01 r	Defines the revolutions required by offline inertia auto-tuning in the positive/negative triangle wave mode in Method 1. Defines the maximum number of revolutions in Method 2.	-	-	100

3.2.2 Online Inertia Auto-tuning

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

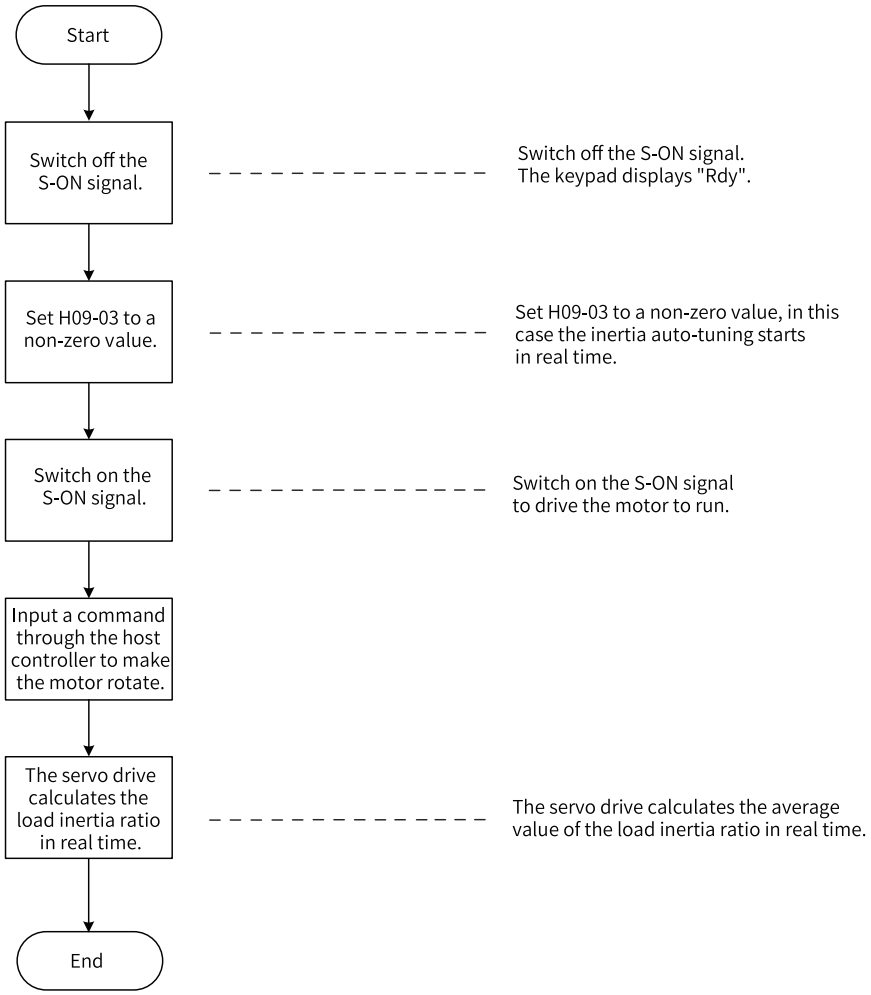


Figure 3-4 Online inertia auto-tuning flowchart

Note

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

- H09-03 = 1: suitable for applications where the actual inertia ratio rarely changes, such as machine tools and wood carving machines
- H09-03 = 2: suitable for applications where the actual inertia ratio changes slowly
- H09-03 = 3: suitable for applications where the actual inertia ratio changes rapidly, such as material handling manipulators.

☆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, staying unchanged 2: Enabled, changing slowly 3: Enabled, changing quickly	-	Defines the online inertia auto-tuning mode.	During running	Immediately	0

3.3 Instructions for ETune Operation

3.3.1 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 will perform the auto-tuning to obtain the optimal gain parameters. The auto-tuned parameters can be saved and exported as a recipe for use in other devices of the same model.

The ETune function applies to applications with slight load inertia changes.

3.3.2 Description of ETune Operation

Operation flowchart

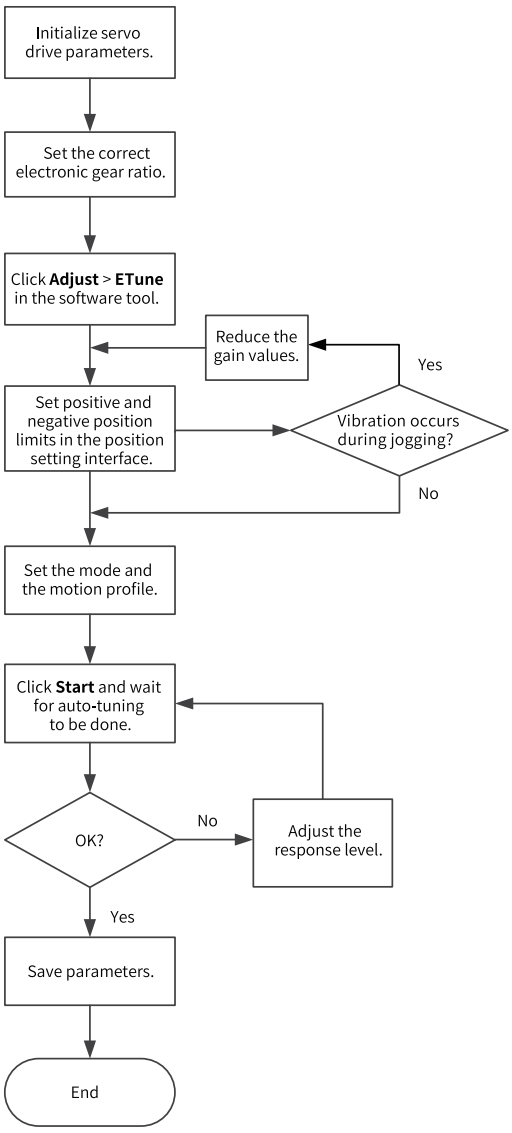
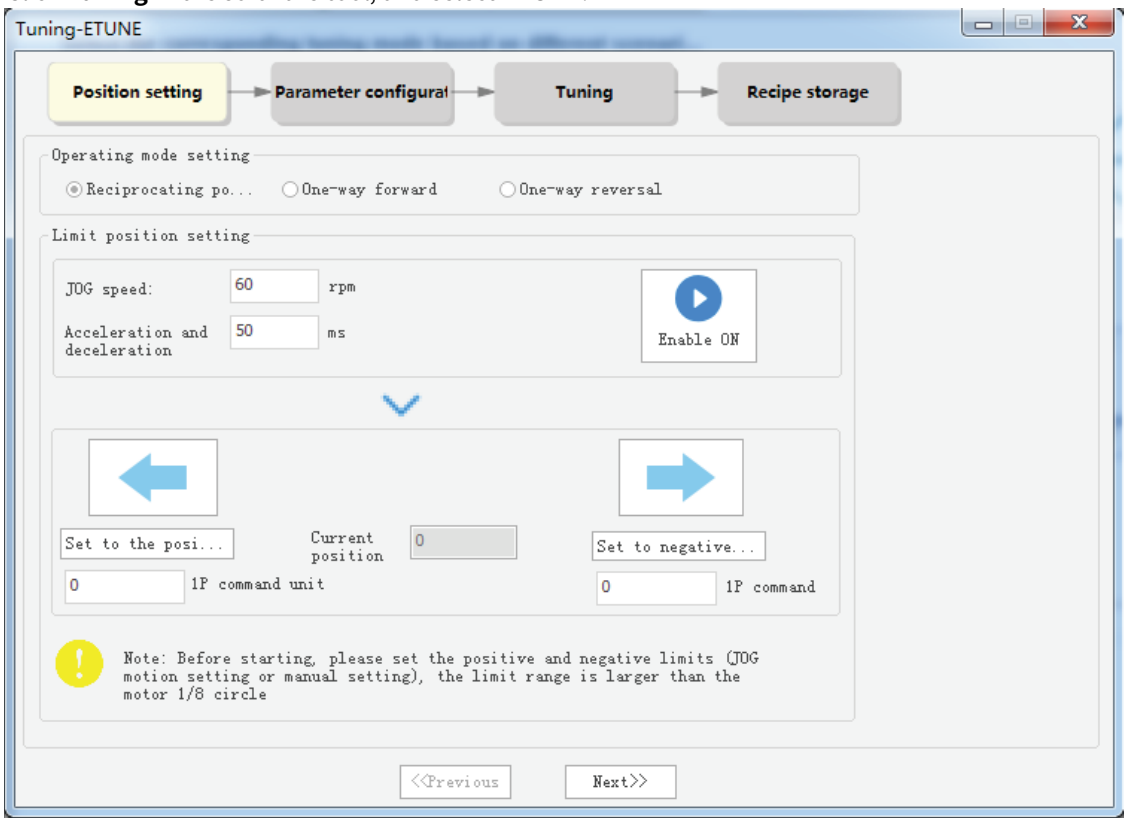


Figure 3-5 Operation flowchart

Description of the flowchart

1. Click **Tuning** in the software tool, and select **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.

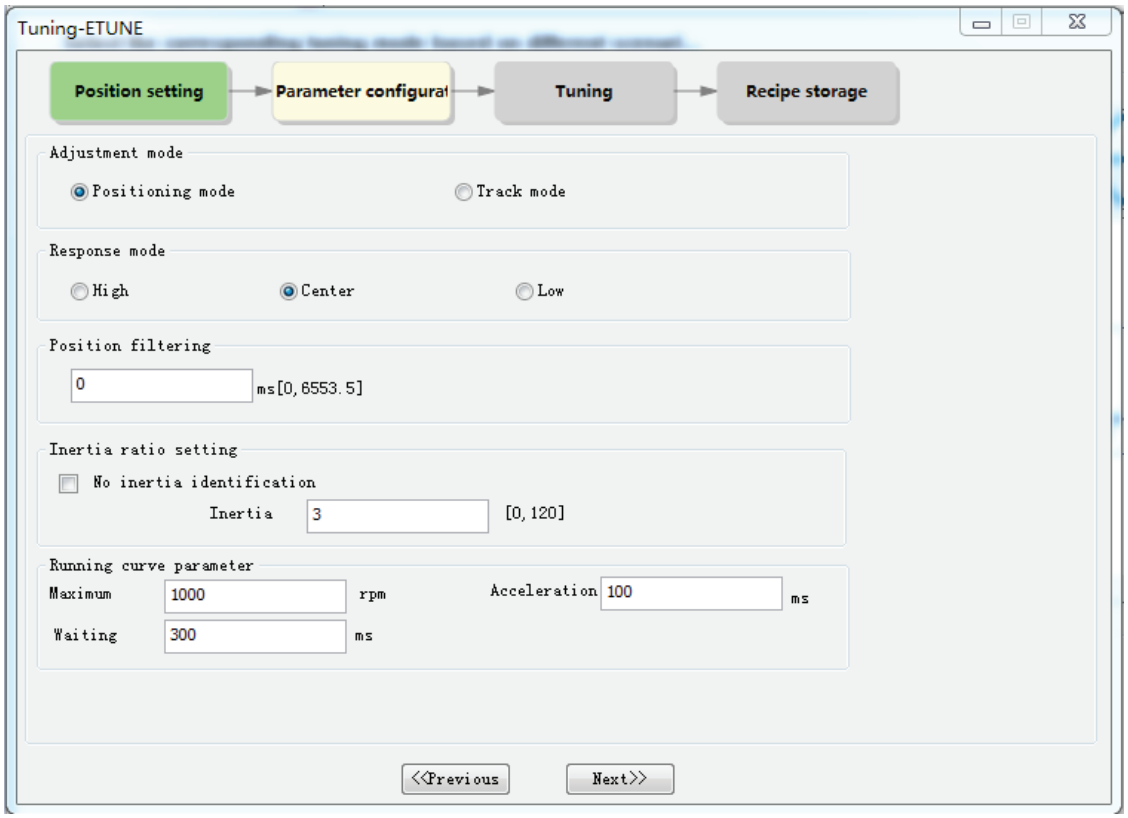
3. Enter the positive and negative position limits appropriate for the motor. The difference between the positive and negative position limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio.
   You can set the position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

   - Method 1: Click **Enable ON** in JOG, and click the left arrow to make the motor move to the positive 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 changes to Enable OFF after a click).
   - Method 2: Enter the positive and negative limits directly.

Note

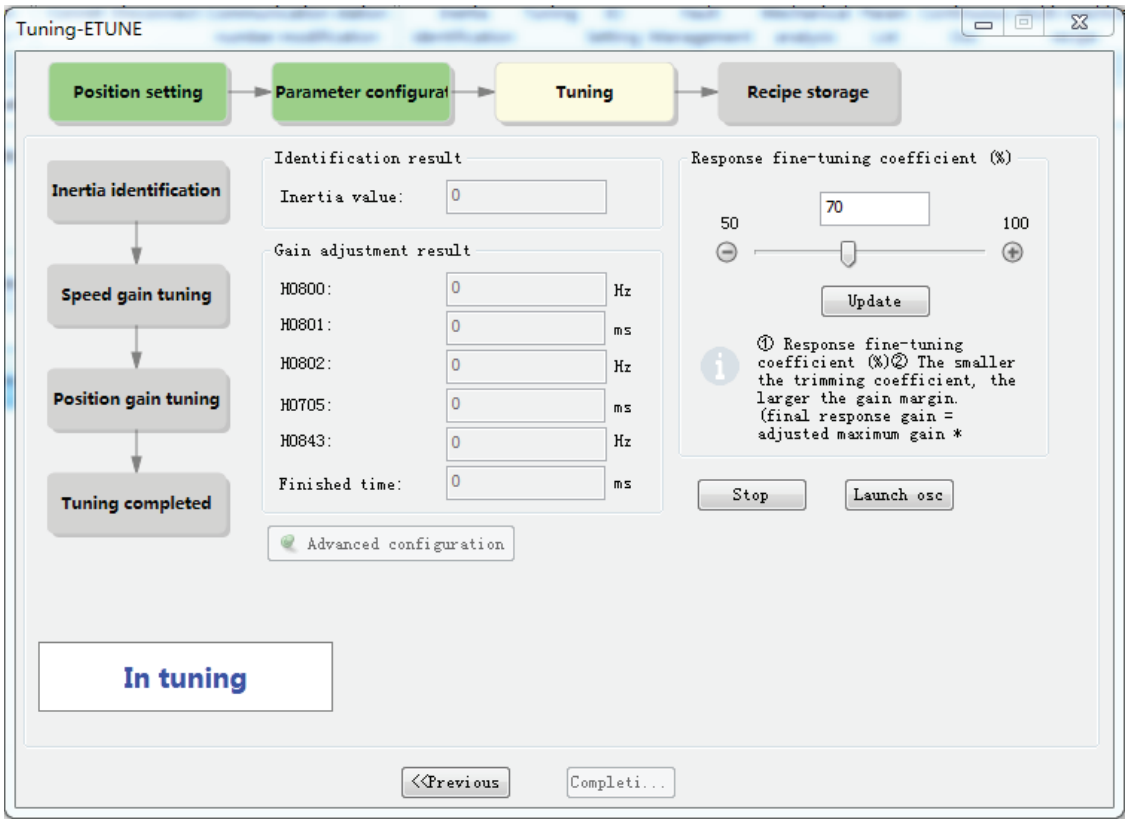
The difference between positive and negative position limits must be larger than 1/8 of one revolution. The larger the limit value, the better the adaptability of auto-tuned parameters, but the longer time will ETune operation take.

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 a correct inertia ratio first (the value of the inertia ratio can be modified directly). You can adjust the stiffness level and position filter time constant based on the responsiveness needed and the position reference noise generated during operation. Then set the motion profile and the maximum speed, acceleration/deceleration time and time interval for auto-tuning.

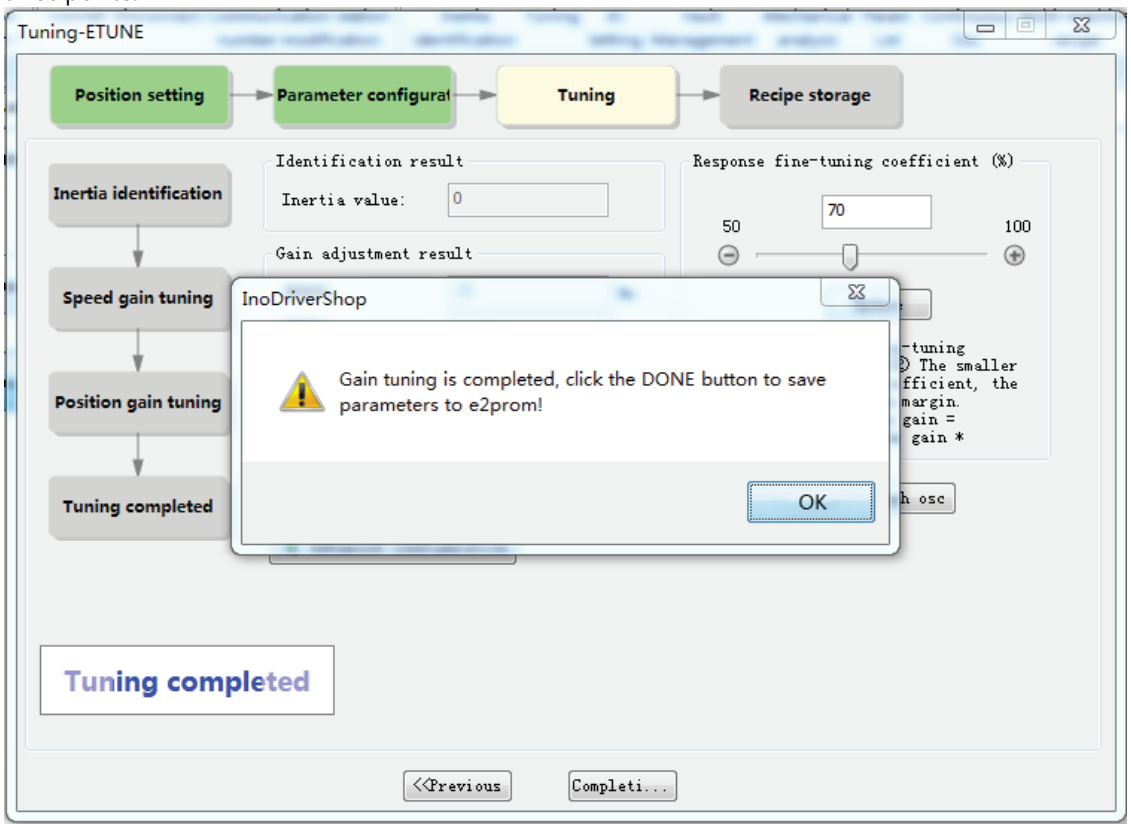


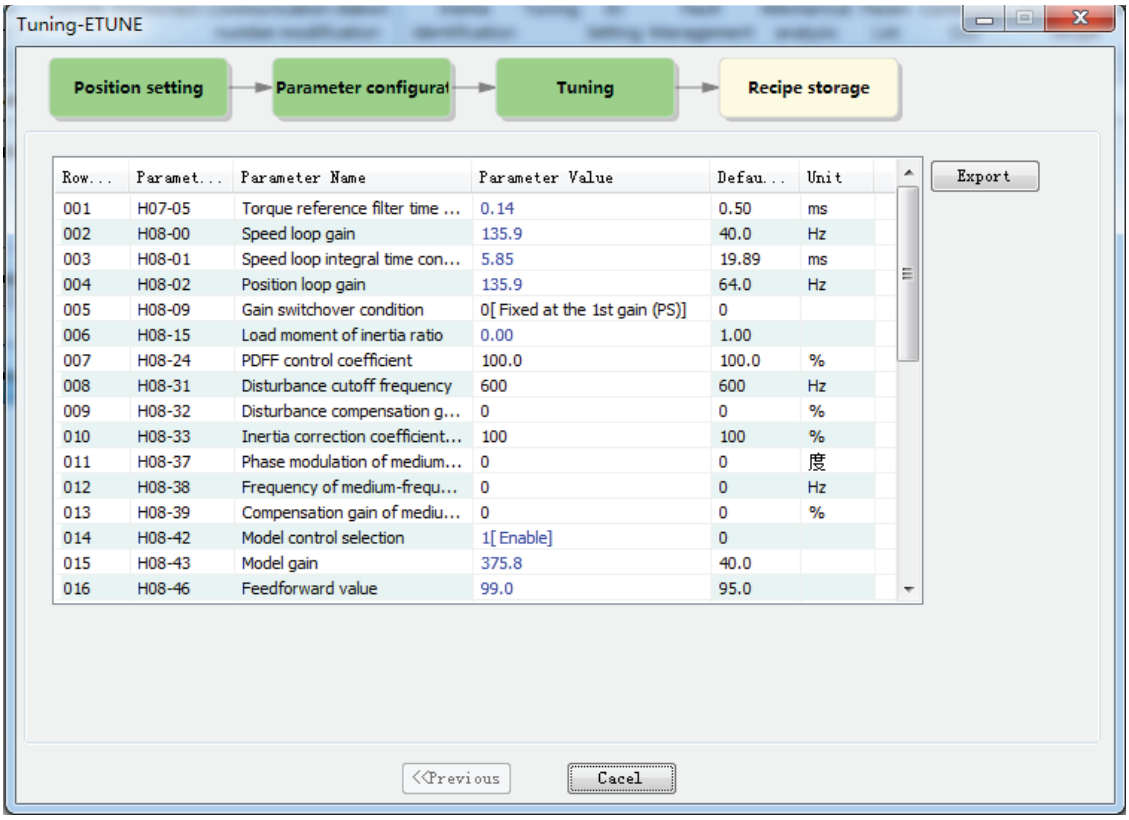
5. Click the **Start** button to start auto-tuning.

- If you choose to perform inertia auto-tuning, the servo drive starts inertia auto-tuning based on the set motion profile first. 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 the **Update** button, gain tuning will be continued based on the fine-tuning coefficient required. After gain tuning is done, you can click the **DONE** button 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	

3.3.3 Precautions

- Before gain auto-tuning, set an electronic gear ratio that fits the actual application.
- You can adjust the maximum speed and acceleration/deceleration time of the motion profile based on actual conditions. The acceleration/deceleration time can be increased properly because positioning will be quickened after auto-tuning.
- 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 the lead screw transmission, shorten the travel distance if the tuning duration is too long.

3.3.4 Solutions to Common Faults

Fault Symptom	Cause	Solution
ER661: Gain values too low	1. Vibration cannot be suppressed.	1. Enable vibration suppression manually to dampen vibration.
	2. Excessive overshoot occurs during positioning.	2. Check whether the positioning threshold is too low. Increase the acceleration/deceleration time and reduce the response level.
	3. The command suffers from noise.	3. Modify the electronic gear ratio to improve the command resolution, or increase the command filter time constant in the "Parameter configuration" interface.
	4. The current fluctuates.	4. Check whether the current of the machine fluctuates periodically.
ER600: Inertia auto-tuning failure	1. Vibration cannot be suppressed.	1. Enable vibration suppression manually to dampen vibration. Then perform ETune again.
	2. The auto-tuned values fluctuate dramatically.	2. Increase the maximum operating speed, reduce the acceleration/deceleration time. In case of a lead screw, shorten its travel distance.
	3. Mechanical couplings of the load are loose or the mechanism is eccentric.	3. Rectify the mechanical faults.
	4. Interruption occurs due to a fault that occurs during auto-tuning.	4. Clear the fault and perform ETune again.

3.4 Instructions for STune Operation

3.4.1 Overview

STune performs gain auto-tuning based on the set stiffness level to fulfill the requirement for rapidity and stability. The STune function applies to applications with slight load inertia changes.

A correct inertia ratio must be obtained before gain auto-tuning.

3.4.2 Description of STune Operation

Operation flowchart

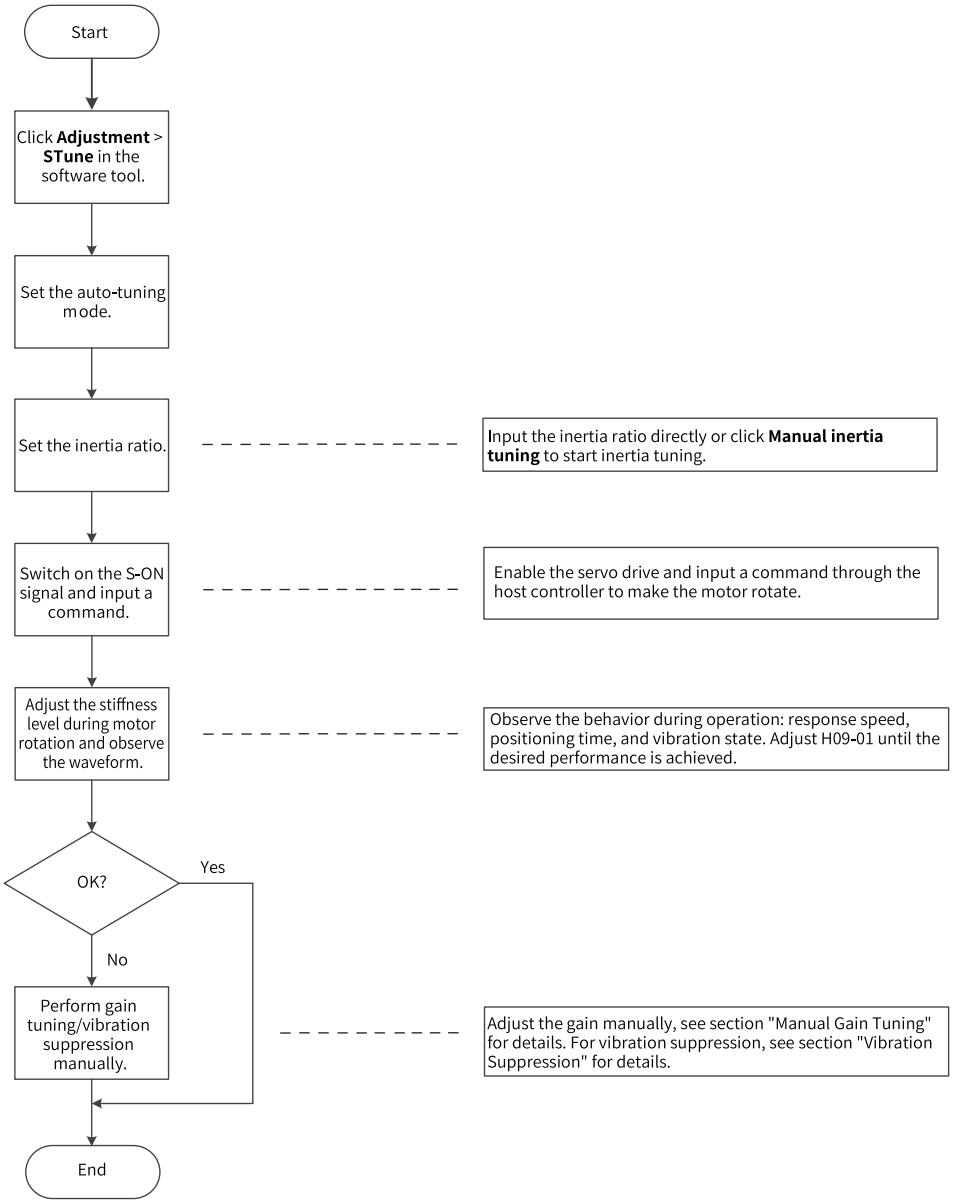


Figure 3-6 Operation flowchart

Description of the flowchart

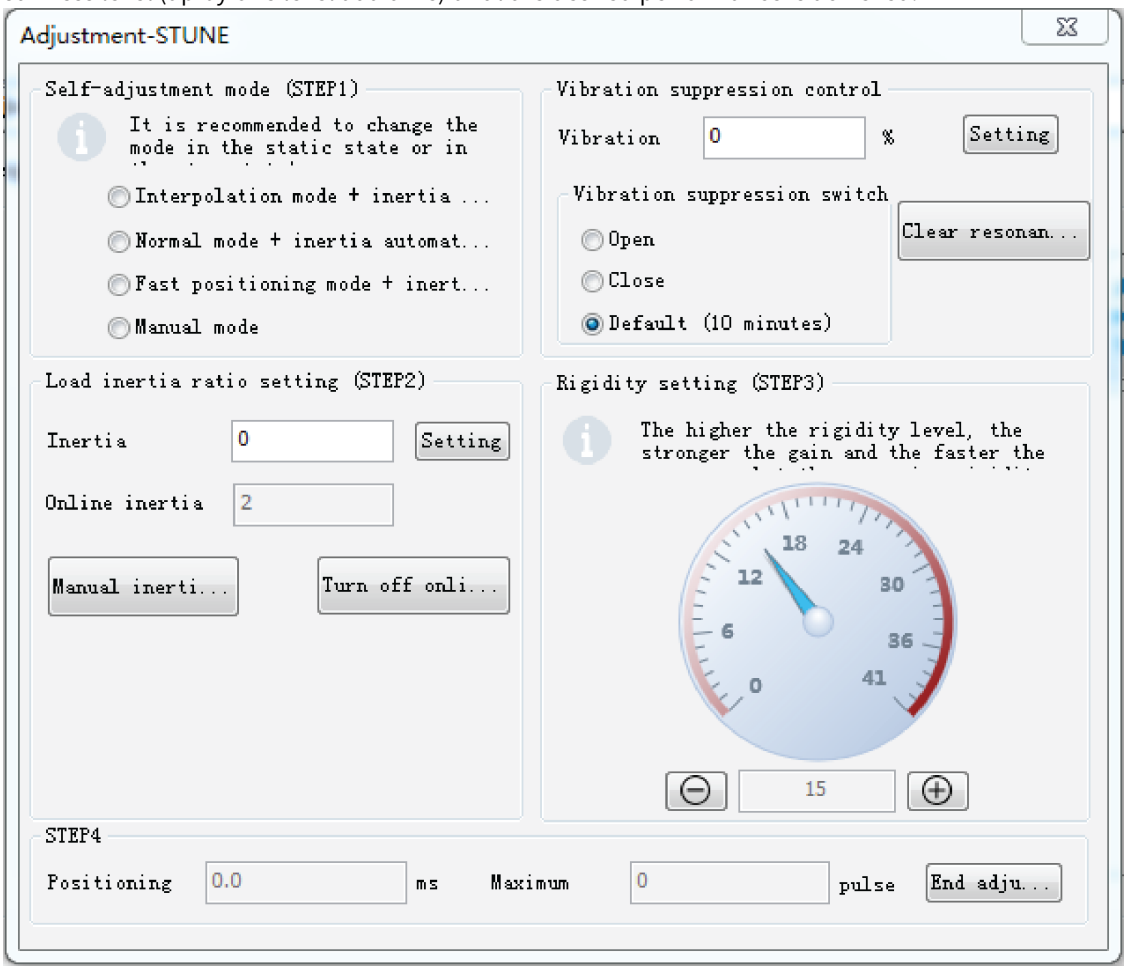
You can set the gain auto-tuning mode through the keypad or the software tool.

1. 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 adjustment. If the inertia is unknown, adjust the inertia manually. If the machine vibrates, decrease the stiffness level before adjusting the inertia manually.
- In modes 3, 4, and 6 shown in the following table, you can adjust the gain through the wizard-type interface directly, without the need for setting an inertia ratio.

Mode	Name	Description
0	Inactive	The gains need to be set manually.
1	Standard mode	The gains are set automatically based on the set stiffness level.
2	Positioning mode	The 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	The gains are set automatically based on the set stiffness level. In this mode, the inertia is auto-tuned and vibration is suppressed automatically. This mode is applicable to multi-axis interpolation.
4	Normal mode + Inertia auto-tuning	The gains are set automatically based on the set stiffness level. The inertia is auto-tuned and vibration is suppressed automatically.
6	Quick positioning mode + Inertia auto-tuning	The 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.

2. Adjust the stiffness level gradually during load operation. The present level will be written to the servo drive automatically. Keep monitoring the waveforms during operation after increasing the stiffness level (up by one level at a time) until the desired performance is achieved.



3.4.3 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.

Table 3–3 Recommended stiffness levels (for reference only)

Recommended Stiffness Level	Type of Load Mechanism
Level 4 to level 8	Large-scale machineries
Level 8 to level 15	Applications with low stiffness such as conveyor belts
Level 15 to level 20	Applications with high stiffness such as ball screws and direct-connected devices

The following five gain auto-tuning modes are available.

Caution

- 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 5 min after power-on. Then the servo drive exits from inertia auto-tuning automatically.
- Do not set H09-00 to 3, 4, or 6 in applications with slow acceleration/deceleration, large vibration, and unstable mechanical couplings.

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

Table 3–4 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 *"Table 3–4" on page 131*, the 2nd group of gain parameters (H08-03 to H08-05, H07-06) are also updated and saved automatically according to the stiffness level defined by H09-01. The position loop gain in the 2nd group of gain parameters has a higher stiffness level than that in the 1st group.

Table 3–5 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 is inactive 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 3–6 Parameters with fixed values in the positioning mode

Para. No.	Name	Value
H08-19	Speed feedforward gain	30.0%
H08-18	Speed feedforward filter time constant	0.50 ms

Values of parameters related to gain switchover are fixed.

Gain switchover is activated automatically in the positioning mode.

Para. No.	Name	Value	Description
H08-08	2nd gain set mode	1	Switchover between the 1st group of gain parameters (H08-00 to H08-02, H07-05) and 2nd group of gain parameters (H08-03 to H08-05, H07-06) is active in the positioning mode. In other modes, the original settings are used.
H08-09	Gain switchover condition	10	The condition for switching the gain set is defined by the setpoint 10 of H08-09 in the positioning mode. In other modes, the original settings are used.
H08-10	Gain switchover delay	5.0 ms	The gain switchover delay is 5.0 ms in the positioning mode. In other modes, the original settings are used.
H08-11	Gain switchover level	50	The gain switchover level is 50 in the positioning mode. In other modes, the original settings are used.
H08-12	Gain switchover dead time	30	The dead time of gain switchover is 30 in the positioning mode. In other modes, the original settings are used.

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

3.5 Manual Gain Tuning

3.5.1 Basic Parameters

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

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

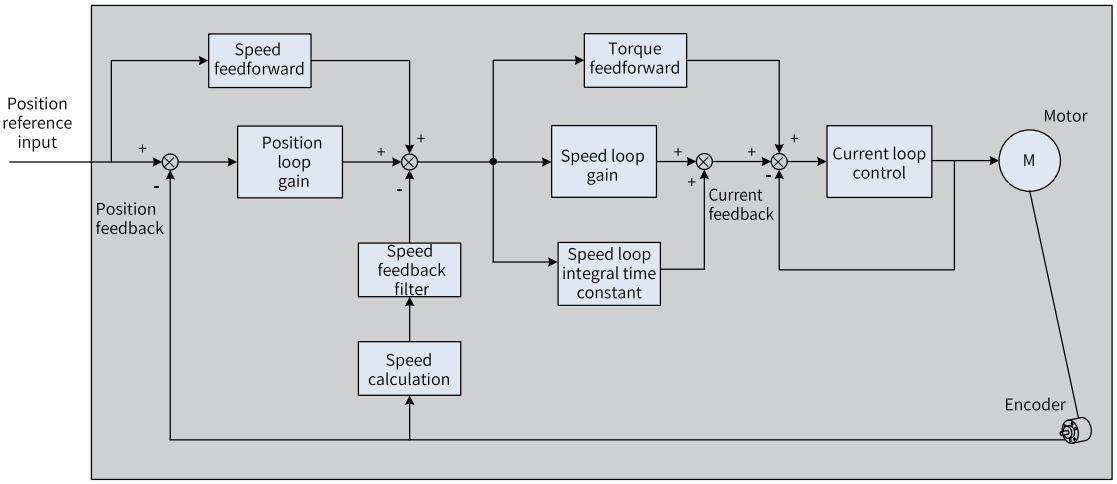


Figure 3-7 Basic control diagram

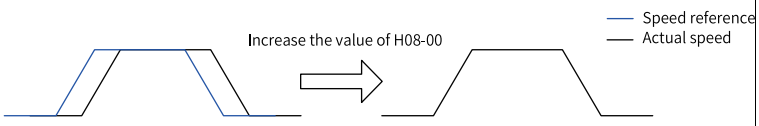
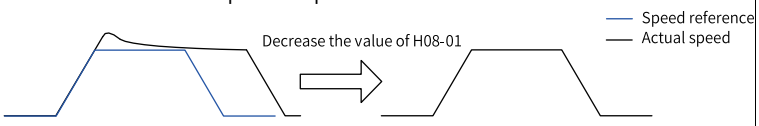
Note

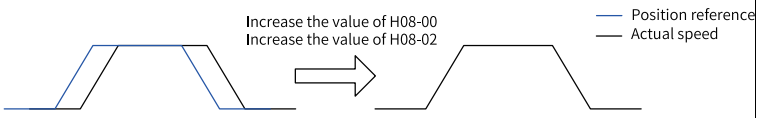
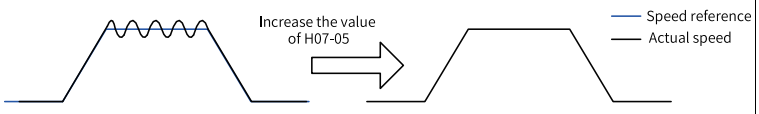
The responsiveness of the inner loop must be higher than that of the outer loop. Otherwise, the system may become unstable.

The current loop gain is set with the highest level of responsiveness by default, avoiding the need for adjustment. It is only needed 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 3–7 Adjustment of gain parameters

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 by the speed loop. When H08-15 (Load moment of inertia) is set correctly, the maximum frequency that can be followed by the speed loop is the setpoint of H08-00.  Adjustment method: • 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 mechanical resonance suppression. For details, see *"Vibration Suppression" on page 154*.
2	H08-01	Speed loop integral time constant	Function: Used to eliminate the speed loop deviation.  Adjustment method: 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 effect and shortens the positioning time, but an excessively low setpoint may easily lead to mechanical vibration. An excessively high setpoint prevents the speed loop deviation from being cleared to zero. When H08-01 is set to 512.00 ms, the integral 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 by the position loop. Maximum following frequency of position loop = H08-02  Adjustment method: To ensure system stability, the maximum following 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: Used to eliminate the high-frequency noise and suppress mechanical resonance.  Adjustment method: Ensure the cutoff frequency of the torque reference low-pass filter is 4 times higher than the maximum following 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 154*. 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	0.1–2000.0	Hz	Defines the proportional gain of the speed loop.	During running	Immediately	40.0
H08-01	Speed loop integral time constant	0.15–512.00	ms	Defines the integral time constant of the speed loop.	During running	Immediately	19.89
H08-02	Position loop gain	0.0–2000.0	Hz	Defines the proportional gain of the position loop.	During running	Immediately	64.0
H07-05	Torque reference filter time constant	0.00–30.00	ms	Defines the filter time constant of the torque reference.	During running	Immediately	0.79

3.5.2 Gain switchover

Gain switchover, which is active in the position/speed control mode only, can be triggered by the internal servo status or an external DI signal for following purposes:

- Suppressing vibration by switching to a lower gain when the motor is at a standstill (S-ON)
- Shortening the positioning time by switching to a higher gain when the motor is at a standstill
- Improving the command-following performance by switching to a higher gain during motor operation
- Adapting to different load devices by switching to different gains through external DI signals

H08-08 = 0

When H08-08 is set to 0, the 1st gain set (H08-00 to H08-02, H07-05) is used, but you can switch between proportional control and proportional integral control through FunIN.3 (GAIN_SEL, gain switchover) for the speed loop.

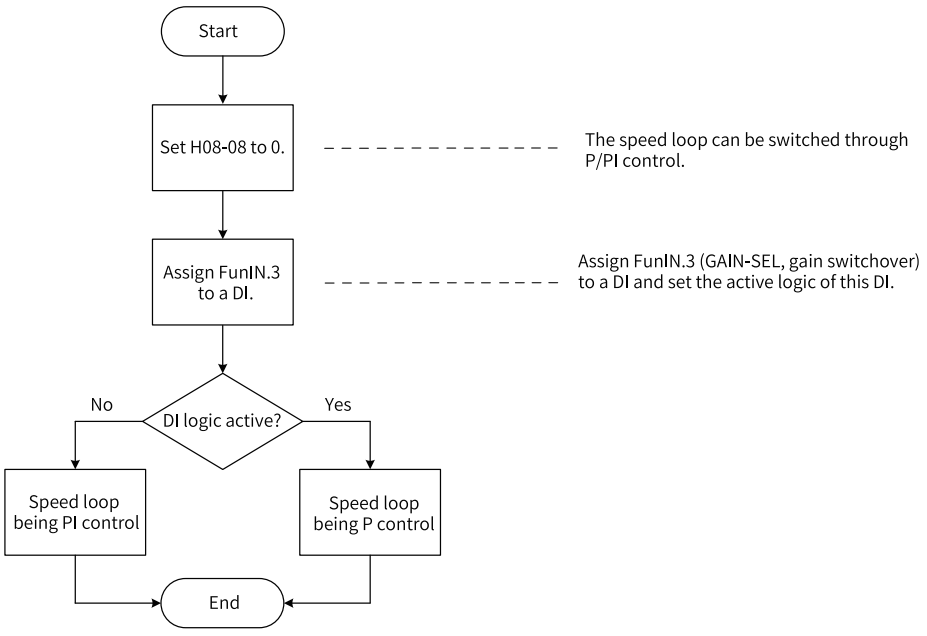


Figure 3-8 Gain switchover flowchart (H08-08 = 0)

H08-08 = 1

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

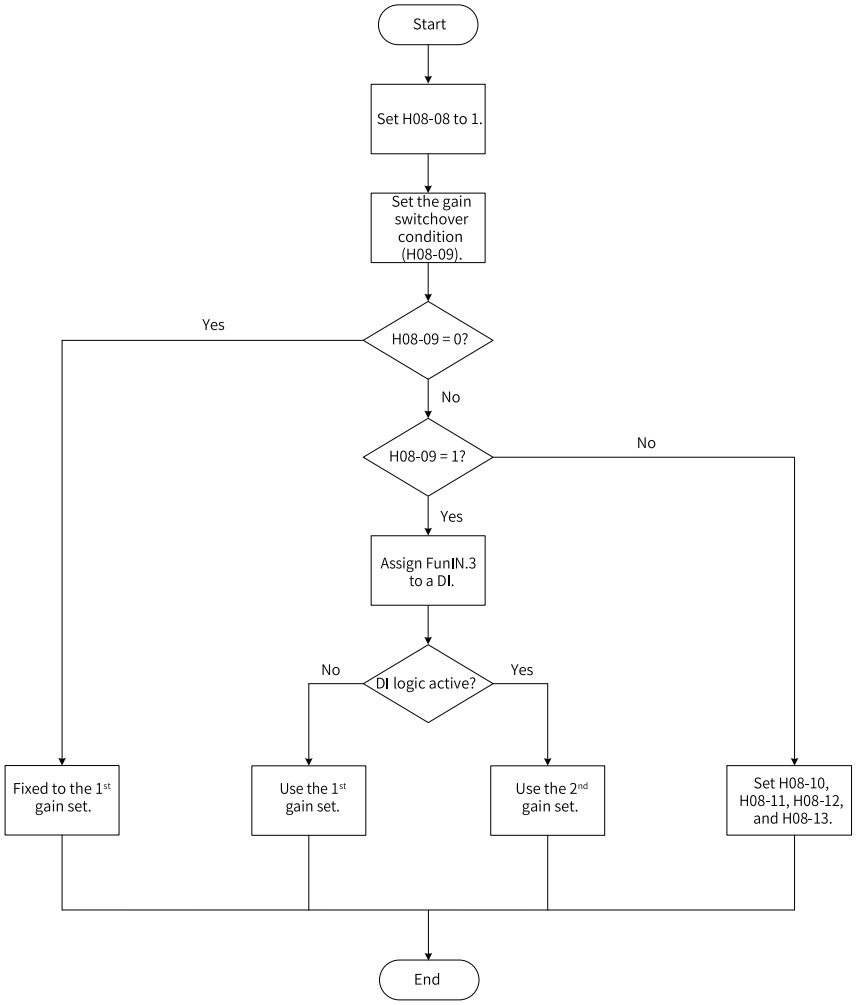
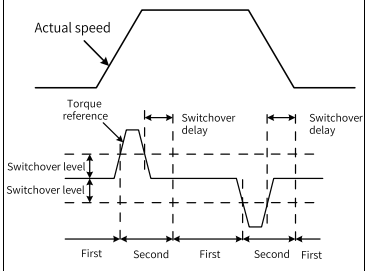
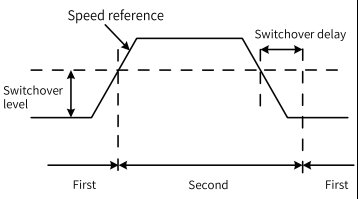
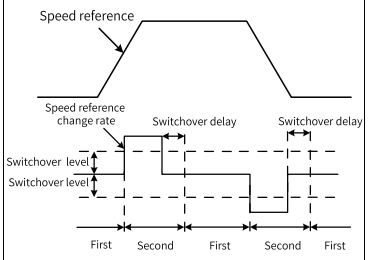
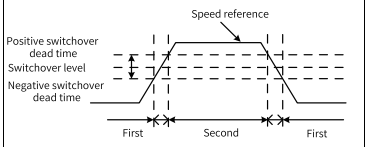
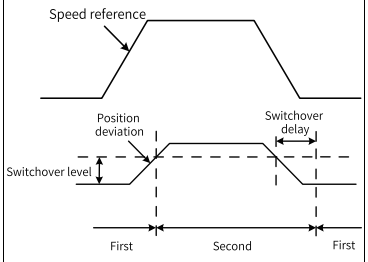
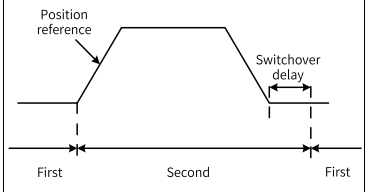
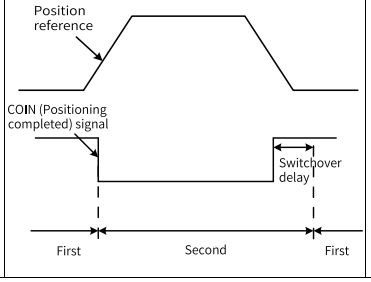


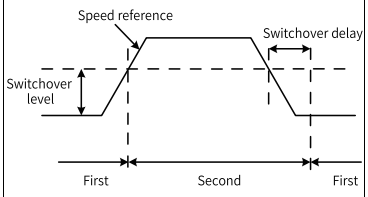
Figure 3-9 Gain switchover flowchart (H08-08 = 1)

Diagrams and parameters related to 11 gain switchover conditions are shown in the following table. The following table describes the diagrams and related parameters of different conditions.

Table 3–8 Descriptions of gain switchover conditions

Gain Switchover Condition			Related Parameters		
H08-09	Condition	Diagram	Delay Time (H08-10)	Switchover Level (H08-11)	Dead Time of Switchover (H08-12)
0	Fixed to the 1st gain set	-	Invalid	Invalid	Invalid
1	Switched by external DI	-	Invalid	Invalid	Invalid

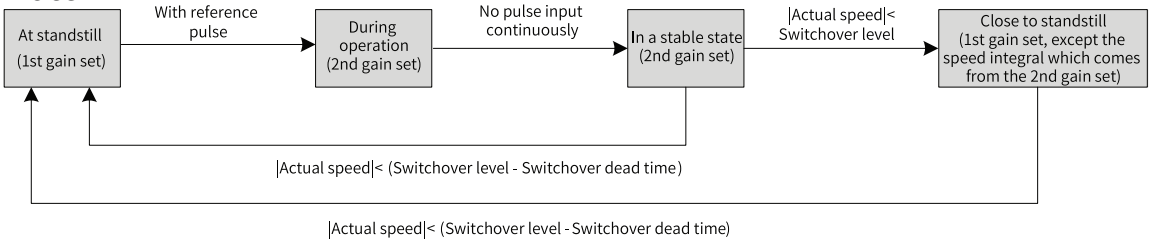
Gain Switchover Condition			Related Parameters		
H08-09	Condition	Diagram	Delay Time (H08-10)	Switchover Level (H08-11)	Dead Time of Switchover (H08-12)
2	Torque reference		Valid	Valid (%)	Valid (%)
3	Speed reference		Valid	Valid	Valid
4	Speed reference change rate		Valid	Valid (10 RPM/s)	Valid (10 RPM/s)
5	High-speed/Low-speed threshold of speed reference		Invalid	Valid (RPM)	Valid (RPM)
6	Position deviation		Valid	Valid (encoder unit)	Valid (encoder unit)
7	Position reference		Valid	Invalid	Invalid
8	Positioning completed		Valid	Invalid	Invalid

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

Caution

H08-10 (Gain switchover delay) is valid only during switching from the 2nd gain set to the 1st gain set.

Note



☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-08	2nd gain set mode	0: Fixed to the 1st gain set, P/PI switched through external DI 1: Gains switched based on the condition defined by H08-09	-	Defines the mode of the 2nd gain set.	During running	Immediately	1
H08-09	Gain switchover condition	0: Fixed to the 1st gain set 1: Switched through external DI 2: Torque reference too large 3: Speed reference too large 4: Speed reference change rate too large 5: High-speed/Low-speed threshold of speed reference 6: Position deviation too large 7: Position reference available 8: Positioning completed 9: Actual speed too large 10: Position reference + Actual speed	-	Defines the gain switchover condition.	During running	Immediately	0
H08-10	Gain switchover delay	0–10	-	Defines the gain switchover delay.	During running	Immediately	5.0
H08-11	Gain switchover level	1–1000	Based on switch-over condi-tions	Defines the gain switchover level.	During running	Immediately	50
H08-12	Gain switchover dead time	0–20000	Based on switch-over condi-tions	Defines the dead time of gain switchover.	During running	Immediately	30
H08-13	Position gain switchover time	0.0–100.0	ms	Defines the position loop gain switchover time.	During running	Immediately	3.0

3.5.3 Comparison of Filters

Name	Description	Applicable Occasion	Impact of Excessive Filtering	Reference
Pulse input pin filter	Prevents interference to ensure the number of pulses received by the servo drive is accurate.	The system wiring does not comply with specifications. The ambient interference is strong.	The number of pulses received by the servo drive is lower than those sent from the host controller.	*"2.1.2 Position Reference Input Setting" on page 15*
Position reference filter	Filters the position references (encoder unit) divided or multiplied by the electronic gear ratio, smoothening motor operation and alleviating shock to the machine.	The acceleration/ deceleration process is not performed on the position references sent from the host controller. The pulse reference frequency is low. The electronic gear ratio is larger than 10.	The response delay is prolonged.	*"2.1.4 Position Reference Filter Function" on page 40*

3.5.4 Feedforward Gain

Speed feedforward

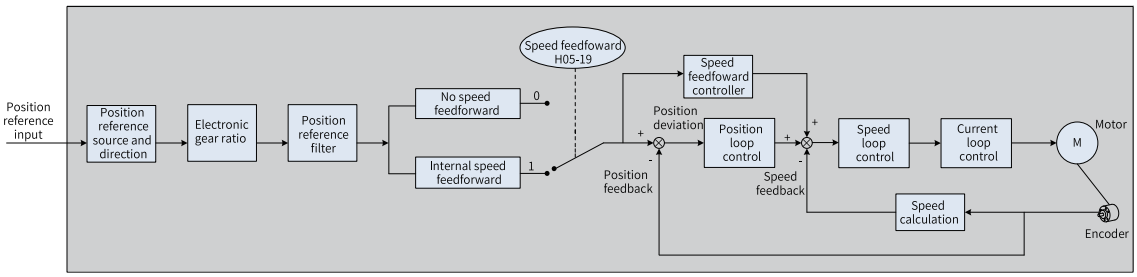


Figure 3-10 Operation diagram of speed feedforward control

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

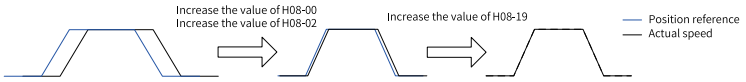
The procedure for setting speed feedforward is as follows:

1. Set the source of the speed feedforward signal.
   Set H05-19 to a non-zero value to activate speed feedforward and locate the corresponding signal source.

Parameter 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 (in encoder unit) as the speed feedforward signal source.

2. Set the speed feedforward parameters.

Set the speed feedforward gain (H08-19) and speed feedforward filter time constant (H08-18).

Parameter No.	Name	Description
H08-18	Speed feedforward filter time constant	 Function: • Increasing the setpoint of H08-19 improves responsiveness but may cause speed overshoot during acceleration/deceleration. • Decreasing the setpoint of H08-18 suppresses speed overshoot during acceleration/deceleration. Increasing the setpoint of H08-18 suppresses the noise caused by a long position reference update cycle, a long drive control cycle, and uneven position reference pulse frequencies, thus reducing COIN (positioning completed) signal jitter. Adjustment method: • Set H08-18 to a fixed value, and then increase the setpoint of H08-19 gradually from 0 to a certain value at which speed feedforward reaches the required effect. • Adjust H08-18 and H08-19 repeatedly until a balanced performance is achieved.
H08-19	Speed feedforward gain	

Torque feedforward

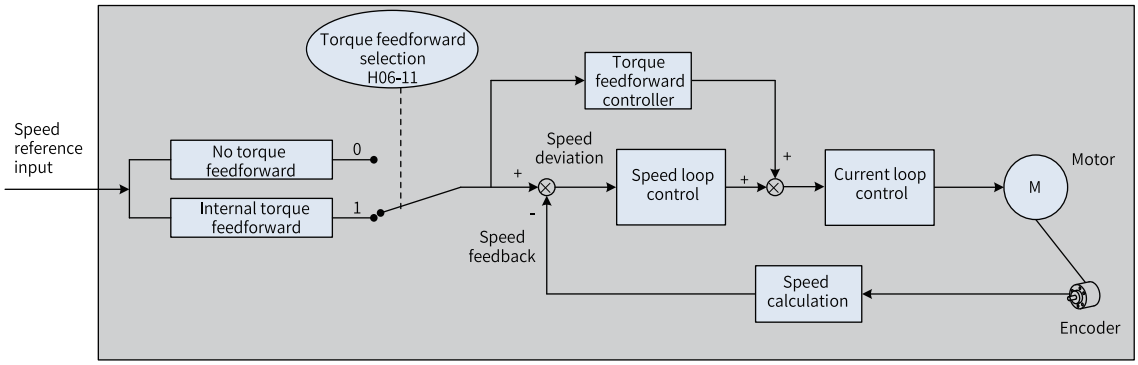


Figure 3-11 Operation diagram of torque feedforward control

In the position control mode, torque feedforward improves torque reference responsiveness and reduces the position deviation during operation at fixed acceleration/deceleration rate. In the speed control mode, torque feedforward improves torque reference responsiveness and reduces the speed deviation during operation at fixed speed.

The procedure for setting torque feedforward is as follows:

1. Set the torque feedforward signal source.
   Set H06-11 to 1 to activate torque feedforward and locate the corresponding signal source.

Parameter No.	Name	Setpoint	Remarks
H06-11	Torque feedforward selection	0: No torque feedforward	-
		1: Internal torque feedforward	Defines the speed reference as the torque feedforward signal source. In the position control mode, the speed reference is generated by the position controller.

2. Set torque feedforward parameters.

Parameter No.	Name	Description
H08-20	Torque feedforward filter time constant	Function: • Increasing the setpoint of H08-21 improves responsiveness but may cause overshoot during acceleration/deceleration. • Decreasing the setpoint of H08-20 suppresses overshoot during acceleration/deceleration. Increasing the setpoint of H08-20 suppresses the noise. Adjustment method: • Keep H08-20 to the default value, and then gradually increase the setpoint 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.
H08-21	Torque feedforward gain	See this section for details.

3.5.5 PDFF control

The pseudo derivative feedback and feedforward (PDFF) control can be used to adjust speed loop control in the non-torque control mode.

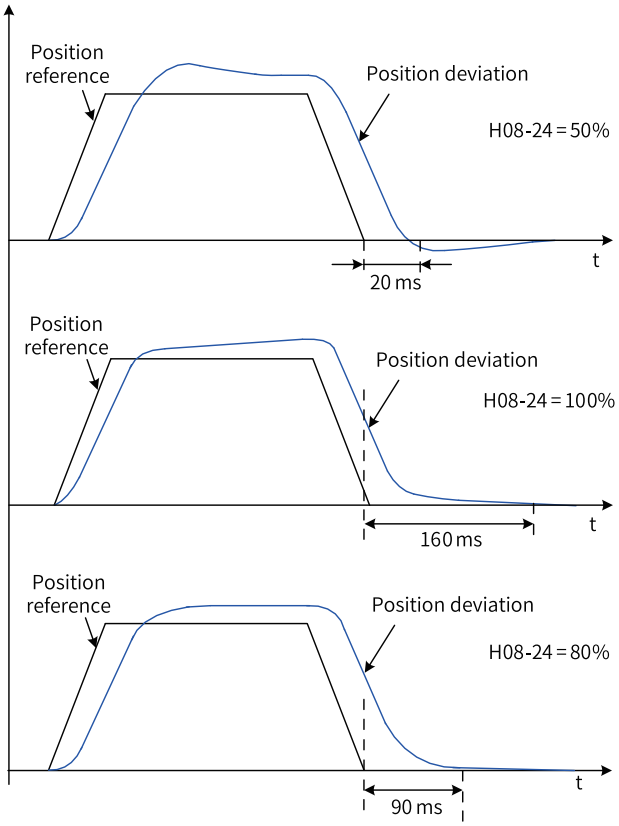


Figure 3-12 Example of PDFF

PDFF control enhances the anti-disturbance capacity of the speed loop and improves the follow-up behavior against speed references through adjusting the speed loop control method.

Parameter No.	Name	Description
H08-24	PDFF control coefficient	Parameter function: • Adjusts the control method of the speed loop in the non-torque control mode. Note: • An excessively small setpoint slows down the responsiveness of the speed loop. • When the speed feedback overshoots, gradually decrease the setpoint of H08-24 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 method does not change and the default proportional integral control is used.

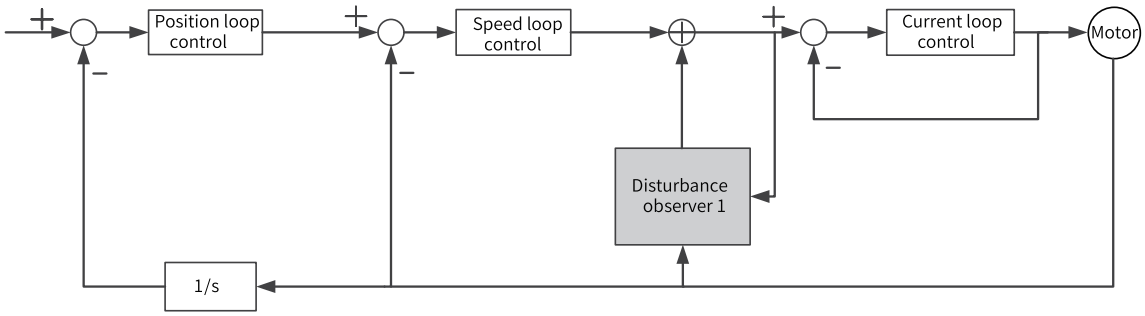
3.5.6 Torque Disturbance Observer

This function is used in a non-torque control mode.

Disturbance observer 1

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 for disturbance observer 1.



Note

1/s: Integral component

Para. No.	Name	Description
H08-31	Disturbance observer cutoff frequency	The higher the cutoff frequency is, the more easily will vibration occur.
H08-32	Disturbance observer compensation coefficient	Defines the compensation percentage.
H08-33	Disturbance observer inertia correction coefficient	H08-33 needs to be changed only when the inertia ratio does not reflect the actual condition. The effective inertia is the inertia setpoint multiplied by H08-33. It is recommended to use the default value of H08-33.

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-31	Disturbance observer cutoff frequency	10–1700	1 Hz	Defines the cutoff frequency of disturbance observer.	During running	Immediately	600
H08-32	Disturbance observer compensation coefficient	0–100	1%	Defines the compensation percentage.	During running	Immediately	0
H08-33	Disturbance observer inertia correction coefficient	1 to 10000	1%	Defines the coefficient for correcting the disturbance observer inertia.	During running	Immediately	100

Disturbance observer 2

The following figure depicts the control block diagram for disturbance observer 2.

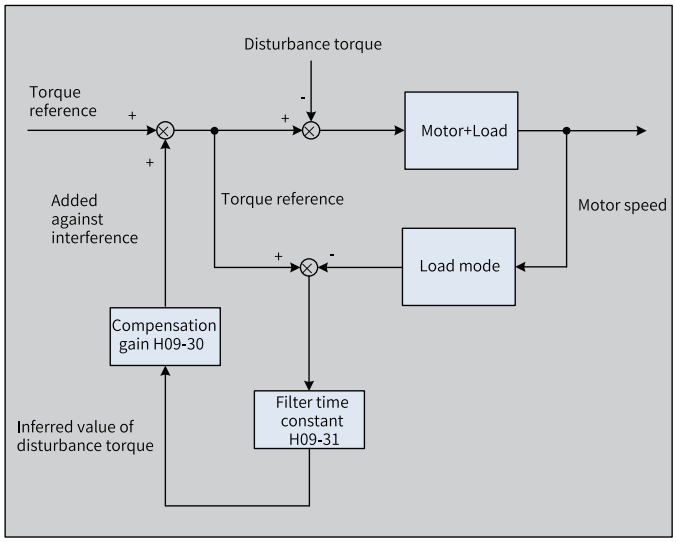


Figure 3-13 Block diagram for disturbance observer 2

The disturbance observer detects and estimates the external disturbance torque suffered by the system and compensates the torque reference accordingly, reducing the effect of external disturbance on the servo system and suppressing vibration.

Para. No.	Name	Description
H09-30	Torque disturbance compensation gain	**Parameter function:** • Increasing the setpoint of H09-30 enhances disturbance suppression but intensifies the noise. • Increasing the setpoint of H09-31 reduces the noise. Decreasing the setpoint of H09-31 enables detection and estimation of the external disturbance torque that features a short delay, which improves the disturbance suppression capacity but intensifies the noise. **Note:** • Set H09-31 to a large value first and then gradually increase the setpoint of H09-30 from 0 to a certain value at which the desired performance is achieved. Next, decrease the setpoint of H09-31 gradually without affecting the effectiveness of the disturbance observer. • Adjust H09-30 and H09-31 repeatedly until a balanced performance is achieved.
H09-31	Filter time constant of torque disturbance observer	

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-18	Speed feedforward filter time constant	0.00–64.00	ms	Defines the filter time constant of the speed feedforward gain.	During running	Immediately	0.00
H08-19	Speed feedforward gain	0.0–100.0	%	Defines the speed feedforward gain.	During running	Immediately	0.0
H08-20	Torque feedforward filter time constant	0.00–64.00	ms	Defines the filter time constant of the torque feedforward gain.	During running	Immediately	0.50
H08-21	Torque feedforward gain	0.0–200.0	ms	Defines the torque feedforward gain.	During running	Immediately	0.0

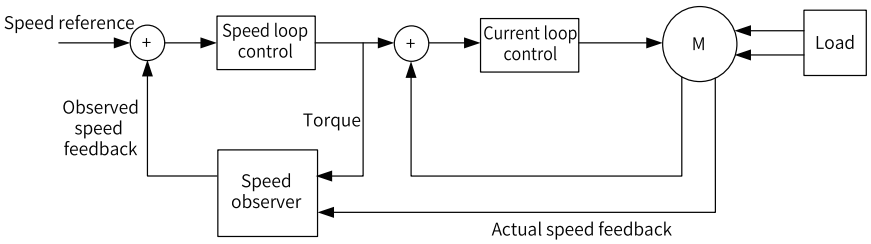
Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H08-24	PDFF control coefficient	0.0–100.0	%	Defines PDFF control coefficient.	During running	Immediately	100.0
H09-30	Torque disturbance compensation gain	0 to 100.0	%	Defines the disturbance torque compensation gain.	During running	Immediately	0.0
H09-31	Filter time constant of torque disturbance observer	0.00–25.00	ms	Defines the filter time constant of the disturbance observer.	During running	Immediately	0.50

3.5.7 Speed Observer

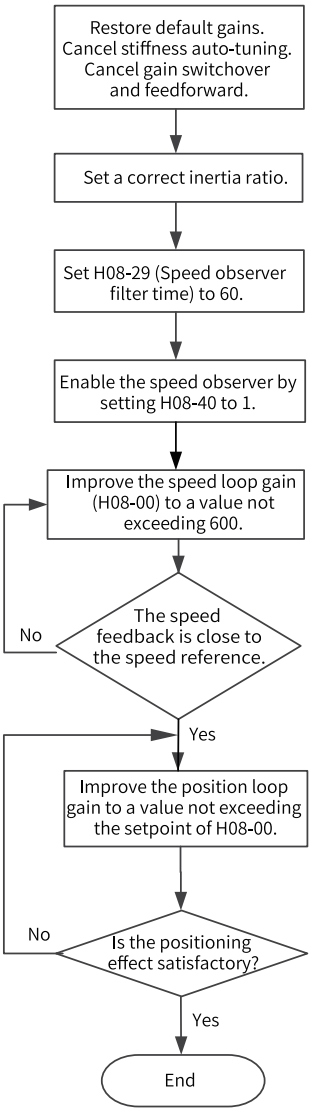
The speed observer, which facilitates quick positioning, applies to applications featuring slight changes in load characteristics and the inertia.

It improves the responsiveness to a higher range and filters high frequencies automatically, improving the gain 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	1–20000	400	During running	Immediately
H08-27	Speed observer cutoff frequency	1 Hz	10–2000	170	During running	Immediately
H08-28	Speed observer inertia correction coefficient	1%	10–10000	100	During running	Immediately
H08-29	Speed observer filter time	0.01 ms	2–2000	80	During running	Immediately
H08-40	Speed observer selection	1	0–1	0	During running	Immediately

3.5.8 Model Tracking Function

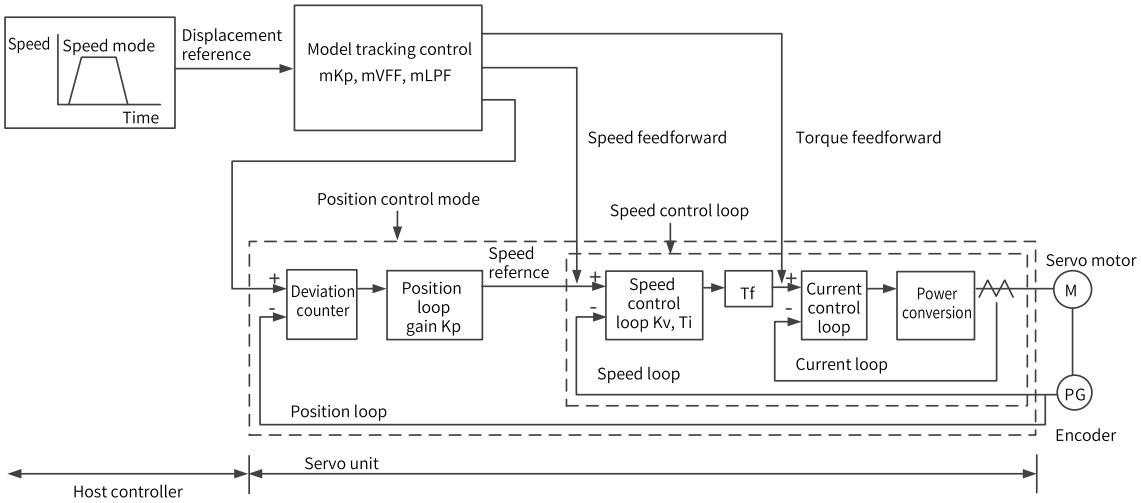
Model tracking function, which is only available in the position control mode, can be used to improve responsiveness and shorten the positioning time.

Parameters used by model tracking are set automatically along with gain parameters through STune or ETune.

Manual adjustment is needed only in the following cases:

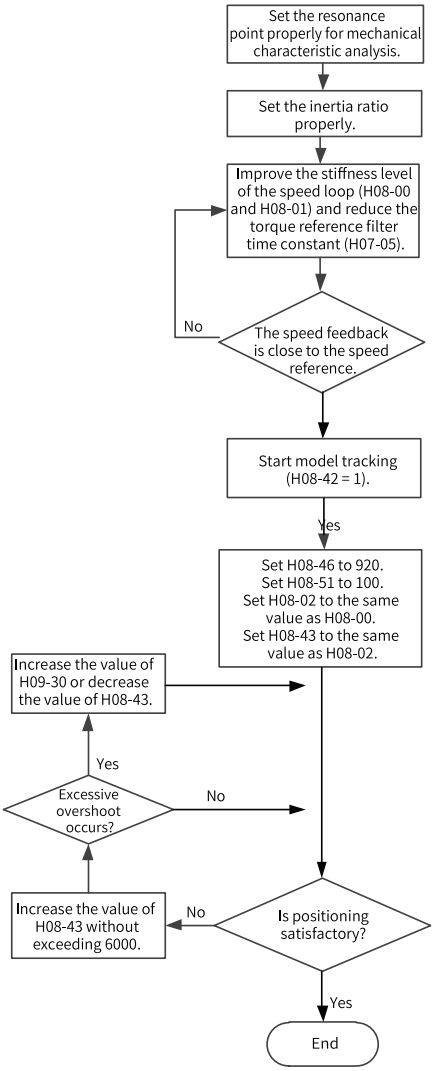
- The auto-tuned values cannot deliver desired performance.
- Improving the responsiveness takes priority over the auto-tuned values.
- Customized gain parameters or customized model tracking control parameters are needed.

The block diagram for model tracking function 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 gain (H08-43)
mVFF: model feedforward (H08-46)
mLPF: model filtering 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	0.01 ms	0–3000	79	During running	Immediately
H08-00	Speed loop gain	0.1 Hz	1–20000	400	During running	Immediately
H08-01	Speed loop integral time constant	0.01 ms	15–51200	1989	During running	Immediately
H08-02	Position loop gain	0.1 Hz	1–20000	640	During running	Immediately
H08-42	Model control selection	1	0–1	0	At stop	Immediately
H08-43	Model gain	0.1	0–10000	400	During running	Immediately

Para. No.	Name	Min. unit	Value Range	Default	Setting Condition	Effective Time
H08-46	Model feedforward	1	0–1024	950	During running	Immediately
H08-51	Model filter time 2	0.01 ms	0–2000	0	During running	Immediately

3.5.9 Friction Compensation

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

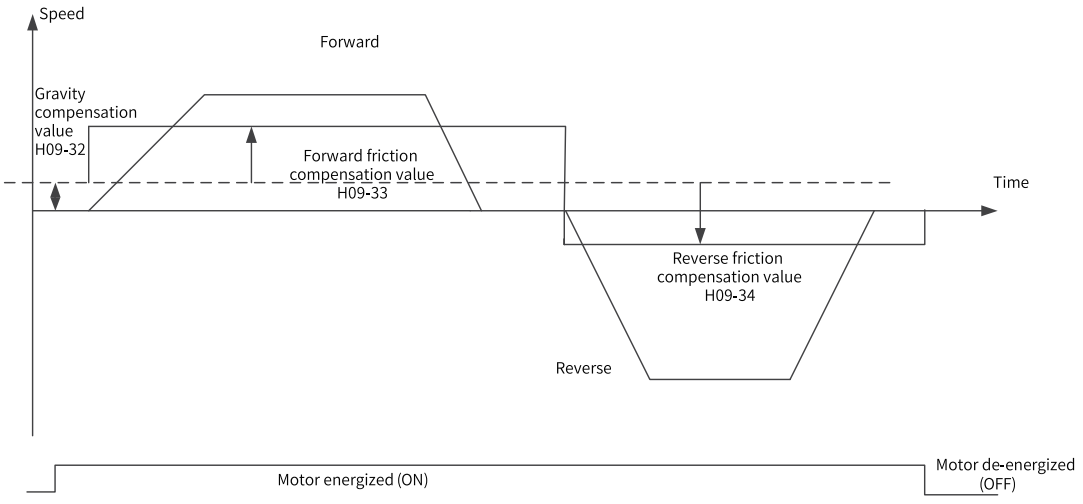
Note

Friction compensation is valid only in the position control mode.

☆Related parameters

Para. No.	Value Range	Description
H09-32 Gravity compensation value	0%–100.0%	Defines the constant compensation torque for vertical gravity load.
H09-33 Forward friction compensation	0%–100.0%	Defines the friction compensation for forward position references.
H09-34 Reverse friction compensation	-100.0%–0%	Defines the friction compensation for reverse position references.
H09-35 Friction compensation speed threshold	0–30.0 RPM	Defines the operating speed after the friction is neutralized.
H09-36 Friction compensation speed	0: Speed reference 1: Model speed (valid only 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 less 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.

3.6 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.

3.6.1 Parameter Adjustment in the Position Control Mode

Obtain the value of H08-15 (Load moment of inertia ratio) through inertia auto-tuning.

Gain parameters in the position control mode are listed in the following tables.

- 1st group of gain parameters

Parameter 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 group of gain parameters

Parameter No.	Name	Description	Default
H07-06	2nd torque reference filter time constant	Defines the torque reference filter time constant.	0.79 ms
H08-03	2nd speed loop gain	Defines the speed loop proportional gain.	40.0 Hz
H08-04	2nd speed loop integral time constant	Defines the integral time constant of the speed loop.	20.00 ms
H08-05	2nd position loop gain	Defines the position loop proportional gain.	64.0 ms
H08-08	2nd gain set mode	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

Parameter No.	Name	Description	Default
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 gain parameters

Parameter 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.	0.0%
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.	0.0%
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 the speed feedback.	4000 Hz
H08-24	PDFF control coefficient	Defines the coefficient of the PDFF controller.	100.0%
H09-30	Torque disturbance compensation gain	Defines the torque disturbance compensation gain.	0.0%
H09-31	Filter time constant of torque disturbance observer	Defines the filter time constant of the disturbance observer.	0.5 ms
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	Used to set the 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

Perform gain auto-tuning to obtain the initial values of the 1st or 2nd group of gain parameters and the common gain parameters.

You can fine-tune the following gain parameters manually.

Parameter No.	Name	Description
H07-05	Torque reference filter time constant	Defines the torque reference filter time constant.
H08-00	Speed loop gain	Defines the speed loop proportional gain.
H08-01	Speed loop integral time constant	Defines the integral time constant of the speed loop.

Parameter No.	Name	Description
H08-02	Position loop gain	Defines the position loop proportional gain.
H08-19	Speed feedforward gain	Defines the speed feedforward gain.

3.6.2 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 for the position loop gains (H08-02 and H08-05). For details, see *"3.6.1 Parameter Adjustment in the Position Control Mode" on page 152*.

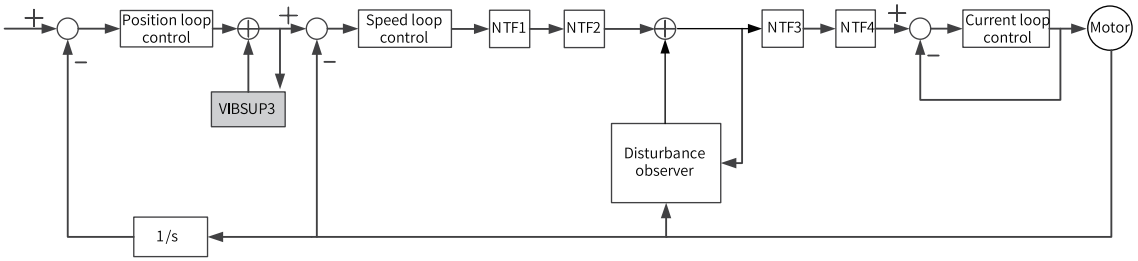
3.6.3 Parameter Adjustment in the Torque Control Mode

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

- If the actual speed reaches the speed limit, the adjustment method is the same as that described in *"3.6.2 Parameter Adjustment in the Speed Control Mode" on page 154*.
- If the actual speed does not reach the speed limit, the adjustment method is the same as that described in *"3.6.2 Parameter Adjustment in the Speed Control Mode" on page 154*, except for the position/speed loop gain and speed loop integral time constant.

3.7 Vibration Suppression

The block diagram for vibration suppression is as follows.



In which:

- In the above figure: NTF1–NTF4: 1st notch to 4th notch
- VIBSUP3: medium- and low-frequency jitter suppression, reduction applied at a carrier frequency lower than 8 K under 300 Hz
- 1/s: Integral component

☆Related parameters

Para. No.	Name	Default	Unit	Minimum Value	Maximum Value	Setting Condition	Effective Time
H08-53	Medium- and low-frequency jitter suppression frequency 3	0	0.1 Hz	0	6000	During running	Immediately
H08-54	Medium- and low-frequency jitter suppression compensation coefficient 3	0	1%	0	200	During running	Immediately
H08-56	Medium- and low-frequency jitter suppression phase modulation coefficient 3	300	1%	0	1600	During running	Immediately

Note

- Jitter suppression phase modulation coefficient: Defines synchronous phase adjustment of the compensation value and vibration. It is recommended to use the default value. Adjustment is needed when the phase of the compensation deviates sharply from the phase of the vibration.
- Jitter suppression frequency: Defines the jitter frequency that needs to be suppressed.
- Jitter suppression compensation coefficient: Defines the compensation coefficient for jitter suppression.

3.7.1 Mechanical Resonance Suppression

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

Mechanical resonance can be suppressed through the torque reference filter (H07-05, H07-06) and the notch.

Torque reference filter (H07-05, H07-06)

To suppress the mechanical resonance, set the filter time constant to attenuate torque references in a 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 gain at certain frequencies to suppress mechanical resonance. After the vibration is suppressed by the notch, you can continue to increase the gain. The working principle of the notch is shown in the following figure.

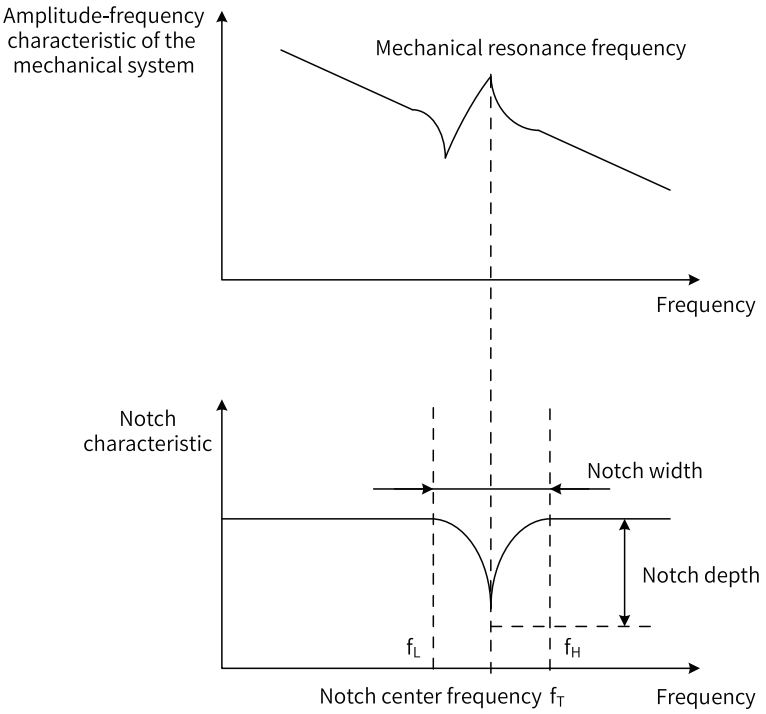


Figure 3-14 Working principle of the notch

A total of four notches can be used, and each is defined by three parameters: notch 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 by the user or set automatically after being configured as adaptive notches (H09-02 =1 or 2).

Table 3–9 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 4000 Hz (default), the notch is invalid.
- The adaptive notch is preferred in resonance suppression. The manual notch can be used in cases where the adaptive notch cannot deliver desired performance.

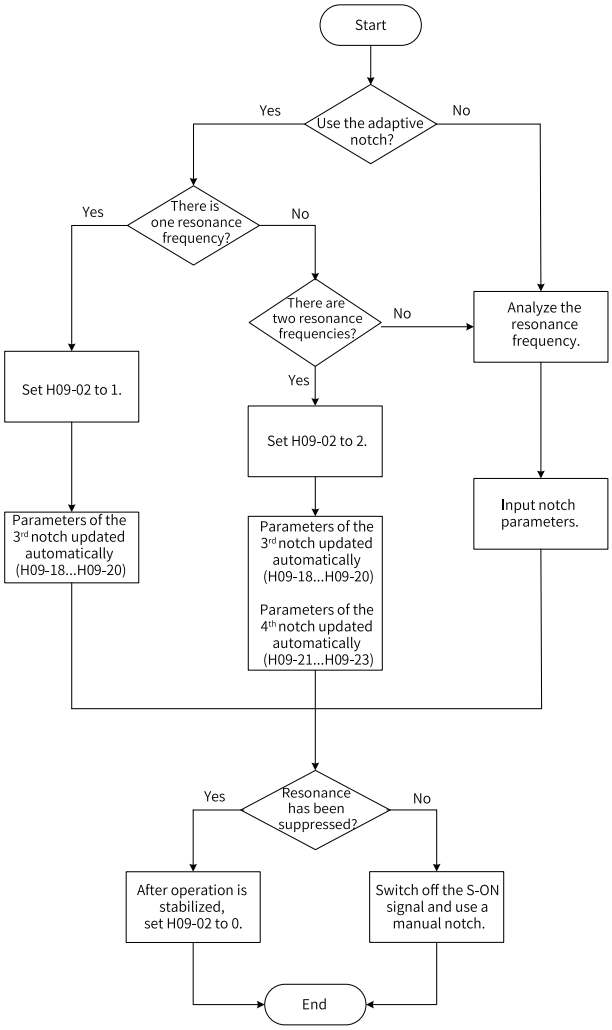


Figure 3-15 Procedure for setting the notch

- 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 to enable one adaptive notch first. 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 their values are saved 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, causing malfunction of the servo drive and intensifying vibration.
  5. If vibration 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 all the four notches as manual notches (H09-02 = 0).

Note

- When the adaptive notch is used, if the S-OFF signal is activated within 30 min, the notch parameters will not be saved to the corresponding parameters.
- When the resonance frequency is below 300 Hz, the suppression effect of the adaptive notch may be degraded.

- Procedure for setting the manual notch:

  1. Analyze the resonance frequency.
  2. When using the manual notch, set the notch frequency to the same value as the actual resonance frequency, which is obtained through the following methods:
     - Use the "Mechanical characteristic analysis" function in the software tool.
     - Calculate the resonance frequency based on the motor phase current displayed on the oscilloscope interface of the software tool.
     - Set H09-02 (Adaptive notch mode) to 3. The servo drive automatically tests the resonance frequency and saves the detected value into H09-24 (Auto-tuned resonance frequency) after start-up.
  3. Input the resonance frequency obtained in step 1 into parameters of the selected notch, and input the width level and depth level of this notch.
  4. If resonance is suppressed, the notch functions well. In this case, you can continue adjusting the gain. If resonance occurs again, repeat steps 1 and 2.
  5. If vibration 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 width whose amplitude attenuation rate is -3 dB relative to the notch center frequency

  The following figure shows the frequency characteristics of the notch. Use the default value 2 in general conditions.

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

  The input at the center frequency is fully suppressed when the depth level is 0 or fully passed when the depth level is 100. Therefore, the smaller the depth level is, the larger the notch depth is, and the stronger the suppression effect will be. Note that a too small depth level may lead to system oscillation.

Note

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

The following figure shows the frequency characteristics of the notch.

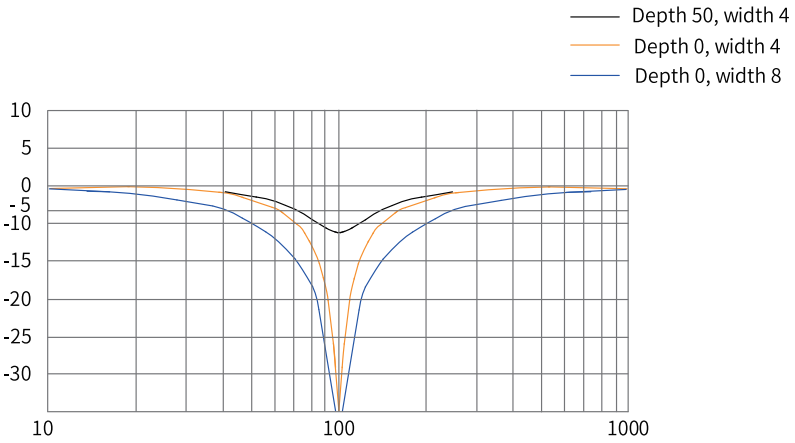


Figure 3-16 Frequency characteristics of the notch

☆Related parameter

Para. No.	Name	Value Range	Description	Setting Condition	Effective Time	Default
H09-02	Adaptive notch mode	0: Parameters of the 3rd and 4th notches no longer updated 1: One adaptive notch activated, parameters of the 3rd notch updated in real time based on the vibration condition 2: Two adaptive notches activated, parameters of the 3rd and 4th notches 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	Immediately	0
H09-12	Frequency of the 1st notch	50–4000	Defines the frequency of the 1st notch.	During running	Immediately	4000
H09-13	Width level of the 1st notch	0–10	Defines the width level of the 1st notch.	During running	Immediately	2
H09-14	Depth level of the 1st notch	0–99	Defines the attenuation level of the 1st notch.	During running	Immediately	0

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

3.7.2 Low-frequency Resonance Suppression at the Mechanical Load End

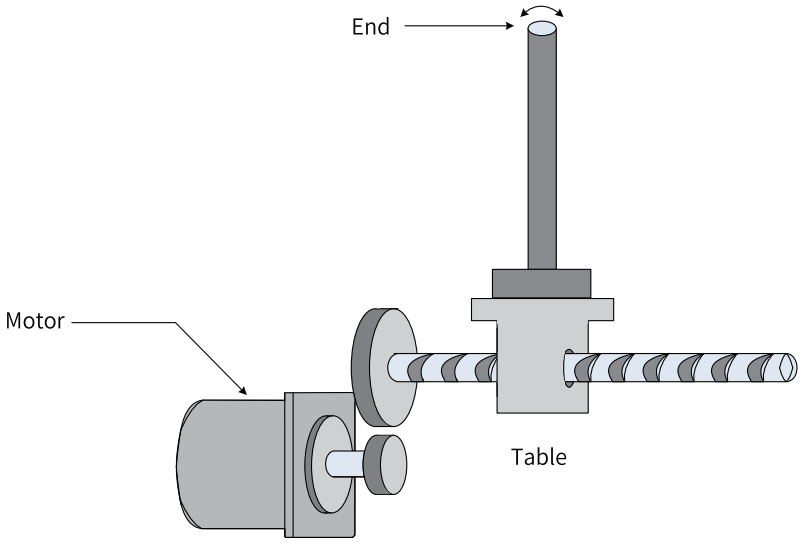


Figure 3-17 Low-frequency vibration at the mechanical load end

If the mechanical load end is long and heavy, vibration may easily occur in this part during emergency stop, affecting the positioning effect. Such vibration is called low-frequency resonance as its frequency is generally within 100 Hz, which is smaller than the mechanical resonance frequency mentioned in *"3.7.1 Mechanical Resonance Suppression" on page 155*. Use the low-frequency resonance suppression function to suppress such vibration.

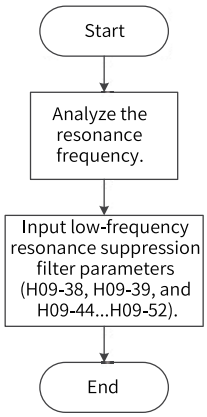


Figure 3-18 Procedure for setting low-frequency resonance suppression filter

First, use the oscilloscope function in the software tool to collect the position deviation waveform of the motor in the locked state. Then calculate the position deviation fluctuation frequency, which is the low-frequency resonance frequency. Finally, input the value of H09-38 manually and use the default value of H09-39. Observe the suppression effect after using the low-frequency resonance suppression filter.

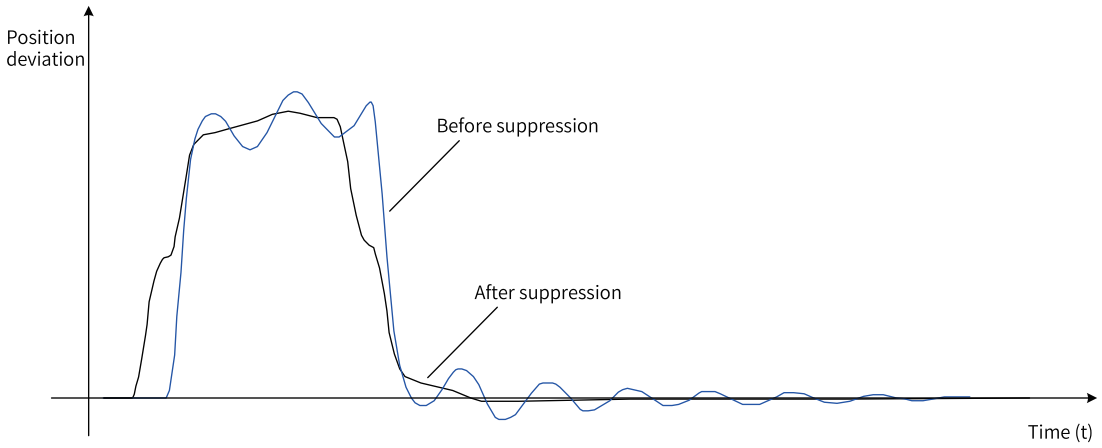


Figure 3-19 Low-frequency resonance suppression effect

☆Related parameters

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-38	Low-frequency resonance suppression frequency at the mechanical load end	1.0–100.0	Hz	Defines the low-frequency resonance suppression frequency.	During running	Immediately	100.0
H09-39	Low-frequency resonance suppression at the mechanical load end	0–3	-	Defines the low frequency resonance suppression level.	During running	Immediately	2
H09-44	Frequency of low-frequency resonance suppression 1 at mechanical load end	0–200.0	Hz	Defines the frequency of the 2nd group of low-frequency resonance suppression. The setpoint 0 indicates this function is disabled.	During running	Immediately	0
H09-45	Responsive-ness of low-frequency resonance suppression 1 at mechanical load end	0.01–10.00	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	Immediately	1.00
H09-47	Width of low-frequency resonance suppression 1 at mechanical load end	0–2.00	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	Immediately	1.00

Para. No.	Name	Value Range	Unit	Description	Setting Condition	Effective Time	Default
H09-49	Frequency of low-frequency resonance suppression 2 at mechanical load end	0–200.0	Hz	Defines the frequency of the 3rd group of low frequency resonance suppression. The setpoint 0 indicates this function is disabled.	During running	Immediately	0
H09-50	Responsive-ness of low-frequency resonance suppression 2 at mechanical load end	0.01–10.00	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	Immediately	1.00
H09-52	Width of low-frequency resonance suppression 2 at mechanical load end	0–2.00	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	Immediately	1.00

3.8 Mechanical Characteristic Analysis

3.8.1 Overview

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

3.8.2 Operating Procedure

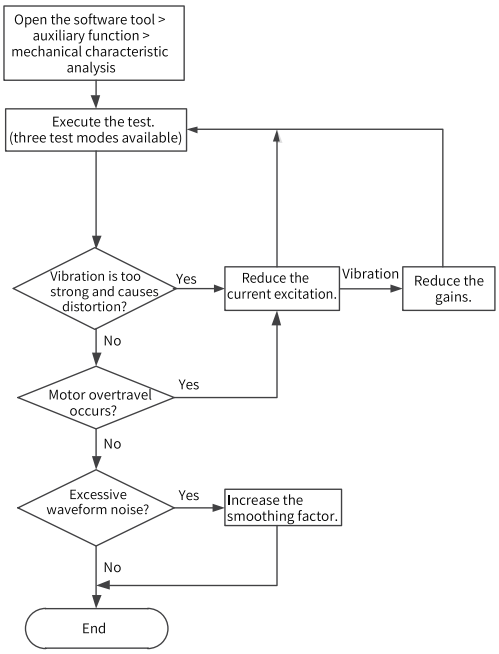


Figure 3-20 Operating procedure for mechanical characteristic analysis

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 small.
- If vibration generated during testing cannot be suppressed by reducing the current excitation, the causes and solutions may be: 1) The gain values are too high. Reduce the speed gain or set notch parameters based on the auto-tuned resonance point. 2) The set inertia ratio is too high. Set the inertia ratio properly.
- In the mechanical characteristic test mode, waveforms before and after notch settings are consistent. In the speed closed loop and speed open loop modes, gain curves in the waveforms are attenuated after notch settings.

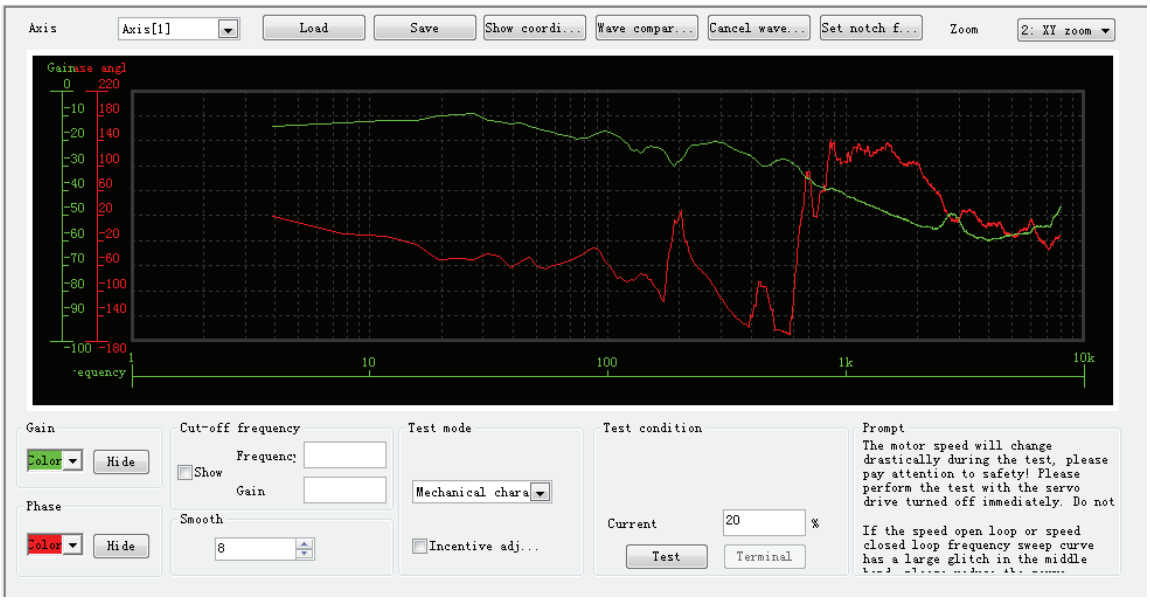


Figure 3-21 Example of the waveform obtained

An example of the waveform obtained with the mechanical characteristic analysis is shown in *"Figure 3–21 Example of the waveform obtained" on page 164*.

4 Troubleshooting

4.1 Troubleshooting During Startup

4.1.1 Position Control Mode

Fault diagnosis

Start Process	Fault Symptom	Cause	Confirming Method
Switching on the control circuit (L1C, L2C) and the main circuit (L1, L2/R, S, T/ L1, L2, L3)	The LED neither lights up nor displays "rdy".	1. The voltage of the control circuit power supply is abnormal.	The fault persists though CN1, CN2, CN3, and CN4 are disconnected. Measure the AC voltage between L1C and L2C.
		2. The voltage of the main circuit power supply is abnormal.	• 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 "nrd". • 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 460 V, the keypad displays "nrd".
		3. The programming terminal is shorted.	Check whether the programming terminal is shorted.
		4. The servo drive is faulty.	-
	The keypad displays "Er.xxx".	Rectify the fault causes according to *"4.2.2 Common Solutions to Faults" on page 177* and *"4.2.3 Solutions to Common Warnings" on page 199*.	
	The keypad displays "rdy" after preceding faults are cleared.		

Start Process	Fault Symptom	Cause	Confirming Method
Switching on the S-ON signal (S-ON signal switched on)	The keypad displays "Er.xxx".	Rectify the fault causes according to "4.2.2 Common Solutions to Faults" on page 177 and "4.2.3 Solutions to Common Warnings" on page 199.	
	The servo motor shaft is in the free running state.	1. The S-ON signal is inactive.	Switch the keypad display to the servo status interface and view whether the keypad displays "rdy" instead of "run". • Check parameters in groups H03 or H17 to see whether FunIN.1 (S-ON) is assigned to a DI. If FunIN.1 is assigned, check whether the corresponding DI logic is active. If FunIN.1 is not assigned, assign FunIN.1 to a DI and activate the logic of this DI. For how to assign FunIN.1 to a DI, see "5.4 Group H03: Terminal Input Parameters" on page 212 and "5.17 Group H17: VDI/VDO Parameters" on page 245. • If the keypad keeps displaying "rdy" even though the S-ON signal has been assigned to a DI through parameters in group H03 or H17 and the corresponding DI logic is active, check whether the DI is connected correctly according to Chapter "Wiring" in SV660P Series Servo Drive Hardware Guide.
		2. The control mode is wrong.	Check whether H02-00 (Control mode selection) is set to 1 (Position control mode). If it is set to 2 (Torque control mode), the motor shaft will is de-energized because the default torque reference is 0.
	The keypad displays "run" after preceding faults are cleared.		
Inputting position references	The servo motor does not rotate.	The value of the position reference counter (H0B-13) is 0.	• The high/low-speed pulse input terminal is wired incorrectly. When H05-00 (Position reference source) is set to 0 (pulse reference), check whether the high/low-speed pulse input terminal is wired correctly according to Chapter "Wiring" in SV660P Series Servo Drive Hardware Guide. Meanwhile, check whether the setting of H05-01 (Pulse reference input terminal selection) is matching. • No position reference is inputted. • Check whether FunIN.13 (Inhibit, position reference inhibited) or FunIN.37 (PulseInhibit, pulse reference inhibited) is used. • When H05-00 (Position reference source) is set to 0 (Pulse input), the host controller or other pulse output device does not output pulses. Check whether there are pulses input to the high/low-speed pulse input terminals. For details, see Chapter "Wiring" in SV660P Series Servo Drive Hardware Guide. • When H05-00 (Position reference source) is set to 1 (Step reference), check whether H05-05 (Step reference) is 0. If not, check whether FunIN.20 (PosStep, step reference enabled) is assigned to a DI and whether the logic of this DI is active. • When H05-00 (Position reference source) is set to 2 (Multi-position reference), check whether parameters in group H11 are set correctly. If yes, check whether FunIN.28 (PosInSen, internal multi-position enable) is assigned to a DI and whether the logic of this DI is active. • If interrupt positioning is used, check whether H05-29 (Interrupt positioning cancel) is set to 1 (Enable). If yes, check whether FunIN.29 (XintFree, interrupt positioning cancel) is used to cancel the interrupt positioning state.

Start Process	Fault Symptom	Cause	Confirming Method
Inputting position references	The servo motor rotates in the reverse direction.	The value of the position reference counter (H0B-13) is a negative number.	• When H05-00 (Position reference source) is set to 0 (Pulse reference), check whether the setting of H05-15 (Pulse reference form) is consistent with the actual input pulses. If not, H05-15 is set improperly or terminals are wired incorrectly. • When H05-00 (Position reference source) is set to 1 (Step reference), check whether the value of H05-05 (Step reference) is a positive or a negative number. • When H05-00 (Position reference source) is set to 2 (Multi-position reference), check the sign (+/-) of each displacement reference value in parameter group H11. • Check whether FunIN.27 (PosDirSel, position reference direction selection) is assigned to a DI and whether the logic of this DI is active. • Check whether H02-02 (Direction of rotation) is set properly.
	The servo motor can rotate after preceding faults are cleared.		
Rotating unstably at low speed	The motor speed is unstable during low-speed operation.	Gains are set improperly.	Perform gain auto-tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
	The motor shaft vibrates leftward and rightward.	The load moment of inertia ratio (H08-15) is excessively high.	If the motor can operate safely , perform inertia auto-tuning and gain auto-tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
	The servo motor can rotate properly after preceding fault causes are rectified.		
Running normally	The positioning is inaccurate.	The position deviation is beyond the permissible range.	Check the position reference counter (H0B-13), feedback pulse counter (H0B-17), and the mechanical stop position according to the following section.

Procedure for checking the causes of inaccurate positioning

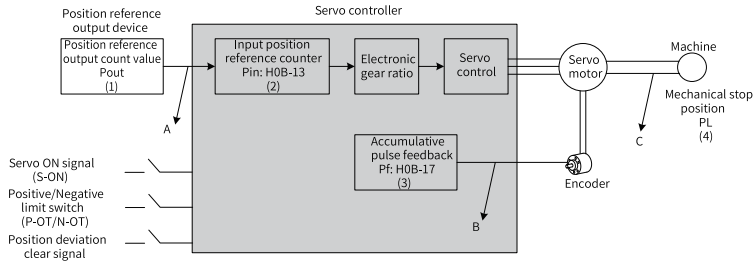


Figure 4-1 Schematic diagram for positioning control

- When inaccurate positioning occurs, check the following four signals in the preceding figure.
  - Output position reference count value (Pout) in the position reference output device (host controller or internal parameters of the servo drive)
  - Input position reference count value (Pin) received by the servo drive, corresponding to H0B-13 (Position reference counter)
  - Accumulative pulse feedback value (Pf) returned by the encoder, corresponding to H0B-17 (Feedback pulse counter)
  - Mechanical stop position (PL)
- The A, B, C shown in the preceding figure represent the three causes that lead to inaccurate positioning.

- A: An input position reference count error occurs due to the noise in the wiring of the host controller and the servo drive.
- B: The input position reference is interrupted during operation of the motor.
  Cause: The S-ON signal is switched off, the positive/negative limit switch signal (P-OT or N-OT) is active, or the position deviation clear signal (ClrPosErr) is active.
- C: Mechanical position slip occurs between the machine and the servo motor.

- In an ideal scenario where the position deviation is 0, the following relations exist:
  - Pout = Pin: Output position reference count value = Input position reference count value
  - Pin x Electronic gear ratio = Pf: Input position reference count value x Electronic gear ratio = Accumulative pulse feedback
  - Pf x △L = PL: Accumulative pulse feedback x Corresponding load displacement per position reference = Mechanical stop position
- When inaccurate positioning occurs, check the cause based on the following steps:
  - Pout ≠ Pin
    Fault cause: A

    To rectify cause A, do as follows:

    1. Check whether the pulse input terminals (low-speed or high-speed pulse input terminal, see Chapter "Wiring" in SV660P Series Servo Drive Hardware Guide) are connected with twisted pairs.
    2. If the open-collector input mode for low-speed pulse input terminals is used, change to the differential input mode.
    3. Route pulse input terminals and the main circuit (L1, L2, R, S, T, U, V, W) through different routes.
    4. If low-speed pulse input terminals are used, increase the filter time constant of low-speed pulse input pins (H0A-24). If high-speed pulse input terminals are used, increase the filter time constant of the high-speed pulse input pins (H0A-30).
  - Pin x Electronic gear ratio ≠ Pf:
    Fault cause: B

    To rectify cause B, do as follows:

    1. Check whether a fault occurs during operation, causing the servo drive to stop before executing all the commands.
    2. If the fault is caused by an active position deviation clear signal (ClrPosErr), check whether the position deviation clear mode (H05-16) is proper.
  - Pf x △L ≠ PL:
    Fault cause: C

    To rectify cause C, check mechanical connections and find the sliding position.

4.1.2 Speed Control Mode

Start Process	Fault Symptom	Cause	Confirming Method
Switching on the control circuit (L1C, L2C) and the main circuit (L1, L2/R, S, T/L1, L2, L3)	The LED neither lights up nor displays "rdy".	1. The voltage of the control circuit power supply is abnormal.	The fault persists though CN1, CN2, CN3, and CN4 are disconnected. Measure the AC voltage between L1C and L2C.
		2. The input voltage is abnormal.	• 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 "nrd". • 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 460 V, the keypad displays "nrd".
		3. The programming terminal is shorted.	Check whether the programming terminal is shorted.
		4. The servo drive is faulty.	-
	The keypad displays "Er.xxx".	Rectify the fault causes according to *"4.2.2 Common Solutions to Faults" on page 177* and *"4.2.3 Solutions to Common Warnings" on page 199*.	
	The keypad displays "rdy" after preceding faults are cleared.		
Switching on the S-ON signal (S-ON signal switched on)	The keypad displays "Er.xxx".	Rectify the fault causes according to *"4.2.2 Common Solutions to Faults" on page 177* and *"4.2.3 Solutions to Common Warnings" on page 199*.	
	The servo motor shaft is in the free running state.	1. The S-ON signal is inactive.	Switch the keypad display to the servo status interface and view whether the keypad displays "rdy" instead of "run". • Check parameters in groups H03 or H17 to see whether FunIN.1 (S-ON) is assigned to a DI. If FunIN.1 is assigned, check whether the corresponding DI logic is active. If FunIN.1 is not assigned, assign FunIN.1 to a DI and activate the logic of this DI. For how to assign FunIN.1 to a DI, see *"5.4 Group H03: Terminal Input Parameters" on page 212* and *"5.17 Group H17: VDI/VDO Parameters" on page 245*. • If the keypad keeps displaying "rdy" even though the S-ON signal has been assigned to a DI through parameters in group H03 or H17 and the corresponding DI logic is active, check whether the DI is connected correctly according to Chapter "Wiring" in SV660P Series Servo Drive Hardware Guide.
		2. The control mode is wrong.	Check whether H02-00 (Control mode selection) is set to 0 (Position control mode). If it is set to 2 (Torque control mode), the motor shaft will be in the free running status because the default torque reference is 0.
	The keypad displays "run" after preceding faults are cleared.		

Start Process	Fault Symptom	Cause	Confirming Method
Inputting speed references	The servo motor does not rotate or the motor speed is incorrect.	The speed reference (H0B-01) is 0.	• The speed reference selected is wrong. Check whether H06-02 (Speed reference selection) is set correctly. • No speed reference is inputted or the speed reference is abnormal. • When the speed reference is set through the keypad, check whether H06-03 (Speed reference set through keypad) is set correctly. • When the speed reference is set through multi-speed references, check whether parameters in group H12 are set correctly. • When the speed reference is set through communication, check whether H31-09 (Speed reference set through communication) is set correctly. • When the speed reference is set through jog speed references, check whether H06-04 (Jog speed) is set correctly and whether FunIN.18 (JOGCMD+, forward jog) and FunIN.19 (JOGCMD, reverse jog) are assigned to DIs and the DI logics are active. • Check whether H06-05 (Acceleration time constant of speed reference) and H06-06 (Deceleration time constant of speed reference) are set correctly. • Check whether FunIN.12 (ZCLAMP, zero clamp) is misassigned and whether the active logic of the corresponding DI is correct.
Inputting speed references	The servo motor rotates in the reverse direction.	The value of the speed reference (H0B-01) is a negative number.	• When the speed reference is set through the keypad, check whether the value of H06-03 (Speed reference set through keypad) is lower than 0. • When the speed reference is set through multi-speed references, check the sign (+/-) of each speed reference value in group H12. • When the speed reference is set through communication, check whether the value of H31-09 (Speed reference set through communication) is lower than 0. • When the speed reference is set through jog speed references, check whether the value of H06-04 (Jog speed) and the active logics of FunIN.18 (JOGCMD+, forward jog) and FunIN.19 (JOGCMD-. reverse jog) match the desired direction of rotation. • Check whether FunIN.26 (SpdDirSel, speed reference direction selection) is assigned to a DI and whether the logic of the DI is active. • Check whether H02-02 (Direction of rotation) is set properly.
	The servo motor can rotate after preceding faults are cleared.		
Rotating unstably at low speed	The motor speed is unstable during low-speed operation.	Gains are set improperly.	Perform gain auto-tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
	The motor shaft vibrates leftward and rightward.	The load moment of inertia ratio (H08-15) is excessively high.	If the motor can operate safely , perform inertia auto-tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide. Perform gain auto-tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.

4.1.3 Torque Control Mode

Start Process	Fault Symptom	Cause	Confirming Method
Switching on the control circuit (L1C, L2C) and the main circuit (L1, L2/R, S, T/L1, L2, L3)	The LED neither lights up nor displays "rdy".	1. The voltage of the control circuit power supply is abnormal.	The fault persists though CN1, CN2, CN3, and CN4 are disconnected. Measure the AC voltage between L1C and L2C.
		2. The voltage of the main circuit power supply is abnormal.	• 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 "nrd". • 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 Θ) is lower than 460 V, the keypad displays "nrd".
		3. The programming terminal is shorted.	Check whether the programming terminal is shorted.
		4. The servo drive is faulty.	-
	The keypad displays "Er.xxx".	Rectify the fault causes according to *"4.2.2 Common Solutions to Faults" on page 177* and *"4.2.3 Solutions to Common Warnings" on page 199*.	
	The keypad displays "rdy" after preceding faults are cleared.		
Switching on the S-ON signal (S-ON signal switched on)	The keypad displays "Er.xxx".	Rectify the fault causes according to *"4.2.2 Common Solutions to Faults" on page 177* and *"4.2.3 Solutions to Common Warnings" on page 199*.	
	The servo motor shaft is in the free running state.	The S-ON signal is inactive.	• Switch the keypad display to the servo status interface and view whether the keypad displays "rdy" instead of "run". • Check parameters in groups H03 or H17 to see whether FunIN.1 (S-ON) is assigned to a DI. If FunIN.1 is assigned, check whether the corresponding DI logic is active. If FunIN.1 is not assigned, assign FunIN.1 to a DI and activate the logic of this DI. For how to assign FunIN.1 to a DI, see *"5.4 Group H03: Terminal Input Parameters" on page 212* and *"5.17 Group H17: VDI/VDO Parameters" on page 245*. • If the keypad keeps displaying "rdy" even though the S-ON signal has been assigned to a DI through parameters in group H03 or H17 and the corresponding DI logic is active, check whether the DI is connected correctly according to Chapter "Wiring" in SV660P Series Servo Drive Hardware Guide.
	The keypad displays "run" after preceding faults are cleared.		
Inputting torque references	The servo motor does not rotate.	The internal torque reference (H0B-02) is 0.	The torque reference selected is wrong. Check whether H07-02 (Torque reference source) is set correctly. No torque reference is inputted. • When the torque reference is set through the keypad, check whether H07-03 (Torque reference set through keypad) is set to 0. • When the torque reference is set through communication, check whether H31-11 (Torque reference set through communication) is set to 0.
	The servo motor rotates in the reverse direction.	The value of the internal torque reference (H0B-02) is a negative number.	• When the torque reference is set through keypad, check whether the value of H07-03 (Torque reference set through keypad) is lower than 0. • When the torque reference is set through communication, check whether the value of H31-11 (Torque reference set through communication) is lower than 0. • Check whether FunIN.25 (ToqDirSel, speed reference direction selection) is assigned and whether the corresponding DI logic is active. • Check whether H02-02 (Direction of rotation) is set properly.
	The servo motor can rotate after preceding faults are cleared.		

Start Process	Fault Symptom	Cause	Confirming Method
Rotating unstably at low speed	The motor speed is unstable during low-speed operation.	Gains are set improperly.	Perform gain auto-tuning.
	The motor shaft vibrates leftward and rightward.	The load moment of inertia ratio (H08-15) is excessively high.	If the servo motor can run safely, perform inertia auto-tuning again. Perform gain auto-tuning.

4.2 Troubleshooting During Operation

4.2.1 Fault and Warning List

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

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

To stop the keypad from displaying the fault/warning, set H0D-01 to 1 (Fault reset enabled) or activate the logic of the DI assigned with FunIN.2 (ALM-RST, fault and warning reset).

- To reset No. 1 and No. 2 resettable faults, switch off the S-ON signal first and then set H0D-01 to 1 or use FunIN.2 (ALM-RST).
- To reset No. 3 warnings, set H0D-01 to 1 or use FunIN.2 (ALM-RST).

Note

- Some faults and warnings can be reset only after the fault causes are rectified by modifying the settings. However, a reset operation does not necessarily activate the modification to settings.
- The control circuit must be powered off and on again in case of modifications that can be activated only after the power supply (L1, L2/L1, L2, L3/L1C, L2C) is powered off and on again.
- For modifications activated after stop, switch off the S-ON signal. The servo drive operates normally only after modifications are activated.

☆Related parameters

Para. No.	Name	Value Range	Function	Setting Condition	Effective Time	Default
H0D-01	Fault reset	0: No operation 1: Enable	Used to stop the keypad from displaying the fault/warning when a resettable fault/ warning occurs. H0D-01 is set to 0 immediately after reset.	At stop	At once	0

☆ Related function No.

Function No.	Name	Function	Function
FunIN.2	ALM-RST	Fault/Warning reset signal	The servo drive may, depending on the warning types, continue running after warning reset. When FunIN.2 is assigned to a low-speed DI, the effective level change of this DI must be kept for more than 3 ms. Otherwise, fault reset will be inactive. Do not assign FunIN.2 to a high-speed DI. Otherwise, fault/warning reset will be inactive. • Inactive: Not resetting the fault/warning • Active: Resetting the fault/warning

Fault and warning log

The servo drive can record the latest 10 faults and warnings and values of status parameters upon the fault/warning event. Among the latest 5 faults/warnings, if a fault/warning occurs repetitively, the servo drive records the fault/warning code and the drive status only once.

A fault/warning will still be saved in the fault log after reset. To remove the fault/warning from the fault log, set H02-31 (System parameter initialization) to 1 or 2.

You can select the specific fault/warning in H0B-33, view the corresponding fault/warning code in H0B-34 and the values of status parameters in H0B-35...H0B-42. For details of these parameters, see Chapter "Parameter List". If no fault occurs, the keypad displays "Er.000" in H0B-34.

The keypad displays "Er.xxx" when you view H0B-34 (Fault code of the selected fault) through the keypad. In "Er.xxx", "xxx" is the fault/warning code. The value of H0B-34 read through the software tool or communication is a decimal, which needs to be converted to a hexadecimal equivalent to indicate the actual fault/warning code. The following table gives examples of such conversion.

Er.xxx	H0B-34 (Decimal)	H0B-34 (Hexadecimal)	Description
Er.101	257	0101	0: No. 1 non-resettable fault 101: Fault code
Er.130	8496	2130	2: No. 1 resettable fault 130: Fault code
Er.121	24865	6121	6: No. 2 resettable fault 121: Fault code
Er.110	57616	E110	E: No. 3 resettable warning 110: Warning code

Fault and Warning List

The servo drive can output the fault/warning code of the highest-level.

To output the fault/warning code, assign FunOUT.12 (ALMO1 (AL1), 1st bit of the fault code), FunOUT.13 (ALMO2 (AL2), 2nd bit of the fault code), and FunOUT.14 (ALMO3 (AL3), 3rd bit of the fault code) to three DOs respectively. When different faults/warnings occur, the level of each of the three DOs changes accordingly.

- No. 1 non-resettable faults:

Table 4–1 No. 1 non-resettable fault list

Display	Fault Name	Fault Type	Resettable	Code Output		
				AL3	AL2	AL1
Er.101	Internal parameter error	No. 1	No	1	1	1
Er.102	Programmable logic configuration fault	No. 1	No	1	1	1
Er.104	Programmable logic interrupted	No. 1	No	1	1	1
Er.105	Internal program error	No. 1	No	1	1	1
Er.108	Parameter storage fault	No. 1	No	1	1	1
Er.120	Product model mismatch	No. 1	No	1	1	1
Er.122	Product mismatch in absolute position mode	No. 1	No	1	1	1
Er.136	Data check error or no parameter saved in the motor ROM	No. 1	No	1	1	1
Er.201	Overcurrent 2	No. 1	No	1	1	0
Er.208	FPGA system sampling operation timeout	No. 1	No	1	1	0
Er.210	Output short-circuited to ground	No. 1	No	1	1	0
Er.220	Phase sequence incorrect	No. 1	No	1	1	0
Er.234	Runaway	No. 1	No	1	1	0
Er.735	Encoder multi-turn counting overflow	No. 1	No	1	1	1
Er.740	Encoder interference	No. 1	No	1	1	1
Er.A33	Encoder data error	No. 1	No	0	1	0
Er.A34	Encoder echo check error	No. 1	No	0	1	0

Note

The value "1" indicates active and "0" indicates inactive. Values "1" and "0" do not indicate high and low levels of the DO.

- No. 1 resettable faults

Table 4–2 No. 1 resettable fault list

Display	Fault Name	Fault Type	Resettable	Code Output		
				AL3	AL2	AL1
Er.130	Different DIs assigned with the same function	No. 1	Yes	1	1	1
Er.207	D/Q-axis current overflow	No. 1	Yes	1	1	0
Er.400	Main circuit overvoltage	No. 1	Yes	0	1	1
Er.410	Main circuit undervoltage	No. 1	Yes	0	1	1
Er.500	Overspeed	No. 1	Yes	0	1	0
Er.602	Angle auto-tuning failure	No. 1	Yes	0	0	0
Er.605	Bootstrap speed too fast	No. 1	Yes	0	0	0
Er.610	Drive overload	No. 1	Yes	0	0	0
Er.620	Motor overload	No. 1	Yes	0	0	0
Er.630	Motor stall over-temperature protection	No. 1	Yes	0	0	0
Er.640	Junction temperature too high	No. 1	Yes	0	0	0
Er.650	Heatsink over-temperature	No. 1	Yes	0	0	0
Er.B00	Position deviation too large	No. 1	Yes	1	0	0

- No. 2 resettable faults

Table 4–3 No. 2 resettable fault list

Display	Fault Name	Fault Type	Resettable	Code Output		
				AL3	AL2	AL1
Er.121	S-ON command invalid	No. 2	Yes	1	1	1
Er.420	Main circuit phase loss	No. 2	Yes	0	1	1
Er.430	Control circuit undervoltage	No. 2	Yes	0	1	1
Er.510	Pulse output overspeed	No. 2	Yes	0	1	0
Er.600	Inertia auto-tuning failure	No. 2	Yes	0	0	0
Er.660	Vibration too strong	No. 2	Yes	0	0	0
Er.661	Gain values too low	No. 2	Yes	0	0	0
Er.666	Runaway	No. 2	Yes	0	0	0
Er.668	Homing method improper	No. 2	Yes	0	0	0
Er.731	Encoder battery failure	No. 2	Yes	1	1	1
Er.733	Encoder multi-turn counting error	No. 2	Yes	1	1	1
Er.B01	Pulse input error	No. 2	Yes	1	0	0
Er.B03	Electronic gear ratio beyond the limit	No. 2	Yes	1	0	0
Er.D03	CAN communication interrupted	No. 2	Yes	1	0	1

- No. 3 resettable warnings

Table 4–4 No. 3 resettable warning list

Display	Name	Fault Type	Resettable	Code Output		
				AL3	AL2	AL1
Er.110	Frequency-division pulse output setting error	No. 3	Yes	1	1	1
Er.601	Homing timeout	No. 3	Yes	0	0	0

Display	Name	Fault Type	Resettable	Code Output		
				AL3	AL2	AL1
Er.730	Encoder battery warning	No. 3	Yes	1	1	1
Er.900	DI emergency braking	No. 3	Yes	1	1	1
Er.909	Motor overload	No. 3	Yes	1	1	0
Er.920	Regenerative resistor overload	No. 3	Yes	1	0	1
Er.922	Resistance of external regenerative resistor too small	No. 3	Yes	1	0	1
Er.924	Regenerative transistor over-temperature	No. 3	Yes	1	0	1
Er.939	The motor power cables are disconnected.	No. 3	Yes	1	0	0
Er.941	Parameter modifications activated at next power-on	No. 3	Yes	0	1	1
Er.942	Parameters saved frequently	No. 3	Yes	0	1	1
Er.950	Forward overtravel warning	No. 3	Yes	0	0	0
Er.952	Reverse overtravel warning	No. 3	Yes	0	0	0
Er.980	An encoder fault occurs.	No. 3	Yes	0	0	1
Er.990	Power input phase loss	No. 3	Yes	0	0	1
Er.994	CAN address conflict	No. 3	Yes	0	0	1
Er.A40	Parameter auto-tuning failure	No. 3	Yes	0	1	0

4.2.2 Common Solutions to Faults

- Er.101: Internal parameter error
  Cause:
  - The total number of parameters changes, which generally occurs after software update.
  - Values of parameters in groups H02 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.	Check whether the control circuit (L1C, L2C) is in the process of power-off or instantaneous power failure occurs.	Restore system parameters to default settings (H02-31 = 1) and write parameters again.
	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)	Increase the power supply capacity or replace with a power supply of higher capacity. Restore system parameters to default settings (H02-31 = 1), and write parameters again.
2. Instantaneous power failure occurs during parameter saving.	Check whether instantaneous power failure occurs when saving parameters.	Power on the system again, restore system parameters to default settings (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.	• Change the write mode and write parameters again. • The servo drive is faulty, replace the servo drive.
4. The software is updated.	Check whether the software is updated.	Reset the servo drive model and servo motor model, and restore system parameters to default settings (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.

- Er.102: Programmable logic configuration fault
  Cause:
  - The software versions of the FPGA the MCU do not match.
  - The FPGA- or MCU-related hardware is damaged, leading to communication failure between MCU and FPGA.

Cause	Confirming Method	Solution
1. The software versions of the FPGA the MCU do not match.	View the MCU software version (H01-00) and FPGA software version (H01-01) through the keypad or the software tool. Check whether the non-zero bits in the most significant bits of these two versions are consistent.	Contact Inovance for technical support. Update the FPGA or MCU software to make them match.
2. The FPGA is faulty.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- Er.104: Programmable logic interrupted
  To distinguish the fault cause, the servo drive displays different internal fault codes under the same external fault code. You can view these internal fault codes in H0B-45.

Cause:

Access to MCU or FPGA times out.

Cause	Confirming Method	Solution
1. The FPGA is faulty (Er.104).	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.
2. The handshaking between FPGA and MCU is abnormal (Er.100).		
3. Internal operation of the servo drive times out (Er.940).		

- Er.105: Internal program error

  Cause:

  - The total number of parameters read/written from the EEPROM is abnormal.
  - The parameter value range is abnormal, which generally occurs after software update.

Cause	Confirming Method	Solution
1. An EEPROM fault occurs.	Check the fault cause according to the method described in Er.101	Restore system parameters to default values (H02-31 = 1) and restart the servo drive.
2. The servo drive is faulty.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- Er.108: Parameter storage fault

  Cause:

  - Parameter values cannot be written to EEPROM.
  - Parameter values cannot be read from EEPROM.

Cause	Confirming Method	Solution
1. An error occurs when writing parameters to EEPROM.	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.
2. An error occurs when reading data from EEPROM.		

- Er.120: Product model mismatch

  Cause:

  The rated current of the motor is higher than that of the servo drive.

Cause	Confirming Method	Solution
1. The product (motor or servo drive) code does not exist.	Check the servo drive and servo motor nameplates to ensure that the equipment used is SV660P series servo drive and 23-bit servo motor. Meanwhile, check whether H00-00 (Motor code) is set to 14101.	If the motor code is unknown, set H00-00 to 14101 when using SV660P series servo drive and 23-bit servo motor.
	Check the servo drive code (H01-02) to see whether this servo drive code exists.	If the servo drive model is unknown, set the servo drive model correctly according to the nameplate.
2. The power rating of the motor does not match that of the servo drive.	Check whether the servo drive code (H01-02) matches the serial-type motor code (H00-05).	Replace the unmatched products.

- Er.121: S-ON command invalid

  Cause:

A redundant S-ON signal is sent when some auxiliary functions are used.

Cause	Confirming Method	Solution
1. The external S-ON signal is active when servo drive is enabled internally.	Check whether the following auxiliary functions are used: Check whether auxiliary functions (H0D-02, H0D-03, and H0D-12) are used and whether FunIN.1 (S-ON signal) is active.	Deactivate the DI assigned with FunIN.1 (both hardware DI and virtual DI).

- Er.122: Product mismatch in absolute position mode

  Cause:

  The motor does not match in the absolute position mode or the motor code is set improperly.

Cause	Confirming Method	Solution
1. The motor does not match or the motor code is set improperly in the absolute position mode.	• Check the motor nameplate to see whether the motor is configured with a multi-turn absolute encoder. • Check whether H00-00 (Motor code) is set properly.	Reset H00-00 (Motor code) according to the motor nameplate or replace with a matching motor.

- Er.130: Different DIs assigned with the same function

  Cause:

  - Different DIs, including hardware DIs and virtual DIs, are assigned with the same function.
  - The DI function No. exceeds the maximum setting number allowed for DI functions.

Cause	Confirming Method	Solution
1. The same function is assigned to different DIs.	Check whether parameters in groups H03 (H03-02, H03-04...H03-20) and H17 (H17-00, H17-02...H17-30) are assigned with the same non-zero DI function No..	Assign different DI function numbers to parameters in groups H03 or H17, and then restart the control circuit to activate the assignment, or switch off the S-ON signal and send a "RESET" signal to activate the assignment.
2. The DI function No. exceeds the maximum setting number allowed for DI functions.	Check whether the MCU program is updated.	Restore system parameters to default values (H02-31 = 1) and restart the servo drive.
3. Parameters are imported through the software: The same DI function is assigned to or canceled by different DIs.	Check whether a DI function is assigned to or canceled by different DIs when importing parameters through the software. Modify the value of H03-10 through the software, and then set H03-02.	

- Er.136: Data check error or no parameter saved in the motor ROM

  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 servo drive model does not match the servo motor model.	View the servo drive and servo motor nameplates to check whether the devices used are SV660P series servo drive and servo motor equipped with 23-bit absolute encoder.	Replace with a mutually-matching servo drive and servo motor and power on again. When using SV660P series servo drive and servo motor equipped with 23-bit absolute encoder, set H00-00 (Motor code) to 14101.
2. A parameter check error occurs or no parameter is saved in the serial encoder ROM.	• Check whether the encoder cable provided by Inovance is used. For cable specifications, see SV660P Series Servo Drive Hardware Guide. The cable must be connected securely without scratching, breaking or poor contact on both ends. • 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 SV660P Series Servo Drive Hardware Guide.	• Use the encoder cable provided by Inovance. Ensure motor terminals are connected securely and servo drive screws are tightened properly. Use a new encoder cable if necessary. • Route encoder cables and power cables (UVW) through different routes.
3. The servo drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

- Er.201: Overcurrent 2

  Cause:

  Hardware overcurrent is detected.

Cause	Confirming Method	Solution
1. References are input simultaneously at the servo drive startup or the reference input is too early.	Check whether a reference is input before the keypad displays "Rdy".	Reference time sequence: Wait for the keypad to display "Rdy", and then switch on the S-ON signal, finally input the reference. Incorporate the reference filter time constant or increase the acceleration/ deceleration time if allowed.
2. The regenerative resistor is of small resistance or short-circuited.	• If the built-in regenerative resistor is used (H02-25 = 0), check whether terminals P ⊕ and D are jumpered. If yes, measure the resistance between terminals C and D. • If an external regenerative resistor is used (H02-25 = 1 or 2), measure the resistance of the external regenerative resistor connected between terminals P⊕ and C. • For details, see section "Specifications of the regenerative resistor" in SV660P Series Servo Drive Selection Guide.	• If the built-in regenerative resistor is used and the resistance is 0, change to use the external regenerative resistor (H02-25 = 1 or 2) and remove the jumper between terminals P ⊕ and D. Select an external regenerative resistor of the same resistance and equal or higher power than the built-in one. • If the resistance of the external regenerative resistor used is lower than H02-21, replace with a new regenerative resistor and connect it between terminals P⊕ and C. For details, see section "Specifications of the regenerative resistor" in SV660P Series Servo Drive Selection Guide. • Set H02-26 (Power of external regenerative resistor) and H02-27 (Resistance of external regenerative resistor) to values consistent with the specifications of the external regenerative resistor used.
3. The motor cables are in poor contact.	Check whether the servo drive power cables and motor cables on the U, V, and W side of the servo drive are loose.	Tighten the cables that are loose or disconnected.
4. Motor cables are grounded.	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 in case of poor insulation.
5. Motor UVW cables are short-circuited.	Disconnect the motor cables and check whether short circuit occurs among U, V, and W phases and whether burrs exist in the wiring.	Connect the motor cables correctly.
6. The motor is damaged due to over-temperature.	Disconnect the motor cables and measure whether the resistance among U, V, and W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.
7. Gains are set improperly and the motor oscillates.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	Perform gain auto-tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.

Cause	Confirming Method	Solution
8. The encoder cable is wired incorrectly, aging, corroded, or connected loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0B-10 (Electrical angle) changes as the motor shaft rotates.	Re-solder, tighten or replace the encoder cable.
9. The servo drive is faulty.	Disconnect the motor cable but the fault persists after the servo drive is powered off and on again.	Replace the servo drive.

- Er.207: D/Q-axis current overflow

  Cause:

  - Abnormal current feedback leads to overflow of the internal register.
  - Abnormal encoder feedback leads to an internal register fault.

Cause	Confirming Method	Solution
1. Axis-D/Q current overflows.	If the fault persists after the servo drive is powered off and on several times, the servo drive is faulty.	Replace the servo drive.

- Er.208: FPGA system sampling operation timeout

  Cause:

  Find the fault cause through the internal fault code H0B-45.

Cause	Confirming Method	Solution
1. The MCU communication times out.	H0B-45 (Internal fault code) = 1208: The internal integrated circuit is damaged.	Replace the servo drive.
2. The encoder communication times out.	H0B-45 (Internal fault code) = 2208: • The encoder cable is connected improperly. • The encoder cable is connected loosely. • The encoder cable is too long. • The encoder communication suffers from interference. • The encoder is faulty.	• It is recommended to use the cables provided by Inovance. For use of customized cables, check whether the customized cable complies with specifications and whether it is a shielded twisted pair cable. • Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts. • Contact the manufacturer. • Route the motor cables and encoder cables through different routes. Ensure the servo motor and servo drive are grounded properly. • Replace the servo motor.

Cause	Confirming Method	Solution
3. The current sampling times out.	H0B-45 (Internal fault code) = 3208: • Check whether ambient devices are generating disturbances and whether multiple disturbance sources such as variable-frequency devices are present inside the cabinet. • The internal current sampling integrated circuit is damaged.	• Route the high-current cables and low-current cables through different routes. • Replace the servo drive.
4. The FPGA operation times out.	H0B-45 (Internal fault code) = 0208: Determine the fault cause according to preceding causes 1, 2, and 3.	See the solutions for causes 1, 2, and 3.

- Er.210: Output short-circuited to ground
  Cause:

  An abnormal motor phase current or bus voltage is detected during auto-inspection upon power-on.

  - The DC bus voltage exceeds the discharge threshold.
  - Phase-U current of servo drives in sizes C, D, and E exceeds 1/4 of the setpoint of H01-07.
  - Overcurrent occurs on phase-P and phase-N of servo drives in sizes A and B.

Cause	Confirming Method	Solution
1. The servo drive power cables (UVW) 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.
4. The motor speed is too high during phase-to-ground detection.	Check whether the motor is in the generating status during power-on.	Reduce the motor speed.

- Er.220: Phase sequence incorrect
  Cause:

  The UVW phase sequence of the servo drive does not match that of the motor, which is detected during angle auto-tuning.

Cause	Confirming Method	Solution
The UVW phase sequence of the servo drive does not match that of the motor.	Er.220 is reported again during angle auto-tuning though the servo drive is powered off and on several times.	Perform wiring and angle auto-tuning again.

- Er.234: Runaway
  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 UVW phase sequence is incorrect.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables in the correct phase sequence.
2. The interference signal causes an error in the initial phase detection of the motor rotor upon power-on.	The UVW phase sequence is correct. But Er.234 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 the devices used are SV660P series servo drive and servo motor equipped with 23-bit absolute encoder.	Replace with a mutually-matching servo drive and servo motor. For use of SV660P series servo drive and 23-bit servo motor, set H00-00 to 14101. Check the motor model, encoder type, and encoder cable connection again.
4. The encoder cable is wired incorrectly, aging, corroded, or connected loosely.	• Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. • Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0B-10 (Electrical angle) changes as the motor shaft rotates.	Re-solder, tighten or replace the encoder cable.
5. The gravity load in vertical axis applications is too heavy.	Check whether the load of the vertical axis is too large. Adjust brake parameters H02-09...H02-12 and observe whether the fault can be cleared.	Lighten the load of the vertical axis, increase the stiffness level, or hide this fault without affecting the safety performance and normal use.

Caution

In applications where the motor drives a vertical axis or is driven by the load, set H0A-12 to 0 to hide the runaway fault.

- Er.400: Main circuit overvoltage

  Cause:

  The DC bus voltage between terminals P⊕ and NΘ 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.	Measure whether the input voltage on the main circuit 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.
3. The regenerative resistor fails.	• If the built-in regenerative resistor is used (H02-25 = 0), check whether terminals P ⊕ and D are jumpered. If yes, measure the resistance between terminals C and D. • If an external regenerative resistor is used (H02-25 = 1 or 2), measure the resistance of the external regenerative resistor connected between terminals P⊕ and C. • For specifications of the regenerative resistor, see SV660P Series Servo Drive Selection Guide.	• If the resistance is "∞" (infinite), the regenerative resistor is disconnected internally. • If a built-in regenerative resistor is used, change to use an external regenerative resistor (H02-25 = 1 or 2) and remove the jumper between terminals P ⊕ and D. Select an external regenerative resistor of the same resistance and equal or higher power than the built-in one. • If an external regenerative resistor is used, replace it with a new one and connect the new one between terminals P⊕ and C. • Set H02-26 (Power of external regenerative resistor) and H02-27 (Resistance of external regenerative resistor) to values consistent with the specifications of the external regenerative resistor used.
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. Compare the measured value with the recommended value.	Connect a new external regenerative resistor with recommended resistance between terminals P⊕ and C. Set H02-26 (Power of external regenerative resistor) and H02-27 (Resistance of external regenerative resistor) to values consistent with 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 terminals P ⊕ and NΘ exceeds the fault 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.

Cause	Confirming Method	Solution
6. The bus voltage sampling value deviates greatly from the measured value.	Check whether H0B-26 (Bus voltage) is within the following range: • 220 V servo drive: H0B-26 ＞ 420 V • 380 V servo drive: H0B-26 > 760 V Check whether the DC bus voltage detected between terminals P⊕ and NΘ is close to the value of 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.

- Er.410: Main circuit undervoltage

  Cause:

  The DC bus voltage is lower than the undervoltage threshold.

  - 220 V servo drive: Normal value: 310 V Overvoltage threshold: 200 V
  - 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 input power supply. Measure whether the input voltages of the main circuit on the non-drive side and the drive side 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) • 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.	Increase the capacity of the power supply. For details, see SV660P Series Servo Drive Selection Guide.
2. Instantaneous power failure occurs.		
3. The voltage of the power supply 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 power input phase loss protection (H0A-00) is disabled.	Replace the cables and connect the main circuit cables correctly. Single-phase: L1, L2 Three-phase: L1, L2, L3/R, S, T
5. The servo drive is faulty.	Check whether H0B-26 (Bus voltage) is within the following range: • 220 V servo drive: H0B-26 ＜ 200 V • 380 V servo drive: H0B-26 < 380 V The fault persists after the main circuit is powered off and on several times.	Replace the servo drive.

- Er.430: Control circuit undervoltage

  Cause:

- 220 V servo drive: Normal value: 310 V Overvoltage threshold: 190 V
- 380 V servo drive: Normal value: 540 V Overvoltage 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. Ensure the power supply is stable in case of power failure.
	Check whether the input voltage of the control circuit cable 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.	Increase the capacity of the power supply.
2. The control circuit cable is in poor contact.	Check whether control circuit cables are well connected and whether their voltages on the servo drive side (L1, L2, L3) are within the preceding range.	Re-connect or replace the cables.

- Er.500: Overspeed

  Cause:

  The actual speed of the motor exceeds the overspeed threshold.

Cause	Confirming Method	Solution
1. The UVW phase sequence of the motor cable is wrong.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables in the correct phase sequence.
2. H0A-08 (Overspeed threshold) is set improperly.	Check whether the overspeed threshold is lower than the maximum speed needed: Overspeed threshold = 1.2 x Maximum motor speed (H0A-08 = 0) Overspeed threshold = H0A-08 (H0A-08 ≠ 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. When the reference source is pulse references in the position control mode: Motor speed (RPM) = $\frac{\text{Input pulse frequency (Hz)}}{\text{Encoder resolution}}$ x Electronic gear ratio x 60 For SV660P series servo drives, the encoder resolution is 8388608 PPR.	• In the position control mode where the position reference source is pulse references, reduce the pulse reference frequency without affecting the positioning accuracy or decrease the electronic gear ratio if the motor speed allows. • In the speed control mode, view the values of the speed reference and speed limit (H06-06...H06-09) and confirm that both values are within the overpseed threshold. • In the torque control mode, set the speed limit to a value within the overspeed threshold. For speed limit in the torque control mode, see SV660P Series Servo Drive Function Guide.
4. The motor speed overshoots.	Check in the software tool whether the speed feedback exceeds the overspeed threshold.	Perform gain auto-tuning or adjust the operating conditions according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
5. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

- Er.510: Pulse output overspeed

  Cause:

  The output pulse frequency exceeds the frequency upper limit allowed by the hardware (2 MHz) when pulse output is used (H05-38 = 0 or 1).

Cause	Confirming Method	Solution
The output pulse frequency exceeds the frequency upper limit allowed by the hardware (2 MHz).	When H05-38 (Servo pulse output source) is set to 0 (Encoder frequency-division output), check whether the output pulse frequency corresponding to the motor speed upon fault event exceeds the limit. Output pulse frequency (Hz) = $\frac{\text{Motor speed (RPM)}}{60}$ x H05-17	Decrease the value of H05-17 (Encoder frequency-division pulses) to allow the output pulse frequency, within the speed range required by the machine, to drop below the frequency upper limit allowed by the hardware.
	The input pulse frequency exceeds 2 MHz or interference exists in the pulse input pins when H05-38 (Servo pulse output source) is set to 1 (Reference pulse synchronous output). • Low-speed pulse input pins: differential input terminals: PULSE+, PULSE-, SIGN+, SIGN-, maximum pulse frequency: 200 kpps • Open-collector input terminals: PULLHI, PULSE+, PULSE-, SIGN+, SIGN-, maximum pulse frequency: 200 kpps • High-speed pulse input pins: differential input terminals: HPULSE +, HPULSE-, HSIGN+, HSIGN-, maximum pulse frequency: 2 Mpps	Decrease the input pulse frequency to a value within the frequency upper limit allowed by hardware. **Note:** In this case, if you do not modify the electronic gear ratio, the motor speed will be reduced. If the input pulse frequency is high but is still within the frequency upper limit allowed by the hardware, take anti-interference measures (use STP cable for pulse input and set pin filter parameters H0A-24 or H0A-30). This is to prevent false warnings caused by interference pulses superimposed to actual pulse references.

- Er.600: Inertia auto-tuning failure
  Cause:
  - The vibration cannot be suppressed. You can set notch parameters (H09-12...H09-23) manually to suppress 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.
- Er.602: Angle auto-tuning failure
- Er.605: Bootstrap speed too fast
  Cause:

  The actual motor speed exceeds the rated speed during bootstrap charging of the servo drive.
- Er.610: Servo drive overload
  Cause:

  The accumulative heat of the servo drive reaches the fault threshold.
- Er.620: 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.	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 (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. The acceleration/ deceleration is too frequent or the load inertia is too large.	Calculate 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 in an individual operation cycle.
4. Gains are improper or the stiffness level is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust gain values again according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
5. The servo drive model or motor model is set improperly.	For SV660P series products, view the serial-type motor code in H00-05 and the servo drive model in H01-02.	Read the servo drive nameplate and set the servo drive model (H01-02) and motor model properly according to section "Servo Drive Model and Nameplate" in SV600P Series Servo Drive Selection Guide.
6. The motor stalls due to mechanical factors, resulting in overload during operation.	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.
7. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

Caution

You can clear the fault or restart the power supply 30s after overload occurs.

- Er.630: Motor stall over-temperature protection
  Cause:

  The actual motor speed is lower than 10 RPM but the torque reference reaches the limit, and such status lasts for the time defined by H0A-32.

Cause	Confirming Method	Solution
1. UVW 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 UVW cables or the encoder cables are disconnected.	Check the wiring.	Connect cables again according to the correct wiring diagram or replace the cables.
3. The motor stalls 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.

- Er.640: Junction temperature too high
  Cause:

  The temperatures of the IGBT and diodes reach the over-temperature threshold (H0A-38).

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 H0B-33 and view H0B-34) to check whether an overload fault/warning is reported (Er.610, Er.620, Er.630, Er.650, Er.909, Er.920, Er.922).	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.

- Er.650: 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 H0B-33 and view H0B-34) to check whether an overload fault/warning is reported (Er.610, Er.620, Er.630, Er.650, Er.909, Er.920, Er.922).	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.
6. The servo drive model is set incorrectly.	Check whether the value of H01-02 is consistent with the model shown on the nameplate. View the servo drive model (H01-02) and check whether the servo drive model is valid according to the SV660P Series Servo Drive Selection Guide.	If the servo drive code is invalid, set the servo drive code correctly according to the SV660P Series Servo Drive Selection Guide.

- Er.660 Vibration too strong
  Cause:

  The vibration is too strong or lasts for too long. The set resonance point will be cleared when Er.660 occurs.

  - Setting H08-58 to 1 hides warnings caused by excessively strong vibration.
  - Setting H08-58 to 2 hides warnings caused by excessively strong vibration and lasting vibration.

- Er.661: Gain values too low
  Cause:

  - The vibration cannot be suppressed. Enable vibration suppression manually to dampen the vibration.
  - Excessive overshoot occurs during positioning. Check whether the positioning threshold is too low. Increase the acceleration/deceleration time and reduce the response level.
  - The command suffers from noise. Modify the electronic gear ratio to improve the command resolution, or increase the command filter time constant in the "Parameter configuration" interface.
  - The current fluctuates. Check whether the current of the machine fluctuates periodically.

- 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.

- Er.666: Runaway
  Cause: A runaway fault occurs. You can hide this fault by setting H0A-02 to 1.
  - H09-26 (Response level) is set to an excessively high value, but the set inertia range is too large (while the actual inertia is low). In this case, vibration may occur due to mismatch.
  -
  - The acceleration/deceleration time is too short, leading to over-saturation.
  - The mechanical couplings are loose and the vibration frequency changes frequently.

- Er.668: Homing method improper
  Cause:

  The homing method does not match the set mode.

Cause	Confirming Method	Solution
1. The motor model does not match the homing method.	View the values of H00-00 (Motor code), H02-01 (Absolute system selection), and H05-69 (Auxiliary homing function). If H05-69 is set to 1 or 3 and H00-00 is set to a value other than 14101 or H02-01 is set to a value other than 0, Er.668 will be reported.	Change the value of H00-00 to 14101 and H02-01 to 0. If other types of fault occurs, the homing method may not be supported.
2. Single-turn homing is configured with the homing trigger mode.	View the values of H05-30 (Homing enable selection), H05-31 (Homing method), and H05-69 (Auxiliary homing function). If H05-69 is set to 1, check whether H05-31 is set to a value between 14...16 and whether the setpoint of H05-30 represents electrical homing.	Set H05-30 to a value representing electrical homing. H05-31 represents the homing method corresponding to single-turn homing.
3. Homing is configured with the single-turn homing mode.	Check whether H05-31 is set to a value between 0...13 and whether H05-69 is set to 3. If H05-69 is set to 3, check whether the homing method defined by H05-31 takes Z signal as the home.	Change the homing method defined by H05-31.

- Er.731: Encoder battery failure
  Cause:

  The voltage of the absolute encoder battery is lower than 3.0 V.

Cause	Confirming Method	Solution
1. The battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set H0D-20 (Absolute encoder reset selection) to 1 (No operation) to clear the fault.
2. The encoder battery voltage is too low.	Measure the battery voltage.	Use a new battery with the matching voltage.

- Er.733: Encoder multi-turn counting error
  Cause:

  An encoder multi-turn counting error occurs.

Cause	Confirming Method	Solution
1. The encoder is faulty.	Set H0D-20 (Absolute encoder reset function) to 1 (Reset the fault) to clear the fault, but Er.733 persists after the servo drive is powered off and on again.	Replace the motor.

- Er.735: Encoder multi-turn counting overflow

  The servo drive detects that the multi-turn counting value of the encoder overflows.

Cause	Confirming Method	Solution
1. Encoder multi-turn counting overflow is detected when H02-01 (Absolute system selection) is set to 1 (Absolute position linear mode).	-	Set H0D-20 (Absolute encoder reset selection) to 1 (Reset the fault) to clear the fault, and then perform a power cycling on the servo drive.

- Er.740: Encoder interference

  Cause:

  The encoder Z signal suffers from interference, resulting in a significant change of the electrical angle corresponding to Z signal.

Cause	Confirming Method	Solution
1. The encoder is wired improperly.	Check the wiring of the encoder.	Connect the encoder cables according to the correct wiring diagram.
2. The encoder cable is connected loosely.	Check whether vibration on site is too strong, which loosens the encoder cable and even damages the encoder.	Re-connect encoder cables and ensure encoder terminals are connected securely.

Cause	Confirming Method	Solution
3. The encoder Z signal suffers from interference.	Check the cable layout on site: • Check whether ambient devices are generating disturbance and whether multiple disturbance sources such as variable-frequency devices are present inside the cabinet. • Make the servo drive stay in "rdy" status and rotate the motor shaft counterclockwise (CCW) manually. Then observe whether the value of H0B-10 (Electrical angle) increases/ decreases smoothly. Turning one circle corresponds to five 0-360° (for Z series motor). For X series motors, turning one circle corresponds to four 0-360°. • If H0B-10 changes abruptly when you rotate the motor shaft, the encoder is faulty. • If no warning is reported during rotation but the servo drive reports a warning during operation, disturbance may be present.	• It is recommended to use the cables provided by Inovance. • If a customized cable is used, check whether this cable is a shielded twisted pair cable that complies with the specifications. • Route the motor cables and encoder cables through different routes. Ensure the servo motor and servo drive are grounded properly. • Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts.
4. The encoder is faulty.	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 position, perform several times of power cycling and observe the change of the electrical angle (H0B-10) upon each power cycling, which 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.

- Er.A33: Encoder data error

  Cause:

  Encoder parameters are abnormal.

Cause	Confirming Method	Solution
1. The serial 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 serial 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.

- Er.B00: Position deviation too large

  Cause:

  The position deviation in the position control mode is larger than the setpoint of H0A-10 (Threshold of excessive position deviation).

Cause	Confirming Method	Solution
1. UVW 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 UVW cables or the encoder cables are disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables must be connected in the correct sequence at both ends. Replace with new cables if necessary and ensure cables are connected properly.
3. The motor stalls 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.
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	Perform gain auto-tuning or manual gain tuning according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
5. The input pulse frequency is high.	When the position reference source is pulse reference, check whether the input pulse frequency is too high. The acceleration/deceleration time is too short or 0.	Reduce the position reference frequency or the electronic gear ratio. When the host controller is used to output position pulses, you can set the acceleration time in the host controller. If the acceleration/deceleration time cannot be set in the host controller, increase the values of H05-04 and H05-06.
6. The value of H0A-10 (Threshold of excessive position deviation) is too low against the operating conditions.	Check whether the value of H0A-10 is too low.	Increase the value of H0A-10.
7. The servo drive/motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position references, position feedback, speed references, and torque references.	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

- Er.B01: Pulse input error

  Cause:

  The pulse input frequency is higher than H0A-09 (Maximum position pulse frequency).

Cause	Confirming Method	Solution
1. The pulse input frequency is higher than H0A-09 (Maximum position pulse frequency).	Check whether H0A-09 is lower than the maximum pulse input frequency required by normal operation.	Reset H0A-09 according to the maximum position pulse frequency needed by normal operations. If the pulse output frequency of the host controller is higher than 4 MHz, decrease it.
2. The input pulse suffers from interference.	Check in the software tool whether the position reference increases abruptly or the value of H0B-13 (Position reference counter) exceeds the number of pulses outputted by host controller. Then, check the grounding condition of cables.	First, use a shielded twisted pair for pulse input and separate pulse input cables from servo drive power cables. Next, when differential input is used in low-speed pulse input terminals (H05-01 = 0), connect the "GND" of the host controller to the "GND" of servo drive; when open-collector input is used, connect the "GND" of the host controller to the "COM" of the servo drive. When high-speed pulse input terminals (H05-01 = 1) are used, only differential input is available, in this case, connect the "GND" of the host controller to the "GND" of the servo drive. Finally, increase the filter time of pulse input terminal pins in H0A-24 or H0A-30 depending on the hardware input terminals used.

- Er.B03: Electronic gear ratio beyond the limit
  Cause:

  The electronic gear ratio exceeds the limit: (0.001 x Encoder resolution/10000, 4000 x Encoder resolution/10000).

Cause	Confirming Method	Solution
The set electronic gear ratio exceeds the preceding limit.	If H05-02 (Pulses per revolution) is set to 0, check the ratios of H05-07 to H05-09 and H05-11 to H05-13. If the setpoint of H05-02 is higher than 0, check the ratios of the encoder resolution to H05-02, H05-07 to H05-09, and H05-11 to H05-13.	Set the ratios of the encoder resolution to H05-02, H05-07 to H05-09, and H05-11 to H05-13 according to the preceding range.
Parameters are modified in a wrong sequence.	Electronic gear ratio-related parameters, namely H05-02, H05-07/H05-09, and H05-11/H05-13, are modified in a wrong sequence, causing Er.B03 to occur during calculating the electronic gear ratio.	Use the fault reset function or perform a power cycling on the servo drive.

- Er.D03: CAN communication interrupted
  Cause:

  The CAN communication times out.

Cause	Confirming Method	Solution
The CAN communication is interrupted due to disconnection of the slave.	Check the status of the CAN communication card indicator of the master PLC. The ERR indicator of the master PLC blinks at a frequency of 1 Hz and the ERR indicators of some slave PLCs keep on (When using PLC software tool, you can monitor D78xx in the component monitoring table of the master. "xx" indicates the station no. in decimal. If corresponding D78xx of some configured stations is 5, it indicates a fault occurs on the slave.)	Check the connection of communication cables between the master and the slave whose ERR indicator keeps on. Check the communication baud rate (H0C-08) of the slave whose ERR indicator keeps on, and adjust the slave baud rate to the same value as that of the master.
The CAN communication is interrupted due to disconnection of the master.	Check the status of the CAN communication card indicator of the master PLC. The ERR indicators of all the slave PLCs keep on. (When using PLC software tool, you can monitor D78xx in the component monitoring table of the master. "xx" indicates the station no. in decimal. If corresponding D78xx of all the configured stations is 5, it indicates a fault occurs on the master.)	Check the cable connections of the master.

4.2.3 Solutions to Common Warnings

- Er.110: Frequency-division pulse output setting error
  Cause:

  The set encoder frequency-division pulses does not match the threshold defined by the encoder specification when encoder frequency-division output is used (H05-38 = 0).

Cause	Confirming Method	Solution
The number of encoder frequency-division pulses is outside the specified range.	For incremental encoders, the number of frequency-division pulses cannot exceed the encoder resolution. The resolution of a 23-bit serial incremental encoder is 8388608 PPR.	Reset H05-17 (Encoder frequency-division pulses) according to the specification.

- Er.601: Homing failure
  Cause:

  The home is not found within the time defined by H05-35 when homing is activated (H05-30 = 1 to 5).

Cause	Confirming Method	Solution
1. The home switch fails.	• There is only high-speed searching but no low-speed searching during homing. • After high-speed searching, the servo drive keeps low-speed searching in the reverse direction.	• If a hardware DI is used, check whether FunIN.31 (HomeSwitch) is set in parameter group H03 and whether the DI is connected properly. Change the DI logic manually and check the value of H0B-03 to see whether the DI level change is received by the servo drive. If not, the DI switch is wired incorrectly. If yes, an error occurs during homing. For details on the homing operation, see section "Homing Function" in SV660P Series Servo Drive Function Guide. • If a virtual DI (VDI) is used, check whether the VDI is used correctly.
2. The homing time limit is too short.	Check whether the value of H05-35 (Time limit for homing) is too small.	Increase the value of H05-35.
3. The speed in high-speed searching for the home switch signal is too low.	Check the distance between the start position of homing and the home switch. Then check whether the setpoint of H05-32 (Speed in high-speed searching for the home switch signal) is too small, resulting in a long homing process.	Increase the value of H05-32.

- Er.730: Encoder battery warning

  Cause:

  The battery voltage of the absolute encoder is lower than 3.0 V.

Cause	Confirming Method	Solution
1. The encoder battery voltage is lower than 3.0 V.	Measure the battery voltage.	Use a new battery with the matching voltage.

- Er.900: DI emergency braking

  Cause:

  The logic of the DI (hardware DI or virtual DI terminal) assigned with FunIN.34 (EmergencyStop) is active.

Cause	Confirming Method	Solution
FunIN.34: Emergency stop, 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.

- Er.909: Motor overload warning

  Cause:

  The accumulative heat of the 60Z series motor (200 W and 400 W) reaches the warning 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, servo motor and the encoder according to the correct wiring diagram.	• Connect cables based on the correct wiring diagram. • It is recommended to use the cables provided by Inovance. • When customized cables are used, prepare and connect the cables according to the wiring instructions.
2. The load is too heavy and the effective torque output 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) 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. The 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. Gains are improper or the stiffness level is too high.	Check whether the motor vibrates and generates an abnormal noise during operation.	Perform gain auto-tuning again according to Chapter "Adjustment" in SV660P Series Servo Drive Function Guide.
5. The servo drive model or motor model is set improperly.	For SV660P series products, view the serial-type motor code in H00-05 and the servo drive code in H01-02.	View the servo drive nameplate and set the servo drive model (H01-02) and the motor model to proper values to make them match (see SV660P Series Servo Drive Selection Guide for the matching relation).
6. Locked-rotor occurs due to mechanical factors, resulting in overload during operation.	Check the reference and 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 value of the reference is not 0 or is very large but the motor speed is 0 in the corresponding mode.	Rectify 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.

- Er.920: Regenerative resistor overload

  Cause:

  The accumulative heat of the regenerative resistor exceeds the set value.

Cause	Confirming Method	Solution
1. The external regenerative resistor is connected improperly, disconnected or loosened.	Remove the external regenerative resistor and measure whether its resistance is "∞" (infinite).	Replace with a new external regenerative resistor. If the resistance measured is the same as the nominal value, connect the regenerative resistor between terminals P⊕ and C.
	Measure whether resistance between terminals P⊕ and C is "∞" (infinite).	Connect the external regenerative resistor between terminals P⊕ and C with a new cable.
2. The jumper between 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.
3. H02-25 (Regenerative resistor type) is set improperly when an external regenerative resistor is used.	View the setpoint of H02-25.	Set H02-25 correctly. • H02-25 = 1 (external regenerative resistor, natural cooling) • H02-25 = 2 (external regenerative resistor, forced-air cooling)
4. The resistance of the external regenerative resistor used is too large.	Measure the resistance of the external regenerative resistor connected between terminals P⊕ and C, and compare the resistance measured with the value described in section "Specifications of the Regenerative Resistor" in SV660P Series Servo Drive Selection Guide to check whether the resistance is too large.	Select a proper regenerative resistor according to section "Specifications of the Regenerative Resistor" in SV660P Series Servo Drive Selection Guide.
5. The setpoint of H02-27 (Resistance of external regenerative resistor) is larger than resistance of the external regenerative resistor used.	Check whether the value of H02-27 is larger than the resistance of the external regenerative resistor connected between terminals P⊕ and C.	Set H02-27 according to the resistance of the external regenerative resistor used.
6. The input voltage of the main circuit exceeds the specified range.	Check whether the input voltage of the main circuit on the servo 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.

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 SV660P Series Servo Drive Function Guide or calculate the total mechanical inertia according to 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 cyclic deceleration interval if allowed.
8. The motor speed is excessively high and the deceleration process 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.

- Er.922: Resistance of the external regenerative resistor too small
  Cause:

  The value of H02-27 (Resistance of external regenerative resistor) is lower than H02-21 (Permissible minimum resistance of regenerative resistor).

Cause	Confirming Method	Solution
When an external regenerative resistor is used (H02-25 = 1 or 2), the resistance of this resistor is lower than the minimum resistance allowed by the servo drive.	Measure the resistance of the external regenerative resistor connected between terminals P⊕ and C to check whether it is smaller than the value of H02-21 (Permissible minimum resistance of regenerative resistor).	• If yes, replace with an external regenerative resistor that matches the servo drive, and connect this resistor between terminals P ⊕ and C. If not, set H02-27 to a value consistent with the resistance of this resistor.

- Er.924: Braking transistor over-temperature
  Cause:

  The estimated temperature of the braking transistor is higher than H0A-38 (Maximum protection threshold).

- Er.939: Motor power cable disconnected
  Cause:

  The actual phase current of the motor is lower than 10% of the rated current. The actual motor speed is low, but the value of the internal torque reference is high.

Cause	Confirming Method	Solution
Motor power cables are disconnected.	Check whether the difference between H0B-24 (Phase current effective value) and H0B-02 (Internal torque reference) is above 500% and whether H0B-00 (Actual motor speed) is lower than 25% of the rated motor speed.	Re-connect the motor power cables or replace with new cables if necessary.

- Er.941: Parameter modifications activated at next power-on

  Cause:

  Modifications of some parameters take effect at next power-on. If these parameters are modified, power off and on the servo drive again.

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.

- Er.942: Parameter saved frequently

  Cause:

  The number of parameters modified at a time exceeds 200.

Cause	Confirming Method	Solution
Too many parameters are modified and saved to EEPROM (H0C-13 = 1) at a brief interval.	Check whether the host controller executes parameter modifications at a brief interval.	Check the operating mode. For parameters that need not be saved to EEPROM, set H0C-13 to 0.

- Er.950: 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 certain DI in group H03 is assigned with FunIN.14. Check whether the logic of DI corresponding to the bit of H0B-03 (Monitored DI status) is active.	Check the operating mode. On the prerequisite of ensuring safety, send a reverse run command or rotate the motor to deactivate the logic of DI assigned with FunIN.14.
2. The servo drive position feedback reaches the positive software position limit.	Check whether the position feedback (H0B-17) is close to the value of H0A-41. Check whether the software position limit is set in H0A-40.	Ensure the servo drive references are proper, allowing the load travel range to be within the software position limit range.

- Er.952: 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 FunIN.15 is set to a DI through parameters in group H03. Check whether the logic of DI corresponding to the bit of H0B-03 (Monitored DI status) is active.	Check the operating 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 (H0B-17) is close to the value of H0A-43. Check whether the software position limit is set in H0A-40.	Ensure the servo drive references are proper, allowing the load travel range to be within the software position limit range.

- Er.980: Encoder fault
  Cause:

  An encoder algorithm error occurs.

Cause	Confirming Method	Solution
The encoder is faulty.	If the fault persists after the servo drive is powered off and on several times, the encoder is faulty.	Replace the servo motor.

- Er.990: Power input phase loss
  Cause:

  A three-phase servo drive below 1 kW is allowed to run under a single-phase power supply, but H0A-00 (Power input phase loss fault/warning selection) is set to 1 (Enabled).

Cause	Confirming Method	Solution
When H0A-00 (Power input phase loss fault/warning selection) is set to 1 (Enable phase loss fault and warning), a warning will be reported if a three-phase servo drive (H01-02 = 5) of 0.75 kW is connected to a single-phase power supply, despite that this servo drive allows single-phase power input.	Check whether the three-phase servo drive is allowed to run under a single-phase power supply.	If the warning persists when a three-phase servo drive is connected to a three-phase power supply, handle this warning as described in Er.420 (Main circuit phase loss). If the warning persists when a three-phase servo drive that allows single-phase power input is connected to a single-phase power supply, set H0A-00 (Power input phase loss fault/warning selection) to 0 (Enable phase loss fault and inhibit phase loss warning).

- Er.994: CAN address conflict

Cause	Confirming Method	Solution
The CANlink address conflict occurs.	Check whether H0C-00 (Servo axis address) is allocated repetitively to different slaves.	Allocate a unique address for each salve and ensure H0C-00 is not allocated repetitively.

4.2.4 Internal Faults

When any one of the following fault occurs, contact Inovance for technical support.

- Er.602: Angle auto-tuning failure
- Er.220: Phase sequence incorrect
- Er.A40: Parameter auto-tuning failure
- Er.111: Internal parameter error

5 Parameters

Parameter Group	Overview of Parameter Groups
Group H00	Servo motor parameters
Group H01	Servo drive parameters
Group H02	Basic control parameters
Group H03	Terminal input parameters
Group H04	Terminal output parameters
Group H05	Position control parameters
Group H06	Speed control parameters
Group H07	Torque control parameters
Group H08	Gain parameters
Group H09	Auto-tuning parameters
Group H0A	Fault and protection parameters
Group H0B	Monitoring parameters
Group H0C	Communication parameters
Group H0D	Auxiliary functions
Group H11	Multi-position parameters
Group H12	Multi-speed parameters
Group H17	VDI/VDO parameters
Group H30	Servo variables read through communication
Group H31	Servo variables set through communication

5.1 Group H00: Servo Motor Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H00-00	Motor code	14000: Inovance motor with 20-bit incremental encoder 14101: Inovance motor with 23-bit absolute encoder	-	14101	Next power-on	At stop	All
H00-02	Customized no.	-	-	-	-	At display	-
H00-04	Encoder version	-	-	-	-	At display	-
H00-05	Serial-type motor code	-	-	-	-	At display	-
H00-08	Absolute encoder type	14100: Multi-turn absolute encoder Others: Single-turn absolute encoder	-	-	Next power-on	At stop	All

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H00-09	Rated voltage	0-220 1-380	V	-	Next power-on	At stop	-
H00-10	Rated power	0.01–655.35	kW	-	Next power-on	At stop	-
H00-11	Rated current	0.01–655.35	A	-	Next power-on	At stop	-
H00-12	Rated torque	0.01–655.35	N·m	-	Next power-on	At stop	-
H00-13	Maximum torque	0.10–655.35	N·m	-	Next power-on	At stop	-
H00-14	Rated speed	100–6000	RPM	-	Next power-on	At stop	-
H00-15	Maximum speed	100–6000	RPM	-	Next power-on	At stop	-
H00-16	Moment of inertia Jm	0.01–655.35	$kgcm^2$	-	Next power-on	At stop	-
H00-17	Number of PMSM pole pairs	2–360	Pole pair	-	Next power-on	At stop	-
H00-18	Stator resistance	0.001–65.535	Ω	-	Next power-on	At stop	-
H00-19	Stator inductance Lq	0.01–655.35	mH	-	Next power-on	At stop	-
H00-20	Stator inductance Ld	0.01–655.35	mH	-	Next power-on	At stop	-
H00-21	Linear back EMF coefficient	0.01–655.35	mV/RPM	-	Next power-on	At stop	-
H00-22	Torque coefficient Kt	0.01–655.35	N·m/Arms	-	Next power-on	At stop	-
H00-23	Electrical constant Te	0.01–655.35	ms	-	Next power-on	At stop	-
H00-24	Mechanical constant Tm	0.01–655.35	ms	-	Next power-on	At stop	-
H00-28	Absolute encoder position offset	0–1073741824	PPR	-	Next power-on	At stop	-
H00-30	Encoder selection (Hex)	0x000: Incremental encoder (UVW-ABZ) 0x013: Inovance encoder	1	0x013	Next power-on	At stop	-
H00-31	Encoder resolution	0–1073741824	PPR	1048576	Next power-on	At stop	-
H00-35	Serial-type motor model	0–65535	1	0	Next power-on	At stop	-
H00-43	Maximum motor current	0.01–655.35	A	0	Next power-on	At stop	-

5.2 Group H01: Servo Drive Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H01-00	MCU software version	0–65535	-	-	-	At display	-
H01-01	FPGA software version	0–65535	-	-	-	At display	-
H01-02	Servo drive code	0–65535	-	-	Next power-on	At stop	-

5.3 Group H02: Basic Control Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H02-00	Control mode selection	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Torque control mode ↔ Speed control mode 4: Speed control mode ↔ Position control mode 5: Torque control mode ↔ Position control mode 6: Torque control mode ↔ Speed control mode ↔ Position control mode	-	1	Immediately	At stop	-
H02-01	Absolute system selection	0: Incremental position mode 1: Absolute position linear mode 2: Absolute position rotation mode	-	0	Next power-on	At stop	All
H02-02	Direction of rotation	0: CCW as forward direction (phase A leads phase B) 1: CW as forward direction (reverse mode, phase A lags behind phase B)	-	0	Next power-on	At stop	PST
H02-03	Output pulse phase	0: CCW as forward direction (phase A leads phase B) 1: CW as forward direction (reverse mode, phase A lags behind phase B)	-	0	Next power-on	At stop	PST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H02-05	Stop mode at S-ON OFF	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping de-energized state 2: Stop at zero speed, keeping dynamic braking state 3: Dynamic braking stop, keeping dynamic braking state	-	0	Immediately	At stop	PST
H02-06	Stop mode at No. 2 fault	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping de-energized state 2: Stop at zero speed, keeping dynamic braking state 3: Dynamic braking stop, keeping dynamic braking state 4: Dynamic braking stop, keeping de-energized state	-	2	Immediately	At stop	PST
H02-07	Stop mode upon 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 state	-	1	Immediately	At stop	PST
H02-08	Stop mode at No. 1 fault	0: Coast to stop, keeping de-energized state 1: Dynamic braking stop, keeping de-energized state 2: Dynamic braking stop, keeping dynamic braking state	-	2	Immediately	At stop	PST
H02-09	Delay from brake output ON to command received	0–500	ms	250	Immediately	During running	PS
H02-10	Delay from brake output OFF to motor de-energized in standstill state	1–1000	ms	150	Immediately	During running	PS
H02-11	Speed threshold at brake output OFF in rotation state	0–3000	RPM	30	Immediately	During running	PS
H02-12	Delay from S-ON OFF to brake output OFF in rotation state	1–1000	ms	500	Immediately	During running	PS

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H02-15	Warning display on the keypad	0: Output warning information immediately 1: Not output warning information	-	0	Immediately	At stop	PST
H02-18	S-ON filter time constant	0–64	ms	0	Immediately	At stop	PST
H02-21	Permissible minimum resistance of regenerative resistor	-	Ω	-	-	At display	PST
H02-22	Power of built-in regenerative resistor	-	W	-	-	At display	PST
H02-23	Resistance of built-in regenerative resistor	-	Ω	-	-	At display	PST
H02-24	Resistor heat dissipation coefficient	10–100	%	30	Immediately	At stop	PST
H02-25	Regenerative resistor type	0: Built-in 1: External, natural cooling 2: External, forced air cooling 3: No regenerative resistor needed	-	0	Immediately	At stop	PST
H02-26	Power of external regenerative resistor	1–65535	W	-	Immediately	At stop	PST
H02-27	Resistance of external regenerative resistor	1–1000	Ω	-	Immediately	At stop	PST
H02-30	User password	0–65535	-	0	Next power-on	At stop	PST
H02-31	System parameter initialization	0: No operation 1: Restore default settings (parameters in groups H00 and H01 excluded) 2: Clear fault log	-	0	Immediately	At stop	PST
H02-32	Default keypad display	0–99	-	50	Immediately	During running	-
H02-34	CAN software version	-	-	-	-	At display	-

5.4 Group H03: Terminal Input Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H03-00	DI function assignment 1 (activated upon power-on)	0–0xFFFF Bit0: FunIN.1 Bit1:FunIN.2 ... Bit15: FunIN.16	-	0	Next power-on	During running	-
H03-01	DI function assignment 2 (activated upon power-on)	0–0xFFFF Bit0: FunIN.17 Bit1:FunIN.18 ... Bit15: FunIN.32	-	0	Next power-on	During running	-
H03-02	DI1 function	0–41	-	14	At stop	During running	-
H03-03	DI1 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-04	DI2 function	0–41	-	15	At stop	During running	-
H03-05	DI2 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-06	DI3 function	0–41	-	13	At stop	During running	-
H03-07	DI3 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-08	DI4 function	0–41	-	2	At stop	During running	-
H03-09	DI4 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-10	DI5 function	0–41	-	1	At stop	During running	-
H03-11	DI5 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-16	DI8 function	0–41	-	31	At stop	During running	-
H03-17	DI8 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-18	DI9 function	0–41	-	0	At stop	During running	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H03-19	DI9 logic	Input polarity: 0–1 0: Active low 1: Active high	-	0	At stop	During running	-
H03-34	DI function assignment 3 (activated upon power-on)	0–0xFFFF Bit0: FunIN.33 Bit1:FunIN.34 … Bit15: FunIN.16	-	0	Next power-on	During running	-
H03-35	DI function assignment 4 (activated upon power-on)	0–0xFFFF Bit0: FunIN.49 Bit1:FunIN.50 … Bit15: FunIN.16	-	0	Next power-on	During running	-
H03-60	DI1 filter time	0–50000	0.01 ms	50	Immediately	During running	-
H03-61	DI2 filter time	0–50000	0.01 ms	50	Immediately	During running	-
H03-62	DI3 filter time	0–50000	0.01 ms	50	Immediately	During running	-
H03-63	DI4 filter time	0–50000	0.01 ms	50	Immediately	During running	-
H03-64	DI5 filter time	0–50000	0.01 ms	50	Immediately	During running	-
H03-65	DI8 filter time	0–50000	0.01 ms	0	Immediately	During running	-
H03-66	DI9 filter time	0–50000	0.01 ms	0	Immediately	During running	-

5.5 Group H04: Terminal Output Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H04-00	DO1 function	0–24	-	1	At stop	During running	-
H04-01	DO1 logic	Output polarity inversion: 0–1 0: Output low level (L) when active (optocoupler ON) 1: Output high level (H) when active (optocoupler OFF)	-	0	At stop	During running	-
H04-02	DO2 function	0–24	-	5	At stop	During running	-
H04-03	DO2 logic	Output polarity inversion: 0–1 0: Output low level (L) when active (optocoupler ON) 1: Output high level (H) when active (optocoupler OFF)	-	0	At stop	During running	-
H04-04	DO3 function	0–24	-	9	At stop	During running	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H04-05	DO3 logic	Output polarity inversion: 0–1 0: Output low level (L) when active (optocoupler ON) 1: Output high level (H) when active (optocoupler OFF)	-	0	At stop	During running	-
H04-06	DO4 function	0–24	-	11	At stop	During running	-
H04-07	DO4 logic	Output polarity inversion: 0–1 0: Output low level (L) when active (optocoupler ON) 1: Output high level (H) when active (optocoupler OFF)	-	0	At stop	During running	-
H04-08	DO5 function	0–24	-	16	At stop	During running	-
H04-09	DO5 logic	Output polarity inversion: 0–1 0: Output low level (L) when active (optocoupler ON) 1: Output high level (H) when active (optocoupler OFF)	-	0	At stop	During running	-
H04-22	DO source	0–31	-	0	Immediately	At stop	-

5.6 Group H05: Position Control Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H05-00	Position reference source	0: Pulse reference 1: Step reference 2: Multi-position reference	-	0	At once	At stop	P
H05-01	Pulse reference input terminal selection	0: Low-speed 1: High-speed	-	0	At once	At stop	P
H05-02	Pulses per revolution	0 to 1048576	PPR	0	Next power-on	At stop	P
H05-04	First-order low-pass filter time constant	0 to 6553.5	ms	0.0	At once	At stop	P
H05-05	Step reference	-9999 to +9999	Reference unit	50	At once	At stop	P
H05-06	Moving average filtering time constant	0.0 to 128.0	ms	0.0	At once	At stop	P
H05-07	Electronic gear ratio 1 (numerator)	1 to 1073741824	-	8388608	At once	During running	P
H05-09	Electronic gear ratio 1 (denominator)	1 to 1073741824	-	10000	At once	During running	P
H05-11	Electronic gear ratio 2 (numerator)	1 to 1073741824	-	8388608	At once	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H05-13	Electronic gear ratio 2 (denominator)	1 to 1073741824	-	10000	At once	During running	P
H05-15	Pulse reference form	0: Pulse + direction, positive logic 1: Pulse+Direction, negative logic 2: Phase A+Phase B quadrature pulse, quadrupled frequency 3: CW + CCW	-	0	Next power-on	At stop	P
H05-16	Clear action	0: Position deviation cleared upon S-ON OFF or fault 1: Position deviation cleared upon S-ON OFF or stop at fault 2: Position deviation cleared upon S-ON OFF or stop at fault; position deviation cleared upon ClrPosErr signal inputted from DI when the servo drive is in RUN state	-	0	At once	At stop	P
H05-17	Number of encoder frequency-division pulses	35 to 32767	PPR	2500	Next power-on	At stop	-
H05-19	Speed feedforward control	0: No speed feedforward 1: Internal speed feedforward	-	1	At once	At stop	P
H05-20	Condition for COIN (positioning completed) signal output	0: Absolute value of position deviation lower than H05-21 1: Absolute value of position deviation lower than H05-21 and filtered position reference being 0 2: Absolute value of position deviation lower than H05-21 and unfiltered position reference being 0 3: Absolute value of position deviation kept lower than H05-21 within the time defined by H05-60 and unfiltered position reference being 0	-	0	At once	During running	P
H05-21	Threshold of positioning completed	1 to 65535	Encoder/ Reference unit	5872	At once	During running	P
H05-22	Proximity threshold	1 to 65535	Encoder/ Reference unit	65535	At once	During running	P
H05-23	Interrupt positioning selection	0: Disable 1: Enable	-	0	Next power-on	At stop	P
H05-24	Displacement of interrupt positioning	0 to 1073741824	Reference unit	10000	At once	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H05-26	Constant operating speed in interrupt positioning	0 to 6000	RPM	200	At once	During running	P
H05-27	Acceleration/ Deceleration time of interrupt positioning	0 to 1000	ms	10	At once	During running	P
H05-29	Interrupt positioning cancel signal	0: Disable 1: Enable	-	1	At once	During running	P
H05-30	Homing selection	0: Disabled 1: Homing enabled through the HomingStart signal inputted from DI 2: Electrical homing enabled through the HomingStart signal inputted from DI 3: Homing enabled immediately upon power-on 4: Homing executed immediately 5: Electrical homing started 6: Current position as the home 8: DI-triggered position as the home	-	0	At once	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H05-31	Homing mode	0: Forward, home switch as deceleration point and home 1: Reverse, home switch as deceleration point and home 2: Forward, Z signal as deceleration point and home 3: Reverse, Z signal as deceleration point and home 4: Forward, home switch as deceleration point and Z signal as home 5: Reverse, home switch as deceleration point and Z signal as home 6: Forward, positive limit switch as deceleration point and home 7: Reverse, negative limit switch as deceleration point and home 8: Forward, positive limit switch as deceleration point and Z signal as home 9: Reverse, negative limit switch as deceleration point signal and Z signal as home 10: Forward, mechanical limit as deceleration point and home 11: Reverse, mechanical limit as deceleration point and home 12: Forward, mechanical limit as deceleration point and Z signal as home 13: Reverse, mechanical limit as deceleration point and Z signal as home 14: Single-turn forward homing 15: Single-turn reverse homing 16: Single-turn nearby homing	-	0	At once	During running	P
H05-32	Speed in high-speed searching for the home switch signal	0 to 3000	RPM	100	At once	During running	P
H05-33	Speed in low-speed searching for the home switch signal	0 to 1000	RPM	10	At once	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H05-34	Acceleration/ Deceleration time during homing	0 to 1000	ms	1000	At once	During running	P
H05-35	Homing time limit	0 to 65535	ms	10000	At once	During running	P
H05-36	Mechanical home offset	-1073741824 to +1073741824	Reference unit	0	At once	During running	P
H05-38	Servo pulse output source	0: Encoder frequency-division output 1: Pulse reference synchronous output 2: Frequency-division or synchronous output inhibited	-	0	Next power-on	At stop	P
H05-39	Electronic gear ratio switchover condition	0: Switching after position reference (in reference unit) kept 0 for 2.5 ms 1: Switching in real time	-	0	At once	At stop	P
H05-40	Mechanical home offset and action upon overtravel	0: H05-36 as the coordinate after homing, reverse homing applied after homing triggered again upon overtravel 1: H05-36 as the relative offset after homing, reverse homing triggered upon hitting the limit 2: H05-36 as the coordinate after homing, reverse homing applied automatically upon overtravel 3: H05-36 as the relative offset after homing, reverse homing applied automatically upon overtravel	-	0	At once	At stop	P
H05-41	Z pulse output polarity	0: Negative (Z pulse being low level) 1: Positive (Z pulse being high level)	-	1	Next power-on	At stop	P
H05-43	Position pulse edge	0: Falling edge-triggered 1: Rising edge-triggered	1	0	Next power-on	During running	PST
H05-46	Position offset in absolute position linear mode (low 32 bits)	-2147483648 to +2147483647	Encoder unit	0	Next power-on	At stop	PST
H05-48	Position offset in absolute position linear mode (high 32 bits)	-2147483648 to +2147483647	Encoder unit	0	Next power-on	At stop	PST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H05-50	Mechanical gear ratio (numerator) in absolute position rotation mode	1 to 65535	1	65535	At once	At stop	All
H05-51	Mechanical gear ratio (denominator) in absolute position rotation mode	1 to 65535	1	1	At once	At stop	All
H05-52	Pulses per load revolution in absolute position rotation mode (low 32 bits)	0 to 4294967295	Encoder unit	0	At once	At stop	All
H05-54	Pulses per load revolution in absolute position rotation mode (high 32 bits)	0 to 4294967295	Encoder unit	0	At once	At stop	All
H05-56	Speed threshold of homing upon hit-and-stop	0 to 1000	RPM	2	At once	During running	P
H05-58	Torque limit of homing upon hit-and-stop	0.0 to 300.0	%	100.0%	At once	During running	P
H05-59	Window time of positioning completed	0 to 30000	ms	1	At once	During running	P
H05-60	Hold time of positioning completed	0 to 30000	ms	0	At once	During running	P
H05-61	Number of encoder frequency-division pulses (32 bits)	0 to 262143	PPR	0	Next power-on	At stop	-
H05-66	Homing time unit	0: ms 1: 10 ms 2: 100 ms	1	0	At once	At stop	P
H05-69	Auxiliary homing function	0: Disable 1: Enable single-turn homing 2: Record single-turn zero offset 3: Start a new search for the Z signal (homing) 4: Clear single-turn zero offset	1	0	Next power-on	At stop	P

5.7 Group H06: Speed Control Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H06-00	Source of main speed reference A	0: Digital setting (H06-03)	-	0	Immediately	At stop	S
H06-01	Source of auxiliary speed reference B	0: Digital setting (H06-03) 5: Multi-speed reference	-	5	Immediately	At stop	S
H06-02	Speed reference source	0: Source of main speed reference A 1: Source of auxiliary speed reference B 2: A+B 3: Switched between A and B 4: Communication	-	0	Immediately	At stop	S
H06-03	Speed reference set through keypad	-6000 to +6000	RPM	200	Immediately	During running	S
H06-04	Jog speed	0–6000	RPM	100	Immediately	During running	S
H06-05	Acceleration ramp time constant of speed reference	0–65535	ms	0	Immediately	During running	S
H06-06	Deceleration ramp time constant of speed reference	0–65535	ms	0	Immediately	During running	S
H06-07	Maximum speed limit	0–6000	RPM	6000	Immediately	During running	S
H06-08	Forward speed limit	0–6000	RPM	6000	Immediately	During running	S
H06-09	Reverse speed limit	0–6000	RPM	6000	Immediately	During running	S
H06-11	Torque feedforward selection	0: No torque feedforward 1: Internal torque feedforward	-	1	Immediately	During running	PS
H06-15	Zero clamp speed threshold	0–6000	RPM	10	Immediately	During running	S
H06-16	Threshold of TGON signal	0–1000	RPM	20	Immediately	During running	S
H06-17	Threshold of V-Cmp signal	0–100	RPM	10	Immediately	During running	S
H06-18	Threshold of V-Arr signal	10–6000	RPM	1000	Immediately	During running	S
H06-19	Threshold of V-Zero signal	1–6000	RPM	10	Immediately	During running	S
H06-28	Cogging torque ripple compensation selection	0–1	-	1	Immediately	During running	PS

5.8 Group H07: Torque Control Parameters

The rated torque of the motor corresponds to 100% of the torque reference.

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H07-00	Source of main torque reference A	0: Digital setting (H07-03)	-	0	Immediately	At stop	T
H07-01	Source of auxiliary torque reference B	0: Digital setting (H07-03) 1: 0 (no function) 2: 0 (no function)	-	1	Immediately	At stop	T
H07-02	Torque reference source	0: Source of main torque reference A 1: Source of auxiliary torque reference B 2: A+B 3: Switched between A and B 4: Communication	-	0	Immediately	At stop	T
H07-03	Torque reference set through keypad	-300.0 to +300.0	%	0	Immediately	During running	T
H07-05	Torque reference filter time constant	0–30.00	ms	0.79	Immediately	During running	PST
H07-06	2nd torque reference filter time constant	0–30.00	ms	0.79	Immediately	During running	PST
H07-07	Torque limit source	0: Positive/Negative internal torque limit 1: Positive/Negative external torque limit (selected by P-CL and N-CL)	-	0	Immediately	At stop	PST
H07-09	Positive internal torque limit	0.0–400.0	%	350.0	Immediately	During running	PST
H07-10	Negative internal torque limit	0.0–400.0	%	350.0	Immediately	During running	PST
H07-11	Positive external torque limit	0.0–400.0	%	350.0	Immediately	During running	PST
H07-12	Negative external torque limit	0.0–400.0	%	350.0	Immediately	During running	PST
H07-17	Speed limit source	0: Internal speed limit (speed limit in torque control) 1: Reserved 2: H07-19 or H07-20 as defined by the DI assigned with FunIN.36 (V-SEL)	-	0	Immediately	During running	T
H07-19	Positive speed limit/ Speed limit 1 in torque control	0–6000	RPM	3000	Immediately	During running	T

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H07-20	Negative speed limit/ Speed limit 2 in torque control	0–6000	RPM	3000	Immediately	During running	T
H07-21	Reference value for torque reach	0.0–300.0	%	0.0	Immediately	During running	PST
H07-22	Threshold of valid torque reach	0.0–300.0	%	20.0	Immediately	During running	PST
H07-23	Threshold of invalid torque reach	0.0–300.0	%	10.0	Immediately	During running	PST
H07-40	Speed limit window in torque control mode	0.5–30.0	ms	1.0	Immediately	During running	T

5.9 Group H08: Gain Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H08-00	Speed loop gain	0.1–2000.0	Hz	400.0	Immediately	During running	PS
H08-01	Speed loop integral time constant	0.15–512.00	ms	19.89	Immediately	During running	PS
H08-02	Position loop gain	0.0–2000.0	Hz	64.0	Immediately	During running	P
H08-03	2nd speed loop gain	0.1–2000.0	Hz	40.0	Immediately	During running	PS
H08-04	2nd speed loop integral time constant	0.15–512.00	ms	40.00	Immediately	During running	PS
H08-05	2nd position loop gain	0.0–2000.0	Hz	64.0	Immediately	During running	P
H08-08	2nd gain set mode	0: Fixed to the 1st gain set, P/PI switched through external DI 1: Gains switched based on the condition defined by H08-09	-	1	Immediately	During running	PST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H08-09	Gain switchover condition	0: Fixed to the 1st gain set (PS) 1: Switched through external DI (PS) 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 too large (P) 10: Position reference+Actual speed (P)	-	0	Immediately	During running	PST
H08-10	Gain switchover delay	0.0–1000.0	ms	5.0	Immediately	During running	PST
H08-11	Gain switchover level	0–20000	Based on switchover conditions	50	Immediately	During running	PST
H08-12	Gain switchover dead time	0–20000	Based on switchover conditions	30	Immediately	During running	PST
H08-13	Position gain switchover time	0.0–1000.0	ms	3.0	Immediately	During running	P
H08-15	Load moment of inertia ratio	0.00–120.00	Multiplier	1.00	Immediately	During running	PST
H08-18	Speed feedforward filter time constant	0.00–64.00	ms	0.50	Immediately	During running	P
H08-19	Speed feedforward gain	0.0–100.0	%	0.0	Immediately	During running	P
H08-20	Torque feedforward filter time constant	0.00–64.00	ms	0.50	Immediately	At stop	PS
H08-21	Torque feedforward gain	0.0–200.0	%	0.0	Immediately	During running	PS
H08-22	Speed feedback filtering option	0: Inhibited 1: Two times 2: Four times 3: Eight times 4: Sixteen times	-	0	Immediately	At stop	PS

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H08-23	Cutoff frequency of speed feedback low-pass filter	100–4000	Hz	4000	Immediately	During running	PS
H08-24	PDFF control coefficient	0.0–100.0	-	100.0	Immediately	During running	PS
H08-27	Speed observer cutoff frequency	10–2000	Hz	170	Immediately	During running	PS
H08-28	Speed inertia correction coefficient	10–10000	%	100	Immediately	During running	PS
H08-29	Speed observer filter time	2–2000	0.01 ms	80	Immediately	During running	PS
H08-31	Disturbance observer cutoff frequency	10–1700	Hz	600	Immediately	During running	PS
H08-32	Disturbance observer compensation coefficient	0–100	%	0	Immediately	During running	PS
H08-33	Disturbance observer inertia correction coefficient	0–100	%	100	Immediately	During running	PS
H08-40	Speed observer selection	0–1	-	0	Immediately	At stop	PS
H08-41	Disturbance observer torque switch	0–2	-	0	Immediately	During running	PS
H08-42	Model control selection	0–1	-	0	Immediately	At stop	P
H08-43	Model gain	0–10000	-	400	Immediately	During running	P
H08-46	Model feedforward	0–1024	-	950	Immediately	During running	P
H08-51	Model filter time 2	0–2000	0.01 ms	0	Immediately	During running	P
H08-53	Medium- and low-frequency jitter suppression frequency 3	0–6000	0.1 Hz	0	Immediately	During running	P
H08-54	Medium- and low-frequency jitter suppression compensation coefficient 3	0–200	%	0	Immediately	During running	P
H08-56	Medium- and low-frequency jitter suppression phase modulation coefficient 3	0–1600	%	0	Immediately	During running	P
H08-58	Er.660 switch	0–2	-	0	Immediately	During running	PS
H08-59	Medium- and low-frequency jitter suppression frequency 4	0–6000	0.1 Hz	0	Immediately	During running	P
H08-60	Medium- and low-frequency jitter suppression compensation coefficient 4	0–200	%	0	Immediately	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H08-61	Medium- and low-frequency jitter suppression phase modulation coefficient 4	0–1600	%	0	Immediately	During running	P
H08-62	Position loop integral time constant	15–51200	0.01 ms	0	Immediately	During running	P
H08-63	2nd position loop integral time constant	15–51200	0.01 ms	0	Immediately	During running	P

5.10 Group H09: Auto-tuning Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H09-00	Gain auto-tuning mode	0: Disabled, gain parameters tuned manually 1: Standard stiffness level mode, 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	Immediately	During running	PST
H09-01	Stiffness level	0–41	-	15	Immediately	During running	PST
H09-02	Adaptive notch mode	0: Adaptive notch no longer updated 1: One adaptive notch (3rd notch) activated 2: Two adaptive notches (3rd and 4th notches) activated 3: Resonance point tested only, displayed in H09-24 4: Values of the 3rd and 4th notches restored to default	-	0	Immediately	During running	PST
H09-03	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	-	0	Immediately	During running	RST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H09-04	Low-frequency resonance suppression mode	0: Vibration frequency set manually 1: Vibration frequency set automatically	-	0	Immediately	During running	P
H09-05	Offline inertia auto-tuning mode	0: Positive/Negative triangular wave mode 1: Jog mode 2: Dual-direction auto-tuning mode 3: Single-direction auto-tuning mode	-	0	Immediately	At stop	PST
H09-06	Maximum speed of inertia auto-tuning	100–1000	RPM	500	Immediately	At stop	PST
H09-07	Time constant for accelerating to the max. speed during inertia auto-tuning	20–800	ms	125	Immediately	At stop	PST
H09-08	Waiting time after an individual inertia auto-tuning	50–10000	ms	800	Immediately	At stop	PST
H09-09	Number of motor revolutions per inertia auto-tuning	0.00–2.00	r	-	-	At display	PST
H09-11	Vibration threshold	0–1000	0.1%	50	Immediately	During running	PS
H09-12	Frequency of the 1st notch	50–4000	Hz	4000	Immediately	During running	PS
H09-13	Width level of the 1st notch	0–20	-	2	Immediately	During running	PS
H09-14	Depth level of the 1st notch	0–99	-	0	Immediately	During running	PS
H09-15	Frequency of the 2nd notch	50–4000	Hz	4000	Immediately	During running	PS
H09-16	Width level of the 2nd notch	0–20	-	2	Immediately	During running	PS
H09-17	Depth level of the 2nd notch	0–99	-	0	Immediately	During running	PS
H09-18	Frequency of the 3rd notch	50–4000	Hz	4000	Immediately	During running	PS
H09-19	Width level of the 3rd notch	0–20	-	2	Immediately	During running	PS
H09-20	Depth level of the 3rd notch	0–99	-	0	Immediately	During running	PS
H09-21	Frequency of the 4th notch	50–4000	Hz	4000	Immediately	During running	PS
H09-22	Width level of the 4th notch	0–20	-	2	Immediately	During running	PS

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H09-23	Depth level of the 4th notch	0–99	-	0	Immediately	During running	PS
H09-24	Auto-tuned resonance frequency	0–2	Hz	0	-	At display	PS
H09-30	Torque disturbance compensation gain	0.0–100.0	%	0.0	Immediately	During running	PS
H09-31	Filter time constant of torque disturbance observer	0.00–25.00	ms	0.50	Immediately	During running	PS
H09-32	Gravity compensation value	0–1000	0.1%	0	Immediately	During running	P
H09-33	Forward friction compensation	0–1000	0.1%	0	Immediately	During running	P
H09-34	Reverse friction compensation	-1000–0	0.1%	0	Immediately	During running	P
H09-35	Friction compensation speed threshold	1–300	0.1 RPM	0	Immediately	During running	P
H09-36	Friction compensation speed	0–0x12	-	0	Immediately	During running	P
H09-37	Vibration monitoring time	0–65535	1s	1200	Immediately	During running	PS
H09-38	Low-frequency resonance frequency at mechanical load end	1.0–100.0	Hz	100.0	Immediately	During running	P
H09-39	Low-frequency resonance suppression at mechanical load end	0–3	-	2	Immediately	During running	P
H09-41	Frequency of the 5th notch	50–8000	Hz	4000	Immediately	During running	PS
H09-42	Width level of the 5th notch	0–20	-	2	Immediately	During running	PS
H09-43	Depth level of the 5th notch	0–99	-	0	Immediately	During running	PS

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H09-44	Frequency of low-frequency resonance suppression 1 at mechanical load end	0–200.0	Hz	0	Immediately	During running	P
H09-45	Responsiveness of low-frequency resonance suppression 1 at mechanical load end	0.01–10	Hz	1.00	Immediately	During running	P
H09-47	Width of low-frequency resonance suppression 1 at mechanical load end	0–2.00	Hz	1.00	Immediately	During running	P
H09-49	Frequency of low-frequency resonance suppression 2 at mechanical load end	0–200.0	Hz	0	Immediately	During running	P
H09-50	Responsiveness of low-frequency resonance suppression 2 at mechanical load end	0.01–10.00	Hz	1.00	Immediately	During running	P
H09-52	Width of low-frequency resonance suppression 2 at mechanical load end	0–2.00	Hz	1.00	Immediately	During running	P

5.11 Group H0A Fault and Protection Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0A-00	Power input phase loss protection	0: Enable phase loss fault and inhibit phase loss warning 1: Enable phase loss fault and warning 2: Inhibit phase loss fault and warning	-	0	Immediately	During running	-
H0A-02	Vibration alarm switch	0: Enable 1: Disable	-	0	Immediately	During running	-
H0A-03	Power-off memory	0: Disable 1: Enable	-	0	Immediately	During running	-
H0A-04	Motor overload protection gain	50–3002	%	100	Immediately	At stop	-
H0A-08	Overspeed threshold	0–10000	RPM	0	Immediately	During running	PST
H0A-09	Maximum position pulse frequency	100–4000	kHz	4000	Immediately	At stop	P
H0A-10	Threshold of excessive position deviation	1–1073741824	Encoder/ Reference unit	27486951	Immediately	During running	P
H0A-12	Runaway protection	0: Disable 1: Enable	-	1	Immediately	During running	PST
H0A-16	Threshold of low-frequency resonance position deviation	1-1000	Encoder unit	5	Immediately	During running	P
H0A-17	Position setting unit	0: Encoder unit 1: Reference unit	-	0	Immediately	At stop	P
H0A-19	DI8 filter time constant	0–255	25 ns	80	Next power-on	At stop	-
H0A-20	DI9 filter time constant	0–255	25 ns	80	Next power-on	At stop	-
H0A-24	Filter time constant of low-speed pulse input pin	0–255	25 ns	30	Next power-on	At stop	P
H0A-25	Filter time constant of speed feedback display value	0–5000	ms	50	Immediately	At stop	-
H0A-26	Motor overload detection	0: Enable 1: Disable 2: No meaning 3: Enable a new motor overload detection	-	3	Immediately	At stop	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0A-27	Speed DO filter time constant	0–5000	ms	10	Immediately	At stop	-
H0A-28	Quadrature encoder filter time constant	0–255	25 ns	30	Next power-on	At stop	-
H0A-30	Filter time constant of high-speed pulse input pin	0–255	25 ns	3	Next power-on	At stop	P
H0A-32	Time window of motor stall over-temperature protection	10–65535	ms	200	Immediately	During running	-
H0A-33	Motor stall over-temperature detection	0: Disable 1: Enable	-	1	Immediately	During running	-
H0A-36	Encoder multi-turn overflow fault	0: Not hide 1: Hide	-	0	Immediately	At stop	All
H0A-40	Software position limit	0: Disabled 1: Enabled immediately upon power-on 2: Enabled after homing	-	0	Immediately	At stop	PST
H0A-41	Maximum value of software position limit	-2147483648 to +2147483647	Reference unit	2147483647	Immediately	At stop	PST
H0A-43	Minimum value of software position limit	-2147483648 to +2147483647	Reference unit	-2147483648	Immediately	At stop	PST

5.12 Group H0B Monitoring Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0B-00	Motor speed actual value	-	RPM	-	-	At display	PST
H0B-01	Speed reference	-	RPM	-	-	At display	PS
H0B-02	Internal torque reference (relative to the rated torque)	-	%	-	-	At display	PST
H0B-03	Monitored DI status	-	-	-	-	At display	PST
H0B-05	Monitored DO status	-	-	-	-	At display	PST
H0B-07	Absolute position counter (32-bit decimal)	-	Reference unit	-	-	At display	PST
H0B-09	Mechanical angle (pulses starting from the home)	-	Encoder unit	-	-	At display	PST
H0B-10	Electrical angle	-	°	-	-	At display	PST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0B-11	Speed corresponding to the input position reference	-	RPM	-	-	At display	P
H0B-12	Average load rate	-	%	-		At display	PST
H0B-13	Input reference pulse counter (32-bit decimal)	-	Reference unit	-	-	At display	P
H0B-15	Encoder position deviation counter (32-bit decimal)	-	Encoder unit	-	-	At display	P
H0B-17	Feedback pulse counter (32-bit decimal)	-	Encoder unit	-	-	At display	PST
H0B-19	Total power-on time (32-bit decimal)	-	s	-	-	At display	PST
H0B-24	RMS value of phase current	-	A	-	-	At display	PST
H0B-26	Bus voltage	-	V	-	-	At display	PST
H0B-27	Power module temperature	-	°C	-	-	At display	PST
H0B-33	Fault log	0: Present fault 1: Last fault 2: 2nd to last fault ... 9: 9th to last fault	-	0	Immediately	During running	PST
H0B-34	Fault code of the selected fault	-	-	-	-	At display	PST
H0B-35	Time stamp upon occurrence of the selected fault	-	s		-	At display	PST
H0B-37	Motor speed upon occurrence of the selected fault	-	RPM	-	-	At display	PST
H0B-38	Motor phase U current upon occurrence of the selected fault	-	A	-	-	At display	PST
H0B-39	Motor phase V current upon occurrence of the selected fault	-	A	-	-	At display	PST
H0B-40	Bus voltage upon occurrence of the selected fault	-	V	-	-	At display	PST
H0B-41	DI status upon occurrence of the selected fault	-	-	-	-	At display	PST
H0B-42	DO status upon occurrence of the selected fault	-	-	-	-	At display	PST
H0B-53	Position deviation counter	-	Reference unit	-	-	At display	P
H0B-55	Motor speed actual value (0.1 RPM)	-	RPM	-	-	At display	PST
H0B-58	Mechanical absolute position (low 32 bits)	-	Encoder unit	0	-	At display	All

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0B-60	Mechanical absolute position (high 32 bits)	-	Encoder unit	0	-	At display	All
H0B-64	Real-time input position reference counter	-	Reference unit	-	-	At display	PST
H0B-70	Number of revolutions fed back by the absolute encoder	-	r	0	-	At display	All
H0B-71	Single-turn position fed back by the absolute encoder	-	Encoder unit	0	-	At display	All
H0B-73	Single-turn offset position of absolute encoder	-	Encoder unit	0	-	At display	All
H0B-77	Absolute position fed back by the absolute encoder (low 32 bits)	-	Encoder unit	0	-	At display	All
H0B-79	Absolute position fed back by the absolute encoder (high 32 bits)	-	Encoder unit	0	-	At display	All
H0B-81	Single-turn position of the rotating load (low 32 bits)	-	Encoder unit	0	-	At display	All
H0B-83	Single-turn position of the rotating load (high 32 bits)	-	Encoder unit	0	-	At display	All
H0B-85	Single-turn position of the rotating load	-	Reference unit	0	-	At display	All

5.13 Group H0C: Communication Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0C-00	Servo axis address	1–247 (0: Broadcast address)	-	1	Immediately	During running	PST
H0C-02	Serial baud rate	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps 6: 115200 bps	-	5	Immediately	During running	PST
H0C-03	Modbus data format	0: No parity, 2 stop bits 1: Even parity, 1 stop bit 2: Odd parity, 1 stop bit 3: No parity, 1 stop bit	-	0	Immediately	During running	PST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0C-08	CAN communication rate	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps 7: 1 Mbps	-	5	Immediately	During running	PST
H0C-09	Communication VDI	0: Disabled 1: Enable	-	0	Immediately	At stop	PST
H0C-10	VDI default value upon power-on	Bit0: VDI1 default value … Bit15: VDI16 default value	-	0	Next power-on	During running	PST
H0C-11	Communication VDO	0: Disabled 1: Enable	-	0	Immediately	At stop	PST
H0C-12	Default level of the VDO assigned with function 0	Bit0: VDO1 default value ... Bit15: VDO16 default value	-	0	Immediately	At stop	PST
H0C-13	Update parameter values written through Modbus communication to EEPROM	0: Not updated to EEPROM 1: Updated to EEPROM, except parameters in groups H0B and H0D	-	1	Immediately	During running	PST
H0C-14	Modbus error code	New protocol: • 0x0001: Illegal function (command code) • 0x0002: Illegal data address • 0x0003: Illegal data • 0x0004: Slave device fault Old protocol: • 0x0002: The command code is not 0x03/0x06/0x10. • 0x0004: The CRC check code received and calculated by the servo drive differs from the check code in the data frame. • 0x0008: The parameter to be accessed does not exist. • 0x0010: The parameter written value exceeds the upper/lower limit. • 0x0080: The parameter being written is modifiable only in the stop state but the servo drive is in the operating state.	1	-	-	At display	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0C-16	Update parameter values written through CAN communication to EEPROM	0: Not updated to EEPROM 1: Updated to EEPROM, except parameters in groups H0B and H0D	-	0	Immediately	During running	PST
H0C-25	Modbus command response delay	0–5000	ms	1	Immediately	During running	PST
H0C-26	Sequence of Modbus communication data bits	0: High 16 bits before low 16 bits 1: Low 16 bits before high 16 bits	1	1	Immediately	During running	PST
H0C-30	Modbus error frame format	0: Old protocol 1: New protocol (standard protocol)	1	1	Immediately	During running	PST

5.14 Group H0D: Auxiliary Function Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H0D-00	Software reset	0: No operation 1: Enable	-	0	Immediately	At stop	-
H0D-01	Fault reset	0: No operation 1: Enable	-	0	Immediately	At stop	-
H0D-02	Offline inertia auto-tuning	-	-	-	Immediately	During running	-
H0D-03	Reserved	-	-	-	-	-	-
H0D-05	Emergency stop	0: No operation 1: Enable	-	0	Immediately	During running	-
H0D-11	Jog function	(with filter)	-	-	-	-	-
H0D-17	Forced DI/DO selection	0: No operation 1: Forced DI enabled, forced DO disabled 2: Forced DO enabled, forced DI disabled 3: Forced DI and DO enabled	-	0	Immediately	During running	-
H0D-18	Forced DI setting	0–0x01FF	-	0x01FF	Immediately	During running	-
H0D-19	Forced DO setting	0–0x001F	-	0	Immediately	During running	-
H0D-20	Absolute encoder reset selection	0: No operation 1: Reset encoder fault 2: Reset encoder fault and multi-turn data	-	0	Immediately	At stop	All

5.15 Group H11: Multi-Position Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H11-00	Multi-position operation mode	0: Individual operation (number of positions defined by H11-01) 1: Cyclic operation (number of positions defined by H11-01) 2: DI-based operation (selected through DI) 3: Cyclic operation (number of positions defined by H11-01) 5: Axis-controlled continuous operation	-	1	Immediately	At stop	P
H11-01	Number of displacement references in multi-position mode	1–16	-	1	Immediately	At stop	P
H11-02	Start displacement no. after pause	Active when H11-00 is set to 0, 1, 3 or 5 0: Continue to execute the unexecuted displacements 1: Start from displacement 1	-	0	Immediately	At stop	P
H11-03	Time unit	0: ms 1: s	-	0	Immediately	At stop	P
H11-04	Displacement reference type	0: Relative displacement reference 1: Absolute displacement reference	-	0	Immediately	During running	P
H11-05	Start displacement no. in sequential operation	0–16	-	0	Immediately	At stop	P
H11-09	Deceleration upon axis-control OFF	0–65535	ms	65535	Immediately	During running	P
H11-10	Start speed of displacement 1	0–6000	RPM	0	Immediately	During running	P
H11-11	Stop speed of displacement 1	0–6000	RPM	0	Immediately	During running	P
H11-12	Displacement 1	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-14	Maximum speed of displacement 1	1–6000	RPM	200	Immediately	During running	P
H11-15	Acceleration/ Deceleration time of displacement 1	0–65535	ms (s)	10	Immediately	During running	P
H11-16	Waiting time after displacement 1	0–10000	ms (s)	10	Immediately	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H11-17	Displacement 2	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-19	Maximum speed of displacement 2	1–6000	RPM	200	Immediately	During running	P
H11-20	Acceleration/ Deceleration time of displacement 2	0–65535	ms (s)	10	Immediately	During running	P
H11-21	Waiting time after displacement 2	0–10000	ms (s)	10	Immediately	During running	P
H11-22	Displacement 3	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-24	Maximum speed of displacement 3	1–6000	RPM	200	Immediately	During running	P
H11-25	Acceleration/ Deceleration time of displacement 3	0–65535	ms (s)	10	Immediately	During running	P
H11-26	Waiting time after displacement 3	0–10000	ms (s)	10	Immediately	During running	P
H11-27	Displacement 4	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-29	Maximum speed of displacement 4	1–6000	RPM	200	Immediately	During running	P
H11-30	Acceleration/ Deceleration time of displacement 4	0–65535	ms (s)	10	Immediately	During running	P
H11-31	Waiting time after displacement 4	0–10000	ms (s)	10	Immediately	During running	P
H11-32	Displacement 5	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-34	Maximum speed of displacement 5	1–6000	RPM	200	Immediately	During running	P
H11-35	Acceleration/ Deceleration time of displacement 5	0–65535	ms (s)	10	Immediately	During running	P
H11-36	Waiting time after displacement 5	0–10000	ms (s)	10	Immediately	During running	P
H11-37	Displacement 6	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-39	Maximum speed of displacement 6	1–6000	RPM	200	Immediately	During running	P
H11-40	Acceleration/ Deceleration time of displacement 6	0–65535	ms (s)	10	Immediately	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H11-41	Waiting time after displacement 6	0–10000	ms (s)	10	Immediately	During running	P
H11-42	Displacement 7	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-44	Maximum speed of displacement 7	1–6000	RPM	200	Immediately	During running	P
H11-45	Acceleration/ Deceleration time of displacement 7	0–65535	ms (s)	10	Immediately	During running	P
H11-46	Waiting time after displacement 7	0–10000	ms (s)	10	Immediately	During running	P
H11-47	Displacement 8	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-49	Maximum speed of displacement 8	1–6000	RPM	200	Immediately	During running	P
H11-50	Acceleration/ Deceleration time of displacement 8	0–65535	ms (s)	10	Immediately	During running	P
H11-51	Waiting time after displacement 8	0–10000	ms (s)	10	Immediately	During running	P
H11-52	Displacement 9	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-54	Maximum speed of displacement 9	1–6000	RPM	200	Immediately	During running	P
H11-55	Acceleration/ Deceleration time of displacement 9	0–65535	ms (s)	10	Immediately	During running	P
H11-56	Waiting time after displacement 9	0–10000	ms (s)	10	Immediately	During running	P
H11-57	Displacement 10	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-59	Maximum speed of displacement 10	1–6000	RPM	200	Immediately	During running	P
H11-60	Acceleration/ Deceleration time of displacement 10	0–65535	ms (s)	10	Immediately	During running	P
H11-61	Waiting time after displacement 10	0–10000	ms (s)	10	Immediately	During running	P
H11-62	Displacement 11	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-64	Maximum speed of displacement 11	1–6000	RPM	200	Immediately	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H11-65	Acceleration/ Deceleration time of displacement 11	0–65535	ms (s)	10	Immediately	During running	P
H11-66	Waiting time after displacement 11	0–10000	ms (s)	10	Immediately	During running	P
H11-67	Displacement 12	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-69	Maximum speed of displacement 12	1–6000	RPM	200	Immediately	During running	P
H11-70	Acceleration/ Deceleration time of displacement 12	0–65535	ms (s)	10	Immediately	During running	P
H11-71	Waiting time after displacement 12	0–10000	ms (s)	10	Immediately	During running	P
H11-72	Displacement 13	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-74	Maximum speed of displacement 13	1–6000	RPM	200	Immediately	During running	P
H11-75	Acceleration/ Deceleration time of displacement 13	0–65535	ms (s)	10	Immediately	During running	P
H11-76	Waiting time after displacement 13	0–10000	ms (s)	10	Immediately	During running	P
H11-77	Displacement 14	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-79	Maximum speed of displacement 14	1–6000	RPM	200	Immediately	During running	P
H11-80	Acceleration/ Deceleration time of displacement 14	0–65535	ms (s)	10	Immediately	During running	P
H11-81	Waiting time after displacement 14	0–10000	ms (s)	10	Immediately	During running	P
H11-82	Displacement 15	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P
H11-84	Maximum speed of displacement 15	1–6000	RPM	200	Immediately	During running	P
H11-85	Acceleration/ Deceleration time of displacement 15	0–65535	ms (s)	10	Immediately	During running	P
H11-86	Waiting time after displacement 15	0–10000	ms (s)	10	Immediately	During running	P
H11-87	Displacement 16	-1073741824 to +1073741824	Reference unit	10000	Immediately	During running	P

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H11-89	Maximum speed of displacement 16	1–6000	RPM	200	Immediately	During running	P
H11-90	Acceleration/ Deceleration time of displacement 16	0–65535	ms (s)	10	Immediately	During running	P
H11-91	Waiting time after displacement 16	0–10000	ms (s)	10	Immediately	During running	P

5.16 Group H12 Multi-Speed Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-00	Multi-speed operation mode	0: Individual operation (number of speeds defined by H12-01) 1: Cyclic operation (number of speeds defined by H12-01) 2: DI-based operation	-	1	Immediately	At stop	S
H12-01	Number of speed references in multi-speed operation	1–16	-	16	Immediately	At stop	S
H12-02	Operating time unit	0: sec 1: min	-	0	Immediately	During running	S
H12-03	Acceleration time 1	0–65535	ms	10	Immediately	During running	S
H12-04	Deceleration time 1	0–65535	ms	10	Immediately	During running	S
H12-05	Acceleration time 2	0–65535	ms	50	Immediately	During running	S
H12-06	Deceleration time 2	0–65535	ms	50	Immediately	During running	S
H12-07	Acceleration time 3	0–65535	ms	100	Immediately	During running	S
H12-08	Deceleration time 3	0–65535	ms	100	Immediately	During running	S
H12-09	Acceleration time 4	0–65535	ms	150	Immediately	During running	S
H12-10	Deceleration time 4	0–65535	ms	150	Immediately	During running	S
H12-20	Speed 1	-6000 to +6000	RPM	0	Immediately	During running	S
H12-21	Operating time of speed 1	0–6553.5	s(min)	5.0	Immediately	During running	S

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-22	Acceleration/ Deceleration time of speed 1	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-23	Speed 2	-6000 to +6000	RPM	100	Immediately	During running	S
H12-24	Operating time of speed 2	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-25	Acceleration/ Deceleration time of speed 2	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-26	Speed 3	-6000 to +6000	RPM	300	Immediately	During running	S
H12-27	Operating time of speed 3	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-28	Acceleration/ Deceleration time of speed 3	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-29	Speed 4	-6000 to +6000	RPM	500	Immediately	During running	S
H12-30	Operating time of speed 4	0–6553.5	s(min)	5.0	Immediately	During running	S

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-31	Acceleration/ Deceleration time of speed 4	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-32	Speed 5	-6000 to +6000	RPM	700	Immediately	During running	S
H12-33	Operating time of speed 5	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-34	Acceleration/ Deceleration time of speed 5	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-35	Speed 6	-6000 to +6000	RPM	900	Immediately	During running	S
H12-36	Operating time of speed 6	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-37	Acceleration/ Deceleration time of speed 6	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-38	Speed 7	-6000 to +6000	RPM	600	Immediately	During running	S
H12-39	Operating time of speed 7	0–6553.5	s(min)	5.0	Immediately	During running	S

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-40	Acceleration/ Deceleration time of speed 7	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-41	Speed 8	-6000 to +6000	RPM	300	Immediately	During running	S
H12-42	Operating time of speed 8	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-43	Acceleration/ Deceleration time of speed 8	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-44	Speed 9	-6000 to +6000	RPM	100	Immediately	During running	S
H12-45	Operating time of speed 9	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-46	Acceleration/ Deceleration time of speed 9	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-47	Speed 10	-6000 to +6000	RPM	-100	Immediately	During running	S
H12-48	Operating time of speed 10	0–6553.5	s(min)	5.0	Immediately	During running	S

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-49	Acceleration/ Deceleration time of speed 10	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-50	Speed 11	-6000 to +6000	RPM	-300	Immediately	During running	S
H12-51	Operating time of speed 11	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-52	Acceleration/ Deceleration time of speed 11	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-53	Speed 12	-6000 to +6000	RPM	-500	Immediately	During running	S
H12-54	Operating time of speed 12	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-55	Acceleration/ Deceleration time of speed 12	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-56	Speed 13	-6000 to +6000	RPM	-700	Immediately	During running	S
H12-57	Operating time of speed 13	0–6553.5	s(min)	5.0	Immediately	During running	S

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-58	Acceleration/ Deceleration time of speed 13	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-59	Speed 14	-6000 to +6000	RPM	-900	Immediately	During running	S
H12-60	Operating time of speed 14	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-61	Acceleration/ Deceleration time of speed 14	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-62	Speed 15	-6000 to +6000	RPM	-600	Immediately	During running	S
H12-63	Operating time of speed 15	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-64	Acceleration/ Deceleration time of speed 15	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S
H12-65	Speed 16	-6000 to +6000	RPM	-300	Immediately	During running	S

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H12-66	Operating time of speed 16	0–6553.5	s(min)	5.0	Immediately	During running	S
H12-67	Acceleration/ Deceleration time of speed 16	0: Zero acceleration/deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	-	0	Immediately	During running	S

5.17 Group H17: VDI/VDO Parameters

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H17-00	VDI1 function	0–41	-	0	At stop	During running	-
H17-01	VDI1 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-02	VDI2 function	0–41	-	0	At stop	During running	-
H17-03	VDI2 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-04	VDI3 function	0–41	-	0	At stop	During running	-
H17-05	VDI3 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-06	VDI4 function	0–41	-	0	At stop	During running	-
H17-07	VDI4 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-08	VDI5 function	0–41	-	0	At stop	During running	-
H17-09	VDI5 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H17-10	VDI6 function	0–41	-	0	At stop	During running	-
H17-11	VDI6 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-12	VDI7 function	0–41	-	0	At stop	During running	-
H17-13	VDI7 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-14	VDI8 function	0–41	-	0	At stop	During running	-
H17-15	VDI8 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-16	VDI9 function	0–41	-	0	At stop	During running	-
H17-17	VDI9 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-18	VDI10 function	0–41	-	0	At stop	During running	-
H17-19	VDI10 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-20	VDI11 function	0–41	-	0	At stop	During running	-
H17-21	VDI11 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-22	VDI12 function	0–41	-	0	At stop	During running	-
H17-23	VDI12 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-24	VDI13 function	0–41	-	0	At stop	During running	-
H17-25	VDI13 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-26	VDI14 function	0–41	-	0	At stop	During running	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H17-27	VDI14 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-28	VDI15 function	0–41	-	0	At stop	During running	-
H17-29	VDI15 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-30	VDI16 function	0–41	-	0	At stop	During running	
H17-31	VDI16 logic	0: Active when the written value is 1 1: Active when the written value changes from 0 to 1	-	0	At stop	During running	-
H17-32	VDO virtual level	-	-	-	-	At display	-
H17-33	VDO1 function	0–24	-	0	At stop	During running	-
H17-34	VDO1 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-35	VDO2 function	0–24	-	0	At stop	During running	-
H17-36	VDO2 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-37	VDO3 function	0–24	-	0	At stop	During running	-
H17-38	VDO3 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-39	VDO4 function	0–24	-	0	At stop	During running	-
H17-40	VDO4 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-41	VDO5 function	0–24	-	0	At stop	During running	-
H17-42	VDO5 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-43	VDO6 function	0–24	-	0	At stop	During running	-
H17-44	VDO6 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-45	VDO7 function	0–24	-	0	At stop	During running	-
H17-46	VDO7 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-47	VDO8 function	0–24	-	0	At stop	During running	-

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H17-48	VDO8 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-49	VDO9 function	0–24	-	0	At stop	During running	-
H17-50	VDO9 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-51	VDO10 function	0–24	-	0	At stop	During running	-
H17-52	VDO10 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-53	VOD11 function	0–24	-	0	At stop	During running	-
H17-54	VDO11 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-55	VDO12 function	0–24	-	0	At stop	During running	-
H17-56	VDO12 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-57	VDO13 function	0–24	-	0	At stop	During running	-
H17-58	VDO13 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-59	VDO14 function	0–24	-	0	At stop	During running	-
H17-60	VDO14 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-61	VDO15 function	0–24	-	0	At stop	During running	-
H17-62	VDO15 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-
H17-63	VDO16 function	0–24	-	0	At stop	During running	-
H17-64	VDO16 logic	0: Output 1 when active 1: Output 0 when active	-	0	At stop	During running	-

5.18 Group H30: Servo Variables Read Through Communication

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H30-00	Servo status read through communication	-	-	-	-	Read-only	PST
H30-01	DO function status 1 read through communication	-	-	-	-	Read-only	PST
H30-02	DO function status 2 read through communication	-	-	-	-	Read-only	PST

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H30-03	Input pulse reference sampling value read through communication	-	-	-	-	At display	PST
H30-04	DI status read through communication	-	-	-	-	At display	PST

5.19 Group H31: Servo Variables Set Through Communication

Para. No.	Name	Value Range	Unit	Default	Effective Time	Setting Condition	Related Mode
H31-00	VDI virtual level set through communication	0–65535	-	0	Immediately	During running	PST
H31-04	DO status set through communication	0–31	-	0	Immediately	During running	PST
H31-09	Speed reference set through communication	-6000.000 to +6000.000	RPM	0	Immediately	During running	S
H31-11	Torque reference set through communication	-100.000 to +100.000	%	0	Immediately	During running	T

5.20 DI/DO Function Definitions

Function No.	Name	Function	Description	Remarks
Input Signal Description				
FunIN.1	S-ON	Servo ON	Inactive: Servo motor disabled Active: Servo motor enabled upon power-on	The corresponding terminal logic must be level-triggered. The change of the corresponding DI/VDI or terminal logic is activated at next power-on.
FunIN.2	ALM-RST	Fault and warning reset	Inactive: Disabled Active: Enabled	Edge-triggered will be applied even if level-triggered is selected. To reset No. 1 and No. 2 resettable faults, switch off the S-ON signal first. The servo drive may, depending on the warning types, continue running after warning reset.
FunIN.3	GAIN-SEL	Gain switchover	• H08-09 = 1: • Inactive: Speed control loop being PI control • Active: Speed control loop being P control • H08-09 = 2: • Inactive: Fixed to the 1st gain set • Active: Fixed to the 2nd gain set	It is recommended that the corresponding terminal logic be level-triggered.

Function No.	Name	Function	Description	Remarks
FunIN.4	CMD-SEL	Main reference (A)/ Auxiliary reference (B) switchover	Inactive: Current reference being A B: Current reference being B	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.5	DIR-SEL	DI-based multi-speed operation direction	Inactive: Default reference direction Active: Opposite to the reference direction	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.6	CMD1	Multi-reference switchover 1	Used to select a reference from 16 references.	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.7	CMD2	Multi-reference switchover 2	Used to select a reference from 16 references.	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.8	CMD3	Multi-reference switchover 3	Used to select a reference from 16 references.	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.9	CMD4	Multi-reference switchover 4	Used to select a reference from 16 references.	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.10	M1-SEL	Mode switchover 1	Used to switch among speed control, position control, and torque control based on the selected control mode (H02-00 = 3/4/5).	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.11	M2-SEL	Mode switchover 2	Used to switch among speed control, position control, and torque control based on the selected control mode (H02-00 = 6).	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.12	ZCLAMP	Zero clamp	Active: Zero clamp enabled Inactive: Zero clamp disabled	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.13	INHIBIT	Position reference inhibit	Active: Reference pulse input inhibited Inactive: Reference pulse input allowed	Applies to internal and external position references. The corresponding terminal logic must be level-triggered.
FunIN.14	P-OT	Positive limit switch	Active: Forward drive inhibited Inactive: Forward drive allowed	Overtravel prevention applies when the machine moves beyond the limit. It is recommended that the corresponding terminal logic be level-triggered.
FunIN.15	N-OT	Negative limit switch	Overtravel prevention applies when the machine moves beyond the limit. Active: Reverse drive inhibited Inactive: Reverse drive allowed	It is recommended that the corresponding terminal logic be level-triggered.

Function No.	Name	Function	Description	Remarks
FunIN.16	P-CL	Positive external torque limit	The torque limit source is switched based on H07-07 (Torque limit source). H07-07 = 1: Active: Positive external torque limit activated Inactive: Positive internal torque limit activated	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.17	N-CL	Negative external torque limit	The torque limit source is switched based on H07-07 (Torque limit source). H07-07 = 1: Active: Negative external torque limit activated Inactive: Negative internal torque limit deactivated	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.18	JOGCMD+	Forward jog	Active: Input based on the reference Inactive: Reference input stopped	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.19	JOGCMD-	Reverse jog	Active: Input in reverse to the reference Inactive: Reference input stopped	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.20	POSSTEP	Step reference selection	Active: Execute step references Inactive: Reference being zero, staying in locked state	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.21	HX1	Hand wheel override signal 1	HX1 active, HX2 inactive: x 10 HX1 inactive, HX2 active: x 100 Others: x 1	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.22	HX2	Hand wheel override signal 2		
FunIN.23	HX_EN	Hand wheel enable signal	Inactive: Position control applied based on H05-00 (Position reference source) Active: Position control applied based on the hand wheel pulse signal received in the position control mode	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.24	GEAR_SEL	Electronic gear ratio switchover	Inactive: Electronic gear ratio 1 Active: Electronic gear ratio 2	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.25	TOQDirSel	Torque reference direction	Inactive: Forward Active: Reverse	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.26	SPDDirSel	Speed reference direction	Inactive: Forward Active: Reverse	It is recommended that the corresponding terminal logic be level-triggered.

Function No.	Name	Function	Description	Remarks
FunIN.27	POSDirSel	Position reference direction	Inactive: Actual position reference direction same as the set direction Active: Actual position reference direction opposite to the set direction	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.28	PosInSen	Multi-position reference selection	Inactive: Internal multi-position reference ignored Active: Internal multi-position reference started	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.29	XintFree	Interrupt positioning canceled	Inactive: Disabled Active: Enabled	-
FunIN.31	HomeSwitch	Home switch	Inactive: Not triggered Active: Triggered	The corresponding terminal logic must be level-triggered. Assign this function to a high-speed DI. If the logic is set to 2 (Rising edge-triggered), the servo drive forcibly changes it to 1 (Active high). If the logic is set to 3 (Falling edge-triggered), the servo drive forcibly changes it to 0 (Active low). If the logic is set to 4 (Rising/Falling edge-triggered), the servo drive forcibly changes it to 0 (Active low).
FunIN.32	HomingStart	Homing function	Inactive: Disabled Active: Enabled	-
FunIN.33	XintInhibit	Interrupt positioning inhibit	Active: Interrupt positioning inhibited Inactive: Interrupt positioning allowed	The corresponding terminal logic must be level-triggered. • If the logic is set to 2 (Rising edge-triggered), the servo drive forcibly changes it to 1 (Active high). • If the logic is set to 3 (Falling edge-triggered), the servo drive forcibly changes it to 0 (Active low). • If the logic is set to 4 (Rising/Falling edge-triggered), the servo drive forcibly changes it to 0 (Active low).
FunIN.34	Emergency Stop	Emergency stop	Active: Position lock applied after stop at zero speed Inactive: Current operating state unaffected	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.35	ClrPosErr	Position deviation clear	Active: Enable Inactive: Disable	It is recommended to assign this function to DI8 or DI9.
FunIN.36	V_LmtSel	Internal speed limit source	Inactive: H07-19 as internal speed limit Active: H07-20 as internal speed limit	It is recommended that the corresponding terminal logic be level-triggered.

Function No.	Name	Function	Description	Remarks
FunIN.37	Pulselnhibit	Pulse reference inhibit	When the position reference source is pulse reference (H05-00 = 0) in the position control mode: Inactive: Respond to pulse references Active: Not respond to pulse references	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.38	MultiBlockTrig	Axis control command write interrupted	When the position reference source is multi-position reference (H05-00 = 2) in the position control mode: Inactive: Command not written Active: Command written and interrupt generated	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.39	MultiBlockWr	Axis control command write uninterrupted	When the position reference source is multi-position reference (H05-00 = 2) in the position control mode: Inactive: Command not written Active: Command written and interrupt not generated	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.40	ClrCmdOkAndArrOk	Command cleared and positioning completed	Inactive: Command not cleared and positioning completed Active: Command cleared and positioning completed	It is recommended that the corresponding terminal logic be level-triggered.
FunIN.41	HomeRecord	Present position as the home	Inactive: Not triggered Active: Triggered	It is recommended that the corresponding terminal logic be level-triggered.
Output signal function				
FunOUT.1	S-RDY	Servo ready	The servo drive is ready to receive the S-ON signal. Active: Servo ready Inactive: Servo not ready	-
FunOUT.2	TGON	Motor rotation output	Inactive: Absolute value of filtered motor speed lower than H06-16 (Threshold of TGON signal) Active: Absolute value of filtered motor speed reaching H06-16 (Threshold of TGON signal)	-
FunOUT.3	ZERO	Zero speed	Inactive: The difference between the motor speed feedback and the reference value exceeds the threshold defined by H06-19. Active: The difference between the motor speed feedback and the reference value does not exceed the threshold defined by H06-19.	-

Function No.	Name	Function	Description	Remarks
FunOUT.4	V-CMP	Speed matching	Active when the absolute value of the difference between the motor speed and the speed reference lower than H06-17 (Threshold of V-Cmp signal) in the speed control mode	-
FunOUT.5	COIN	Positioning completed	Active when position deviation pulses reaching H05-21 (Threshold of positioning completed) in the position control mode	-
FunOUT.6	NEAR	Proximity	Active when position deviation pulses reaching H05-22 (Threshold of proximity) in the position control mode	-
FunOUT.7	C-LT	Torque limit	Torque limit acknowledge signal: Active: Motor torque limited Inactive: Motor torque unlimited	-
FunOUT.8	V-LT	Speed limit	Speed limit acknowledge signal in the torque control mode: Active: Motor speed limited Inactive: Motor speed unlimited	-
FunOUT.9	BK	Brake output	Brake signal output: Active: Brake released Inactive: Brake applied	-
FunOUT.10	WARN	Warning output	Warning output active (ON)	-
FunOUT.11	ALM	Fault output	Active upon fault event	-
FunOUT.12	ALMO1	Output 3-digit warning code	Output 3-digit warning code	-
FunOUT.13	ALMO2	Output 3-digit warning code	Output 3-digit warning code	-
FunOUT.14	ALMO3	Output 3-digit warning code	Output 3-digit warning code	-
FunOUT.15	Xintcoin	Interrupt positioning completed	Active: Interrupt positioning completed Inactive: Interrupt positioning not completed	-
FunOUT.16	HomeAttain	Homing output	Homing state: Active: Homing applied Inactive: Homing not applied	-
FunOUT.17	ElecHome Attain	Electrical homing output	Electrical homing state: Active: Electrical Homing applied Inactive: Electrical Homing not applied	-

Function No.	Name	Function	Description	Remarks
FunOUT.18	ToqReach	Torque reach output	Active: Torque absolute value reaching the setpoint Inactive: Torque absolute value lower than the setpoint	-
FunOUT.19	V-Arr	Speed reach output	Active: Speed feedback reaching the setpoint Inactive: Speed feedback not reaching the setpoint	-
FunOUT.20	AngIntRdy	Angle auto-tuning output	Active: Angle auto-tuning completed Inactive: Angle auto-tuning not completed	-
FunOUT.21	DB	Dynamic braking output	Active: Dynamic brake relay opened Inactive: Dynamic brake relay closed	-
FunOUT.22	CmdOk	Internal command output	Active: Internal command completed Inactive: Internal command not completed	-
FunOUT.23	WrNextBlockEn	Write next block enabled	Active: Writing the next block allowed Inactive: Writing the next block inhibited	-
FunOUT.24	McOk	Motion control output	Active: Motion control completed Inactive: Motion control not completed	-

Appendix: CANlink Enhanced Axis Control Parameters

Table –1 List of default parameters for enhanced axis control

Para. No.	Description	Default
H11-00	Multi-position operation mode	5: Axis-controlled continuous operation
H11-04	Displacement reference type	1: Absolute displacement reference
H11-05	Start displacement no. in sequential operation	1
H11-16	Waiting time after displacement 1	0
H05-00	Main position reference source	2: Multi-position reference (internal position reference)
H05-02	Pulses per revolution	10000
H05-30	Homing selection	1: Homing enabled by signal input from DI
H05-31	Homing mode	1: Reverse homing, home switch as the deceleration point and the home
H05-32	Speed in high-speed searching for the home switch signal	200 RPM
H05-33	Speed in low-speed searching for the home switch signal	20 RPM
H05-35	Homing time limit	30000 ms
H05-40	Mechanical home offset and action upon overtravel	3: H05-36 (Mechanical home offset) used as the relative offset after homing, reverse homing applied automatically upon overtravel
H09-00	Gain auto-tuning mode	1: Standard stiffness level mode
H09-02	Adaptive notch mode	1: Only one adaptive notch (3rd notch) activated
H0C-09	Communication VDI	1: Enable
H0C-11	Communication VDO	1: Enable
H04-00	DO1 function	0: No assignment
H04-02	DO2 function	0: No assignment
H04-04	DO3 function	9: Brake
H04-06	DO4 function	0: No assignment
H04-08	VDO5 function	0: No assignment
H03-06	DI3 function	0: No assignment
H03-08	DI4 function	0: No assignment
H03-10	DI5 function	0: No assignment
H17-00	VDI1 function	1: Servo ON
H17-02	VDI2 function	18: Forward jog
H17-04	VDI3 function	19: Reverse jog
H17-06	VDI4 function	28: Multi-position reference selection
H17-08	VDI5 function	32: Homing enable
H17-10	VDI6 function	34: Emergency stop
H17-12	VDI7 function	2: Fault and warning reset signal
H17-14	VDI8 function	38: Command-write interrupted
H17-15	VDI8 logic	1: Active when the written value changes from 0 to 1
H17-16	VDI9 function	Active: Command-write not interrupted
H17-17	VDI9 logic	1: Active when the written value changes from 0 to 1
H17-18	VDI10 function	40: Positioning and reference completed signal cleared

Note

See the following for how to use CANlink enhanced axis control function:

1. Set H02-31 to 1 to restore parameters to default values.
2. Set H11-00 to 5. If the previous value of H11-00 is not 5, setting it to 5 enables enhanced axis control function. Parameter involved will be correlated automatically. See the detailed setpoints in the preceding table.
3. If the previous value of H11-00 is 5, setting it to a value other than 5 restores all the parameters listed in the preceding table to default values.

Shenzhen Inovance Technology Co., Ltd.

Shenzhen Inovance Technology Co., Ltd.
Add.: Building E, Hongwei Industry Park, Liuxian Road, Baocheng No. 70 Zone, Bao'an District, Shenzhen
Tel: +86-755-2979 9595
Fax: +86-755-2961 9897
http://www.inovance.com

Suzhou Inovance Technology Co., Ltd.

Add.: No. 16 Youxiang Road, Yuexi Town, Wuzhong District, Suzhou 215104, P.R. China
Tel: +86-755-2979 6666
Fax: +86-755-2961 6720
http://wwww.inovance.com

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