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SV670N-INT Series Servo Drive

User Guide

Industrial Automation | New Energy Vehicle | Intelligent Elevator | Intelligent Robot | Digital Energy | Rail Transit

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Waste Disposal

Storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel can identify the risks of the product/system and prevent possible dangers.

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Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

Thank you for purchasing the SV670N-INT series servo drive developed by Inovance.

The SV670N-INT series servo drive is a premium servo drive featuring high speed, high precision, high performance, and commissioning-free functions. It is compliant with CE, UL, KC, EAC, and UKCA certifications. It is specially suitable for scenarios that require premium functions.

The drive covers a power range from 0.05 kW to 7.5 kW and supports the EtherCAT communication protocol. Used together with the host controller, multiple servo drives can be networked for operation through EtherCAT. The servo drive comes with adaptive stiffness level setting, inertia auto-tuning, and vibration suppression functions for easy use. The servo drive, together with an MS1 series high-response servo motor (with ultra-low, low or medium inertia) equipped with a 23-bit single-turn/multi-turn absolute encoder or a third-party servo motor, serves to deliver a quiet and stable operation and accurate process control through the fully closed-loop function and internal process segment function.

In addition, the drive supports STO function as an optional function. It is equipped with dynamic braking function as standard. This servo drive serves to achieve quick and accurate position control, speed control, and torque control through high-performance solutions for automation equipment in industries such as electronic manufacturing, lithium batteries, manipulators, packaging, and machine tools.

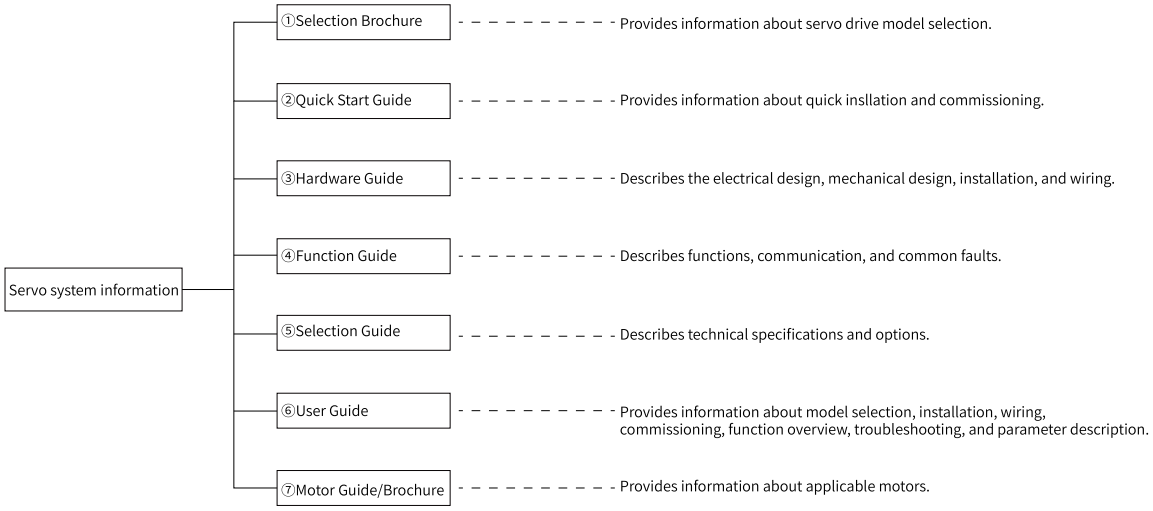
This guide provides information about selection, installation, commissioning, functions, troubleshooting, and parameters of the equipment.

Note

The speed unit of a servo motor and a DDR motor in RPM, and that of a DDL motor is mm/s. RPM is used throughout this guide. Unless otherwise specified, an RPM value is equivalent to the mm/s one.

More data

The following figure and table describe related documents of the drive.



No.	Name	Code	Description
①	SV670-INT Series Flagship Servo Drive	19120413	Provides information about product selection, including the list of supporting components, technical data on the drive and motor, and cable selection guide.
②	SV670N-INT Series Servo Quick Start Guide	PS00021336	Introduces product models, installation, and quick commissioning.
③	SV670N-INT Series Servo Drive Hardware Guide	PS00021335	Describes the installation and wiring of the drive, including pre-installation preparation, unpacking and handling, mechanical installation, and electrical installation.
④	SV670N-INT Series Servo Drive Function Guide	PS00021337	Describes the functions and parameters of the product, including function overview, basic servo functions, tuning instructions, and parameter descriptions.
⑤	SV670N-INT Series Servo Drive Selection Guide	PS00021334	Provides information about product selection, including the list of supporting components, technical data on the drive and motor, and cable selection guide.
⑥	SV670N-INT Series Servo Drive User Guide	PS00021333	Provides information about model selection, installation, commissioning, function, troubleshooting and parameters of the equipment.
⑦	MS1-R Series Servo Motor Selection Guide	PS00004605	Describes product information, general specifications, motor selection, cable selection, certification categories and standards of the motor.
	MS1-R Series Servo Motor Installation Guide	PS00005407	Describes the installation of the motor, including motor installation flowcharts, wiring, unpacking and handling, mechanical installation, and electrical installation.

Revision history

Date	Version	Revision
July 2026	B01	• Updated section "Safety Parameters": Retained content only about the STO function. • Made minor corrections.
June 2026	B00	**Added:** • Motor information. • Content to section "ETune". • Section "Voltage Injection Auto-tuning". **Updated:** • Made structural optimization. • Updated the installation/ambient temperatures. • Updated the list of applicable cables. • Updated section "Magnetic Pole Auto-tuning". • Updated section "Auto-tuning Process". • Updated section "STune". • Updated topic "Fuse (CE)". • Updated topic "Fuse (UL)". • Update topic "Circuit Breaker (CE)". • Update topic "Circuit Breaker (UL)". • Updated section "Instructions for Installing the EMC Filter": Added instructions for connecting multiple drives to one EMC filter. • Updated topics "Parameter Description" and "Troubleshooting". • Updated section "Fully-closed Loop": Added safety precautions for the fully closed-loop function. • Updated section "EMC Filter": Added configurations for connecting multiple drives to one EMC filter. • Updated section "Certifications, Directives, and Standards": Updated the functional safety certifications. • Updated section "Routine Maintenance Checklist": Added the brake circuit to the routine checklist. • Updated section "Installing the Motor Management Library": Updated the overload thermal threshold current in Motor overload protection method 3. **Deleted:** • Content about P-type models. • Information about the built-in brake. • Information about the built-in brake in some descriptions. • Information about H02.16. • Content related to FunIN.25, FunIN.26, and FunIN.27.
December 2024	A00	Initial release.

Access to the guide

This guide is not delivered with the product. You can download the PDF version in the following ways:

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- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by using the product for unintended functions
- Damage caused by using the product outside the specified scope
- Secondary damage caused by force majeure (natural disaster, earthquake, lightning strike)

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For details, see the Warranty Card.

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1 Fundamental Safety Instructions

1.1 General Safety Instructions

Safety disclaimer

- This chapter provides essential safety instructions for proper use of the product. Before using this product, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe injury, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" signs in this guide are only supplements to the safety instructions, and do not reflect all safety instructions to be followed.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper use.

Safety levels and definitions

	Indicates that failure to comply with the notice can result in death or severe personal injury.
	Indicates that failure to comply with the notice may result in severe personal injury or death.
	Indicates that failure to comply with the notice may result in minor or moderate injury or equipment damage.

Safety Instructions

- Drawings in the guide are sometimes shown without covers or protective guards. Install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Operators must take mechanical protection measures to protect their safety. For example, they must wear safety shoes, safety clothing, safety glasses, protective gloves and sleeves, or other protective equipment.

Unpacking



- Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking.
- Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking.
- Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.



- 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 for damage, rust, or dents on the surfaces of the product and accessories upon unpacking.
- After unpacking, check the contents against the packing list to ensure that the equipment and accessories are in the correct quantities, and that all documentation is complete.

Storage and transportation



- Large or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply could result in personal injury or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely connected components may fall off and result in personal injury or equipment damage.
- Do not stand or stay below the product which is being hoisted.
- 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 could result in personal injury or equipment damage.



- Handle the equipment with care and mind your step during transportation to prevent personal injury 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 could result in personal injury.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply could result in equipment damage.
- Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration.
- Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time.
- Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation.
- Do not transport the equipment with other devices or items that may impact or cause harm to the equipment.

Installation
 • Ensure peripheral power distribution requirements are met, and select air switches, fuses, cables, and cable terminals correctly. • Use standard torque for screw fastening, and use appropriate terminal crimping tools for crimping terminals. • Ensure heat dissipation requirements are met and design inlet and outlet airflow duct properly. • Avoid environments with dripping water, conductive foreign objects (such as carbon fiber filaments, conductive metal dust, metal chips), and salt spray. **Failure to follow the above instructions will pose a fire risk.** • This equipment must be operated only by trained and qualified electrical personnel. Non-professionals must not operate this equipment.
 • Read through the guide and safety instructions before installation. • Do not install this equipment in places with strong electric or magnetic field. • Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply may 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 an enclosed environment (such as a cabinet or case), use cooling devices (such as fans or air conditioners) to cool the space and meet the installation environment requirements. Failure to do so can result in equipment overtemperature or fire accidents. • 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 terminal device, appropriate guard devices (guards for fire, electrical, and mechanical protection) meeting applicable IEC standards and local laws and regulations must be provided. • 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 may result in a fire. **The edges of the equipment metal enclosure are sharp. Note the following precautions during installation to avoid personal injury or cable damage:** • When performing installation, handling, or maintenance operations, always wear cut-resistant gloves. • Avoid direct skin contact with enclosure edges and cut surfaces during operation.
 • Cover the top of the product 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 product and causing faults. After installation, remove the cloth or paper on top of the product 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, switch off all power supplies of the device. Wait for at least the time designated on the 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 can result in electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board and other exposed live parts with power on. Failure to comply can result in electric shock.
- Make sure that the equipment and product are grounded properly. Failure to comply can result in the risk of electric shock.

WARNING

- Do not connect the power cable to output terminals of the equipment or product. Failure to comply may cause equipment damage or even a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used must comply with corresponding cross-sectional area and shielding requirements. The shield of the shielded cable must be grounded at one end properly.
- Tighten the terminal screws with the torque specified in the user guide. Insufficient or excessive torque may cause overheating and damage to the joint, which could result in fire.
- After wiring is done, ensure that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply could result in electric shock or equipment damage.
- Avoid direct skin contact with enclosure edges and cut surfaces during operation.
- Route cables carefully during wiring. Avoid pressing them against sharp edges, which may cause squeezing or cutting. It is recommended to use protective sleeves or route cables away from such edges.
- If the enclosure has a protective film, remove it only after installation is completed and all work involving sharp edges has been finished.

Caution

- During wiring, follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap. Failure to comply may result in damage to the equipment or its internal circuits.
- Use the shielded twisted pair cable to wire the control circuit, and connect the shield to the grounding terminal of the equipment. Failure to comply may 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.
- Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Do not touch any terminals, or remove any part of the equipment at power-on. Failure to comply will result in an electric shock.

WARNING

- Perform a trial run after wiring and parameter setting to ensure that 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. Using an incorrect supply voltage may cause a fire.
- Before power-on, check that no one is near the equipment, motor, or other mechanical parts. Failure to comply may result in personal injuries or even death.

Operation

DANGER

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

WARNING

- Do not touch the enclosure, fan, or resistor with bare hands. Failure to comply may result in burns.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.
- If the branch circuit protective device applies, it indicates that the fault current may have been cut off. To reduce the risk of fire or electric shock, inspect the current-carrying components and other components of the drive. Replace any damaged components immediately. If the current component of the overload relay is burned out, replace the entire overload relay.

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 may result in an electric shock.
- Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.
- When using a permanent magnet (PM) motor, do not touch the motor terminals while the motor is rotating, because induced voltage may be present at the terminals even after the product is powered off. Failure to comply may result in 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 may result in electric shock.
- Before inspection or repair, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.

WARNING

- Submit a request for repair based on the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage circuit breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply could result in equipment damage, personal injury, or death.
- Troubleshooting and repair of a faulty or damaged equipment must be performed by professionals based on the repair instructions, with the repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not use damaged equipment. Failure to comply could result in death, personal injury, or severe equipment damage.
- Recheck the wiring and reset the parameters after equipment replacement.

Disposal
WARNING • Dispose of the retired equipment in accordance with applicable national regulations and standards. Failure to comply could result in property damage, personal injury, or death. • Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

Additional precautions

Cautions for the dynamic brake

- Dynamic braking can only be used for emergency shutdown in case of equipment faults and sudden power failure. Do not trigger faults or power failure frequently.
- When the equipment is operating at high speed, ensure an interval of more than five minutes for the dynamic braking function. Failure to comply may result in damage to the internal dynamic braking circuit.
- Dynamic braking is common in rotating mechanical structures. For example, when a motor has stopped running, it keeps rotating due to the inertia of its load. In this case, this motor is in the generating state and short circuit current passes through the dynamic brake. If this situation continues, the drive, and even the motor, may be burned.

Precautions for grounding

When applications such as electric welders are involved, connect the PE cable of the motor to the screws of the die-cast structural component of the drive. Failure to comply may result in motor burnout.

Effects of electromagnetic fields on medical implants

The motor is hazardous to persons wearing medical implants nearby the equipment.

The electromagnetic field affects the function of medical implants being used (such as cardiac pacemakers), resulting in malfunctioning.

Safety labels

To ensure safe operation, comply with equipment-related safety labels. The following table describes the meanings of the safety labels.

Safety labels	Description
	• Connect the grounding terminal properly to prevent electric shock. Read through the guide and follow the safety instructions. • Do not touch terminals within 15 minutes after power-off to prevent electric shock. • Do not touch the heatsink when power is on. Failure to comply may result in burn.

1.2 Industrial Information Security

The product provides interfaces for network connection and data transmission. To protect factories, systems, machines, and networks from cyberattacks, it is essential to implement proper protection mechanism for industrial security.

Customers are responsible for providing and maintaining a secure connection between the product and their network or any other network to protect their factories, systems, machines, and networks from unauthorized access. Such systems or machines can be connected to an enterprise network or the Internet only when a secure connection is established and appropriate security measures (such as using antivirus software or installing firewalls) are in place.

Inovance continuously develops and improves its products and solutions to enhance safety. It is strongly recommended that you update the product promptly and always use the latest version.

Caution

Malware (such as viruses, Trojans, and worms) can bring the device into an unsafe operating state, resulting in death, serious injury, and property damage. Observe the following precautions:

- Always use the latest software version. If the product version is no longer supported or the latest version is not used, you will be exposed to increased risk of cyber attacks.
- Develop and maintain appropriate protective measures (including but not limited to antivirus software, firewalls, WAF, IPS/IDS, situational awareness system, identity authentication, and data encryption) to prevent the files in mobile storage devices from being damaged by malware, and to protect the products, networks, systems, and interfaces from unauthorized access, tampering, hacking, data leakage, or information theft.
- Check all safety-related interfaces and settings after commissioning.

1.3 Certifications, Directives, and Standards

Table 1–1 Compliance list

Certification	Directive		Standard
CE certification	EMC directive	2014/30/EU	EN IEC 61800-3
	LVD directive	2014/35/EU	EN 61800-5-1 EN 60034-1 EN 60034-5
	RoHS directive	2011/65/EU 2015/863/EU	-
Functional safety certification	Machinery directive	2006/42/EC	EN ISO 13849-1 EN 61800-5-2 EN IEC 62061
	-		EN-AR-N 61508
UL/cUL certification	-		UL61800-5-1 CSA C22.2 No.274 UL 1004-1 UL 1004-6 CSA C22.2 No.100

Note

The product certifications comply with the directives and standards specified in the preceding table.

1.4 Terms and Abbreviations

Terms and Abbreviations	Description
Cat.	Category of safety components in the control system. The categories are B, 1, 2, 3, and 4.
CCF	Common cause failure
DCavg	The average diagnostic coverage (%).
DTI	The diagnostic test interval time.
SFF	The safe failure fraction.
HFT	The hardware fault tolerance.
PFH	The probability of a dangerous failure per hour.
PL	The performance level.
SC	The system capability.
SIL	The safety integrity level.
T_1	The proof test interval.
DI	Digital input.
DO	Digital output.
PCB	Printed circuit board.
MCU	The microcomputer unit.
FPGA	The field programmable gate array.
MTTFd	The mean time to dangerous failure.
SRA	The safety-related application parameter.
nSRA	The non-SRA parameter.
STO	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start. When the STO function is enabled, the servo stops according to the stop mode (H02.08).

1.5 Safety Parameters

The STO function is available only in -FS models.

Item	Safety parameters
SIL	SIL3, IEC 61508 Maximum SIL3, EN IEC 62061
PFH	STO safety function: PFH ≤ 0.73×10^{-9} [1/h] (0.73% of SIL3)
Cat.	3, EN ISO 13849-1
PL	e, EN ISO 13849-1
DTI	STO safety function: ≤ 10 ms
MTTFd	645.64 years
DCavg	≥ 90% (medium)
T_1	20 years
Mission time	20 years
HFT	1
SC	SC3

Item	Safety parameters
MTTR	0 hour
MRT	0 hour
Operation mode	High demand or continuous mode
Device type	Type B

Note

- See ISO13849-2: 2012 for failure modes of devices.
- Failure sharing of different failure modes of each device.
- See SN29500 for failure rate of each device.
- The average maximum ambient temperature is 55 °C.
- To know more about the λ_{DD} and λ_{DU} of each safety function, contact Inovance technical support staff.

2 Model Selection

2.1 List of Model Selection (Compatible with MS1-R-INT Series Servo Motor)

Servo motor				Servo drive SV670-INT			
Models without brake	Models with brake	Flange size (mm)	Capacity (kW)	Voltage class:	Size	Model	No.
Ratings of MS1H1 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H1-05B30CB-A330R-INT	MS1H1-05B30CB-A332R-INT	40	0.05	Single-phase/ Three-phase 200 V	A	S1R6	00002
MS1H1-10B30CB-A330R-INT	MS1H1-10B30CB-A332R-INT	40	0.1	Single-phase/ Three-phase 200 V			
MS1H1-20B30CB-A331R-INT	MS1H1-20B30CB-A334R-INT	60	0.2	Single-phase/ Three-phase 200 V			
MS1H1-40B30CB-A331R-INT	MS1H1-40B30CB-A334R-INT	60	0.4	Single-phase/ Three-phase 200 V		S2R8	00003
MS1H1-55B30CB-A331R-INT	-	80	0.55	Single-phase/ Three-phase 200 V	C	S5R5	00005
MS1H1-75B30CB-A331R-INT	MS1H1-75B30CB-A334R-INT	80	0.75	Single-phase/ Three-phase 200 V		S5R5	00005
MS1H1-10C30CB-A331R-INT	MS1H1-10C30CB-A334R-INT	80	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006
Ratings of MS1H2 (n_N= 3000 rpm, n_{max}= 6000 rpm) series motors							
MS1H2-10C30CB-A331R-INT	MS1H2-10C30CB-A334R-INT	100	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006
MS1H2-10C30CD-A331R-INT	MS1H2-10C30CD-A334R-INT	100	1.0	Three-phase 400 V		T3R5	10001
MS1H2-15C30CB-A331R-INT	MS1H2-15C30CB-A334R-INT	100	1.5	Single-phase/ Three-phase 200 V	D	S012	00007
MS1H2-15C30CD-A331R-INT	MS1H2-15C30CD-A334R-INT	100	1.5	Three-phase 400 V	C	T5R4	10002
MS1H2-20C30CB-A331R-INT	MS1H2-20C30CB-A334R-INT	100	2.0	Three-phase 200 V	E	S018	00008

Servo motor				Servo drive SV670-INT			
Models without brake	Models with brake	Flange size (mm)	Capacity (kW)	Voltage class:	Size	Model	No.
MS1H2-20C30CD-A331R-INT	MS1H2-20C30CD-A334R-INT	100	2.0	Three-phase 400 V	D	T8R4	10003
MS1H2-25C30CB-A331R-INT	MS1H2-25C30CB-A334R-INT	100	2.5	Three-phase 200 V	E	S022	00009
MS1H2-25C30CD-A331R-INT	MS1H2-25C30CD-A334R-INT	100	2.5	Three-phase 400 V	D	T012	10004
MS1H2-30C30CB-A331R-INT	MS1H2-30C30CB-A334R-INT	130	3.0	Three-phase 200 V	E	S022	00009
MS1H2-30C30CD-A331R-INT	MS1H2-30C30CD-A334R-INT	130	3.0	Three-phase 400 V	D	T012	10004
MS1H2-40C30CB-A331R-INT	MS1H2-40C30CB-A334R-INT	130	4.0	Three-phase 200 V	E	S027	00010
MS1H2-40C30CD-A331R-INT	MS1H2-40C30CD-A334R-INT	130	4.0	Three-phase 400 V	E	T017	10005
MS1H2-50C30CB-A331R-INT	MS1H2-50C30CB-A334R-INT	130	5.0	Three-phase 200 V		S027	00010
MS1H2-50C30CD-A331R-INT	MS1H2-50C30CD-A334R-INT	130	5.0	Three-phase 400 V		T021	10006
Ratings of MS1H3 (n_N=1500 rpm, n_{max}= 4500 rpm) series motors							
MS1H3-85B15CB-A331R-INT	MS1H3-85B15CB-A334R-INT	130	0.85	Single-phase/ Three-phase 200 V	C	S7R6	00006
MS1H3-85B15CD-A331R-INT	MS1H3-85B15CD-A334R-INT	130	0.85	Three-phase 400 V		T3R5	10001
MS1H3-13C15CB-A331R-INT	MS1H3-13C15CB-A334R-INT	130	1.3	Single-phase/ Three-phase 200 V	D	S012	00007
MS1H3-13C15CD-A331R-INT	MS1H3-13C15CD-A334R-INT	130	1.3	Three-phase 400 V	C	T5R4	10002
MS1H3-18C15CB-A331R-INT	MS1H3-18C15CB-A334R-INT	130	1.8	Three-phase 200 V	D	S012	00007
MS1H3-18C15CD-A331R-INT	MS1H3-18C15CD-A334R-INT	130	1.8	Three-phase 400 V	D	T8R4	10003
MS1H3-29C15CB-A331R-INT	MS1H3-29C15CB-A334R-INT	180	2.9	Three-phase 200 V	E	S022	00009
MS1H3-29C15CD-A331R-INT	MS1H3-29C15CD-A334R-INT	180	2.9	Three-phase 400 V	D	T012	10004
MS1H3-44C15CB-A331R-INT	MS1H3-44C15CB-A334R-INT	180	4.4	Three-phase 200 V	E	S027	00010

Servo motor				Servo drive SV670-INT			
Models without brake	Models with brake	Flange size (mm)	Capacity (kW)	Voltage class:	Size	Model	No.
MS1H3-44C15CD-A331R-INT	MS1H3-44C15CD-A334R-INT	180	4.4	Three-phase 400 V	E	T017	10005
MS1H3-55C15CD-A331R-INT	MS1H3-55C15CD-A334R-INT	180	5.5	Three-phase 400 V		T021	10006
MS1H3-75C15CD-A331R-INT	MS1H3-75C15CD-A334R-INT	180	7.5	Three-phase 400 V		T026	10007
Ratings of MS1H4 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H4-05B30CB-A330R-INT	MS1H4-05B30CB-A332R-INT	40	0.05	Single-phase/ Three-phase 200 V	A	S1R6	00002
MS1H4-10B30CB-A330R-INT	MS1H4-10B30CB-A332R-INT	40	0.1	Single-phase/ Three-phase 200 V		S1R6	00002
MS1H4-05B30CB-A331R-INT	MS1H4-05B30CB-A334R-INT	40	0.05	Single-phase/ Three-phase 200 V		S1R6	00002
MS1H4-10B30CB-A331R-INT	MS1H4-10B30CB-A334R-INT	40	0.1	Single-phase/ Three-phase 200 V		S1R6	00002
MS1H4-20B30CB-A331R-INT	MS1H4-20B30CB-A334R-INT	60	0.2	Single-phase/ Three-phase 200 V		S1R6	00002
MS1H4-40B30CB-A331R-INT	MS1H4-40B30CB-A334R-INT	60	0.4	Single-phase/ Three-phase 200 V		S2R8	00003
MS1H4-55B30CB-A331R-INT	-	80	0.55	Single-phase/ Three-phase 200 V	C	S5R5	00005
MS1H4-75B30CB-A331R-INT	MS1H4-75B30CB-A334R-INT	80	0.75	Single-phase/ Three-phase 200 V		S5R5	00005
MS1H4-10C30CB-A331R-INT	MS1H4-10C30CB-A334R-INT	80	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006

Note

- [1] See the torque-speed characteristics curves of this model for drives with S012 in *MS1-R Series Servo Motor Selection Guide*.
- [2] See the torque-speed characteristics curves of this model for drives with T8R4 in *MS1-R Series Servo Motor Selection Guide*.
- [3] See the torque-speed characteristics curves of this model for drives with T017 in *MS1-R Series Servo Motor Selection Guide*.

2.2 Model Selection (Compatible with MS1-R-INT Series Servo Motor with Battery-free Encoder)

Servo motor				Servo drive SV670-INT Series			
Model without brake	Model with brake	Frame size (mm)	Capacity (kW)	Voltage class	Size	Recommended model	No.
Ratings of MS1H1 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H1-05B30CB-V330R-INT	MS1H1-05B30CB-V332R-INT	40	0.05	Single-phase/ Three-phase 200 V	A	S1R6	00002
MS1H1-10B30CB-V330R-INT	MS1H1-10B30CB-V332R-INT	40	0.1	Single-phase/ Three-phase 200 V			
MS1H1-20B30CB-V331R-INT	MS1H1-20B30CB-V334R-INT	60	0.2	Single-phase/ Three-phase 200 V			
MS1H1-40B30CB-V331R-INT	MS1H1-40B30CB-V334R-INT	60	0.4	Single-phase/ Three-phase 200 V		S2R8	00003
MS1H1-55B30CB-V331R-INT	-	80	0.55	Single-phase/ Three-phase 200 V	C	S5R5	00005
MS1H1-75B30CB-V331R-INT	MS1H1-75B30CB-V334R-INT	80	0.75	Single-phase/ Three-phase 200 V		S5R5	00005
MS1H1-10C30CB-V331R-INT	MS1H1-10C30CB-V334R-INT	80	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006
Ratings of MS1H2 (n_N= 3000 rpm, n_{max}= 6000 rpm) series motors							
MS1H2-10C30CB-V331R-INT	MS1H2-10C30CB-V334R-INT	100	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006
MS1H2-10C30CD-V331R-INT	MS1H2-10C30CD-V334R-INT	100	1.0	Three-phase 400 V		T3R5	10001
MS1H2-15C30CB-V331R-INT	MS1H2-15C30CB-V334R-INT	100	1.5	Single-phase/ Three-phase 200 V	D	S012	00007
MS1H2-15C30CD-V331R-INT	MS1H2-15C30CD-V334R-INT	100	1.5	Three-phase 400 V	C	T5R4	10002
MS1H2-20C30CB-V331R-INT	MS1H2-20C30CB-V334R-INT	100	2.0	Three-phase 200 V	E	S018[1]	00008
MS1H2-20C30CD-V331R-INT	MS1H2-20C30CD-V334R-INT	100	2.0	Three-phase 400 V	D	T8R4	10003
MS1H2-25C30CB-V331R-INT	MS1H2-25C30CB-V334R-INT	100	2.5	Three-phase 200 V	E	S022	00009

Servo motor				Servo drive SV670-INT Series			
Model without brake	Model with brake	Frame size (mm)	Capacity (kW)	Voltage class	Size	Recommended model	No.
MS1H2-25C30CD-V331R-INT	MS1H2-25C30CD-V334R-INT	100	2.5	Three-phase 400 V	D	T012[2]	10004
MS1H2-30C30CB-V331R-INT	MS1H2-30C30CB-V334R-INT	130	3.0	Three-phase 200 V	E	S022	00009
MS1H2-30C30CD-V331R-INT	MS1H2-30C30CD-V334R-INT	130	3.0	Three-phase 400 V	D	T012	10004
MS1H2-40C30CB-V331R-INT	MS1H2-40C30CB-V334R-INT	130	4.0	Three-phase 200 V	E	S027	00010
MS1H2-40C30CD-V331R-INT	MS1H2-40C30CD-V334R-INT	130	4.0	Three-phase 400 V	E	T017	10005
MS1H2-50C30CB-V331R-INT	MS1H2-50C30CB-V334R-INT	130	5.0	Three-phase 200 V		S027	00010
MS1H2-50C30CD-V331R-INT	MS1H2-50C30CD-V334R-INT	130	5.0	Three-phase 400 V		T021[3]	10006
Ratings of MS1H3 (n_N=1500 rpm, n_{max}= 4500 rpm) series motors							
MS1H3-85B15CB-V331R-INT	MS1H3-85B15CB-V334R-INT	130	0.85	Single-phase/ Three-phase 200 V	C	S7R6	00006
MS1H3-85B15CD-V331R-INT	MS1H3-85B15CD-V334R-INT	130	0.85	Three-phase 400 V		T3R5	10001
MS1H3-13C15CB-V331R-INT	MS1H3-13C15CB-V334R-INT	130	1.3	Single-phase/ Three-phase 200 V	D	S012	00007
MS1H3-13C15CD-V331R-INT	MS1H3-13C15CD-V334R-INT	130	1.3	Three-phase 400 V	C	T5R4	10002
MS1H3-18C15CB-V331R-INT	MS1H3-18C15CB-V334R-INT	130	1.8	Three-phase 200 V	D	S012	00007
MS1H3-18C15CD-V331R-INT	MS1H3-18C15CD-V334R-INT	130	1.8	Three-phase 400 V	D	T8R4	10003
MS1H3-29C15CB-V331R-INT	MS1H3-29C15CB-V334R-INT	180	2.9	Three-phase 200 V	E	S022	00009
MS1H3-29C15CD-V331R-INT	MS1H3-29C15CD-V334R-INT	180	2.9	Three-phase 400 V	D	T012	10004
MS1H3-44C15CB-V331R-INT	MS1H3-44C15CB-V334R-INT	180	4.4	Three-phase 200 V	E	S027	00010
MS1H3-44C15CD-V331R-INT	MS1H3-44C15CD-V334R-INT	180	4.4	Three-phase 400 V	E	T017	10005
MS1H3-55C15CD-V331R-INT	MS1H3-55C15CD-V334R-INT	180	5.5	Three-phase 400 V		T021	10006
MS1H3-75C15CD-V331R-INT	MS1H3-75C15CD-V334R-INT	180	7.5	Three-phase 400 V		T026	10007

Servo motor				Servo drive SV670-INT Series			
Model without brake	Model with brake	Frame size (mm)	Capacity (kW)	Voltage class	Size	Recommended model	No.
Ratings of MS1H4 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H4-05B30CB-V330R-INT	MS1H4-05B30CB-V332R-INT	40	0.05	Single-phase/ Three-phase 200 V	A	S1R6	00002
MS1H4-05B30CB-V331R-INT	MS1H4-05B30CB-V334R-INT	40	0.05	Single-phase/ Three-phase 200 V			
MS1H4-10B30CB-V332R-INT	MS1H4-10B30CB-V332R-INT	40	0.1	Single-phase/ Three-phase 200 V			
MS1H4-10B30CB-V334R-INT	MS1H4-10B30CB-V334R-INT	40	0.1	Single-phase/ Three-phase 200 V			
MS1H4-20B30CB-V331R-INT	MS1H4-20B30CB-V334R-INT	60	0.2	Single-phase/ Three-phase 200 V			
MS1H4-40B30CB-V331R-INT	MS1H4-40B30CB-V334R-INT	60	0.4	Single-phase/ Three-phase 200 V		S2R8	00003
MS1H4-55B30CB-V331R-INT	-	80	0.55	Single-phase/ Three-phase 200 V	C	S5R5	00005
MS1H4-75B30CB-V331R-INT	MS1H4-75B30CB-V334R-INT	80	0.75	Single-phase/ Three-phase 200 V		S5R5	00005
MS1H4-10C30CB-V331R-INT	MS1H4-10C30CB-V334R-INT	80	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006

Note

- [1] See the torque-speed characteristics curves of this model for drives with S012. The drive parameters does not change.
- [2] See the torque-speed characteristics curves of this model for drives with T8R4. The drive parameters does not change.
- [3] See the torque-speed characteristics curves of this model for drives with T017. The drive parameters does not change.
- [4] See the torque-speed characteristics curves of this model for drives with S018. The drive parameters does not change.
- Models of drives:
  - S - 200 V voltage class
  - T - 400 V voltage class
  - 1R6 - Rated output current = 1.6 A; 2R8 - Rated output current = 2.8 A…; 026 - Rated output current = 26 A; 027 - Rated output current = 27 A
- Different motors match different series of servo drives. The maximum speed and maximum torque output of the motor vary slightly. See the selection guide of the servo drive for details.
- Servo motors designed to work with 23-bit (V3) or 26-bit (V6) encoders have the same dimensions.
- The MS1-R series motors equipped with the V6/V3/A6/A3 encoders have the same dimensions.

2.3 List of Motor Model Selection (Compatible with LMC Linear Module)

Motor model	Servo drive model SV670-INT series	Power cable length (m)				
		3	5	8	10	12
LMC88100Y1-INT LMC88-130Y1-INT LMC88-185Y1-INT LMC88-240Y1-INT	S5R5	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC118-130Y1-INT LMC118-185Y1-INT	S5R5	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC118-240Y2-INT	S7R6	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC118-185Y3-INT LMC118-355Y3-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150-10.0-TTS-2-INT	S6-L-M150-12.0-TTS-2-INT
LMC168-185Y1-INT	S5R5	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC168-130Y2-INT LMC168-240Y2-INT	S7R6	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC168-185Y3-INT LMC168-240Y4-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150-10.0-TTS-2-INT	S6-L-M150-12.0-TTS-2-INT
LMC188-240Y2-INT	S7R6	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT

Motor model	Servo drive model SV670-INT series	Power cable length (m)				
		3	5	8	10	12
LMC188-355Y3-INT LMC188-240Y4-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150-10.0-TTS-2-INT	S6-L-M150-12.0-TTS-2-INT
LMC188-355Y6-INT	S021	S6-L-M040-3.0-TTS-2-INT	S6-L-M040-5.0-TTS-2-INT	S6-L-M040-8.0-TTS-2-INT	S6-L-M040-10.0-TTS-2-INT	S6-L-M040-12.0-TTS-2-INT
LMC228-240Y4-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150- 10.0-TTS-2-INT	S6-L-M150- 12.0-TTS-2-INT
LMC228-290Y5-INT	S017	S6-L-M040-3.0-TTS-2-INT	S6-L-M040-5.0-TTS-2-INT	S6-L-M040-8.0-TTS-2-INT	S6-L-M040- 10.0-TTS-2-INT	S6-L-M040- 12.0-TTS-2-INT

2.4 List of Motor Model Selection (Compatible with MP Series Torque Motor)

Motor model	Servo drive SV670-INT series	Extension power cable length (3 m)	Extension power cable length (5 m)	Extension power cable length (10 m)
MP1-112F10AB-U313X-INT	S2R8	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
MP1-140S10BB-U323X-INT	S012	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
MP1-175S11BB-U333X-INT	S012	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
MP1-220S15BB-U323X-INT	S012	S6-L-M0BD-3.0-INT	S6-L-M0BD-5.0-INT	S6-L-M0BD-10.0-INT
MP1-220S30BD-U323X-INT	T021	S6-L-M0BD-3.0-INT	S6-L-M0BD-5.0-INT	S6-L-M0BD-10.0-INT
MP1-220S30BD-U323L-C-INT	T026	S6-L-M0BD-3.0-INT	S6-L-M0BD-5.0-INT	S6-L-M0BD-10.0-INT

2.5 List of Motor Model Selection (Compatible with ISM Series Torque Motor)

Motor model	Servo drive SV670-INT series	Extension power cable length (3 m)	Extension power cable length (5 m)	Extension power cable length (10 m)
ISMT1-160F12AB-A113X-INT	S2R8	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
ISMT1-160F12AB-A133X-INT				
ISMT1-160F45AB-A133X-INT				

3 Product Information

3.1 Drive

3.1.1 Model and Nameplate

Model description

SV670 ① N ② S ③ 2R8 ④ I ⑤ - FS ⑥ - INT ⑦

① **Product series** SV670: SV670 general-purpose servo drive	④ **Rated output current**		⑤ **Model configuration** I: Standard type
② **Product type** N: EtherCAT communication type	S: 200 V	1R6: 1.6 A 2R8: 2.8 A 5R5: 5.5 A 7R6: 7.6 A 012: 12.0 A 018: 18.0 A 022: 22.0 A 027: 27.0 A	⑥ **Non-standard functions** Blank: Standard FS: Functional safety models only come with STO
③ **Voltage class** S: 200 V T: 400V	T: 400V	3R5: 3.5 A 5R4: 5.4 A 8R4: 8.4 A 012: 12.0 A 017: 17.0 A 021: 21.0 A 026: 26.0 A	⑦ **Model configuration** INT: General (global version)

Nameplate description

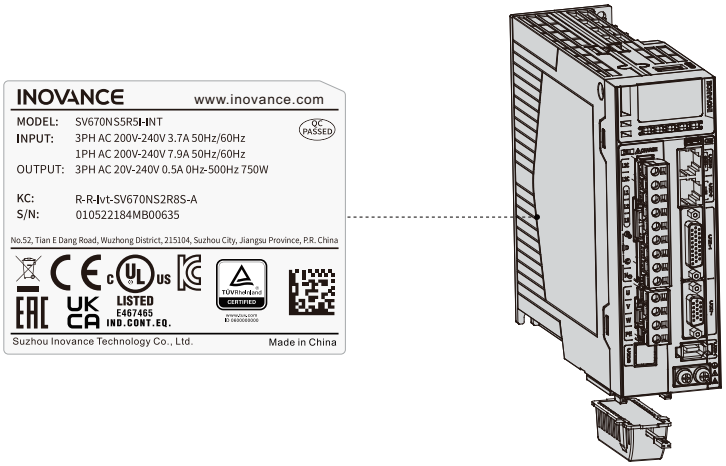


Figure 3-1 Nameplate

Encryption of the production serial number

01050202 4 S 7 00001
① ② ③ ④ ⑤

① **Internal code** Product material code	③ **Year** 9: 2009 A: 2010 ... S: 2024 ... Note: I, L, O, and Q are skipped.	⑤ **Lot number** 00001: 1st in current month 00002: 2nd in current month 00003: 3rd in current month ... Range: 00001 to 99999
② **Manufacturer code** 4: Suzhou Inovance	④ **Month** 1: January 2: February ... A: October B: November C: December	

Example: S/N 010502024S700001 indicates the drive is manufactured in July, 2024.

3.1.2 Components

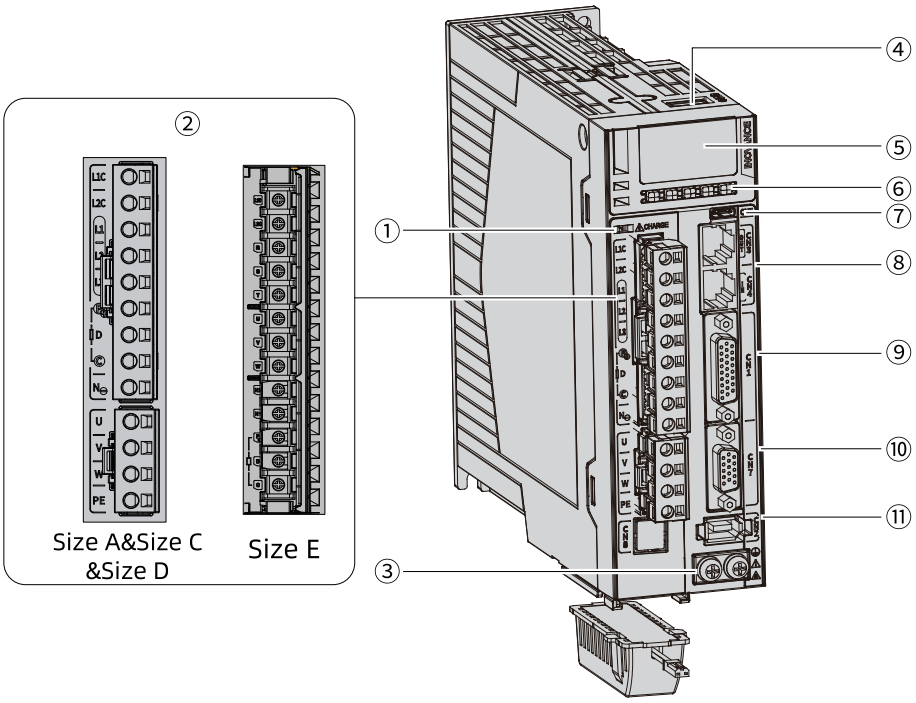


Figure 3-2 Servo drive components

Table 3–1 Description of servo drive components

No.	Component		Description
①	CHARGE (bus voltage indicator)		Indicates that electric charges are present in the bus capacitor. When the indicator turns on, charges possibly still exist in the internal capacitor of the servo unit, even if the power supply of the main circuit is OFF. To prevent electric shock, do not touch the power supply terminals when this indicator lights up.
② (Size A, Size C, and Size D)	Main circuit terminal	L1C, L2C (control circuit power input terminals)	Input the control circuit power supply according to the rated voltage class on the nameplate.
		L1, L2, L3 (main circuit power input terminals)[1]	Input the control circuit power supply according to the rated voltage class on the nameplate.
		P⊕, D, and C (terminals for connecting an external braking resistor)[2]	Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor between terminals P⊕ and C.
		P ⊕ , N ⊖ (servo bus terminals)	Used by the common DC bus for multiple servo drives.
		U, V, W, PE (terminals for connecting the servo motor)	Used to connect the U, V, and W phases and grounding terminal of the motor.

No.	Component		Description
② (Size E)	Main circuit terminal	L1C, L2C (control circuit power input terminals)	Input the control circuit power supply according to the rated voltage class on the nameplate.
		R, S, and T (main circuit power input terminals)[1]	Input the control circuit power supply according to the rated voltage class on the nameplate.
		P⊕, D, C (terminals for connecting external braking resistor)	Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor between terminals P⊕ and C.
		N2, N1 (terminals for connecting external reactor)	Terminals N1 and N2 are jumpered by default. To suppress harmonics in the power supply, remove the jumper between terminals N1 and N2 first and connect an external DC reactor between terminals N1 and N2.
		U, V, W (terminals for connecting the servo motor)	Used to connect the U, V, and W phases of the motor.
③	Servo drive grounding terminal		Connected to the grounding terminal of the power supply for grounding purpose.
④	CN6 STO safety function terminal[1]		Connected to external functional safety signals for functional safety purpose.
⑤	LED display		A 5-digit 8-segment LED display that shows the operation state and parameter setting of the servo system.
⑥	Keys		M: Used to switch parameters in sequence. ▲: Increases the value of the blinking bit. ▲: Decreases the value of the blinking bit. ◀◀: Shifts the blinking bit leftwards (Press and hold: Move to the next page when the displayed number exceeds five digits). S: Saves modifications and enters the next menu.
⑦	CN5 (communication terminal)		Supports online upgrade and commissioning with the software tool when the drive is powered on.
⑧	CN3, CN4 (EtherCAT communication terminals)		CN4 (IN): Connected to the master or the last slave. CN3 (OUT): Connected to the next slave.
⑨	CN1 (control terminal)		Used by reference input signals and other I/O signals.
⑩	CN7 (encoder feedback terminal)		Supports communication-type encoders and pulse-type encoders.
⑪	CN2 (encoder feedback terminal)		Connected to the motor encoder terminal.

Note

- The built-in braking resistor or jumper bar is not available in model S2R8. If an external braking resistor is required, connect it between terminals P⊕ and C.
- [1]: The CN6 STO safety function terminal is available only to non-standard models (-FS).

3.2 MS1-R-INT Series Servo Motor

3.2.1 Model and Nameplate

Model

MS1 H1 - 75B 30C B - A3 3 1 R - INT
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① **MS1 series servo motor**	② **Inertia and capacity** H1: Low inertia, small capacity H2: Low inertia, medium capacity H3: Medium inertia, medium capacity H4: Medium inertia, small capacity	③ **Rated power (W)** Comprised of one letter and two digits B: × 10 C: × 100 Example: 75B means 750 W.
④ **Rated speed (rpm)** Comprised of one letter and two digits B: × 10 C: × 100 Example: 30C means 3,000 rpm.	⑤ **Voltage class** B: 200 V D: 400 V	⑥ **Encoder type** Comprised of one letter and one digit A6: 26-bit multi-turn absolute encoder S6: functional safety type 26-bit multi-turn absolute encoder A3: 23-bit multi-turn absolute encoder U2: 20-bit single-turn absolute encoder (for 25-flange motors)
⑦ **Shaft connection mode** 3: Solid shaft, with key and threaded hole	⑧ **Brake, reducer, and oil sealing** 0: Without oil seal or brake 1: With oil seal, without brake 2: Without oil seal, with brake 4: With oil seal and brake	⑨ **Sub-series No.** R: R version ⑩ **Customized function** INT: International version

Note

- The description of the model only describes the naming conventions and does not recommend the specific motor models. For details of the model selection, see the Model Selection chapter.
- If you have other customized requirements, contact Inovance.

Nameplate description

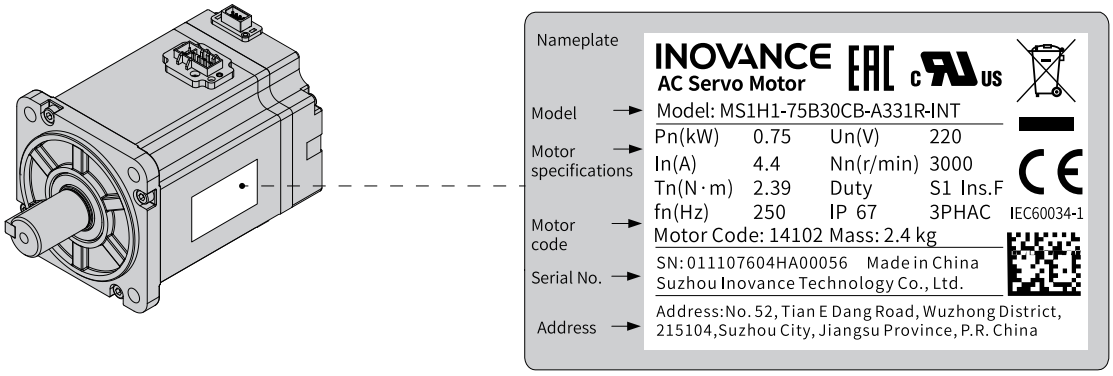


Figure 3-3 Model and Nameplate

3.2.2 Components

Motor (40-flange)

- **Terminal-type servo motor**

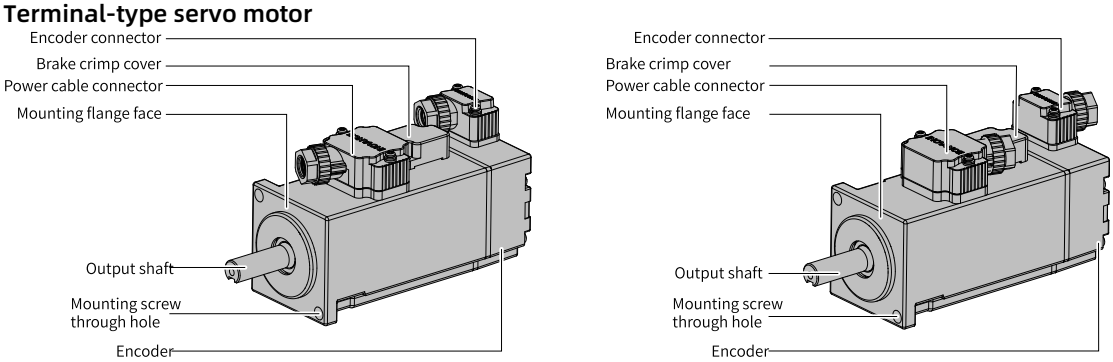


Figure 3-4 Components of terminal-type servo motors (Left: motor with front cable outlet; Right: motor with rear cable outlet)

- **Flying leads type servo motors**

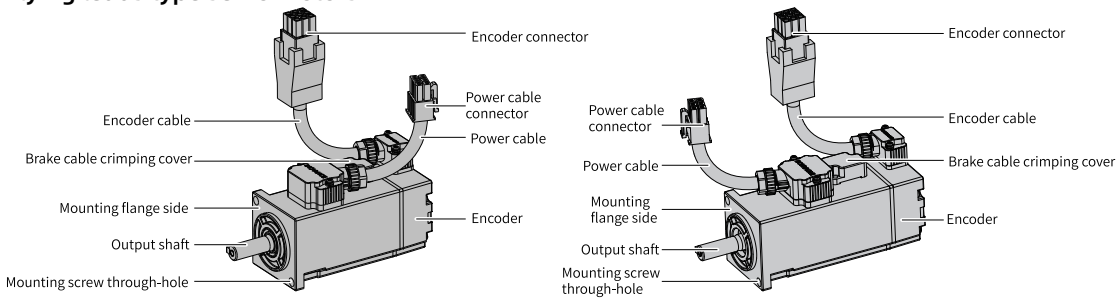


Figure 3-5 Components of the flying leads motor (left: 50 W flying leads motor, right: 100 W flying leads motor)

Note

- For 50 W terminal-type models, use rear outlet for power cables.
- For 100 W models, if the mounting flange face is internally stepped type, only terminal-type models can be used, which are equipped with power cables with rear outlet.
- For details, see the motor dimension diagrams.

Motor (60- and 80-flange)

- **Terminal-type servo motor**

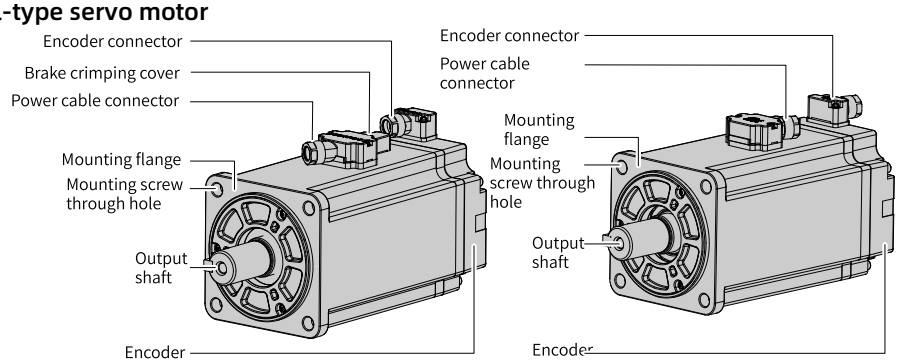


Figure 3-6 Components of terminal-type servo motors (Left: motor with front cable outlet; Right: motor with rear cable outlet)

- **Flying leads type servo motors**

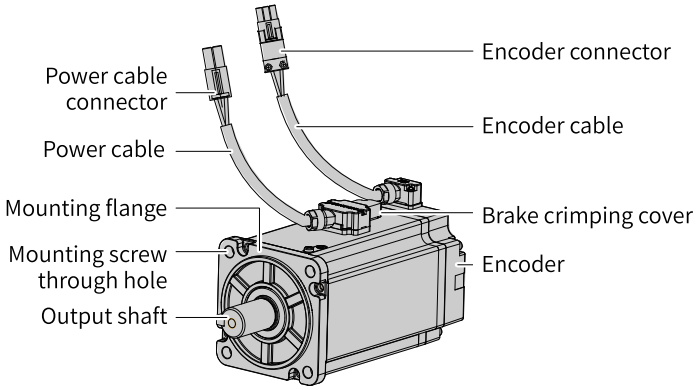


Figure 3-7 Components of the flying leads motor (front cable outlet as standard)

Motor (100-, 130- and 180-flange)

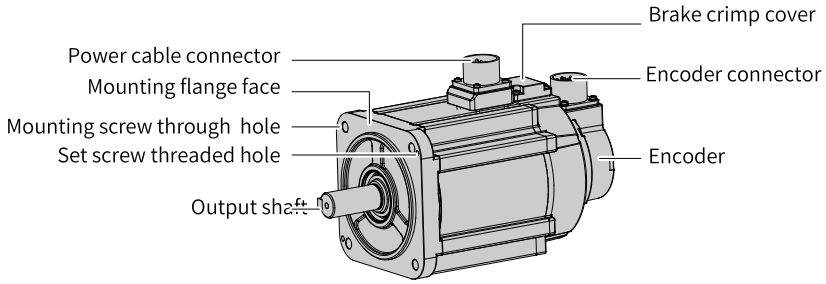


Figure 3-8 Components of servo drives in frame sizes 100/130/180

3.3 MS1-R Series Servo Motor with Battery-free Encoder

3.3.1 Model and Nameplate

Model Description

MS1 H1 - 75B 30C B - V3 3 1 R - INT
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① **MS1 Series Servo Motor**	② **Inertia and capacity** H1: Low inertia, small capacity H2: Low inertia, medium capacity H3: Medium inertia, medium capacity H4: Medium inertia, small capacity	③ **Rated Power (W)** Comprised of one letter and two digits B: x 10 C: x 100 Example: 75B indicates 750 W.
④ **Rated speed (rpm)** Comprised of one letter and two digits B: x 10 C: x 100 Example: 30C indicates 3,000 rpm.	⑤ **Voltage class** B: 200 V D: 400 V	⑥ **Encoder type** Comprised of one letter and one digit V6: Battery-less 26-bit multi-turn absolute encoder V3: Battery-less 23-bit multi-turn absolute encoder
⑦ **Shaft connection mode** 3: Solid shaft, with key and threaded hole	⑧ **Brake, reducer, and oil seal** 0: Without oil seal or brake 1: With oil seal but no brake 2: With brake but no oil seal 4: With oil seal and brake	⑨ **Sub-series No.** R: R version ⑩ **Custom function** INT: Global version

Note

- The description of the model only describes the naming conventions and does not recommend the specific motor models. For details of the model selection, see the Model Selection chapter.
- If you have other customized requirements, contact Inovance.

Nameplate description

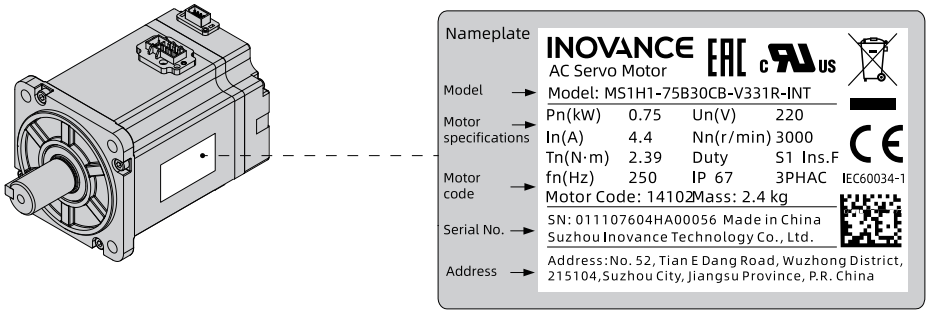


Figure 3-9 Model and Nameplate

3.3.2 Components

Motor (frame sizes 40/60/80)

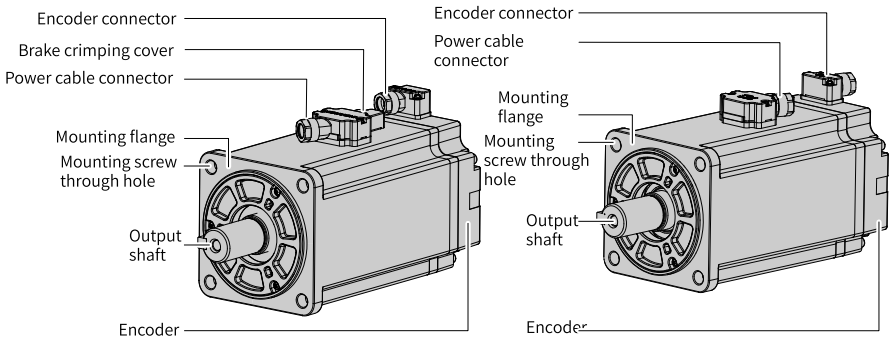


Figure 3-10 Components of servo drives in frame sizes 40/60/80 (Left: motor with front cable outlet; Right: motor with rear cable outlet)

Note

- For 50 W terminal-type models, use rear outlet for power cables.
- For 100 W models, if the mounting flange face is internally stepped type, only terminal-type models can be used, which are equipped with power cables with rear outlet.

Motor (frame sizes 100/ 130/180)

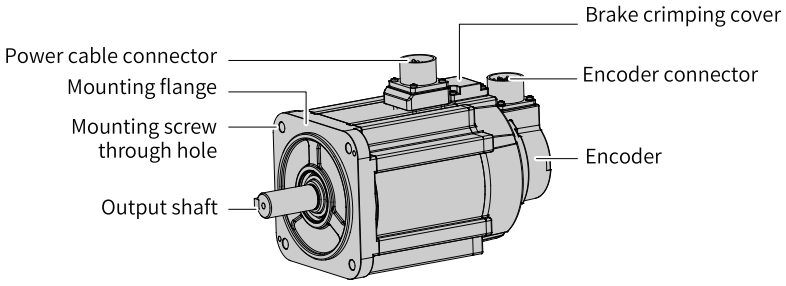


Figure 3-11 Components of servo drives in frame sizes 100/130/180

3.4 ISM Series Torque Motor

3.4.1 Model description

ISM ① T ② 1 ③ - 160 ④ F ⑤ 12A ⑥ B ⑦ - A1 ⑧ 3 ⑨ 3 ⑩ X ⑪ - INT ⑫

① **Product family** ISM: Motor	⑥ **Maximum torque (N·m)** One letter and two digits A: x 1 B: x 10 C: x 100 D: x 1000 E: x 10000 Example: 12A: 12N·m	⑨ **Installation accuracy** The mechanical deviation must be lower than this value in both the axial and radial directions. 1: Must not exceed 5 μm 2: Must not exceed 10 μm 3: Must not exceed 30 μm
② **Product type** T: torque motor		
③ **Generation** 1: G1 2: G2		
④ **Frame size** 85: Diameter of 85 mm 160: Diameter of 160 mm 208: Diameter of 208 mm 264: Diameter of 264 mm	⑦ **Voltage class (V)** B: 200 V D: 400 V	⑩ **Connector type** 1: Connector 2: Cable gland - Straight outlet of 3 m 3: Cable gland - Straight outlet of 0.3 m
⑤ **Basic structure** S: Standard, cylindrical mounting flange F: Flange, rectangle mounting flange	⑧ **Encoder type** One letter and one digit A1: 23-bit single-turn absolute encoder A3: 64-bit sine-cosine absolute encoder with Hiperface A5: 128-bit sine-cosine absolute encoder with Hiperface	⑪ **Cooling method** X: Natural cooling F: Fan cooling L: Water-cooling ⑫ **Model configuration** INT: Global version

3.4.2 Components

ISMT1-160F12AB-A133X-INT

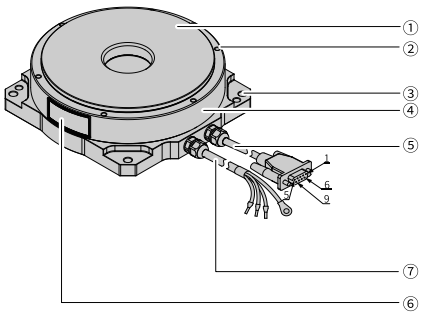
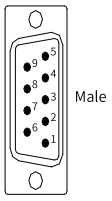


Figure 3-12 Components of ISMT1-160F12AB-A133X-INT

Table 3–2 Motor Components

<table>
<tr><th>No.</th><th>Component</th><th>Description</th></tr>
<tr><td>①</td><td>Mounting flange for rotary platen</td><td>The mounting flange that is used to install the load-side rotary platen.</td></tr>
<tr><td>②</td><td>Rotary platen positioning pin hole</td><td>The positioning pin holes that are used to install the rotary platen.</td></tr>
<tr><td>③</td><td>Stator installation pin hole</td><td>The pin holes that are used to install the stator.</td></tr>
<tr><td>④</td><td>Rotary platen</td><td>The DDR rotor.</td></tr>
<tr><td>⑤</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assignment</td><td>SIN+</td><td>SIN-</td><td>COS+</td><td>CO-S-</td><td>-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assignment</td><td>DATA+/Z+</td><td>DATA-/Z-</td><td>GND</td><td colspan="2">+Vcc</td></tr>
</table>


</td></tr>
<tr><td>⑥</td><td>Nameplate</td><td>The motor specifications.</td></tr>
<tr><td>⑦</td><td>Power cable</td><td>
<table>
<tr><td>Conductor color</td><td>White</td><td>Black</td><td>Red</td><td>Yellow/Green</td></tr>
<tr><td>Description</td><td>U</td><td>V</td><td>W</td><td>Grounding</td></tr>
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ISMT1-160F45AB-A133X-INT

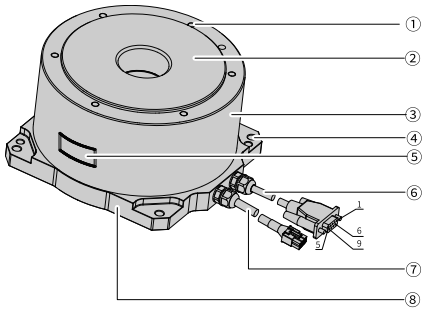
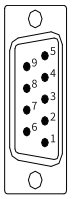


Figure 3-13 Components of ISMT1-160F45AB-A133X-INT

Table 3–3 Motor Components

No.	Component	Description
①	Rotary platen positioning pin hole	The positioning pin holes that are used to install the rotary platen.
②	Mounting flange for rotary platen	The mounting flange that is used to install the load-side rotary platen.
③	Rotary platen	The DDR rotor.
④	Stator installation pin hole	The pin holes that are used to install the stator.
⑤	Nameplate	The motor specifications.

<table>
<tr><th>No.</th><th>Component</th><th>Description</th></tr>
<tr><td>⑥</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assign-ment</td><td>SIN+</td><td>SIN-</td><td>COS+</td><td>CO-S-</td><td>-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assign-ment</td><td>DA-TA +/Z+</td><td>DA-TA-/ Z-</td><td>GND</td><td colspan="2">+Vcc</td></tr>
</table>


</td></tr>
<tr><td>⑦</td><td>Power cable</td><td>
<table>
<tr><td>Conductor color</td><td>White</td><td>Black</td><td>Red</td><td>Yellow/ Green</td></tr>
<tr><td>Description</td><td>U</td><td>V</td><td>W</td><td>Ground-ing</td></tr>
</table>
</td></tr>
<tr><td>⑧</td><td>Stator</td><td>The motor stator.</td></tr>
</table>

3.5 MP Series Torque Motor

3.5.1 Model Description

M P 1 - 112 F 10A B - U3 1 3 X - INT
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

① **Product family** M: Motor	⑥ **Maximum torque (N·m)** One letter and two digits A: x 1 B: x 10 C: x 100 D: x 1000 E: x 10000 Example: 12A: 12N·m	⑨ **Installation accuracy** The mechanical deviation must be lower than this value in both the axial and radial directions. 0: Must not exceed 3 μm 1: Must not exceed 5 μm 2: Must not exceed 10 μm 3: Must not exceed 30 μm
② **Product type** P: Torque motor (DDR)		
③ **Product Code** 1: G1 2: G2		
④ **Frame size** 112: Diameter of 112 mm 140: Diameter of 140 mm 160: Diameter of 160 mm 175: Diameter of 175 mm 220: Diameter of 220 mm	⑦ **Voltage class (V)** B: 200 V D: 400 V	⑩ **Connector type** 1: Metal aviation plug 2: Cable gland - Straight outlet of 3 m (U-type terminal) 3: Cable gland - Straight outlet of 0.3 m (6-pin plastic terminal) 4: Cable gland - Straight outlet of 3 m (pin terminal)

⑤ **Basic structure**	⑧ **Encoder type**	⑪ **Cooling method**
S: Standard mounting flange, cylindrical F: Mounting flange, rectangle	One letter and one digit U3: 23-bit single-turn absolute encoder U4: 64-bit sine-cosine absolute encoder with Hiperface U5: 128-bit sine-cosine absolute encoder with Hiperface	X: Natural cooling F: Fan cooling L: Water-cooling ⑫ **Model configuration** INT: Global version

3.5.2 Components

MP1-175S11BB-U333X-INT

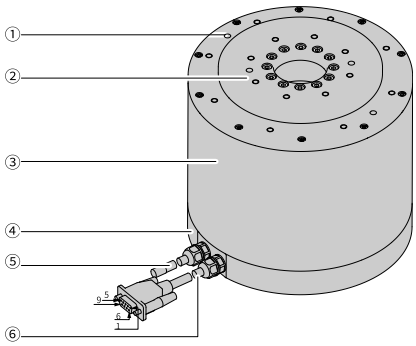
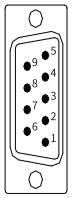


Figure 3-14 Components of MP1-175S11BB-U333X-INT

Table 3–4 Motor Components

No.	Component	Description
①	Rotary platen positioning pin hole	The positioning pin holes that are used to install the rotary platen.
②	Mounting flange for rotary platen	The mounting flange that is used to install the load-side rotary platen.
③	Rotary platen	The DDR rotor.
④	Stator	The motor stator.
⑤	Power cable	<table><tr><td>Conductor color</td><td>White</td><td>Black</td><td>Red</td><td>Yellow/ Green</td></tr><tr><td>Description</td><td>U</td><td>V</td><td>W</td><td>Ground-ing</td></tr></table>
⑥	Signal cable	<table><tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Pin assign-ment</td><td>PS+</td><td>PS-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr><tr><td>Pin assign-ment</td><td>-</td><td>+5V</td><td>GND</td><td colspan="2">-</td></tr></table>  Male

MP1-112F10AB-U313X-INT

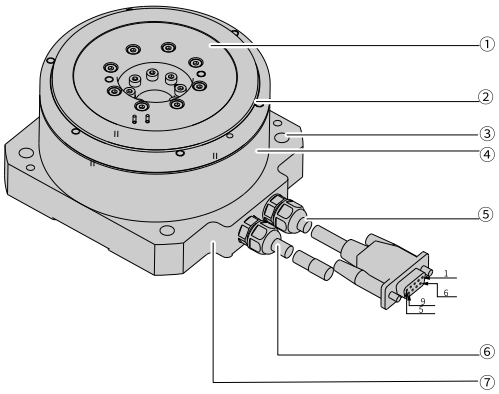
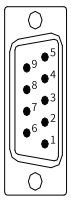


Figure 3-15 Components of MP1-112F10AB-U313X-INT

Table 3–5 Motor Components

<table>
<tr><th>No.</th><th>Component</th><th>Description</th></tr>
<tr><td>①</td><td>Mounting flange for rotary platen</td><td>The mounting flange that is used to install the load-side rotary platen.</td></tr>
<tr><td>②</td><td>Rotary platen positioning pin hole</td><td>The positioning pin holes that are used to install the rotary platen.</td></tr>
<tr><td>③</td><td>Stator installation pin hole</td><td>The pin holes that are used to install the stator.</td></tr>
<tr><td>④</td><td>Rotary platen</td><td>The DDR rotor.</td></tr>
<tr><td>⑤</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assign-ment</td><td>PS+</td><td>PS-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assign-ment</td><td>-</td><td>+5V</td><td>GND</td><td colspan="2">-</td></tr>
</table>


</td></tr>
<tr><td>⑥</td><td>Power cable</td><td>
<table>
<tr><td>Conductor color</td><td>White</td><td>Black</td><td>Red</td><td>Yellow/ Green</td></tr>
<tr><td>Description</td><td>U</td><td>V</td><td>W</td><td>Ground-ing</td></tr>
</table>
</td></tr>
<tr><td>⑦</td><td>Stator</td><td>The motor stator.</td></tr>
</table>

MP1-220S30BD-U323L-INT

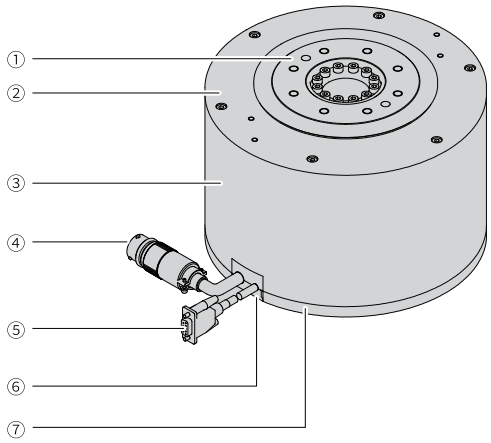
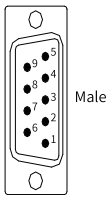


Figure 3-16 Components of MP1-220S30BD-U323L-INT

Table 3–6 Motor Components

<table>
<tr><th>No.</th><th>Component</th><th>Description</th></tr>
<tr><td>①</td><td>Payload mounting pallet</td><td>The mounting flange that is used to install the load-side rotary platen</td></tr>
<tr><td>②</td><td>Front cover</td><td>The front cover of the motor stator.</td></tr>
<tr><td>③</td><td>Enclosure</td><td>The enclosure of the motor stator.</td></tr>
<tr><td>④</td><td>Power cable</td><td>
<table>
<tr><td>Conductor color</td><td>White</td><td>Black</td><td>Red</td><td>Yellow/ Green</td></tr>
<tr><td>Description</td><td>U</td><td>V</td><td>W</td><td>Ground-ing</td></tr>
</table>
</td></tr>
<tr><td>⑤</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assign-ment</td><td>PS+</td><td>PS-</td><td>-</td><td>PTC+</td><td>P-T-C-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assign-ment</td><td>-</td><td>+5V</td><td>GND</td><td colspan="2">-</td></tr>
</table>


</td></tr>
<tr><td>⑥</td><td>Crimping pliers</td><td>Cable limit parts</td></tr>
<tr><td>⑦</td><td>Frame size</td><td>Installation base of DDR</td></tr>
</table>

3.6 LMC Linear Module

3.6.1 Model Description

LM C 1 - E 1 2 - 0500 PXX X - 6 003 F P 1 1 - N 221227 - INT
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱

① **Product family** LM: Linear module	⑩ **Feedback type** 1: 0.1 μm grating 2: 0.5 μm grating 3: 1 μm grating 4: 1 μm magnetic grating 5: Inovance communication-type absolute optical scale 6: Inovance communication-type magnetic scale 7: Inovance communication-type incremental optical scale 8: Others 9: Third-party RU2 series incremental grating with a resolution of 0.1 μm A: third-party RU2 series incremental grating with a resolution of 0.5 μm B: Third-party RU2 series incremental grating with a resolution of 1 μm C: Third-party ABS series BiSS-C absolute grating with a resolution of 0.05 μm D: Third-party ABS series BiSS-C absolute grating with a resolution of 0.1 μm E: Third-party ABS series BiSS-C absolute grating with a resolution of 0.5 μm F: Inovance ELOI series TTL incremental grating with a resolution of 0.05 μm G: Inovance ELOI series TTL incremental grating with a resolution of 0.1 μm H: Inovance ELOI series TTL incremental grating with a resolution of 0.5 μm J: Inovance ELOI series TTL incremental grating with a resolution of 1 μm	⑬ **Optoelectronic switch** Q: No optoelectronic switch N: NPN type P: PNP type
② **Product type** C: Compact		⑭ **Guideway brand** 1: THK 2: HIWIN 3: WON 4: SBC
③ **Product iteration** 1: First generation 2: Second generation		
④ **Flange size** A: 110 mm B: 140 mm C: 170 mm D: 210 mm E: 88 mm F: 118 mm G: 168 mm H: 188 mm K: 228 mm L: 120 mm		⑮ **Drag chain, side protective plate, and centralized lubrication system** 0: Not equipped with a drag chain, a side protective plate, or a centralized lubrication system 1: Equipped with a vertical drag chain, without a side protective plate or a centralized lubrication system 2: Not equipped a drag chain or a centralized lubrication system, but with a side protective plate 3: Equipped with a vertical drag chain, a side protective plate, but without a centralized lubrication system 4: Not equipped with a drag chain or a side protective plate, but with a centralized lubrication system 5: Equipped with a vertical drag chain and a centralized lubrication system, but with a side protective plate 6: Not equipped with a drag chain, but with a side protective plate and a centralized lubrication system 7: Equipped with a vertical drag chain, a side protective plate, and a centralized lubrication system
⑤ **Number of rotors** 1: 1 2: 2		
⑥ **Color** 1: Natural color 2: Black		

⑦ **Itinerary** 0500: Active travel of 500 mm for single-rotor motors and 500 mm for multi-rotor motors	⑪ **Cable length** 003: 0.3 m 030: 3 m	⑯ **Design type** N: Normal R: Right mirror L: Left mirror
⑧ **Motor code** PXX: For details, see the motor code comparison table.	⑫ **Drive and Hall sensor** F: Without a Hall sensor, but with an SV670-INT N-type drive (200 V input) H: With a Hall sensor and an SV670-INT N-type drive (200 V input) L: Without a Hall sensor, but with an SV670-INT N-type drive (400 V input) N: With a Hall sensor and an SV670-INT N-type drive (400 V input)	⑰ **Design date** 221227: Date of the initial plan
⑨ **Motor wiring** 1: Y1 2: Y2 3: Y3 4: Y4 5: Y5 6: Y6		⑱ **Model/Type** INT: International version

3.6.2 Components

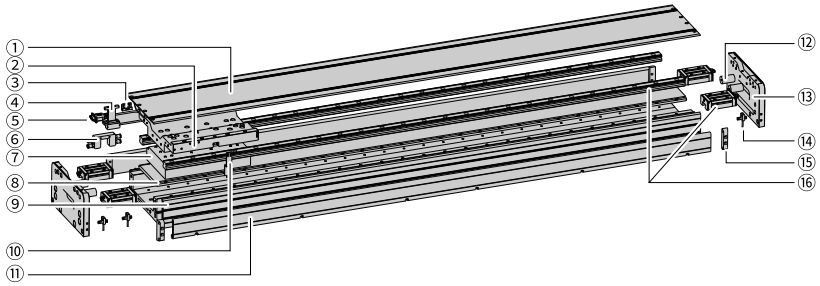


Figure 3-17 Components of LMC series linear motor

No.	Name	Remarks	No.	Name	Remarks
①	Dust-proof cover	Used to prevent dust.	⑨	Base	Indicates the linear module base.
②	Sliding table	Used to install the working load.	⑩	Photosensitive film	Detects light signals.
③	Clamp fixing block	Used to secure the wire harness.	⑪	Side protective plate	Used in the area in the protective side.
④	Mounting base of the read head	Used to hold the read head.	⑫	Urethane rubber	Used to dampen the shock of the motor.
⑤	Encoder	Used in a position feedback system.	⑬	End plate	Used for end protection and easy handling.
⑥	Centralized oil injection system	Used to supply the lubricating oil.	⑭	Optoelectronic switch	Software position limit
⑦	Integrated potting of the rotor	Provides driving force.	⑮	Fixing block on the side plate	Used to secure the components on the side plate.
⑧	Stator	Provides magnetic field.	⑯	Rail slider	Ensures linear motion of the rotor.

4 System Connection

4.1 System Composition

- The servo drive is directly connected to an industrial power supply, with no isolation such as a transformer. A fuse or circuit breaker therefore must be connected to the input power supply to prevent electric shock in the servo system. For the sake of safety, install a residual current device (RCD) to provide protections against overload and short circuit or a specialized RCD to protect the grounding cable.
- Do not start or stop the motor by using the electromagnetic contactor. As a high-inductance device, the motor may generate transient high voltage that may break down the contactor.
- When connecting an external power supply to the control circuit or a 24 VDC power supply, pay attention to the power capacity as insufficient power capacity will lead to insufficient supply current, resulting in failure of the servo drive or the brake. This is especially true when the power supply is used to power up multiple servo drives or brakes. The brake must be powered up by a 24 VDC power supply that matches the motor model and meets the brake power requirements.



Observe the following precautions when connecting the external braking resistor:

- The built-in braking resistor or jumper bar is not available in model S2R8. If an external braking resistor is required, connect it between terminals P ⊕ and C.
- Remove the jumper between terminals P ⊕ and D before using the external braking resistor. Failure to comply will result in overcurrent and damage the braking transistor.
- Do not connect the external braking resistor directly to the positive or negative pole of the bus. Failure to comply will damage the drive and result in a fire.
- Select a resistor with resistance higher than or equal to the minimum allowable value. Failure to comply will result in Er.201 (overcurrent) or damage the drive.
- Before you operate the servo drive, make sure that parameters H02.25 (braking resistor setting), H02.26 (power of external braking resistor), and H02.27 (resistance of external braking resistor) are properly set.
- Install the external braking resistor on incombustible matters, such as metal.

4.2 System Connection Diagram

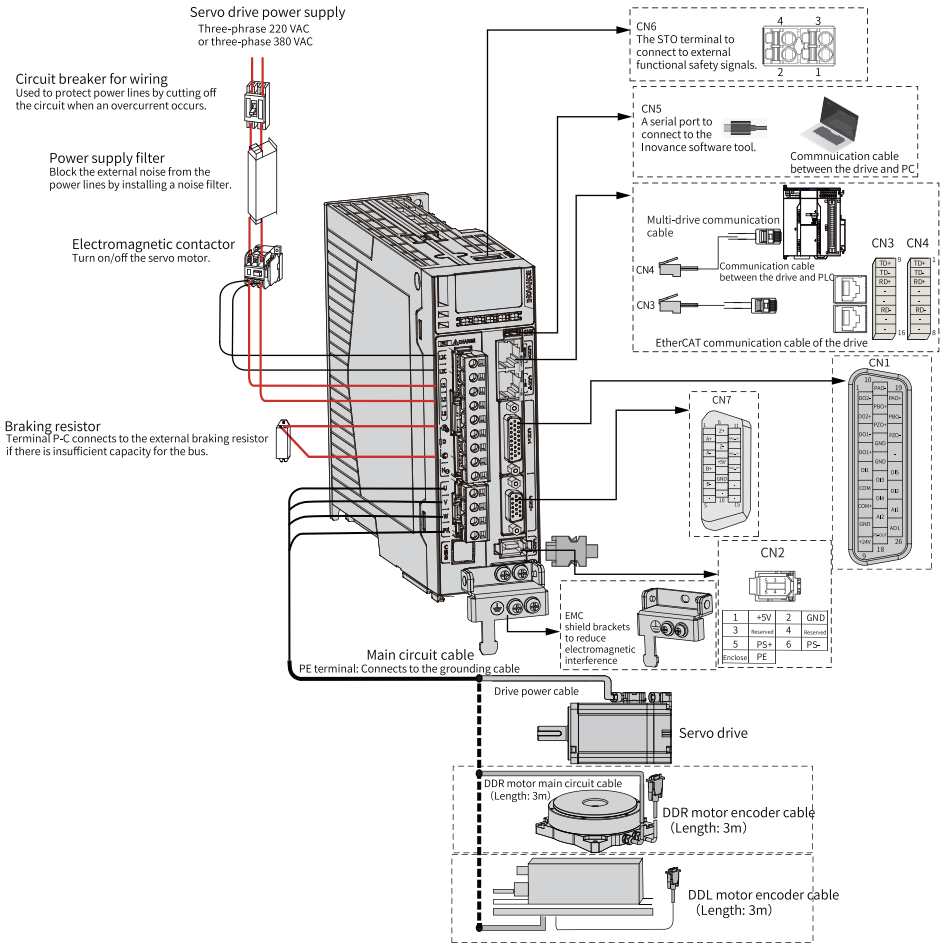


Figure 4-1 Motor System Wiring Diagram

Note

- CN6 (STO terminal) is applicable only to non-standard "-FS" models.
- When an external braking resistor is needed, remove the jumper bar between terminals P ⊕ and D, and then connect the external braking resistor between terminals P ⊕ and C. If an external braking resistor is not needed, short terminals P ⊕ and D. Size A models are not equipped with built-in braking resistors or jumper bars between terminals P ⊕ and D. Before you use the equipment, make sure that the braking resistor parameters H02.25, H02.26, and H02.27 are correctly set.

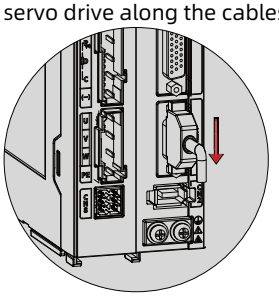
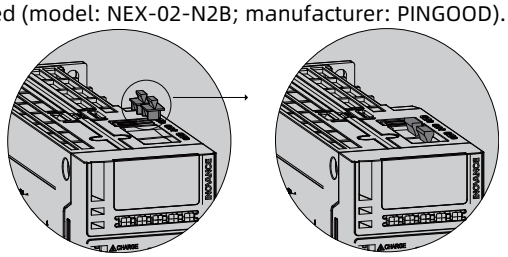
5 Installation

5.1 Installation Instructions

- Observe the installation direction described in this user guide. Failure to comply may result in equipment fault or damage.
- Do not install or operate damaged or defective equipment. Failure to comply will result in personal injury.
- Do not install the equipment in environments exposed to water splashes or corrosive gases. Failure to comply will result in equipment fault.
- Do not install the equipment near inflammable gases or combustible objects. Failure to comply will result in a fire or electric shock.
- Install the equipment inside a fire-proof cabinet that provides electrical protection. Failure to comply may result in a fire.
- Ensure the specified clearance is reserved among the servo drive, the interior surface of the control cabinet, and other machines. Failure to comply can result in a fire or equipment fault.
- Do not put heavy objects on the equipment. Failure to comply may result in personal injury or equipment damage.
- Do not impose large impact on the equipment. Failure to comply may result in equipment damage.
- Do not block the air inlet/outlet of the equipment or allow unwanted objects to fall into the equipment. Failure to comply may result in a fire or equipment fault.

Table 5–1 Installation precautions

Item	Description
Method	• Install the servo drive vertically and upward to facilitate heat dissipation. For installation of multiple servo drives inside the cabinet, install them side by side. For dual-row installation, install an air guide plate. • Make sure that the servo drive is installed vertically to the wall. Cool the servo drive down with natural convection or a cooling fan. Secure the servo drive to the mounting surface through two to four mounting holes. The number of mounting holes depends on the capacity of the servo drive. • Install the servo drive vertically to the wall, with its front (actual mounting face) facing the operator. • The mounting bracket (if needed) must be made of incombustible materials.
Cooling	Reserve sufficient space around the servo drive to ensure a good heat dissipation through the cooling fan or natural convection. Take the heat dissipated by other devices inside the cabinet into consideration. Install a cooling fan to the upper part of the servo drive to avoid excessive temperature rise in a certain area, keeping an even temperature inside the control cabinet.
Grounding	Ground the grounding terminal properly. Failure to comply may result in electric shock or malfunction due to interference.

Item	Description
Wiring requirements	As shown in the figure below, route the servo drive cables downwards to prevent liquid from flowing into the servo drive along the cables.  Route the cable connected downwards.
Dust-proof cover (included in the standard configuration)	Insert the dust-proof cover into the communication port (CN3/CN4) not in use. This is to prevent unwanted objects, such as solids or liquids, from falling into the servo drive and resulting in faults. Each servo drive is delivered with two dust-proof covers inserted into the communication ports by default. You can place an order for more dust-proof covers as needed (model: NEX-02-N2B; manufacturer: PINGOOD).  **Note:** • Dust-proof cover: Prevents unwanted objects, such as solids or liquids, from falling into the servo drive and resulting in faults. • Dust-proof covers are delivered along with the servo drive. Keep the dust-proof covers in a proper place.

5.2 Pre-installation Preparation

5.2.1 Requirements on Installation Personnel

The product/system described in this manual may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified professionals can identify the risks of the product/system and prevent possible dangers.

All the mechanical operations may be executed only by trained professionals that not only familiar with the installation position, mechanical installation, troubleshooting/maintenance, but also meet the following requirements:

- Received safety training and passed related examinations or received training on mechanical operations (such as mechanical engineers or electrical engineers)
- Familiar with electrical equipment and basic mechanical characteristics and installation requirements of the motor
- Physically qualified for mechanical operations

- Familiar with this manual especially all the safety precautions

All the electrical operations may be executed only by trained professionals that not only familiar with the installation position, mechanical installation, troubleshooting/maintenance, but also meet the following requirements:

- Received professional electrical training (such as electrical engineers)
- Familiar with this manual especially all the safety precautions

Danger

Do not touch live parts. Failure to comply can lead to severe injury or even death.

- Operations on the electrical equipment can be performed by professionals only.
- Observe local safety regulation during operation.

5.2.2 Installation Environment

Table 5–2 Environment requirements

Item	Requirement
Installation location	Indoor
Grid overvoltage category	Overvoltage category (OVC): III
Altitude	The maximum altitude is 2000 m. • 1000 m and below: Derating is not required. • For altitudes above 1000 m, derate 1% for every additional 100 m. • For altitudes above 2000 m, contact Inovance.
Temperature	• Installation/Ambient temperature: 0°C to +55°C. When the temperature ranges from 0°C to +45°C, no derating is required. For temperature above 45°C, derate 2% for every additional 1°C. • Storage/Transportation temperature: -40°C to +70°C. • To improve the reliability of the drive, use the drive in environments without dramatic temperature change. • When installing the drive into an enclosed environment such as a control cabinet, use a cooling fan or air conditioner to keep the temperature of the inlet air below 45°C. Failure to comply will result in over-temperature or a fire. • Install the drive on a flame-retardant surface, with sufficient clearance reserved for heat dissipation. • Take measures to prevent the drive from being frozen.
Ambient humidity	< 90% RH, without condensation
Storage humidity	< 90% RH, without condensation
Vibration resistance	Operation: • 5 Hz to 8.4 Hz: 3.5 mm displacement • 8.4 Hz to 200 Hz: 1 g Product package: • 5 Hz to 100 Hz: 0.01 g^2/Hz • 200 Hz: 0.001g^2/Hz • Grms = 1.14 g
Impact resistance	Below 19.6 m/s^2

Item	Requirement
IP rating	IP20 Note: Terminals are excluded, which have an IP rating of IP00.
Environment	Pollution degree 2 and below Install the drive in a location that meets the following requirements: • Free from direct sunlight, dust, corrosive gas, combustible or explosive gas, oil mist, water vapor, drip, salt, harmful gases/liquids, and radioactive substances • Insusceptible to vibration (away from equipment that may generate strong vibration, such as a punch press) • Free from unwanted objects such as metallic dust, oil, and water that may enter the drive • Do not use the drive in vacuum environments.

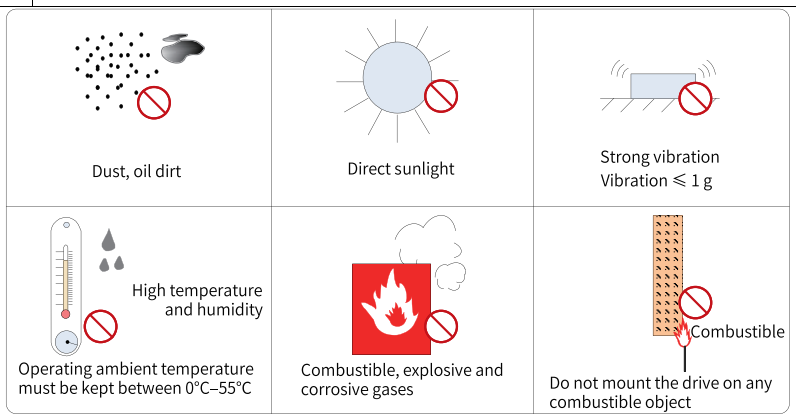


Figure 5-1 Environment requirements

5.2.3 Installation Clearance

Clearance for side-by-side installation

Drives in different specifications require different installation clearances. It is recommended to reserve a horizontal clearance of at least 10 mm (0.39 in.) on both sides among drives, a horizontal clearance of at least 20 mm (0.79 in.) on both sides among drives and control cabinets, and a vertical clearance of at least 80 mm (3.15 in.) on the top and bottom among drives and control cabinets.

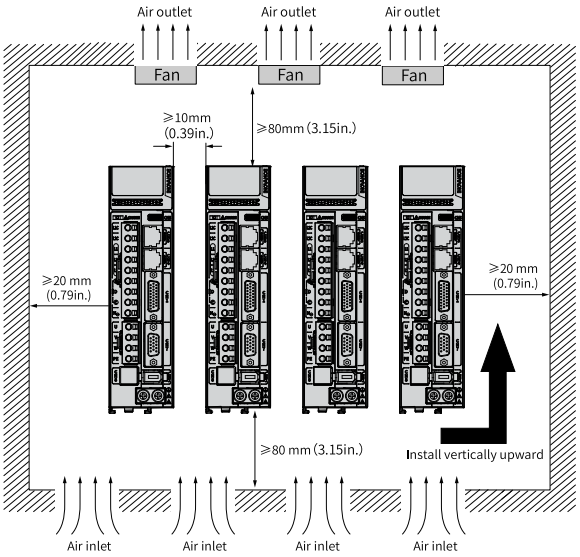


Figure 5-2 Clearance for side-by-side installation

Compact installation

Drives in size A support compact installation, in which a clearance of at least 1 mm (0.04 in.) must be reserved between every two drives. When adopting compact installation, derate the load to 75% of the rated load.

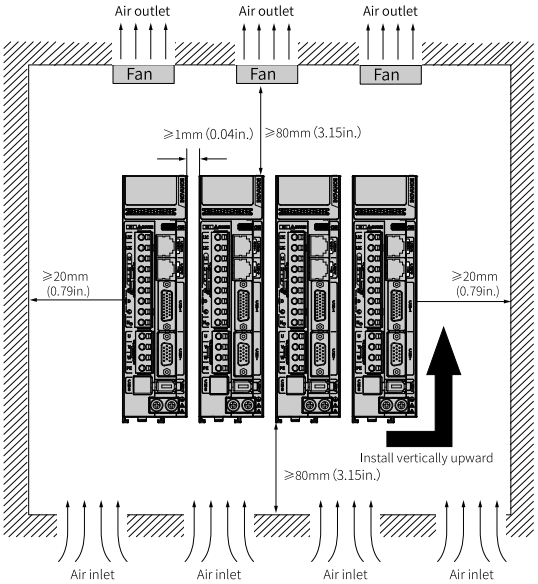


Figure 5-3 Clearance for compact installation

Close installation

Drives in sizes C and D support close installation without derating.

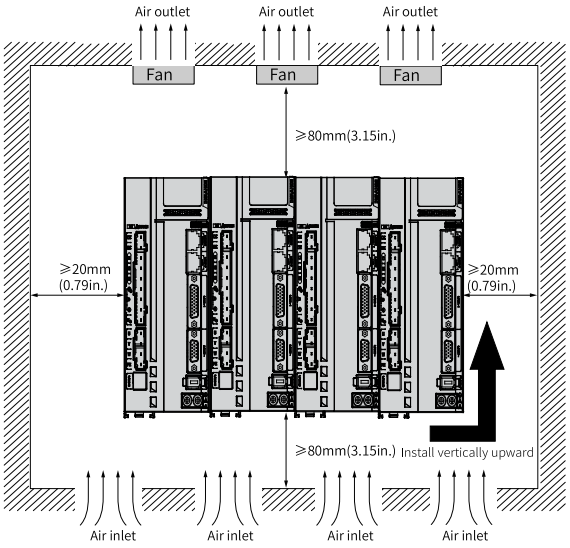


Figure 5-4 Zero-clearance installation

5.2.4 Installation Dimensions

Servo Drives in Size A (Rated Power: 0.2 kW to 0.4 kW)

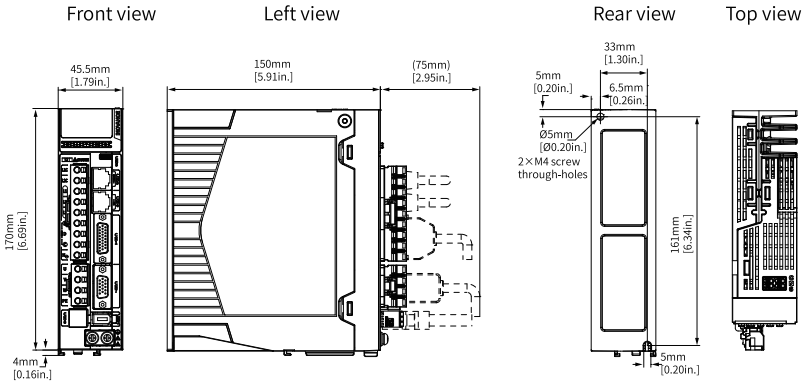


Figure 5-5 Dimensions of servo drives in size A

Fixing screws: 2 × M4; recommended tightening torque: 1.2 N·m

Weight: 0.96 kg

Servo drives in Size C (Rated power: 0.75 kW to 1.5 kW)

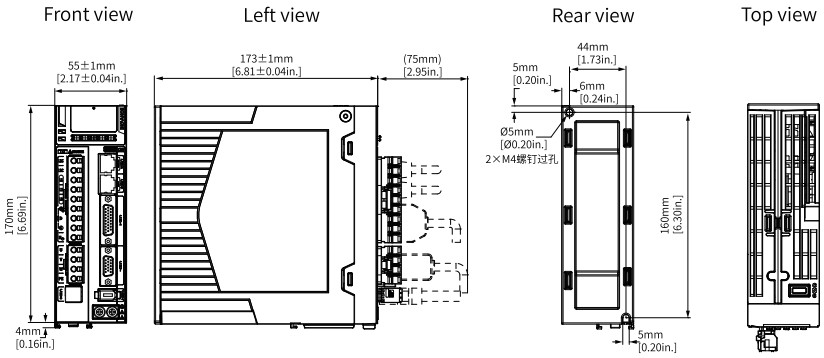


Figure 5-6 Dimension drawing of servo drives in Size C

Fixing screws: 2 × M4; recommended tightening torque: 1.2 N·m

Weight: 1.3 kg

Servo Drives in Size D (Rated Power: 1.5 kW to 3.0 kW)

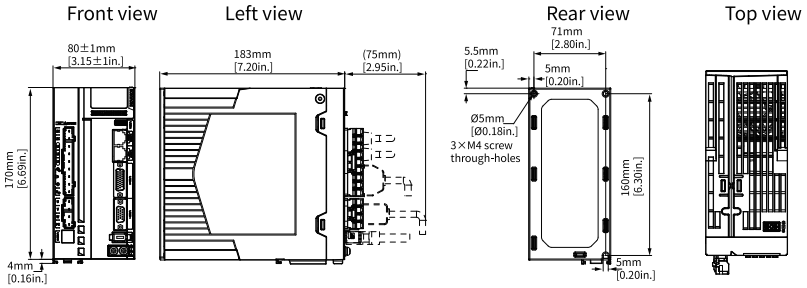


Figure 5-7 Dimension drawing of servo drives in Size D

Fixing screws: 3 × M4; recommended tightening torque: 1.2 N·m

Weight: 1.8 kg

Servo Drives in Size E (Rated Power: 2.0 kW to 7.5 kW)

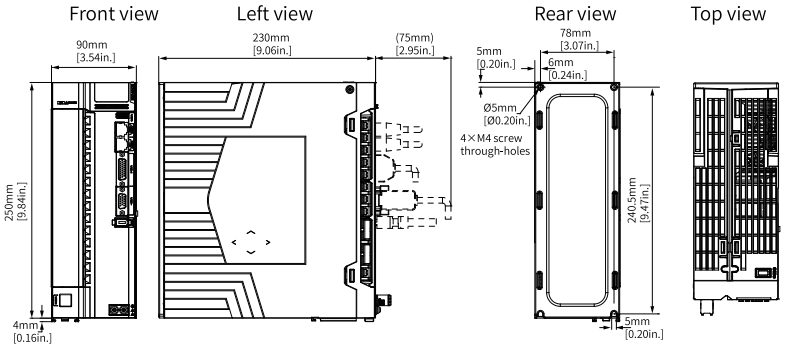


Figure 5-8 Dimension drawing of servo drives in Size E

Fixing screws: 4 × M4; recommended tightening torque: 1.2 N·m

Weight: 3.6 kg

5.2.5 Requirements on Optional Parts

5.2.5.1 Instructions for Installing the Fuse and Circuit Breaker

Caution

To prevent electric shocks, when the fuse is blown or the circuit breaker trips, wait for at least the time designated on the warning label before powering on the drive or operating peripheral devices. Failure to comply will result in death, severe personal injury, or equipment damage.

5.2.5.2 Instructions for Installing the AC Input Reactor

The AC input reactor is an option used to suppress the harmonics in the input current. In applications where harmonics need to be suppressed, install an external AC input reactor.

The following figure shows the connection of the AC input reactor.

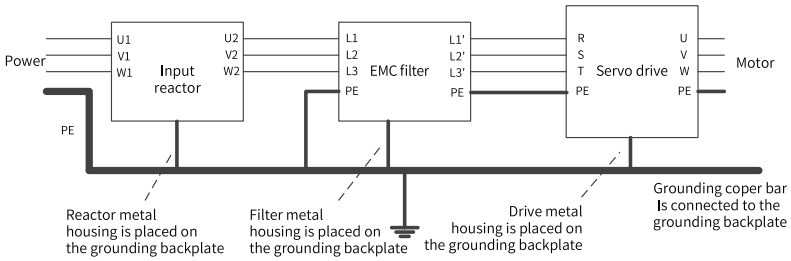


Figure 5-9 Connection of the AC input reactor

5.2.5.3 Instructions for Installing the EMC Filter

5.2.5.3.1 Connecting One Drive to One EMC Filter

Note

- Keep the connecting cable between the filter and the drive as short as possible (shorter than 30 cm).
- Ensure that the filter and drive are connected to the same grounding reference plane, and ensure that the filter is reliably grounded, otherwise the filtering effect cannot be achieved.

For voltage classes of three-phase power supply, the connection diagram of the EMC filter to the drive is shown in the figure below.

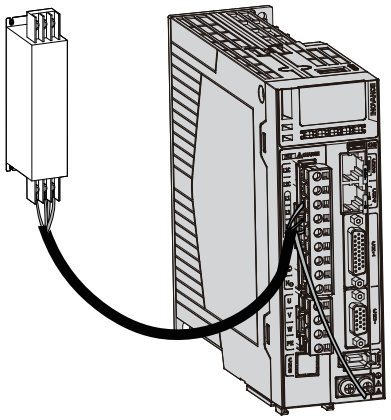


Figure 5-10 Connection of the EMC filter

5.2.5.3.2 Connecting Multiple Drives to One EMC Filter

If you use voltage classes of three-phase power supply, see User Guide > Options > Peripheral Electrical Components > EMC Filter > Connecting Multiple Drives to One EMC Filter for details about connecting one EMS filter to multiple drives.

5.2.5.4 Instructions for Installing Magnetic Ring and Ferrite Clamp

The drive generates strong interference during operation and may disturb or be disturbed by other devices in the case of improper routing or grounding. In this case, wind the drive output (U/V/W) cables around the magnetic ring by two to four turns, and wind the signal cable around the magnetic ring or ferrite clamp by one or two turns.

- Amorphous magnetic ring: featuring high permeability when the frequency is within 1 MHz and excellent anti-interference performance, but not as low-cost as the ferrite clamp
- Ferrite clamp: featuring high permeability when the frequency is above 1 MHz and excellent suppression performance on interference generated by low-power drives and signal cables

The following figure shows the connection of the magnetic ring and ferrite clamp.

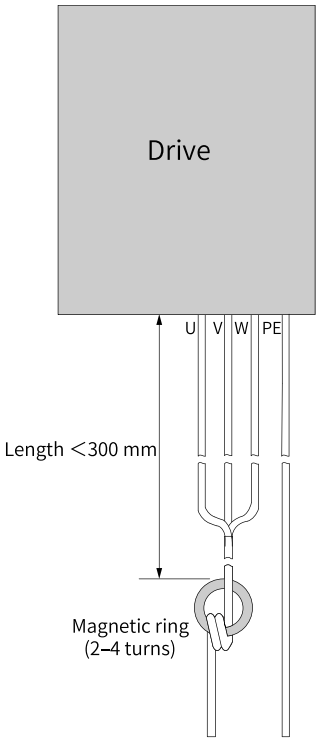


Figure 5-11 Installing the magnetic ring

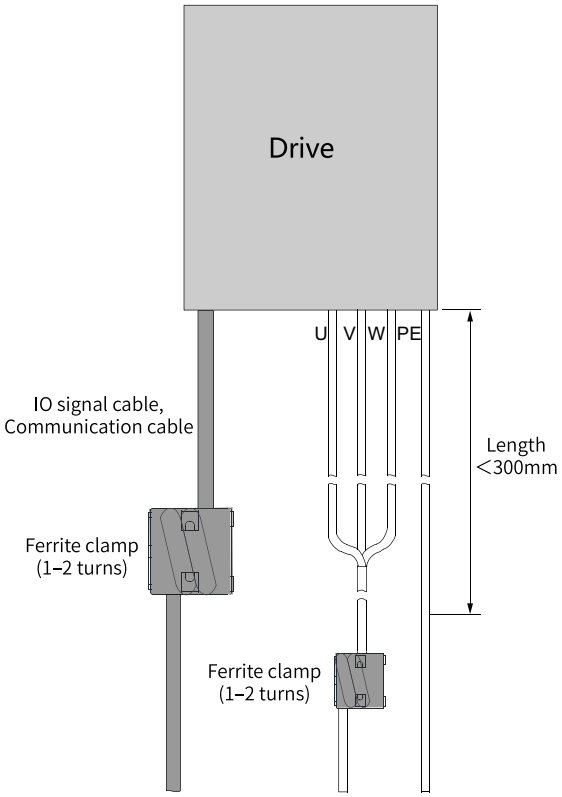


Figure 5-12 Installing the ferrite clamp

5.2.5.5 Instructions for Installing the Shield Bracket

To reduce electromagnetic interference, an EMC bracket and clamp are used with the drive cables.

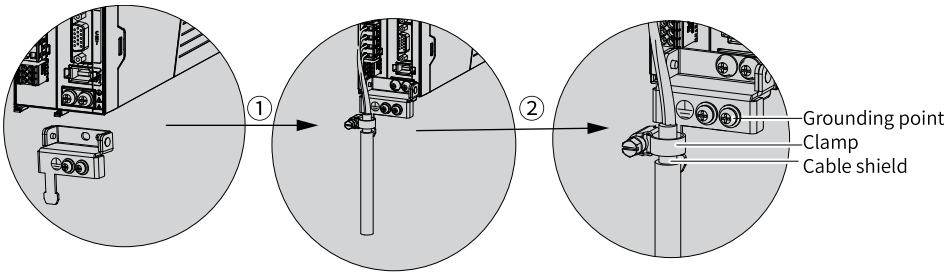


Figure 5-13 Installation of the shield bracket

- ①: Secure the shield bracket to the drive by using two M4 screws, with a recommended tightening torque of 1.2 N·m.
- ②: Place the clamp over the cable shield and the shield bracket, then tighten the screws to secure the cable shield to the shield bracket. Based on the wiring diagram, complete the wiring of the motor power cables and the brake cable.

5.2.6 Cable installation requirements

There are many cables connecting to the drive, including the power supply cables, power cables, encoder cables, control cables and communication cables. For specific cable specifications, see section "Cables" and "Cable Specifications and Model Requirements" in the user guide.

If you have special requirements on the cables, contact Inovance.

5.3 Unpacking and Transportation

Check the following items upon unpacking.

Item	Description
Check whether the product complies with your order.	Check whether the drive model and specifications comply with your order. See the dimensions of the packing box in *"Table 5-3" on page 65*. The deliverables include the product, cushion, carton box, and screw bag, as shown in *"Figure 5-14" on page 66* .
Check whether the product is intact.	Check whether the product is in good condition. If there is any missing or damage, contact Inovance or your supplier immediately.

Table 5–3 Dimensions of the outer packing box (unit: mm)

Size	Model SV670N-INT series servo drive	Outer width (mm)	Outer height (mm)	Outer depth (mm)	Weight (kg)
A	S1R6, S2R8	240	193	85	1.13
C	S5R5, S7R6, T3R5, T5R4	230	223	95	1.5
D	S012, T8R4, T012	240	223	125	2
E	S018, S022, S027, T017, T021, T026	325	285	145	3.9

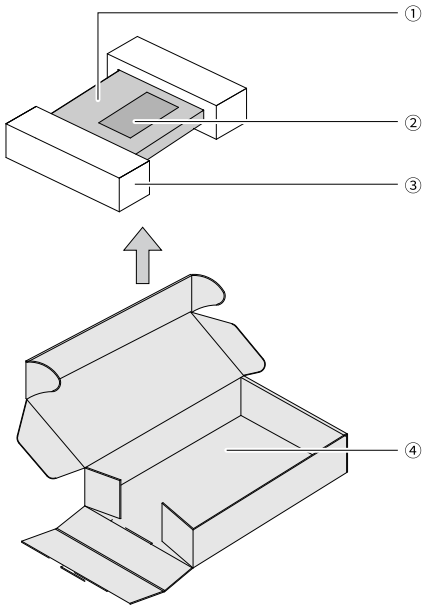


Figure 5-14 Contents inside the packing box

No.	Name
①	Product
②	Terminal accessory kit
③	Cushion
④	Carton box

Table 5–4 Contents of the terminal accessory kit

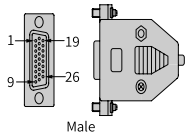
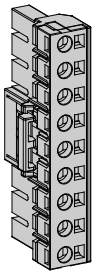
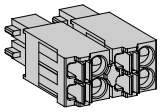
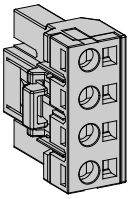
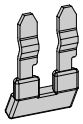
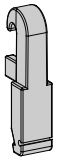
Diagram	Name	Applicable model
	Cable set - Servo drive S6-C74-DB26 connector kit (RoHS)	All models
	Pluggable terminal block - Connector - Spring clamp-type wiring - 9P - Black - With safety lock	All models
	Pluggable terminal block - plug - spring clamp-type wiring - 2 x 2P - orange - printing on both sides	FS models (With STO function)
	Pluggable terminal block - Connector - Spring clamp-type wiring - 4P - Black	All models

Diagram	Name	Applicable model
	Jumper bar - 16A - Pluggable bridging	All models
	Plastic parts - Connector wiring key - For use with the servo drive power connector	All models

Caution

The terminal accessories package list of SV670 is subject to the actual products.

If you need to purchase the terminal accessory kit separately, contact Inovance. For the material code of the accessory kit for each model, see the following table.

Table 5–5 Material code of the accessory kit for each model

Material code	Name
Standard Motor	
98050929	Accessories (sale)-S6-C176-N-SV670N Size A terminal accessory package
98050930	Accessories (sale)-S6-C177-N-SV670N Size C/D terminal accessory package
FS Model (With STO function)	
98050931	Accessories (sale)-S6-C178-N-SV670N-FS Size A terminal accessory package
98050932	Accessories (sale)-S6-C179-N-SV670N-FS Size C/D terminal accessory package
98050933	Accessories (sale)-S6-C122-N-SV670N-FS Size A terminal accessory package

5.4 Mechanical Installation

5.4.1 Pre-installation Check

Table 5–6 Pre-inspection checklist

No.	Item	Checked
1	The delivered product is consistent with your order.	□
2	No deformation or cracks are present on the casing.	□
3	All screws are in position and tightened.	□
4	The signal terminal is free from fracture, foreign objects and bent pins.	□

5.4.2 Installing the Drive

The drive supports only backplate mounting.

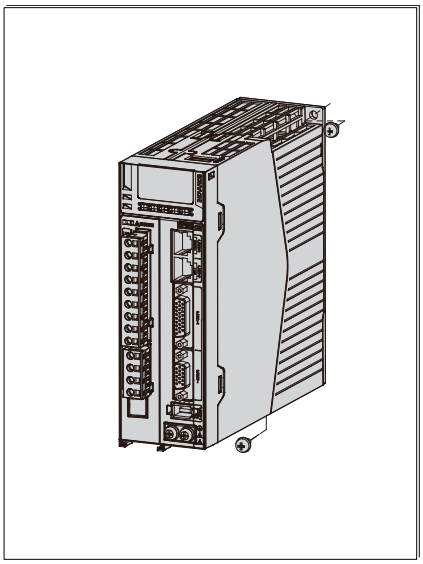


Figure 5-15 Backplate mounting

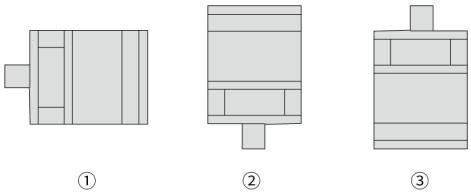
Note

- Servo drives in sizes A and C are secured by two screws, with one screw on the top and the other one at the bottom.
- Servo drives in size D are secured by three screws, with two screws on the top and another one at the bottom.
- Servo drives in size E are secured by four screws, with two screws on the top and the other two at the bottom.
- M4 screw, tightening torque: 1.2 N·m

5.4.3 Installing the Motor

Installation direction

The MS1 series motor is flange-mounted. The installation directions are shown in the following figure.



The motor can be horizontally or vertically mounted. When adopting the mechanical structure ③:

- Note the allowable axial force of the motor (gravity of the drive unit) and the IP rating requirement.
- Install the output shaft upwards to prevent intrusion of the oil into the motor.
- Ensure that the direction is suitable for operation conditions.

Heat dissipation

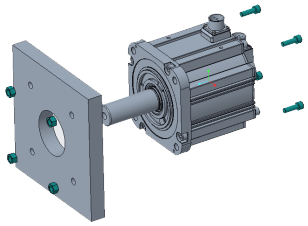
The MS1 series motor is naturally cooled. The internal heat is consumed through heat conduction, heat radiation, and natural convection. A heatsink is used for heat conduction. For details, see *“Installation instructions” on page 69*. To ensure adequate heat dissipation, keep at least 100 mm spacing between adjacent parts on three sides.

When the motor is used together with a reducer, the motor needs to be derated based on the mounting surface dimensions of the reducer. For details, see the corresponding heatsink derating curve of the base in MS1-R Series Servo Motor Selection Guide.

Installation instructions

The mechanical and electrical installation of the motor must be performed by trained professionals:

- Obey the data on the nameplate and the warning labels attached to the motor.
- Ensure that the environmental conditions of the installation site (such as temperature and installation height) meet the requirements. It is forbidden to use the motor in explosive environment.
- Thoroughly remove the preservative from the shaft extension with a commonly used solvent.
- To ensure heat dissipation, install a heatsink between the machine tool and the motor. The larger the heatsink, the better the heat dissipation effect will be. The recommended size and material of the heatsink are as follows.



  - MS1H1 to MS1H4: 250 × 250 × 6 (aluminum)
  - MS1H2-10C to 25C: 400 × 400 × 20 (steel)
  - MS1H2-30C to 50C: 400 × 400 × 20 (steel)
  - MS1H3-85B to 18C: 400 × 400 × 20 (steel)
  - MS1H3-29C to 55C: 550 × 550 × 30 (aluminum)
  - MS1H3-75C: 700 × 700 × 30 (aluminum)

  Do not put an insulator, such as a pad, between the servo motor and heat sink. Otherwise, motor temperature will rise, and the motor may fail.

- For vertical mounting with the shaft extension upwards, ensure that no liquid enters the upper bearing.
- When using a motor with oil seal, lower the oil level until it is below the lip of the oil seal.
- To prevent excessive wear of the oil seal, leave a small amount of oil on the lip for lubrication.
- The motor must be installed on a flat, vibration-free, distortion-resistant support flange surface.
- Use hexagon socket screws with strength grade of at least 8.8.
- When tightening the fixing screws, prevent the screws from deforming.
- Obey the recommended tightening torque values of motor flange fixing screws. See table *"Table 5-7 Recommended tightening torques for fixing screws" on page 69*.
- For motors with a flange of 180 mm or above, remove or tighten the lifting lugs after the motor is mounted.

Table 5-7 Recommended tightening torques for fixing screws

Frame size (mm)	Screw quantity and specifications	Tightening torque (N•m)
40	2 × M4	2.4
60	4 × M5	4.7
80	4 × M6	8
100	4 × M6	8
130	4 × M8	20
180	4 × M12	65

Note

- To avoid damage to the motor, do not hit or squeeze the shaft extension.
- To avoid corrosion,
  - When cleaning rust and stains at the end of motor shaft, use ordinary detergent.
  - Keep detergent away from the bearings and seals.
- Do not soak the oil seal in the oil. Oil inside the servo motor may cause malfunction.

Installing the brake motor

After the brake is energized, the electric excitation coil closes and the armature is released. After the power is cut off, the brake holds the motor shaft through a mechanical elastic device. The brake is only used for stopping the motor. Frequent use will shorten its service life. If it is not absolutely necessary, do not use it for emergency stop or deceleration.

The rated voltage of the brake is 24 VDC±10%. The minimum voltage that is supplied on the connector at the motor side must be 24 VDC (-10%) to ensure proper brake release. When the maximum voltage 24 VDC (+10%) is exceeded, the brake may be applied again. The voltage drop on the cable should be considered for long brake cables. The approximate calculation of voltage drop ΔU of a copper cable is as follows:

$\Delta U\ [V] = 0.042\ \Omega \cdot mm^2/m \cdot (L/q) \cdot I_{Brake}$

Where: L = Cable length (m), q = Cross-sectional area of brake cable conductor (mm^2), I_{brake} = Brake DC current (A)

The close time and open time of the brake vary with the discharge circuit. Ensure that the operation delay time is obtained from the actual device.

Avoid starting the motor repeatedly for a short time when the brake is still connected. Therefore, the switching time of the brake and the switching time of the relay should be considered in the drive control circuit or the enabling circuit.

For applications where the gravity shaft or mechanical parts may fall, take protective measures such as using an anti-falling mechanism with dual safety structure.

Note

- When the motor with a brake is accelerating, stopping or running at low speed, the rotating disc of the brake will produce a slight friction sound, which is not a fault or abnormality.
- Because the brake backlash will occur when the brake is not electrified, there will be a tiny return clearance in the rotating direction of the motor shaft, which is normal.

Mechanical connection

Install and remove transmission units, such as couplings, gears and pulleys, only using appropriate tools.

- Use the threaded hole on the shaft extension.
- Heat up the transmission unit when necessary.
- Use a washer to protect the shaft extension center during disassembly.

- The motor with a keyway has been tested for half-key balance before delivery. If necessary, you can perform full balancing for the motor with transmission units.

Coupling

- Use a dedicated flexible coupling. It is recommended to use a double leaf spring coupling that allow a certain eccentric angle.
- To prevent malfunction, use a coupling with a proper size.
- The centering of the coupling varies according to the speed used and the model of the coupling. Install the coupling according to the mechanical precision allowed by the coupling.

Conveyor connection

- Select the appropriate conveyor according to the allowable radial load of the servo motor and the output power of the motor.
- When installing the conveyor, ensure that its tension is lower than the specified allowable radial load.
- See the instructions of the conveyor manufacturer for detailed installation precautions.

5.4.4 Post-Installation Inspection

Table 5–8 Checklist

No.	Description	Yes
1	Terminal screws are tightened to the specified torque and marked.	☐
2	The servo drive and the external braking resistor are placed on incombustible objects.	☐
3	There are no unwanted objects (such as cable terminals and metal chippings) that may cause short circuit of the signal cable and power cable inside or outside the servo drive.	☐
4	The servo motor is installed properly. The motor shaft is connected to the machine securely.	☐
5	The servo motor and the connected machine are in good condition and ready to run.	☐
6	The connector of the main circuit cable is crimped and installed firmly.	☐

6 Wiring

6.1 Wiring Precautions

6.1.1 Safety Precautions

Caution

- The drive must be powered by a TN/TT star-connected power system. Do not use the IT power system. Failure to comply may lead to electric shock.
- Do not connect the U/V/W terminal of the drive or motor to a three-phase power supply or mains frequency power supply. Failure to comply may result in personal injury or a fire.
- Cut off the main power supply through ALM (fault signal) only. Failure to comply may result in a fire due to overtemperature of the braking resistor upon braking transistor faults.
- A brake device must be installed for vertical shaft applications. Connect the 24 V brake power supply with correct polarity. Improper connection can result in falling of the shaft, leading to personal injury or product damage.
- Do not place heavy objects on the cable or pull the cable forcefully. Failure to comply may damage the cable and result in electric shock.
- An electromagnetic contactor must be installed between the input power supply and the main circuit power supply of the drive (single-phase: L1, L2; three-phase: L1, L2, L3/R, S, T) to ensure the power can be cut off upon faults.
- The main circuit cables must be kept away from the motor to prevent the cable insulation from being damaged by an overheated motor.

Note

- Use a power supply filter to reduce the electromagnetic interference on electronic devices surrounding the servo drive.
- Connect the servo drive to the motor directly. Do not use an electromagnetic contactor during wiring. Failure to comply may result in equipment fault.
- The specifications and installation method of external cables must comply with the applicable local regulations.
- Observe the following requirements during wiring of the power supply and main circuit:
  - Install safety devices such as a circuit breaker to prevent short circuit in external circuits. Failure to comply may result in a fire.
  - Perform operations only after the connector is completely de-energized, with single wire per terminal and proper insulation. Failure to comply may result in electric shock.
  - When inserting cables, take care to prevent the cable conductor burrs from being short-circuited to the adjacent cable.
  - Cut off the main circuit power supply and switch off the S-ON signal after an alarm signal is detected.
  - After all cables are connected, it is recommended to tie them at the point 10 cm to 20 cm away from the connector end.

6.1.2 Interference Resistance

1. Use single-point parallel grounding with grounding resistance ≤ 0.1 Ω and grounding conductor cross-sectional area ≥ phase conductor cross-sectional area.
2. For use in the residential environment or environment subject to strong noise interference, install an EMC filter on the input side of the power supply cable to prevent radio frequency interference.

3. To prevent malfunction due to electromagnetic interference, take the following measures:

   a. Route high-current cables and low-current cables through different routes with a distance of at least 30 cm. Do not bundle them together or route them in the same cable duct.
   b. Install the host controller and EMC filter near the servo drive.
   c. Install a surge protection device on the relay, threaded sleeve, and electromagnetic contactor coils.
   d. Do not share the power supply with an electric welder or a discharge machining device. When the servo drive is placed near a high-frequency generator, install an EMC filter on the input side of the power supply line.
   e. Use a metal backplate for as the mounting backplate, and apply protective coating to both the backplate and the mounting position of the drive. Ensure the backplate is in effective conductive connection with the heatsink of the drive.

4. To prevent potential electromagnetic interference, ground properly according to the following instructions.

   a. Grounding of the motor enclosure: Connect the grounding terminal of the motor to the grounding point of the drive, and ensure the grounding point is securely grounded (see section "System Connection Diagram" for the grounding point) to mitigate potential electromagnetic interference (EMI).
   b. Grounding of the power cable shield: Ground both ends of the shield or the metal conduit in the motor main circuit. Crimping is preferable to ensure good contact.
   c. Grounding of the drive: Ground the PE terminal of the drive properly, and secure the fixing screw of this terminal properly to ensure good contact.

6.1.3 Instructions for Use of Cables

- Do not bend or apply stress to cables. The conductor of a signal cable may be easily fractured. Be cautious during use.
- In scenarios where cables need to be moved, use flexible cables. Ordinary cables are easily damaged after being bent for a long time. Cables of low-power servo motors cannot be used for movement.
- If the cable drag chain is used, ensure the following requirements are met.
  - Do not fix or bundle the cables inside the cable carrier. The cables can be bundled and fixed only at two unmovable ends of the cable drag chain.
  - Cables cannot be wound or twisted.
  - The space factor inside the cable drag chain cannot exceed 60%.
  - Do not use cables with different sizes together; otherwise, the thick cable may crush the thin cable. If thick and thin cables need to be used together, use a spacer plate to separate them.

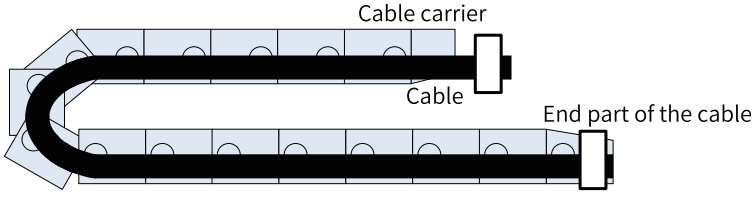


Figure 6-1 Cable drag chain

6.2 Electrical Wiring Diagram

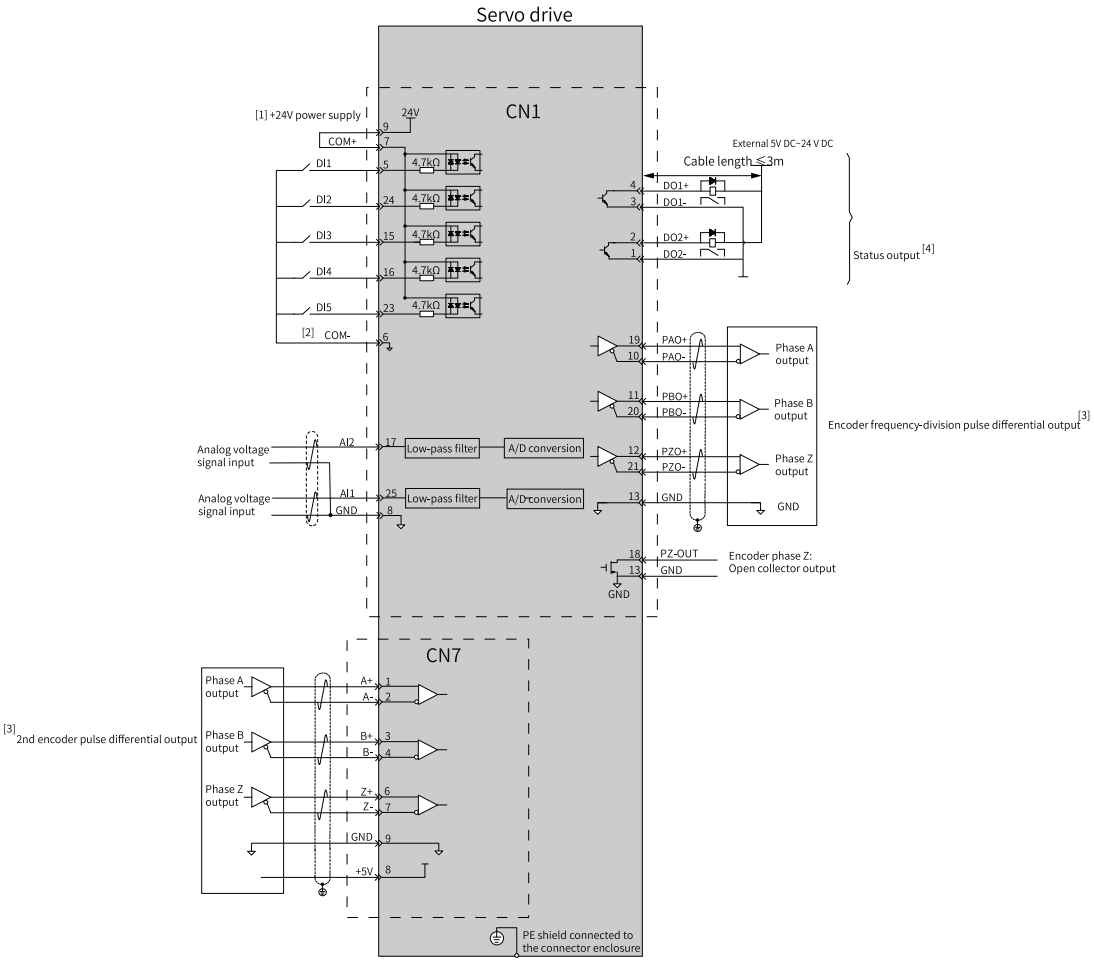


Figure 6-2 Electrical Wiring Diagram

Note

- indicates shielded twisted pairs.
- [1] The range of the internal +24 V power supply is 20 V to 30 V, with maximum operating current being 150 mA.
- [2] DI4 and DI5 are high-speed DIs that must be used according to their functions assigned. DI allows external power supplies. See *" DI circuit" on page 91* for details.
- [3] Use shielded twisted pairs as frequency-division output cables and full closed-loop input cables, with both ends of the cable shield connected to PE. Connect GND to the signal ground of the host controller properly.
- [4] The DO power supply (voltage range: 5 V to 24 V) needs to be prepared by users. The DO terminals support 30 VDC voltage and 50 mA current to the maximum. You can enable optocoupler input on the affiliated device through an additional current limiting resistor. For details, see *" DO circuit" on page 92*.

6.3 Introduction to Main Circuit Terminals

6.3.1 Terminal layout

Servo drives in Size A, Size C, and Size D (rated power: 0.2 kW to 3.0 kW)

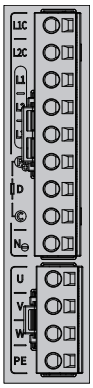


Figure 6-3 Main circuit terminal pin layout of servo drives in size A/C/D

Table 6–1 Main circuit terminal pins of servo drives in Size A/C/D

Component	Description
L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
L1, L2, and L3 (main circuit power input terminal)[1]	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
$P_{\oplus}$, D, C (external braking resistor terminal)	Remove the jumper bar between terminals $P_{\oplus}$ and D before connecting an external braking resistor between terminals $P_{\oplus}$ and C.
$P_{\oplus}$, $N_{\ominus}$ (servo bus terminal)	Used by the common DC bus for multiple drives.
U, V, W, PE (terminals for connecting the servo motor)	Used to connect the U, V, and W phases and grounding terminal of the motor.

Note

[1]: The power input terminals of the 200V servo drive's main circuit are L1, L2, and L3, you can use any two of which for single-phase input.

Servo drives in Size E (rated power: 2.0 kW to 7.5 kW)

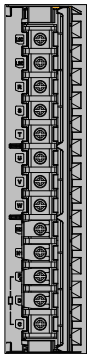


Figure 6-4 Main circuit terminal pin layout of servo drive in Size E

Table 6–2 Main circuit terminal pins of servo drive in Size E

Component	Description
L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
R, S, and T (main circuit power input terminals)[1]	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
P ⊕ , D, C (external braking resistor terminal)	Remove the jumper bar between terminals P ⊕ and D before connecting an external braking resistor between terminals P ⊕ and C.
N2 and N1 (terminals for connecting an external reactor)	N1 is shorted to N2 with a jumper by default. To suppress power supply harmonics, remove the jumper and connect an external DC reactor between N1 and N2.
U, V, W (terminals for connecting the servo motor)	Used to connect U, V, and W phases of the motor.

Note

[1] For 200 V drives, the main circuit power input terminals of the drive are L1, L2, and L3, any two of which can be used for single-phase input.

6.3.2 Wiring Precautions and Requirements

Danger

- Do not connect the output terminals U, V, and W of the drive to a three-phase power supply. Failure to comply may result in physical injury or a fire.
- Do not connect the motor terminals U, V, and W to a mains power supply. Failure to comply may result in physical injury or a fire.
- The main circuit cable must be away from the motor to prevent its insulation from being damaged by high temperature of the motor surface.
- onnect the servo drive to the motor directly. Do not use an electromagnetic contactor during wiring. Failure to comply may result in equipment fault.

Caution

- Do not use power from the IT grid system for the drive. Use the power from TT/TN grid system for the drive. Failure to comply may result in an electric shock.
- Connect a electromagnetic contactor between the input power supply and the main circuit power supply of the servo drive (R, S and T) to form a structure which allows independent power cutoff on the servo drive power side. This is to prevent fire accident caused by continuous high current generated upon fault.
- Check that the input power supply of the battery simulator is within the specified voltage range. Failure to comply may result in faults.
- Use the ALM (fault) signal to cut off the main circuit power supply. A faulty braking transistor may overheat the braking resistor and lead to a fire.
- Connect the PE terminal of the drive to the PE terminal of the control cabinet. Failure to comply may result in an electric shock.
- Ground the entire system properly. Failure to comply may result in malfunction.
- After the power supply is switched off, residual voltage is still present in the internal capacitor of the device, wait for at least 15 min before further operations. Failure to comply may result in electric shock.
- The specifications and installation of external cables must comply with applicable local regulations.
- Observe the following requirements when the servo drive is used on a vertical axis.
  - Set the safety device properly to prevent the workpiece from falling upon alarm or overtravel.
  - Ensure the positive/negative polarity of the 24 V power supply is correct. Otherwise, the axis may fall and cause personal injury or equipment damage.
- It is recommended to use Teflon cables featuring a higher temperature limit when the temperature inside the cabinet exceeds the temperature limit of regular cables. As the surface of regular cables may be easily hardened and cracked under low temperature, take thermal insulation measures for cables laid in environments with low temperature.
- The servo drive must be grounded properly. Failure to comply may result in device malfunction or damage.

Caution

- Observe the following requirements when you wire the power supply and main circuit:
  - When the main circuit terminal is a connector, remove the connector from the servo drive before wiring.
  - Insert only one cable into one cable terminal of the connector. Do not insert multiple cables into the same cable terminal.
  - When you insert cables, do not short-circuit the cable conductor burrs with the neighboring cables.
  - Insulate the connecting part of the power supply terminals to prevent electric shock.
  - Do not directly connect a 220 V servo drive to a 380 V power supply.
  - Install safety devices such as a circuit breaker to prevent short circuit in external circuits. Failure to comply may result in a fire.
  - Cut off the main circuit power supply and switch off the S-ON signal after an alarm signal is detected.
  - After all cables are connected, it is recommended to tie them at the point 10 cm to 20 cm away from the connector end.
- Do not put heavy objects onto cables or pull cables with excessive force. Failure to comply may result in cable damage, leading to an electric shock.
- Use a power supply filter to reduce the electromagnetic interference on electronic devices surrounding the servo drive.

6.3.3 Cable Model Requirements

- Ensure the cable bending radius meets the related requirements (fixed cable ≥ 5D, flexible cable ≥ 10D) to prevent internal conductor breakage due to long-term bending.
- Use cables with a rated voltage above 600 VAC and rated temperature above 75°C. Under an ambient temperature of 30°C and normal cooling conditions, the permissible current density of

the cable cannot exceed 8 A/mm² when the total current is below 50 A, or 5 A/mm² when the total current is above 50 A. In case of high ambient temperature or bundled cables, adjust the permissible current density (A/mm²) according to the following formula.

Allowable current density = 8 × reduction coefficient of current-carrying conductor density × current correction coefficient

$$\text{Current correction coefficient} = \sqrt{(\text{Cable max. allowable temperature} - \text{Ambient temperature}) / 30}$$

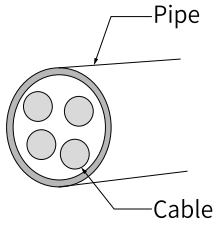


Table 6–3 Current carrying density derating coefficient of conductor

Number of cables in a duct	Current reduction coefficient
< 3	0.7
4	0.63
5 to 6	0.56
7 to 15	0.49

- It is recommended to route power cables and signal cables separately to avoid EMC interference, with a minimum distance of 30 cm between them.

To comply with the EMC standards, use shielded cables. For details, see *"Figure 6-5" on page 78* .

Or use a four-core shielded cable, with one core being the PE wire. The shield of the shielded cable consists of coaxial cooper braids to suppress radio frequency interference. To enhance the shielding performance and conductivity, the braided density of the shield must be greater than or equal to 85%.

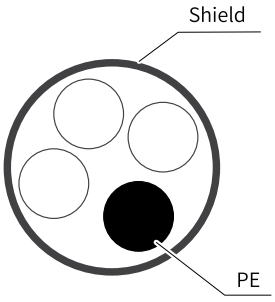


Figure 6-5 Recommended power cable types

For a correct example of how to connect the power shielded cable, see the wiring diagram in section "Instructions for installing the shield bracket".

6.3.4 Cable Specifications

6.3.4.1 Cable Specifications (CE)

Table 6–4 Recommended main circuit cables

Servo drive model			L1C, L2C		L1, L2, L3/R, S, T		P ⊕, D, C, N1, N2, and N1		U, V, W, PE		Grounding terminal	
Size	Model	Rated input current (A)	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
Single-phase 200 V												
A	S1R6	2.3	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S2R8	4	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
C	S5R5	7.9	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S7R6	9.6	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 0.52	20	3.33	12
D	S012	12.8	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 1.31	16	3.33	12
Three-phase 200 V												
A	S1R6	1.1	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S2R8	2.3	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
C	S5R5	4.4	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S7R6	5.1	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
D	S012	8	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 1.31	16	3.33	12
E	S018	8.7	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	S022	11	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	S027	23.8	2 x 0.75	18	3 x 3.33	12	2 x 0.75	18	4 x 3.33	12	3.33	12
Three-phase 400 V												
C	T3R5	2.4	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	T5R4	3.6	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
D	T8R4	5.6	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	T012	8	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 1.31	16	3.33	12
E	T017	12	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	T021	16	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	T026	21	2 x 0.75	18	3 x 3.33	12	2 x 0.75	18	4 x 3.33	12	3.33	12

Note

Cable selection should be carried out in line with the standard EN60204-1 according to the circuit breaker current.

Table 6–5 Recommended servo cable specifications and models

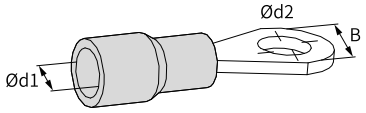
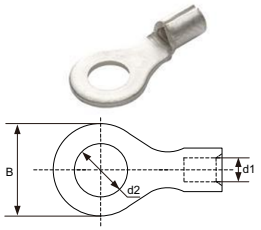
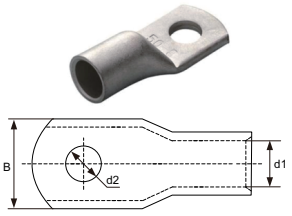
Cable type	Cable size	Outer diameter (mm)
Power cable	4 x 12 AWG	12.2±0.4
	4x14AWG	10.5±0.3
	4 × 16 AWG	9.5+0.4
	4 × 20 AWG	6.5+0.2
Power cable shield	4 × 12 AWG	12.9+0.4
	4 × 14 AWG	11.2+0.4
	4 × 16 AWG	10.1+0.4
	4 × 20 AWG	6.5±0.2
Power cable + brake cable	4 x 20 AWG + 2 x 24 AWG	6.5±0.2
Brake cable	2 x 18 AWG	5.8±0.2
	2 × 20 AWG	5.0±0.2

Table 6–6 Main circuit cable lug model and tightening torque

Servo drive model			Recommended PVC cable model (at 40℃)			
Size	Model	Rated input current (A)	U, V, W, PE	Recommended model of brake cable lug	Recommended Model of Grounding Cable Lug	Tightening Torque (N·m)
Single-phase 200 V						
A	S1R6	2.3	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	4				
C	S5R5	7.9				
	S7R6	9.6	GTVE15008	GTVE10008		
D	S012	12.8			TNR3.5-4	1.36
Three-phase 200 V						
A	S1R6	1.1	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	2.3				
C	S5R5	4.4				
	S7R6	5.1				
D	S012	8.0			TNR3.5-4	1.36
E	S018	8.7			TNR5.5-4	1.36
	S022	11.0	GTVE15008	GTVE10008		
	S027	23.8	GTVE60010	GTVE60010	GTNR10-4	1.36
Three-phase 400 V						
C	T3R5	2.4	GTVE10008	GTVE05008	TVR2-4	1.36
	T5R4	3.6				
D	T8R4	5.6			TNR3.5-4	1.36
	T012	8.0				

Servo drive model			Recommended PVC cable model (at 40℃)			
Size	Model	Rated input current (A)	U, V, W, PE	Recommended model of brake cable lug	Recommended Model of Grounding Cable Lug	Tightening Torque (N·m)
E	T017	12.0	TVR1.25-4	GTVE10008	TNR5.5-4	1.36
	T021	16.0	TVR2-4	GTVE10008		1.36
	T026	21.0	TVR5.5-4	GTVE60010	GTNR10-4	1.36

Table 6–7 Recommended dimension and drawing of the grounding cable lug

Lug model		d1 (mm)	d2 (mm)	B (mm)	Appearance
TVR	2-4	4.8	4.3	8.5	
TNR	3.5-4	3.2	4.3	9.5	
	5.5-4	3.5	4.3	9.5	
GTNR	10-4	5.0	4.3	12.4	

6.3.4.2 Cable Specifications (UL)

Table 6–8 Recommended main circuit cables

Servo drive model			L1C, L2C		L1, L2, L3/R, S, T		P ⊕, D, C, N1, N2, and N1		U, V, W, PE		Grounding terminal	
Size	Model	Rated input current (A)	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
Single-phase 200 V												
A	S1R6	2.3	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
	S2R8	4	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
C	S5R5	7.9	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
	S7R6	9.6	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
D	S012	12.8	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 1.31	16	3.33	12
Three-phase 200 V												
A	S1R6	1.1	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
	S2R8	2.3	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12

Servo drive model			L1C, L2C		L1, L2, L3/R, S, T		P ⊕, D, C, N1, N2, and N1		U, V, W, PE		Grounding terminal	
Size	Model	Rated input current (A)	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
C	S5R5	4.4	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
	S7R6	5.1	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
D	S012	8	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 1.31	16	3.33	12
E	S018	8.7	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	S022	11	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	S027	23.8	2 x 2.08	14	3 x 3.33	12	2 x 0.75	18	4 x 3.33	12	3.33	12
Three-phase 400 V												
C	T3R5	2.4	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
	T5R4	3.6	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
D	T8R4	5.6	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 0.52	20	3.33	12
	T012	8	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 1.31	16	3.33	12
E	T017	12	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	T021	16	2 x 2.08	14	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	T026	21	2 x 2.08	14	3 x 3.33	12	2 x 0.75	18	4 x 3.33	12	3.33	12

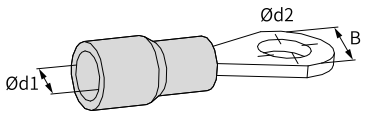
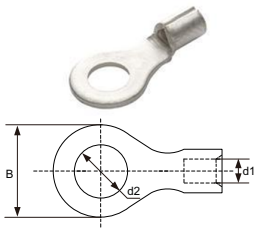
Table 6–9 Recommended servo cable specifications and models

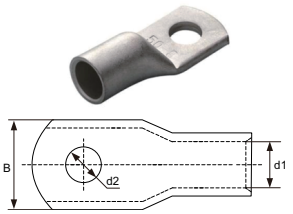
Cable type	Cable size	Outer diameter (mm)
Power cable	4 x 12 AWG	12.2±0.4
	4x14 AWG	10.5±0.3
	4 × 16 AWG	9.5+0.4
	4 × 20 AWG	6.5+0.2
Power cable shield	4 x 12 AWG	12.9+0.4
	4 × 14 AWG	11.2+0.4
	4 × 16 AWG	10.1+0.4
	4 × 20 AWG	6.5±0.2
Power cable + brake cable	4 x 20 AWG + 2 x 24 AWG	6.5±0.2
Brake cable	2 x 18 AWG	5.8±0.2
	2 × 20 AWG	5.0±0.2

Table 6–10 Main circuit cable lug model and tightening torque

Servo drive model			Recommended PVC cable model (at 40℃)			
Size	Model	Rated input current (A)	U, V, W, PE	Recommended model of brake cable lug	Recommended Model of Grounding Cable Lug	Tightening Torque (N·m)
Single-phase 200 V						
A	S1R6	2.3	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	4				
C	S5R5	7.9				
	S7R6	9.6	GTVE15008	GTVE10008		
D	S012	12.8			TNR3.5-4	1.36
Three-phase 200 V						
A	S1R6	1.1	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	2.3				
C	S5R5	4.4				
	S7R6	5.1				
D	S012	8.0			TNR3.5-4	1.36
E	S018	8.7			TNR5.5-4	1.36
	S022	11.0	GTVE15008	GTVE10008		
	S027	23.8	GTVE60010	GTVE60010	GTNR10-4	1.36
Three-phase 400 V						
C	T3R5	2.4	GTVE10008	GTVE05008	TVR2-4	1.36
	T5R4	3.6				
D	T8R4	5.6			TNR3.5-4	1.36
	T012	8.0				
E	T017	12.0	TVR1.25-4	GTVE10008	TNR5.5-4	1.36
	T021	16.0	TVR2-4	GTVE10008		1.36
	T026	21.0	TVR5.5-4	GTVE60010	GTNR10-4	1.36

Table 6–11 Recommended dimension and drawing of the grounding cable lug

Lug model		d1 (mm)	d2 (mm)	B (mm)	Appearance
TVR	2-4	4.8	4.3	8.5	
TNR	3.5-4	3.2	4.3	9.5	
	5.5-4	3.5	4.3	9.5	

Lug model		d1 (mm)	d2 (mm)	B (mm)	Appearance
GTNR	10-4	5.0	4.3	12.4	

6.3.5 Wiring Examples

6.3.5.1 Power Supply Wiring Example

Single-phase 200 V models

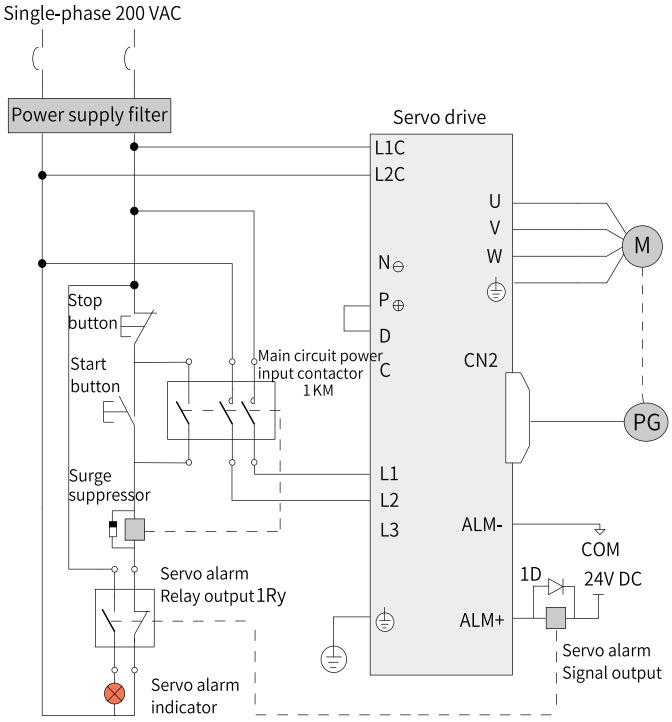


Figure 6-6 Main circuit wiring of single-phase 200 V models

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply will be automatically cut off. S2R8 is not configured with built-in braking resistors. To connect an external braking resistor, remove the jumper between P ⊕ and D before you connect an external braking resistor between P ⊕ and C.

Three-phase 200 V models

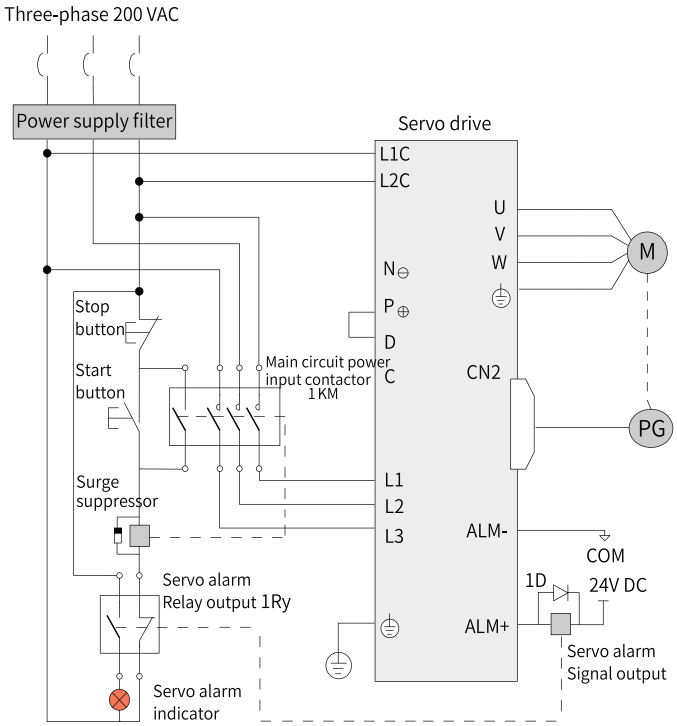


Figure 6-7 Main circuit wiring of three-phase 200 V models

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply is automatically cut off and the alarm indicator lights up.

Three-phase 400 V models

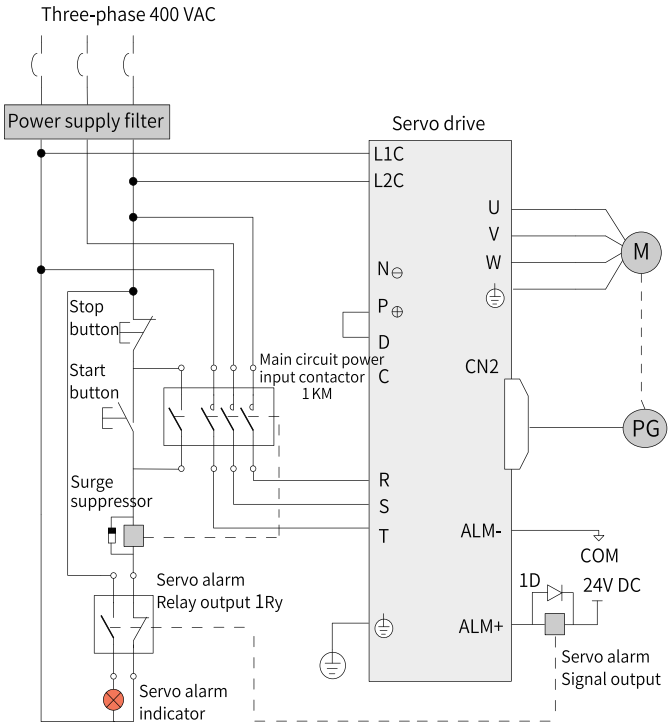


Figure 6-8 Main circuit wiring of three-phase 400 V models

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply is automatically cut off and the alarm indicator lights up.

6.3.5.2 Wiring of the Grounding Cable

Observe the following requirements to ensure a proper grounding of the servo drive.

Warning

- To prevent electric shocks, ground the grounding terminal properly. Observe related national or regional regulations during grounding.
- To prevent electric shocks, ensure the protective grounding conductor complies with technical specifications and local safety standards. Keep the length of the grounding cable as short as possible. As the leakage current of a single drive does not exceed AC 3.5 mA or DC 10 mA, the grounding cable of the drive must be has the same conductor cross-sectional area as the phase cable. On the other hand, the leakage current of multiple drives connected in parallel may exceed 3.5 mA, therefore, it is recommended to use a copper protective grounding conductor with a cross-sectional area of at least 10 mm^2, or use two protective grounding conductors with the same specification. The cross-sectional area of the grounding cable (except the motor grounding cable) must not be smaller than 2.5 mm^2.
- The dimensions of the grounding cable must comply with the electrical device technical standards. Keep the length of the grounding cable as short as possible. Failure to comply will lead to unstable potential in the grounding terminals away from the grounding point due to leakage current, resulting in an electric shock.

Caution

- For use of multiple servo drives, observe all the grounding instructions for the drive. Improper grounding of the device will lead to malfunction of the drive and the device.
- Do not share the same grounding cable with other devices (such as welding machines or high-current electrical devices). Improper grounding of the device will lead to drive or device faults caused by electrical interference.

Grounding requirements

Observe the following requirements to ensure a proper grounding of the drive.

- The protective grounding conductor must be a yellow/green cable comprised of copper conductors. Do not connect the protective grounding conductor to a switching device (such as a circuit breaker) in serial.
- Ground the grounding terminal properly. Improper grounding will lead to device malfunction or damage.
- Do not connect the grounding terminal to the N terminal of the neutral wire of the power supply.
- It is recommended to install the drive on a conductive metal surface. Ensure the whole conductive bottom of the drive is connected properly to the mounting face.
- Tighten the grounding screw with specified tightening torque to prevent the protective grounding conductor from being secured improperly.

Multi-drive grounding

Side-by-side installation of multiple drives:

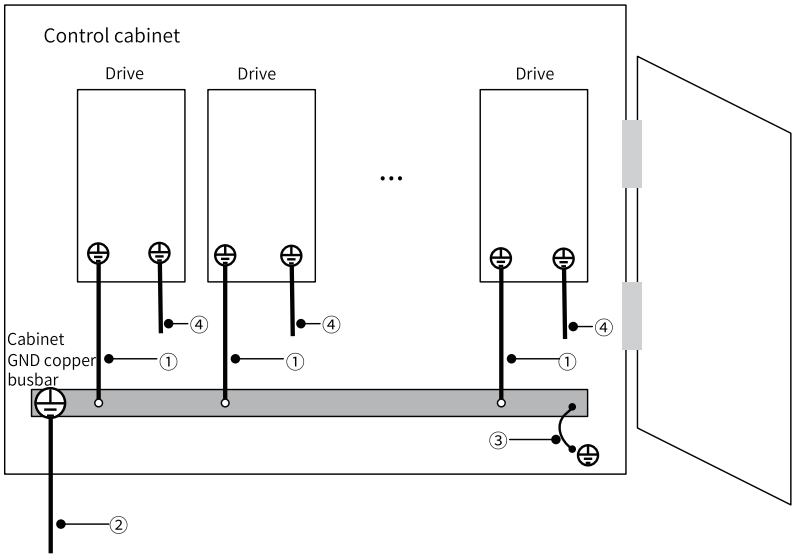


Table 6–12 Description for grounding of multiple drives installed in parallel

No.	Wiring
①	Connect the main circuit input PE terminal of the drive to the grounding copper busbar of the control cabinet through a protective grounding conductor.
②	Connect the PE cable on the input power supply side to the grounding copper busbar of the control cabinet.

No.	Wiring
③	Connect the grounding copper busbar of the control cabinet to the metal enclosure of the control cabinet through the protective grounding conductor.
④	Connect the motor output cable shield to the output PE terminal of the servo drive.

Grounding the control cabinet system

The most cost-effective method of suppressing interference in a control cabinet is to isolate the interference source from devices that may be interfered with. Divide the control cabinet into multiple EMC compartments or use multiple control cabinets based on the intensity of interference sources, and install each device in accordance with the following wiring principles.

Table 6–13 Wiring requirements

No.	Wiring requirements
1	Place the control unit and the drive unit in two separate control cabinets.
2	If multiple control cabinets are used, connect the control cabinets by using a PE cable with a cross-sectional area of at least 16 mm^2 for equipotentiality between the control cabinets.
3	If only one control cabinet is used, place different devices in different compartments of the control cabinet based on signal intensity.
4	Apply equipotential bonding to devices in different compartments inside the control cabinet.
5	Shield all communication (such as RS485) and signal cables drawn from the control cabinet.
6	Place the power input filter in a position near the input interface of the control cabinet.
7	Apply spray coating to each grounding point in the control cabinet.

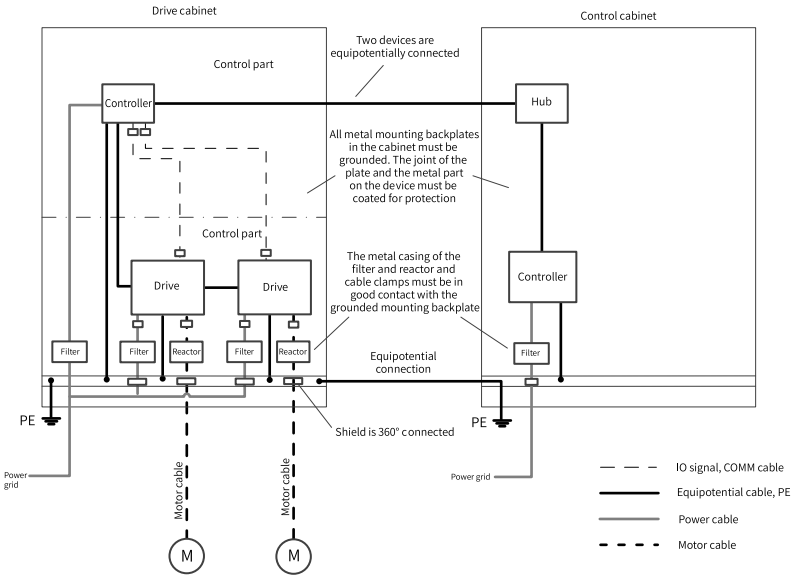


Figure 6-9 Recommended wiring for the control cabinet system

6.4 Control Terminal CN1

6.4.1 Terminal layout

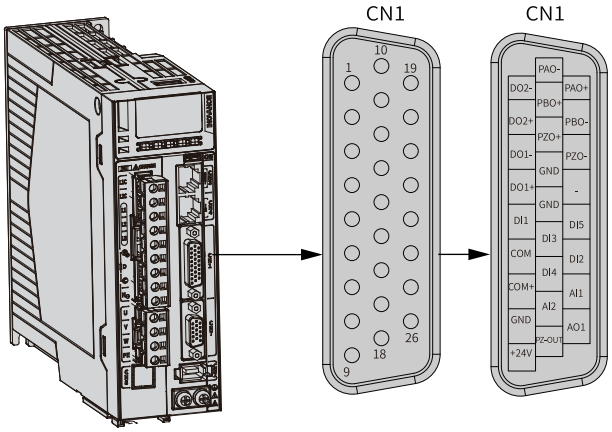


Figure 6-10 Control terminal (CN1) layout

Note

Use shielded cables as signal cables, with both ends of the shielded cable grounded.

Table 6–14 Description of DI/DO signals

Signal		Default function	Pin No.	Description
General	DI1	P-OT	5	Positive limit switch
	DI2	N-OT	24	Negative limit switch
	DI3	HomeSwitch	15	Home switch
	DI4	Emergence Stop	16	Emergency stop
	DI5	TouchProbe1	23	Touch probe 1
	+24 V		9	Internal 24 V power supply; voltage range: 20 V to 30 V; maximum output current: 150 mA (@25℃)
	COM-		6	
	COM+		7	Common terminal of DI terminals
	DO1+	S-RDY+	4	Ready to switch on
	DO1-	S-RDY-	3	
	DO2+	BK+	2	With brake
	DO2-	BK-	1	

Table 6–15 Specifications of encoder frequency-division output signals

Signal		Pin No.	Description	
General	PAO+	19	Phase A output signal	Phases A+B quadrature pulse output signal
	PAO-	10		
	PBO+	11	Phase B output signal	
	PBO-	20		
	PZO+	12	Phase Z output signal	Origin pulse output signal
	PZ-	21		
	PZ-OUT	18	Origin pulse OC output signal	
	GND	13	Home pulse open-collector output signal ground	
	PE	Housing	-	

Table 6–16 Specifications of AI/AO signals

Signal		Pin No.	Description
General	AO1	26	Analog output Voltage range: –10 V to +10 V
	GND	8	Common terminal of AI/AO
	AI1	25	Voltage-type AI1 12bit Voltage range: –10 V to +10 V Maximum allowable voltage: ±12 V
	AI2	17	Voltage-type AI2 12bit Voltage range: –10 V to +10 V Maximum allowable voltage: ±12 V
	PE	Housing	-

6.4.2 Wiring Precautions and Requirements

I/O signals include DI/DO signals and relay output signals.

Observe the following requirement during control circuit wiring:

Caution

- When connecting DO terminals to relays, ensure the polarity of the flywheel diode is correct. Wrong polarity will result in equipment damage or signal output failure.
- Keep a distance of at least 30 cm between main circuit cables (RST and UVW) and I/O signal cables/encoder cables. Otherwise equipment may malfunction due to disturbed I/O signals.
- Use twisted pairs or multi-conductor shielded twisted pairs as the I/O signal cable or encoder cable. Failure to comply may result in equipment malfunction.

6.4.3 Cable Specifications and Models

Observe the requirements in standard EN 60204-1 during connecting control circuit cables.

I/O signal cable selection

It is recommended to use shielded signal cables to prevent I/O signal circuit from being disturbed by external noise. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pair (STP) cables for digital signals.

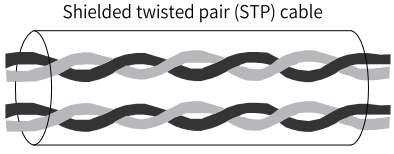


Figure 6-11 Diagram of shielded twisted pairs

Control cable specifications

Table 6–17 Recommended control cable specifications

Control terminal	Connector fit/Material No.	Recommended cable specifications (AWG)
CN1	DB26	16–26

6.4.4 Wiring Examples

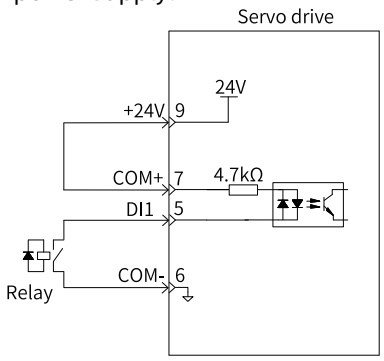
6.4.4.1 DI/DO Signals

DI circuit

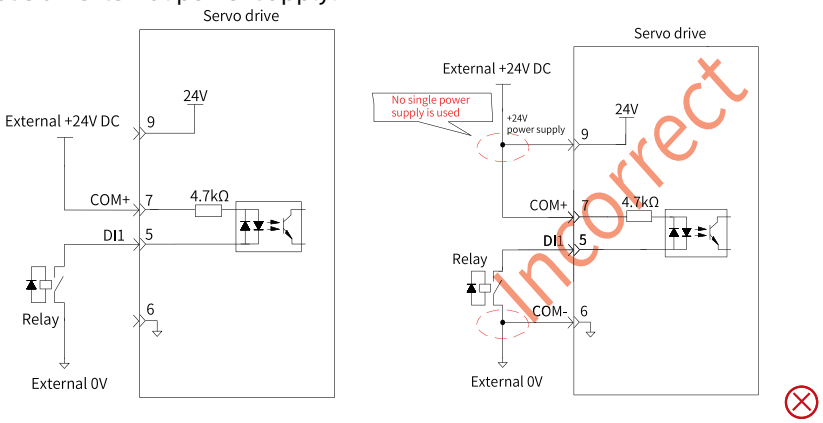
The following takes the DI1 circuit as an example. The other DI circuits are the same.

For details about terminal layout, see *"Table 6-14 Description of DI/DO signals" on page 89*.

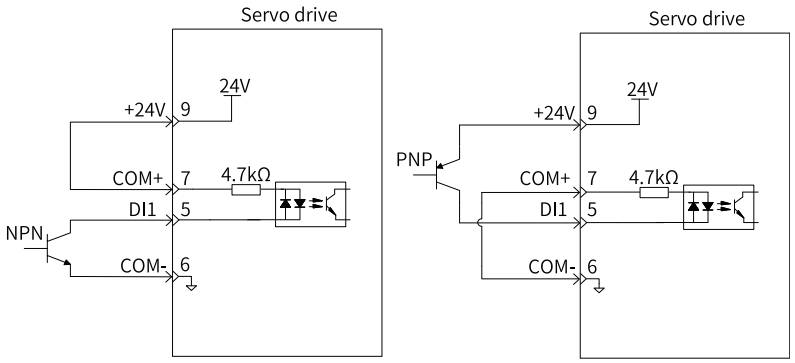
- The host controller provides relay output:
  - When you use the internal 24 V power supply:



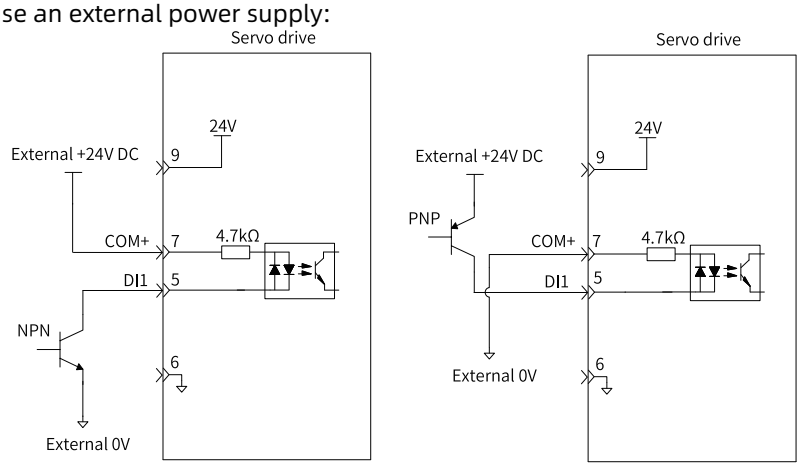
  - When you use an external power supply:



- The host controller provides open-collector output.
  - When you use the internal 24 V power supply:



- When you use an external power supply:



Note

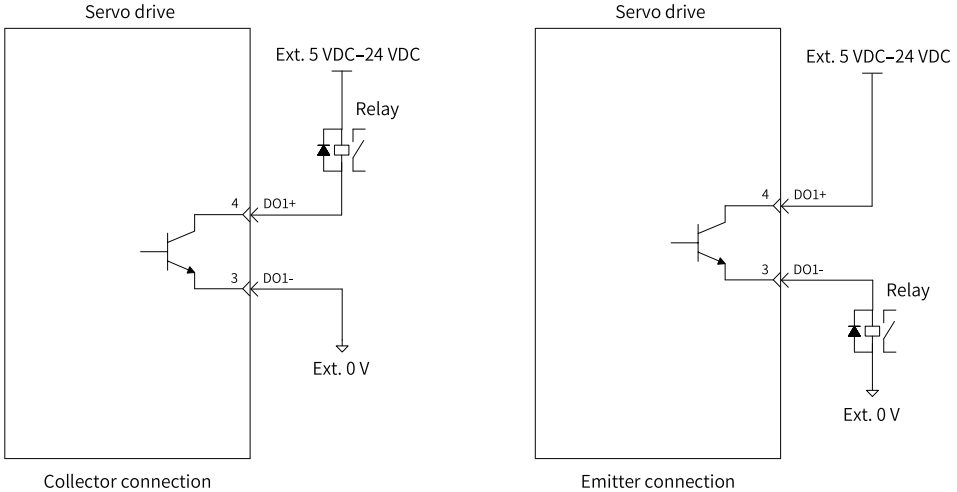
PNP and NPN input cannot be used together in the same circuit.

DO circuit

The following takes the DO circuit as an example. The other DO circuits are the same.

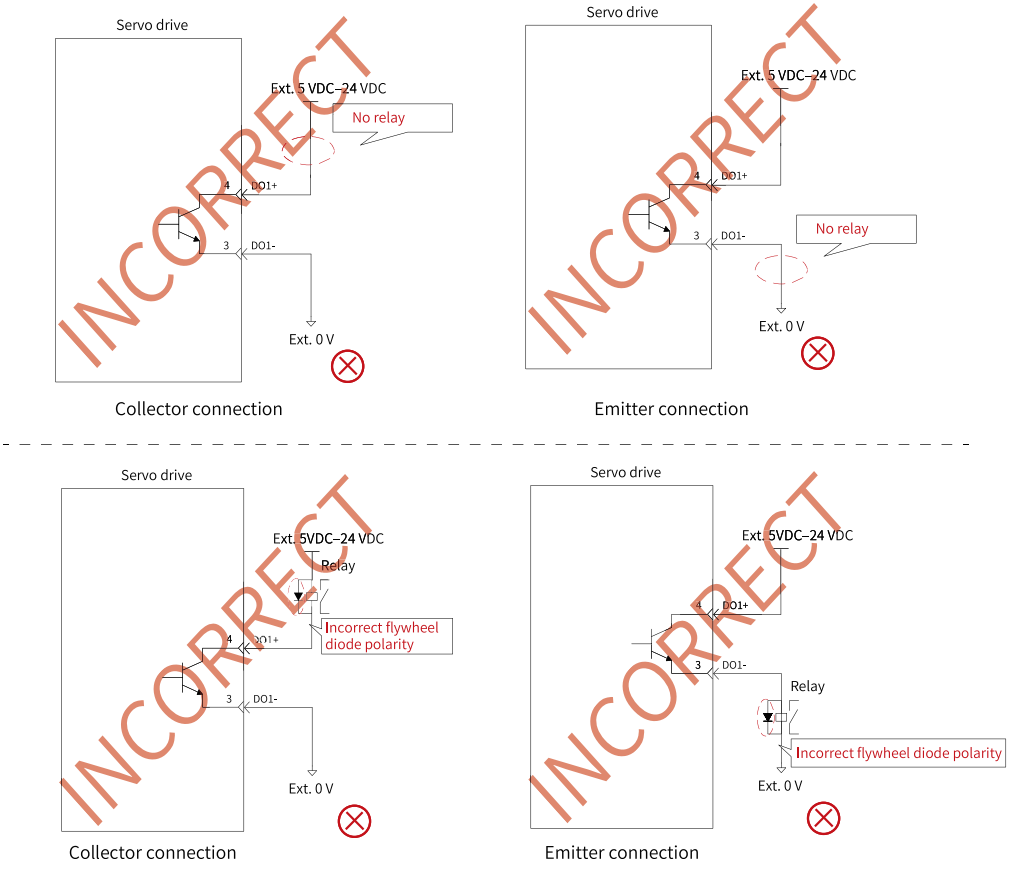
For details about terminal layout, see *"Table 6-14 Description of DI/DO signals" on page 89*.

- When the host controller provides relay input:

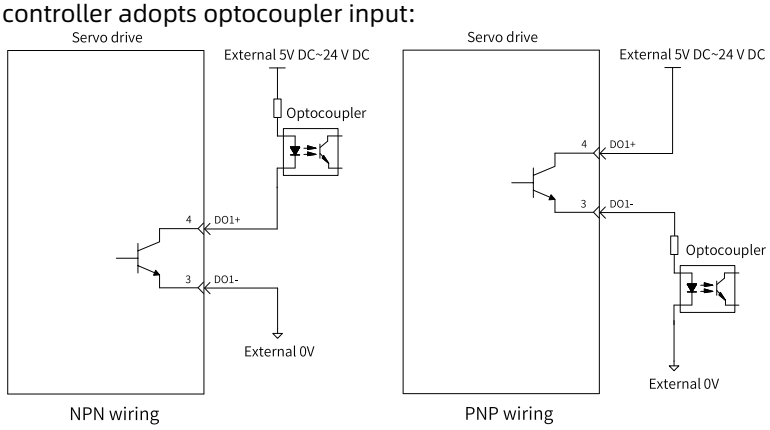


Note

When the host controller provides relay input, a flywheel diode must be installed. Otherwise, the DO terminals may be damaged.



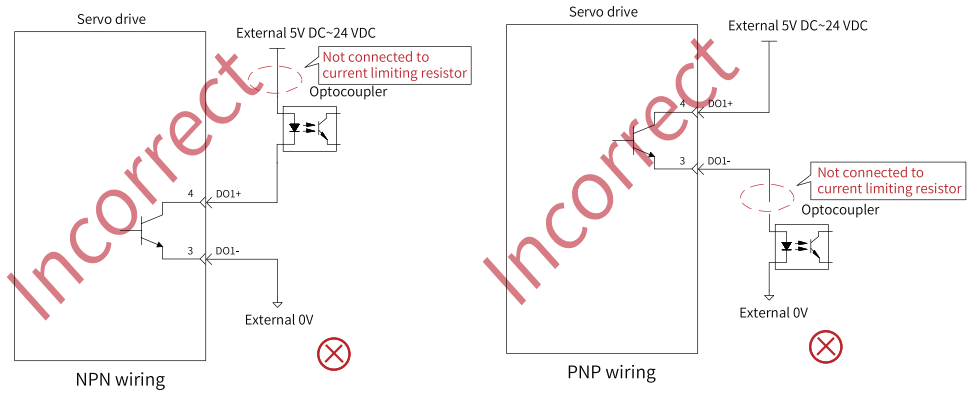
- When the host controller adopts optocoupler input:



Note

The maximum permissible voltage and current capacity of the optocoupler output circuit inside the servo drive are as follows:

- Max. voltage: 30 VDC
- Max. current: DC 50 mA

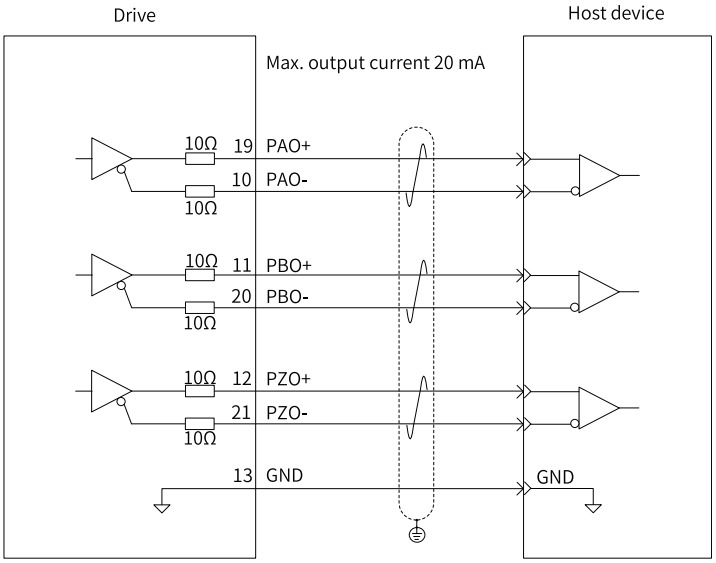


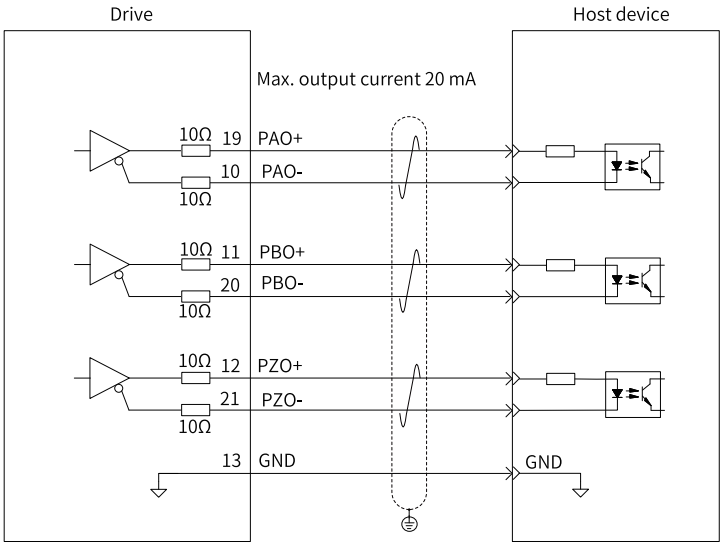
6.4.4.2 Encoder Frequency-Division Output Signals

Encoder frequency-division output circuit outputs differential signals via the differential drive. Typically, this circuit provides feedback signals to the host controller in a position control system. Use a differential or optocoupler receiving circuit on the host controller side to receive feedback signals. The maximum output current is 20 mA.

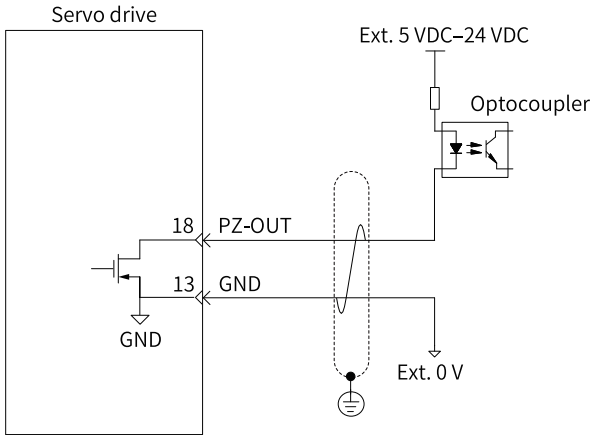
The following takes the encoder frequency-division output signal as an example. The other frequency-division output signal interface circuits are the same.

For details about terminal layout, see *"Table 6-15 Specifications of encoder frequency-division output signals" on page 89*.





Encoder phase Z output circuit outputs OC signals. Typically, this circuit provides feedback signals to the host controller in a position control system. An optocoupler circuit, relay circuit, or bus receiver circuit must be used in the host controller to receive feedback signals.



Caution

To reduce noise interference, use shielded twisted pairs to connect the 5V GND of the host controller to the GND of the servo drive.

6.4.4.3 AI/AO Signals

The following takes the analog signal as an example. The other analog signal interface circuits are the same.

For details about terminal layout, see *"Table 6-16 Specifications of AI/AO signals" on page 90*.

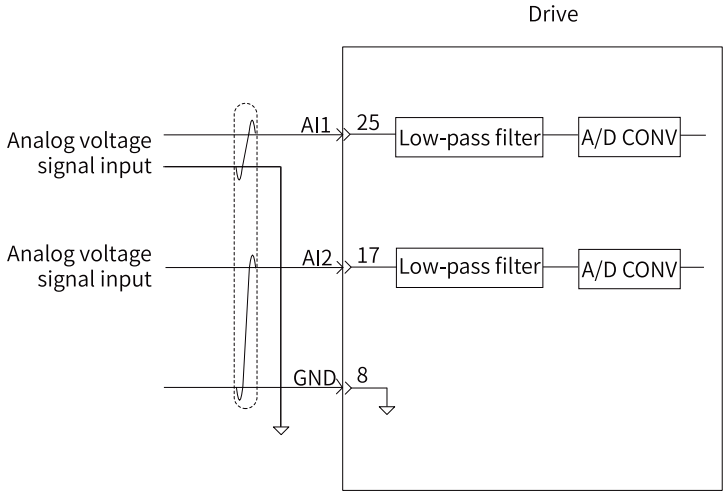
AI signal

The input terminals for analog speed and signals are AI1 and AI2.

AI1 is a voltage-type analog input terminal with a resolution of 12 bits. The voltage value is set in group H03.

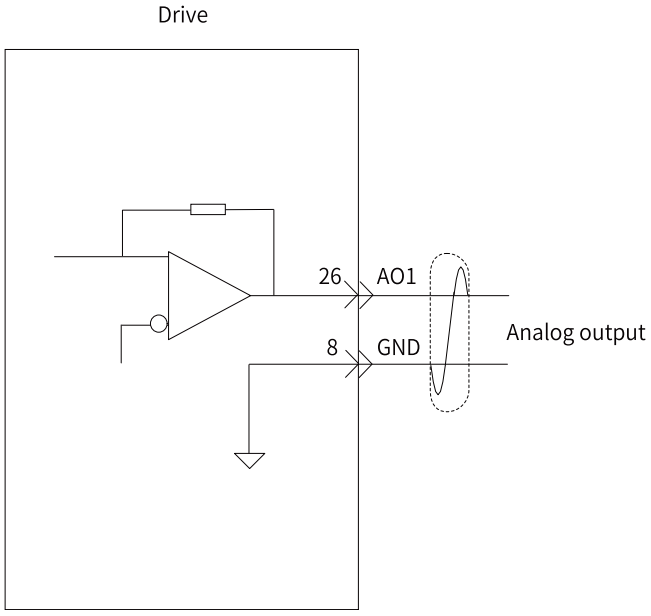
AI2 is a voltage-type analog input terminal with a resolution of 12 bits. The voltage value is set in group H03.

- Voltage-type input specification: -10 V to +10 V; maximum permissible voltage: ±12 V
- Input impedance: about 74 kΩ



AO signal

The output terminal for analog speed and torque signals is AO1, supporting a voltage range of -10 V to +10 V. The voltage value is set in group H04.



6.4.4.4 Wiring of the Brake

The brake is used to lock the motor position when the drive is in the non-operational status, preventing the mechanical load from moving due to gravity or external force.

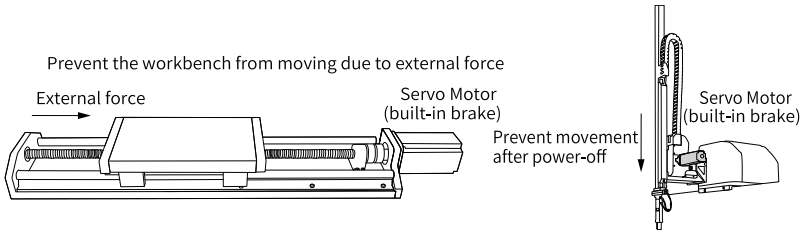


Figure 6-12 How the brake works

Caution

- Use the built-in brake for position-lock purpose only. Do not use this brake for any other purposes (such as braking) other than position-lock in the stop state.
- The brake should be controlled by the servo drive itself. It is not recommended to use a PLC to control the brake.
- The brake coil has no polarity.
- After the motor stops, switch off the servo-ON (S-ON) signal.
- When brake coils are energized (the brake is released), magnetic flux leakage may occur at the shaft end. Pay special attention when using magnetic sensors around the motor.

The connection of the motor brake input signal has no polarity. Users need to prepare a 24 V power supply. Make sure that DO control and the brake use different power supplies. The following figure shows the standard wiring of the brake signal (BK) and holding brake power supply.

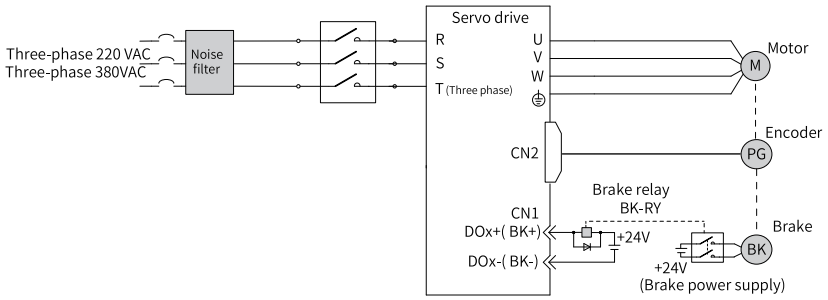


Figure 6-13 Wiring of the brake

Note

- Make sure that different power supplies are used to power the brake and brake control signals. This is to avoid electromagnetic interference on electronic devices.
- It is recommended to use cables with a cross-sectional area above 0.5 mm^2.
- In the preceding figure, the value represented by X in DO X+ and DO X - must be the same. For example, if the drive has two DO terminals, set X to 1 or 2.

Pay attention to the following precautions at wiring:

To decide the length of the cable on the motor brake side, consider voltage drop caused by the cable resistance. The input voltage must be at least 21.6 V to make the brake work. The following table lists brake specifications of Inovance motors.

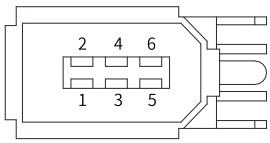
Table 6–18 Brake specifications

Motor model	Holding torque (N·m)	Power supply voltage (VDC) ±10%	Coil resistance (Ω)±7%	Excitation current (A)	Release time (ms)	Close time (ms)	Backlash (°)
MS1H1-05B/10B MS1H4-10B	0.32	24	83.5	0.29	≤ 20	≤ 40	≤ 1.5
MS1H1-20B/40B MS1H4-20B/40B	1.5		75.79	0.32	≤ 20	≤ 60	≤ 1
MS1H1-75B/10C MS1H4-75B/10C	3.2		57.6	0.42	≤ 40	≤ 60	≤ 1
MS1H2-10C/15C/ 20C/25C	8		32.73	0.73	≤ 40	≤ 100	≤ 1
MS1H2-30C/40C/50C MS1H3-85B/13C/ 18C	16		24	1	≤ 60	≤ 120	≤ 1
MS1H3-29C/44C/ 55C/75C	50		18.58	1.29	≤ 100	≤ 200	≤ 1

6.5 Encoder Terminal CN2

6.5.1 Terminal Layout

Terminal layout



Encoder signal terminal CN2 (drive side)

Figure 6-14 Terminal pin layout of the encoder

Table 6–19 Pin assignment

Pin No.	Assignment	Description
1	+5V	5V power supply
2	GND	
3	Reserved	-
4	Reserved	-
5	PS+	Encoder signal
6	PS-	
Enclosure	PE	Shield

Terminal description

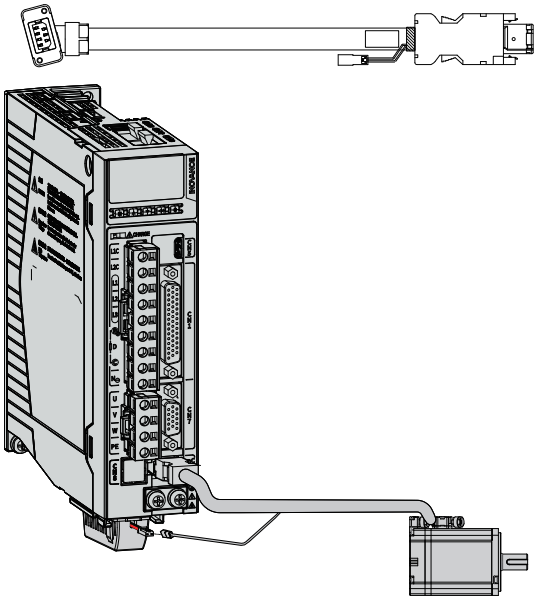


Figure 6-15 Wiring example of absolute encoder signals [1]

Note

- [1]: The preceding figure shows the wiring of a 23-bit multi-turn absolute encoder.
- The encoder cable color is subject to the color of the actual product. Cable colors mentioned in this guide all refer to Inovance cables.

The following figure describes the lead wire color of the battery box.

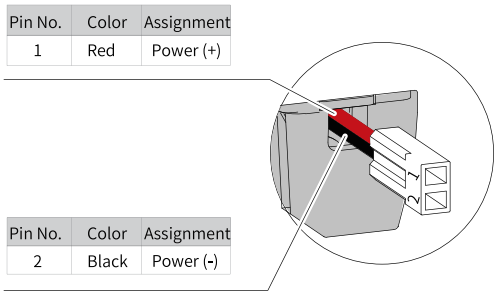


Figure 6-16 Lead wire color of the battery box

Note

- 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.
- Model of the battery box (battery included): S6-C4A

6.5.2 Cable Requirements

Note

It is recommended to use 22AWG to 26AWG cables for 10B, 20B, 40B, and 75B series motors. If the length of the cable needed exceeds the allowable value, increase the cross sectional area of the cable properly. See the following table for details.

Table 6–20 Recommended cables

Cable Size (AWG)	Line Resistance (Ω/km)	Allowable Length (m)
3P x 26	143	0 to 10
1P×22+2P×26	54.3	10 to 26.4
1P×20+2P×24	33.9	26.4 to 42.2
1P×18+2P×22	21.4	42.2 to 66.8
1P×16+2P×18	13.5	66.8 to 105.0

Note

- The preceding length can be increased by 2 m to 3 m.
- For cables higher than 16AWG, contact the sales personnel.
- The letter P in the preceding table indicates twisted pairs, in which 1P represents +5V/0V twisted pair, 2P represents DC+/- twisted pair and PS+/- twisted pair, and 3P represents +5V/0V twisted pair, DC+/- twisted pair, and PS+/- twisted pair.
- For cross-sectional areas of the cables, contact Inovance technical support.

6.5.3 Adapters of Power Cables and Encoder Cables

Recommended power cable connectors are Molex-39039062 and Molex-469990295. The recommended encoder cable is TE-1-172169-9. See the following figure.

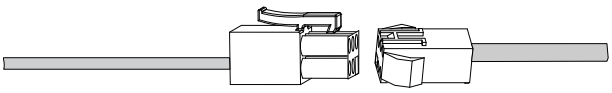


Figure 6-17 Power cable adapter

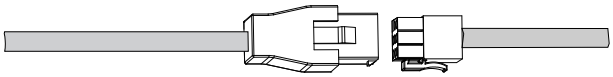


Figure 6-18 Encoder cable adapter

6.6 Communication Terminals CN3 and CN4

6.6.1 Terminal Arrangement

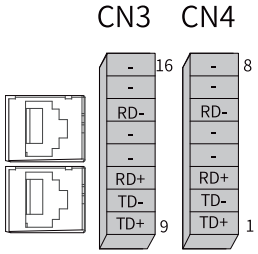


Figure 6-19 Communication Terminal pin layout of the servo drive

Table 6–21 EtherCAT communication terminal pins

Pin No.	Name	Description
1	TD+	Data transmission +
2	TD-	Data transmission -
3	RD+	Data reception +
4 and 5	-	-
6	RD-	Data reception -
7 and 8	-	-
9	TD+	Data transmission +
10	TD-	Data transmission -
11	RD+	Data reception +
12 and 13	-	-
14	RD-	Data reception -
15 and 16	-	-

6.6.2 Cable Requirements

Rules

EtherCAT cables are connected to the network ports (IN and OUT) equipped with the metal shield. The electrical characteristics are compliant with IEEE 802.3 and ISO 8877 standards.

Communication cable types

Table 6–22 Cable data

Material code	Cable model	Cable length (m)	Cable specifications
15040261	S6-L-T04-0.3	0.3	CAT.5E 4-core cable
15040262	S6-L-T04-3.0	3.0	
15041960	S6-L-T04-0.2	0.2	
15041961	S6-L-T04-0.5	0.5	
15041962	S6-L-T04-1.0	1.0	
15041963	S6-L-T04-2.0	2.0	
15041964	S6-L-T04-5.0	5.0	
15041965	S6-L-T04-10.0	10.0	
1504QV45	S6-L-T07-0.3	0.3	CAT6A 8-core cable
1504QV46	S6-L-T07-1.0	1.0	
1504QV47	S6-L-T07-3.0	3.0	

Material code	Cable model	Cable length (m)	Cable specifications
1504QV49	S6-L-T08-0.3	0.3	CAT7 8-core cable
1504QV50	S6-L-T08-1.0	1.0	
1504QV51	S6-L-T08-3.0	3.0	

Communication cable specifications

Table 6–23 Specifications

Item	Description
UL	Compliant with UL certification
CAT.5E cable	CAT.5E 4-core cable
CAT6A cable	CAT6A 8-core cable
CAT7 cable	CAT7 8-core cable
Double shield	Braided shield (coverage: 85%), aluminum foil shield (coverage: 100%)
Ambient temperature	-40℃ to +60℃

Communication cable selection

The EtherCAT communication cable must be Ethernet Category 5 (100Base) network cable or high-strength shielded network cable. The cable for the servo drive must be the shielded network cable with the length no longer than 100 m. The shielded network cable enhances the anti-interference capacity of the system.

If you need to use other EtherCAT communication cables, you can refer to the related specifications provided by Beckhoff.

In the planning stage, always refer to the measurement data provided by the cable manufacturer. If the connection between the devices is flexible, use flexible cables to avoid damage. If connectors are installed in a chemically corrosive environment, use cables with special coating to avoid damage. If other environmental restrictions exist in the application, customized cables must be used according to the specific information provided by the cable manufacturer.

Selection of link cables (recommended by Beckhoff):

For permanent links, the cables must meet the angle value in the worst case described in *"Table 6-24 References for fixed cables of a permanent link" on page 102* and *"Table 6-25 References for flexible cables of a permanent link" on page 103*.

Table 6–24 References for fixed cables of a permanent link

Characteristics	Type **A** cable (fixed)
Cable nominal impedance (tolerance)	100 Ω ± 15 Ω (IEC 61156-5)
Non-balanced or balanced	Balanced
DC round-trip resistance a	≤ 115 Ω/km
Number of conductors	4 (2 pairs)
Shield	S/FTQ
Transmission impedance	< 50 mΩ/m at 10 MHz
Installation type	Stationary, fixed after installation

Characteristics	Type **A** cable (fixed)
Delay deviation	≤ 20 ns/100 m
The DC round-trip resistance a (also called DC circuit resistance) is calculated by measuring the DC resistance of the two-way cable. That is, you connect two pairs of wires at one side of the cable and measure the resistance between the same wires at the other side. If the measured resistance between two ends of a single cable is about half of the value of the round-trip resistance, the corresponding reference value should also be ≤ 57.5 Ω/km.	

Table 6–25 References for flexible cables of a permanent link

Characteristics	Type **B** cable (flexible)
Cable nominal impedance (tolerance)	100 Ω ± 15 Ω (IEC 61156-5)
Non-balanced or balanced	Balanced
DC round-trip resistance a	≤ 115 Ω/km
Number of conductors	4 (2 pairs)
Shield	S/FTQ
Transmission impedance	< 50 mΩ/m at 10 MHz
Installation type	Flexible, occasional movement or vibration
Delay deviation	≤ 20 ns/100 m
The DC round-trip resistance a (also called DC circuit resistance) is calculated by measuring the DC resistance of the two-way cable. That is, you connect two pairs of wires at one side of the cable and measure the resistance between the same wires at the other side. If the measured resistance between two ends of a single cable is about half of the value of the round-trip resistance, the corresponding reference value should also be ≤ 57.5 Ω/km.	

Table 6–26 Cable example for a permanent link

	Fixed	Flexible
Shield	S/FTQ	S/FTQ
Round-trip resistance	≤ 115 Ω/km	≤ 115 Ω/km
Insertion loss (@100 MHz)	19.5 dB/100 m	21.3 dB/100 m
Near-end crosstalk (@100 MHz)	50 dB/100 m	50 dB/100 m

Only four cables are used for EtherCAT communication. Therefore, it is recommended to use four-conductor (two pairs) balanced Ethernet cables. You can also use four pairs of cables, provided that their performance in IL and NEXT is consistent with that of the four-conductor cables and does not exceed the angle value of the worst case reported in *"Table 6-24 References for fixed cables of a permanent link" on page 102* and *"Table 6-25 References for flexible cables of a permanent link" on page 103*. The unused cable pairs (especially if these cable pairs are not connected correctly to devices) will actually increase the signal crosstalk between adjacent cable pairs and reduce the cable performance.

6.6.3 EtherCAT Communication Wiring Example

CN3 and CN4 are EtherCAT connectors. Connect CN4 (IN) to the communication port of the master and CN3 (OUT) to the next slave. For details about the CN3 and CN4 terminal pins, see *"Table 6-21 EtherCAT communication terminal pins" on page 101*.

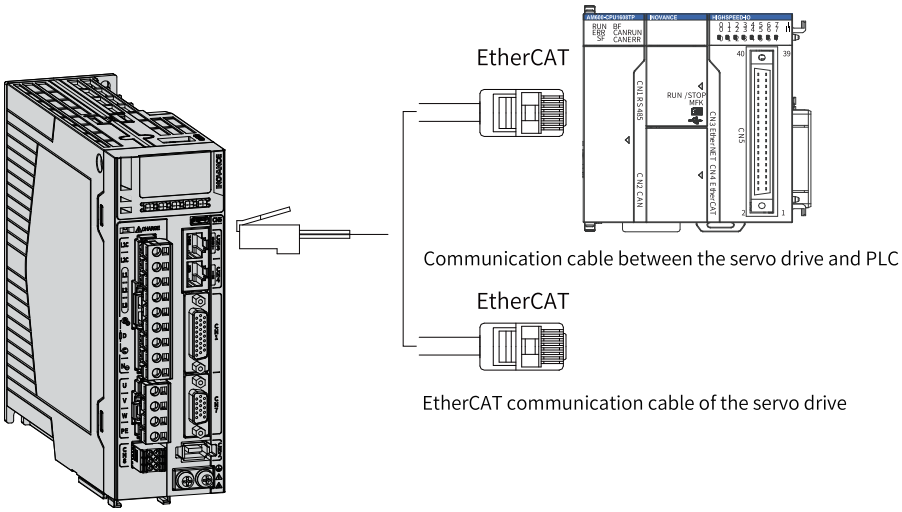


Figure 6-20 Wiring of communication cables

Topology

The communication topology of EtherCAT is flexible without any limit, as shown in *"Figure 6-21 Communication network topology" on page 104*. The drive carries IN and OUT ports.

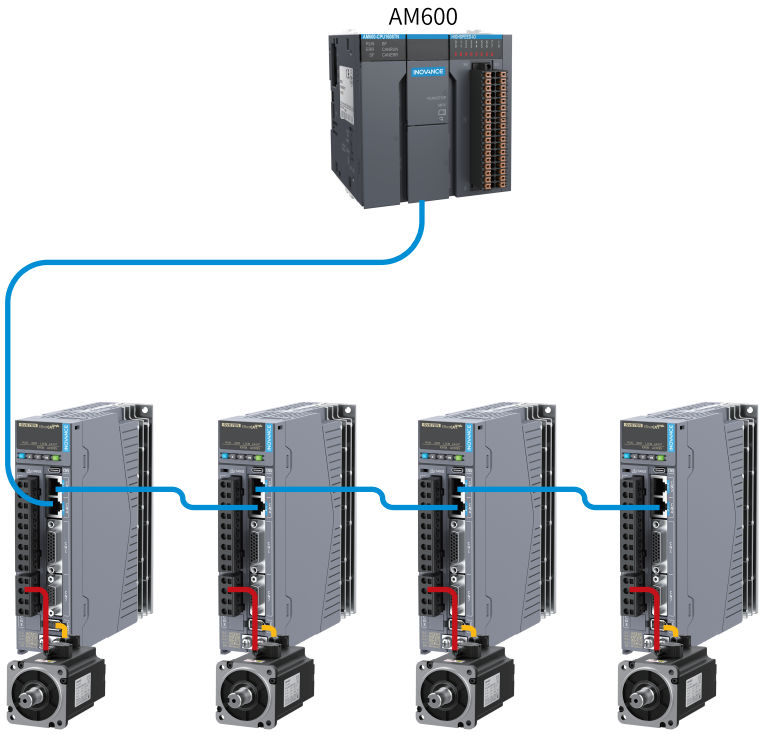
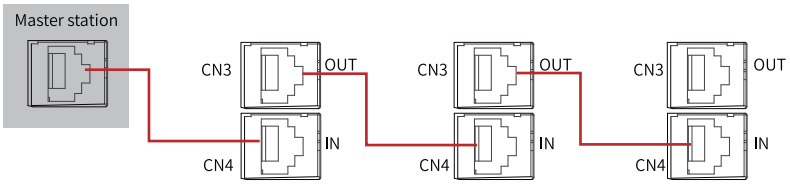
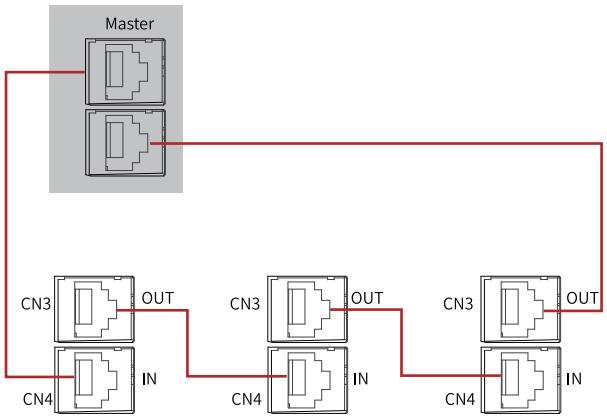


Figure 6-21 Communication network topology

Linear topology:



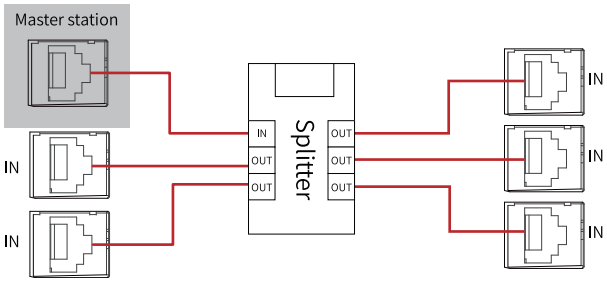
Ring topology



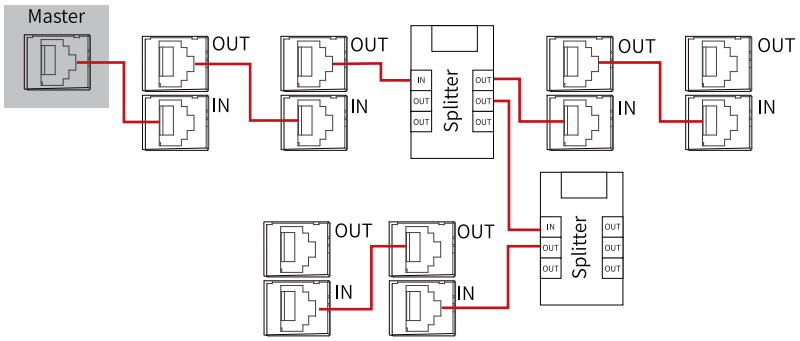
Note

When using the redundant ring, set H0E.36 (EtherCAT AL enhanced link) to 1 (Enable). Power on the drive so that the setting become effective.

Star topology:



Tree topology:



6.7 Communication Terminal CN5

Terminal layout

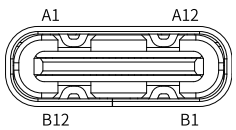


Table 6–27 Pin assignment of communication terminal CN5

Pin No.	Definition	Description
A1 B1	GND	Signal reference GND
A4 B4	VBUS	USB power supply
A5 B5	-	-
A6 B6	DP	Differential data transmission
A7 B7	DN	Differential data transmission
A8 B8	-	-
A9 B9	VBUS	USB power supply
A12 B12	GND	Signal reference GND

Terminal description

This terminal is a commissioning port connected with the PC. The communication cable must be of fast-charging Type-C with a magnetic ring. It must be equipped with a grounding wire, aluminum foil and metal shielding layer. Its length can be up to 3 m.

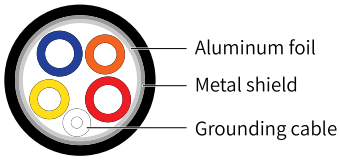


Figure 6-22 Recommended cables

Note

- Supports online upgrade and commissioning with the software tool when the drive is powered on.
- In USB mode, the terminal only supports download and upload of parameters, and driver firmware update.
- The terminal uses USB power supply. If there is a fault that cannot be completely reset, disconnect the USB power supply and drive control power, and then power on again.
- If the PC does not provide sufficient USB ports, use a mainstream USB expansion module. In USB mode, to prevent power failure, it is recommended to use a USB expansion module with independent power supply.
- If the drive is powered only through USB, the drive may fail to enter USB mode due to insufficient power supply from the computer's USB port, and the panel displays the error. In such cases, it is recommended to use a USB 3.0 port with stronger power supply capability or power the control circuit of the drive.

6.8 STO Safety Terminal (CN6)

6.8.1 Terminal layout

Note

The CN6 STO safety function terminal is only suitable for -FS models.

Terminal layout

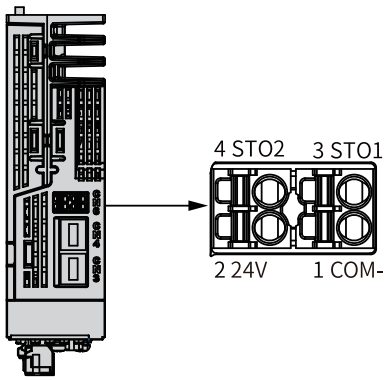
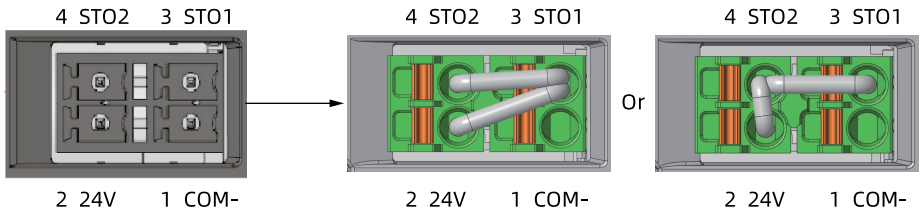


Table 6–28 Pin assignment of STO safety terminal

Pin No.	Assignment	Description
1	COM-	STO reference ground
2	24 V	Internal 24 V power supply
3	STO1	Control input for STO1
4	STO2	Control input for STO2

Two isolated inputs are configured to dual-channel inputs of the STO function: STO1/STO2.

To facilitate commissioning, additional pin with supply voltage (+24V) is integrated. The bridging of the 24 V terminal to STO1/STO2 is needed in case the safety circuit is installed but STO function is not needed.



Terminal Description

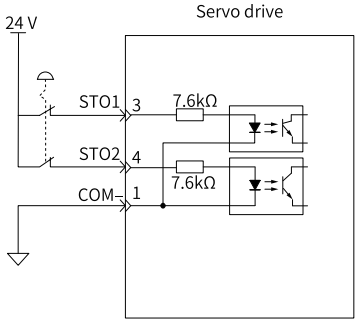
- **Electrical specifications and connection of the input circuit**
  This section describes the characteristics of the input signals assigned to the CN6 connectors.
  - Specifications
    The servo drive operates normally only when the input states of STO1 and STO2 are both "High" ("1" or "H").

The servo drive does not operate when the input states of STO1 or STO2 are different or are both "Low" ("0" or "L").

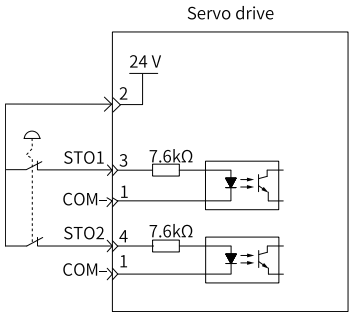
- The following table describes the electrical characteristics of Safety Request Input Signal.

Item	Characteristics	Description
Voltage range	24 VDC (±15%)	-
Input current	3.6 mA (Typ.)	Input current of STO1 and STO2 (3.6 mA)
Logic level standard	"0" < 5 V, "1" > 15 V	-
Digital input impedance	7.6 kΩ	-

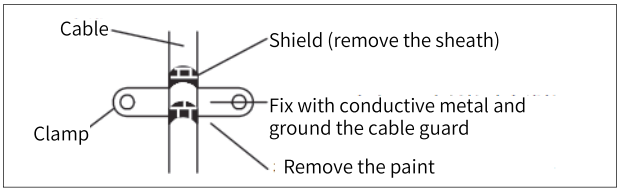
- Wiring example when the external 24 V is used



- Wiring example when the internal 24 V is used



- **EMC requirements**
  - To avoid short circuit between two adjacent conductors, either use cable with shield connected to the protective bonding circuit on each separate conductor, or use flat cables with one earthed conductor between each signal conductor.
  - Double-shielded or single-shielded twisted multi-pair cable is strongly recommended.
  - Secure and ground the cable shield using a piece of conductive metal strip.
    Example of cable clamp:



  - The maximum allowable cable length between the drive and the safety switch is 30 m.
- **Additional requirements**
  - All cables must be well protected, routed and secured where practicable.
  - Ensure that cables are not pinched or pulled during installation.

- Route the two STO DI channels through different routes to prevent possible faults. If impossible, protect the cable with double shields.

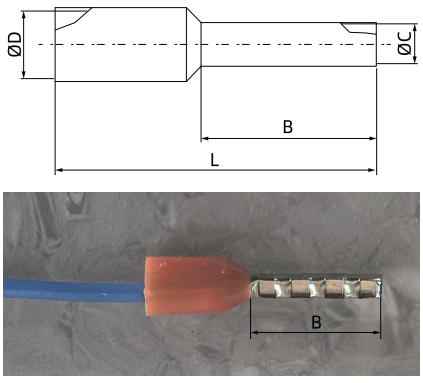
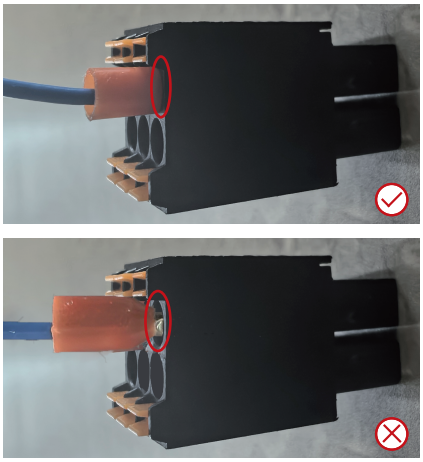
Cable	Description
Category	Low voltage, double-shielded or single-shielded twisted multi-pair cable
Maximum size	0.8mm² (18 AWG)
Minimum size	0.3mm² (28 AWG)
Maximum length	The maximum distance between STO input and the operating contact is 30 m.

Applicable servo drives

The STO function applies to the following servo drives (-FS models):

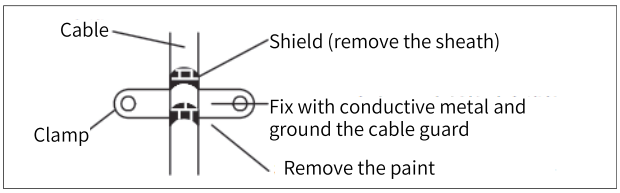
Size	Power range (kW)	Structure	W × H × D (mm³)
A	0.2 to 0.4	Split-type structure	45.5 × 170 × 150
C	0.75 to 1.5	Split-type structure	55 × 170 × 173
D	1.5 to 3	Split-type structure	80 × 170 × 183
E	2 to 7.5	Split-type structure	90 × 250 × 230

6.8.2 Wiring Precautions and Requirements

Pre-installation inspection	During installation
	
Tubular terminal contact area (B) ≤ 8 mm	Fully insert the terminal during installation to avoid exposing the tubular terminal contact area.

EMC requirements

- To avoid short circuits between two adjacent conductors, either use shielded cables connected to the protective ground, or use flat cables with one grounding wire inserted between each two signal conductors.
- It is recommended to use double-shield or single-shield twisted multi-pair cables.
- Fix and ground the cable shield by using a piece of conductive metal.
  Example of cable clamp:



- The maximum allowable cable length between the drive and the safety switch is 30 m.

Additional requirements

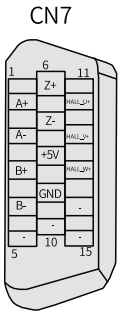
- All wiring must be well protected, routed, and clamped where practicable.
- Make sure that the cable is not pulled or pinched during installation.
- Route the two STO DI channels through different routes to prevent possible faults. If impossible, protect the cable with double shields.

Cable	Description
Category	Low voltage, double-shielded or single-shielded twisted multi-pair cable.
Maximum size	0.8 mm^2 (18 AWG)
Minimum size	0.3 mm^2 and 28 AWG
Maximum length	30 m between STO inputs and the operating contact

6.9 2nd Encoder Terminal CN7

6.9.1 Terminal layout

Terminal layout



Pin No.	Assignment	Description	Pin No.	Assignment	Description
1	A+	Encoder pulse phase A input+	9	GND	Power supply reference ground
2	A-	Encoder pulse phase A input-	10	-	-
3	B+	Encoder pulse phase B input+	11	HALL_U+	Hall signal U
4	B-	Encoder pulse phase B input-	12	HALL_V+	Hall signal V
5	-	-	13	HALL_W+	Hall signal W

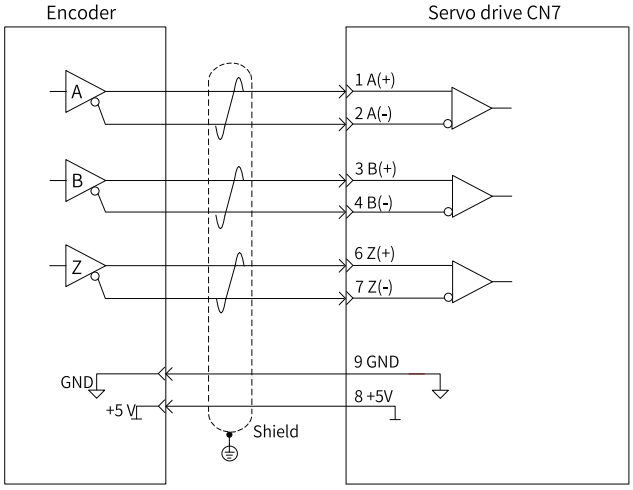
Pin No.	Assign ment	Description	Pin No.	Assign ment	Description
6	Z+	Encoder pulse phase Z input+	14	-	-
7	Z-	Encoder pulse phase Z input-	15	-	-
8	+5 V	Encoder 5 V power supply (load current lower than 200 mA)	Housing	PE	Shield

Note

The total load current cannot exceed 200 mA when No.8 and No.14 pins are used together.

Terminal Description

Use shielded twisted pairs to match the high input frequency.



- To reduce noise interference, connect the reference ground of the external encoder to the GND of the drive. Use shielded cables and connect the shield to the CN7 terminal enclosure.
- The input mode of the external encoder is differential input.
- The maximum pulse frequency supported by a phase A/B linear encoder is 4 Mpps.
- The pulse input terminal of a phase A/B encoder supports open circuit detection.

Suppose the current consumed by the motor encoder is 200 mA, you can select the cable based on the following recommendations.

Table 6–29 Recommended cable between the servo drive and linear motor encoder

Wire gauge	Cable unit resistance	Allowable cable length
26 AWG (0.13 mm^2)	143 Ω/km	8.0 m
25AWG ($^{0.15mm2}$)	89.4 Ω/km	14.0 m
24AWG (0.21mm^2)	79.6 Ω/km	15.0 m
23AWG (0.26mm^2)	68.5 Ω/km	18.0 m
22AWG (0.32mm^2)	54.3 Ω/km	23.0 m
21AWG (0.41mm^2)	42.7 Ω/km	29.0 m

Assume that the current consumed by the motor encoder is higher than 200 mA.

you can select the cable based on the following formula.

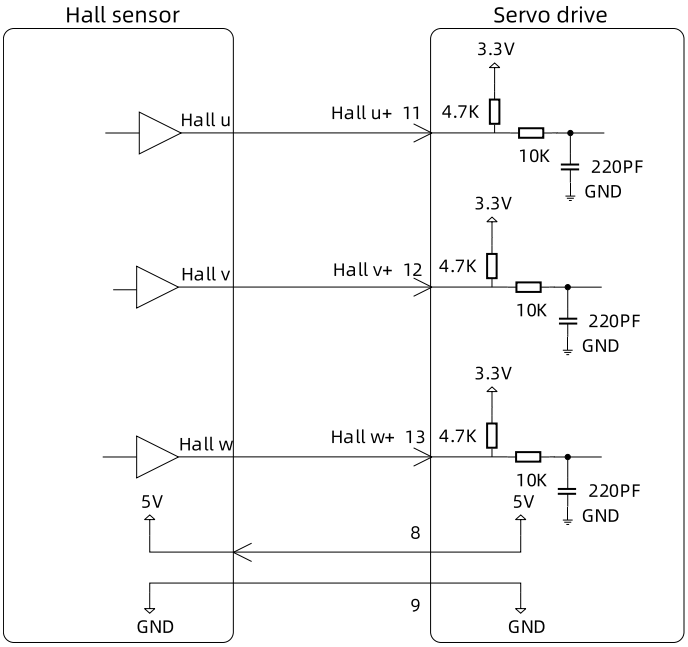
$$L2=\frac{\triangle U_{max2}}{I_{encoder}x2R_{unit}}$$

In the preceding formula, △U is 0.5 V. $I_{encoder}$ represents the current consumed by the encoder (see the encoder user guide for details), R_{unit} represents the unit resistance (Ω/km) of the cable, and L2 represents the allowable cable length.

Note

Hall signals support only 3.3 V voltage input.

6.9.2 Wiring Examples



Note

1. To reduce noise interference, connect the reference ground of the sensor to the GND of the drive. Use shielded twisted pair cables and connect the shield to the enclosure of the CN7 terminal to reduce noise interference.
2. The input mode of the external Hall sensor is single-ended input. Only 3.3 V voltage input is supported.
3. The total load current cannot exceed 200 mA when No. 8 and No. 9 pins are used at the same time.
4. For differential input of the external Hall sensor, see the description of the encoder signal adapter box.

6.10 Adapter Terminal S6-C220

Terminal layout

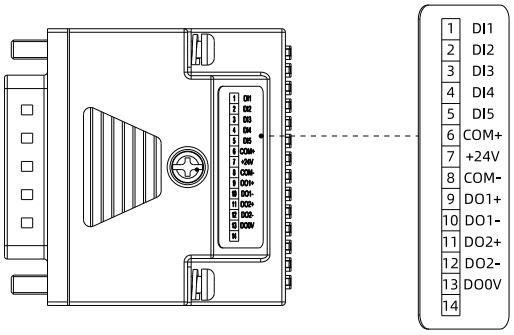


Figure 6-23 Layout of terminal pins

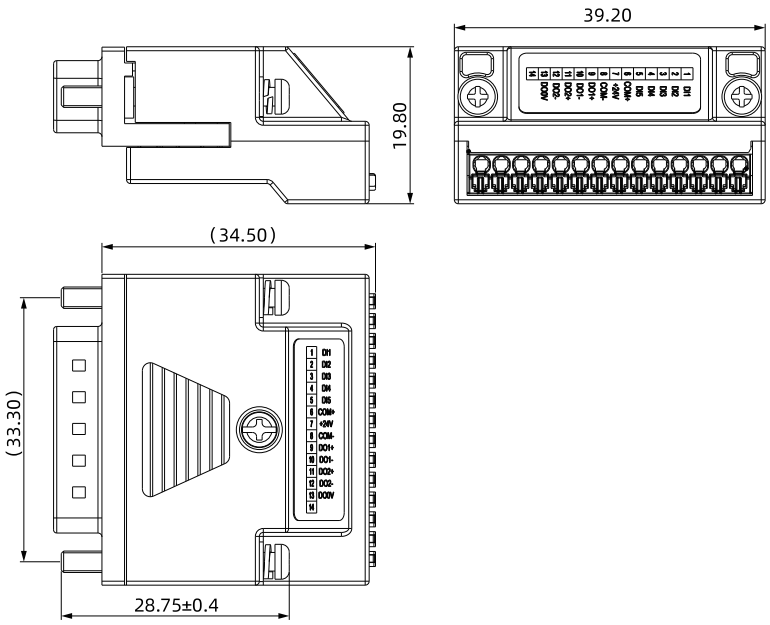
Pin No.	Pin assignment	Pin No.	Pin assignment
1	DI1	8	COM-
2	DI2	9	DO1+
3	DI3	10	DO1-
4	DI4	11	DO2+
5	DI5	12	DO2-
6	COM+	13	DO0V
7	+24V	14	-

Terminal description

The control terminal adapter of the servo is used to convert interfaces between the servo drive and different devices in multi-application scenarios. It ensures stable connection and communication between the servo drive and other devices in industrial automation systems.

The S6-C220 adapter terminal is suitable for CN1 control terminals (S6-C74).

Terminal dimensions



6.11 Grounding

6.11.1 Grounding Requirement (CE)

Observe the following requirements to ensure a proper grounding of the product.

Danger

- Measures against electrical shock: Ground the grounding terminal properly. The grounding method must comply with the electrical installation regulations in the applicable country/region.
- When using a welding machine or other high-current equipment, ensure that no stray current flows through the internal protective earth (PE) conductor. Otherwise, fire accidents may occur.

Caution

1. Grounding conductor selection: The protective grounding conductor must meet the equipment technical specifications and IEC safety standards, and must be selected according to the following principles:
   - Single-drive system: Leakage current ≤ AC 3.5 mA/DC 10 mA, cross-sectional area ≥ cross-sectional area of phase conductor
   - Multi-drive in parallel: When leakage current > AC 3.5 mA, use a copper conductor with cross-sectional area ≥ 10 mm^2 or a dual-conductor for redundant connection.
2. Grounding cables (except motor grounding cables) must meet requirements of GB/T 12668.501 and EN/IEC 61800-5-1. In any case, the cross-sectional area of each protective grounding conductor that does not form part of the power cable or cable jacket cannot be less than 2.5 mm^2.
3. The grounding cable length must be minimized, and the cable dimensions must follow the electrical equipment technical standards to prevent potential drift of the grounding point due to leakage current.
4. For multi-drive systems, ground the system according to specifications. Improper grounding may cause equipment malfunction.
5. Do not share the grounding circuit with welding equipment or high-current devices. Failure to comply may result in system faults due to electrical interference.

6.11.2 Grounding Requirements (UL)

To ensure proper grounding of this product, the following grounding requirements are specified according to UL 61800-5-1:

1. The grounding cable size shall comply with the requirements of ANSI/NFPA 70 Article 250.122 and the associated table.
2. For equipment connected by cables, the grounding cable must not be disconnected while the device is energized.

6.11.3 Wiring Precautions

Observe the following requirements to ensure a proper grounding of the product.

- The protective grounding conductor must be yellow-green copper cables and cannot be connected in series with circuit breakers or other switching devices.
- The grounding terminal must be grounded properly. Do not connect the grounding terminal to the power supply neutral (N) terminal.
- Install the drive on a conductive metal mounting surface. Ensure that the whole conductive bottom of the drive is bonded properly to the mounting surface.

6.11.4 Wiring Examples

6.11.4.1 Single-Drive Grounding

For grounding of a single drive, see *" System connection diagram" on page 53*.

6.11.4.2 Multi-Drive Grounding

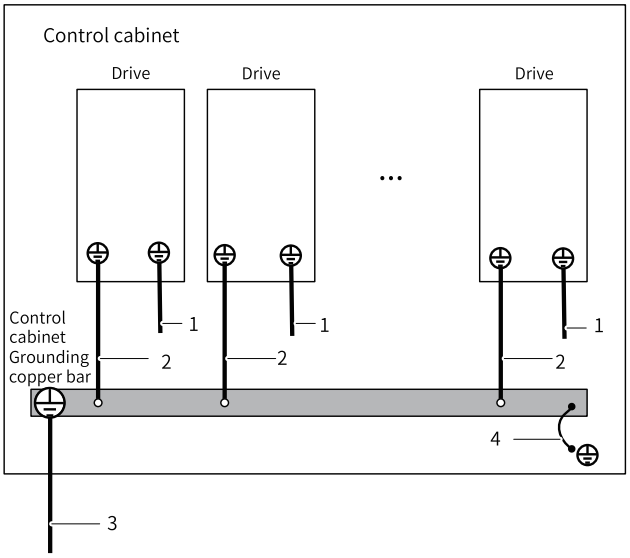


Figure 6-24 Multi-drive grounding

Table 6–30 Description of parallel grounding of multiple drives

No.	Wiring description
①	Connect the motor output cable shield to the output PE terminal of the servo drive.
②	Connect the main circuit input PE terminal of the drive to the grounding copper busbar of the control cabinet through a protective grounding conductor.
③	Connect the PE cable on the input power supply side to the grounding copper busbar of the control cabinet.
④	Connect the grounding copper busbar of the control cabinet to the metal enclosure of the control cabinet through the protective grounding conductor.

6.11.4.3 Grounding of the Control Cabinet System

The most cost-effective method of suppressing interference in a control cabinet is to isolate the interference source from devices that may be interfered with. Divide the control cabinet into multiple EMC compartments or use multiple control cabinets based on the intensity of interference sources, and install each device in accordance with the following wiring principles.

Table 6–31 Wiring requirements

No.	Wiring requirements
1	Place the control unit and the drive unit in two separate control cabinets.
2	If multiple control cabinets are used, connect the control cabinets by using a grounding cable with a cross-sectional area of at least 16 mm^2 for equipotentiality between the control cabinets.
3	If only one control cabinet is used, place different devices in different compartments of the control cabinet based on signal intensity.
4	Apply equipotential bonding to devices in different compartments inside the control cabinet.
5	Shield all communication and signal cables routed out from the control cabinet.
6	Place the power input filter in a position near the input interface of the cabinet.
7	Apply spray coating to each grounding point in the control cabinet.

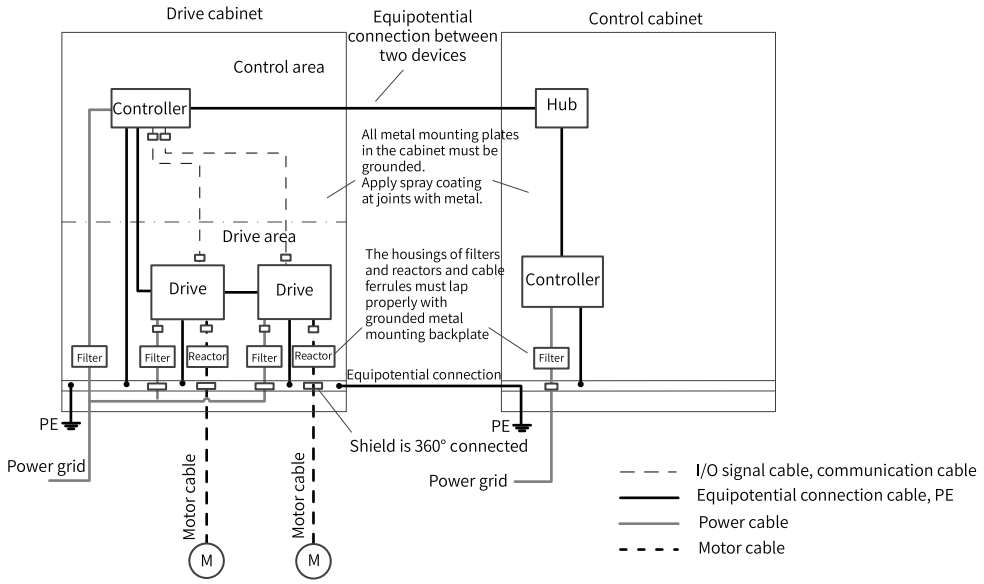


Figure 6-25 Recommended wiring for the control cabinet system

6.12 Wiring of Options

6.12.1 Wiring of the Braking Resistor

Connecting an external braking resistor

When the motor torque direction is opposite to the speed direction, the energy is transmitted from the motor back to the servo drive, causing rise of the bus voltage. When the bus voltage rises to the braking threshold, the energy is consumed by the braking resistor according to the braking requirements. Otherwise, the drive will be damaged. You can use either a built-in or external braking resistor. Do not use a built-in braking resistor and an external braking resistor at the same time.

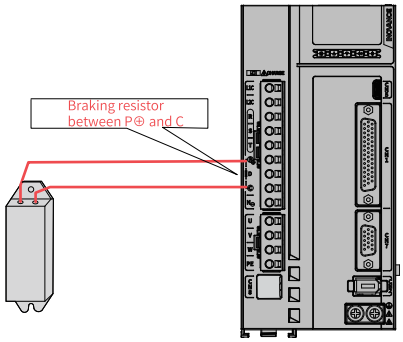


Figure 6-26 Wiring of external braking resistor

For cables (CE) used for terminals P⊕ and C, see *"6.3.4.1 Cable Specifications (CE)" on page 79*. For recommended cable specifications (UL), see *"6.3.4.2 Cable Specifications (UL)" on page 81*.

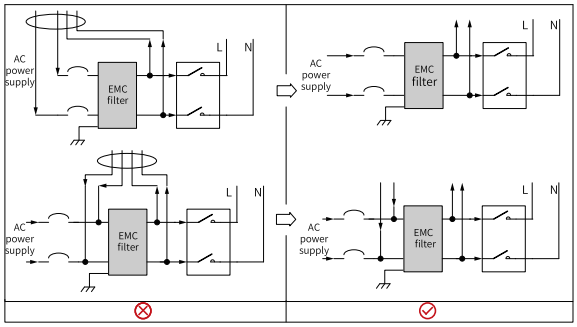
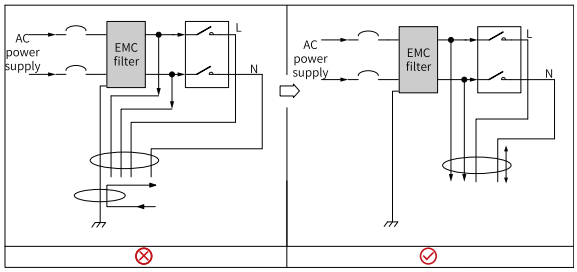
Caution

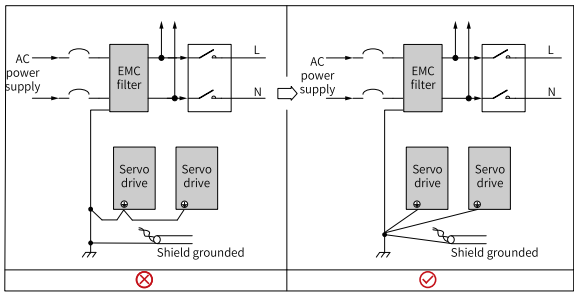
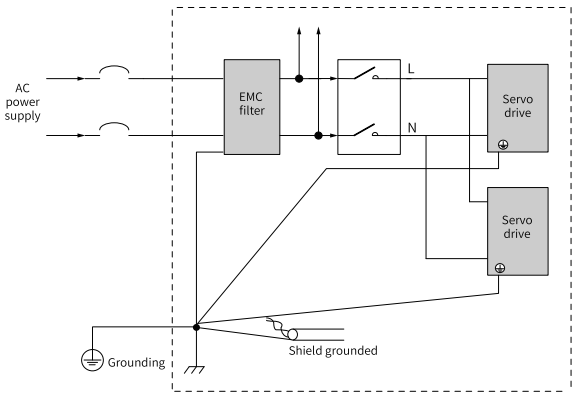
Observe the following precautions when wiring the external braking resistor:

- The built-in braking resistor or jumper bar is not available in models S1R6 and S2R8. If an external braking resistor is needed for these models, connect it between terminals P ⊕ and C.
- Remove the jumper between terminals P ⊕ and D before using the external braking resistor. Failure to comply can result in overcurrent and damage the braking transistor.
- Do not connect the external regenerative resistor to the positive or negative pole of the bus directly. Failure to comply will damage the servo drive and result in a fire.
- Select a resistor with resistance higher than or equal to the minimum permissible value. Failure to comply will result in Er.201 (Overcurrent) or damage the servo drive.
- Make sure parameters H02.25 (Braking resistor setting), H02.26 (Power of external braking resistor) and H02.27 (Resistance of external braking resistor) are set properly before you operate the servo drive.
- Install the external braking resistor on incombustible surfaces (such as metal).

6.12.2 Wiring of the Power Supply Filter

To prevent interference from the power cable and reduce impact of the servo drive on other sensitive devices, install a proper EMC filter on the input side of the power supply according to the input current. In addition, install an EMC filter on the power supply cable of peripheral equipment if necessary. Observe the following precautions when installing and wiring EMC filters.

No.	Precautions	Wiring example
1	Do not place the input and output cables of the EMC filer in the same duct or bundle them together.	 Figure 6-27 Separate routing of EMC filter input and output cables
2	Route the grounding cable and the output power cable of the EMC filter through different routes.	 Figure 6-28 Separate routing of the grounding cable and output power cable

No.	Precautions	Wiring example
3	Use a separate grounding cable as short and thick as possible for the EMC filter. Do not share the grounding cable with other grounding devices.	 Figure 6-29 Single-point grounding
4	Ground the EMC filter inside the cabinet. If the EMC filter and the servo drive are installed in the same control cabinet, fix the EMC filter and the servo drive on the same metal plate. Make sure the contact part is in good conductive condition, and ground the metal plate properly.	 Figure 6-30 Grounding of the EMC filter

6.12.3 Wiring of Surge Protection Device

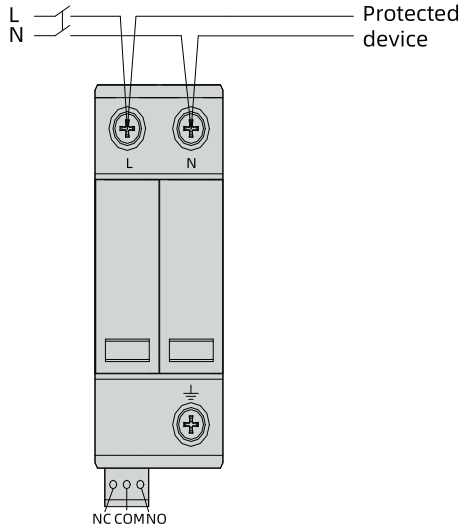
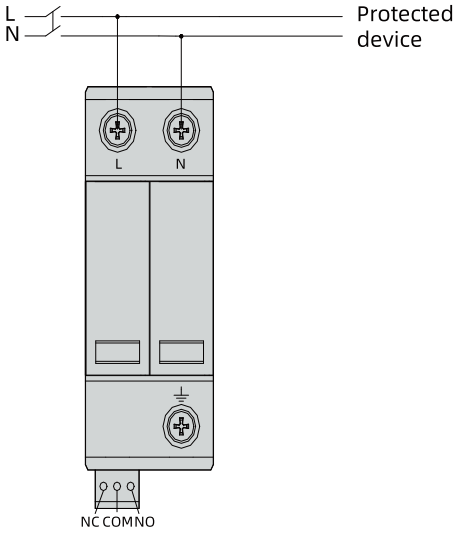
6.12.3.1 Wiring Precautions and Requirements

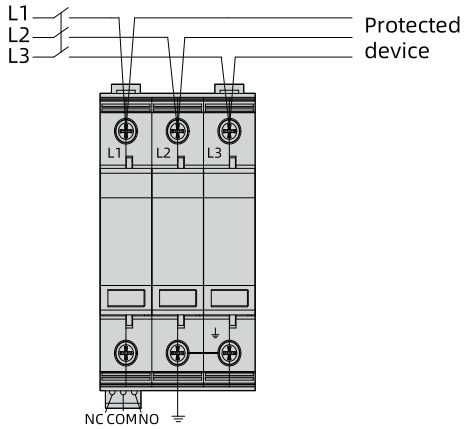
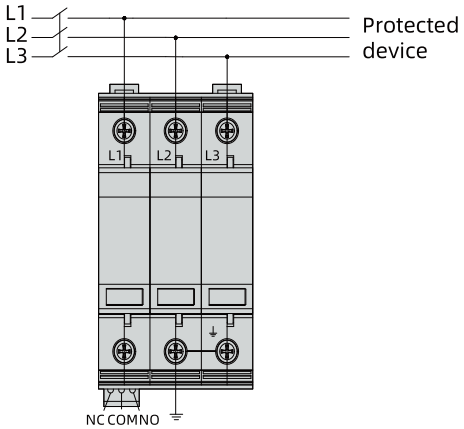
- A proper fuse or circuit breaker must be connected in series in the upstream of the power supply surge protection device.
- The power supply must be disconnected during wiring. Never operate with power on. When connecting to the power supply, strictly follow the wiring labels and PE on the product. Improper connection can damage the surge protection device.
- The power supply surge protection device requires no special maintenance. You only need to check whether the module is loose and whether the status indicator is normal regularly.
- If any one of the following conditions occurs, the power supply surge protection device fails. In this case, replace it.
  - The status indicator of the power supply surge protection device turns red.
  - The alarm dry contact NC-COM of the power supply surge protection device changes to the open circuit state, and NO-COM changes to the short circuit state.

6.12.3.2 Wiring Example

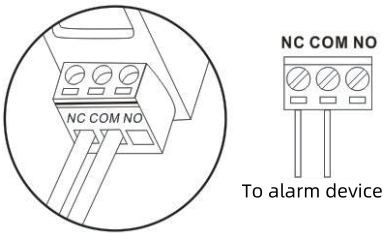
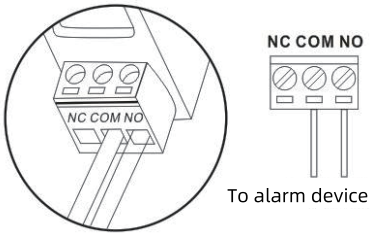
Wiring method

The product is fixed using a standard 35 mm rail. The wiring method is as follows.

V-shaped wiring (recommended) - Single-phase	Direct parallel wiring - Single-phase
 V-shaped wiring	 Direct parallel wiring • Total wiring length ≤ 0.5 m • Minimize the difference in length among phase cables.

V-shaped wiring (recommended) - Three-phase	Direct parallel wiring - Three-phase
 V-shaped wiring	 Direct parallel wiring • Total wiring length ≤ 0.5 m • Minimize the difference in length among phase cables.

Alarm wiring

Open circuit alarm: Use NO-COM terminal.	Short circuit alarm: Use NC-COM terminal.
 Remote alarm connection method 1 (NO normally, short-circuited upon fault)	 Remote alarm connection method 2 (NO normally, short-circuited upon fault)

Installation and inspection

After installation, insert the surge protection module into place and check whether it is operating normally. The operating status of the surge suppression device is described as follows:

Status	Indicator	NC-COM	NO-COM
Running	Green	Short circuit	Open circuit
Failure	Red	Open circuit	Short circuit

6.13 Post-wiring Inspection

After wiring is done, check the following items.

No.	Item	Pass
1	The drive is grounded properly.	□
2	The power supply (input power) voltage matches the rated input voltage of the drive.	□
3	The power supply (input power) is connected to L1/L2/L3 and secured with the specified tightening torque.	□
4	A proper power supply (input power) fuse and circuit breaker are installed.	□
5	The motor is connected to U/V/W, and all terminals are secured with the specified tightening torque.	□
6	An external braking resistor (if present) is connected to P and C and secured properly.	□
7	Motor cables (and braking resistor cables, if any) are routed away from other cables (>30 cm).	□
8	No power factor compensation devices are present in the motor cables.	□
9	External control circuit wiring of the control unit is correctly connected.	□
10	No tools, foreign objects, or dust from drilling are left inside the servo drive.	□
11	The power (input power) voltage is not directly connected to the output of the drive.	□

6.14 Solutions to Common EMC Problems

6.14.1 Malfunction of Residual Current Device

If a residual current device (RCD) is needed, select the RCD according to the following requirements:

- Use a B-type RCD because the drive may generate DC leakage current in the protective conductor.
- For each drive, use an RCD whose tripping current is not lower than 100 mA to prevent RCD malfunction due to high-frequency leakage current generated by the drive.
- When multiple drives are connected in parallel and share one RCD, select an RCD whose tripping current is not lower than 300 mA.
- It is recommended to use Chint or Schneider RCDs.

If the RCD malfunctions, perform troubleshooting according to the following table:

Table 6–32 Solution for leakage current

Symptom	Possible cause	Solution
Tripped upon power-on	The anti-interference performance of the RCD is poor.	• Use an RCD from a recommended manufacturer. • Use an RCD with a higher tripping current. • Move the unbalanced load to the line side of the RCD.
	The tripping current of the RCD is too low.	
	Unbalanced load is connected to the load side of the RCD.	
	The capacitance of the front end of the drive is too high.	
Tripping during operation	The anti-interference performance of the RCD is poor.	• Use an RCD from a recommended manufacturer. • Use an RCD with a higher tripping current. • Install a simple filter on the input side of the drive, and wind the LN/RST cables through a magnetic ring near the RCD, as shown in *"Figure 6-31 Magnetic ring on the input side" on page 122*. • Reduce the carrier frequency without compromising the performance. • Use shorter motor cables.
	The tripping current of the RCD is too low.	
	Unbalanced load is connected to the load side of the RCD.	
	For motor cables and the motor, the distributed capacitance to ground is too high.	

Figure 6-31 Magnetic ring on the input side

6.14.2 Harmonic Suppression

To suppress harmonics and improve the power factor to allow the drive to fulfill the standards, install an AC input reactor on the input side of the drive. For details about the reactor models, see "Options" > "Peripheral Electrical Components" > "AC Input Reactor" in the User Guide. For installation methods, see *"5.2.5.2 Instructions for Installing the AC Input Reactor" on page 62*.

6.14.3 Control Circuit Interference

6.14.3.1 Common I/O Signal Interference

The drive generates strong interference during operation. Although EMC measures are taken, interference may still exist due to improper wiring or grounding during use. When the drive disturbs or is disturbed by other devices, adopt the following measures.

Step	Step
1	Use shielded cables as the I/O signal cables and connect the shield to the PE terminal. For details, see *"6.4.3 Cable Specifications and Models" on page 90*.
2	Properly connect the PE terminal of the motor to the PE terminal of the servo drive, and connect the PE terminal of the servo drive to the PE terminal of the grid.
3	Add an equipotential bonding grounding wire between the host controller and the servo drive.
4	Wind the magnetic ring around the drive output (U/V/W) cables by two to four turns (see *"5.2.5.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 63*).
5	Increase the filter capacitance for low-speed DIs. A capacitance up to 0.1 μF is recommended, as shown in *"Figure 6-32 I/O signal cables with capacitance increased" on page 123*.
6	Increase the filter capacitance between AI and GND. A capacitance up to 0.22 μF is recommended.
7	Wind the magnetic ring or ferrite clamp to the signal cable by one or two turns (see *"5.2.5.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 63*)) .
8	Use shielded power cables and ground the shield properly.

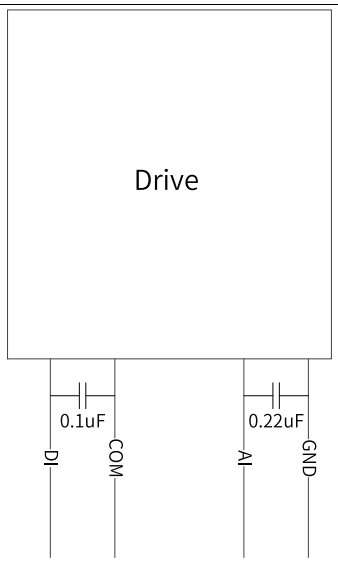


Figure 6-32 I/O signal cables with capacitance increased

6.14.4 Communication Interference

6.14.4.1 EtherCAT Communication Interference

Take the measures listed in the following table to suppress interference.

No.	Step
1	The communication cable must be shielded Cat 5e cables.
2	The communication port is tight and secure without the risk of poor contact.

No.	Step
3	Separate communication cables from power cables with a distance of at least 30 cm.
4	Add an equipotential bonding grounding cable among the nodes during multi-node communication. For details, see *" Grounding the control cabinet system" on page 88*.
5	Ensure the length of the cable between two nodes does not exceed 100 m.
6	Install ferrite clamps on both sides of the communication cable and wind the magnetic ring by one or two turns. For details, see *"5.2.5.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 63*.
7	Install the magnetic ring on the output side (UVW) of the drive by two to four turns. For details, see *"5.2.5.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 63*.
8	Use shielded power cables and ground the shield properly.

7 Commissioning Tools

7.1 Keypad

7.1.1 Components

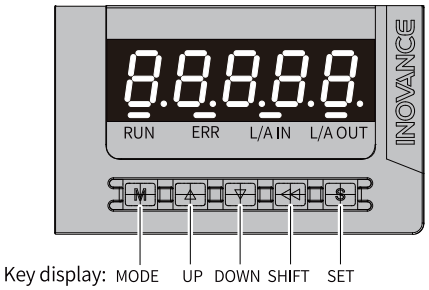


Figure 7-1 Appearance of the operating panel

The keypad of the SV670N-INT Series servo drive consists of a 5-digit, 8-segment LED screen, 5 keys and 4 status indicators. The keypad is used for value display, parameter setting, user password setting, and general function execution.

Keys

The following table takes parameter setting as an example to describe the general functions of the keys.

Table 7–1 Descriptions of keys

Name	Icon	Description
MODE	M	Switches among different modes. Returns to the previous menu.
UP	▲	Increases the value of the blinking digit for the LED.
DOWN	▼	Decreases the value of the blinking digit for the LED.
SHIFT	◀◀	Shifts the blinking digit for the LED. You can view the high digits of the number consisting of more than 5 digits.
SET	S	Switches to the lower-level menu. Executes commands such as saving parameter setpoints.

Indicators

Note

The status indicators apply to N-type models only.

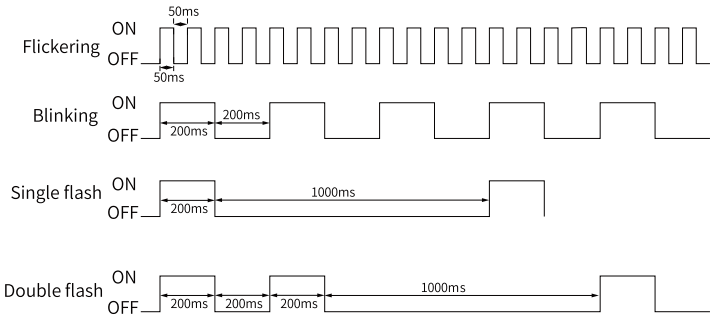


Figure 7-2 Description of indicators

Table 7–2 Description of indicators

Indicator	State	Description
RUN	OFF	INIT state.
	Blinking (on for 200 ms and off for 200 ms)	Pre-Operational state.
	Single flash (on for 200 ms and off for 1,000 ms)	Safe-Operational state.
	ON	Operational state.
ERR indicator	OFF	No network error.
	Blinking (on for 200 ms and off for 200 ms)	Communication setting error.
	Single flash (on for 200 ms and off for 1,000 ms)	Synchronization event error.
	Double flash (on for 200 ms and off for 200 ms, and then on for 200 ms and off for 1,000 ms)	Watchdog timeout.
L/A IN indicator[1] L/A OUT indicator	OFF	Link not established.
	Flickering (on for 50 ms and off for 50 ms)	Link established. Data transceiving signals are present.
	ON	Link established. No data transceiving signal is present.

Note

- [1]: L/A IN and L/A OUT indicate the Link state and operation state of the physical layer of each port.
- The ERR light is red when on and the other three indicator lights are green when on.

7.1.2 Panel display

Table 7–3 LED display and actual data

Display	Actual data	Display	Actual data	Display	Actual data	Display	Actual data
0	0	9	9	h	h	r	r
1	1	A	A	c	c	t	t
2	2	b	B	J	J	U	U

Display	Actual data	Display	Actual data	Display	Actual data	Display	Actual data
3	3	C	C	L	L	y	y
4	4	d	D	n	n	T	T
5	5	E	E	N	N	u	u
6	6	F	F	o	o	-	-
7	7	H	H	P	P	-	-
8	8	G	G	q	q	-	-

The panel can display the running status, parameter, faults, and monitored information during running of the servo drive.

- Status display: displays the current servo drive status, such as servo ready or servo running
- Parameter display: displays parameters and their setpoints
- Fault display: displays faults and alarms that occur on the servo drive
- Monitored value display: displays the values of monitoring parameters

Mappings between the panel display and the operation object of the host controller

The mappings between the parameter displayed on the panel (in decimal) and the object dictionary operated by the host controller (in hexadecimal, "Index" and "Sub-index") are as follows.

Object dictionary index = 0x2000 + Parameter group number

Object dictionary sub-index = Hexadecimal offset within the parameter group + 1. For example:

Panel display	Object dictionary operated by the host controller
H02.15	2002.10h

Note

The following section describes only the display and parameter settings on the keypad side (in decimal), which are different from those displayed in the software tool (in hexadecimal). Make necessary value conversions during use.

Display mode switchover

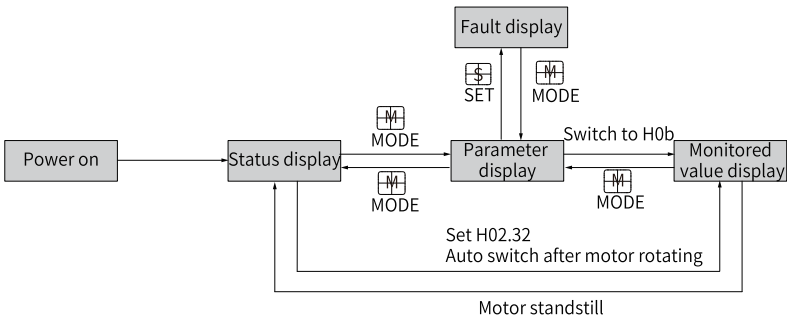


Figure 7-3 Switchover among different display modes

- The panel enters status display immediately upon power-on.
- Press MODE to switch among different display modes based on the conditions shown in *"Figure 7-3" on page 127* .
- In status display mode, set H02.32 to select the monitored parameter. When the motor rotates, the operation panel automatically switches to the monitoring display mode. After the motor stops, the panel automatically restores to the status display mode.
- In parameter display mode, after you select the parameter to be monitored in group H0b, the panel switches to monitored information display.
- When a fault occurs, the operation panel immediately enters the fault display mode, and all 5-digit LEDs blink. Press SET to stop the LEDs from blinking, and then press MODE to switch to parameter display.

Status display

Display	Name	Scenario	Description
	81nr.x Servo not ready	The initialization is done, but the servo drive is not ready.	Definition of "81nr.x": For specific causes and troubleshooting methods, see *"Table 7-4" on page 129*
	-88rn Servo running (Run)	The S-ON signal is active.	The servo is running.
	-88ry Servo ready (Ready)	The servo drive is ready to run.	The servo drive is ready to run and waits for the enabling signal from the host controller.
	1-A: Control modes	-	Displays the present operation mode of the drive in hexadecimal digits. 1: Profile position mode 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 8: Cyclic synchronous position mode 9: Cyclic synchronous velocity mode A: Cyclic synchronous torque mode
	1-8: Communication status	-	Displays the status of the slave EtherCAT status machine in the form of characters. 1: Initialization 2: Pre-operational 4: Safe-operational 8: Running
	- CN3 connection indication	The EtherCAT output is connected.	Solid OFF: No communication connection is detected in the physical layer. Solid ON: Communication connection is detected in the physical layer.
	- CN4 connection indication	The EtherCAT input is connected.	

Display	Name	Scenario	Description
	STO STO function display selection	If there is no fault or alarm, the servo drive is in the ready state and STO is activated	Check whether the 24 V input of the STO terminal is disconnected.

STO function display selection:

Defines whether to display the STO status or report E150.0 after the STO function is triggered.

0: Displays the STO status. The operating panel displays "sto_" after the STO function is triggered. In this case, no fault is reported and there is no output from the fault DO.

1: Displays the STO fault. The operating panel displays "E150.0" after the STO function is triggered. In this case, the drive reports E150.0 and the fault DO generates output.

Table 7–4 Cause and troubleshooting of display "nrd.x/81nr.x"

nrd.x/81nr.x	Cause	Troubleshooting
nrd.1/81nr.1	The control voltage H0b.57 is lower than the undervoltage threshold H01.78 (200 VAC input threshold: 190 VDC; 400 VAC input threshold: 400 VDC).	1 .Check whether the L1C and L2C inputs meet the input specifications. 2 .If yes, read H0b.57. If H0b. 57 is close to 0, the hardware circuit may be damaged.
nrd.2/81nr.2	Inputs of L1 to L3 are abnormal.	1 .Use a multimeter to check whether there is voltage input in L1 to L3. 2 .Use an oscilloscope to test whether phase loss occurs on L1 to L3.
nrd.3/81nr.3	The bus voltage H0b.26 is lower than the undervoltage threshold H01.42 (200 VAC input threshold: about 200 VDC; 400 VAC input threshold: about 400 VDC).	1 .Check if input L1 to L3 meet the input specifications. 2 .If yes, and H0b.26 is close to 0, the hardware circuit may be damaged.
nrd.4/81nr.4	The soft-start resistor of the drive is not bypassed.	Check whether the bus voltage (H0b.26) is within the normal range (200 VAC input: 235 VDC to 378 VDC; 400 VAC input: 478 VDC to 751 VDC).
nrd.5/81nr.5	Initialization of the encoder is not completed.	Request technical support from the manufacturer.
nrd.6/81nr.6	Short circuit to ground detection is not completed.	Check the value of H0b-57.
nrd.7/81nr.7	Some items are not initialization.	Check whether any other items are not initialized, such as the safety board.
nrd.9/81nr.9	Initialization of the fully closed-loop encoder is not completed.	Request technical support from the manufacturer.

Parameter display

Parameters are divided into 14 groups based on their functions. A parameter can be located quickly based on the parameter group it belongs to. For details, see *" Parameter Descriptions" on page 525*.

- Display of parameter groups

Display	Name	Description
HXX.YY	Parameter group	XX: Parameter group No. (Hexadecimal) YY: Offset within the parameter group (decimal)

For example, H02.00 is displayed as follows:

Display	Name	Description
	H02.00	02: Parameter group number 00: Offset within the parameter group

- Display of negative numbers and numbers with different lengths
  - Signed number of 4 digits and below or unsigned number of 5 digits and below
    Such numbers are displayed on one interface (five digits). For signed numbers, the highest bit "-" represents the negative symbol.

    For example, -9999 is displayed as follows:

    For example, 65535 is displayed as follows:

  - Signed number with more than 4 digits and unsigned number with more than 5 digits
    Such numbers are displayed from low to high bits (5 bits per page) on several pages: Present page + Value on present page, as shown in the following figure. Hold down SHIFT for more than 2s to switch to the next page.

    For example, "-1073741824" is displayed as follows:

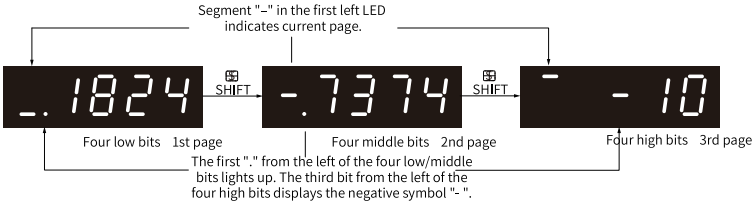
    

    Figure 7-4 Display of "-1073741824"

    For example, 1073741824 is displayed as follows:

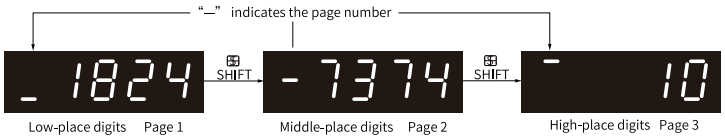
    

    Figure 7-5 Display of "1073741824"

- Display of the decimal point

The segment "." of the ones indicates the decimal point. This segment does not blink.

Display	Name	Description
	Decimal point	100.0

- Display of parameter setting status

Display	Name	Scenario	Description
	Done Parameter setting completed	The parameter has been set.	The parameter has been set and saved to the servo (Done). The servo drive can execute other operations.
	F.InIt Restore to default settings	Parameter initialization is in progress (H02.31 = 1).	The servo drive is restoring parameters to default values (Function Code Initialize). After parameter initialization is done, switch on the control power supply again.
	Error Incorrect password	The user password (H02.30) is activated, but the password entered is incorrect.	An incorrect password is entered. You need to enter the password again.
	TunE	The one-key auto-tuning function is enabled.	The function of auto-tuning with one-key is in progress.
	FAIL	The one-key auto-tuning function is enabled.	The function of auto-tuning with one key fails.
	AdJ_ (auto-tuning)	Enable tuning: phase sequence tuning and resistance and inductance tuning.	The drive is in the auto-tuning process.

Fault display

- The operating panel can display present or previous faults and errors. For details about troubleshooting, see *" Troubleshooting" on page 895*.
- When a fault or an alarm occurs, the operation panel immediately displays the corresponding fault or alarm code. When multiple faults or alarms occur, the operation panel displays the fault or alarm code of the highest fault level.
- Set in H0b.33 the number of history faults that can be viewed. View H0b.34 to check the selected fault or alarm codes.
- You can clear the latest 20 faults or alarms saved in the servo drive by setting H02.31 to 2.

For example, "E941.0" is displayed as following:

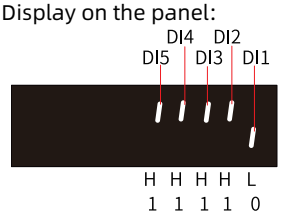
Display	Name	Description
	E941.0 Alarm code	E: A fault or alarm occurs on the servo drive. 941.0: the alarm code

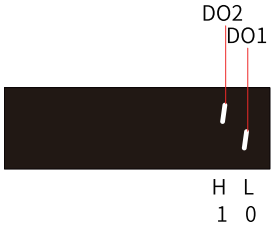
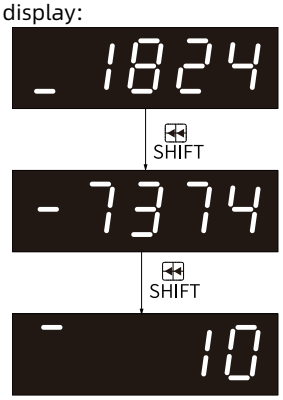
Monitoring information display

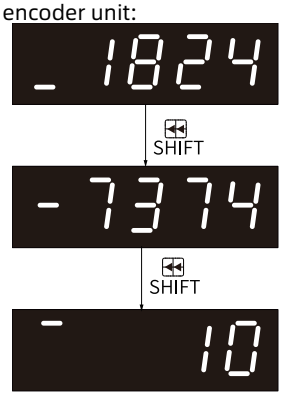
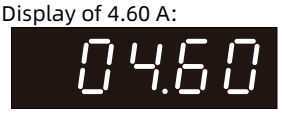
- Group H0b: The parameters in this group are used to monitor the running status of the servo drive. You can enable panel monitoring display by setting H02.32. The parameter group number displayed is H0b and the group offset is the value set by H02.32.

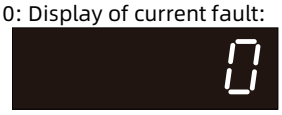
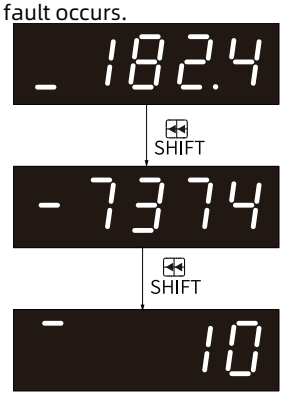
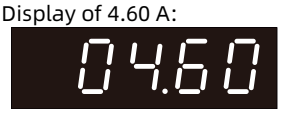
- When H02.32 is set to a valid group offset, the motor enters the state display mode when it is at a standstill and enters the parameter display mode when the motor is in the rotating state. The mode switchover is irrelevant to the S-ON signal of the servo.
- For example, if the motor changes from the standstill state to the running state when H02.32 is set to 00, the display switches from "Status display mode" to "Parameter display mode" and displays the parameter value corresponding to H0b.00.

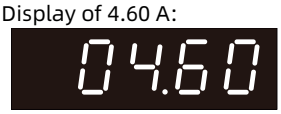
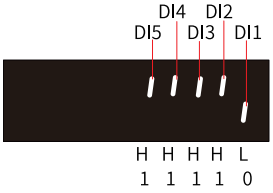
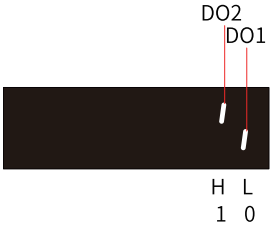
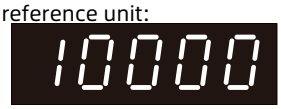
The following table describes the monitoring parameters in group H0b.

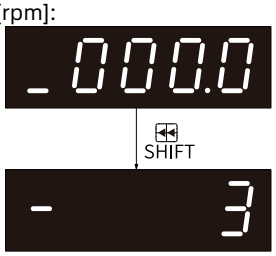
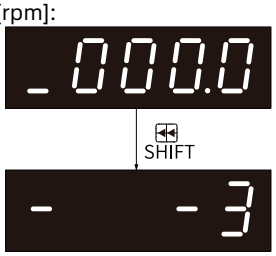
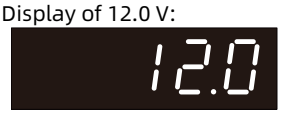
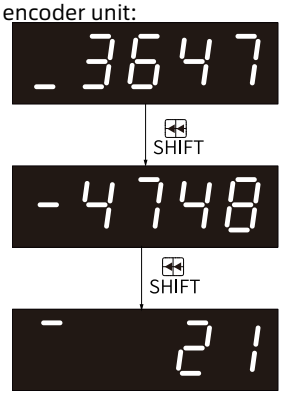
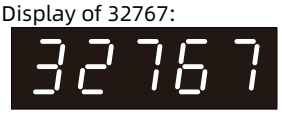
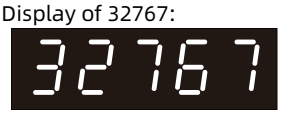
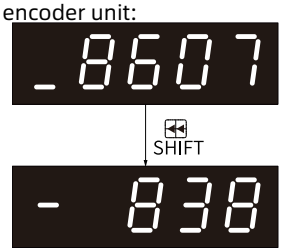
Parameter	Name	Unit	Description	Example
H0b.00	Actual motor speed	[mm/s]/[rpm]	Indicates the actual motor speed after round-off, which is accurate to 1 [mm/s]/[rpm].	Display of 3000 (mm/s)/rpm:  Display of -3000 [mm/s]/[rpm]: 
H0b.01	Speed reference	[mm/s]/[rpm]	Indicates the present speed reference (accurate to 1 [mm/s]/[rpm]) of the drive in the position and speed control modes.	Display of 3000 (mm/s)/rpm:  Display of -3000 [mm/s]/[rpm]: 
H0b.02	Internal torque reference	%	Indicates the current torque reference in units of 0.1%. The value 100.0% corresponds to the rated torque of the motor.	Display of 100.0%:  Display of -100.0%: 
H0b.03	Monitored DI state	-	Indicates the level status of DI1 to DI5: Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0") The H0b.03 value read by the software tool is a decimal.	For example, if DI1 is at a low level and DI2 to DI5 are at high levels: The corresponding binary value is "11110", and the value of H0b.03 read in the software tool is 0x001E. Display on the panel: 

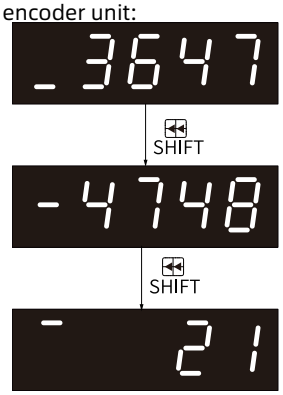
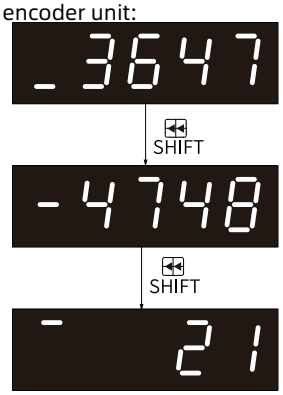
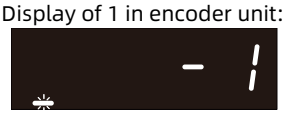
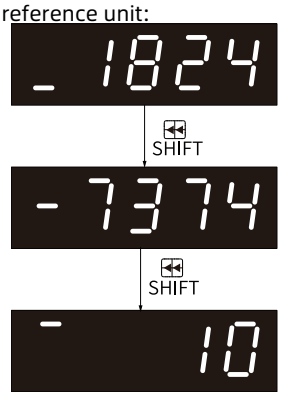
Parameter	Name	Unit	Description	Example
H0b.05	Monitored DO state	-	Indicates the level status of DO1 to DO2: Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0") The value of H0b.05 read in the software tool is a decimal.	For example, if DO1 is low level and DO2 is high level: The binary value is "10". The value of H0b.05 read in the software tool is 0x0004. Display on the panel: 
H0b.07	Absolute position counter (displayed in 32-bit decimal)	Reference unit	Indicates the current absolute position of the motor (in reference unit).	1073741824 referent units display: 
H0b.09	Mechanical angle	°	Indicates the present mechanical angle of the motor.	Display of 360.0°: 
H0b.10	Rotation angle (electrical angle)	°	Indicates the present electrical angle of the motor.	Display of 360.0°: 
H0b.12	Average load ratio	%	Indicates the percentage of the average load torque to the rated torque of the motor.	Display of 100.0%: 
H0b.15	Encoder position deviation counter (32-bit decimal display)	Encoder unit	Encoder position deviation = Sum of input position references (encoder unit) - Sum of pulses fed back by the encoder (encoder unit)	Display of 10000 in encoder unit: 

Parameter	Name	Unit	Description	Example
H0b.17	Feedback pulse counter (32-bit decimal display)	Encoder unit	Counts and displays the number of pulses fed back by the encoder (in encoder unit). ***Note*** When a motor with an absolute encoder is used, H0b.17 only reflects the values of the low 32 bits of the motor position feedback. To obtain the actual motor position feedback, view H0b.77 (Encoder position with low 32 bits) and H0b.79 (Encoder position with high 32 bits).	Display of 1073741824 in encoder unit: 
H0b.19	Total power-on time (32-bit decimal)	s	Counts and displays the total power-on time of the servo drive.	Display of 429496729.5s: 
H0b.24	Effective value of phase current	A	Displays the RMS value of the phase current of the linear motor.	Display of 4.60 A: 
H0b.26	Bus voltage	V	Displays the DC bus voltage of the main circuit, that is, the voltage between P⊕ and P-.	Display of 311.0 V rectified from 200 VAC:  Display of 537.0 V rectified from 400 VAC: 
H0b.27	Module temperature	℃	Displays the temperature of the power module inside the servo drive.	Display of 27℃: 

Parameter	Name	Unit	Description	Example
H0b.33	Fault record	-	Set the number of historical faults to be viewed. 0: Current fault 1: Latest fault 2: Last 2nd fault ... 9: Last 9th fault	0: Display of current fault: 
H0b.34	Fault code of the selected fault	-	H0b.33 is used to set the number of historical faults to be viewed, and H0b.34 is used to display the faults. When no fault occurs, the displayed value of H0b.34 is E000.0.	If H0b.33 is 0, and H0b.34 is E941.0, the current fault code is 941.0. Display: 
H0b.35	Timestamp of the selected fault	s	Displays the total servo operation time when the selected fault occurs. If no fault occurs, the displayed value of H0b.35 is 0.	If H0b.34 is E941.0 and H0b.35 is 107374182.4, the current fault code is 941.0 and the total operating time of the servo drive is 107374182.4s when the fault occurs. 
H0b.37	Motor speed upon the selected fault	[mm/s]/[rpm]	Displays the linear motor speed when the selected fault occurs. When no fault occurs, the value of H0b.37 is 0.	Display of 3000 (mm/s)/ rpm:  Display of -3000 [mm/s]/ [rpm]: 
H0b.38	Motor phase U current upon selected fault	A	Displays the phase U winding current effective value of the linear motor when the selected fault occurs. When no fault occurs, the value of H0b.38 is 0.	Display of 4.60 A: 

Parameter	Name	Unit	Description	Example
H0b.39	Motor phase V current upon displayed fault	A	Displays the phase V winding current effective value of the linear motor when the selected fault occurs. When no fault occurs, the value of H0b.39 is 0.	Display of 4.60 A: 
H0b.40	Bus voltage upon occurrence of the selected fault	V	Displays the DC bus voltage of the main circuit when the selected fault occurs. When no fault occurs, the value of H0b.40 is 0.	Display of 311.0 V rectified from 200 VAC:  Display of 537.0 V rectified from 400 VAC: 
H0b.41	Input terminal state upon selected fault	-	Displays the high and low level status of DI1 to DI5 when the selected fault occurs. The method for determining the DI level status is the same as that of H0b.03. When no fault occurs, all DIs are displayed as low level in H0b.41 (indicated by the decimal value 0).	Taking the example of reading H0b.41=0x0001 as an example: The corresponding binary code is "0000 0000 0000 0001". 
H0b.43	Output terminal status upon selected fault	-	Displays the high and low level status of DO1 and DO2 when the selected fault occurs. View this parameter in the same way as viewing H0b.05. When no fault occurs, all DOs are displayed as low level in H0b.42 (indicated by the decimal value 0).	Display when H0b.43 is 0x0002: 
H0b.53	Position deviation counter (displayed in 32-bit decimal)	Reference unit	Position deviation = Sum of input position references (reference unit) - Sum of pulses fed back by the encoder (reference unit)	Display of 10000 in reference unit: 

Parameter	Name	Unit	Description	Example
H0b.55	Actual motor speed	[mm/s]/[rpm]	Indicates the actual value of motor speed, which is accurate to 0.1 [mm/s]/ [rpm].	Display of 3000.0 [mm/s]/ [rpm]:  Display of -3000.0 [mm/s]/ [rpm]: 
H0b.57	Control circuit voltage	V	Displays the DC voltage of the control circuit.	Display of 12.0 V: 
H0b.58	Mechanical absolute position (low 32 bits)	Encoder unit	Displays the mechanical absolute position (low 32 bits) when an absolute encoder is used.	Display of 2147483647 in encoder unit: 
H0b.60	Mechanical absolute position (32 high-order bits)	Encoder unit	Displays the mechanical absolute position (high 32 bits) when an absolute encoder is used.	Display of 32767: 
H0b.70	Number of the absolute encoder revolutions	Rev	Displays the present number of revolutions of the absolute encoder.	Display of 32767: 
H0b.71	Single-turn position feedback of an absolute encoder	Encoder unit	Displays the single-turn position feedback of the absolute encoder.	Display of 8388607 in encoder unit: 

Parameter	Name	Unit	Description	Example
H0b.77	Absolute encoder position (low 32 bits)	Encoder unit	Displays the absolute position (low 32 bits) of the motor when the absolute encoder is used.	Display of 2147483647 in encoder unit: 
H0b.79	Position (high 32 bits) of the absolute encoder	Encoder unit	Displays the absolute position (high 32 bits) of the motor when the absolute encoder is used.	Display of -1 in encoder unit: 
H0b.81	Rotating load single-turn position feedback (low 32 bits)	Encoder unit	Displays the position feedback (low 32 bits) of the mechanical load when the absolute system works in the rotation mode.	Display of 2147483647 in encoder unit: 
H0b.83	Rotating load single-turn position feedback (high 32 bits)	Encoder unit	Displays the position feedback (high 32 bits) of the mechanical load when the absolute system works in rotation mode.	Display of 1 in encoder unit: 
H0b.85	Single-turn position of the load in rotation mode	Reference unit	Displays the mechanical absolute position when the absolute system works in rotating mode.	Display of 1073741824 in reference unit: 

7.1.3 Parameter Settings

Example of parameter settings

You can set parameters through the keypad. For details, see *" Parameter Descriptions" on page 525*. The following figure shows how to switch from the position control mode to speed control mode by using the keypad after power-on.

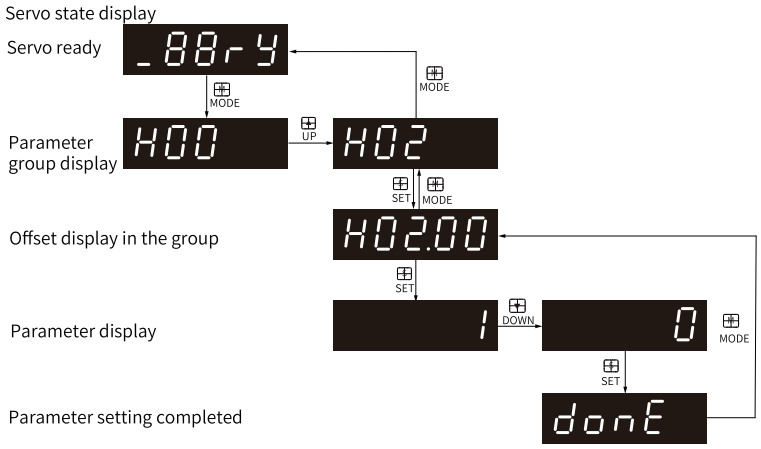


Figure 7-6 Example of parameter settings

For details about the keys, see table "Descriptions of keys". *"Table 7-1 Descriptions of keys" on page 125*

After parameter setting is done, that is, "donE" is displayed on the keypad, press **MODE** to return to the parameter group interface (interface of "H02.00").

Forced DI/DO signals

Digital signals include digital input signals (DI signal) and digital output signals (DO signal). You can configure the DI and DO functions and terminal logic to parameters in group H03 and H04 via keypad or host controller communication. Then, the host controller can control functions of the servo drive via DI signals and the servo drive can output DO signals to the host controller.

The servo drive also provides forced DI/DO functions. The forced DIs can be used to test the DI functions of the servo drive, and the forced DOs can be used to check the DO signal connection between the host controller and the servo drive.

Forced DI signal input

After this function is enabled, all DI signal levels are controlled by the forced DI setting (H0d.18), independent of external DI signal status.

- Procedure:

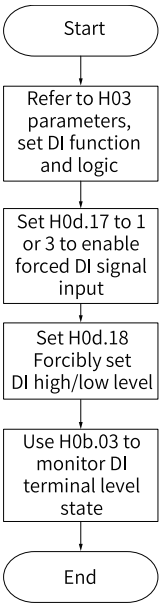


Figure 7-7 Procedure for setting forced DI function

Set the DI logic through parameters in group H03. H0d.18 is used to set the forced DI level. The keypad displays the value in hexadecimal. H0b.03is used to monitor the DI level status. The keypad displays the level in hexadecimal. The value of H0b.03 read in the software tool is a hexadecimal.

Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.17	200d-12h	Forced DI/DO function switch	bit0: Forced DI enable switch 0: Disable 1: Enable bit1: Forced DO enable switch 0: Disable 1: Enable	0	-	Real time	*"H0d_en.17" on page 658*

- Example:
  As shown in the following figure, when the terminal logic is active at low level, DI1, DI6, and DI7 are active, while DI2 to DI5 and DI8 are inactive. Because the hexadecimal value of the binary value "10011110" is "9E", the value of H0d.18 can be set to "9E". In this case, the keypad of H0b.03 displays DI1, DI6, and DI7 as low level while DI2 to DI5 and DI8 as high level. If the DI function is error-free, the value read by H0b.03 is consistent with the value set by H0d.18. The value read by the software tool is 9E, which is a hexadecimal.

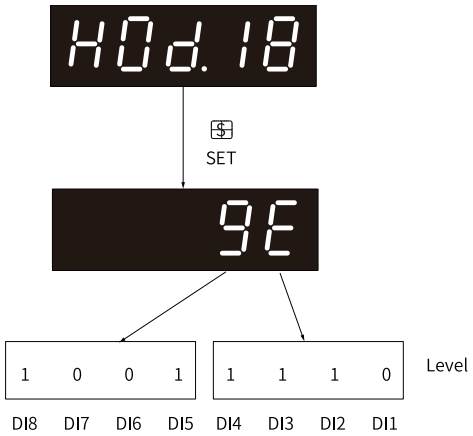


Figure 7-8 Setpoints of H0d.18

Monitor the DI level states via H0b.03. The keypad display is as follows:

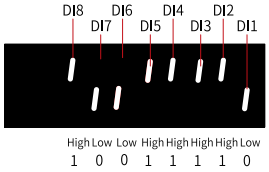


Figure 7-9 DI level states corresponding to bits of H0b.03

Note

Upper LED segment turned ON: high level (indicated by "1"). Lower LED segments ON: low level (indicated by "0")

- Exiting the forced DO function
  The forced DI function is not retentive upon power-off. After power-on again or after you set H0d.17 to 0, normal DI functions are restored.

Forced DO function

After this function is enabled, all DO signal levels are controlled by the forced DO setting (H0d.19), independent of internal DO signal status.

- Procedure

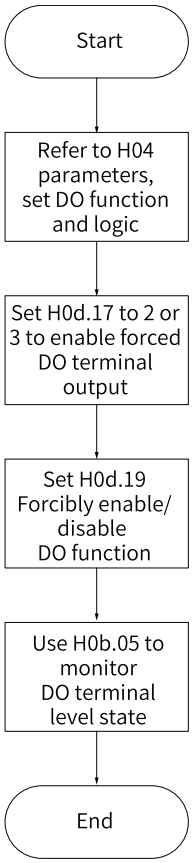


Figure 7-10 Procedure for setting forced DO function

Set the DO logic through parameters in group H04. H0d.19 is used to set whether the forced DO function is active. The keypad displays the value in hexadecimal. H0b.05 is used to monitor the DO level status. The keypad displays the level, and the value of H0b.05 read in the software tool is a hexadecimal.

- Example:
  As shown in the following figure, when the terminal logic is active at high level, DO2 to DO5 are active, while DO1 is inactive. Because the hexadecimal value of the binary value "00011110" is "1E", the value of H0d.19 can be set to 1E. In this case, the keypad of H0b.05 displays DO2 to DO5 as high level while DO1 as low level. If the DO function is error-free, the value read by H0b.05 is consistent with the value set by H0d.19. The value of H0b.05 read by the software tool is 1E, which is a hexadecimal.

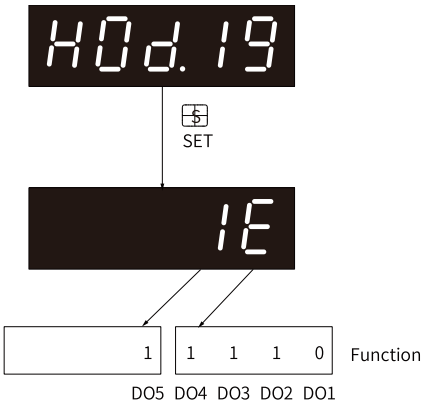


Figure 7-11 Setpoints of H0d.19

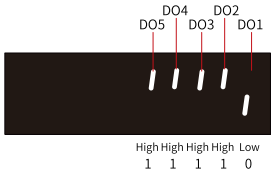


Figure 7-12 Display H0b.05 when all DO are "active high"

- Exiting the forced DO function
  The forced DO function is not retentive upon power-off. After power-on again or after you set H0d.17 to 0, normal DO functions are restored.

Bus-controlled forced DO function[1]

Note

[1]. Forced DO signals controlled by the bus apply only to SV670N-INT.

Allocate function 31 to the corresponding DO. After this function is enabled, all DO signal levels are controlled by 60FE.01h (Physical output) and are unrelated to the internal DO signal status.

- Procedure

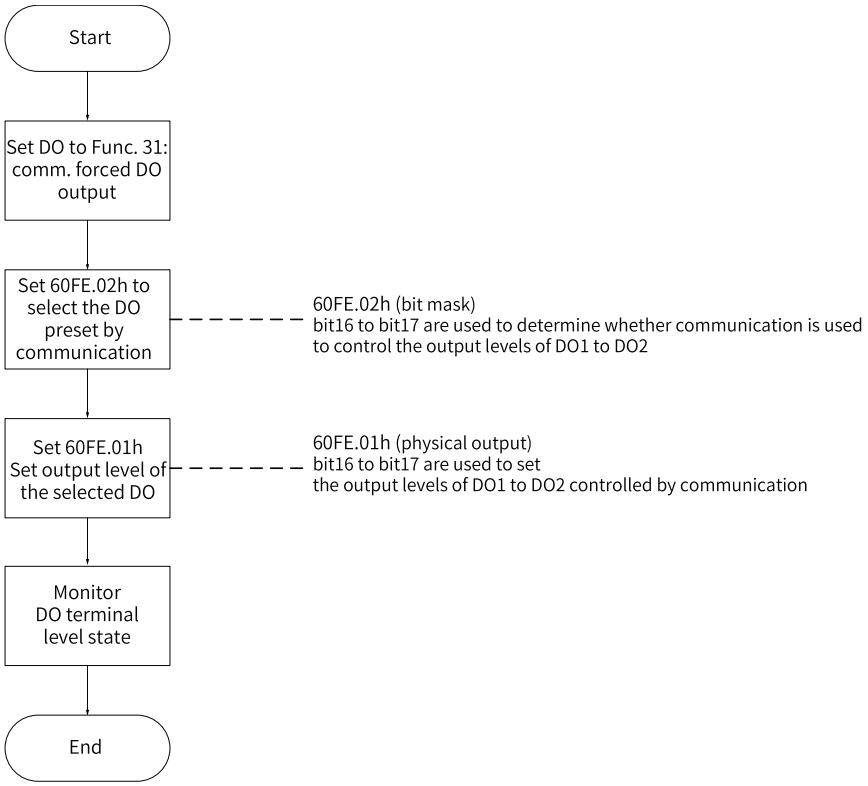


Figure 7-13 Procedure for setting forced DO function in bus control mode

60FEh (Digital output) can be used to forcibly set the DO level through the bus, regardless of the internal DO status of the drive.

Bit	DO	60FE.02h (physical output switch)	60FE.01h (physical output)
16	DO1	1: DO1 forced output switch	DO1 forced output (0: OFF; 1: ON)
17	DO2	1: DO2 forced output switch	DO2 forced output (0: OFF; 1: ON)

When bit16 to bit17 of 60FE.02h and 60FE.01h are set to 1, the forced DO function is ON.

H0b.05 is used to monitor the DO level status. The keypad displays the level, and the value of H0b.05 read by the software tool is a hexadecimal.

Example: To make the output levels of DO1 to DO2 be forcibly set by the bus, in which DO1 outputs low level and DO2 outputs high level, set as follows:

Set 60FE.02h to 0x00030000, and 60FE.01h to 0x00020000. Monitor the DO level status through H0b.05. The keypad displays as follows.

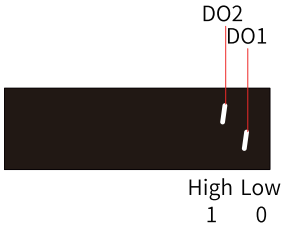


Figure 7-14 Display of H0b.05 when DO signals are controlled by the bus

- Disconnection logic

Table 7–5 EtherCAT forced DO in non-operational status (Setpoints of H04.23)

bit0	bit1	Description
0	0	The status of DO1 and DO2 remains unchanged after they are offline.
1	0	DO1 does not output after it is offline, and the status of DO2 remains unchanged after it is offline.
0	1	DO2 does not output after it is offline, and the status of DO1 remains unchanged after it is offline.
1	1	DO1 and DO2 do not output after they are offline.

User Password

After the user password (H02.30) is activated, only authorized operators can set parameters. Other operators can only view parameters.

- Setting the user password
  The following figure shows how to set the user password to "00001".

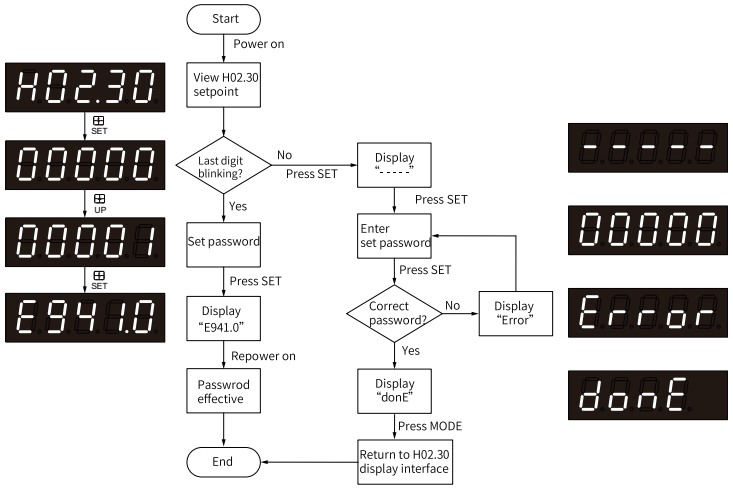


Figure 7-15 Procedure for setting the user password

- To change the user password, enter the current password first to authorize the access to parameter settings. Enter H02.30 again, and then set a new password according to the method described in the preceding figure.

Note

If the last bit does not blink, the access to parameters is password protected. If the last bit blinks, password is not needed or the password entered is correct.

- Disabling the user password
  Enter the existing user password, and set H02.30 to "00000". The user password is disabled.

7.2 Commissioning Software

7.2.1 Installation

1. Software

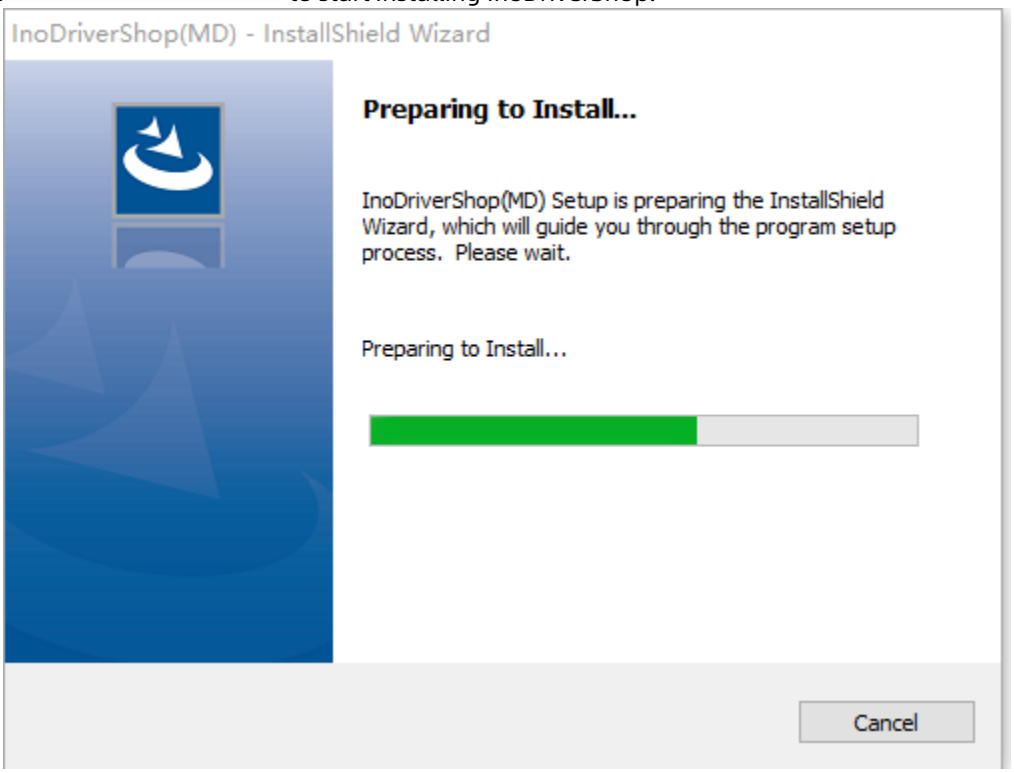
   a. Visit the official website of Inovance as shown below.
   http://www.inovance.com

   b. Choose "Support → Download", and then type in the keyword "InoDriverShop" and click "Search".

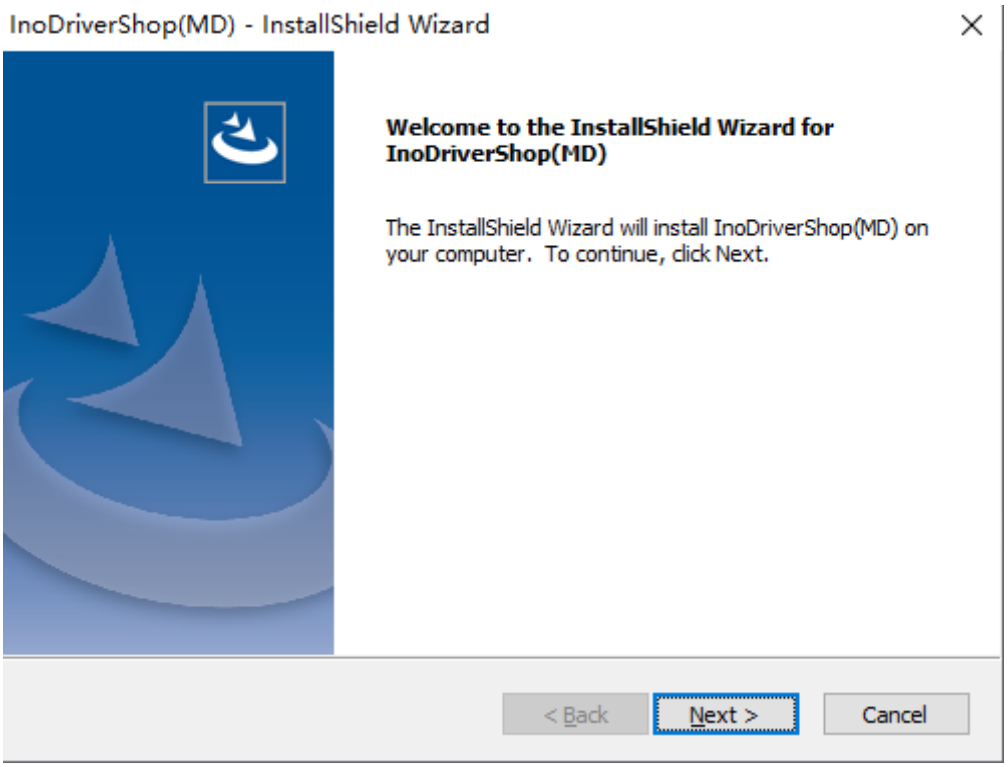
   c. Click "Download".

2. Unzip the package downloaded.

3. Click InoDriverShop.exe to start installing InoDriverShop.

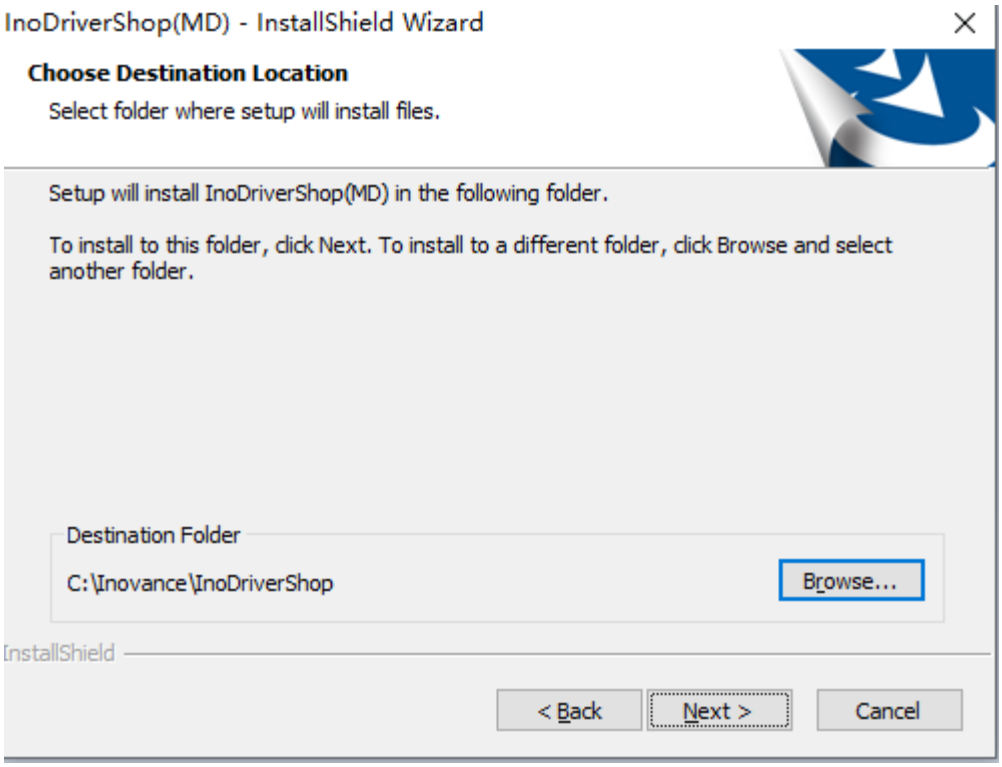


4. Click "Next".

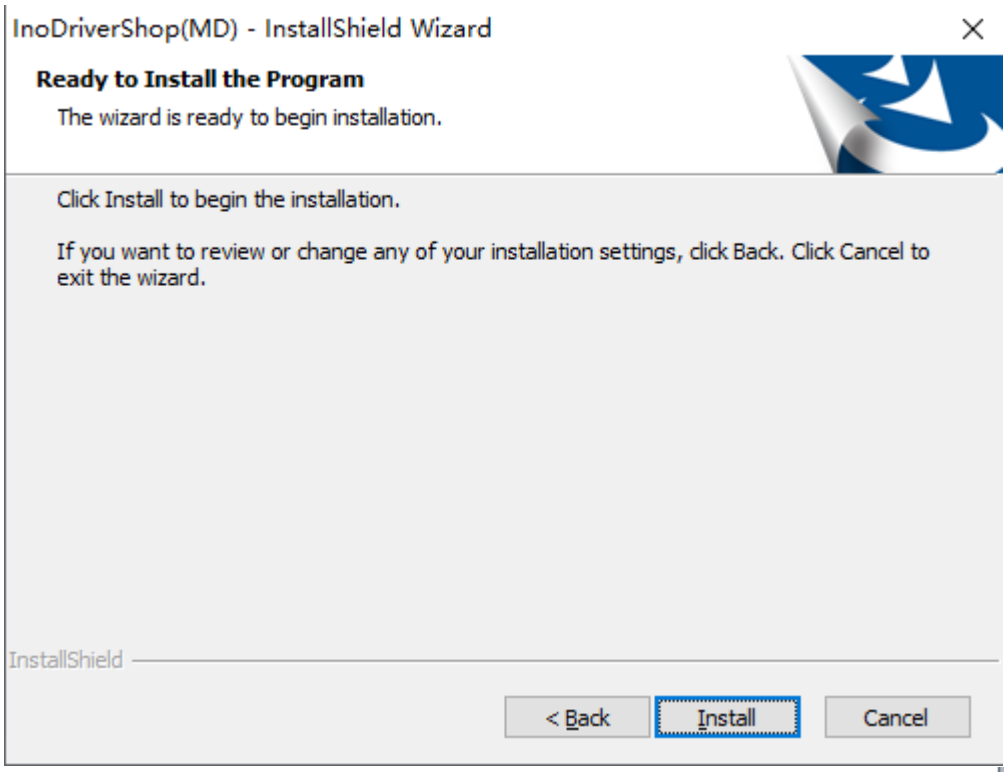


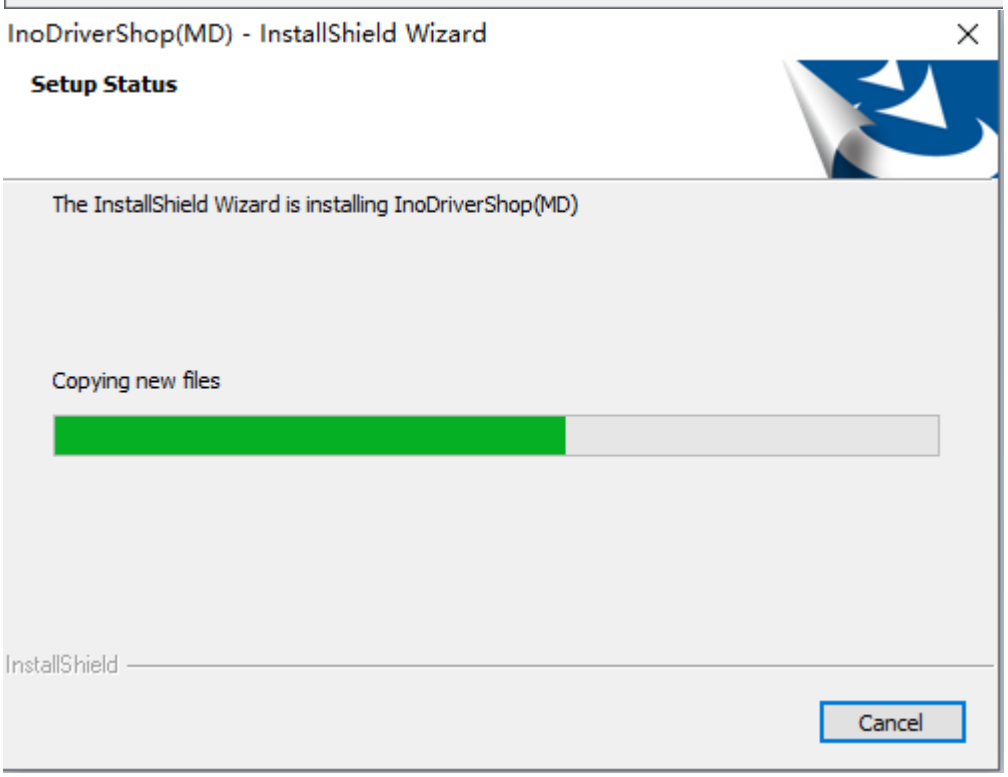
5. You can select the directory for installation as needed through the Browse button. The default directory for installation is "C:\Program Files\Inovance\InoDriverShop".
   In online upgrade, InoDriverShop will be upgraded directly in the original directory.

   After selecting the directory for installation, click "Next".

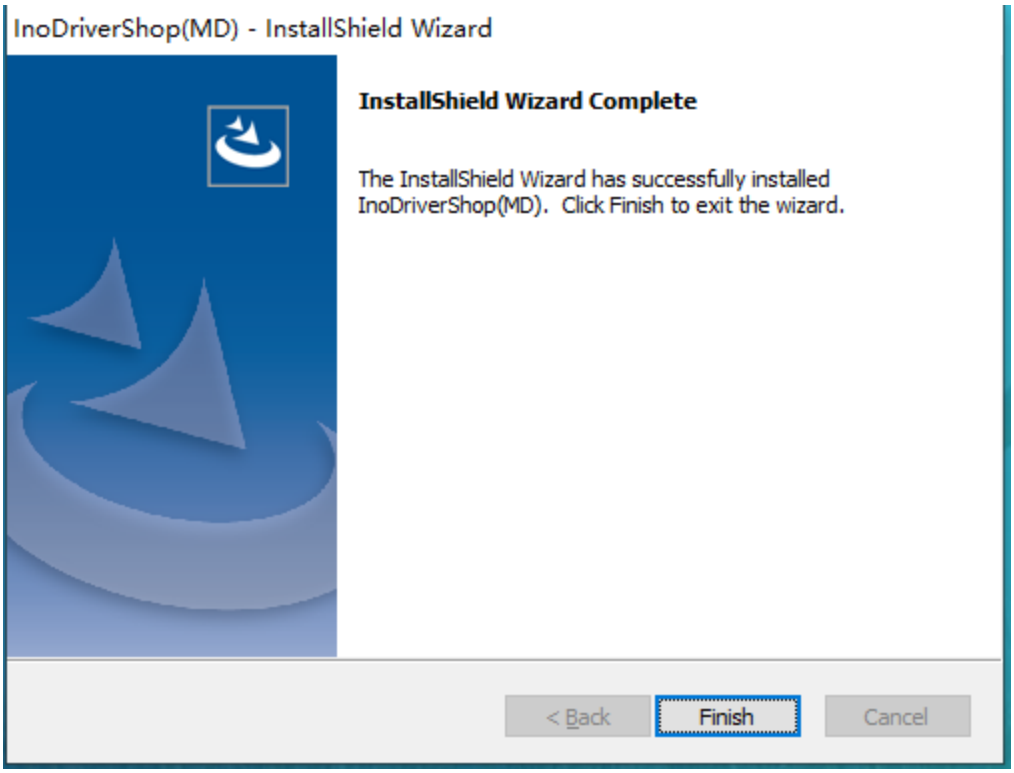


6. Click "Install" to start installation.





7. After installation is done, click "Finish".



8. A shortcut icon for InoDriverShop will be generated automatically on the desktop.



7.2.2 Connection

1. Start InoDriverShop.

- Double-click  to start InoDriverShop.

- If there is no shortcut for InoDriverShop on your desktop, click **Start** and search for **InoDriverShop**.

2. Create a project.

a. Click ① shown in the following figure to create a project.

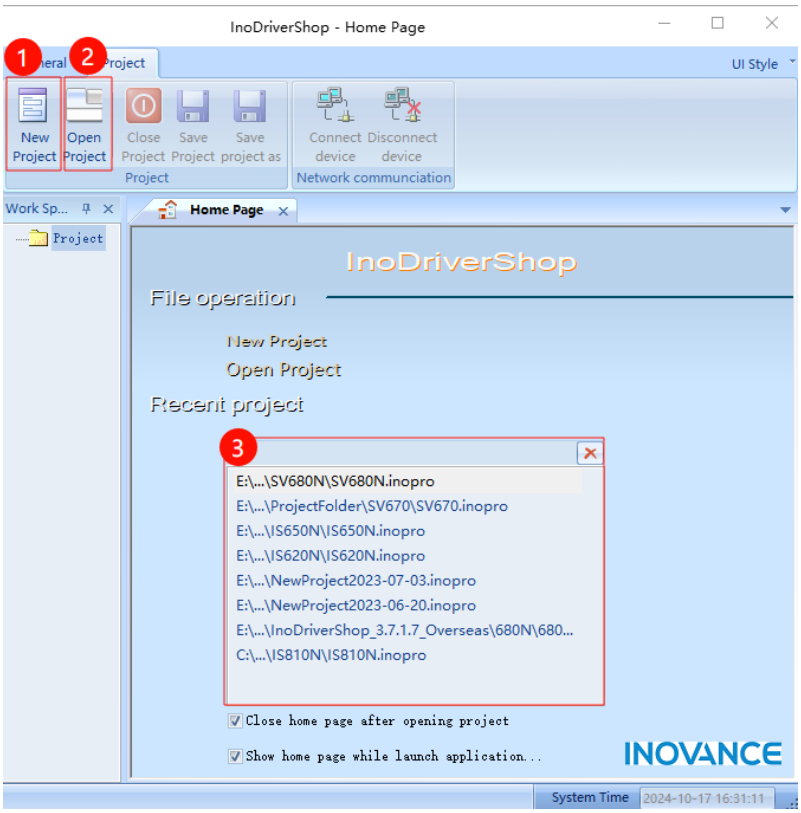


Figure 7-16 InoDriverShop startup dialog box

Note

You can select ② or ③ in the preceding figure to open the project saved before.

b. Open the **Project Guide** wizard.

Click **Online** or **Offline** in area ① and click the product series in area ②. Then, load the default communication parameters in area ③ based on the selected product series.

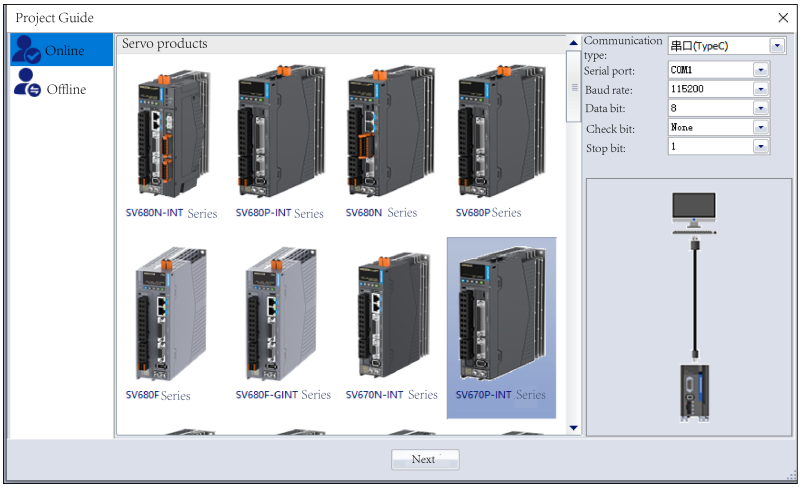


Figure 7-17 Project Guide wizard

c. Click **Next page** to create a project.

- The following figure shows the wizard page for creating a project for an online device. The device is automatically scanned. Select the device to be commissioned and click **Finish**.

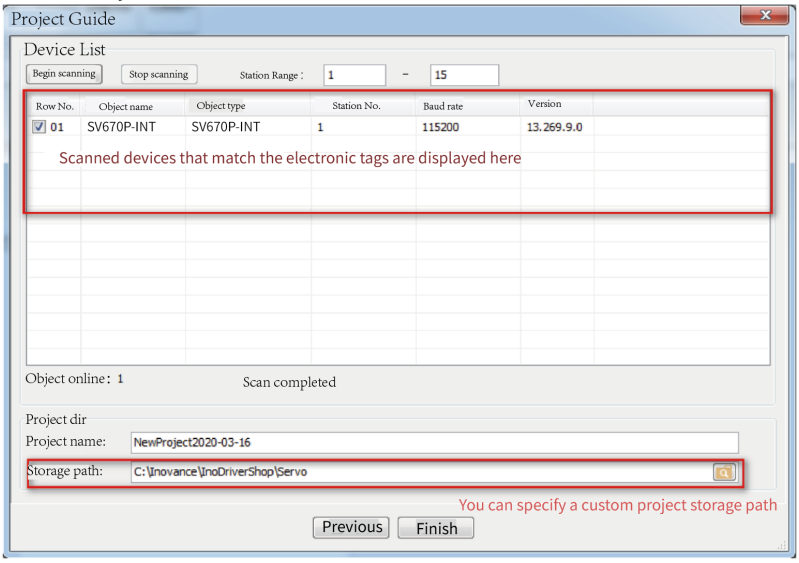


Figure 7-18 Scan page

- The following figure shows the wizard page for creating a project for an offline device. In area ①, you can select the Slave ID, Object Type, and Software Version as needed. In area ②, you can add different standards or customized devices. In area ④, you can specify a storage directory. You can also create multiple offline devices as needed and click Finish in area ⑤.

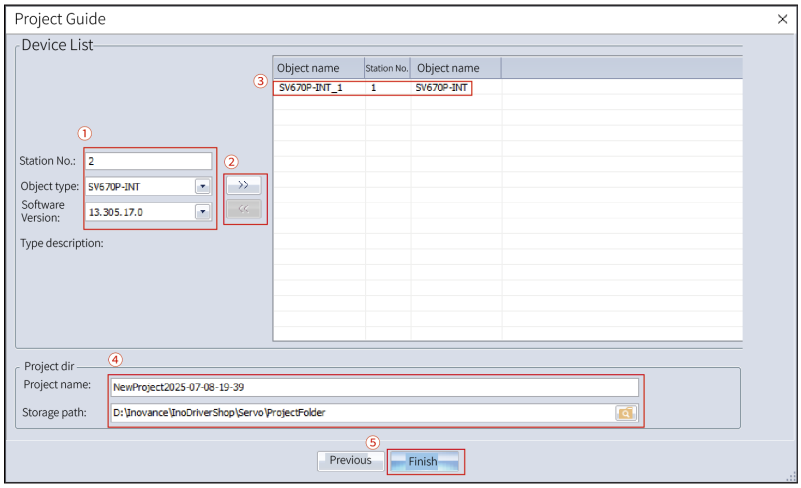


Figure 7-19 Project Guide interface for offline device

Note

① Station No., ④ Project name, and the storage directory can be changed as needed.

d. The project has been created.

3. The wizard is shown as follows.

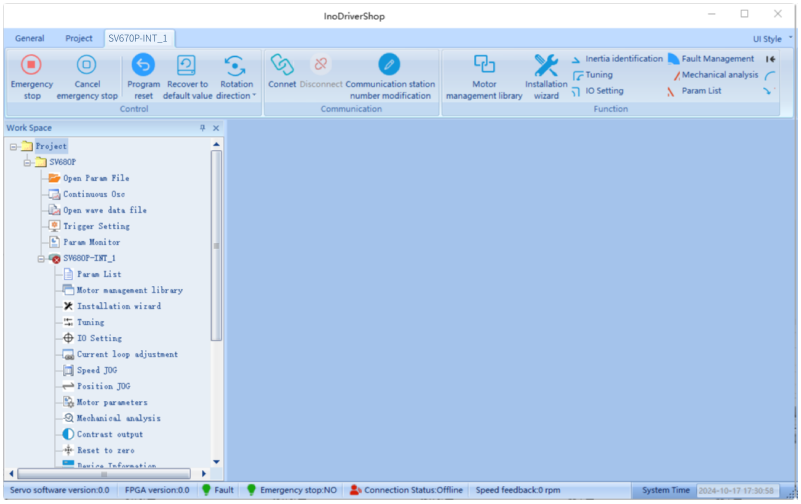


Figure 7-20 Wizard

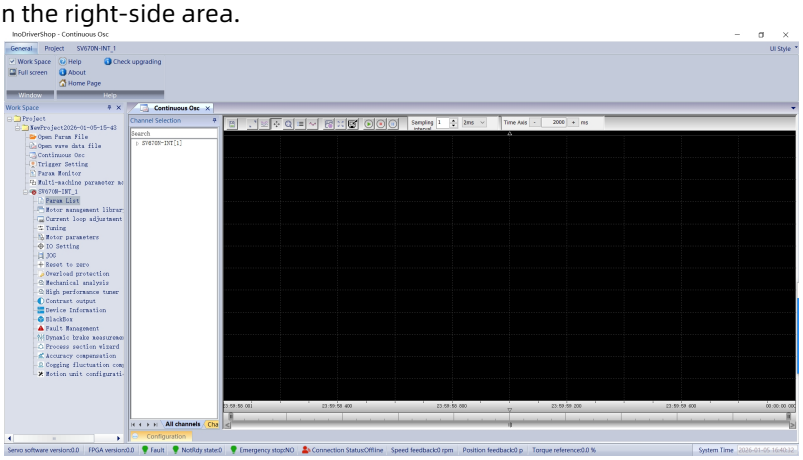
Note

When you create a new online or offline project, the parameter property will be automatically updated to match the motor upon connection for the first time. If the motor type changes, the parameter property will also be updated automatically.

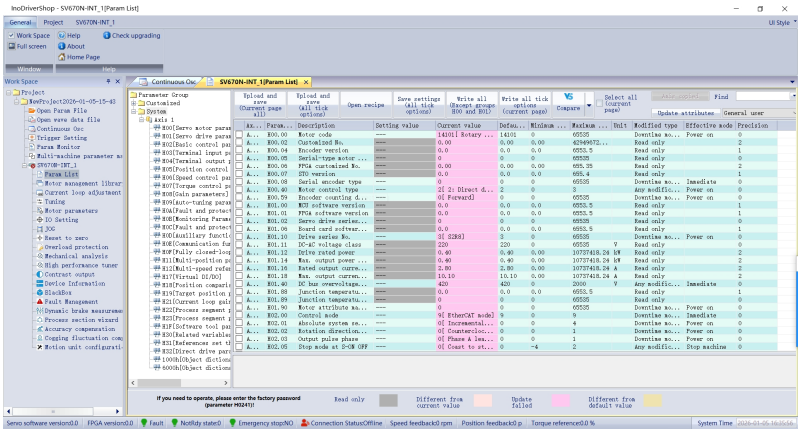
7.2.3 Common Software Functions

InoDriverShop provides the following functions:

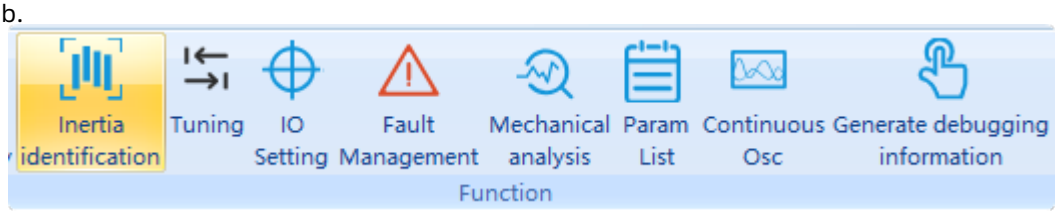
- Oscilloscope: Detects and saves the instantaneous data during operation. In the work area, double-click Continuous OSC in the navigation pane to open the view of the continuous oscilloscope in the right-side area.

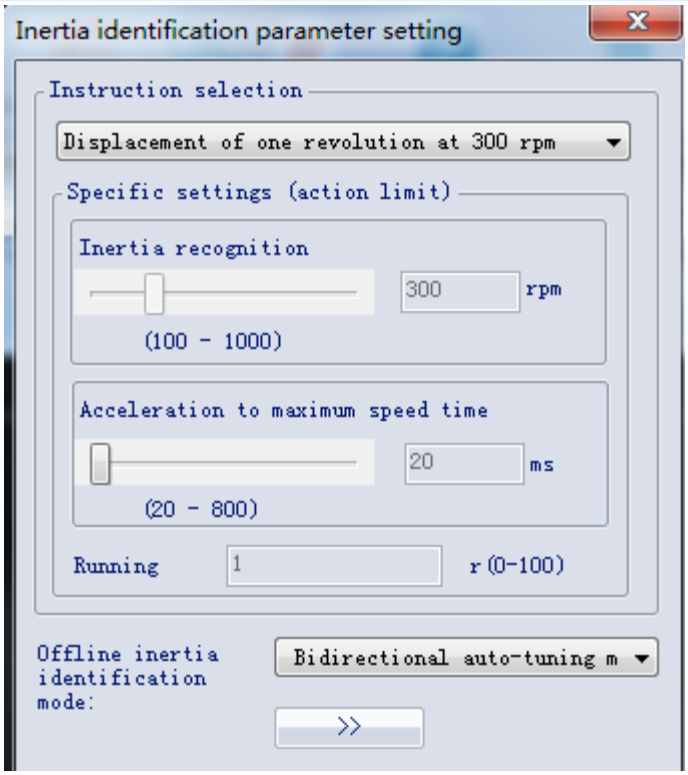


- Parameter management: Reads and downloads parameters in batches. In the work area, double-click Parameter list in the navigation pane to open the view of the parameter list in the right-side area. The values of the drive parameters are displayed in the parameter list. You can modify the parameter values and write them to the drive as needed.

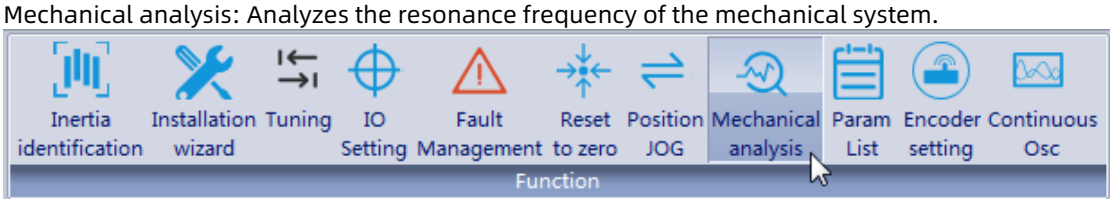


- Inertia auto-tuning: Performs auto-tuning on the load inertia ratio. Select the drive axis that you want to operate from the drop-down list and set the inertia auto-tuning parameters. After setting the inertia auto-tuning parameters, click the button at the bottom to go to the inertia auto-tuning tab.

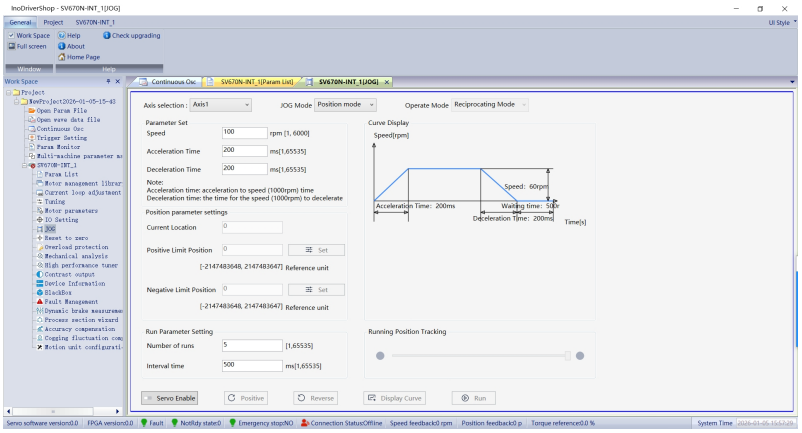




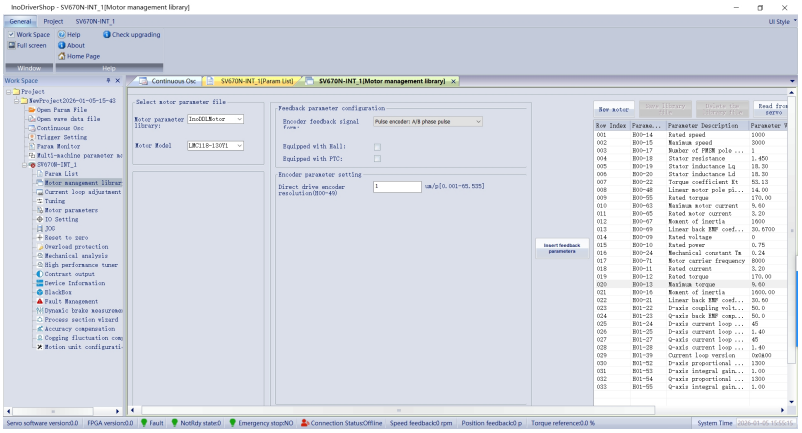
- Mechanical analysis: Analyzes the resonance frequency of the mechanical system.



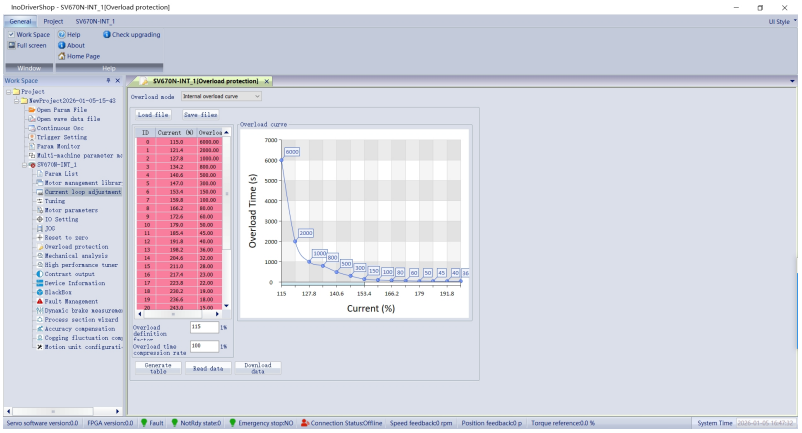
- Motion JOG: Generates position references to make the motor reciprocate. Select the target drive axis from the drop-down list and set and enable the function parameters for position logging.



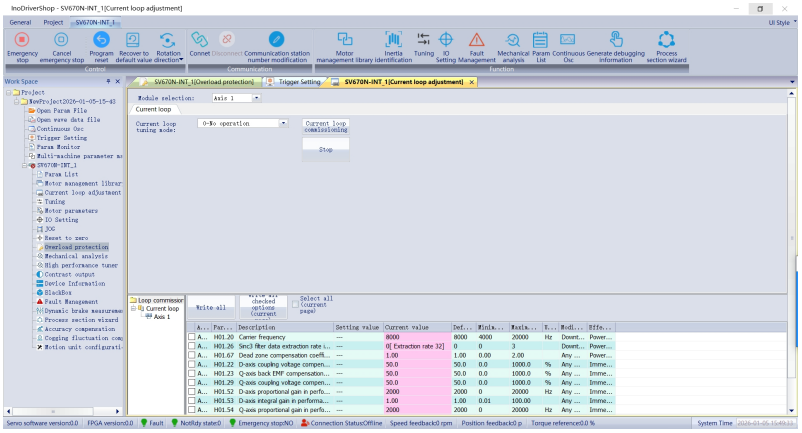
- Gain tuning: Adjusts the rigidity level and monitors the motion data.
- Motor management library: Saves and manages motor parameters.



- Overload curve: Selects motor overload protection methods.



- Current loop auto-tuning: Commissions the current loop.



- Homing of the host controller: For the homing method, see 6098h descriptions in *SV670-INT Series Servo Drive Function Guide*.

8 Commissioning and Operation

8.1 Commissioned Object

The following table describes types of motors supported by SV670N-INT.

Motor type	Component type	Compatibility	Description
DDL motor	Position feedback	Inovance communication encoder	-
		ABZ incremental encoder (with TTL signal)	The maximum frequency supported by AB quadrature signals is 4 MHz.
DDR motor	Position feedback	Inovance communication encoder	23-bit, 20-bit
		ABZ incremental encoder (with TTL signal)	The maximum frequency supported by AB quadrature signals is 4 MHz.
ROT motor	Position feedback	Inovance communication encoder	23-bit, 20-bit
		ABZ incremental encoder (with TTL signal)	The maximum frequency supported by AB quadrature signals is 4 MHz.
		Nikon encoder	17-bit, 20-bit
		TAMAGAWA encoder	17-bit, 23-bit
	Limit signal device	Switch	For details about DI specifications, see *SV670N-INT Series Servo Drive Hardware Guide*.

8.2 Commissioning Flowchart

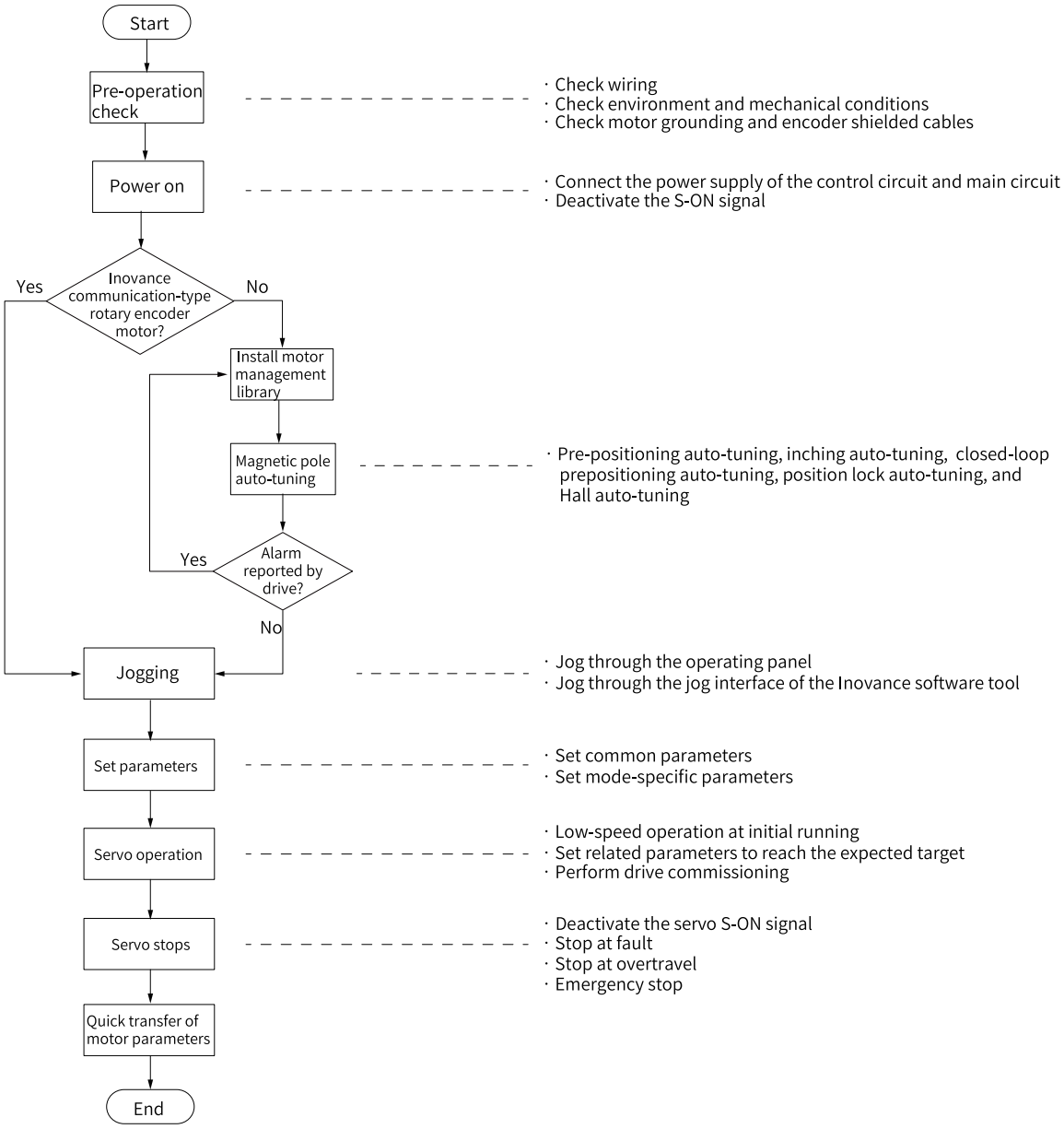


Figure 8-1 Commissioning flowchart of the drive

8.3 Pre-operation Inspection

Check the following items before operating the servo drive and the motor.

Table 8–1 Checklist before operation

No.	Item	Yes
Wiring		
1	The power input terminals (L1C, L2C, L1, L2, L3, R, S, T) of the servo drive are connected properly.	□
2	The main circuit cables (U, V, W) of the motor are connected to the U/V/W terminals of the drive correctly.	□

No.	Item	Yes
3	No short circuit exists in the power input terminals (L1C, L2C, L1, L2, L3, R, S, T) or main circuit output terminals (U, V, W) of the servo drive.	☐
4	The control signal cables, such as the brake signal cable and overtravel protection signal cable, are connected properly.	☐
5	The servo drive and motor are grounded properly.	☐
6	The stress suffered by the cable is within the specified range.	☐
7	All the wiring terminals are insulated properly.	☐
8	The shield layer of the encoder cable is reliably connected with the PE terminal on the drive.	☐
Environment and Mechanical Conditions		
1	There are no unwanted objects (such as cable terminals and metal chippings) that may cause short circuit of the signal cable and power cable inside or outside the servo drive.	☐
2	The servo drive and the external braking resistor are placed on incombustible objects.	☐
3	The motor is installed properly. The motor shaft is connected to the machine securely.	☐
4	The motor and the machine it is connected to are in good condition and ready to run.	☐

8.4 Power-on

Switching on the input power supply

The power input terminals are L1C and L2C (control circuit power input terminals) and L1,L2, and L3 or R, S, T (main circuit power input terminals).

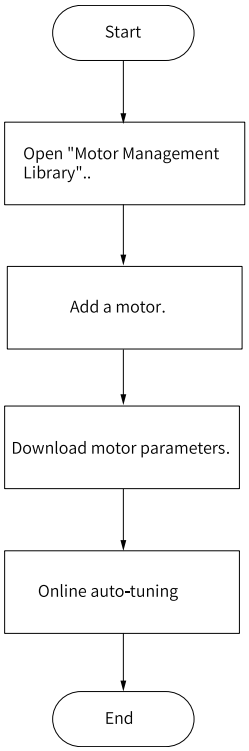
After the power supply is switched on, if the bus voltage indicator is in the normal state and the keypad displays reset → nrd.x → rdy in sequence, the drive is ready to run and waits for the S-ON signal.

Note

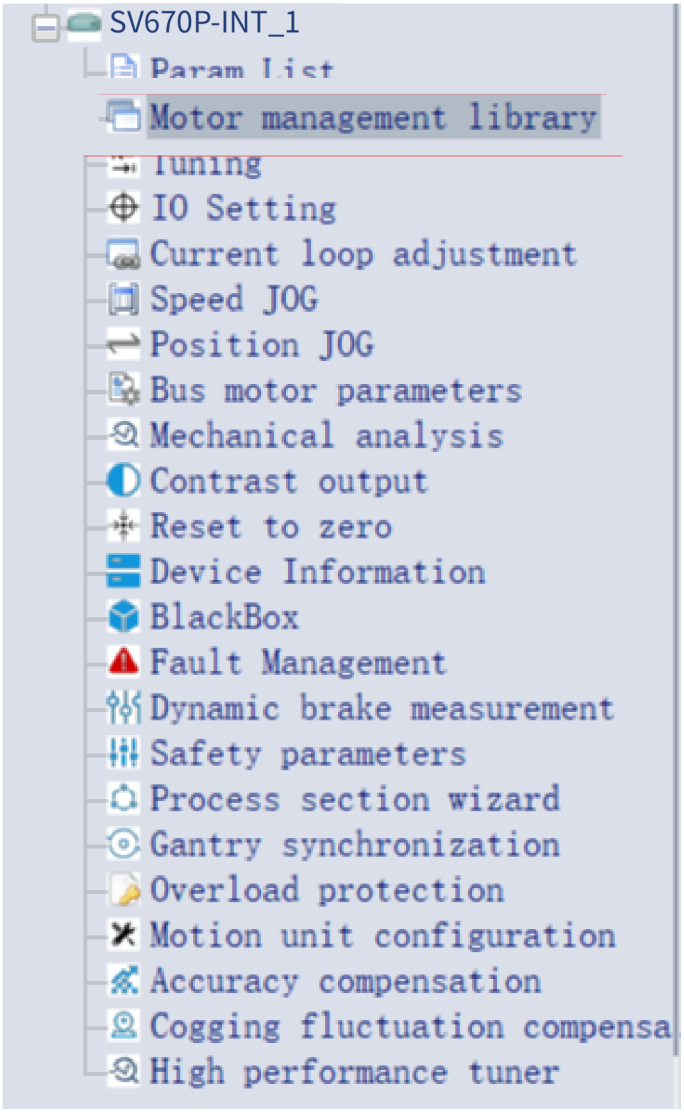
- To connect the main circuit to a single-phase 200 VAC to 220 VAC power supply, use any two of the L1, L2, and L1, L2 and L3 terminals.
- If the keypad keeps displaying "nrd.x" or a fault code, see *"7.1.2 Panel display" on page 126* for troubleshooting.

8.5 Installing the Motor Management Library

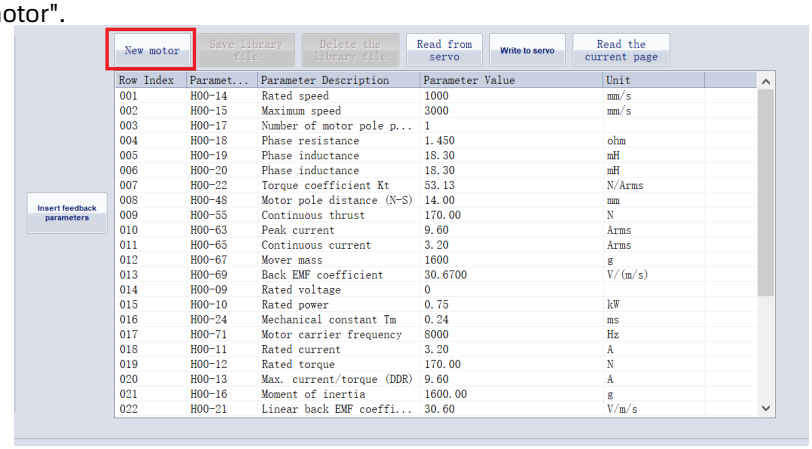
New motor matching



1. Open InoDriverShop.exe, create a SV670N-INT project, and then click Motor management library in the left-side navigation pane. The motor management library allows you to create and manage your own motor libraries.



2. Click "New motor".



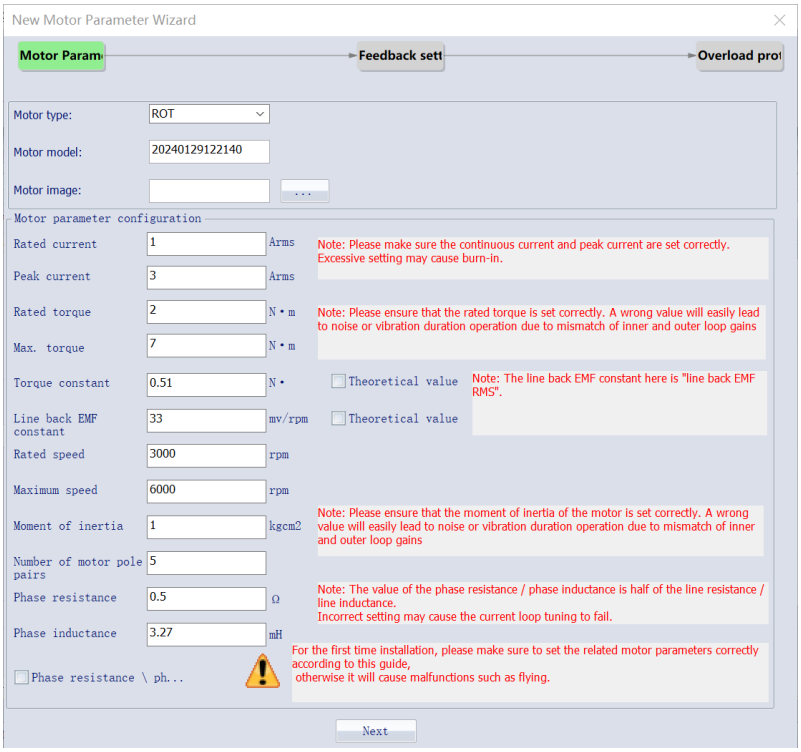
3. Set motor parameters.

a. Select the motor type, enter the motor model, and then enter the motor parameters.

Note

Motor parameters are slightly different for different motor types, so it is important to select the correct motor type. Failure to comply may result in the following consequences:

- Motor runaway: Such as motor runaway, stall, and overspeed
- The motor does not show the above symptoms, but the servo reports motor overtemperature protection (E630.0), motor runaway (E234.0), and motor overspeed (E500.x) faults.

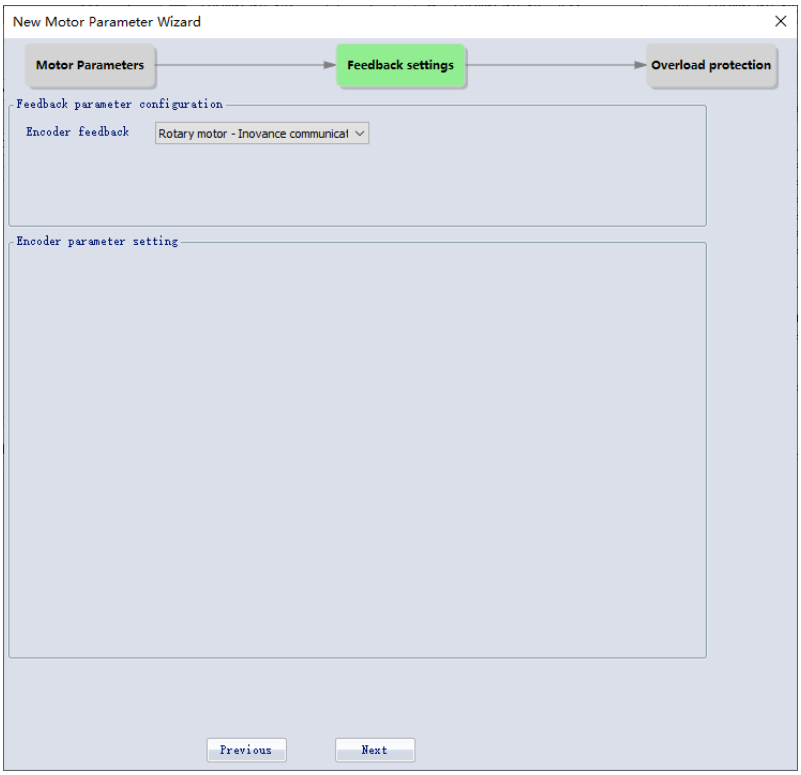


b. Select a correct encoder feedback type and set the motor parameter correctly.

Note

Motor parameters are slightly different for different motor types, so it is important to select the correct motor type. Failure to comply may result in the following consequences:

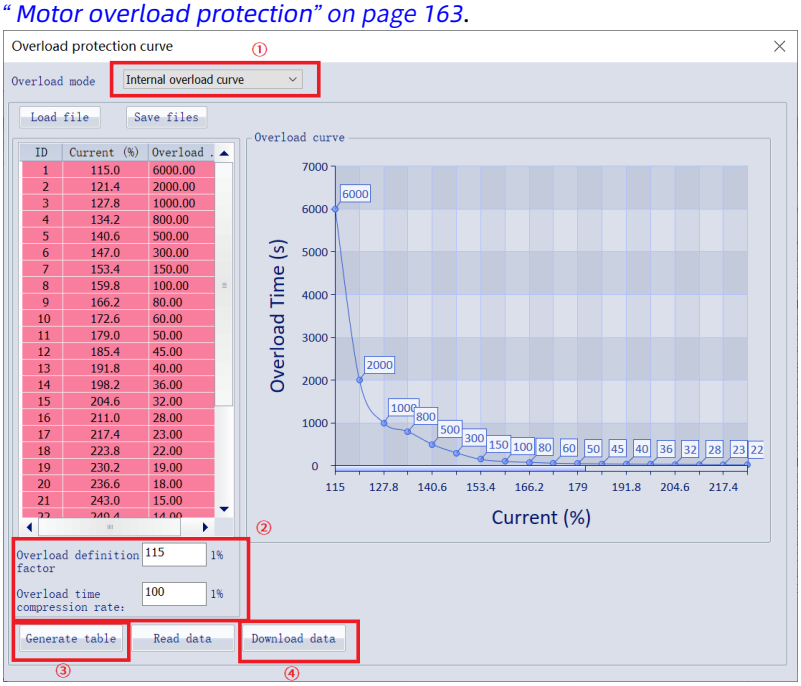
- Motor runaway: Such as motor runaway, stall, and overspeed
- The motor does not show the above symptoms, but the servo reports motor overtemperature protection (E630.0), motor runaway (E234.0), and motor overspeed (E500.x) faults.



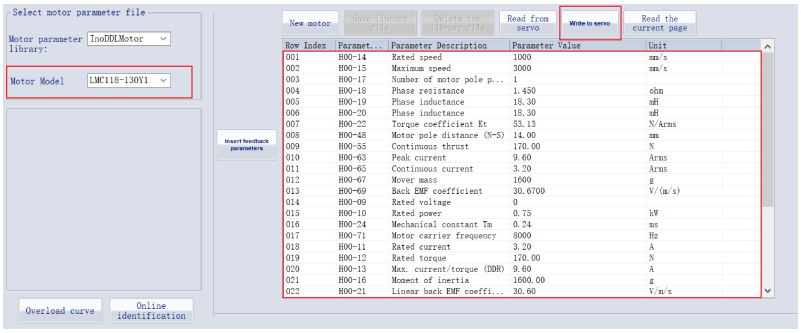
Note

- ABZ incremental encoders: include encoders with Z signals and those without Z signals. Incorrect configurations may cause errors.
- Inovance T5 interpolator: The T5 interpolator converts analog signals or pulse signals into communication signals. The number of communication signal lines converted is fixed to 8388608. You need to configure the parameters of the input interpolator.

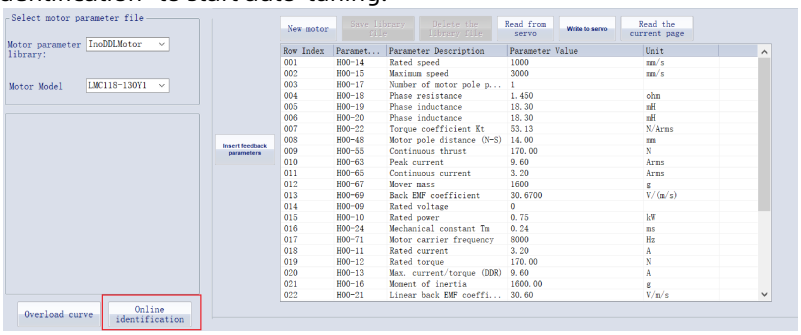
c. Select an overload protection mode, and click "Finish". For details about overload protection settings, see *" Motor overload protection" on page 163*.



4. Return to the motor management library interface. All motor parameters are displayed in the right table. Confirm that the parameters are set correctly, and click "Write to servo" to download the parameters.



5. Click "Online identification" to start auto-tuning.



Motor overload protection

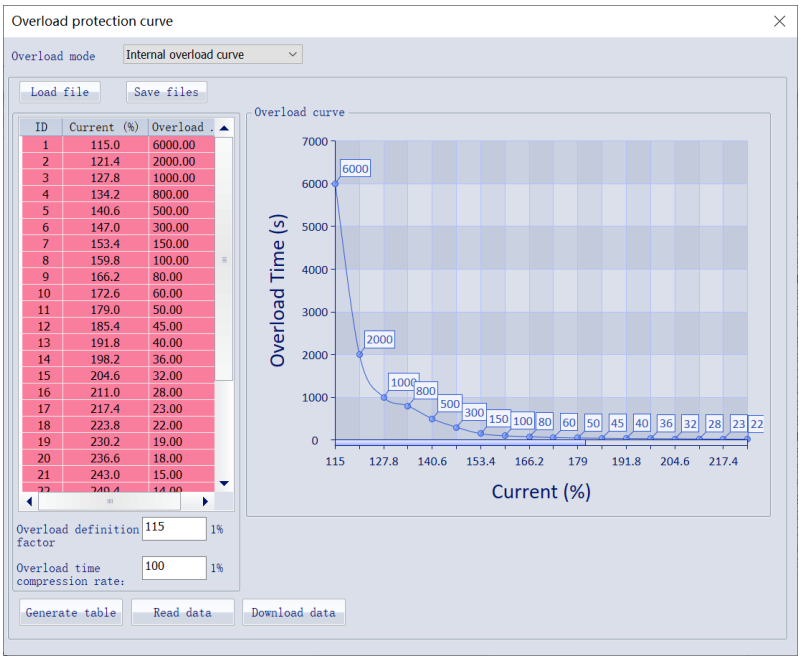
The SV670N-INT provides three motor overload protection methods, including internal overload curve download, overload curve download, and motor overload current limit.

Method 1: Internal overload curve download

To fit more applications, this mode provides two parameter tuning overload curves, namely overload thermal threshold coefficient and overload time compression ratio.

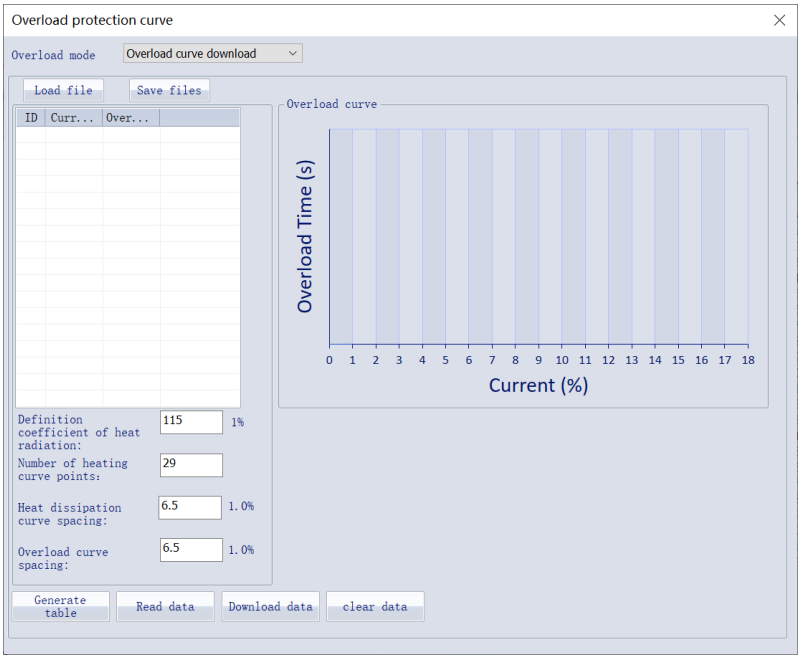
The overload thermal threshold coefficient is a current value (empirical value: about 115%) at which the motor keeps running continuously. The motor can finally stay at a constant temperature due to balance between heating and heat dissipation. To be specific, if the motor current is higher than this value, the motor continues to heat up. If it is lower than this value, the motor enters the heat dissipation state.

The overload time compression ratio is the overall compression overload time. For example, if the current keeps at 200% for 30 seconds, an alarm is reported. If you modify the overload time compression ratio to 150% and click Generate table, the current keeps at 200% for about 50s.



Method 2: Overload curve download

This method applied to scenarios that require high motor overload capability. You need to know the of the overload curve of the matched motor and then write it into the drive.



Method 3: Motor overload current limit

This method estimates the motor heat threshold according to the duration of peak current, and then limits the motor current according to the heat generated by the motor real-time current to protect the motor.

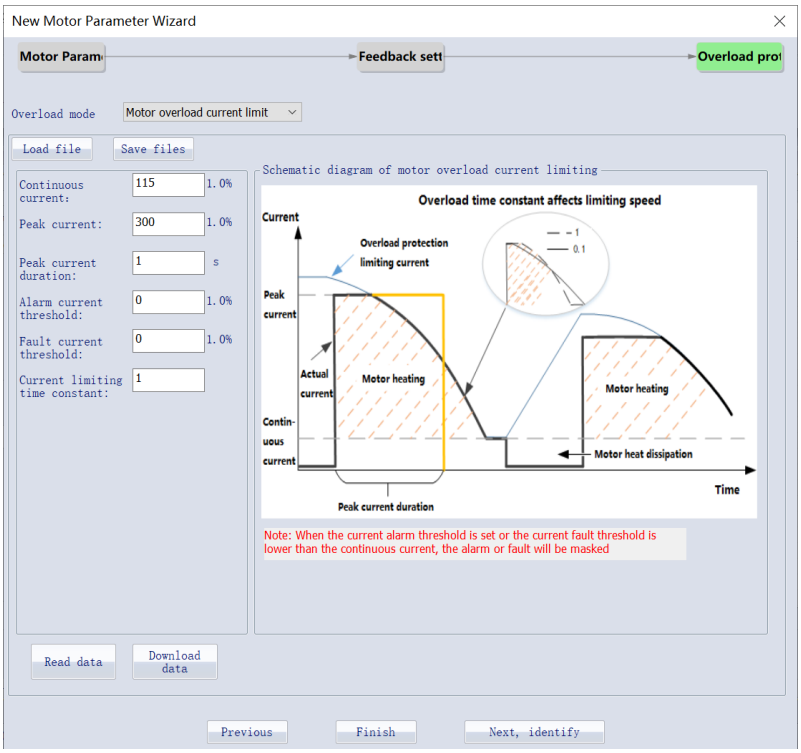
- Thermal threshold current: This parameter takes effect when the motor overload current limit is enabled. It is the rated motor current percentage. When this value is exceeded, the motor keeps heating up. The default value 115% applies to Inovance motors. It is recommended to set this parameter to 100% for third-party motors. If the overload characteristics of the motor is of poor

performance, it is recommended to reduce the values of H32.73, H32.74, H32.75, and H32.76 when motor current limit protection is enabled.

- Peak current: It defines the ratio of the peak current that can be reached by the motor to the rated current of the motor.
- Peak current duration: The maximum heat that can be reached by the motor is calculated based on the maximum peak current duration. Then the maximum heat is used as the motor overload alarm threshold.
- Current threshold for alarm: An alarm will be reported when the limited current for protection falls below this threshold.
- Current threshold for fault: A fault will be reported when the limited current for protection falls below this threshold.

Note

As the minimum value of the current limit protection is the thermal threshold current, when the current threshold for alarms and faults is lower than the thermal threshold current, the fault and alarm cannot be reported.



8.6 Magnetic Pole Auto-tuning

Overview

Before using the drive to control a direct drive or third-party motor, perform magnetic pole auto-tuning (initial electrical angle auto-tuning H0d.03) to determine the control electrical reference of the drive, after which the motor can run normally.

The drive provides 6 magnetic pole identification methods, which are detailed as follows.

Method	Motion range	Applicable motor	Applicable encoder	Load capacity
Pre-positioning	Large	Barrel/U-shaped	All	Weak
Inching	Small	All	Optical scale	Medium
Hall device auto-tuning	/	High-power	All	Strong
Position lock	Tiny	All	All	Strong
Closed-loop pre-positioning	Large	All	All	Strong
Voltage injection auto-tuning	Tiny	Iron-core motors	All	Weak

Method	Characteristics	Applicable scenario	Advantage and disadvantage
Pre-positioning	Dynamic auto-tuning	Scenario where the rotor is allowed to move between two pole pitches.	Advantages: Extensive applications
			Disadvantage • The rotor may move violently (overshoot within the travel range). • Disturbance is not allowed.
Closed-loop pre-positioning		Scenario where the rotor is allowed to move between two pole pitches. Auto-tuning can be performed at the hard limit.	Advantages: Extensive applications
			Disadvantage Long movement distance
Inching		Scenarios with light load (within half rated load) or no load	Advantages: The motor movement range is very small (within hundreds of pulses, which is related to the set value), which cannot be observed by naked eyes.
			Disadvantage Disturbance is not allowed.
Position lock	Quasi-static auto-tuning	With load, Z-axis, and external disturbance. The auto-tuning process allows the range of 100P (encoder unit).	Advantages: It features barely observable movement and strong disturbance resistance. An alarm will be triggered in case of mechanical interference.
			Disadvantage: For a specific DDL motor or application, you may need to fine tune the default parameters to ensure successful auto-tuning.
Hall device auto-tuning	Static auto-tuning	Scenarios where the rotor is not allowed to move when the motor is powered on.	Advantages: Initial angle auto-tuning is not required after power-on.
			Disadvantage Increased cost since an additional Hall device is required. (If static auto-tuning is selected, it is recommended to use this method first.)

Method	Characteristics	Applicable scenario	Advantage and disadvantage
Voltage Injection Auto-tuning	Static auto-tuning	Motors with brake or lock shaft	Advantages: Auto-tuning can be performed in the shaft-locked or brake state. No action is taken during auto-tuning.
			Disadvantage Noise during auto-tuning. Actions during auto-tuning even when the motor is not in the shaft-locked state.

Note

Dynamic auto-tuning is preferred when the rotor has small inertia and is able to move, while static auto-tuning is preferred when the rotor has large inertia and cannot move.

Auto-tuning states

The states are different when you match different encoders.

- For the motor with incremental encoder, the magnetic pole auto-tuning is automatically carried out during first enabling after power-on by default. If starting conditions of angle auto-tuning are set, auto-tuning will be started according to the conditions.
- For the motor with absolute encoder or after first auto-tuning on the magnetic pole for the motor with incremental encoder is successful upon power-on, auto-tuning can only be carried out by setting H0d.03.

Auto-tuning states are as follows.

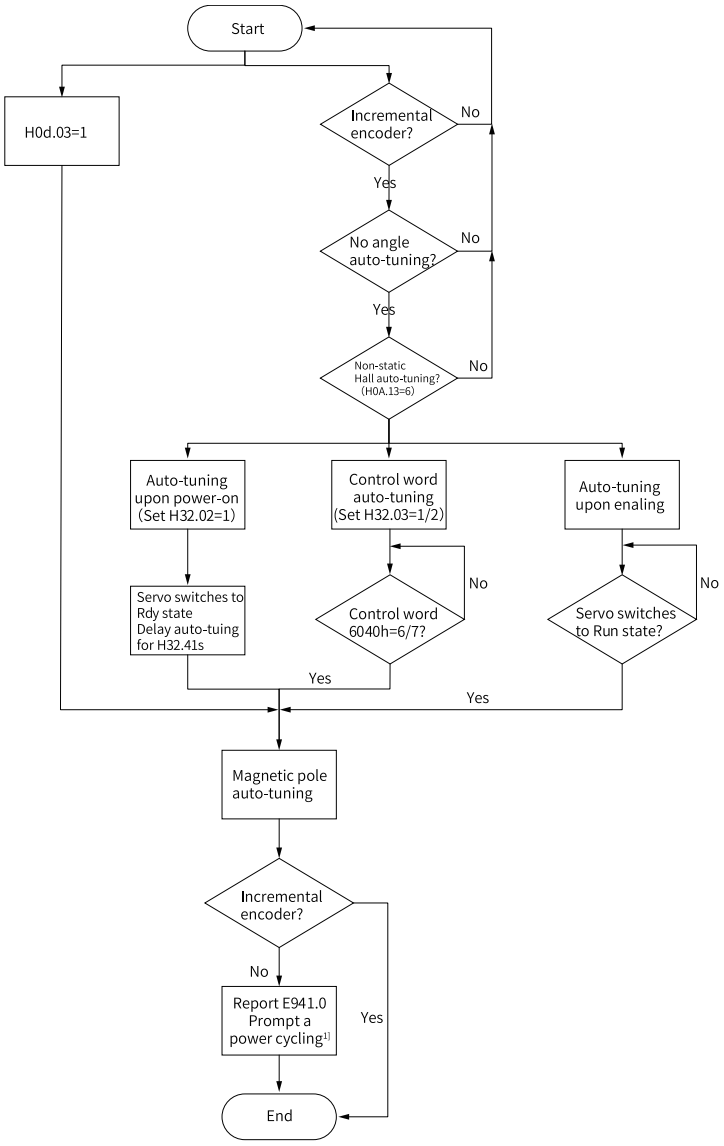


Figure 8-2 Flow chart of magnetic pole auto-tuning state

Note

- [1]: Motors with an Inovance absolute encoder must be completely powered off and then on. Complete power-off: The USB cable and control power are disconnected.After the angle auto-tuning of the Inovance encoder is done, wait for the parameter to be written, and then perform power-off (H0d.04 restored to 0 or 3).
- No prompt is generated when angle auto-tuning is not performed on an incremental encoder. If a prompt is needed, set through the bit of H32.04 (bit0 of H32.04: alarm bit of 6041h; bit1: alarm E602.9). If neither bit0 or bit1 is set, neither is active. If only bit0 is set, bit0 is active. If only bit1 is set, bit1 is active. If both bit0 and bit1 are set, only bit0 is active. The alarm bit or alarm is reset automatically after angle auto-tuning is done.
- For N-mode, the motor can rotate during initial angle auto-tuning upon power-on of a non-Hall incremental encoder, which can result in deviation between 607Ah (Target position) and 6064h (Position feedback). After auto-tuning is done, the motor moves towards the target position after the drive is enabled. In this case, the motor jitters slightly, which is normal. You can set H32.06 to 1 to align 607Ah (Target position) with 6064h (Position feedback), preventing the motor from moving during initial angle auto-tuning.

8.6.1 Auto-tuning Process

Motors with a Hall device use Hall auto-tuning. Motors without a Hall device use other auto-tuning methods. Magnetic pole auto-tuning can be divided into two types of process based on whether a Hall device is used.

Process without a Hall device

Applicable method: pre-positioning auto-tuning, inching auto-tuning, closed-loop prepositioning auto-tuning, position lock auto-tuning, and voltage injection auto-tuning.

The flowchart is as follows.

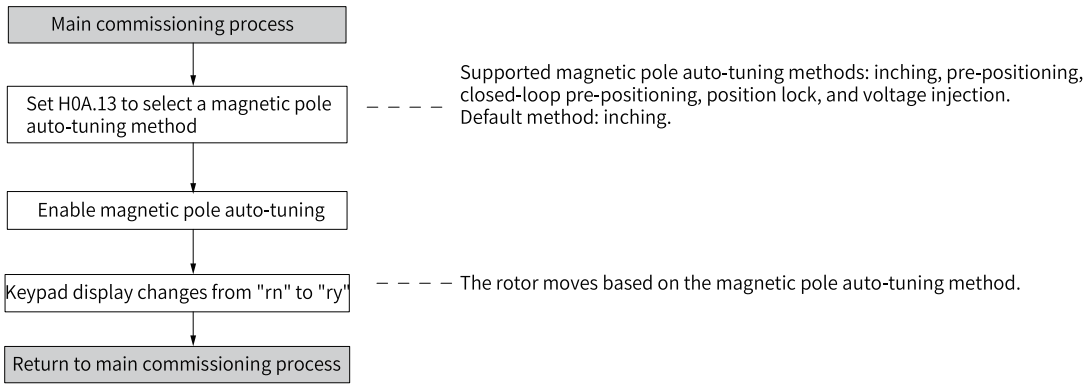


Figure 8-3 Flowchart for magnetic pole auto-tuning without a Hall device

Process with a Hall device

Applicable method: Hall device auto-tuning

The flowchart is as follows.

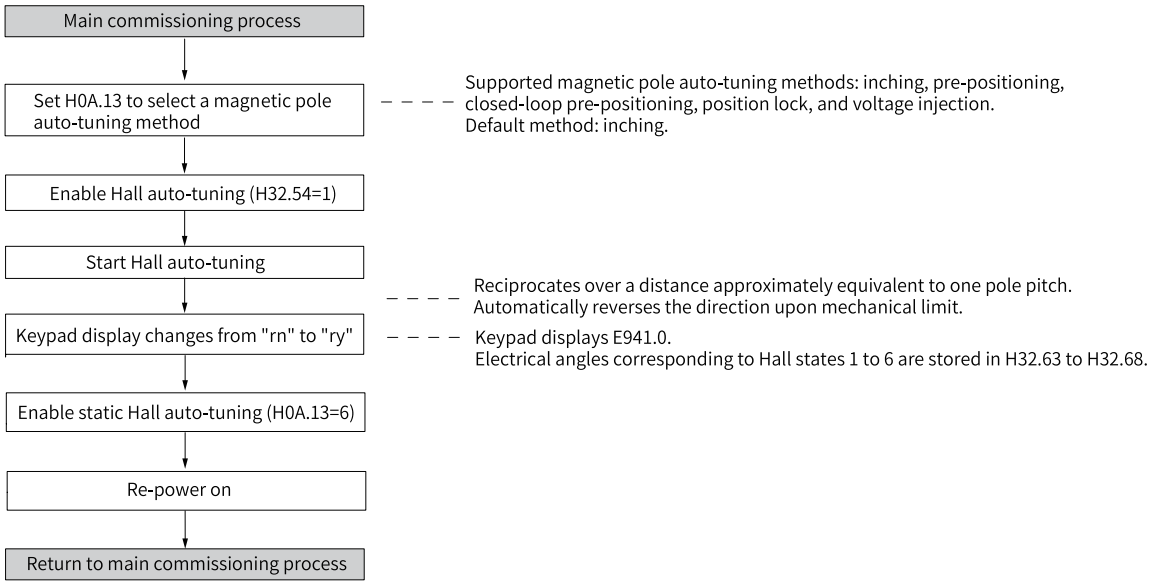


Figure 8-4 Flowchart for magnetic pole auto-tuning with a Hall device

8.6.2 Pre-positioning Auto-tuning

For details about how to perform pre-positioning auto-tuning, see *" Process without a Hall device" on page 169*.

During magnetic pole auto-tuning through pre-positioning, the drive drives the motor for several reciprocating movements, and the rotor is finally positioned near the electrical angle.

Table 8–2 Pre-positioning Auto-tuning

Rotor action	Maximum displacement	Auto-tuning completed
The motor moves quickly from the power-on position to the pre-defined position where the electrical angle is 0 degree, and then make movement within a smaller distance. (Avoid mechanical interference)	During this process, the motor may move violently within a large distance, with the maximum displacement being a pole pitch between N-S.	If the status on the keypad changes from "rn" to "ry", auto-tuning is completed. The auto-tuning process takes about 10s.

Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 6: Angle auto-tuning through static Hall 8: Angle auto-tuning through closed-loop pre-positioning 9: Angle auto-tuning through position lock	0	-	At stop	*" H0A_en.13" on page 621*

8.6.3 Inching Auto-tuning

For details about how to perform inching auto-tuning, see *" Process without a Hall device" on page 169*.

During angle auto-tuning through inching, the motor rotor moves side to side within a small distance, generating a rattling current sound. If the status on the keypad changes from "rn" to "ry", auto-tuning is completed and you can proceed to commissioning. If E602 is reported during auto-tuning, auto-tuning fails.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 6: Angle auto-tuning through static Hall 8: Angle auto-tuning through closed-loop pre-positioning 9: Angle auto-tuning through position lock	0	-	At stop	"H0A_en.13" on page 621
H32.10	2032-0Bh	Max. reference current in angle auto-tuning through inching	10.0 to 300.0	100.0	%	At stop	"H32_en.10" on page 828
H32.13	2032-0Eh	Motor action threshold (ROT/DDR) in angle auto-tuning through inching	0.001 to 20.000	0.200	deg	At stop	"H32_en.13" on page 828
H32.14	2032-0Fh	Motor standstill threshold (ROT/DDR) in angle auto-tuning through inching	0.1 to 100.0	1.0	(mm/s)/RPM	At stop	"H32_en.14" on page 828
H32.15	2032-10h	Motor action threshold (DDL) in angle auto-tuning through inching	0.001 to 20.000	0.200	mm	At stop	"H32_en.15" on page 828
H32.16	2032-11h	Motor standstill threshold (DDL) in angle auto-tuning through inching	0.1 to 100.0	1.0	mm/s	At stop	"H32_en.16" on page 829

Note

- Make sure that the motor phase sequence is correct during angle auto-tuning through inching. Otherwise, auto-tuning may fail.
- If auto-tuning fails, troubleshoot the fault according to the fault subcode "Table 8-3" on page 172 .

Table 8–3 Related faults

Fault code	Name	Description
E602.0	Locked rotor during angle auto-tuning	• Check for locked rotor. • Check whether power cables are correctly connected. • If a locked-rotor fault is reported when the motor moves, check the motor movement threshold and reduce it accordingly.
E602.3	Excessive encoder feedback fluctuation during angle auto-tuning	When the encoder resolution is low and there is fluctuation, the motor standstill conditions are not met. Check the static speed feedback fluctuation of the encoder, and increase the value of motor standstill threshold in angle auto-tuning through inching appropriately.
E602.6	Angle auto-tuning is not convergent.	• Check whether the machine is affected by other vibration sources. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. •

8.6.4 Closed-Loop Pre-positioning Auto-tuning

For details about how to perform close-loop pre-positioning auto-tuning, see *" Process without a Hall device" on page 169*.

Closed-loop pre-positioning auto-tuning is similar to pre-positioning. The drive moves the motor side to side within a certain distance to determine the initial electric angle of the motor. In the process, closed-loop control is used to ensure smooth running. This auto-tuning mode has a strong load capacity, which is unaffected by the motor and encoder characteristics and ensures high auto-tuning accuracy.

If the mechanical limit is reached during auto-tuning, the rotor automatically returns and auto-tuning is completed.

The related parameters are described as follows:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 6: Angle auto-tuning through static Hall 8: Angle auto-tuning through closed-loop pre-positioning 9: Angle auto-tuning through position lock	0	-	At stop	*" H0A_en.13" on page 621*
H32.20	2032-15h	Max. reference current in angle auto-tuning through pre-positioning (closed-loop)	10.0 to 300.0	100.0	%	At stop	*" H32_en.20" on page 829*

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H32.22	2032-17h	Electrical angle reference in angle auto-tuning through pre-positioning (closed-loop)	0.0 to 360.0	0.0	deg	At stop	"H32_en.22" on page 829
H32.23	2032-18h	Electrical angle reference change range in angle auto-tuning through pre-positioning (closed-loop)	10.0 to 170.0	90.0	deg	At stop	"H32_en.23" on page 830
H32.24	2032-19h	Motor stop threshold (ROT/DDR) in angle auto-tuning through pre-positioning (closed-loop)	0.1 to 100.0	1.0	[mm/s]/[rpm]	At stop	"H32_en.24" on page 830
H32.26	2032-1Bh	Damping in angle auto-tuning through pre-positioning (closed-loop)	0.00 to 655.35	0.00	[N/(m/s)]/[N·m/rpm]	At stop	"H32_en.26" on page 830

Note

If the auto-tuning fails, see the specific fault subcode "Table 8-4" on page 173 to rectify the fault.

Table 8–4 Related faults

Fault code	Name	Description
E602.0	Angle auto-tuning locked-rotor	• Check for locked rotor. • Check whether power cables are correctly connected.
E602.1	Angle auto-tuning overtravel	The displacement during auto-tuning exceeds one pole pitch. • Check for external interferences. • The auto-tuning current or ramp rate is too high or the auto-tuning speed loop damping is too low. The motor overshoots, causing overtravel.
E602.2	Incorrect U/V/W phase sequence detected in angle auto-tuning	• Switch to phase sequence auto-tuning first to complete phase sequence auto-tuning and then perform closed-loop pre-positioning angle auto-tuning again. • Manually adjust the phase sequence.

Fault code	Name	Description
E602.3	Excessive encoder feedback fluctuation during angle auto-tuning	When the encoder resolution is low and there is fluctuation, the motor stop conditions are not met. Check the static speed feedback fluctuation of the encoder, and increase the threshold of motor stop during closed-loop pre-positioning accordingly.
E602.4	Angle auto-tuning timeout	The single-step process of side-to-side movement exceeds 30s. • Check for locked rotor. • Check whether power cables are correctly connected. • If motor movement is too slow, increase the auto-tuning current or reduce the auto-tuning speed loop damping. • If the motor stops after moving for a certain distance and then a timeout alarm is reported, increase the motor stop threshold accordingly.

8.6.5 Position Lock Auto-tuning

For the use of position lock auto-tuning, see *" Process without a Hall device" on page 169*.

This auto-tuning method features barely observable movement and strong disturbance resistance. Moreover, the magnetic pole position can be correctly tuned regardless of any mechanical interference and no alarm is reported.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 6: Angle auto-tuning through static Hall 8: Angle auto-tuning through closed-loop pre-positioning 9: Angle auto-tuning through position lock	0	-	At stop	*" H0A_en.13" on page 621*
H32.30	2032-1Fh	Max. reference current in angle auto-tuning through position lock	10.0 to 300.0	100.0	%	At stop	*" H32_en.30" on page 831*
H32.33	2032-22h	Motor action threshold (ROT/DDR) in angle auto-tuning through position lock	0.001 to 20.000	0.200	deg	At stop	*" H32_en.33" on page 831*
H32.34	2032-23h	Motor standstill threshold (ROT/DDR) in angle auto-tuning through position lock	0.1 to 100.0	1.0	(mm/s)/RPM	At stop	*" H32_en.34" on page 832*

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H32.35	2032-24h	Motor action threshold (DDL) in angle auto-tuning through position lock	0.001 to 20.000	0.200	mm	At stop	"H32_en.35" on page 832
H32.36	2032-25h	Motor standstill threshold (DDL) in angle auto-tuning through position lock	0.1 to 100.0	1.0	mm/s	At stop	"H32_en.36" on page 832
H32.38	2032-27h	Inertia ratio in angle auto-tuning through position lock	0.00 to 120.00	0.00	-	At stop	"H32_en.38" on page 833
H32.39	2032-28h	Gain class in angle auto-tuning through position lock	4 to 31	12	level	At stop	"H32_en.39" on page 833

Note

- Position lock is an angle auto-tuning method with position closed loop. The position closed loop mode ensures that the movement during auto-tuning is reduced greatly than other angle auto-tuning methods.
- However, you need to set the auto-tuning gain parameters due to the position closed loop regulator.
- Set the auto-tuning inertia ratio and auto-tuning gain level according to the actual applications.
- If you do not know the load inertia or loop gain level during initial installation of the motor, it is recommended to use other auto-tuning methods to complete inertia auto-tuning and basic gain auto-tuning before switching to the position lock method.

Table 8–5 Related faults

Fault code	Parameter name	Description
E602.0	Locked rotor during angle auto-tuning	• Check for locked rotor. • Check whether power cables are correctly connected. • If a locked-rotor fault is reported when the motor moves, check the motor movement threshold and reduce it accordingly.
E602.1	Angle auto-tuning overtravel	Large movement is detected during auto-tuning. • Set a proper auto-tuning inertia ratio and appropriately increase the auto-tuning gain level. • Contact the manufacturer technical support engineers.
E602.3	Excessive encoder feedback fluctuation during angle auto-tuning	When the encoder resolution is low and there is fluctuation, the motor standstill conditions are not met. Check the static speed feedback fluctuation of the encoder, and increase the value of motor standstill threshold in angle auto-tuning through inching appropriately.
E602.6	Angle auto-tuning is not convergent.	• Check whether the machine is affected by other vibration sources. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. • Check whether the angle gain is so high that the angle auto-tuning is not convergent..

8.6.6 Hall Device Auto-tuning

For details about how to perform Hall magnetic pole auto-tuning, see " *Process with a Hall device*" *on page 169*.

During magnetic pole auto-tuning through Hall signals, the Hall device must be correctly installed to trigger the Hall dynamic auto-tuning function of the drive. The Hall device status and electrical angle must be stored in H32.63 to H32.68 for enabling static Hall auto-tuning (H0A.13 = 6). Then, static Hall auto-tuning is enabled upon re-power on.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 6: Angle auto-tuning through static Hall 8: Angle auto-tuning through closed-loop pre-positioning 9: Angle auto-tuning through position lock	0	-	At stop	" *H0A_en.13*" *on page 621*
H32.54	2032-37h	Hall auto-tuning selection	0 to 65535	0	-	At stop	" *H32_en.54*" *on page 835*
H32.55	2032-38h	Manual tuning of Hall signal U/V/W	0 to 7	0	-	At stop	" *H32_en.55*" *on page 835*
H32.56	2032-39h	U/V/W filter time of Hall signal	0 to 10	5	ms	Real time	" *H32_en.56*" *on page 835*
H32.57	2032-3Ah	Hall closed-loop stall speed	0 to 65535	2	(mm/s)/rpm	At stop	" *H32_en.57*" *on page 836*
H32.58	2032-3Bh	Hall closed-loop stall current	0.0 to 300.0	120.0	%	At stop	" *H32_en.58*" *on page 836*
H32.59	2032-3Ch	Hall closed-loop stall window time	0 to 2000	10	ms	At stop	" *H32_en.59*" *on page 836*
H32.60	2032-3Dh	Hall closed-loop inertia ratio	0.00 to 120.00	0.00	-	At stop	" *H32_en.60*" *on page 836*
H32.61	2032-3Eh	Hall closed-loop stiffness	4 to 31	12	-	At stop	" *H32_en.61*" *on page 837*

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H32.62	2032-3Fh	Electrical angle save flag	0 to 65535	0	-	Real time	"H32_en.62" on page 837
H32.63	2032-40h	Electrical angle of Hall 1	0 to 65535	0	-	At stop	"H32_en.63" on page 837
H32.64	2032-41h	Electrical angle of Hall 2	0 to 65535	0	-	At stop	"H32_en.64" on page 837
H32.65	2032-42h	Electric angle of Hall 3	0 to 65535	0	-	At stop	"H32_en.65" on page 838
H32.66	2032-43h	Electrical angle of Hall 4	0 to 65535	0	-	At stop	"H32_en.66" on page 838
H32.67	2032-44h	Electrical angle of Hall 5	0 to 65535	0	-	At stop	"H32_en.67" on page 838
H32.68	2032-45h	Electric angle of Hall 6	0 to 65535	0	-	At stop	"H32_en.68" on page 838

8.6.7 Voltage Injection Auto-tuning

For details about how to perform voltage injection auto-tuning without a Hall device, see "Process without a Hall device" on page 169.

This auto-tuning method supports auto-tuning in the shaft-locked or external brake state. Current injection may generate a rattling current sound. In different states, the motor responds as follows:

- If this auto-tuning method is used in the shaft-locked or external brake state, the motor does not rotate during auto-tuning.
- If this auto-tuning method is used in the non-shaft-locked state. The motor performs minor actions during auto-tuning.

If the status on the keypad changes from "rn" to "ry", auto-tuning is completed and you can proceed to commissioning. If E602 is reported during auto-tuning, auto-tuning fails.

Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 6: Angle auto-tuning through static Hall 8: Angle auto-tuning through closed-loop pre-positioning 9: Angle auto-tuning through position lock	0	-	At stop	"H0A_en.13" on page 621

Note

- Ensure that the motor phase sequence is correct during angle auto-tuning through voltage injection. Otherwise, auto-tuning can fail.
- Auto-tuning through voltage injection is applicable only to iron-core motors, ROT motors, and DDR motors, but not DDL motors.
- For DDL motors, if other auto-tuning methods fail, perform the following tests before performing angle auto-tuning through voltage injection:Perform angle auto-tuning through voltage injection on five different positions with power on when the software is not reset and record the five auto-tuned values (H00.28). You can perform angle auto-tuning through voltage injection on this DDL only if the maximum deviation among the five auto-tuned values is within 5400.
- If auto-tuning fails, see "Table 8-6 Related faults" on page 178.

Table 8–6 Related faults

Fault code	Parameter name	Description
E602.1	Angle auto-tuning overtravel	During auto-tuning, the motion range is more than 10° electrical angle. • Check for external interferences. • The resistor damping is small, and the motion range during auto-tuning is large. It is recommended to lock the motor shaft or increase the mechanical damping before auto-tuning.

8.7 Jogging

Caution

When using the jog function, set the S-ON signal of the servo drive to OFF. Otherwise, this function cannot be used.

The jog function can be used in trial run to check whether the motor rotates properly without abnormal vibration or noise generated during rotation.

This operation can be performed by using the **keypad in speed control mode and position control mode, the Inovance servo commissioning software in speed control mode, and DI jogging**.

Note

The acceleration and deceleration time constants of speed and position references can be set through H06.12 during jogging.

Using the keypad (speed control mode)

- Commissioning procedure

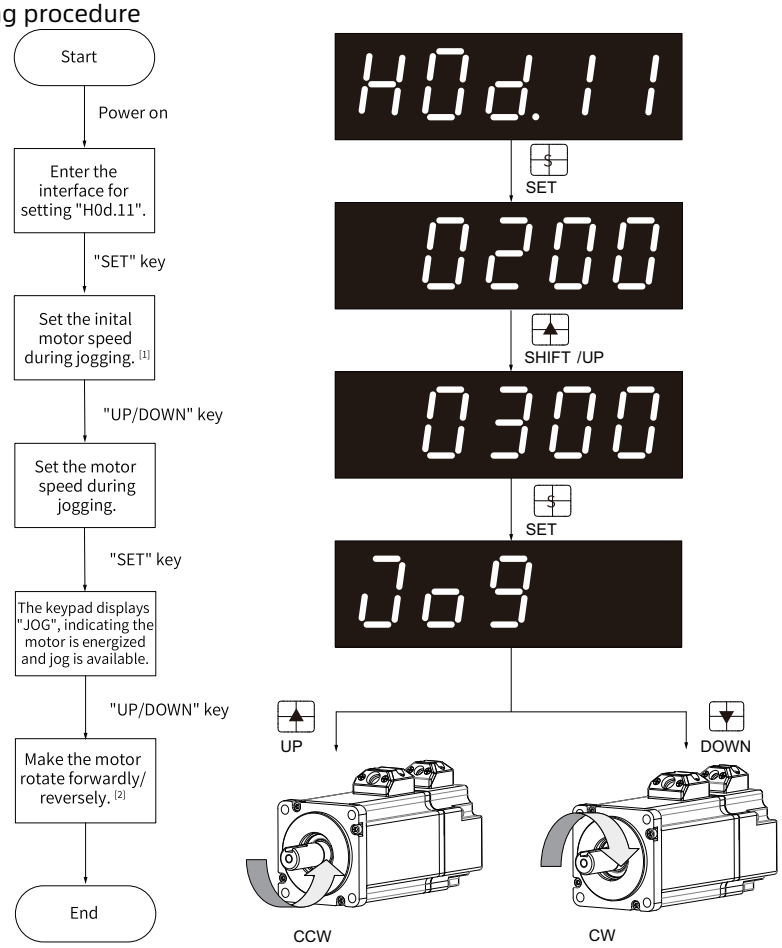


Figure 8-5 Procedure for setting the jog function

Note

- [1]: Press the UP or DOWN key to increase or decrease the jog speed. After exiting from the jog mode, the motor reverts to the initial speed.
- [2]: If magnetic pole auto-tuning is not performed after the incremental encoder motor is powered on, the auto-tuning will be automatically carried out at this time. After auto-tuning, press key UP or DOWN to enable the motor to rotate in forward or reverse direction. After you release the key, the motor stops running immediately.

- Procedure:

1. Enter the jog mode by setting H0d.11 on the keypad.

   The keypad displays the default jog speed at this moment.
2. Adjust the jog speed through the **UP/DOWN** key and press the **SET** key to enter the jog state.

   The keypad displays "JOG" at this moment, and the motor is energized.

3. Press and hold the **UP/DOWN** key to make the motor jog forwardly or reversely.
4. Press the **MODE** key to exit the jog mode and return to the previous menu.

H06.04 is reset to the default value.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.04	2006-05h	DI jog speed reference	0 to 10000	150	rpm	Real time	"H06_en.04" on page 566

Jogging through the software tool

Procedure:

1. Open the **Speed JOG** interface in the software tool.
2. Set the jog speed.
3. After switching the servo status to ON, press the forward/reverse arrow displayed on the interface to switch between forward and reverse jog.

Jogging through the DI

Note

Note: The jog function can be activated through the DI in any control mode.

Procedure:

1. Assign FunIN.18 and FunIN.19 to two external Dis in group H03.
2. Set H06.04.
3. Make the motor jog forwardly or reversely through changing the DI level.

☆Related parameters

Parameter code	Parameter name	Function	Description
FunIN.18	JOGCMD+	Forward jog	Active: Input based on command Inactive: Command input stopped
FunIN.19	JOGCMD-	Reverse jog	Active: Input in reverse to the command Inactive: Command input stopped

Using the keypad (position control mode)

Procedure:

1. Enter the jog mode by setting H0d.08 through the keypad.
   The keypad displays the default jog speed at this moment.
2. Adjust the jog speed through the **UP/DOWN** key and press the **SET** key to enter the jog state.
   The keypad displays "JOG-P" at this moment, and the motor is energized.

3. Press and hold the **UP/DOWN** key to make the motor jog forwardly or reversely.
   Press the **MODE** key to exit the jog mode and return to the previous menu.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.12	2006-0Dh	Acceleration/ Deceleration ramp time of speed JOG	0 to 65535	10	ms	Real time	"H06_en.12" on page 568

8.8 Setting Parameters

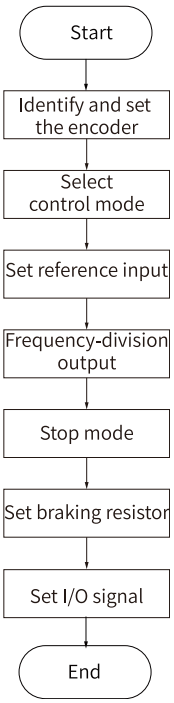


Figure 8-6 General parameter setting flowchart

Encoder identification and settings

Check whether parameter H00.00 (motor SN) matches the motor.

Set H02.02 (rotation direction) to directly change the rotation direction without changing the input command polarity.

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H00.00	2000-01h	Motor SN	20000: Linear motor - Pulse-type encoder 14202: Linear motor - Inovance communication-type 23-bit encoder 20001: DDR motor - Pulse-type encoder 14201: DDR motor - Inovance communication-type 23-bit encoder 20002: Rotary motor - Pulse-type encoder 14000: Rotary motor - Inovance communication-type 20-bit encoder 14101: Rotary motor - Inovance communication-type 23-bit encoder 14020: Rotary motor - Harmonic 20-bit encoder - 2.5 M baud rate 14021: Rotary motor - Harmonic 17-bit encoder - 2.5 M baud rate 14022: Rotary motor - Harmonic 17-bit encoder - 4 M baud rate 14120: Rotary motor - Nikon 20-bit encoder - 2.5 M baud rate 14121: Rotary motor - Nikon 17-bit encoder - 2.5 M baud rate 14122: Rotary motor - Nikon 17-bit encoder - 4 M baud rate 14130: Rotary motor - TAMAGAWA 17-bit encoder 14131: Rotary motor - TAMAGAWA 23-bit encoder	14101	-	At stop

The change of H02.02 does not affect the pulse output form or the sign (+/-) of monitoring parameter values.

The direction of "forward drive" in overtravel prevention is the same as that defined by H02.02.

Setting electronic gear ratio

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
6091.01h	6091-01h	Motor resolution	1 to 4294967295	1	-	At stop
6091.02h	6091-02h	Shaft resolution	1 to 4294967295	1	-	At stop

Setting stop mode

The stop modes include "Servo stop mode at S-ON OFF", "Stop mode at No.2 fault", "Stop mode at overtravel", and "Stop mode at No.1 fault".

1. Select the stop mode for stop at S-ON OFF.

   ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H02.05	2002-06h	Stop mode at S-ON OFF	-4: Ramp to stop as defined by 6085h, keeping dynamic braking state -3: Stop at zero speed, keeping dynamic braking state -2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state 2: Dynamic braking stop, keeping de-energized state	0	-	Real time

2. Select the stop mode at No.2 fault.

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H02.06	2002-07h	Stop mode at No.2 fault	-5: Stop at zero speed, keeping dynamic braking state -4: Stop at emergency stop torque, keeping dynamic braking state -3: Ramp to stop as defined by 6085h, keeping dynamic braking state -2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state	2	-	Real time

3. Select the stop mode at overtravel.

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H02.07	2002-08h	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state 3: Ramp to stop as defined by 6085h, keeping de-energized state 4: Ramp to stop as defined by 6085h, keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel	1	-	At stop

4. Stop mode at No. 1 fault

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H02.08	2002-09h	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	-	At stop

Setting brake

The brake is used to prevent the servo motor shaft from moving and lock the motor position when the servo drive is not running. This is to keep the mechanical motion parts from moving due to gravity or external forces.

Caution

- Use the built-in brake for position-lock purpose only. Do not use this brake for any other purposes (such as braking) other than position lock in the stop state.
- The brake coil has no polarity.
- After the motor stops, switch off the S-ON signal.
- If instruments such as a magnetic sensor is operating near the motor, flux leakage may occur on the motor shaft end when brake coils are energized (open).

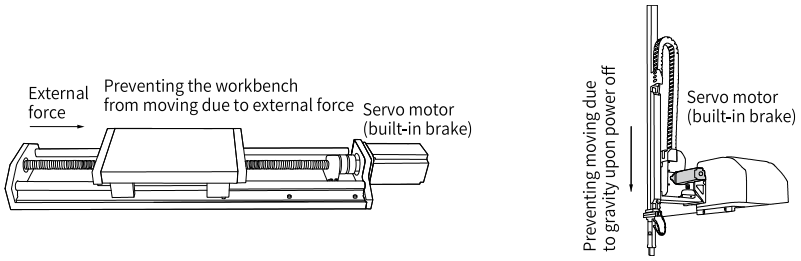


Figure 8-7 How the brake works

Table 8–7 Brake specifications

Motor model	Holding torque (N·m)	Power supply voltage (VDC) ±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Excitation current (A)	Release time (ms)	Close time (ms)	Backlash (°)
MS1H1-05B/10B MS1H4-10B	0.32	24	6.1	94.4	0.25	≤ 20	≤ 40	≤ 1.5
MS1H1-20B/40B MS1H4-20B/40B	1.5		7.6	75.79	0.32	≤ 20	≤ 60	≤ 1.5
MS1H1-75B/10C MS1H4-75B/10C	3.2		10	57.6	0.42	≤ 40	≤ 60	≤ 1
MS1H2-10C/15C/20C/25C	8		17.6	32.73	0.73	≤ 40	≤ 100	≤ 1
MS1H2-30C/40C/50C	16		24	24	1	≤ 60	≤ 120	≤ 1
MS1H3-85B/13C/18C	16		24	24	1	≤ 60	≤ 120	≤ 1
MS1H3-29C/44C/55C/75C	50		31	18.58	1.29	≤ 100	≤ 200	≤ 1

Note

- Do not use a holding brake for braking.
- The release time and operation time of the brake depend on the discharge circuit. Be sure to confirm the operation delay of your equipment before use.
- You need to prepare the 24 VDC power supply yourself.

- Brake sequence in normal state

  The brake sequence in the normal state is further divided into the following two types:

  - Standstill: The actual motor speed is lower than 20 RPM.
  - Rotating: The motor speed is equal to or higher than 20 RPM.

- Brake sequence for motor at standstill

  If the servo enabling (S-ON) signal changes from ON to OFF, and the present motor speed is lower than 20 RPM, the servo drive acts according to the brake time sequence in the static state of the motor.

Caution

- After the brake output signal changes from OFF to ON, do not input a position/speed/torque reference within the time defined by H02.09. Otherwise, reference loss or an operation error may occur.
- The torque limit cannot be set to zero after the brake is released.
- When the motor is used to drive a vertical axis, the motion part may move slightly under the influence of gravity or external forces. If the S-ON signal is switched off, the brake output is immediately set to OFF when the motor is at standstill. However, within the time defined by H02.10, the motor is still energized, preventing the load from moving under the influence of gravity or external forces.

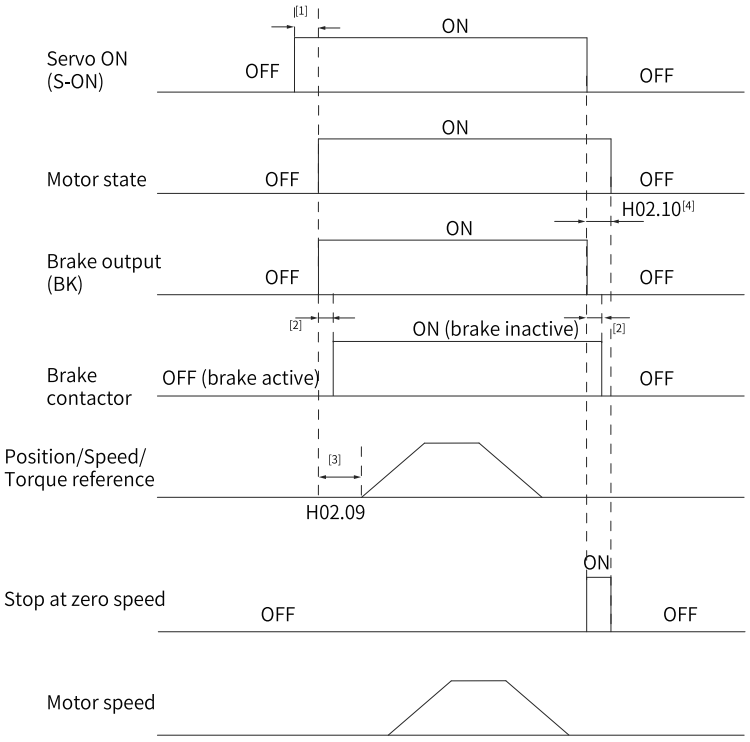


Figure 8-8 Brake sequence for motor at standstill

Note

- [1]: When the S-ON signal is switched on, the brake output is set to "ON" at a delay of about 80 ms, with motor being energized at the same time.
- [2]: For delay of brake contactor actions, see *"Table 8-7 Brake specifications" on page 185*.
- [3]: The interval time, starting from the moment when brake output is set to "ON" to the moment when a command is input, must be higher than the setpoint of H02.09.
- [4]: When the S-ON signal is switched off with motor at standstill (motor speed lower than 30 rpm), the brake output is set to "OFF". You can set in H02.10 the delay of the motor in entering the de-energized state after the brake output is set to "OFF".

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H02.09	2002-0Ah	Delay from brake output ON to command received	0 to 500	250	ms	Real time
H02.10	2002-0Bh	Delay from brake output OFF to motor de-energized	50 to 1000	150	ms	Real time

- Brake sequence of the motor in the rotation state

  If the servo enabling signal (S-ON) changes from OFF to ON, and the current motor speed is equal to or larger than 20 RPM, the servo drive acts according to the brake time sequence for the motor in the rotation state.

Caution

- When the S-ON signal is switched on, do not input a position/speed/torque reference within the time defined by H02.09. Otherwise, reference loss or an operation error may occur.
- If the S-ON signal is switched off when the motor is still rotating, the motor enters the "Stop at zero speed" state, but the brake output can be set to "OFF" only when one of the following conditions is met:
  - The motor has decelerated to the value defined by H02.11, but the time defined by H02.12 is not reached.
  - The time defined by H02.12 has been reached, but the motor speed is still higher than the value defined by H02.11.
- The motor is still energized within 50 ms after the brake output changes from "ON" to "OFF". This is to prevent the motion parts from moving under the influence of gravity or external force.

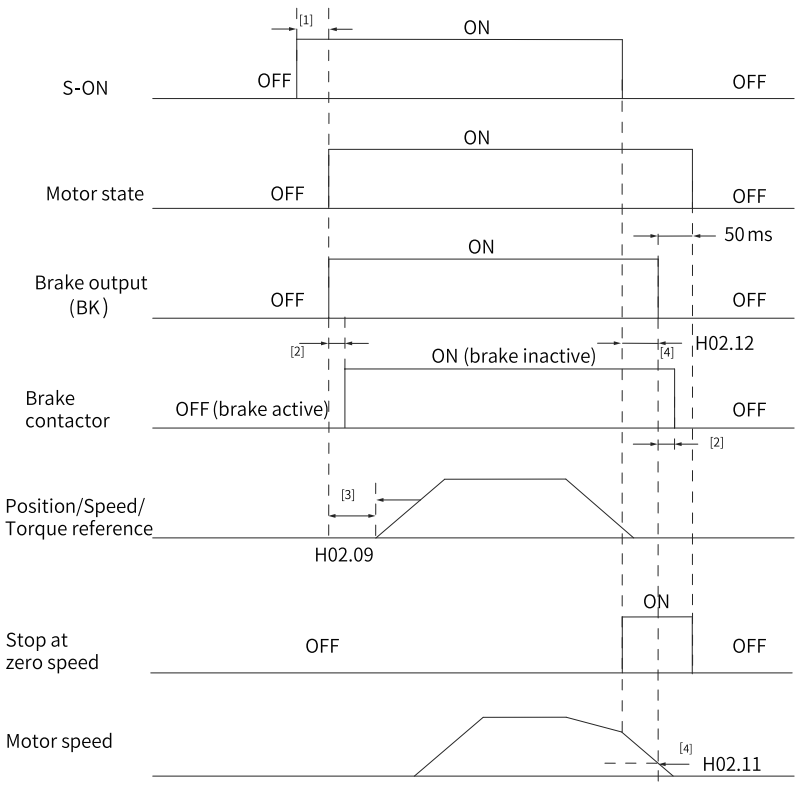


Figure 8-9 Brake time sequence for the motor in the rotation state

Note

- [1]: When the S-ON signal is switched on, the brake output is set to "ON" at a delay of about 80 ms, with motor being energized at the same time.
- [2]: For delay of brake contactor actions, see *"Table 8-7 Brake specifications" on page 185*.
- [3]: The interval time, starting from the moment when brake output is set to "ON" to the moment when a command is input, must be higher than the setpoint of H02.09.
- [4]: When the motor is rotating and S-ON is OFF, the motor enters a non-energized state when the brake outputs OFF after the delay set in H02.12 or the speed feedback is less than H02.11.

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H02.11	2002-0Ch	Motor speed threshold at brake output OFF in rotation state	20 to 3000	30	rpm	Real time
H02.12	2002-0Dh	Delay from S-ON OFF to brake output OFF in rotation state	1 to 65535	500	ms	Real time

- Brake sequence in the fault state

  Servo drive faults can be classified into No. 1 faults and No. 2 faults based on the stop mode. For details, see *SV670-INT Series Servo Drive Function Guide*. The brake time sequence for the servo drive in the fault state changes with the fault class.

  - In case of No. 1 faults:

    The condition for brake output is the same as that for the brake time sequence for the motor in the rotation state when the servo drive is normal. That is, the brake output signal becomes OFF only when one of the following conditions is met:

    - The motor has decelerated to the value defined by H02.11, but the time defined by H02.12 is not reached.
    - The time defined by H02.12 is reached, but the motor speed is still higher than the value defined by H02.11.

  - In case of No. 2 faults:

    When a No. 2 fault occurs and the brake is enabled, the stop mode is forced to "Stop at zero speed, keeping dynamic braking status".

    In this case, the servo motor stops at zero speed first. When the actual motor speed is lower than 20 RPM, the brake output signal immediately becomes OFF, but the motor is still in the energized state within the time defined by H02.10.

Setting I/O signal

The input/output signal settings are the same as that in section "DI/DO setting mode selection".

8.9 Servo Drive Operation

Switch on the S-ON signal.

When the drive is ready to run, the keypad displays "88rn".

If no command is input, the motor does not rotate and stays locked. After a command is input, the motor starts operation.

Table 8–8 Operation of the servo drive

No.	Item	Checked
1	During initial operation, set a proper command to make the motor run at a low speed and check whether the motor rotates properly.	□
2	Check whether the motor rotates in the correct direction. If the direction of rotation is opposite to the expected direction, check the input command signal and the command direction setting signal.	□
3	If the motor direction of rotation is correct, view the actual speed in H0b.00 and average load ratio in H0b.12 through the keypad or the software tool.	□
4	After checking the preceding conditions, adjust related parameters to make the motor operate as desired.	□
5	Adjust the drive according to section "Adjustment" in Function Guide.	□

Power-on sequence diagram

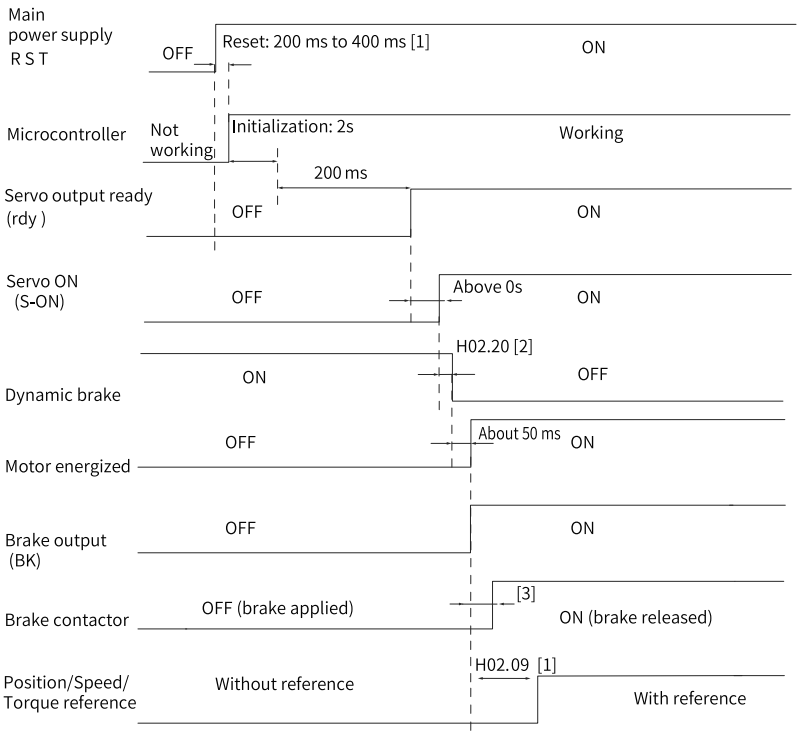


Figure 8-10 Power-on sequence diagram

Note

- [1] The DI signal used for fault reset (FunIN.2: ALM-RST) is edge triggered.
- [2] The dynamic brake is included in the standard configuration.
- [3] For the delay of brake contactor operation, see the technical data of the motor for details.
- [4] If the brake is not used, H02.09 is invalid.

Sequence diagram for stop at alarm or fault

- No. 1 fault: Coast to stop, keeping de-energized status

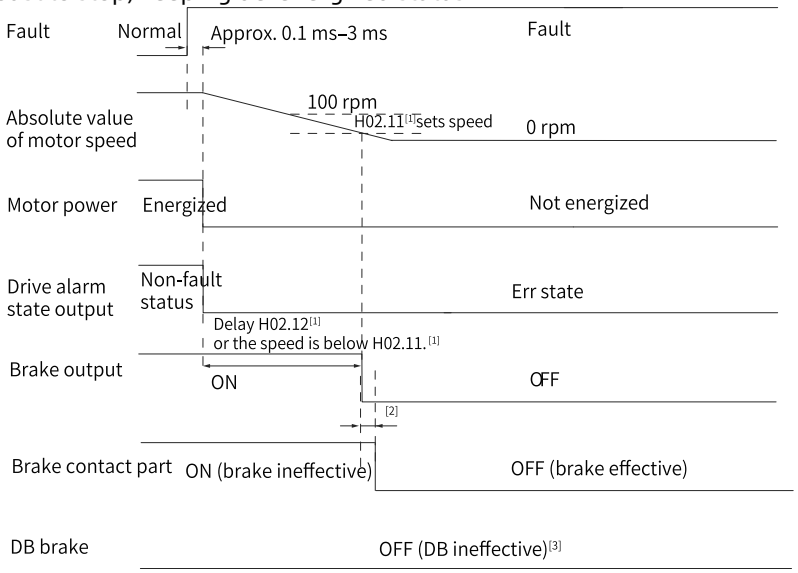


Figure 8-11 Sequence of "coast to stop, keeping de-energized state" at No. 1 fault

Note

- [1] If the brake is not used, H02.11 and H02.12 are ineffective.
- [2] For the delay of brake contactor operation, see the technical data of the motor for details.
- [3] The dynamic brake is included in the standard configuration.

- No. 1 fault (without brake): Dynamic braking stop, keeping de-energized state

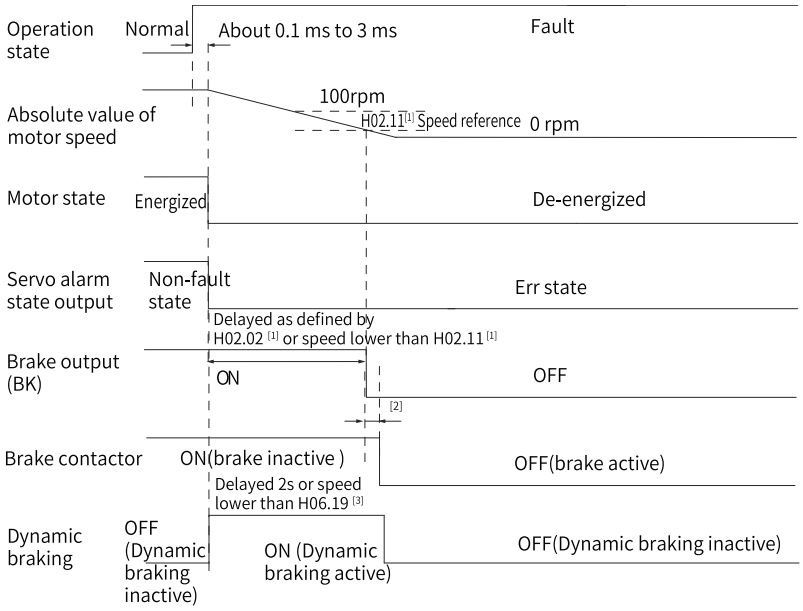


Figure 8-12 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 1 fault

Note

- [1] If the brake is not used, H02.11 and H02.12 are ineffective.
- [2] For the delay of brake contactor operation, see the technical data of the motor for details.
- [3] The dynamic brake is included in the standard configuration.

- No. 1 fault: Dynamic braking stop, keeping dynamic braking state

Figure 8-13 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 1 fault

Note

- [1] If the brake is not used, H02.11 and H02.12 are ineffective.
- [2] For the delay of brake contactor operation, see the technical data of the motor for details.
- [3] The dynamic brake is included in the standard configuration.

- No. 2 fault (without brake): Coast to stop, keeping de-energized state

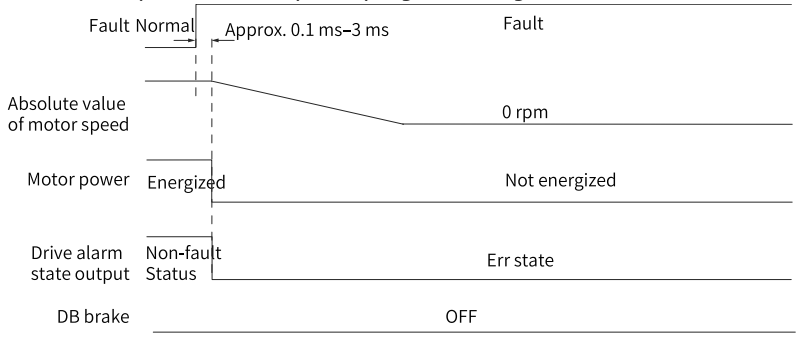


Figure 8-14 Sequence of "Coast to stop, keeping de-energized state" at No. 2 fault

- No. 2 fault (without brake): Stop at zero speed, keeping de-energized status

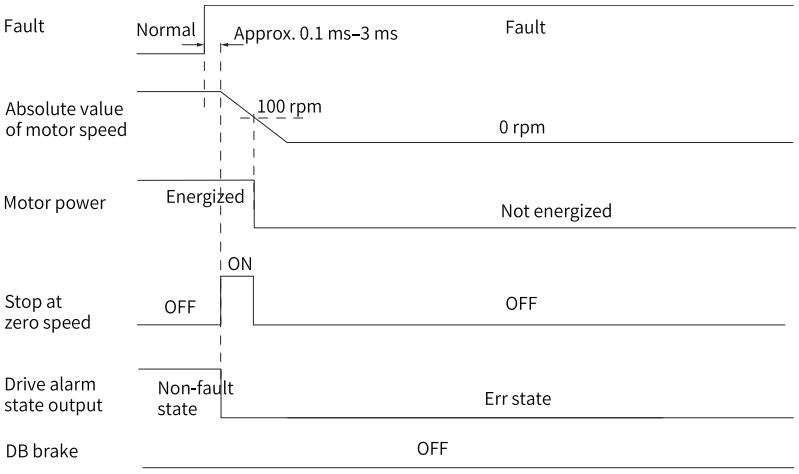


Figure 8-15 Sequence of "Stop at zero speed, keeping de-energized state" at No. 2 fault (without brake)

- No. 2 fault (without brake): Stop at zero speed, keeping dynamic braking state

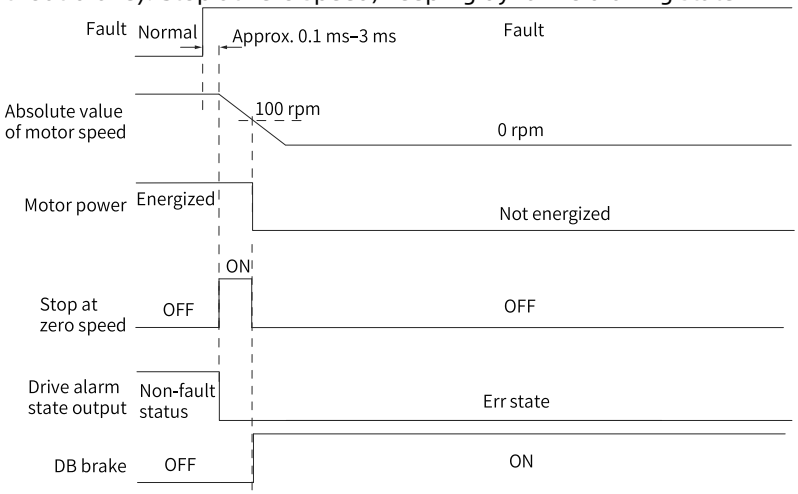


Figure 8-16 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (without brake)

- No. 2 fault (without brake): Dynamic braking stop, keeping dynamic braking state

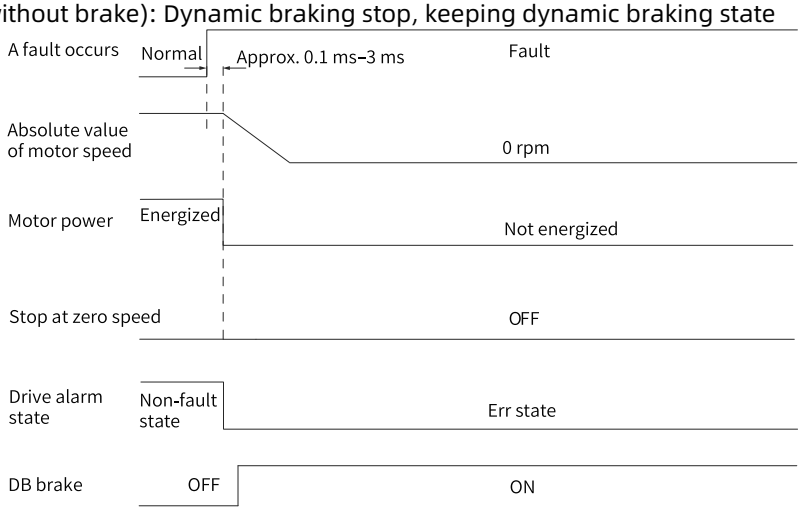


Figure 8-17 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 2 fault (without brake)

- No. 2 fault (without brake): Dynamic braking stop, keeping de-energized state

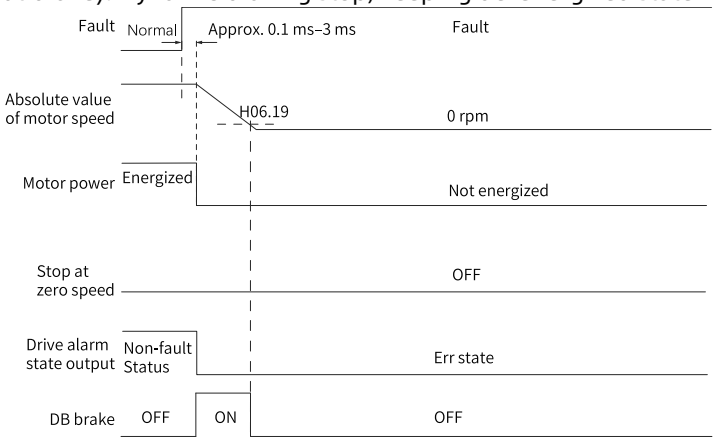


Figure 8-18 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 2 fault (without brake)

- No. 2 fault (with brake): Stop at zero speed, keeping dynamic braking status

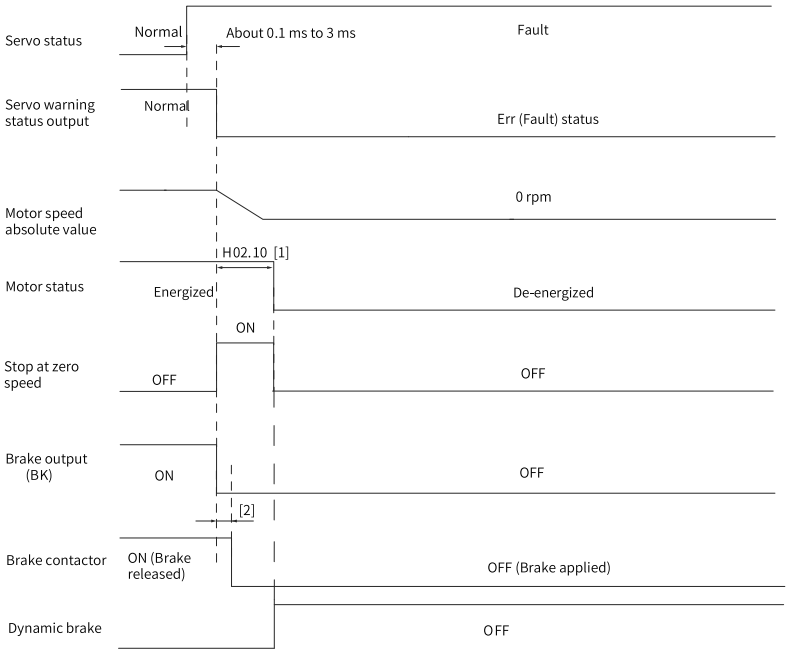


Figure 8-19 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (with brake)

Note

- [1] If the brake is not used, H02.10 is invalid.
- [2] For the delay of brake contactor operation, see the technical data of the motor for details.

- When a No. 3 alarm occurs on the servo drive, such as E900.0 (DI emergency braking), E950.0 (Positive limit switch alarm), and E952.0 (Negative limit switch alarm), the servo drive stops according to *"Figure 8-20 Sequence for alarms that cause stop" on page 194*.
- Alarms for stop caused by overtravel or brake: Stop at zero speed, keeping position lock state

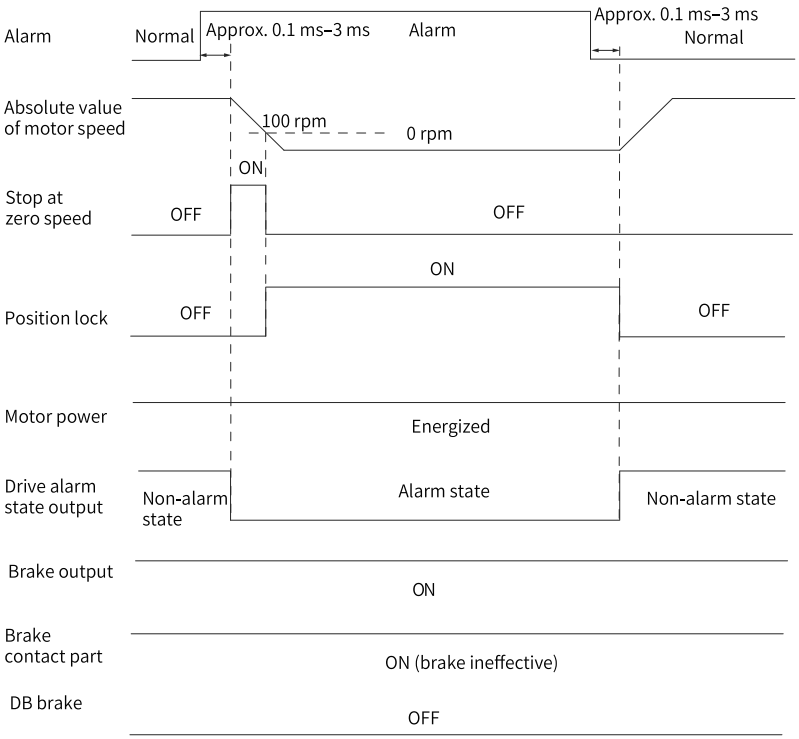


Figure 8-20 Sequence for alarms that cause stop

Other alarms do not affect the operation state of the drive. The sequence diagram for these alarms is shown in *"Figure 8-21 Sequence for alarms that do not cause stop" on page 194*.

- Alarms that do not cause stop

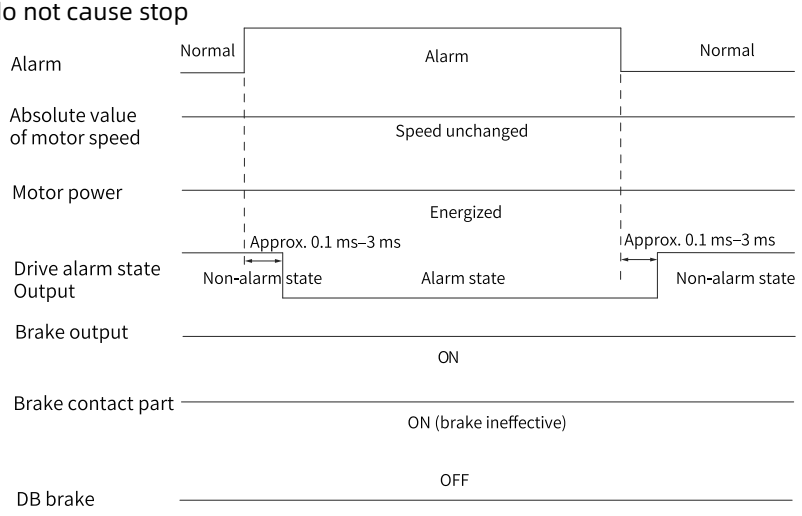


Figure 8-21 Sequence for alarms that do not cause stop

- Fault reset

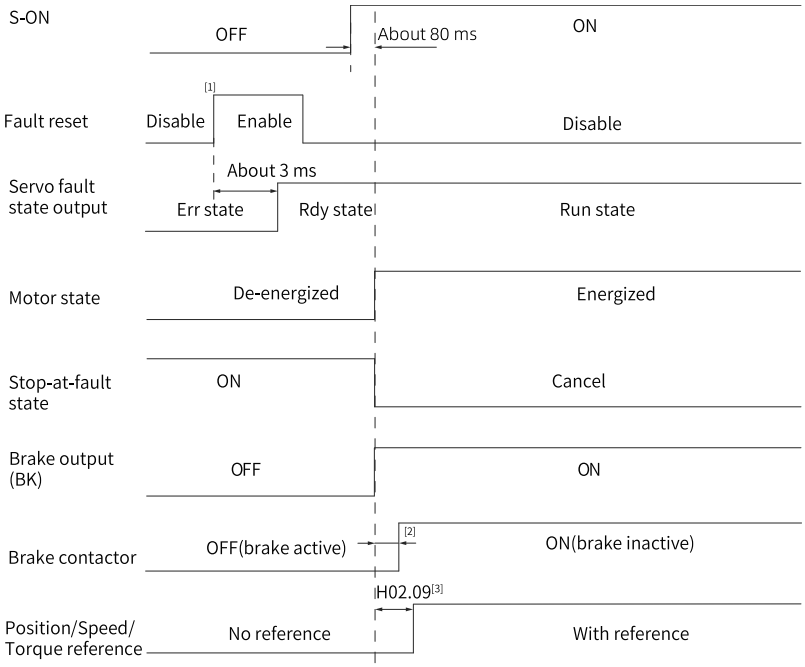


Figure 8-22 Sequence for fault reset

Note

- [1] The DI signal used for fault reset (FunIN.2: ALM-RST) is edge triggered.
- [2] For the delay of brake contactor operation, see the technical data of the motor for details.
- [3] If the brake is not used, H02.09 is invalid.

8.10 Servo Drive Stop

Five types of stop modes are available for the servo drive: coast to stop, stop at zero speed, ramp to stop, stop at emergency stop torque, and dynamic braking stop, along with three types of stop states: de-energized, position lock, and dynamic braking. The following table describes the stop modes.

Table 8–9 Comparison among different stop modes

Stop mode	Description	Characteristics
Coast to stop	The motor is de-energized and coasts to 0 RPM. The deceleration time is affected by the mechanical inertia and mechanical friction.	This mode features smooth and slow deceleration with small mechanical shocks.
Stop at zero speed	The motor immediately decelerates to 0 rpm and stops.	This mode features quick deceleration with obvious mechanical shocks.
Ramp to stop	The motor smoothly decelerates to 0 rpm upon position/speed/torque reference input.	This mode features smooth and controllable deceleration with small mechanical shocks.

Stop mode	Description	Characteristics
Stop at emergency stop torque	The servo drive outputs reverse braking torque to stop the motor.	Features quick deceleration with obvious mechanical shock.
Dynamic braking	The motor is in the dynamic braking status.	This mode features quick deceleration with obvious mechanical shocks.

Table 8–10 Comparison among different stop states

Stop mode	Description
De-energized	The motor is de-energized but the motor shaft can rotate freely after the motor stops rotating.
Position lock	The motor shaft is locked and cannot rotate freely after the motor stops rotating.
Dynamic braking	The motor is de-energized and the motor shaft cannot rotate freely after the motor stops rotating.

The stop events can be divided into the following types: stop at S-ON OFF, stop at fault, stop at overtravel, emergency stop, quick stop, and halt. The following section describes the stop events.

Stop at S-ON OFF

Deactivate the S-ON signal through communication to make the drive stop according to the stop mode at S-ON OFF.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.05	2002-06h	Stop mode at S-ON OFF	-4: Ramp to stop as defined by 6085h, keeping dynamic braking state -3: Stop at zero speed, keeping dynamic braking state -2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Dynamic braking stop, keeping de-energized state	0	-	Real time	"H02_en.05" on page 535

Stop at fault

The stop mode varies with the fault type. For fault classification, see section "Fault Code Description".

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.06	2002-07h	Stop mode at No.2 fault	-5: Stop at zero speed, keeping dynamic braking state -4: Stop at emergency stop torque, keeping dynamic braking state -3: Ramp to stop as defined by 6085h, keeping dynamic braking state -2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state	2	-	Real time	"H02_en.06" on page 535

Stop at overtravel

★Terms:

- Overtravel: The mechanical motion goes beyond the designed range of safe movement.
- Stop at overtravel: When a motion part moves beyond the range of safe movement, the limit switch outputs a level change signal, and the servo drive forcibly stops the motor.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.07	2002-08h	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state 3: Ramp to stop as defined by 6085h, keeping de-energized state 4: Ramp to stop as defined by 6085h, keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel	1	-	At stop	"H02_en.07" on page 536

When overtravel occurs on a motor used to drive a vertical axis, the workpiece may fall. To prevent the risk of falling, set H02.07 (stop mode at overtravel) to 1 (stop at zero speed, keeping position lock state). When the workpiece moves linearly, install the limit switch to prevent mechanical damage. When overtravel occurs, input a reverse RUN command to make the motor (workpiece) run in the opposite direction.

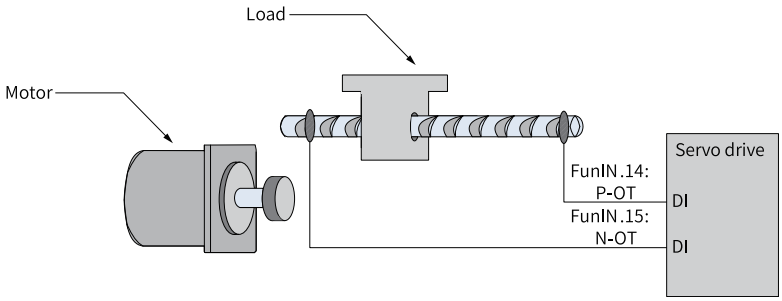


Figure 8-23 Installation of limit switches

To use the "stop at overtravel" function, assign FunIN.14 (P-OT, positive limit switch) and FunIN.15 (N-OT, negative limit switch) to two DIs of the drive and set the active logic of these DIs. This enables the drive to receive the level signals input from the limit switches. The servo drive enters the "stop at overtravel" state or exists the state based on the state of the DI level.

☆ Related parameters

Code	Name	Function	Description
FunIN.14	P-OT	Positive limit switch	When the mechanical movement is beyond the movable range, the overtravel prevention function will be activated. Inactive: Forward driving enabled Active: Forward driving disabled
FunIN.15	N-OT	Negative limit switch	When the machine moves beyond the specified range, overtravel prevention applies. Inactive: Reverse drive permitted Active: Reverse drive inhibited

Emergency stop

The servo drive supports two emergency stop modes:

- Using DI function 34: FunIN.34 (emergency stop)

  ☆ Related parameters

Code	Name	Function	Description
FunIN.34	Emergency stop	Braking	Inactive: Current operating state unaffected Active: The servo drive stops according to the stop mode defined by 605Ah.

- Using the auxiliary function: emergency stop (H0d.05)

  When H0D-05 is enabled, the servo drive will stop in the stop mode defined by H02.05 or 605Ch regardless of the running status.

  When emergency stop is enabled, the motor stops according to the mode specified by the parameter H02.18.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.05	200d-06h	Emergency stop	0: No operation 1: Emergency stop	0	-	Real time	"H0d_en.05" on page 656
H02.05	2002-06h	Stop mode at S-ON OFF	-4: Ramp to stop as defined by 6085h, keeping dynamic braking state -3: Stop at zero speed, keeping dynamic braking state -2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Dynamic braking stop, keeping de-energized state	0	-	Real time	"H02_en.05" on page 535
H02.15	2002-10h	LED alarm display	0: Output alarm information immediately 1: Not output alarm information	0	-	Real time	"H02_en.15" on page 538
H02.18	2002-13h	Quick stop mode	0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state 6: Ramp to stop as defined by 6085h, keeping position lock state 7: Stop at emergency stop torque, keeping position lock state	2	-	Real time	"H02_en.18" on page 539

Quick stop

Quick stop applies when bit 2 (Quick stop) of the control word 6040h is set to 0 (Active) during operation of the servo drive. The stop mode is defined by 605Ah.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
605Ah	605Ah	Quick stop mode	0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state 6: Ramp to stop as defined by 6085h, keeping position lock state 7: Stop at emergency stop torque, keeping position lock state	2	-	Real time	"605Ah" on page 873

Halt

The halt function applies when bit 8 of the control word 6040h is set to 1 (Halt) during operation of the servo drive. The halt mode is defined by 605Dh.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
605Dh	605Dh	Halt mode	1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping position lock state 2: Ramp to stop as defined by 6085h, keeping position lock state 3: Stop at emergency stop torque, keeping position lock state	1	-	Real time	"605Dh" on page 874

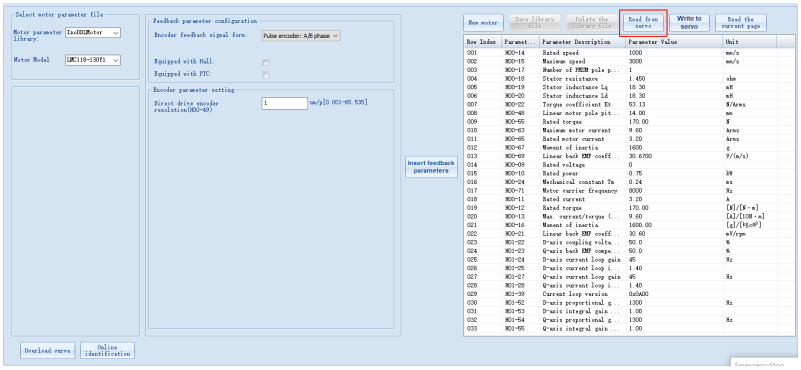


Do not set the deceleration time to an excessively low value. An excessively low value will lead to a long stop distance, incurring the risk of collision.

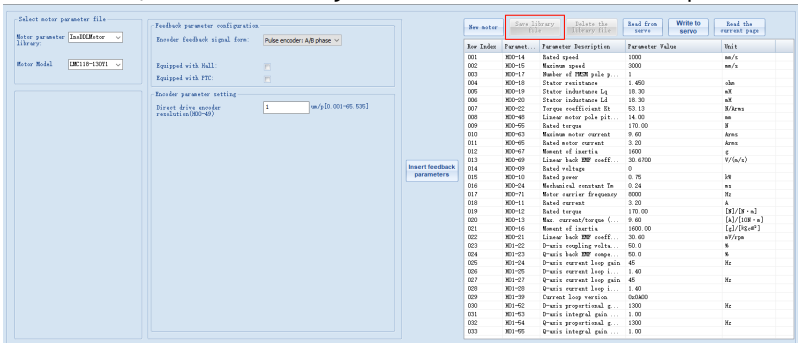
8.11 Quick Transfer of Motor Parameters

If you want to import parameters of a normal running motor from a drive to another one which will connect to a motor of the same type, perform the following steps:

1. Open the **installation Management Library** interface, connect the drive with the motor connected, and select **Read from servo**.



2. After parameters are read, click **Save library file** to save the current motor parameters.



3. Connect a new drive. In the left pane, select the user motor library from the motor parameter library, select the library file saved in step 2 from the motor model, and click **Write to servo**.
4. Click **Online auto-tuning** and select the **angle auto-tuning** interface to complete auto-tuning.

9 Tuning

9.1 Overview

The servo drive must drive the motor as quick and accurate as possible to follow the commands from the host controller or internal setting. Gain adjustment needs to be performed to meet such requirement.

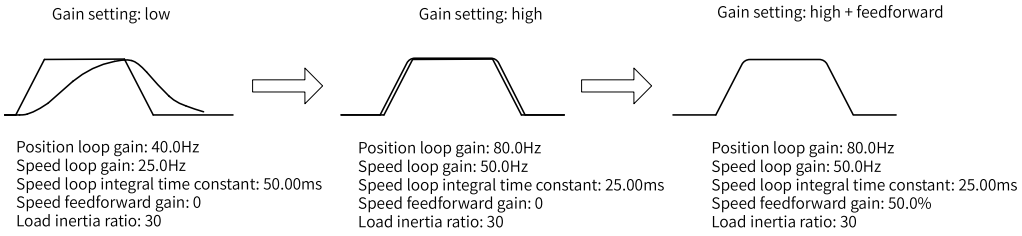


Figure 9-1 Example of gain tuning

The gain is defined by a combination of multiple parameters that affect each other. Such parameters include the position loop gain, speed loop gain, filter and load moment of inertia ratio. The values of these parameters must be balanced against each other during gain tuning.

Note

Before gain tuning, perform jogging and ensure that the motor can run normally.

The following figure shows the general flowchart for gain tuning.

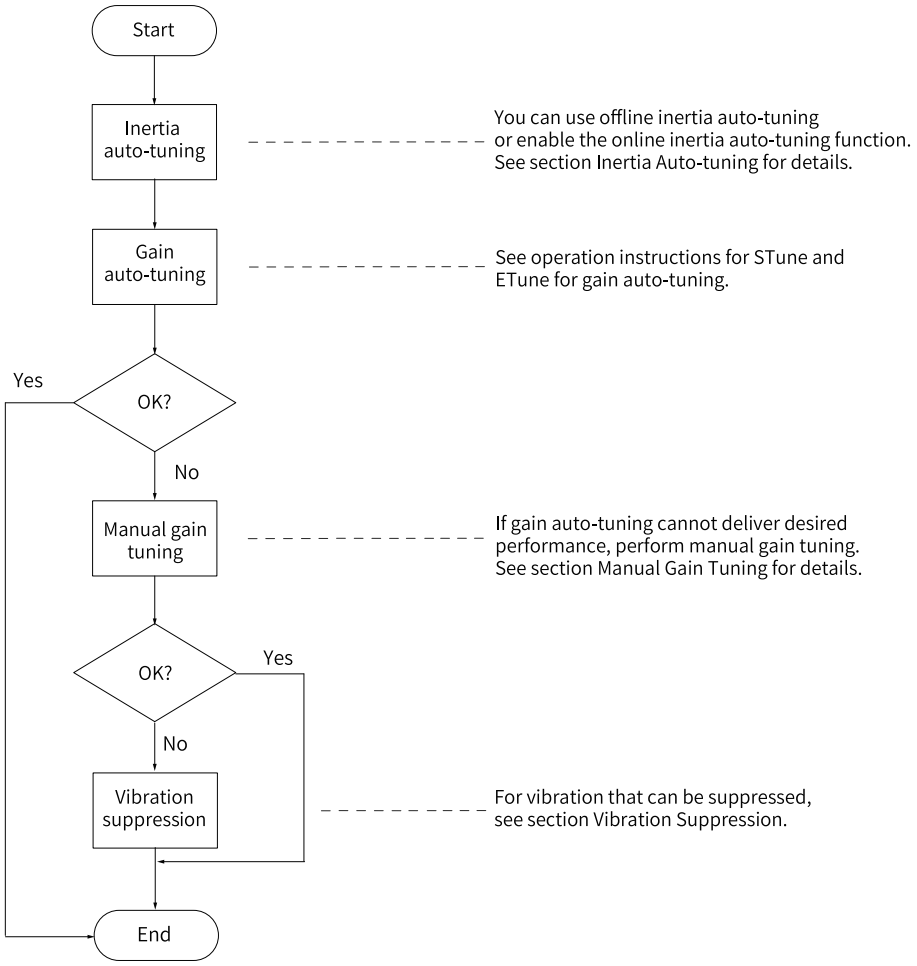


Figure 9-2 Steps

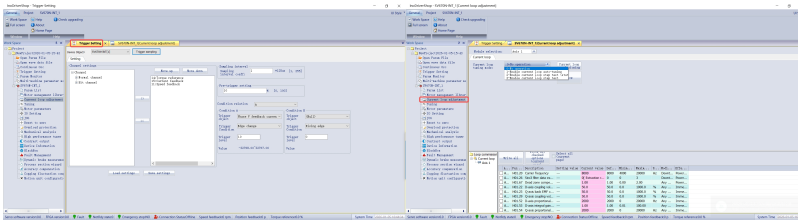
9.2 Speed Current Loop Tuning

Speed current loop parameter tuning

As the inner loop of the servo control system, the responsiveness and stability of the current loop play a vital role in the final performance of the system.

To facilitate quick commissioning of current loop gain parameters and ensure high bandwidth and quick responsiveness of the current loop, the software tool provides a current loop tuning control.

This module integrates the current loop tuning window and trigger setting observation window. The window functions are related to each other. After you select the commissioning mode and click Start Commissioning, the drive performs commissioning and tuning. The trigger setting window collects related waveforms simultaneously.

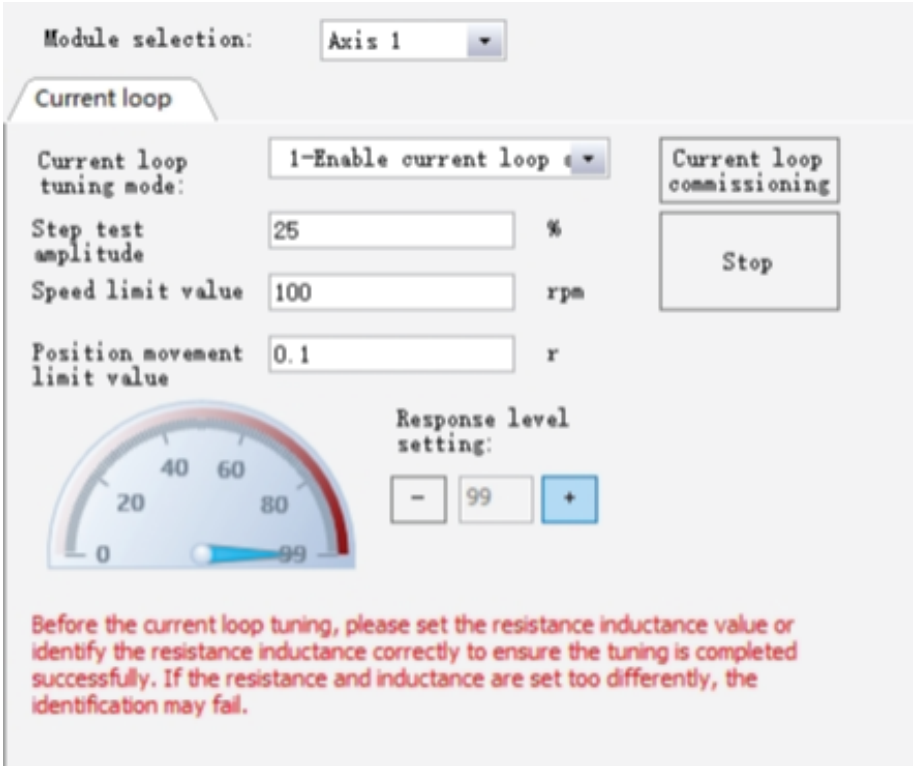


Three modes of current loop auto-tuning are available for commissioning or observation. The following section describes the functions.

1. **Current loop auto-tuning**

   This mode provides a static auto-tuning mode of the current loop. After startup, the drive performs tuning of the gain parameters related to the current loop.

   You can set the response level. The larger the response level, the better the responsiveness and bandwidth of the final tuning current loop.



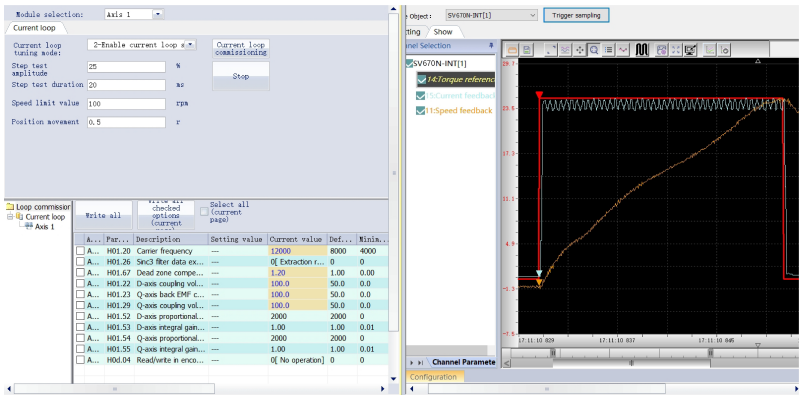
Note

Over-high current loop response may also excite current loop control noise. In actual use,you should set the response level as needed to obtain the balance between current loop responsiveness and noise.

Parameter	Description
Auto-tuning step test amplitude	The excitation signal amplitude during auto-tuning.
Speed limit	The maximum speed that the current excitation can reach to maintain stability.
Displacement limit	The maximum distance that the current excitation can act to maintain stability.
Response level setting	The expected current loop response level.

2. **Current loop step test amplitude**

   This mode provides a static current loop step response observation mode. You can manually adjust the current loop gain parameters in this mode to verify the current loop response.



Parameter	Description
Static step test amplitude	The step excitation signal amplitude.
Step test duration	The step excitation signal duration.
Speed limit	The maximum speed that the current excitation can reach to maintain stability
Displacement limit	The maximum distance that the current excitation can act to maintain stability

3. **Current loop step test**

   This mode provides a dynamic current loop step response observation mode. The method used is the same as the static step test. You can manually adjust the current loop gain parameters in this mode to verify the current loop response.

Note

In this mode, the motor will move a certain distance. You can restrict the movement by setting the speed limit value and the position movement limit value.

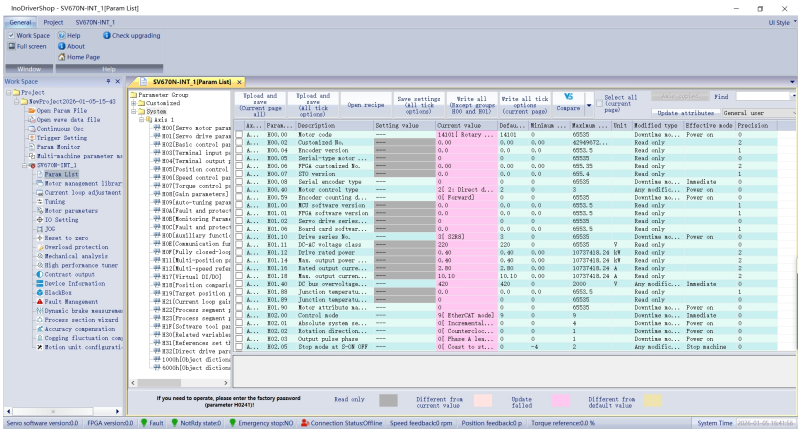
Current loop gain switchover

Current loop gain switchover is an advanced mode for current loop commissioning, which is used as a supplement to current loop parameter commissioning. This mode allows you to adjust poor or unstable current loop response caused by differences in inductive saturation characteristics of certain motors.

When inductance saturation exists in the valid operating range of the controlled motor, the current loop gain is usually matched by theoretical calculation based on inductance parameters. In this case, large differences in inductance saturation may result in poor or unstable current loop response in a single group of gains. In this case, you can use the current loop gain switchover function.

The SV670N-INT series servo drive provides 32 groups of current loop gain switchover coefficients, which are not enabled by default. You can use them as needed.

- Theoretically, gain switchover coefficients under different loads can be obtained directly through the inductance saturation characteristic curve provided by the motor manufacturer.
- In actual scenarios, you can also adjust the gain coefficient manually based on the actual effect under different load rates.



9.3 Inertia Auto-tuning

The load inertia ratio (H08.15) is calculated through the following formula:

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

The inertia ratio is an important parameter of the servo system, and quick commissioning can be implemented with the correct setting of this parameter.

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

The following two inertia auto-tuning modes are available:

- Offline Inertia Auto-tuning
  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
  Send a command to the servo drive through the host controller to make motor act accordingly to finish inertia auto-tuning. Online inertia auto-tuning involves the host controller.

Note

The following requirements must be met to ensure correct calculation of the inertia ratio:

- The actual maximum speed of the motor is higher than 150 rpm.
- The acceleration rate during acceleration/deceleration of the motor is higher than 3000 rpm/s.
- The load torque is stable without dramatic changes.
- The actual inertia ratio does not exceed 120.
- Inertia auto-tuning may fail in case of a large backlash of the transmission mechanism.

9.3.1 Offline Inertia Auto-tuning

Check the following items before performing offline inertia auto-tuning:

The motor must meet the following requirements:

- A travel distance of more than one revolutions in the forward/reverse direction is available between the mechanical limit switches.

Danger

Ensure limit switches are installed to the machine and a travel distance as described above is reserved to prevent overtravel during inertia auto-tuning.

- The required number of revolutions (H09.09) is fulfilled.
  View H09.06, H09.07, and H09.09. Make sure that the travel distance available for the motor in the stop position is larger than H09.09. If not, decrease H09.06 or H09.07 until the requirements are met.

Offline inertia auto-tuning procedure:

1. Switch off the S-ON signal.
2. In parameter display mode, switch to H0d.02 and press SET to enable offline inertia auto-tuning.
3. Press the UP/DOWN key to perform offline inertia auto-tuning.
4. 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 unidirectional operations only, set H09.05 to 1.
5. Wait until the value displayed on the keypad is stabilized.
6. Hold the SET key down until the operating panel displays "SAVE".
7. Press the MODE key to exit.

For scenarios that require a large load inertia, set H08.15 (Load moment of inertia), to the approximate value, preventing intense system vibration caused by a low initial inertia.

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

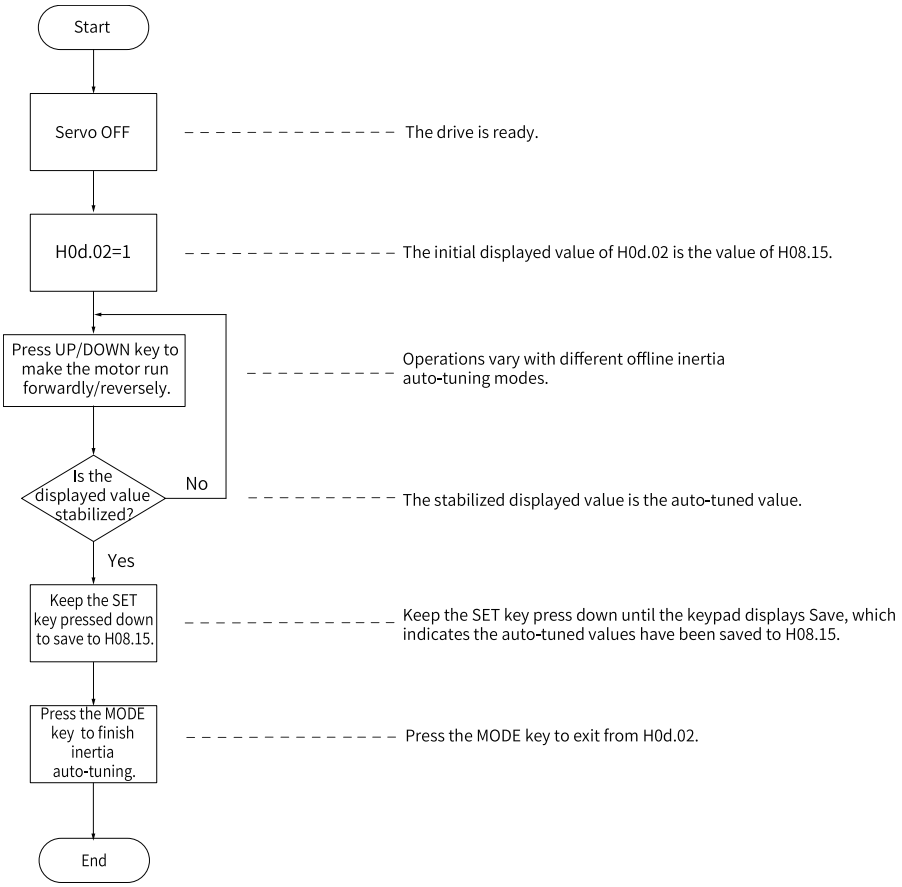


Figure 9-3 Offline inertia auto-tuning flowchart

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.05	2009-06h	Offline inertia auto-tuning mode	0: Bi-directional 1: Unidirectional	0	-	At stop	"H09_en.05" on page 603
H09.06	2009-07h	Maximum speed of inertia auto-tuning	100 to 1000	500	rpm	At stop	"H09_en.06" on page 603
H09.07	2009-08h	Time constant for accelerating to max. speed during inertia auto-tuning	10 to 5000	125	ms	At stop	"H09_en.07" on page 603
H09.08	2009-09h	Interval time after an individual inertia auto-tuning	50 to 10000	800	ms	At stop	"H09_en.08" on page 603
H09.09	2009-0Ah	Motor movement distance per inertia auto-tuning	0.00 to 100.00	1.00	-	Real time	"H09_en.09" on page 604
H0d.02	200d-03h	Inertia auto-tuning	0 to 65	0	-	Real time	"H0d_en.02" on page 656

9.3.2 Online Inertia Auto-tuning

The servo drive supports online inertia auto-tuning. The online inertia auto-tuning flowchart is shown as follows.

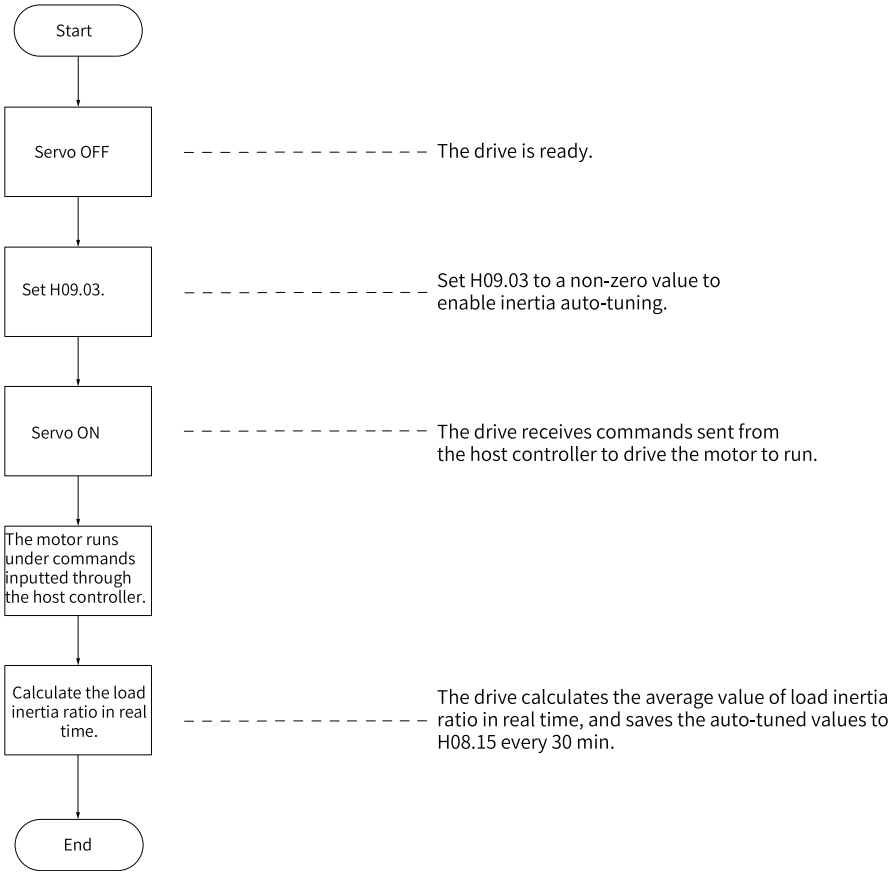


Figure 9-4 Online inertia auto-tuning flowchart

Note

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

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.03	2009-04h	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	0	-	Real time	"H09_en.03" on page 602

9.4 Automatic Gain Tuning

9.4.1 STune

Overview

STune performs automatic gain tuning based on the set stiffness level to fulfill the needs for rapidity and stability.

STune (mode 4) is turned on by default and will be turned off automatically after the drive operates as commanded for 5 min.

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

Note

In STune modes 3, 4, 5, 6, 8, and 9, you need to perform load inertia auto-tuning through online inertia auto-tuning and ensure the following conditions are met:

- The load inertia changes quickly.
- The load torque changes quickly.
- Low-speed operation. For ROT motors, the speed is lower than 100 rpm. For DDR motor, the speed is lower than 20 rpm. For DDL motors, the speed is lower than 20 mm/s.
- Acceleration/Deceleration is slow (lower than 1000 rpm per second).
- The acceleration/deceleration torque is lower than the unbalanced load/viscous friction torque.

If the conditions for online inertia auto-tuning cannot be fulfilled, manually set the correct inertia ratio.

Procedure

- **Procedure flowchart**

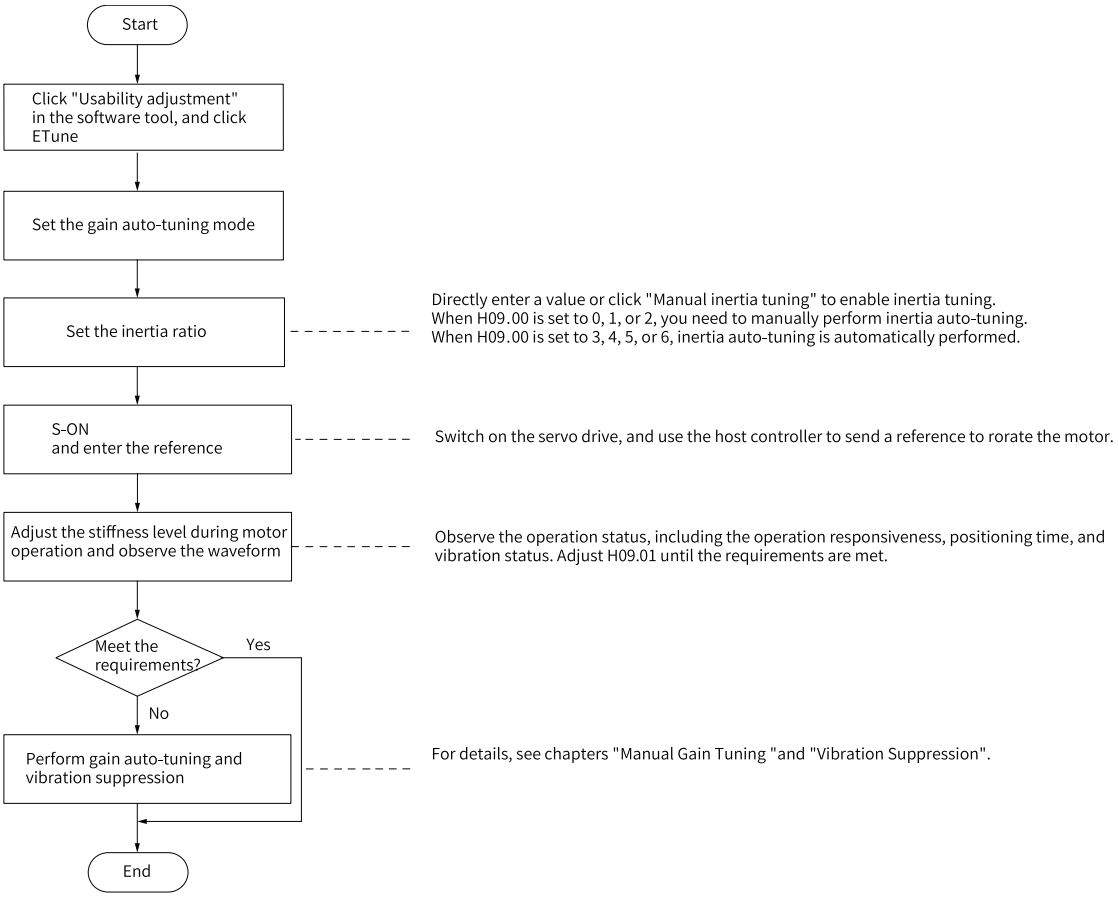


Figure 9-5 Procedure flowchart

- **Description**

  You can set the automatic gain tuning mode through the panel or the software tool.

  1. Select the automatic gain tuning mode.

     - In modes 0, 1, and 2 shown in the following table, you need to set the inertia ratio before stiffness tuning. If the inertia is unknown, manually adjust the inertia. If vibration occurs on the machine, decrease the stiffness level before manually adjusting the inertia.
     - In modes 3, 4, 5, 6, 8, and 9, you can perform tuning through the wizard-type interface directly, without the need for setting an inertia ratio.

Mode	Name	Description
0	Inactive	The gains need to be manually tuned.
1	Standard stiffness meter mode	The gain is automatically tuned based on the stiffness setting.
2	Positioning mode	The gain is automatically tuned based on the stiffness setting. This mode is applicable to scenarios requiring quick positioning.
3	Interpolation mode+Inertia auto-tuning	The gain is automatically tuned based on the stiffness setting. In this mode, inertia is auto-tuned and vibration is automatically suppressed. This mode is applicable to multi-axis interpolation.
4	Normal mode + Inertia auto-tuning	The gain is automatically tuned based on the stiffness setting. The inertia is auto-tuned and vibration is automatically suppressed.

Mode	Name	Description
5	STune mode 5	The gain is automatically tuned based on the stiffness setting. This mode applies to applications where linear motors are used.
6	Quick positioning mode + Inertia auto-tuning	The gain is automatically tuned based on the stiffness setting. Inertia is auto-tuned and vibration is automatically suppressed. This mode is applicable to occasions requiring quick positioning.
8	New model tracking mode +Inertia auto-tuning	The gain is automatically tuned based on the stiffness setting. This mode applies to applications requiring quick positioning.
9	Model tracking B+ Inertia auto-tuning + Friction compensation	The gain is automatically tuned based on the stiffness setting. This mode applies to applications requiring quick positioning.

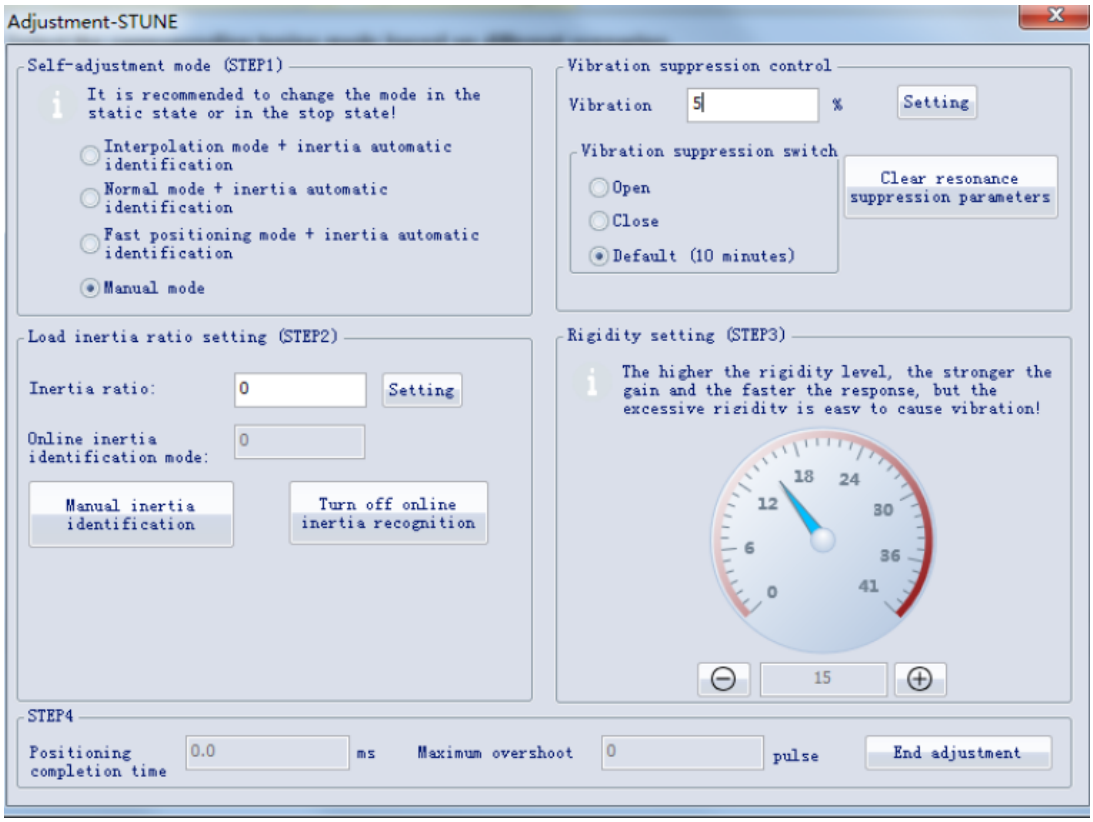
2. Gradually adjust the stiffness level during operation of the load. The present stiffness level value will be automatically written to the drive. Keep monitoring the operating waveform after increasing the stiffness level (increase by one level at a time) until desired performance is achieved.
3. In STune modes 3, 4, 5, 6, 8, and 9, when the speed keeps higher than 100 r/min for more than 5 min, H09.00 returns to 0 automatically. In this case, the drive will exit the STune mode.

   After tuning, you can set H09.00 to 0 to exit the STune mode.

   To modify the STune time, set H09.37.
4. In STune modes 3, 4, 5, 6, 8, and 9, resonance will be suppressed automatically. If the performance of automatic resonance suppression is inadequate, set H09.58 to 1 to clear resonance suppression parameters, reduce the stiffness level, and perform STune again.
5. In multi-axis trajectories, perform single-axis commissioning first to determine the highest response of each axis and modify the response of each axis manually to ensure position responses of different axes are consistent.

   In STune modes 3, 4, and 5, determine the minimum value of H08.02 [Position loop gain]. Then set H09.00 of each axis to 0 and set H08.02 of each axis to the same value.

   In STune mode 6, 8, and 9, determine the minimum value of H08.43 [Model gain]. Then set H09.00 of each axis to 0, and set H08.43 of each axis to the same value.



Note

To ensure a stable operation of STune modes 3, 4, 5, 6, 8 and 9, gain parameters will be adjusted along with the inertia ratio when the inertia ratio is higher than 13. In multi-axis trajectories, responses may be inconsistent under the same stiffness level.

Additional information

Load inertia ratio range

- In scenarios requiring high response, the inertia ratio must be lower than 500% and should not exceed 1000%.
  - For belt pulley or gear rack not requiring high stiffness and accuracy, the inertia ratio should not exceed 1000%.
  - For lead screw or cardan shaft requiring high stiffness and accuracy, the inertia ratio should not exceed 500%.
  - In scenarios where high positioning accuracy or response is required, the inertia ratio should not exceed 200%.
- In scenarios requiring a certain accuracy and dynamic response, the inertia ratio should not exceed 3000%.
- When the inertia ratio exceeds 3000%, it is difficult to adjust and trajectory control cannot be performed. It is only applicable to mechanisms for point-to-point control and rotary motion but the acceleration/deceleration time should be large.

Stiffness meter setting

The value range of H09.01 (Stiffness level) is 0 to 41. Level 0 indicates the weakest stiffness and lowest gain and level 41 indicates the strongest stiffness and highest gain.

The following table lists the stiffness levels for different load types for your reference.

Table 9–1 Stiffness levels

Recommended stiffness level	Load mechanism
Level 8 to level 12	Large-scale machinery
Level 12 to level 18	Scenarios with low stiffness such as the conveyors
Above level 18	Scenarios with high stiffness such as the ball screws and direct-connected motors

The following eight gain auto-tuning modes are available.

- Standard stiffness meter mode (H09.00 set to 1)
  The 1st gain parameters (H08.00 to H08.02 and H07.05) are automatically updated and saved based on the rigidity level set in H09.01.

  Table 9–2 Parameters updated automatically in standard stiffness meter mode

Parameter	Name
H08.00	Speed loop gain
H08.01	Speed loop integral time constant
H08.02	Position loop gain
H07.05	Filter time constant of torque reference

- Positioning mode (H09.00 is set to 2)
  On the basis of *"Table 9-2" on page 214*, the 2nd gain set (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 gain set is two stiffness levels higher than the 1st gain set.

  Table 9–3 Parameters updated automatically in positioning mode

Parameter	Name	Description
H08.03	2nd speed loop gain	-
H08.04	2nd speed loop integral time constant	If H08.04 is set to remain at 512.00 ms, the 2nd speed loop integral action is invalid and only proportional control is used in the speed loop.
H08.05	2nd position loop gain	-
H07.06	2nd torque reference filter time constant	-

  Speed feedforward parameters are assigned default values. You can change the values.

  Table 9–4 Parameters with fixed values in positioning mode

Parameter	Name
H08.19	Speed feedforward gain
H08.18	Speed feedforward filter time constant

  Gain switchover parameters are assigned default values. You can change the values.

  Gain switchover is automatically activated in positioning mode.

Parameter	Name	Parameter value	Description
H08.08	2nd gain mode setting	1	Switchover between the 1st gain set (H08.00 to H08.02, H07.05) and 2nd gain set (H08.03 to H08.05, H07.06) is active in positioning mode. In other modes, the original setting is used.
H08.09	Gain switchover condition selection	10	In positioning mode, the gain switchover condition is that H08.09 is set to 10. In other modes, the original setting is used.
H08.10	Gain switchover delay	5.0 ms	In positioning mode, the gain switchover delay is 5.0 ms. In other modes, the original setting is used.
H08.11	Gain switchover level	50	In positioning mode, the gain switchover level is 50. In other modes, the original setting is used.
H08.12	Gain switchover time lag	30	In positioning mode, the gain switchover dead time is 30. In other modes, the original setting is used.

Note

In gain auto-tuning mode, parameters updated automatically along with H09.01 and parameters with fixed values cannot be changes manually. To modify such parameters, set H09.00 to 0 to exit the auto-tuning mode.

- In STune mode 3, 4, 5, 6, 8, and 9,
  resonance suppression is automatically performed. When the load changes or the mechanical structure is re-installed, the system resonance frequency changes accordingly. Set H09.58 to 1 (Enable) and enable the STune mode again after clearing resonance suppression parameters.

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H08.37	2008-26h	Phase modulation for medium-frequency jitter suppression 2	-90 to +90	0	°	Real time	"H08_en.37" on page 595
H08.38	2008-27h	Frequency for medium-frequency jitter suppression 2	0 to 1000	0	Hz	Real time	"H08_en.38" on page 595
H08.39	2008-28h	Compensation gain for medium-frequency jitter suppression 2	0 to 300	0	%	Real time	"H08_en.39" on page 595
H09.18	2009-13h	Frequency of the 3rd notch	50 to 8000	8000	Hz	Real time	"H09_en.18" on page 606
H09.19	2009-14h	Bandwidth level of the 3rd notch	0 to 20	2	-	Real time	"H09_en.19" on page 606
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	0	-	Real time	"H09_en.20" on page 606
H09.21	2009-16h	Frequency of the 4th notch	50 to 8000	8000	Hz	Real time	"H09_en.21" on page 606

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H09.22	2009-17h	Bandwidth level of the 4th notch	0 to 20	2	-	Real time	"H09_en.22" on page 607
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	0	-	Real time	"H09_en.23" on page 607
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disable 1: Enable	0	-	Real time	"H09_en.58" on page 613

Note

- If H09.00 is set to 3, 4, 5, 6, 8, or 9, the drive will suppress the vibration and perform inertia auto-tuning automatically within 10 min after power-on or stiffness level setting. After vibration suppression and inertia auto-tuning are done, the drive exits auto-tuning state. The time can be adjusted by the vibration suppression switch (H09.37). If the inertia auto-tuning function is deactivated automatically, switching to modes 3, 4, 5, 6, 8, or 9 will not activate inertia auto-tuning again.
- Do not set H09.00 to 3, 4, 5, or 6 in applications with slow acceleration/deceleration, excessive vibration, and unstable mechanical couplings.
- In applications where the inertia does not change, set H09.03 (Online inertia auto-tuning mode) to 1 (Enabled, changing slowly). In applications where the inertia changes quickly, set H09.03 to 3 (Enabled, changing quickly).

Solutions to common faults

E661.0: STune failure.

Gain drop during STune tuning reaching the lower limit: Position loop gain < 5; Speed loop gain < 5; Model loop gain < 10.

- Manually set the notch when vibration cannot be automatically suppressed.
- Modify the electronic gear ratio to improve the command resolution, and increase the command filter time constant in the parameter configuration interface.
- Increase the value of H09.11 as appropriate.
- Check whether the current of the machine fluctuates periodically.

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H08.37	2008-26h	Phase modulation for medium-frequency jitter suppression 2	-90 to +90	0	°	Real time	"H08_en.37" on page 595
H08.38	2008-27h	Frequency for medium-frequency jitter suppression 2	0 to 1000	0	Hz	Real time	"H08_en.38" on page 595

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H08.39	2008-28h	Compensation gain for medium-frequency jitter suppression 2	0 to 300	0	%	Real time	"H08_en.39" on page 595
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disable 1: Enable	0	-	Real time	"H09_en.58" on page 613

9.4.2 ETune

Overview

ETune is a wizard-type auto-adjustment function used to guide users to set corresponding curve trajectories and response parameters. After the curve trajectories and response parameters are set, the servo drive automatically performs auto-tuning to generate 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 is intended to be used in scenarios featuring slight load inertia changes.

Procedure

- **Procedure flowchart**

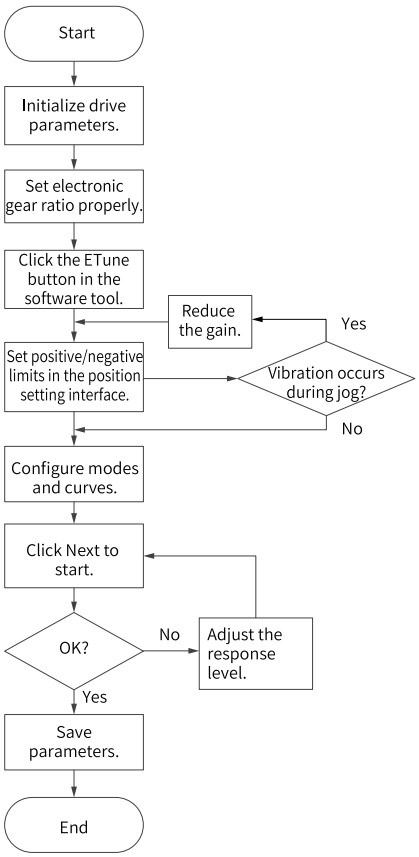
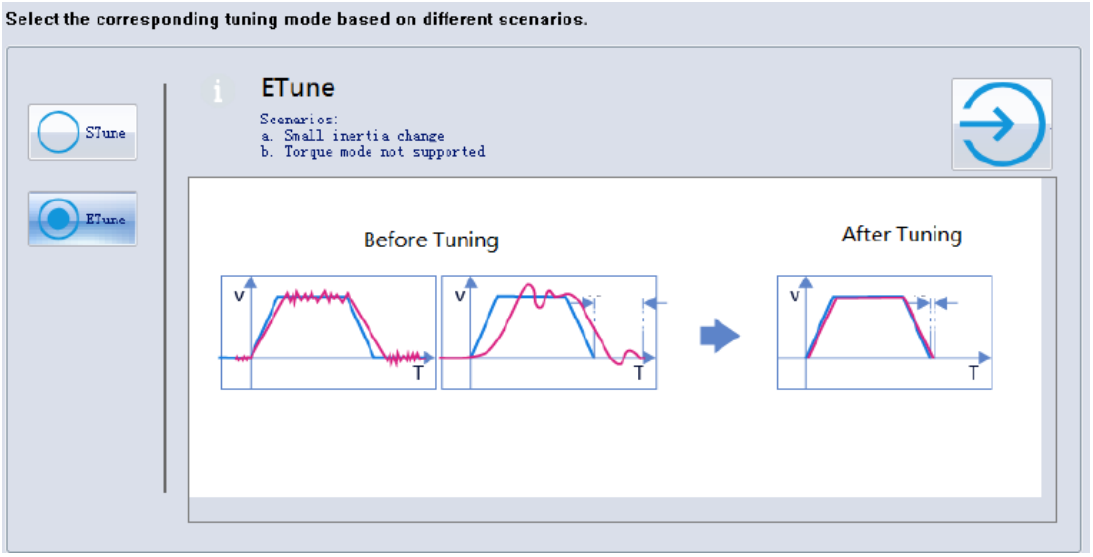


Figure 9-6 Procedure flowchart

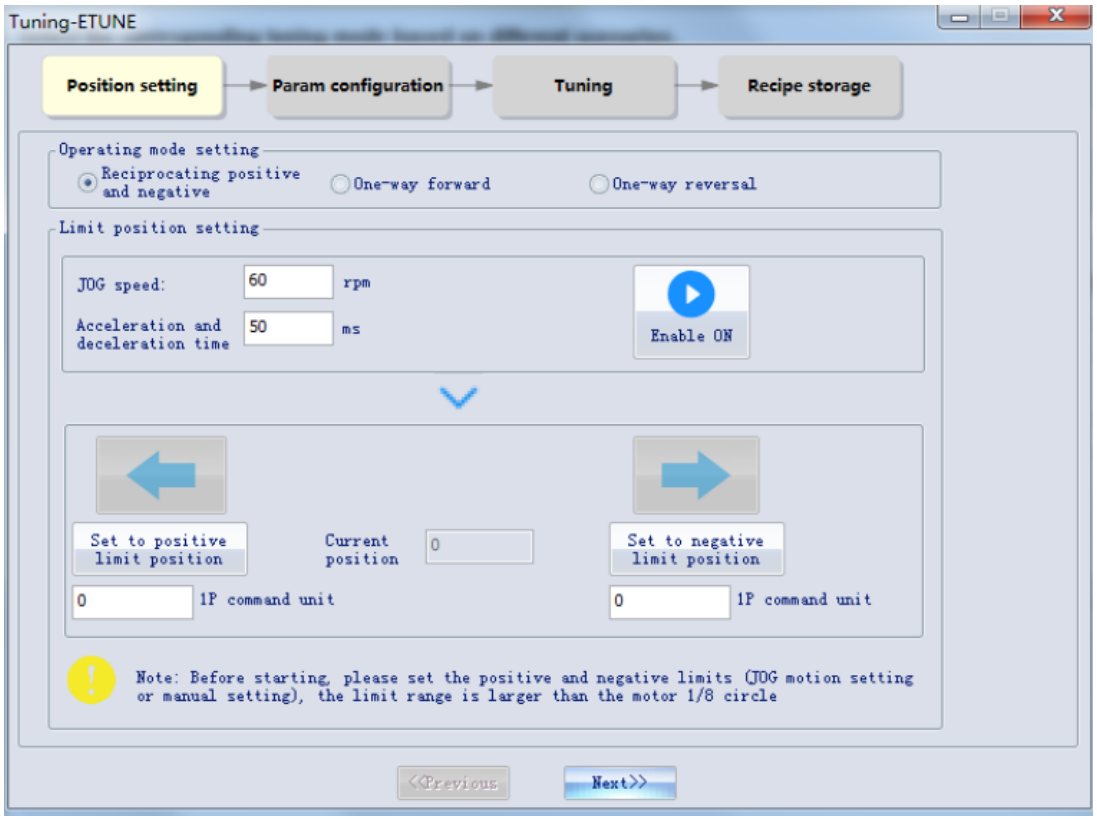
- **Steps and descriptions**

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



2. Select any of the following three operation modes based on the operating direction allowed by the machine.

   - In **Reciprocating po...** mode, the motor keeps reciprocating within the positive and negative position limits.
   - In **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 **One-way reversal** mode, the motor takes the difference between the positive and negative position limits as the maximum distance per action and keeps running in the reverse direction.



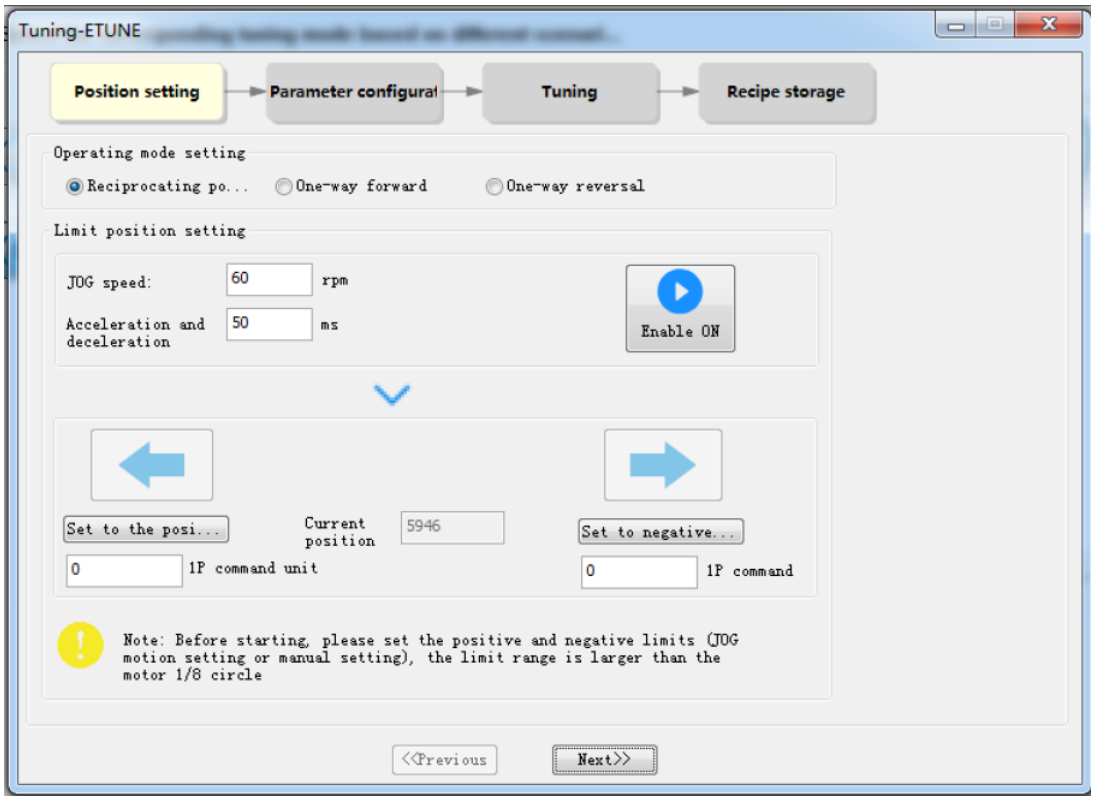
3. Specify the positive and negative limit positions allowed by the motor. The difference between the positive and negative limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio.

   You can set the positive and negative position limits through the following two methods.

   - Method 1: Click **Enable ON**, and then click ⬅ to make the motor move to the positive position limit. Next, click **Set to positive limit position**. Follow the same procedure for setting the negative position limit, and click **Enable OFF** (the **Enable ON** button turns to **Enable OFF** after a click).
   - Method 2: Directly enter the positive and negative limits.

Note

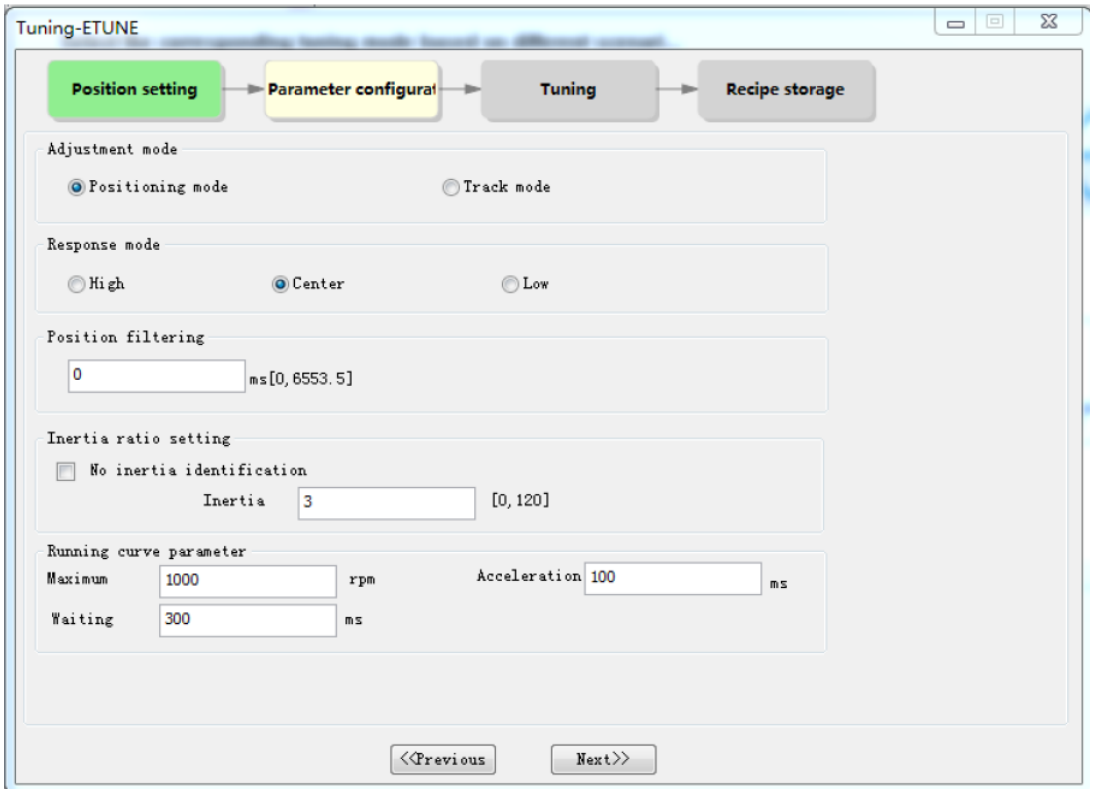
The difference between the positive and negative position limits must be larger than 1/8 of one revolution. The larger the value of the limit position, the better the adaptability of the auto-tuned parameters, but the longer will ETune adjustment take.



4. Click **Next** to switch to the mode parameter setting step.

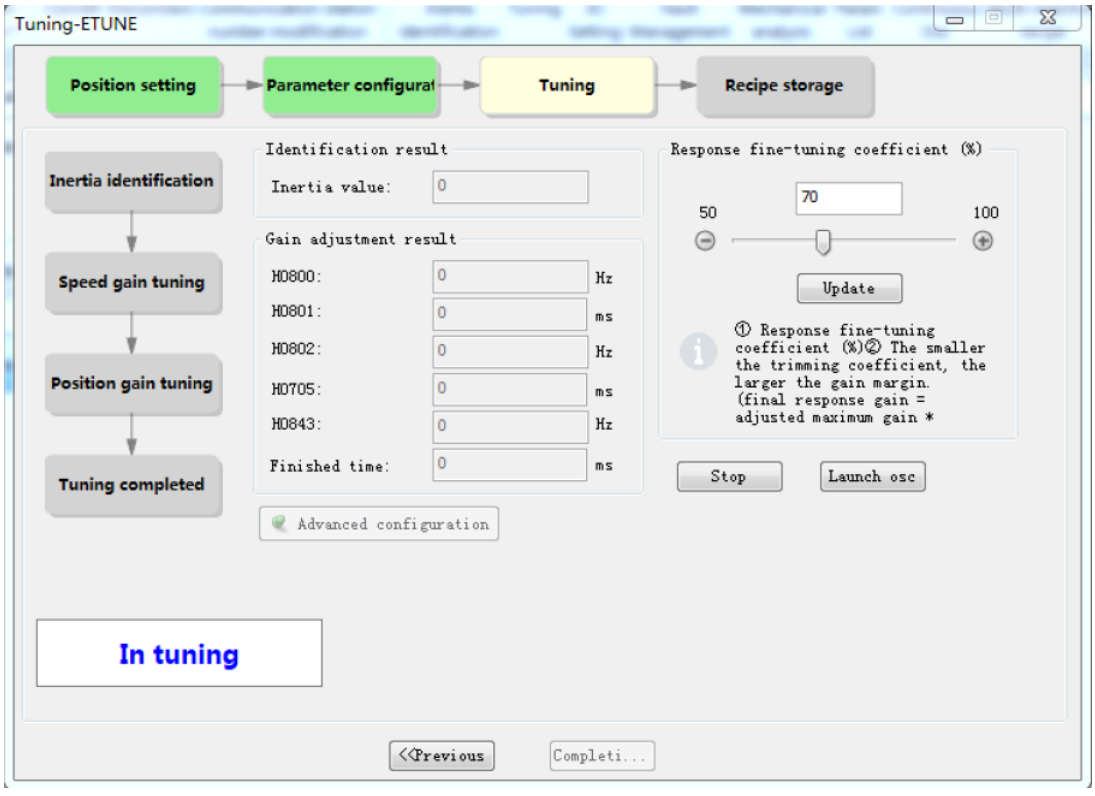
   The adjustment mode is divided into Positioning mode and Track mode.

   Auto-tuning of the inertia ratio is optional. If you choose not to perform inertia auto-tuning, set the correct inertia ratio (the inertia ratio can be modified directly). You can adjust the response level and position filter time constant based on the required responsiveness and the position reference noise generated during operation. Then, configure the motion profile by setting the maximum speed, acceleration/deceleration time, and interval time for auto-tuning.

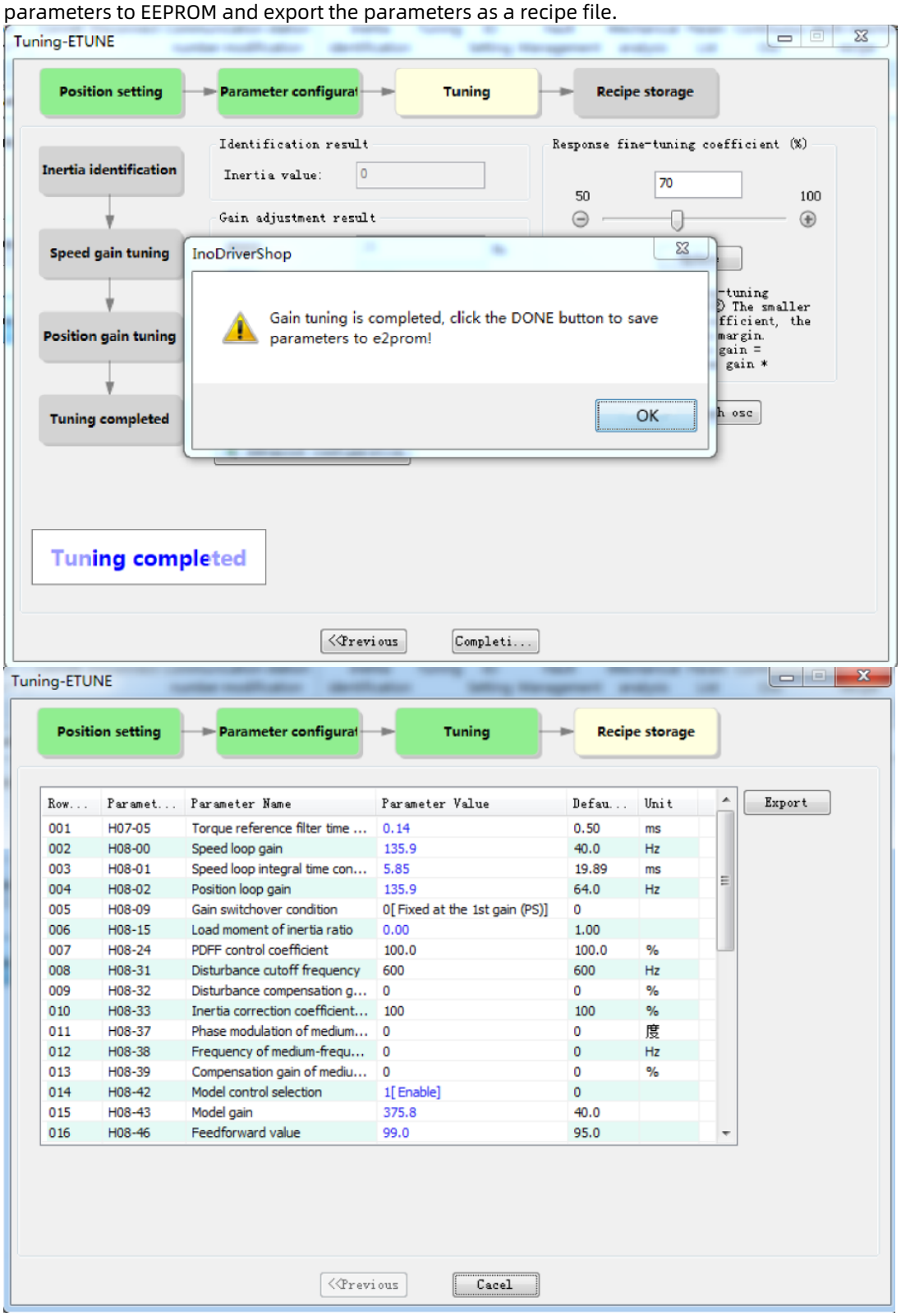


5. Click **Next** to start auto-tuning.

- If you choose to perform inertia auto-tuning, the drive starts inertia auto-tuning based on the set motion profile. After inertia auto-tuning is completed, the drive starts automatic gain tuning.
- If you choose not to perform inertia auto-tuning on the start page, the drive starts automatic gain tuning directly after startup.



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



Precautions

- 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 accelerated 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 lead screw transmission, shorten the travel distance if the tuning duration is too long.
- Set the response mode to "High" for high-stiffness devices or scenarios with high response requirements. Set the response mode to "Medium" for medium-stiffness devices or scenarios with medium response requirements. Set the response mode to "Low" for low-stiffness devices.
- If the fault is reported due to resonance during tuning, perform tuning again after switching to a lower response level.

Solutions to common faults

Fault	Cause	Solution
E662.0: ETune failure	Check whether resonance that occurred during ETune operation cannot be suppressed.	• Manually set the notch when vibration cannot be automatically suppressed. • Modify the electronic gear ratio to improve the command resolution, or increase the command filter time constant in the parameter configuration interface. • Increase the value of H09.11 as appropriate. • Check whether the current of the machine fluctuates periodically. • Check whether the positioning threshold is too low. Increase the reference acceleration/deceleration time.
E600.0: Inertia auto-tuning failure	• Continuous vibration occurs during auto-tuning. • The auto-tuned values fluctuate greatly. • Mechanical couplings of the load are loose or eccentric. • An alarm occurs during auto-tuning and causes interruption. • The vibration cannot be suppressed if the load carries a large inertia. In this case, increase the acceleration/deceleration time to ensure that the motor current is unsaturated. • The position tracking performance is inadequate, which is usually caused by the situation that the maximum motor speed is lower than the speed set by inertia auto-tuning, leading to position tracking error.	• Rectify the fault and perform inertia auto-tuning again. • For vibration that cannot be suppressed, enable vibration suppression. • Make sure that mechanical couplings are connected securely. • Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation. • Make sure that the speed setpoint is lower than the maximum motor speed.

9.5 Manual Gain Tuning

9.5.1 Technical Data

When automatic gain tuning cannot fulfill the requirements, perform manual gain tuning to achieve better result.

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

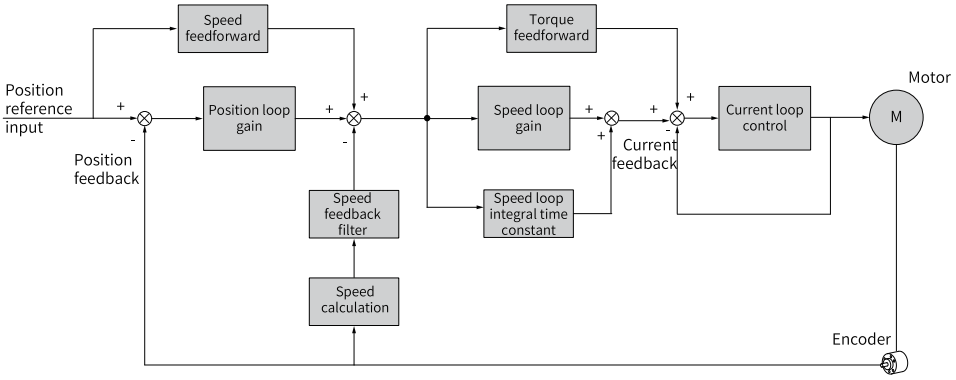


Figure 9-7 Basic control for manual gain tuning

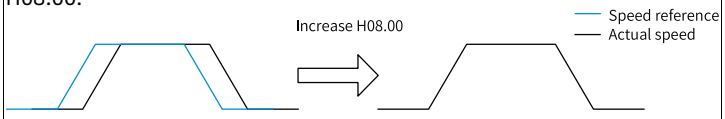
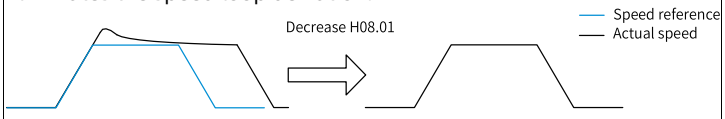
Caution

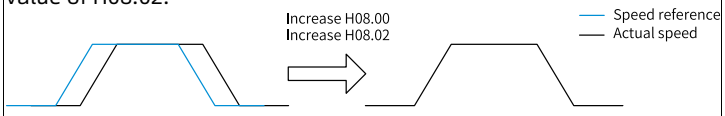
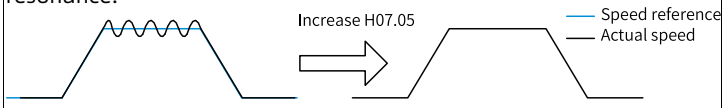
The response level of the inner loop must be higher than that of the outer loop. If it is not observed, the system may be unstable.

The current loop gain has been set with the highest level of responsiveness by default, avoiding the need for adjustment. However, the default current loop gain may not be appropriate when you match it against a third-party motor. In this case, automatic gain tuning of the current loop is required. You only need to adjust the position loop gain, speed loop gain, and other auxiliary gains. For gain tuning in 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 9–5 Gain tunning parameters

Step	Parameter	Parameter 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 inertia ratio) is correctly set, the maximum frequency that can be followed by the speed loop is the setpoint of H08.00.  Note: • Increasing the setpoint without incurring extra noise or vibration shortens the positioning time, stabilizes the speed, and improves the follow-up behavior. • If noise occurs, decrease the setpoint. • If mechanical vibration occurs, enable mechanical resonance suppression. For details, see *"Vibration Suppression" on page 247*.
2	H08.01	Speed loop integral time constant	Function: Eliminates the speed loop deviation.  Note: Set H08.01 according to the following formula: 500 ≤ H08.00 x H08.01 ≤ 1000 For example, if H08.00 is set to 40.0 Hz, the setpoint of H08.01 must meet the following requirement: 12.50 ms ≤ H08.01 ≤ 25.00 ms Decreasing the setpoint strengthens the integral action and shortens the positioning time, but an excessively low setpoint may easily lead to mechanical vibration. An excessively high setpoint prevents the speed loop deviation from being cleared. When H08.01 is set to 512.00 ms, the integral is invalid.

Step	Parameter	Parameter name	Description
3	H08.02	Position loop gain	Function: It sets the position reference maximum frequency followed by the position loop. The maximum follow-up frequency of the position loop equals the value of H08.02.  Note: To ensure system stability, the maximum follow-up frequency of the speed loop must be 3 to 5 times higher than that of the position loop. $3 \leqslant \frac{2 \times \pi \times H08.00}{H08.02} \leqslant 5$ For example, when H08.00 is set to 40.0 Hz, the position loop gain must meet the following requirement: 50.2 Hz ≤ H08.02 ≤ 83.7 Hz Adjust the setting based on the positioning time. Increasing the setpoint shortens the positioning time and improves the anti-interference capacity of a motor at standstill. An excessively high setpoint may easily lead to system instability and oscillation.
4	H07.05	Torque reference filter time constant	Function: Eliminates the high-frequency noise and suppresses mechanical resonance.  Note: Ensure the cutoff frequency of the torque reference low-pass filter is 4 times higher than the maximum follow-up frequency of the speed loop, as shown in the following formula: $\frac{1000}{2 \times \pi \times H07.05} \geqslant (H08.00) \times 4$ For example, when H08.00 is set to 40.0 Hz, the setpoint of H07.05 must be lower than or equal to 1.00 ms. If vibration occurs after H08.00 is increased, adjust H07.05 to suppress the vibration. For details, see *" Vibration Suppression" on page 247*. An excessively high setpoint weakens the responsiveness of the current loop. To suppress vibration at stop, increase H08.00 and decrease H07.05. If strong vibration occurs upon stop, decrease the setpoint of H07.05.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"H07_en.05" on page 580
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"H08_en.00" on page 586
H08.01	2008-02h	Speed loop integral time constant	0.15 to 512.00	19.89	ms	Real time	"H08_en.01" on page 587
H08.02	2008-03h	Position loop gain	0.0 to 2000.0	64.0	Hz	Real time	"H08_en.02" on page 587

9.5.2 Gain Switchover

Gain switchover can be triggered by internal and external DI signals. It is active only in position and speed control modes. Gain switchover achieves the following purposes:

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

H08.08 = 0

When H08.08 is set to 0, the 1st gain (H08.00 to H08.02 and 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.

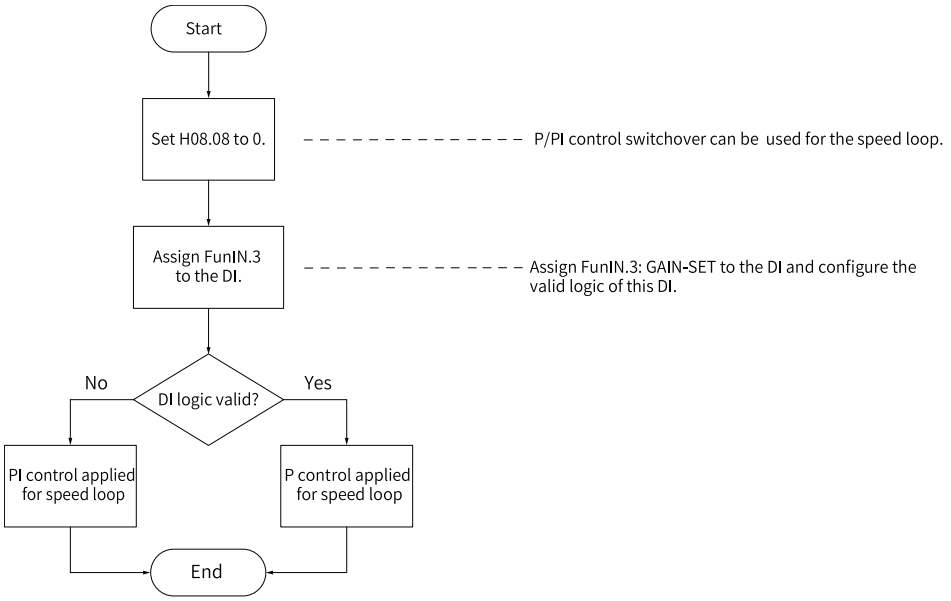


Figure 9-8 Gain switchover flowchart when H08.08 is set to 0

H08.08 = 1

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

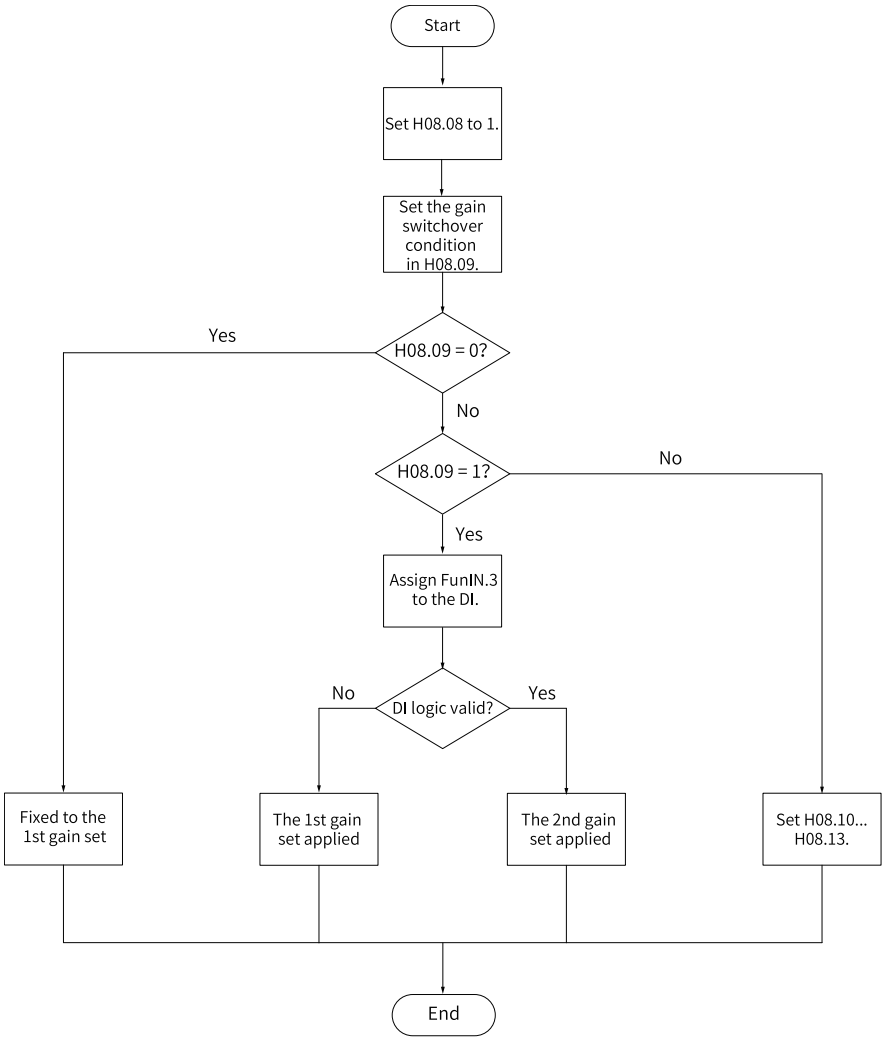
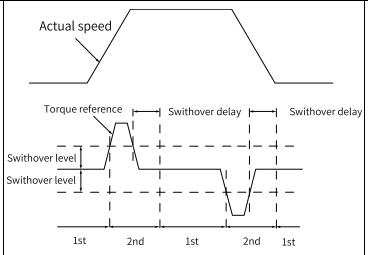
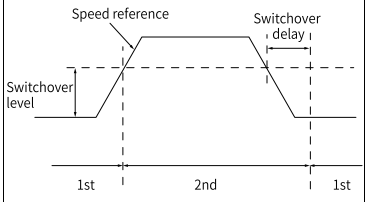
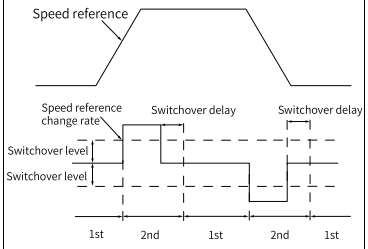
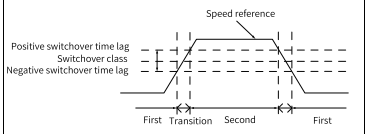
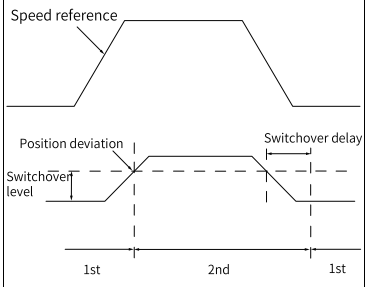
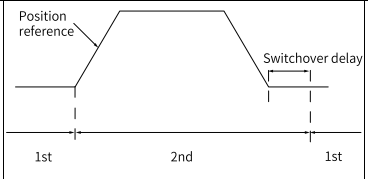
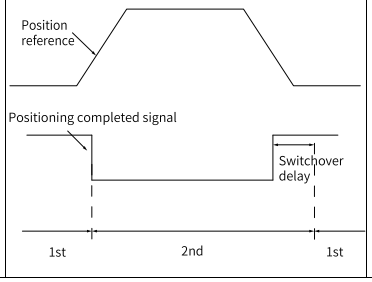


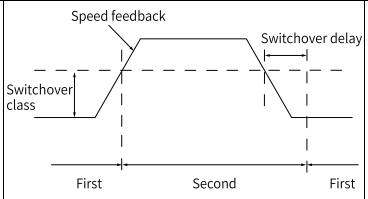
Figure 9-9 Gain switchover flowchart when H08.08 is set to 1

Table 3-8 shows the diagrams and parameters for 11 types of gain switchover conditions. The following table describes the diagrams and related parameters of different conditions.

Table 9–6 Conditions for gain switchover

Gain switchover condition			Related parameter		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	Gain switchover level (H08.11)	Switchover dead time (H08.12)
0	Fixed to the 1st gain set	-	Inactive	Inactive	Inactive
1	Switchover triggered by external DI signal	-	Inactive	Inactive	Inactive

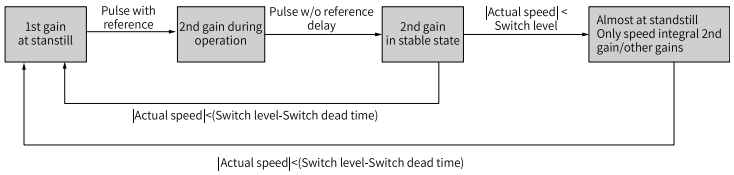
Gain switchover condition			Related parameter		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	Gain switchover level (H08.11)	Switchover dead time (H08.12)
2	Torque reference		Active	Active (%)	Active (%)
3	Speed reference		Active	Active	Active
4	Speed reference change rate		Active	Active (10 rpm/s)	Inactive (10 rpm/s)
5	Speed reference high/low-speed threshold		Inactive	Active (rpm)	Active (rpm)
6	Position deviation		Active	Active (encoder unit)	Active (encoder unit)
7	Position demand value		Active	Inactive	Inactive
8	Positioning uncompleted		Active	Inactive	Inactive

Gain switchover condition			Related parameter		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	Gain switchover level (H08.11)	Switchover dead time (H08.12)
9	Velocity actual value		Active	Active (rpm)	Active (rpm)
10	Position reference + Actual speed	See the following note for details.	Active	Active (rpm)	Active (rpm)

Caution

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

Note



☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.08	2008-09h	2nd gain mode setting	0: Fixed to the 1st gain, switched between P and PI as defined by bit26 of external 60FEh 1: Switched between the 1st and 2nd gain sets as defined by H08.09	1	-	Real time	"H08_en.08" on page 588
H08.09	2008-0Ah	Gain switchover condition	0: Fixed to the 1st gain set (PS) 1: Switched as defined by bit26 of 60FEh 2: Torque reference too large (PS) 3: Speed reference too large (PS) 4: Speed reference change rate too large (PS) 5: Speed reference low/high speed threshold (PS) 6: Position deviation too large (P) 7: Position reference available (P) 8: Positioning unfinished (P) 9: Actual speed (P) 10: Position reference + Actual speed (P)	0	-	Real time	"H08_en.09" on page 588
H08.10	2008-0Bh	Gain switchover delay	0.0 to 1000.0	5.0	ms	Real time	"H08_en.10" on page 589
H08.11	2008-0Ch	Gain switchover level	0 to 20000	50	-	Real time	"H08_en.11" on page 589
H08.12	2008-0Dh	Gain switchover hysteresis	0 to 20000	30	-	Real time	"H08_en.12" on page 590
H08.13	2008-0Eh	Position gain switchover time	0.0 to 1000.0	3.0	ms	Real time	"H08_en.13" on page 590

9.5.3 Position Reference Filter

Name	Function	Applicable scenario	Impact of excessive filtering
Position reference filter	Filters the position references (encoder unit) or multiplied by the electronic gear ratio to smoothen the operation process of the motor and reduce 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.

9.5.4 Feedforward Gain

Speed feedforward is applicable to the position control mode. The speed feedforward function can be used to improve the speed reference responsiveness and reduce the position deviation at a fixed speed.

Speed feedforward

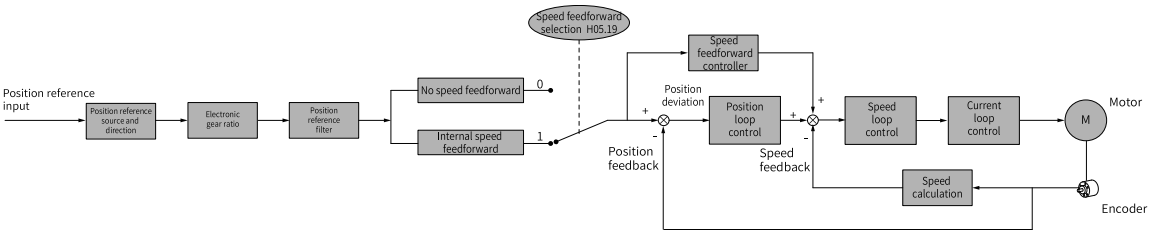


Figure 9-10 Procedure for speed feedforward control

Procedure for speed feedforward:

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

Parameter code	Parameter name	Setpoint	Description
H05.19	Speed feedforward control	0: No speed feedforward	-
		1: Internal speed feedforward	Defines the speed corresponding to the position reference (encoder unit) the speed feedforward signal source.
		2: 60B1h used as speed offset	-
		3: Zero phase control	-

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

   ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.18	2008-13h	Time constant of speed feedforward filter	0.00 to 64.00	0.50	ms	Real time	"H08_en.18" on page 591
H08.19	2008-14h	Speed feedforward gain	0.0 to 100.0	0.0	%	Real time	"H08_en.19" on page 591

Zero phase control

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

The loop calculation model is shown in the following figure.

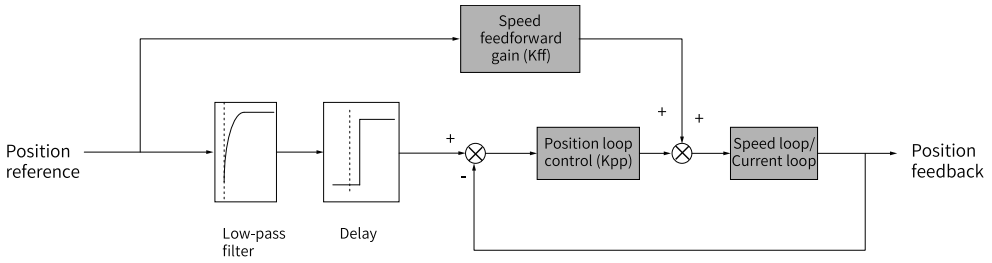


Figure 9-11 Zero phase control

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.04	2005-05h	First-order low-pass filter time constant	0.0 to 6553.5	0.0	ms	At stop	"H05_en.04" on page 554
H05.19	2005-14h	Speed feedforward control	0: No speed feedforward 1: Internal speed feedforward 2: H05.72 3: Zero phase	1	-	At stop	"H05_en.19" on page 555
H08.17	2008-12h	Zero phase delay	0.0 to 4.0	0.0	ms	Real time	"H08_en.17" on page 591

Torque feedforward

In position control mode, torque feedforward can be used to improve torque reference responsiveness and reduce the position deviation during operation at constant acceleration/deceleration rate.

In speed control mode, torque feedforward can be used to improve speed reference responsiveness and reduce the speed deviation during operation at constant speed.

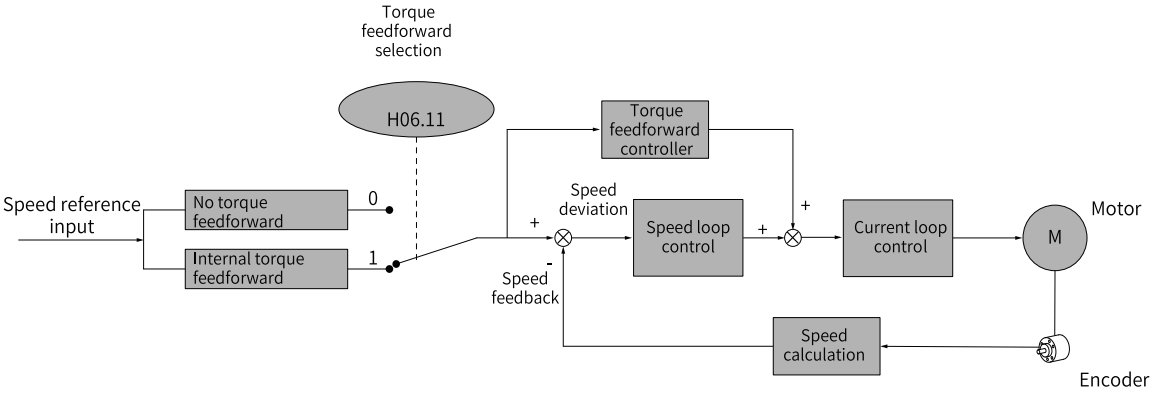


Figure 9-12 Torque feedforward function

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 code	Parameter name	Value range	Description
H06.11	Torque feedforward control	0: No torque feedforward	-
		1: Internal torque feedforward	Use the speed reference as the source of the torque feedforward signal. In position control mode, the speed reference is outputted from the position controller.

2. Set torque feedforward parameters.

Parameter code	Parameter name	Description
H08.20	Torque feedforward filter time constant	Function: • Increasing H08.21 improves responsiveness but may cause speed overshoot during acceleration/deceleration. • Decreasing H08.20 suppresses overshoot during acceleration/deceleration. Increasing H08.20 suppresses the noise. Note: • Set H08.20 to the default value, and then increase H08.21 gradually from 0 to a certain value at which torque feedfoward reaches 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.

9.5.5 PDFF Control

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

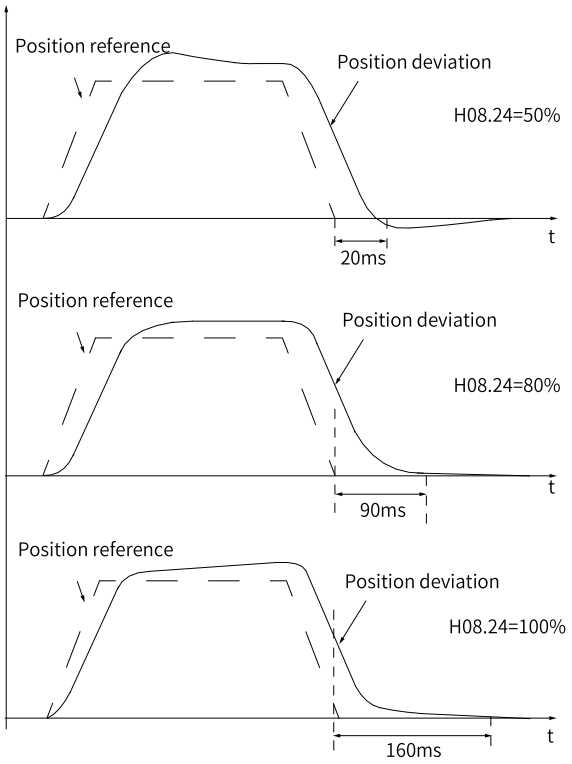


Figure 9-13 Example of PDFF control

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

Parameter	Name	Description
H08.24	PDFF control coefficient	Function: • Defines the control method of the speed loop in the non-torque control modes. Note: • Setting H08.24 to an excessively low value 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.

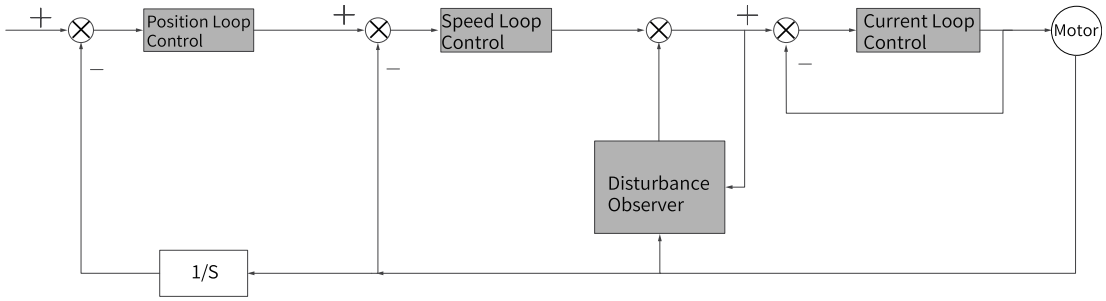
9.5.6 Torque Disturbance Observer

This function is intended to be used in non-torque control modes.

Disturbance observer

The disturbance observer is used to observe external disturbance. You can set different cutoff frequencies and compensation values to observe and suppress the disturbance within the frequency range.

The following figure shows the control block diagram of the disturbance observer.



Note

1/S: Integral term

Parameter code	Parameter name	Description
H08.31	Disturbance cutoff frequency	The higher the cutoff frequency, the more easily will vibration occur.
H08.32	Disturbance compensation gain	Defines the compensation percentage for the observer.
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 acting inertia is the product of the set inertia and H08.33. It is recommended to use the default value of H08.33.

☆Related parameters

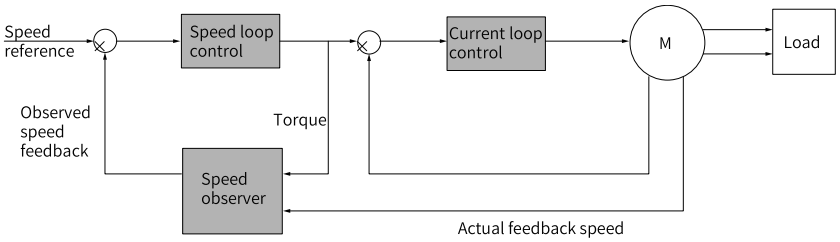
Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.31	2008-20h	Disturbance cutoff frequency	1 to 4000	600	Hz	Real time	"H08_en.31" on page 594
H08.32	2008-21h	Disturbance compensation gain	0 to 100	0	%	Real time	"H08_en.32" on page 594
H08.33	2008-22h	Disturbance observer inertia correction coefficient	1 to 1600	100	%	Real time	"H08_en.33" on page 595

9.5.7 Speed Observer

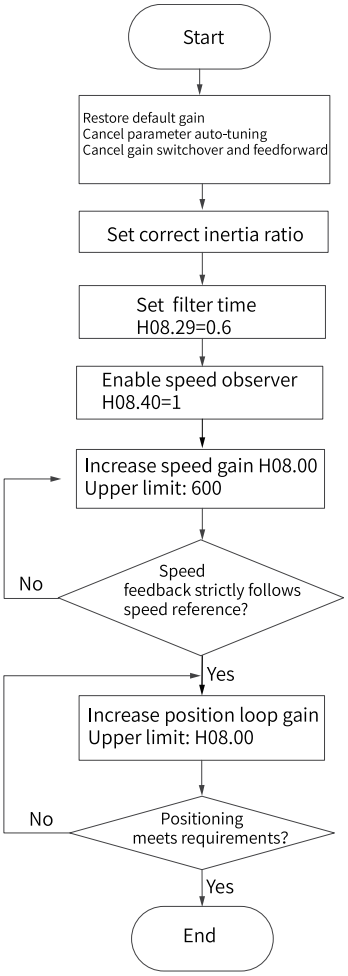
The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.

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

The block diagram for the speed observer is as follows.



Commissioning procedure



Note

- Before using the speed observer, set H08.15 (Load inertia ratio) to a proper value or perform inertia auto-tuning. A wrong inertia ratio can cause vibration.
- Setting H08.27, H08.28, or H08.29 to excessively low or high values can result in motor vibration.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"H08_en.00" on page 586
H08.27	2008-1Ch	Speed observer cutoff frequency	50 to 600	170	Hz	Real time	"H08_en.27" on page 593
H08.28	2008-1Dh	Speed observer inertia correction coefficient	1 to 1600	100	%	Real time	"H08_en.28" on page 594
H08.29	2008-1Eh	Speed observer filter time	0.00 to 10.00	0.80	ms	Real time	"H08_en.29" on page 594
H08.40	2008-29h	Speed observer selection	0: Disable 1: Enable	0	-	Real time	"H08_en.40" on page 596

9.5.8 Model Tracking

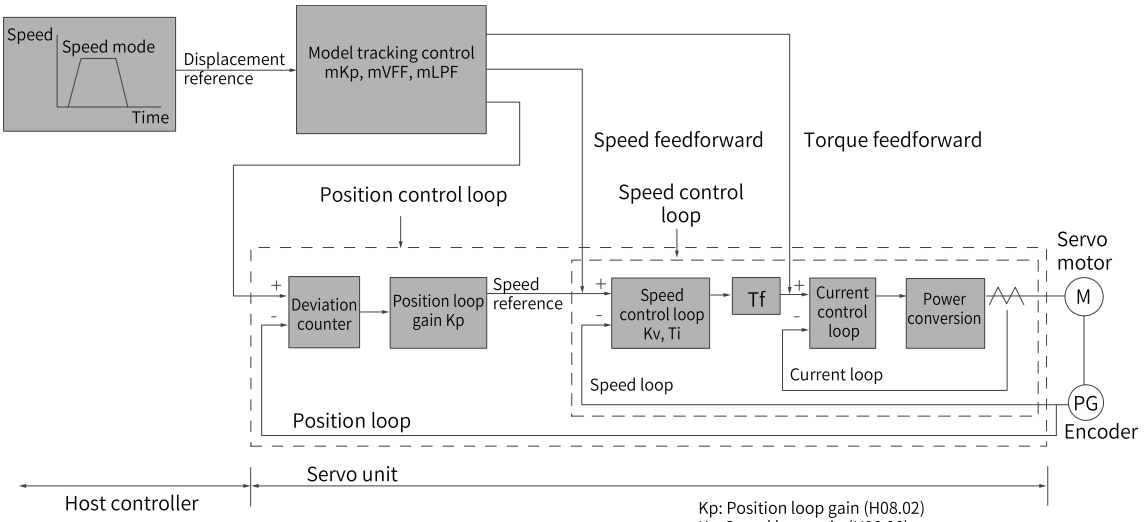
The model tracking control, which is only available in position control mode, can be used to improve responsiveness and shorten the positioning time. It is available only in position control mode.

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

However, manual tuning is needed in the following situations:

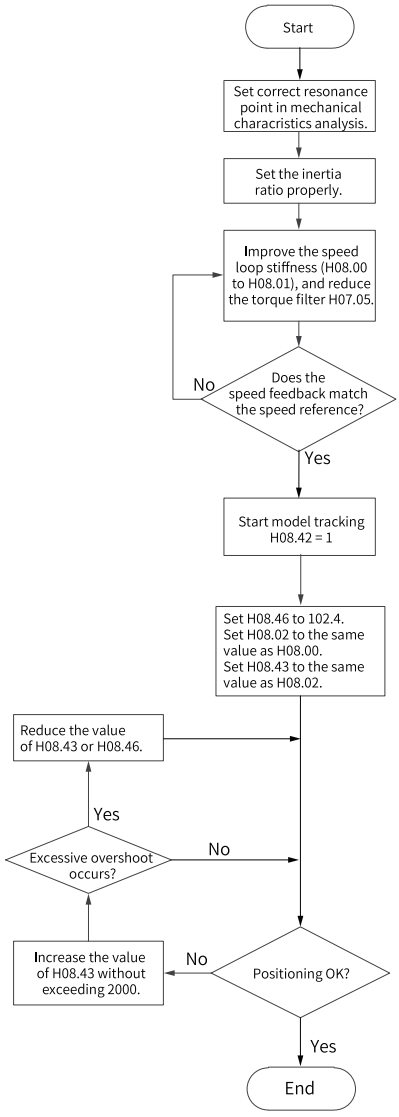
- The auto-tuned values cannot deliver desired performance.
- Improving the responsiveness takes priority over the auto-tuned or customized values.
- User-defined gain parameters or model tracking control parameters are needed.

The block diagram for model tracking control is as follows.



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

Commissioning procedure



Note

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

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"H07_en.05" on page 580
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"H08_en.00" on page 586
H08.01	2008-02h	Speed loop integral time constant	0.15 to 512.00	19.89	ms	Real time	"H08_en.01" on page 587
H08.02	2008-03h	Position loop gain	0.0 to 2000.0	64.0	Hz	Real time	"H08_en.02" on page 587
H08.42	2008-2Bh	Model control selection	0: Disable 1: Enable 2: Reserved 3: New model tracking 4: Model tracking B	0	-	Real time	"H08_en.42" on page 596
H08.43	2008-2Ch	Model gain	0.1 to 2000.0	40.0	-	Real time	"H08_en.43" on page 596
H08.46	2008-2Fh	Feedforward value	0.0 to 102.4	95.0	-	Real time	"H08_en.46" on page 596

9.5.9 Friction Compensation

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

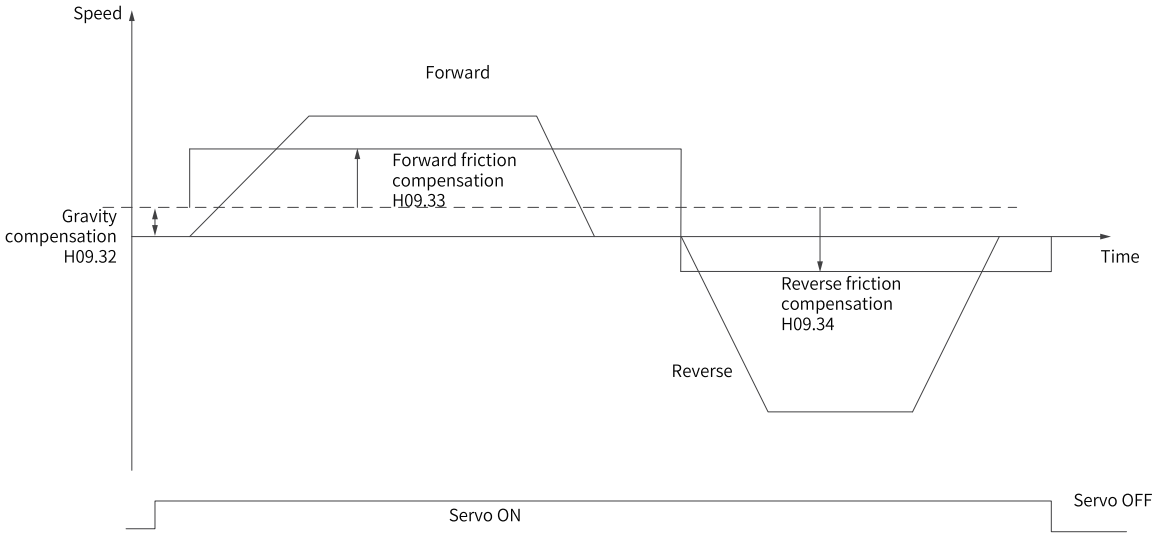
Note

Friction compensation is effective only in the position mode.

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.32	2009-21h	Gravity compensation value	-100.0 to 100.0	0.0	%	Real time	"H09_en.32" on page 607
H09.33	2009-22h	Positive friction compensation value	0.0 to 100.0	0.0	%	Real time	"H09_en.33" on page 608
H09.34	2009-23h	Negative friction compensation value	-100.0 to 0.0	0.0	%	Real time	"H09_en.34" on page 608
H09.35	2009-24h	Friction compensation speed	0.0 to 20.0	2.0	-	Real time	"H09_en.35" on page 608
H09.36	2009-25h	Friction compensation speed	0: Slow mode+Speed reference 1: Slow mode+Model speed 2: Slow mode+Speed feedback 3: Slow mode+Observe speed 16: Quick mode +Speed reference 17: Quick mode +Model speed 18: Quick mode +Speed feedback 19: Quick mode+Observe speed	0x0	-	Real time	"H09_en.36" on page 608

The diagram for friction compensation is as follows.



Note

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.

9.5.10 Motor Cogging Torque Ripple Compensation

The motor cogging torque ripple compensation function is used to compensate for the torque ripple caused by the motor cog, suppressing the speed fluctuation caused by the cogging torque ripple under low control loop gain, ensuring system stability, and reducing the speed fluctuation.

The SV670N-INT series drive supports two applicable scenarios for general-purpose rotary (ROT) motors and direct-drive rotary (DDR) motors[1]:

Note

[1]: DDR refers to a direct drive torque motor.

- **ROT/DDR motors with Inovance absolute encoders**
  In this scenario, compensation data is obtained before the motor is delivered. You do not need to manually obtain the compensation data. You only need to set H06.28 to enable or disable this function.

Parameter code	Communication address	Parameter name	Setpoint	Default value	Unit	Change mode
H06.28	2006 to 1Dh	Cogging torque ripple compensation	0 to 1	1	-	At stop

- **ROT/DDR motors with incremental encoders (Incremental communication encoder with Inovance T5 interpolator and ABZ incremental encoder with TTL signals)**
  In this scenario, you need to perform auto-tuning on motor cogging torque ripples and obtain the compensation table before you can enable the cogging torque ripple compensation function. Angle auto-tuning and homing must be completed before auto-tuning and compensation can take effect. The flowchart is as follows:

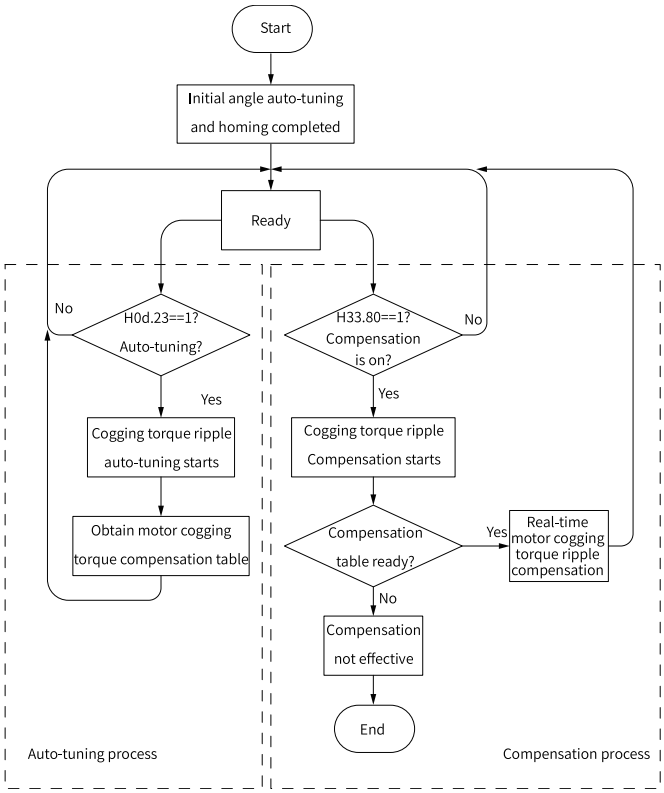


Figure 9-14 Flowchart of ROT/DDR motors with incremental encoder

Parameter code	Communication address	Parameter name	Setpoint	Default value	Unit	Change mode
H33.80	2033 to 51h	Motor cogging torque ripple compensation data storage position	0: Stored in the encoder 1: Stored in the Flash	0	-	At stop
H0d.23	200d-18h	Motor cogging torque ripple auto-tuning	0: Disable 1: Enabled	0	-	At stop

When auto-tuning of motor torque ripple is enabled (H0d.23 = 1), the SV670N-INT drive moves the motor for several revolutions to obtain a torque ripple compensation table.

Note

During this process, you need to ensure that the motor has enough operating range to avoid collision. To avoid external disturbance, it is recommended to perform auto-tuning with the motor disconnected from the load.

After auto-tuning is completed, motor torque ripple compensation is automatically enabled (H06.28 = 1). This function takes effect after the drive is powered off and powered on again and angle auto-tuning and homing are completed. You can manually disable this function (H06.28 = 0) when compensation is not required.

9.6 Parameter Tuning 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.

9.6.1 Parameter Adjustment in Speed Control Mode

Parameter adjustment in speed control mode is the same as that in position control mode, except for the position loop gain (H08.02 and H08.05). For details, see *"9.6.2 Parameter Adjustment in Position Control Mode" on page 245*.

9.6.2 Parameter Adjustment in Position Control Mode

Obtain the value of H08.15 (load inertia ratio) by performing inertia auto-tuning.

Gain Parameters in Position Control Mode:

- 1st gain set:

Parameter code	Parameter name	Description	Default value
H07.05	Torque reference filter time constant 1	Defines the torque reference filter time constant.	0.50 ms
H08.00	Speed loop gain	Defines the speed loop proportional gain.	40.0 Hz
H08.01	Speed loop integral time constant	Defines the integral time constant of the speed loop.	19.89 ms
H08.02	Position loop gain	Defines the position loop proportional gain.	64.0 Hz

- 2nd gain set:

Parameter code	Parameter name	Description	Default value
H07.06	Torque reference filter time constant 2	Defines the torque reference filter time constant.	0.27 ms
H08.03	2nd speed loop gain	Defines the speed loop proportional gain.	75.0 Hz
H08.04	2nd speed loop integral time constant	Defines the integral time constant of the speed loop.	10.61 ms
H08.05	2nd position loop gain	Defines the position loop proportional gain.	120.0 Hz
H08.08	2nd gain mode setting	Defines the mode of the 2nd gain set.	1
H08.09	Gain switchover condition	Used to set the condition for gain switchover.	0
H08.10	Gain switchover delay	Defines the gain switchover delay.	5.0 ms
H08.11	Gain switchover level	Defines the gain switchover level.	50
H08.12	Gain switchover hysteresis	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 set

Parameter code	Parameter name	Description	Default value
H08.18	Time constant of speed feedforward filter	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	Defines the speed feedback filtering function.	0
H08.23	Cutoff frequency of speed feedback low-pass filter	Defines the cutoff frequency of the first-order low-pass filter for speed feedback.	8000 Hz
H08.24	PDFF control coefficient	Defines the coefficient of the PDFF controller.	100.0%
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 suppression 1 at the mechanical end	Defines the frequency of the low-frequency resonance suppression filter.	100.0 Hz
H09.39	Low-frequency resonance suppression 1 at the mechanical end	Defines the setting of low-frequency resonance suppression filter.	2

Perform automatic gain tuning to obtain the initial values of the 1st or 2nd gain set and the common gain set.

Manually fine-tune the following gains.

Parameter code	Parameter name	Description	Default value
H07.05	Torque reference filter time constant 1	Defines the torque reference filter time constant.	0.50 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
H08.19	Speed feedforward gain	Defines the speed feedforward gain.	0.0%

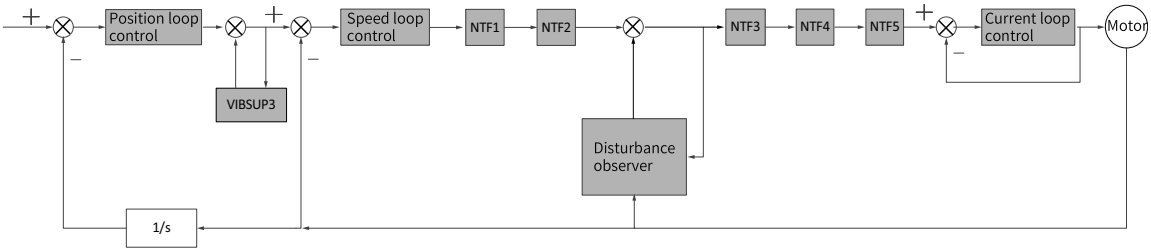
9.6.3 Parameter Adjustment in Torque Control Mode

Parameter adjustment in torque control mode vary with the following conditions:

- If the actual speed reaches the upper speed limit, the adjustment method is the same as that described in *"9.6.1 Parameter Adjustment in Speed Control Mode" on page 245*.
- If the actual speed does not reach the upper speed limit, the adjustment method is the same as that described in *"9.6.1 Parameter Adjustment in Speed Control Mode" on page 245*, except for the position and speed loop gain and speed loop integral time constant.

9.7 Vibration Suppression

The block diagram of vibration suppression is as follows:



Where:

- NTF1–5: 1st notch to 5th notch
- VIBSUP3: Suppression of medium- and low-frequency vibration
- 1/s: integral element

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.53	2008-36h	Medium- and low-frequency jitter suppression frequency 3	0.0 to 300.0	0.0	Hz	Real time	*"H08_en.53" on page 597*
H08.54	2008-37h	Medium- and low-frequency jitter suppression compensation 3	0 to 200	0	%	Real time	*"H08_en.54" on page 597*
H08.56	2008-39h	Medium- and low-frequency jitter suppression phase modulation 3	0 to 600	100	%	Real time	*"H08_en.56" on page 598*

Note

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

9.7.1 Mechanical Resonance Suppression

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

Mechanical resonance can be suppressed in the following two methods:

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

To suppress the mechanical resonance, set the filter time constant to enable the torque reference to be attenuated in the frequency range above the cutoff frequency.

Filter cutoff frequency fc (Hz) = 1/[2π x H07.05 (ms) x 0.001]

Notch

The notch reduces the gain at certain frequencies to suppress mechanical resonance. After the vibration is suppressed by the notch, you can continue to increase the gain. The following figure shows how the notch works.

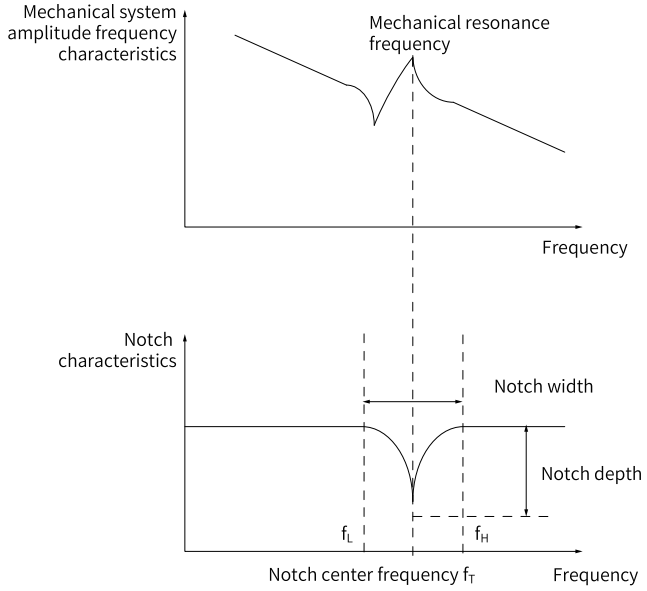


Figure 9-15 How the notch works

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

Table 9–7 Description of notch parameters

Item	Manual notch			Manual/Adaptive Notch	
	1st Notch	2nd Notch	5th Notch	3rd Notch	4th Notch
Frequency	H09.12	H09.15	H09.41	H09.18	H09.21
Width level	H09.13	H09.16	H09.42	H09.19	H09.22
Depth level	H09.14	H09.17	H09.43	H09.20	H09.23

Note

- When the frequency is 8000 Hz (default), the notch is inactive.
- The adaptive notch is preferred for resonance suppression. The manual notch can be used in cases where the adaptive notch cannot deliver desired performance.

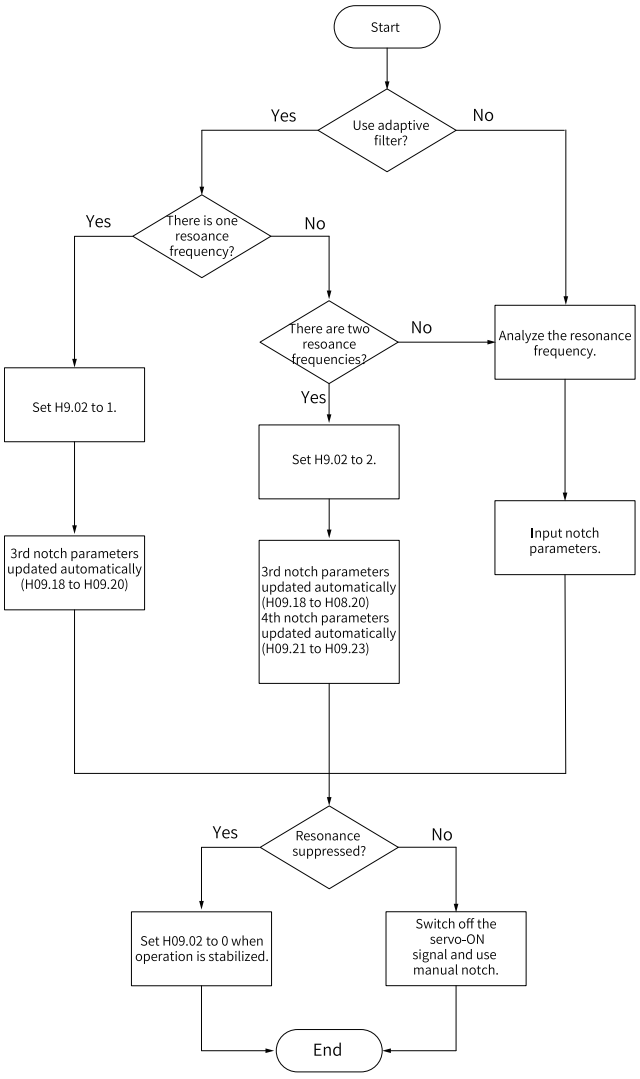


Figure 9-16 Using the notch

- Procedure for setting the adaptive notch:

  1. Set H09.02 (Adaptive notch mode selection) to 1 or 2 based on the number of resonance frequencies.
  2. When resonance occurs, set H09.02 to 1 first to enable one adaptive notch. If new resonance occurs after gain adjustment, set H09.02 to 2 to enable two adaptive notches.
  3. Parameters of the 3rd or 4th notches are updated automatically during operation, and parameter values are saved automatically to the corresponding parameters in group H09 every 30 minutes.

4. If resonance is suppressed, the adaptive notch works. After the servo drive runs stably for a period of time, set H09.02 to 0 and the parameters of the adaptive notch are fixed to the last updated values.

   This is to prevent notch parameters from being updated to wrong values due to misoperation. Wrong values will intensify resonance.
5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.
6. If more than two resonance frequencies exist, the problem cannot be solved only by using the adaptive notches. In this case, add a manual notch. Additionally use the manual notch, or use all the four notches as manual ones (H09.02 = 0).

Note

- When adaptive notch is applied, if the S-OFF signal is activated within 30 min, the notch parameters will not be saved to the corresponding parameter
- 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 same value as the actual resonance frequency obtained in the following ways: The resonance frequency can be obtained by using the following methods:
     - Use the "Mechanical characteristic analysis" function in the Inovance software tool.
     - Calculate the resonance frequency based on the motor phase current displayed on the oscilloscope interface of the software tool.
     - Set H09.02 to 3. During operation, the drive automatically detects the resonance frequency and stores it in H09.24.
  3. Input the resonance frequency obtained in step 1 to the parameter of the selected notch, and input the width level and depth level of this notch.
  4. If resonance has been suppressed, it indicates the notch functions well and you can continue adjusting the gain. If resonance occurs again, repeat steps 1 and 2.
  5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.

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

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

  Where:

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

  $f_H - f_L$ is the notch width, that is, the frequency bandwidth with an amplitude attenuation rate of -3 dB relative to the notch central frequency.

  The following figure shows the correspondence. Use the default value 2 in normal cases.

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

When the depth level is 0, the input is completely suppressed at the center frequency. When the depth level is 99, the input can be fully passed at the center frequency. Therefore, a lower depth level indicates a higher notch depth and a stronger suppression effect. Note that an excessively low depth level may lead to system oscillation.

Note

If the amplitude frequency characteristic curve obtained through the mechanical analysis function does not have obvious peak, it indicates that vibration occurs actually. Such vibration may not be mechanical resonance, and cannot be suppressed by the notch. It occurs because the gain reaches the limit, and can be suppressed only by reducing the gain or the filter time of torque reference.

The following figure shows the frequency characteristics of the notch.

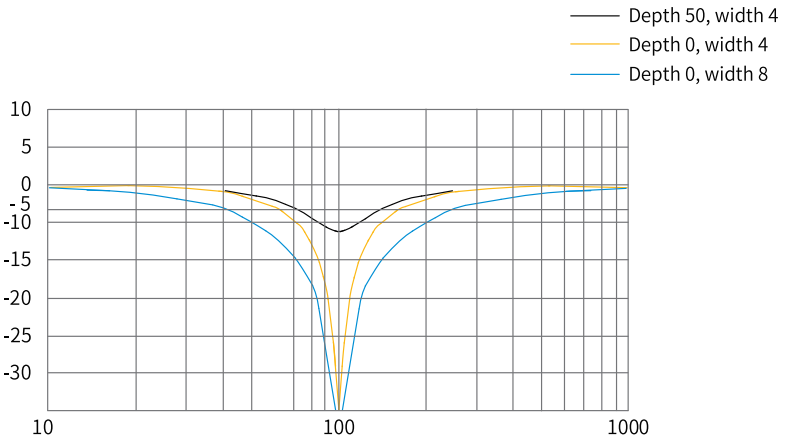


Figure 9-17 Notch frequency characteristics

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.02	2009-03h	Adaptive notch mode	0: Adaptive notch no longer updated 1: One adaptive notch activated (3rd notch) 2: Two adaptive notches activated (3rd and 4th notches) 3: Resonance point tested only (displayed in H09.24) 4: Adaptive notch cleared, values of 3rd and 4th notches restored to default	0	-	Real time	"H09_en.02" on page 602
H09.12	2009-0Dh	Frequency of the 1st notch	50 to 8000	8000	Hz	Real time	"H09_en.12" on page 604
H09.13	2009-0Eh	Width level of the 1st notch	0 to 20	2	-	Real time	"H09_en.13" on page 604
H09.14	2009-0Fh	Depth level of the 1st notch	0 to 99	0	-	Real time	"H09_en.14" on page 605

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.15	2009-10h	Frequency of the 2nd notch	50 to 8000	8000	Hz	Real time	"H09_en.15" on page 605
H09.16	2009-11h	Width level of the 2nd notch	0 to 20	2	-	Real time	"H09_en.16" on page 605
H09.17	2009-12h	Depth level of the 2nd notch	0 to 99	0	-	Real time	"H09_en.17" on page 605
H09.18	2009-13h	Frequency of the 3rd notch	50 to 8000	8000	Hz	Real time	"H09_en.18" on page 606
H09.19	2009-14h	Width level of the 3rd notch	0 to 20	2	-	Real time	"H09_en.19" on page 606
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	0	-	Real time	"H09_en.20" on page 606
H09.21	2009-16h	Frequency of the 4th notch	50 to 8000	8000	Hz	Real time	"H09_en.21" on page 606
H09.22	2009-17h	Width level of the 4th notch	0 to 20	2	-	Real time	"H09_en.22" on page 607
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	0	-	Real time	"H09_en.23" on page 607
H09.24	2009-19h	Auto-tuned resonance frequency	0 to 5000	0	Hz	Unchangeable	"H09_en.24" on page 607
H09.41	2009-2Ah	Frequency of the 5th notch	50 to 8000	8000	Hz	Real time	"H09_en.41" on page 610
H09.42	2009-2Bh	Width level of the 5th notch	0 to 20	2	-	Real time	"H09_en.42" on page 610
H09.43	2009-2Ch	Depth level of the 5th notch	0 to 99	0	-	Real time	"H09_en.43" on page 610

9.7.2 Low-Frequency Resonance Suppression at the Mechanical End

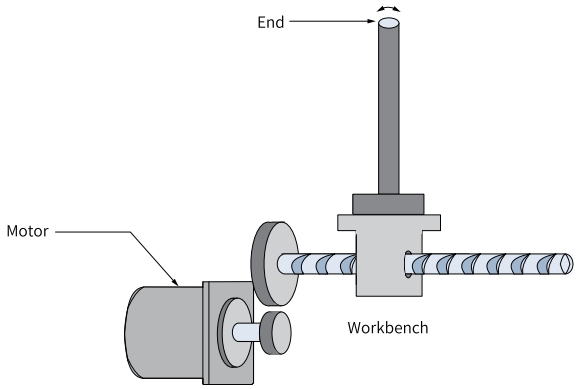


Figure 9-18 Low-frequency vibration at the mechanical end

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 lower than the mechanical resonance frequency mentioned in *"9.7.1 Mechanical Resonance Suppression" on page 248*. The low-frequency resonance suppression function can reduce such vibration.

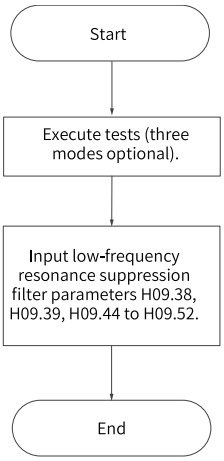


Figure 9-19 Procedure for setting low-frequency resonance suppression filter

First, use the oscilloscope function in the software tool to collect the position deviation waveform of the motor in the positioning 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 resonance suppression effect after using the low-frequency resonance suppression filter.

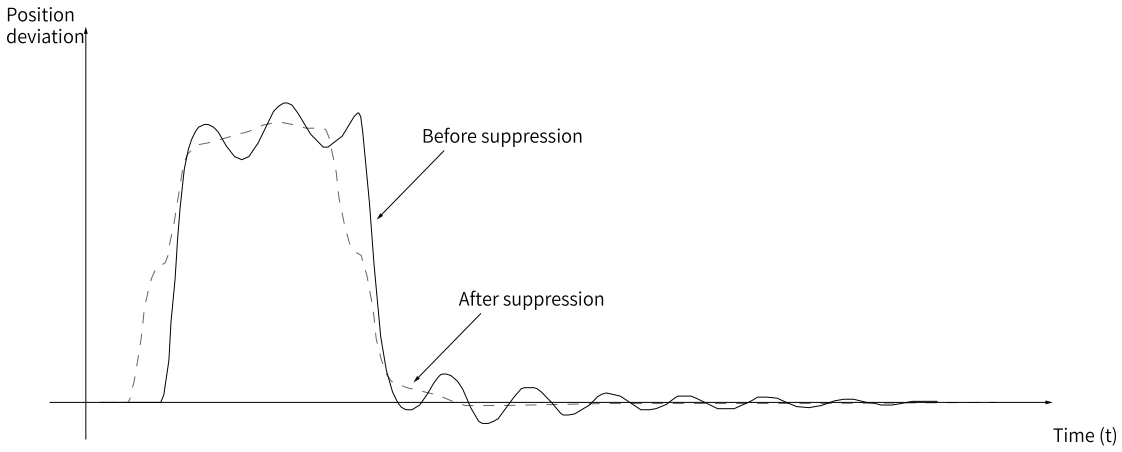


Figure 9-20 Low-frequency resonance suppression effect

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.38	2009-27h	Frequency of low-frequency resonance suppression 1 at the mechanical end	1.0 to 100.0	100.0	Hz	At stop	"H09_en.38" on page 609
H09.39	2009-28h	Low-frequency resonance suppression 1 at the mechanical end	0 to 3	2	-	At stop	"H09_en.39" on page 609
H09.44	2009-2Dh	Frequency of low-frequency resonance suppression 2 at mechanical load end	0.0 to 200.0	0.0	-	At stop	"H09_en.44" on page 610
H09.45	2009-2Eh	Responsiveness of low-frequency resonance suppression 2 at mechanical load end	0.01 to 10.00	1.00	-	At stop	"H09_en.45" on page 611
H09.47	2009-30h	Width of low-frequency resonance suppression 2 at mechanical load end	0.00 to 2.00	1.00	-	At stop	"H09_en.47" on page 611

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.49	2009-32h	Frequency of low-frequency resonance suppression 3 at mechanical load end	0.0 to 200.0	0.0	-	At stop	"H09_en.49" on page 611
H09.50	2009-33h	Responsiveness of low-frequency resonance suppression 3 at mechanical load end	0.01 to 10.00	1.00	-	At stop	"H09_en.50" on page 611
H09.52	2009-35h	Width of low-frequency resonance suppression 3 at mechanical load end	0.00 to 2.00	1.00	-	At stop	"H09_en.52" on page 612

9.8 Mechanical Characteristic Analysis

Overview

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

Steps

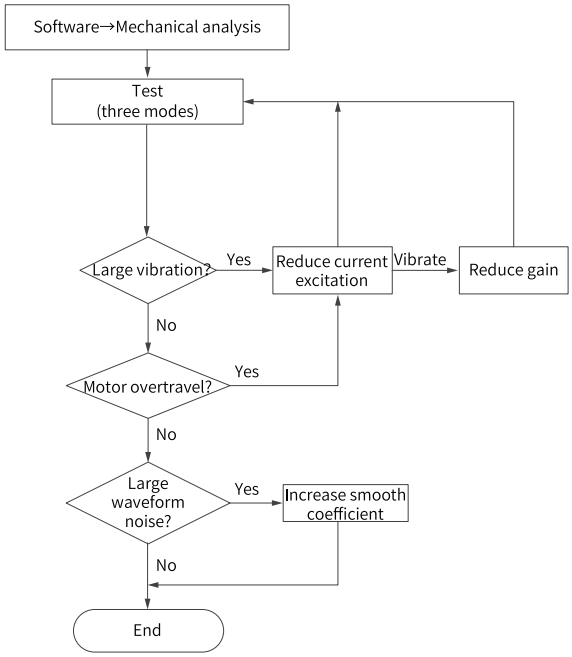


Figure 9-21 Operating procedure for mechanical characteristic analysis

Note

- To avoid large vibration during the test, set the current excitation to 10% during initial execution.
- The analysis waveform may be distorted if the current excitation is too low.
- 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.
- After setting the notch, the waveform under mechanical characteristic test mode is the same with that before the setting, but the speed closed loop and speed open loop modes will be attenuated.

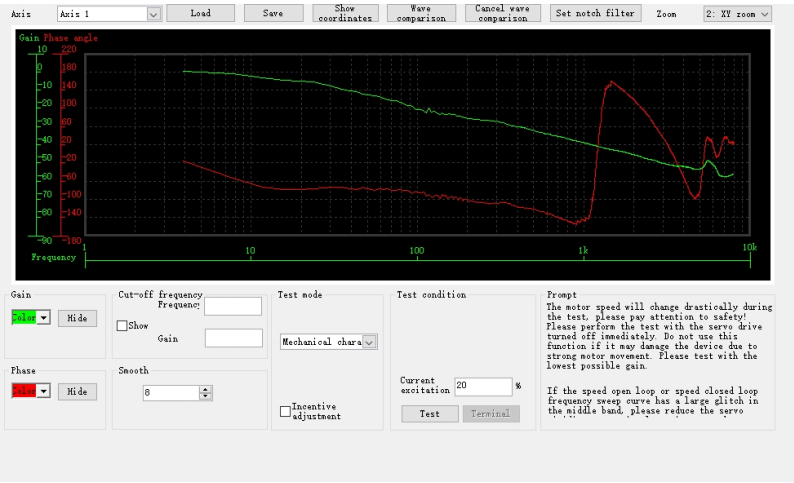


Figure 9-22 Example of the waveform obtained

An example of the waveform obtained with the mechanical characteristic analysis is shown in *"Figure 9-22 Example of the waveform obtained" on page 256*.

9.9 High-performance Tuning

Overview

High-performance tuning is an upgrade function of mechanical characteristic analysis. In addition to analyzing mechanical resonance frequencies and system bandwidth, it can also simulate the effect of adding filters and tuning parameters on loop control. Up to 8 kHz response characteristic analysis is available and measurement and simulation of mechanical characteristics, current loops, and frequency-domain characteristics of speed/position control (open-loop and closed-loop) are supported.

Note

- Before frequency domain measurement, you need to set H02.00 to the corresponding speed mode or position mode. Other modes may trigger an abnormal servo state alarm.
- During the measurement, do not disconnect the drive from the software, otherwise the measurement process will be interrupted.

Procedure

1. **Generate a measurement curve**

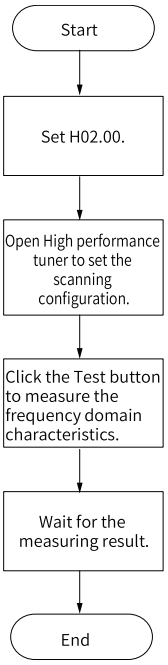


Figure 9-23 Process for generating a measurement curve

a. In the **Work Space** section, select **High performance tuner** and click **Sweep configuration**.

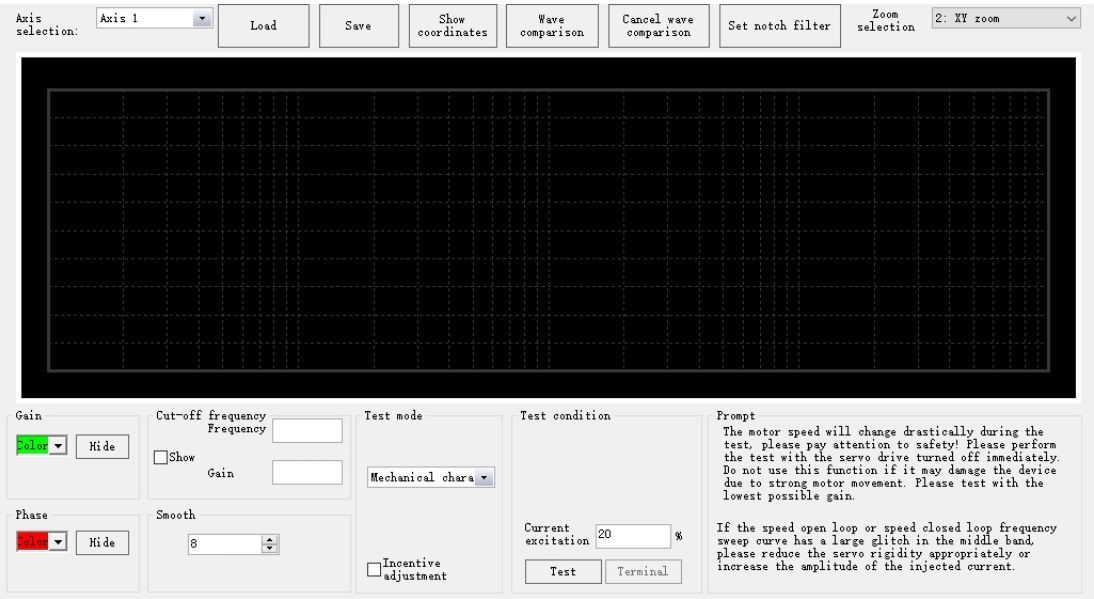


Figure 9-24 Sweep configuration

☆Related parameters:

Parameter code	Parameter name	Unit
H09.71	Low starting frequency	Hz
H09.72	End frequency	Hz
H09.73	Low-frequency points	-
H09.74	Excitation amplitude	%
H09.75	High starting frequency	Hz
H09.76	High frequency points	-

b. After the sweep completes, the frequency-domain characteristics are generated. In the following figure, the red and orange curves indicate the measured values and the green and brown curves indicate the simulation values.

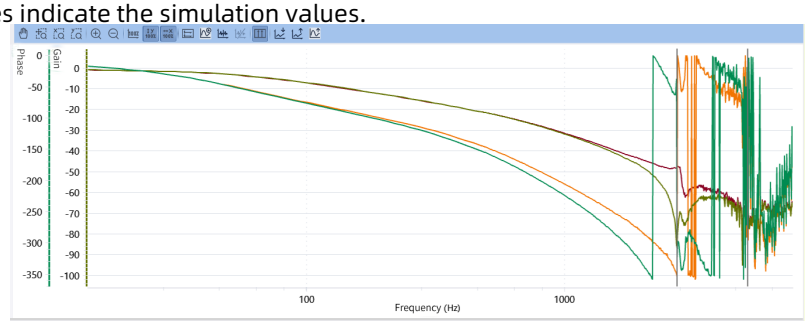


Figure 9-25 Frequency-domain curves (red and orange curves: measured values, green and brown curves: simulation values)

Note

- To avoid large vibration during the test, set the current excitation to 10% during initial execution.
- The analysis waveform may be distorted if the current excitation is too low.
- If vibration is present during the test, and cannot be eliminated by reducing current excitation, possible causes and measures are:
  - 1) The gain is too high. Reduce the speed gain or set the notch based on the auto-tuned resonance point.
  - 2) The set inertia ratio is too high. Rectify the setting.

2. **Tune loop control**

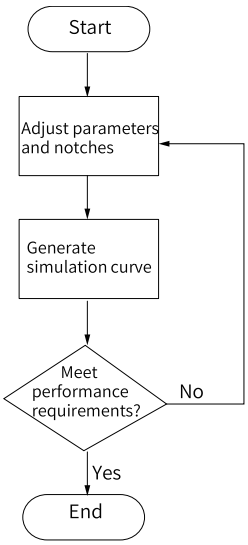


Figure 9-26 Process of loop tuning

After you tune the parameter settings and four notches, a simulation curve is generated, which reflects the effect of parameter tuning on the system.

☆Related parameters:

Parameter code	Parameter name	Type
H08.00	Speed loop gain	Gain
H08.01	Speed loop integral time	Gain
H08.02	Position loop gain	Gain
H08.05	Inertia ratio	Gain
H07.05	Torque reference filter	Filter
H09.77 to H09.81	Biquad filter	Filter
H09.12 to H09.23	Notch	Filter

Note

Notch filter 1 becomes a notch only when it is not enabled. It can be configured as first-order low-pass, second-order low-pass, lead-lag, or custom biquad filter.

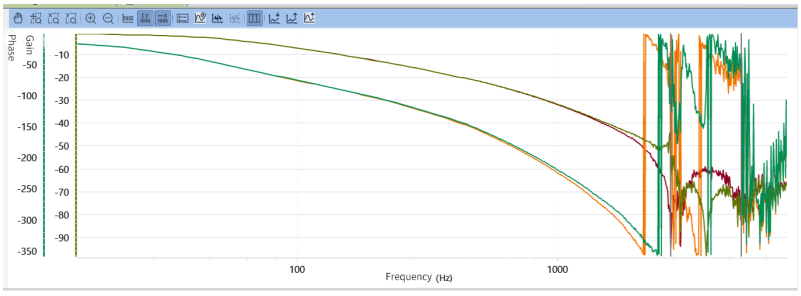


Figure 9-27 Comparison between the simulation curve of notch 2 and the measurement curve

10 Function Description

Functions of the servo drive are listed below. See details in corresponding chapters.

Function		Description	References
Model specifications		Supports servo motors and third-party motors supported by SV670-INT series drives.	-
Second encoder		Supports ABZ incremental encoders with TTL signals.	-
High-resolution encoder		The servo drive is equipped with a high-performance encoder with resolution up to 2^{23} (8388608) PPR.	-
AI, AO		Supports AI and AO.	-
External regenerative resistor		Used in case of insufficient braking capacity of the built-in braking resistor.	*SV670N-INT Series Servo Drive Hardware Guide*
Electronic gear ratio		Input pulse can be reduced or amplified: 0.001–4000 × Encoder ÷ 10000.	-
Status display		Used to display the drive status through the 5-bit 8-segment LED on the keypad.	-
External I/O display		Used to display ON/OFF status of external I/O signals.	-
Inertia auto-tuning	Offline	The servo drive automatically calculates the load inertia ratio through inertia auto-tuning.	-
	Online	The host controller sends a command to make the motor rotate, and the servo drive calculates the load inertia ratio in real time.	-
Automatic gain tuning	Supports two auto-tuning modes: STune and ETune.	The servo drive generates a group of gain parameters based on the correct inertia ratio.	-

Function		Description	References
Manual gain tuning	Basic gains	If the auto-tuned gain values fail to deliver desired performance, fine-tune the gains manually to improve the performance.	-
	Gain switchover	Used to apply different gains for different status (operating or stop) of the motor. Gains can also be switched by external terminals during operation.	-
	Reference filter	Smoothens the position, speed, and torque references.	-
	Feedforward gain	The feedforward function is enabled to improve the following performance.	-
	PDFF Control	Adjusts the speed loop control mode to improve the anti-interference capability at low frequency range.	-
	Torque disturbance observer	Improves the resistance against torque disturbance.	-
	Speed observer	The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.	-
	Model tracking	The model tracking function can be used to improve responsiveness and shorten the positioning time. It is available only in position control mode.	-
	Friction compensation	Friction compensation uses different positive/negative compensation values according to the direction of operation. It is valid only in position control mode.	-
	Motor tooth space torque ripple compensation	Reduces speed fluctuations while ensuring system stability.	-
Parameter adjustment in different control modes	Parameter adjustment in speed control/torque mode	-	-
Vibration suppression	Mechanical resonance suppression	Notches are used to suppress the mechanical resonance that may be generated when the response speed is excessively high.	-
	Low-frequency resonance suppression at the mechanical end	Activate the filter used to suppress low-frequency resonance.	-
Mechanical characteristic analysis		Used to analyze the resonance frequency and characteristics of the mechanical system through a PC installed with Inovance software tool.	-
High-performance tuning		High-performance tuning is an upgrade function of mechanical characteristic analysis. In addition to analyzing mechanical resonance frequencies and system bandwidth, it can also simulate the effect of adding filters and tuning parameters on loop control.	-
Profile position (PP) mode		The host controller sets parameters through the bus, and the servo drive generates position references and performs positioning control.	-
Profile velocity (PV) mode		The host controller sets parameters through the bus, and the servo drive generates speed references and performs speed control.	-

Function	Description	References
Profile torque (PT) mode	The host controller sets parameters through the bus, and the servo drive generates torque references and performs torque control.	-
Homing mode (HM)	The host controller selects the homing mode through parameters, and the servo drive performs homing automatically with the position feedback set to the preset value.	-
Process segment mode	By setting the process segment mode, the servo drive can perform positioning control, constant speed control, and parameter writing according to the planning instructions of the servo itself and the process segment setting instructions.	-
Position control mode	Used to make the servo drive operate in the position control mode. **Note: N-type models support only the multi-position function.**	-
Speed control mode	Used to make the servo drive operate in the speed control mode.	-
Torque control mode	Used to make the servo drive operate in the torque control mode.	-
Cyclic synchronous position (CSP) mode	The host controller generates position references and sends the references cyclically through the bus. The servo drive performs positioning control.	-
Cyclic synchronous velocity (CSV) mode	The host controller generates speed references and sends the references cyclically through the bus. The servo drive performs speed control.	-
Cyclic synchronous torque (CST) mode	The host controller generates torque references and sends the references cyclically through the bus. The servo drive performs torque control.	-
Position reference filter	Used to achieve smooth acceleration and deceleration.	-
Interrupt positioning	Used to interrupt present position reference and execute the set displacement.	-
Frequency-division output function	Used to output the position reference pulses or the position pulses fed back by the encoder in the form of phase A/phase B quadrature pulses.	-
Homing	Used to search for the mechanical home automatically to locate the relative position between the mechanical home and mechanical zero	-
Zero clamp	Used to keep the motor speed below a certain value in the speed control mode to lock the position.	-
DI signal assignment	Used to assign functions such as S-ON to corresponding pins.	-
Forced DO	Used to output signals not related to the drive status forcibly or used to check the wiring of output signals.	-
Touch probe	The touch probe function is the same as the position latch function.	-
Black box	The black box function is used to capture and save the data generated upon occurrence of faults or under designated conditions.	-

Function	Description	References
SEMI F47 voltage drop	With combination of this function and H0A.84 (instantaneous power outage holding time), the drive can continue to run when the power supply voltage decreases.	-
Position comparison output	Used to output a DO signal with designated pulse width after the drive reaches the preset target position.	-
STO function	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents the machine from unexpected startup.	-

11 Basic Functions of the Servo Drive

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

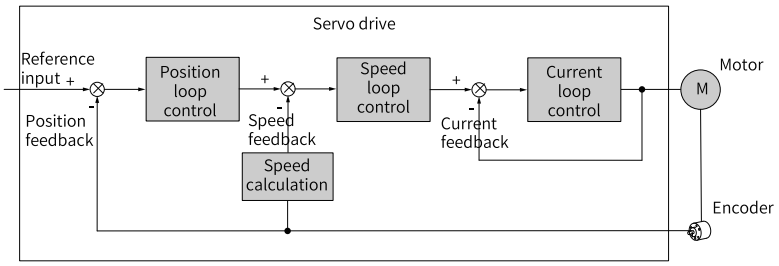


Figure 11-1 Structure of a basic servo system

As the control core of the servo system, the servo drive performs accurate position, speed, torque, or hybrid control on the servo motor by processing the input signals and feedback signals. Position control is the most important mode of a servo system.

Descriptions of the control modes are as follows:

- Position control mode
  Position control is used to control the position of a motor by sending position references. In position control mode, the target position of a motor is determined by the sum of position references, and the motor speed is determined by the position reference frequency. The servo drive performs quick and accurate position and speed control through the encoder installed on the motor or an external encoder (full closed-loop control). The position control mode mainly applies to scenarios that require positioning control, such as manipulators, surface mounted technology (SMT) machines, engraving and milling machines (pulse train references), and computer numerical control (CNC) machine tools.
- Speed Control Mode
  Speed control In speed control mode, the servo drive performs quick and accurate speed control through the speed reference sent through communication. The speed control mode mainly applies to scenarios that require speed control or where a host controller is used for position control or the commands sent from the host controller are used as the speed references for the servo drive, such as the engraving and milling machines.
- Torque control mode
  In torque control mode, the motor current is in linear relation with the torque. Therefore, torque control is implemented through current control. The servo drive controls the motor output torque based on torque references. The torque reference can be set through communication. This control mode is mainly applicable to winding and unwinding devices with strict tension requirements. In these scenarios, the torque always changes with the winding radius so that the tension will not change along with the change of the winding radius.

11.1 Setting and Display of Operation Modes

Introduction to servo operation modes

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 875
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 875

Communication synchronization cycle supported by each mode

The SV670N-INT series servo drive supports a minimum synchronization cycle of 250 μs and a maximum synchronization cycle of 20 ms.

11.2 Conversion Factors

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

The gear ratio is comprised of the numerator 6091.01h and the denominator 6091.02h. It determines the proportional relation between the load shaft displacement (reference unit) and the motor displacement (encoder unit), as shown below.

Motor displacement = Load shaft displacement x Gear ratio

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

The calculation formula is as follows.

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

☆Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6091.01h	6091-01h	Motor resolution	1 to 4294967295	1	-	At stop	"6091_en.01h" on page 884
6091.02h	6091-02h	Shaft resolution	1 to 4294967295	1	-	At stop	"6091_en.02h" on page 885

Take the load ball screw as an example:

Minimum reference unit f_c = 1 mm

Lead P_B = 10 mm/r

Reduction ratio n = 5:1

Inovance 23-bit serial encoder resolution P = 8388608 (p/r)

The position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor revolution P x n}}{P_B} = \frac{8388608 \times 5}{10} = \frac{41943040}{10} = 4194304$$

Therefore, 6091.01h = 4194304; 6091.02h = 1. That means when the load shaft displacement is 1 mm, the motor displacement is 4194304.

Reduce the values of 6091.01h and 6091.02h to a point where there is no common divisor, and take the final value.

11.3 Servo Drive States

Abide by the process stipulated in the CiA402 protocol when operating the servo drive. Otherwise, the servo drive cannot run in the specified state.

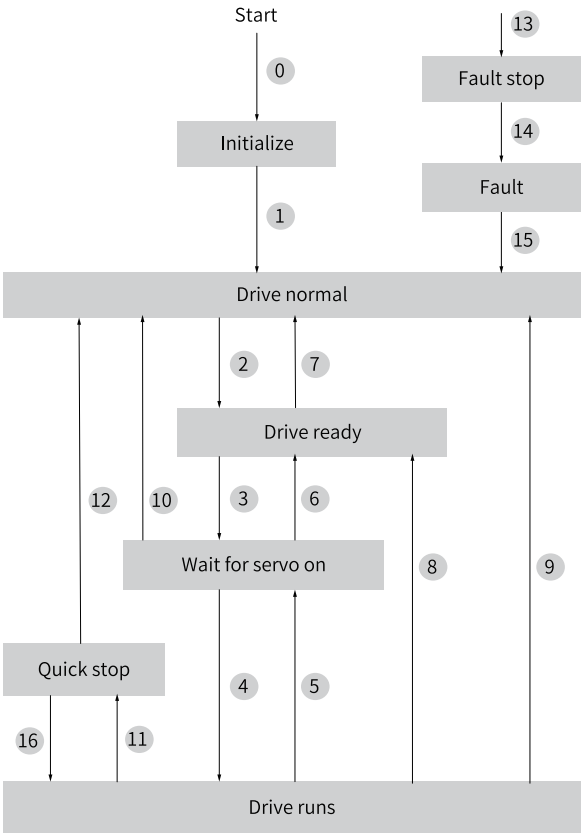


Figure 11-2 Switchover of CiA402 state machine

The following table describes different states.

Initialization	Initialization of the servo drive and internal self-inspection are completed. Parameters cannot be set and the driving function cannot be executed.
No fault	No fault exists in the servo drive or the fault has been cleared. Parameters can be set.
Ready to switch on	The servo drive is ready to run. Parameters can be set.
Wait for the S-ON signal	The servo drive is waiting for the S-ON signal. Parameters can be set.
Servo operating	The servo drive is operating properly and a certain operation mode has been enabled. The motor is energized and starts rotating when the speed reference value inputted is not 0. Only parameters whose "Setting Condition" is "During running" can be set.
Quick stop	Quick stop is activated and the servo drive is in the process of quick stop. Only parameters whose "Setting Condition" is "During running" can be set.
Stop at fault	A fault occurs and the servo drive is in the process of stop. Only parameters whose "Setting Condition" is "During running" can be set.
Fault	The stop process is done and all the drive functions are disabled. Parameters can be modified for troubleshooting purpose.

The following table describes the control commands and status switchover.

CiA402 state switchover		Control word 6040h	bit0 to bit9 [1] of status word 6041h
0	Power-on → Initialization	Natural transition, control command not required	0x0000
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly enters status 13.	0x0250/0x270
2	No fault → Servo ready	0x0006	0x0231
3	Servo ready → Waiting for the S-ON signal	0x0007	0x0233
4	Waiting for the S-ON signal → Servo running	0x000F	0x0237
5	Servo running → Waiting for the S-ON signal	0x0007	0x0233
6	Waiting for the S-ON signal → Servo ready	0x0006	0x0231
7	Servo ready → No fault	0x0000	0x0250
8	Servo running → Servo ready	0x0006	0x0231
9	Servo running → No fault	0x0000	0x0250
10	Waiting for the S-ON signal → No fault	0x0000	0x0250
11	Servo running → Quick stop	0x0002	0x0217
12	Quick stop → No fault	Quick stop mode 605Ah can be set to 0 to 3. The process is performed automatically and no control command is required.	0x0250
13	No fault → Stop upon fault	If a fault occurs in any status other than "fault", the servo drive automatically switches to the stop-at-fault state, without the need for a control command.	0x021F
14	Stop at fault → Fault	Natural transition applies after stop and no control command is required.	0x0218
15	Fault → No fault	0x80 bit7 is rising edge-triggered. bit7 is maintained at 1, and other control commands are ineffective.	0x0250
16	Quick stop → Servo running	Set 605A to a value between 5 and 7. 0x0F will be sent after stop.	0x0237

Note

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

11.3.1 Control Word 6040h

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Accessibility:	Read/write	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Name		Description
0	Switch on	Switch on	1: Valid; 0: Invalid
1	Enable voltage	Enable voltage	1: Valid; 0: Invalid
2	Quick stop	Quick stop	0: Valid; 1: Invalid
3	Enable operation	Operation enabled	1: Valid; 0: Invalid
4 to 6	Operation mode specific	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault Reset	Fault reset	0: Invalid 0→1: Fault reset is available only for faults and alarms that can be reset. 1: Other control commands are invalid. 1→0: Invalid
8	Halt	Halt	1: Valid; 0: Invalid
9	Operation mode specific	Operation mode specific	Related to the servo drive operation mode.
10	Reserved	Reserve	Not assigned
11 to 15	Manufacturer-specific	Manufacturer-specific	Manufacturer-specific

Note

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

11.3.2 Status Word 6041h

6041h **Status word**

Communication address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Table 11–1 Description of each bit of 6041h

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active, 0: Inactive
1	Switch on	Switch on	1: Active, 0: Inactive
2	Operation enabled	Operation enabled	1: Active, 0: Inactive
3	Fault	Fault	1: Active, 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active, 0: Inactive
7	Warning	Warning	1: Active, 0: Inactive
8	Manufacturer specific	Manufacturer specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive
10	Target reach	Target reach	1: Active, 0: Inactive
11	Internal limit active	Internal limit active	1: Active, 0: Inactive
12 to 13	Operation mode specific	Operation mode specific	Related to the servo drive operation mode.
14	Manufacturer specific	Manufacturer specific	Undefined
15	Home find	Home find	0: Home not found 1: Homing completed

Table 11–2 Descriptions of setpoints of 6041h

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

Note

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

11.4 Process Segment Mode

Set H02.00 (Control mode) to 7 (Position control mode) through the keypad or Inovance software tool to make the drive operate in the process segment mode. The process segment mode is a multi-function position mode integrated with homing, constant speed control, and positioning control.

16 process segments are available, in which process segment 0 is the homing mode and process segments 1 to 15 are defined by users. The interval time and linkage mode among process segments can also be selected as needed. The setting flowchart is as follows.

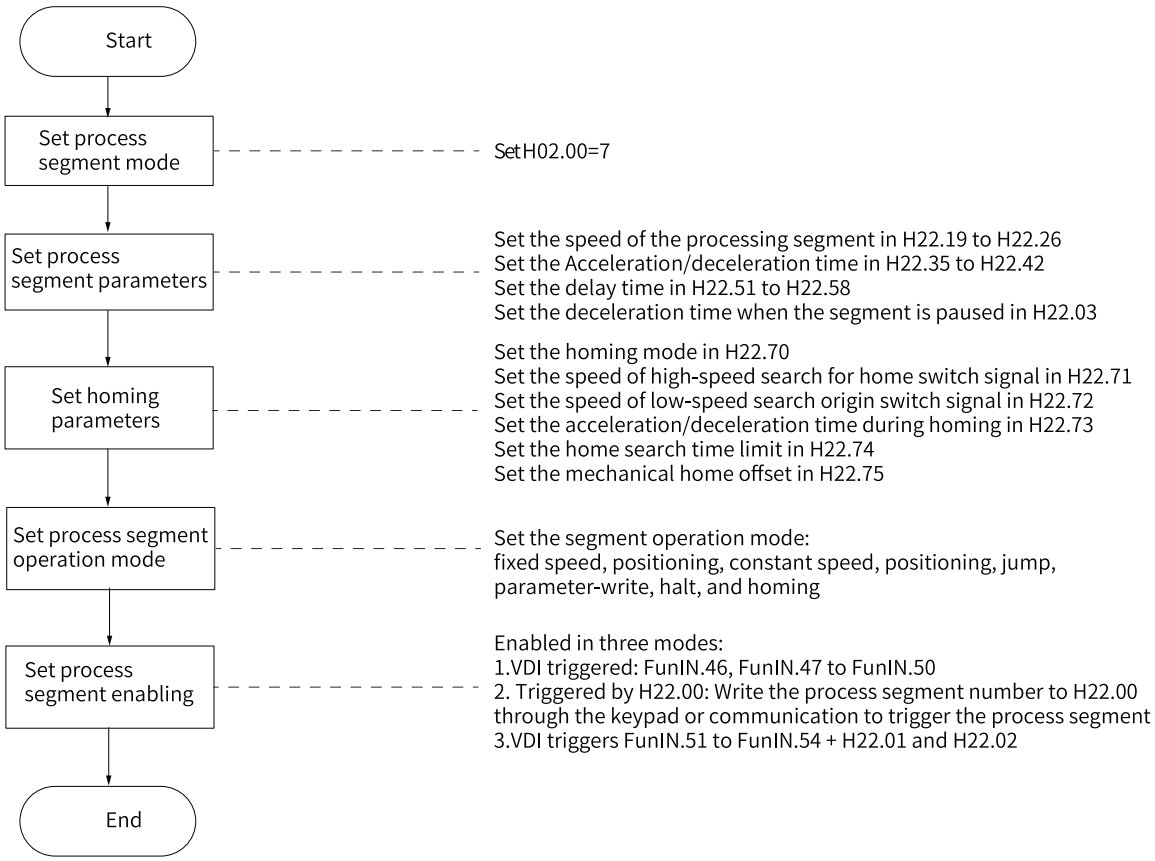


Figure 11-3 Flowchart for setting process segment mode

11.4.1 Mode Triggering

The following table shows how to trigger the process segment mode.

Triggered By	Triggered From	Description
DI triggering	DI: FunIN.46 (PrEnable) + FunIN.47–50 (PrCMD1–4)	Combine FunIN.47–FunIN.50 to form the process segment number to be triggered. Trigger the process segment through the rising edge of FunIN.46.
Parameter	H22.00	Write the process segment number to H22.00 through the keypad or communication to trigger the process segment.
DI + parameter triggering	DI: FunIN.51–54 (PrEvent1–4) + H22.01/ H22.02	Set the process segment number to be triggered through H22.01 and H22.02. H22.01: DI: Triggered by the rising edge of FunIN.51–FunIN.54 H22.02: DI: Triggered by the falling edge of FunIN.51–FunIN.54
Homing	DI: FunIN.32 (HomingStart)	Trigger the process segment through the rising edge of FunIN.32.
	H22.00 = 0	Parameter H22.00 = 0.
	FunIN.46 + FunIN.47–FunIN.50 (combined segment number being 0)	When the process segment is triggered by the rising edge of FunIN.46, the motor executes homing based on the set homing mode and home speed.
Halt	DI: FunIN.55 (PrSuspend)	Trigger the process segment through the rising edge of FunIN.55.
	H22.00 = 1000	When H22.00 is set to 1000, the process segment in progress is stopped immediately and the motor ramps to stop based on the deceleration time defined by H22.03. The motor remains enabled after stop.

When a DI is used to trigger the process segment, assign the DI of the servo drive with corresponding function and set the active logic of this DI.

Note

- PrEnable, PrSuspend, and PrEvent1 to PrEvent4 signals are edge-triggered. When DI is used, the effective signal width of the DI must be at least 0.125 ms.
- In process segment mode, FunIN.32 (HomingStart) is used to trigger the process segment homing mode.
- In position mode, FunIN.32 (HomingStart) is used to trigger the local homing mode.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.00	2022-01h	Process segment command trigger	0 to 1000	0	-	Real time	*"H22_en.00" on page 789*
H22.01	2022-02h	Process segment triggered by the event rising edge	0 to 65535	0	-	Real time	*"H22_en.01" on page 789*

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.02	2022-03h	Process segment triggered by the event falling edge	0 to 65535	0	-	Real time	"H22_en.02" on page 790
H22.03	2022-04h	Acceleration/ Deceleration time upon technology segment pause	0: Acceleration/Deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4 5: Acceleration/Deceleration time 5 6: Acceleration/Deceleration time 6 7: Acceleration/Deceleration time 7	0	-	Real time	"H22_en.03" on page 790

Table 11–3 Description of function No.

Code	Name	Function	Description
FunIN.32	HomingStart	Homing enable	Active: Homing enabled (The HomingStart signal cannot be triggered repeatedly during homing.) Inactive: Homing inhibited
FunIN.46	ProceSon	Process segment enable	The process segment can be enabled only when the rising edge of the ProceSon signal is active. Otherwise, the process segment function is ineffective.
FunIN.47	ProceCmd1	Process segment command switchover 1	The segment number is a 4-bit binary. The relationship between the segment number and ProceCmd1...ProceCmd4 is shown in "Table 11-4" on page 274. The DI logic is level-triggered. The ProceCmd value is 1 upon active level input or 0 upon inactive level input.
FunIN.48	ProceCmd2	Process segment command switchover 2	
FunIN.49	ProceCmd3	Process segment command switchover 3	
FunIN.50	ProceCmd4	Process segment command switchover 4	
FunIN.51	ProceEvTri1	Event trigger process segment 1	The DI assigned with event trigger process segment is used together with H22.01 and H22.02.
FunIN.52	ProceEvTri2	Event trigger process segment 2	
FunIN.53	ProceEvTri3	Event trigger process segment 3	
FunIN.54	ProceEvTri4	Event trigger process segment 4	
FunIN.55	ProceStop	Process segment pause	When the rising edge of the ProceStop signal is active, the process segment in progress stops immediately and the motor ramps to stop based on the deceleration time defined by H22.03. The motor remains enabled after stop.

Table 11–4 Relationship between the segment number and CMD1 to CMD4

ProceCmd4	ProceCmd3	ProceCmd2	ProceCmd1	Segment No.
0	0	0	0	0
0	0	0	1	1
...				
1	1	1	1	15

11.4.2 Related Parameters

The speed setpoint (SpdSet) and acceleration/deceleration time (AccTime/DecTime) for each segment in the process segment, and the interval time (DelayTime) upon completion of each process segment are set by three groups of parameters respectively, with each parameter group containing eight parameters.

During operation, you can select one parameters from these three parameter groups respectively to generate the process segment.

1. Speed setpoint (SpdSet) (0.1 rpm to 6000.0 rpm)
   Corresponding to H22.19 to H22.26 (unit: 0.1 rpm).

2. Acceleration/Deceleration time (AccTime/DecTime) (0 ms to 65535 ms)
   Corresponding to H22.35 to H22.42

   The acceleration/deceleration time indicates the time for a motor to change from 0 rpm to 1000 rpm. The actual acceleration/deceleration time is therefore as follows:

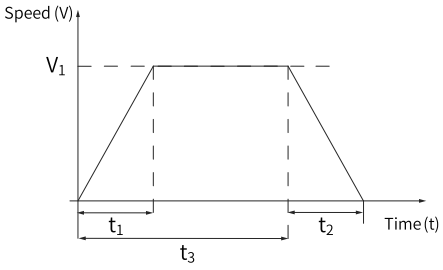


Figure 11-4 Example of the curve in fixed speed mode

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

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

   The actual deceleration time t_2 is:

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

3. Interval time after completion of process segment (DelayTime) (0 ms to 65535 ms)
   Corresponding to H22.51 to H22.58.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.19	2022-14h	Target speed	0.1 to 6000.0	50.0	(mm/s)/ rpm	Real time	"H22_en.19" on page 792
H22.20	2022-15h	Target speed 1	0.1 to 6000.0	200.0	(mm/s)/ rpm	Real time	"H22_en.20" on page 792
H22.21	2022-16h	Target speed 2	0.1 to 6000.0	500.0	(mm/s)/ rpm	Real time	"H22_en.21" on page 793
H22.22	2022-17h	Target speed 3	0.1 to 6000.0	1000.0	(mm/s)/ rpm	Real time	"H22_en.22" on page 793
H22.23	2022-18h	Target speed 4	0.1 to 6000.0	1500.0	(mm/s)/ rpm	Real time	"H22_en.23" on page 793
H22.24	2022-19h	Target speed 5	0.1 to 6000.0	2000.0	(mm/s)/ rpm	Real time	"H22_en.24" on page 793
H22.25	2022-1Ah	Target speed 6	0.1 to 6000.0	2500.0	(mm/s)/ rpm	Real time	"H22_en.25" on page 794
H22.26	2022-1Bh	Target speed 7	0.1 to 6000.0	3000.0	(mm/s)/ rpm	Real time	"H22_en.26" on page 794
H22.35	2022-24h	Acceleration/ deceleration time	0 to 65535	50	ms	Real time	"H22_en.35" on page 794
H22.36	2022-25h	Acceleration/ Deceleration time 1	0 to 65535	200	ms	Real time	"H22_en.36" on page 794
H22.37	2022-26h	Acceleration/ Deceleration time 2	0 to 65535	500	ms	Real time	"H22_en.37" on page 795
H22.38	2022-27h	Acceleration/ Deceleration time 3	0 to 65535	1000	ms	Real time	"H22_en.38" on page 795
H22.39	2022-28h	Acceleration/ Deceleration time 4	0 to 65535	1500	ms	Real time	"H22_en.39" on page 795
H22.40	2022-29h	Acceleration/ Deceleration time 5	0 to 65535	2000	ms	Real time	"H22_en.40" on page 795

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.41	2022-2Ah	Acceleration/ Deceleration time 6	0 to 65535	2500	ms	Real time	"H22_en.41" on page 796
H22.42	2022-2Bh	Acceleration/ Deceleration time 7	0 to 65535	3000	ms	Real time	"H22_en.42" on page 796
H22.51	2022-34h	Delay after completion of the process segment	0 to 65535	0	ms	Real time	"H22_en.51" on page 796
H22.52	2022-35h	Delay time 1 after completion of the process segment	0 to 65535	50	ms	Real time	"H22_en.52" on page 796
H22.53	2022-36h	Delay time 2 after completion of the process segment	0 to 65535	200	ms	Real time	"H22_en.53" on page 797
H22.54	2022-37h	Delay time 3 after completion of the process segment	0 to 65535	500	ms	Real time	"H22_en.54" on page 797
H22.55	2022-38h	Delay time 4 after completion of the process segment	0 to 65535	1000	ms	Real time	"H22_en.55" on page 797
H22.56	2022-39h	Delay time 5 after completion of the process segment	0 to 65535	1500	ms	Real time	"H22_en.56" on page 797
H22.57	2022-3Ah	Delay time 6 after completion of the process segment	0 to 65535	2000	ms	Real time	"H22_en.57" on page 797
H22.58	2022-3Bh	Delay time 7 after completion of the process segment	0 to 65535	3000	ms	Real time	"H22_en.58" on page 798

11.4.3 Operation Mode

The process segment mode supports the homing mode, constant speed mode, and positioning mode. Six operation modes are available, which are homing mode, constant speed mode, positioning mode, jump mode, parameter-write mode, and halt mode.

The homing mode is set in process segment 0 and the halt mode is set in process segment 1000. Other modes are set in process segments 1 to 15.

Each group of process segments is comprised of two parts: process segment definition and process segment data. The process segment parameters are H23.00 to H23.62 (16 groups in total), with each parameter group containing two 32-bit parameters.

Definition of process segment		
Bit	Function	Value
3 to 0	Mode	bit3 to bit0 / Process segment mode / Description of process segment 0001 / Constant speed mode / - 0010 / Positioning mode / Stop after positioning is completed 0011 / Positioning mode / Execute the next segment after positioning is completed 0111 / Jump mode / Jump to the designated process segment 1000 / Parameter-write mode / Write specific parameters
7 to 4	-	-
11–8	-	-
15 to 12	-	-
19 to 16	-	-
23 to 20	-	-
27 to 24	-	-
31 to 28	-	-

Process segment data	
Bit	Value
31 to 0	-

Note

If block 15 is the NC block that is automatically loaded to the last, the first block applies after block 15 is executed.

Homing mode

When process segment 0 is triggered, the homing function is triggered.

In process segment mode, the software homing function cannot be enabled.

See the following table for definitions of the homing mode.

Definition of process segment		
Bit	Function	Value
3 to 0	-	-
7–4	PathNum	0: The motor stops after homing is completed. 1 to 15: After homing is completed, the PathNum segment is executed automatically after the DelayTime elapses.
11 to 8	-	-
15 to 12	-	-
19 to 16	-	-
23 to 20	DelayTime	Index of the interval time after the process segment is executed. Indexes H22.51 to H22.58.
27 to 24	-	-
31 to 28	-	-

Process segment data	
Bit	Value
31 to 0	Process segment data (32-bit) (not in use).

Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.70	2022-47h	Homing mode of process segment	-32768 to 32767	-2	-	Real time	"H22_en.70" on page 798
H22.71	2022-48h	Speed of high-speed search for home switch signal	0 to 3000	100	(mm/s)/RPM	Real time	"H22_en.71" on page 798
H22.72	2022-49h	Speed of low-speed search for home switch signal	0 to 1000	10	(mm/s)/RPM	Real time	"H22_en.72" on page 798
H22.73	2022-4Ah	Acceleration/Deceleration time during homing	0 to 1000	1000	ms	Real time	"H22_en.73" on page 799
H22.74	2022-4Bh	Home search time limit	0 to 65535	10000	ms	Real time	"H22_en.74" on page 799
H22.75	2022-4Ch	Mechanical home offset	-2147483648 to 2147483647	0	Reference unit	Real time	"H22_en.75" on page 799
H22.79	2022-50h	Relative/Absolute homing	0 to 65535	0	-	Real time	"H22_en.79" on page 799

☆ Related parameters

Code	Name	Function	Description
FunOut.16	HomeAttain	Homing is completed.	Active: Homing completed in the process segment mode Inactive: Homing not completed

Constant speed mode

Mode 1 is the constant speed mode. When the constant speed mode is in progress, the motor operates to the set speed based on the set acceleration/deceleration time, and then keeps operating at the set speed.

<table>
<tr><th colspan="3">Definition of process segment</th></tr>
<tr><th>Bit</th><th>Function definition</th><th>Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td>1</td></tr>
<tr><td>7 to 4</td><td>Func</td><td>
<table>
<tr><th>Bit</th><th>Function definition</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See “ Special mode” on page 285Special Modes for details.</td></tr>
<tr><td>5</td><td>Loading next segment (Auto)</td><td>The next process segment applies after the constant speed is reached and the DelayTime elapses.</td></tr>
<tr><td>6</td><td>Unit</td><td>0: 0.1 rpm
1: PPS (pulses/s) (reference unit)</td></tr>
<tr><td>7</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
<tr><td>11-8</td><td>AccTime</td><td rowspan="2">Index of the acceleration/deceleration time.
Indexes H22.35 to H22.42.</td></tr>
<tr><td>15 to 12</td><td>DecTime</td></tr>
<tr><td>19 to 16</td><td>…</td><td>-</td></tr>
<tr><td>23 to 20</td><td>DelayTime</td><td>Index of the interval time after the process segment is executed.
Indexes H22.51 to H22.58.</td></tr>
<tr><td>27 to 24</td><td>-</td><td>-</td></tr>
<tr><td>31 to 28</td><td>-</td><td>-</td></tr>
</table>

Process segment data	
Bit	Value
31 to 0	Target speed (accurate to 0.1 rpm).

Where:

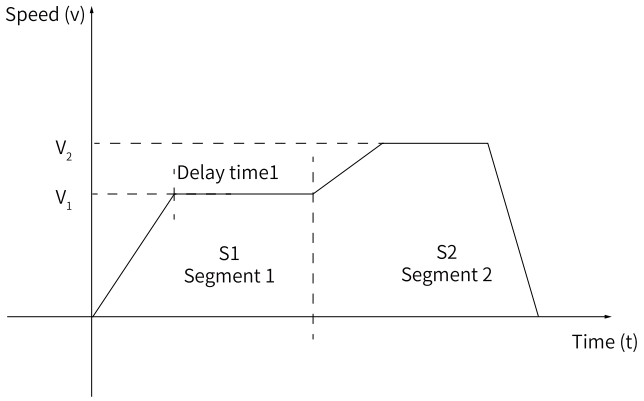


Figure 11-5 Time-Speed curve

Segment 1: Constant speed mode; DelayTime1: Time interval set for the constant speed mode; V_1: Speed set for the constant speed mode.

Segment 2: Positioning mode; V_2: Speed set for the positioning mode.

S1 represents displacement 1 and S2 represents displacement 2.

Positioning mode

Modes 2 and 3 indicate positioning mode. In mode 2, the servo drive stops after positioning is completed. In mode 3, the next segment will be executed after positioning is completed.

When positioning mode is in progress, the motor accelerates or decelerates from the present speed to the set speed based on the set acceleration/deceleration time. After operating at constant speed for a period of time, the motor decelerates to 0 rpm based on the set deceleration time. Finally, the motor stops at the position set by the positioning mode.

<table>
<tr><th colspan="3">Definition of process segment</th></tr>
<tr><th>Bit</th><th>Function definition</th><th>Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td>Positioning mode 2: Stopped after positioning is completed
Position mode 3: Executing the next segment after positioning is completed</td></tr>
<tr><td>7 to 4</td><td>Func</td><td>
<table>
<tr><th>Bit</th><th>Function definition</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See “Special mode” on page 285Special Modes for details.</td></tr>
<tr><td>5</td><td>Overlap (OverLap)</td><td>The present segment can overlap with the next segment. During overlapping, the interval time of present segment is set to 0 forcibly. See “Special mode” on page 285Special Modes for details.</td></tr>
<tr><td>6</td><td rowspan="2">Position reference type (CmdType)</td><td rowspan="2">bit6 and bit7 set to 00: Absolute positioning command (Final position = Target position)
bit6 and bit7 set to 10: Incremental positioning command (Final position = Previous final position + Target position)</td></tr>
<tr><td>7</td></tr>
</table>
</td></tr>
<tr><td>11 to 8</td><td>AccTime</td><td rowspan="2">Index of the acceleration/deceleration time.
Indexes H22.35 to H22.42.</td></tr>
<tr><td>15 to 12</td><td>DecTime</td></tr>
<tr><td>19 to 16</td><td>SpdSet</td><td>Index of the speed setpoint.
Indexes H22.19 to H22.26.</td></tr>
<tr><td>23 to 20</td><td>DelayTime</td><td>Index of the interval time after the process segment is executed.
Indexes H22.51 to H22.58.</td></tr>
<tr><td>27 to 24</td><td>-</td><td>-</td></tr>
<tr><td>31 to 28</td><td>-</td><td>-</td></tr>
</table>

Process segment data	
Bit	Value
31 to 0	Target position (32-bit) (reference unit)

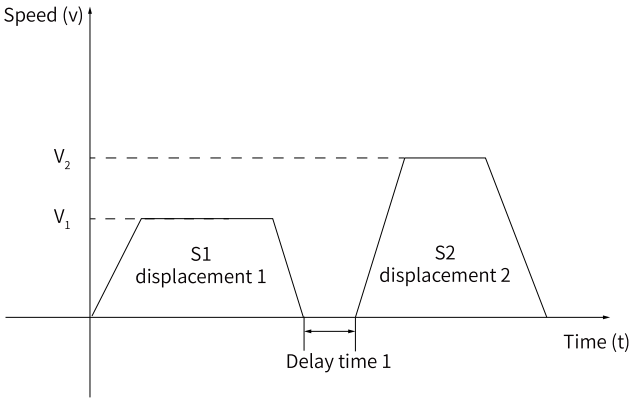


Figure 11-6 Time-speed curve

Segment 1: positioning mode; Mode = 3; OverLap = 0; Delaytime1: interval time set for the positioning mode; V_1: speed set for the positioning mode.

Segment 2: positioning mode; Mode = 2; ImmedUpd = 0; V_2: speed set for the positioning mode.

S1 represents displacement 1 and S2 represents displacement 2.

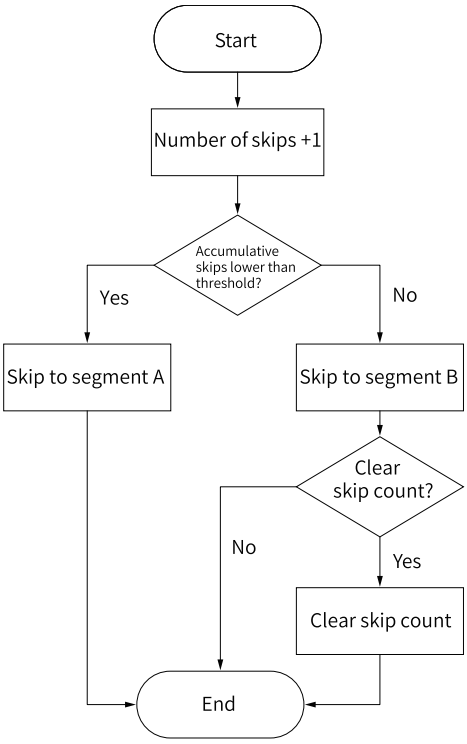
Jump mode

Mode 7 represents the jump mode. When the jump mode is in progress, the servo drive can jump to any process segment. When the target process segment exceeds the process segment range, E126.0 occurs.

Definition of process segment		
Bit	Function definition	Value
3 to 0	Mode	7
4	Updated immediately (ImmedUpd)	The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See *" Special mode" on page 285Special Modes* for details.
8 to 5	Jump threshold	Index of the jump threshold. Indexes H22.83 to H22.90.
9	Flag for clearing the accumulative count value when the motor jumps to process segment B	1: Clear the cumulative number of jumps when the motor jumps to process segment B.
19 to 10	-	-
23 to 20	DelayTime	Index of the interval time after the process segment is executed. Indexes H22.51 to H22.58.
31 to 24	-	-

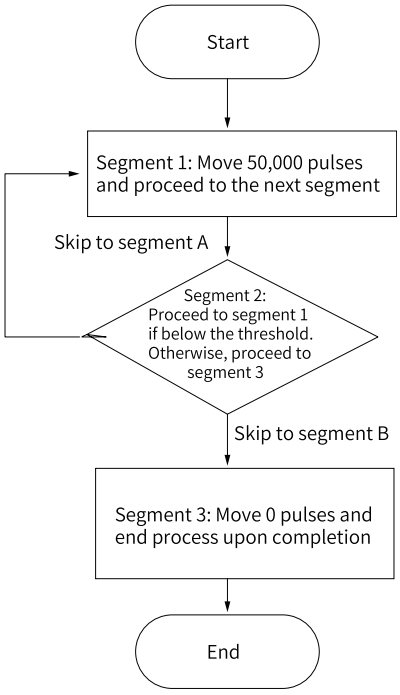
Process segment data	
Bit	Value
7 to 0	Process segment number
15 to 8	Process segment A number
31 to 16	Cumulative number of jumps.

Process segment jumping is subject to the threshold. Each jump is recorded and included in the total number of jumps. When the total number of jumps is lower than the set threshold, the motor jumps to process segment A. If the motor jumps to process segment B and bit9 is set to 1, the total number of jumps is cleared. The total number of jumps starts from 1 at the next jump. The execution flowchart is as follows:

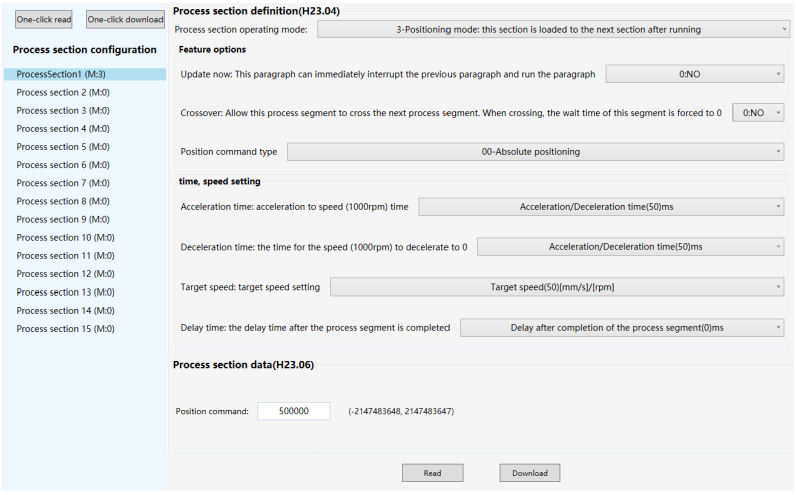


Application cases

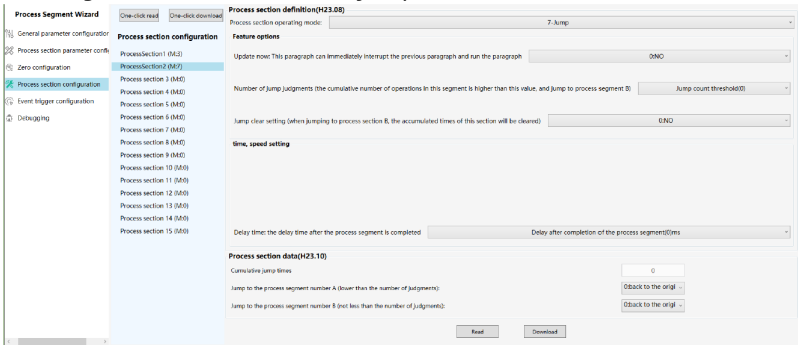
The process segment jump function is used to control repetitive multi-position segment execution.



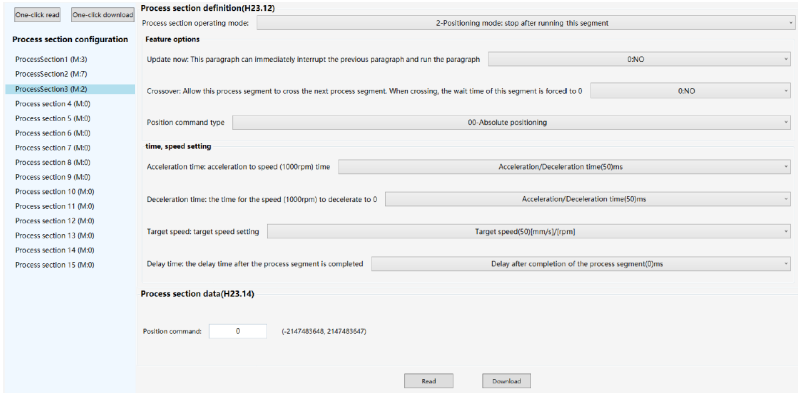
1. Set process segment 1 to the position mode, and set forward operation for 50,000 pulses.



2. Configure process segment 2 and enable the jump function.



3. Set process segment 3 to the positioning mode, and end the operation upon completion.



Parameter-write mode

Mode 8 represents the parameter-write mode. When parameter-write mode is in progress, you can re-write new parameters to the designated parameters and the new parameter can be saved to EEPROM as needed.

<table>
<tr><th colspan="4">Definition of process segment</th></tr>
<tr><th>Bit</th><th>Function definition</th><th colspan="2">Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td colspan="2">8</td></tr>
<tr><td>7 to 4</td><td>Func</td><td colspan="2"><table>
<tr><th>Bit</th><th>Function definition</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See “ Special mode” on page 285Special Modes for details.</td></tr>
<tr><td>5</td><td>Automatically loading next segment (Auto)</td><td>The next process segment applies after the Delaytime elapses.</td></tr>
<tr><td>6</td><td>Save (Save)</td><td>0: Parameters not saved to EEPROM
1: Parameters saved to EEPROM</td></tr>
<tr><td>7</td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td>11 to 8</td><td rowspan="2">Index (H_Idx)</td><td colspan="2" rowspan="2">Parameter number</td></tr>
<tr><td>15 to 12</td></tr>
<tr><td>19 to 16</td><td rowspan="2">Group number (H_Grp)</td><td colspan="2" rowspan="2">Group No.</td></tr>
<tr><td>23 to 20</td></tr>
<tr><td>27 to 24</td><td>DelayTime</td><td colspan="2">Index of the interval time after the process segment is executed.
Indexes H22.51 to H22.58.</td></tr>
<tr><td>31 to 28</td><td>-</td><td colspan="2">-</td></tr>
</table>

Process segment data	
Bit	Value
31 to 0	Designated parameter data (32-bit)

Halt mode

During operation of the process segment (positioning mode, constant speed mode, or homing mode), if 1000 is written to H22.00 or FunIN.55 (PrSuspend) is triggered, the motor interrupts present operation mode immediately and ramps to stop based on the deceleration time defined by H22.03. After stop, the motor keeps enabled and stays at a standstill. When the process segment is triggered again, the motor resumes normal operation.

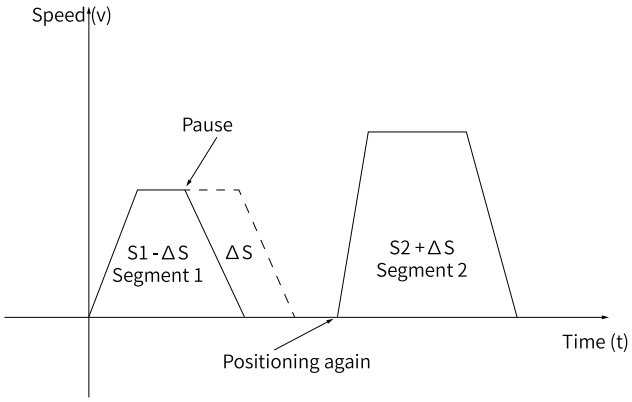


Figure 11-7 Time-speed curve

Segment 1: positioning mode (The motor ramps to stop when pause is triggered during operation).

Segment 2: Positioning mode.

S1 represents the set displacement 1. S2 represents the set displacement 2. ΔS represents the remaining displacement after stop at specified position.

Special mode

ImmedUpd and OverLap functions are special functions which serve to generate complex process segment paths once triggered.

- **Overlap (OverLap)**
  When the overlap function is in progress, the present process segment can overlap with the next process segment. During overlapping, the interval time of present segment is set to 0 forcibly. The overlap function can be used in positioning control only.

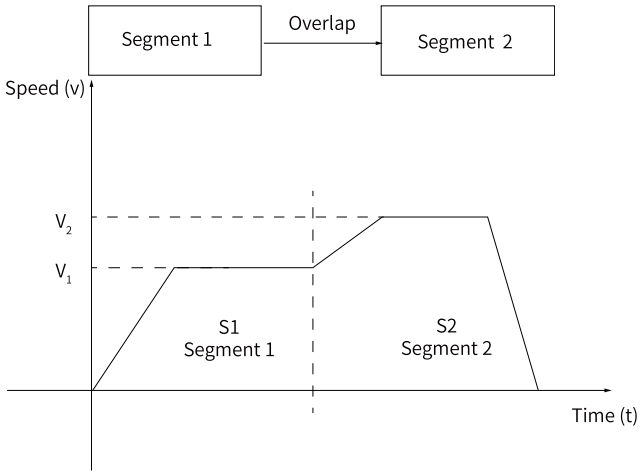


Figure 11-8 Time-speed curve

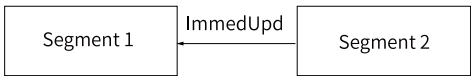
Segment 1: positioning mode; Mode = 3; OverLap = 1; V_1: speed set for the positioning mode.

Segment 2: positioning mode; ImmedUpd = 0; V_2: speed set for the positioning mode.

S1 represents the displacement for segment 1 and S2 represents the displacement for segment 2.

- **Updated immediately (ImmedUpd)**

When the ImmedUpd mode is in progress, the present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. The ImmedUpd mode can be used in positioning control and constant speed control.



The ImmedUpd mode can be further divided into internal ImmedUpd mode and external ImmedUpd mode.

- Internal ImmedUpd mode

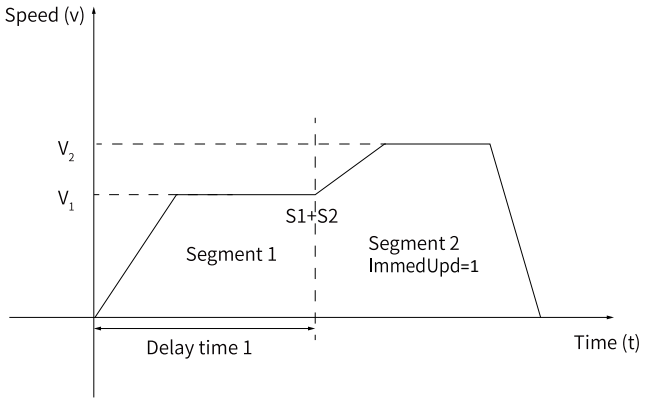


Figure 11-9 Time-speed curve

Segment 1: positioning mode; Mode = 3; DelayTime1: interval time set for the positioning mode; V_1: speed set for the positioning mode.

Segment 2: ImmedUpd = 1, V_2: speed set for segment 2.

If segment 2 is positioning mode, S1 is the displacement for segment 1, and S2 is the displacement for segment 2, then the final positioning position is the sum of S1 and S2.

- External ImmedUpd mode

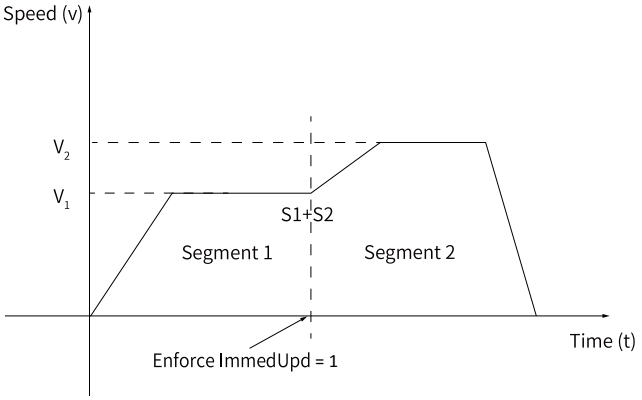


Figure 11-10 Time-speed curve

Segment 1: positioning mode; V_1: speed set for the positioning mode.

Segment 2: ImmedUpd = 1, V_2: speed set for segment 2.

If segment 2 is positioning mode, S1 is the displacement for segment 1, and S2 is the displacement for segment 2, then the final positioning position is the sum of S1 and S2.

Note

- The ImmedUpd function has higher priority over the overlap function. When the overlap function is set for process segment 1 and the ImmedUpd function is set for process segment 2, the ImmedUpd function will be executed immediately when process segments 1 and 2 are in progress.
- The external ImmedUpd function has higher priority over the internal ImmedUpd function.

11.4.4 DO and Sequence

FunOUT.22 (CmdOK, internal command completed) can be used to check whether the process segment command has been transmitted. FunOUT.5 (COIN, positioning completed) can be used to check whether positioning is completed. FunOUT.24 (McOk, motion control completed) can be used to check whether motion control is completed.

The sequence for process segment is shown as follows (taking positioning mode and H05.20 = 0 as example):

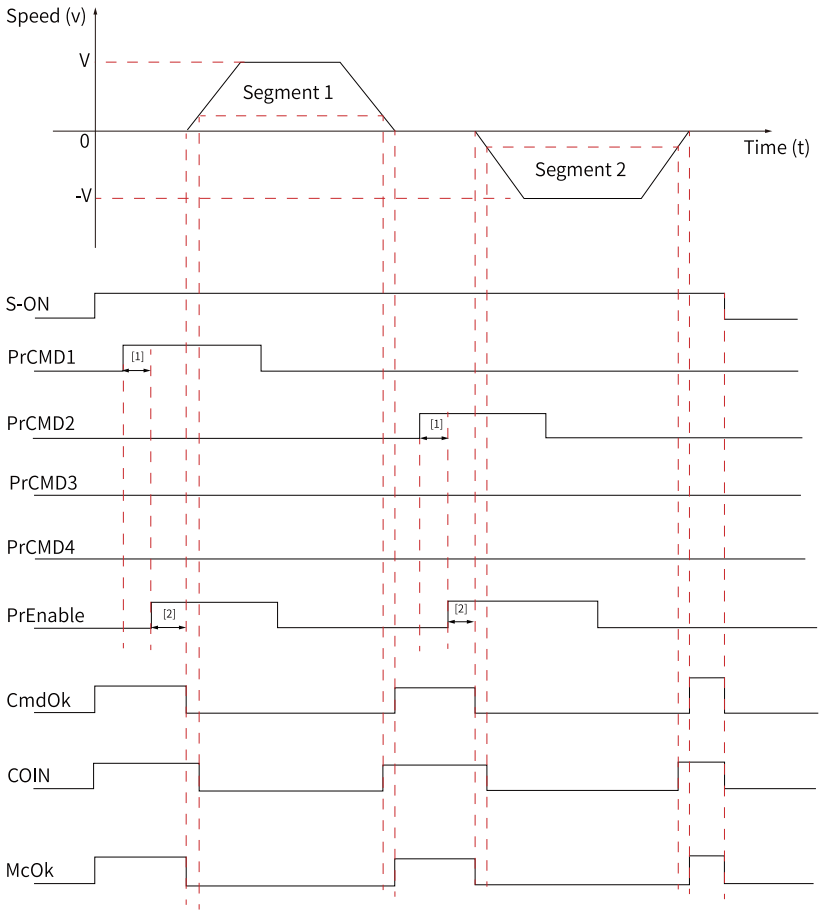


Figure 11-11 Sequence of process segment

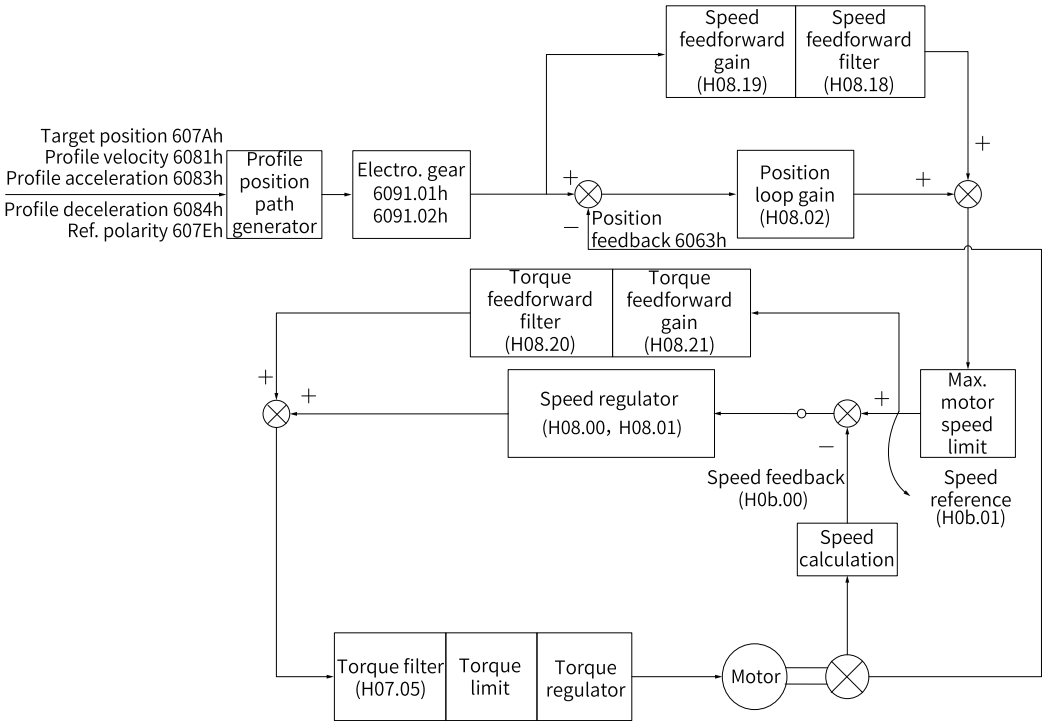
Note

- [1] When DI is used, the effective signal width of the DI must be at least 0.125 ms.
- [2] The PrEnable signal is edge-triggered. The effective signal width of the DI must be at least 0.125 ms.

11.5 Profile Position (PP) Mode

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

11.5.1 Function Block Diagram



11.5.2 Configuration Block Diagram

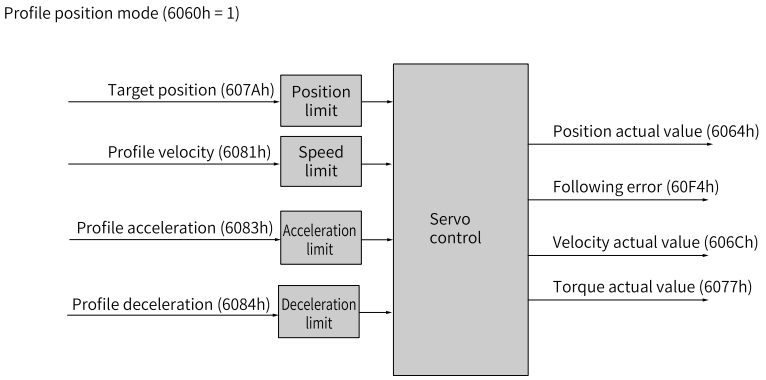


Figure 11-12 PP mode

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

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

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

Sequential mode:

The target position of present segment is in the process of positioning. After the new target position is generated, the controller sets bit4 (New set-point) of the control word to 1, and the servo drive executes positioning towards the new target position.

In the sequential mode, the sequence of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word is as follows.

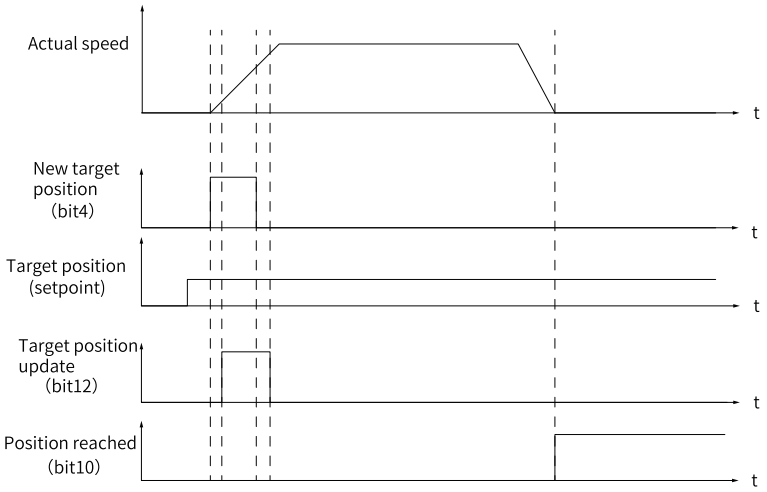
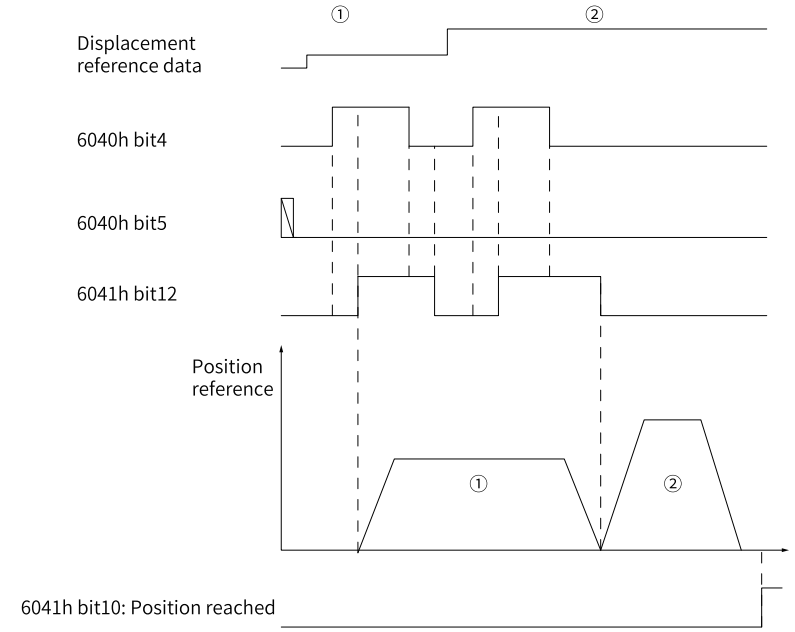


Figure 11-13 Sequence in sequential mode

Single-point mode:

The target position of present segment is in the process of positioning. After the new target position is prepared, the controller sets the new set-point bit to 1, and the servo drive performs positioning based on the new target position after the position reference of present segment is transmitted.

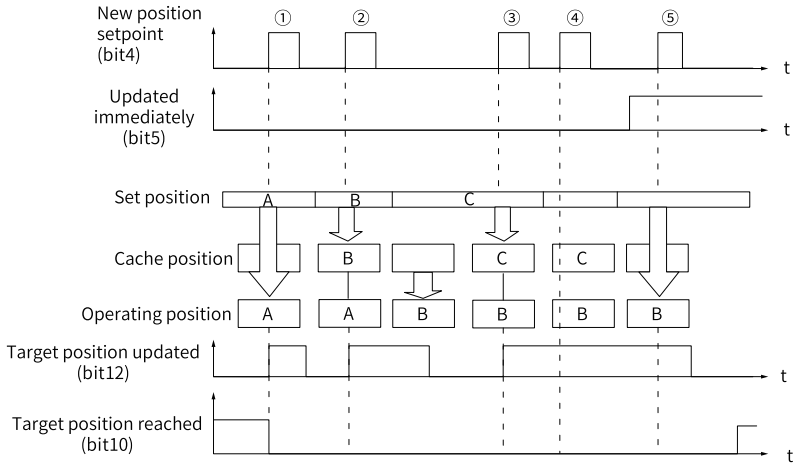
The sequence of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word is as follows.



Note: If you need to change any parameter of the displacement reference, send the trigger signal again.

Figure 11-14 Sequence in the single-point mode

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



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

11.5.3 Recommended Configuration

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

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
607Ah: target position	6064h: position actual value	Mandatory
6081h: profile velocity	-	Mandatory
6083h: profile acceleration	-	Optional
6084h: profile deceleration	-	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

11.5.4 Related Parameters

6040h **Control word**

Communication address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:
0x0 to 0xFFFF

Description:
For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Switch on	Switch on	1: Active, 0: Inactive
1	Enable voltage	Enable voltage	1: Active, 0: Inactive
2	Quick stop	Quick stop	0: Active, 1: Inactive
3	Enable operation	Enable operation	1: Active, 0: Inactive
4	New set-point	New set-point	0→1: Trigger new target position 1→0: Clear bit12 of the status word
5	Change set immediately	Change set immediately	0: Not immediately 1: Immediately
6	abs/rel	abs/rel	0: abs 1: rel
8	Halt	Halt	0: Keep running 1: Halt

6041h **Status word**

Communication address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Access: RO Mapping: TPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active, 0: Inactive
1	Switch on	Switch on	1: Active, 0: Inactive
2	Operation enabled	Operation enabled	1: Active, 0: Inactive
3	Fault	Fault	1: Active, 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active, 0: Inactive
7	Warning	Warning	1: Active, 0: Inactive
8	Manufacturer specific	Manufacturer specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive
10	Target reach	Target reach	0: The target position is not reached. 1: The target position is reached.
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Set-point acknowledge	Set-point acknowledge	0: Acknowledged 1: Not acknowledged
13	Following error	Following error	0: No error 1: Excessive deviation
14	Manufacturer specific	Manufacturer specific	Undefined
15	Home find	Home find	0: Home not found 1: Homing completed

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode	N type 1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	N type "6060h" on page 875
6061h	6061h	Operation mode display	N type 1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	N type "6061h" on page 875
6064h	6064h	Position actual value	-2147483648 to 2147483647	0	Reference unit	Read-only	"6064h" on page 876
6065h	6065h	Following error window	0 to 4294967295	27486951	Reference unit	Real time	"6065h" on page 877
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 877
6067h	6067h	Position window	0 to 4294967295	5872	Reference unit	Real time	"6067h" on page 877
6068h	6068h	Position window time	0 to 65535	0	ms	Real time	"6068h" on page 877
607Ah	607Ah	Target position	-2147483648 to 2147483647	0	Reference unit	Real time	"607Ah" on page 880
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882
6081h	6081h	Profile velocity	0 to 4294967295	111848106	Reference unit/s	Real time	"6081h" on page 882

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"6083h" on page 883
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"6084h" on page 883

11.5.5 Related Function Settings

Note

In absolute position mode, the running direction of the servo is determined by the direction of the shortest relative displacement between the start absolute position and the target absolute position (607Ah).

Positioning completed

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6067h	6067h	Position window	0 to 4294967295	N type: 5872	Reference unit	Real time	N type "6067h" on page 877
6068h	6068h	Position window time	0 to 65535	0	ms	Real time	"6068h" on page 877

Note

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

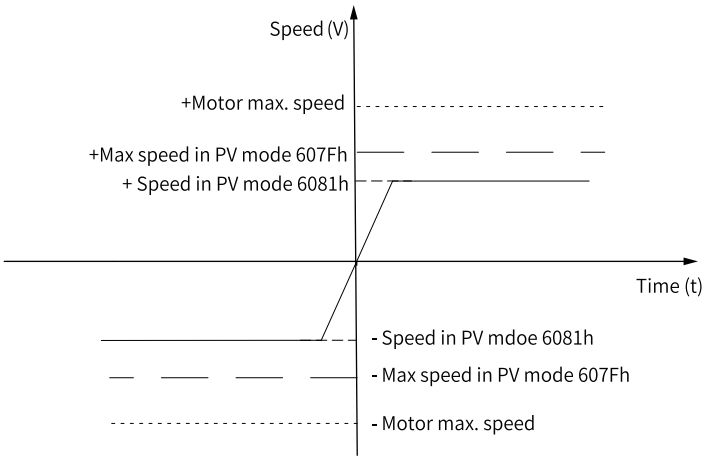
Position deviation monitoring function

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Following error window	0 to 4294967295	N type: 27486951	Reference unit	Real time	N type "6065h" on page 877
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 877

Speed limit

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



☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882

Acceleration and deceleration limits

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"6083h" on page 883
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"6084h" on page 883

Polarity

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

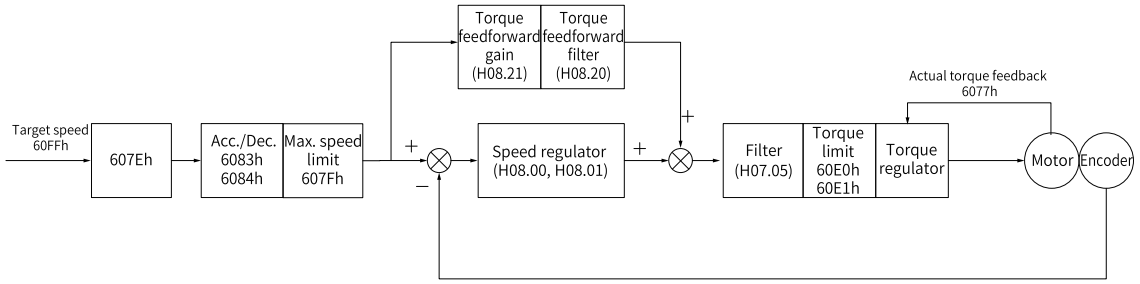
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882

11.6 Profile Velocity (PV) Mode

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

11.6.1 Function Block Diagram



11.6.2 Configuration Block Diagram

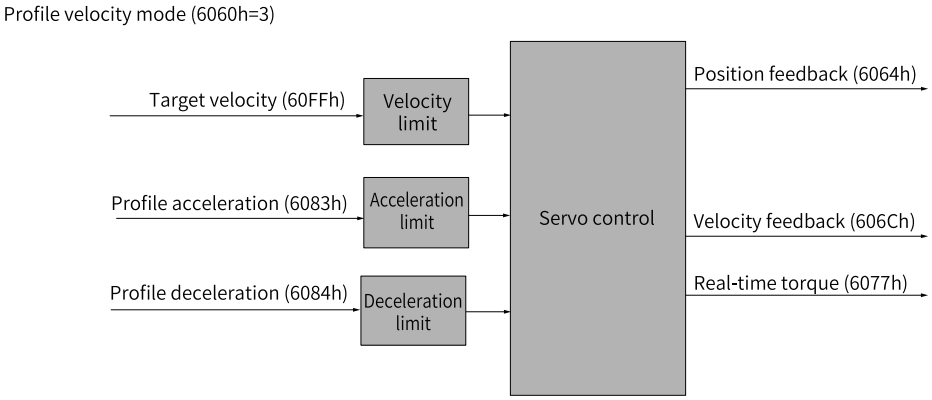


Figure 11-15 Configuration block diagram in PV mode

11.6.3 Recommended Configuration

The following table describes the basic configuration for the profile velocity (PV) mode.

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity	-	Mandatory
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
6083h: profile acceleration	-	Optional
6084h: profile deceleration	-	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

11.6.4 Related Parameters

6040h **Control word**

Communication address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:
0x0 to 0xFFFF
Description:
For details about the control word, see the Communication Guide.

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

6041h **Status word**

Communication address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:
0x0 to 0xFFFF
Description:
For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active, 0: Inactive
1	Switch on	Switch on	1: Active, 0: Inactive
2	Enable operation	Operation enabled	1: Active, 0: Inactive
3	Fault	Fault	1: Active, 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active, 0: Inactive
7	Warning	Warning	1: Active, 0: Inactive
8	Manufacturer specific	Manufacturer specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive

Bit	Parameter name		Description
10	Target reach	Target reach	0: The target velocity is not reached. 1: The target velocity is reached.
11	Internal limit active	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12	Speed	Speed	0: Speed is not 0 1: Speed is 0
13	-	N/A	N/A
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	-	N/A	N/A

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
606Ch	606Ch	Velocity actual value	-2147483648 to 2147483647	0	Reference unit/s	Read-only	"606Ch" on page 878
606Dh	606Dh	Velocity window	0 to 65535	10	rpm	Real time	"606Dh" on page 878
606Eh	606Eh	Velocity window time	0 to 65535	0	ms	Real time	"606Eh" on page 878
606Fh	606Fh	Zero speed signal threshold	0 to 65535	10	rpm	Real time	"606Fh" on page 879
6070h	6070h	Velocity threshold time	0 to 65535	0	ms	Real time	"6070h" on page 879
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"6083h" on page 883
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"6084h" on page 883
60FFh	60FFh	PV, CSV mode speed reference	-2147483648 to 2147483647	0	Reference unit/s	Real time	"60FFh" on page 893

11.6.5 Related Function Settings

Monitoring on speed reach status

This function can be used to check whether the speed reference of the servo drive is consistent with the motor speed feedback.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
606Dh	606Dh	Velocity window	0 to 65535	10	rpm	Real time	"606Dh" on page 878
606Eh	606Eh	Velocity window time	0 to 65535	0	ms	Real time	"606Eh" on page 878

Monitoring on zero speed

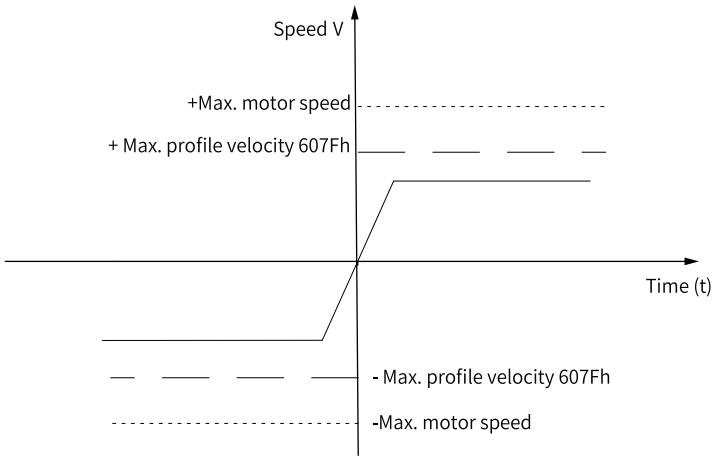
This function is used to check whether the absolute value of motor speed feedback is lower than the set threshold. If yes, the motor is considered to be close to standstill (zero speed). Bit12 of 6041h is set to 1.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
606Fh	606Fh	Zero speed signal threshold	0 to 65535	10	rpm	Real time	"606Fh" on page 879
6070h	6070h	Velocity threshold time	0 to 65535	0	ms	Real time	"6070h" on page 879

Speed limit

In PV mode, 607Fh can be used to limit the maximum speed in forward/reverse running, but its value must not exceed the max. allowable speed of the motor.



☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882

Acceleration and deceleration limits

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"60C5h" on page 890
60C6h	60C6h	Maximum deceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"60C6h" on page 890

Polarity

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

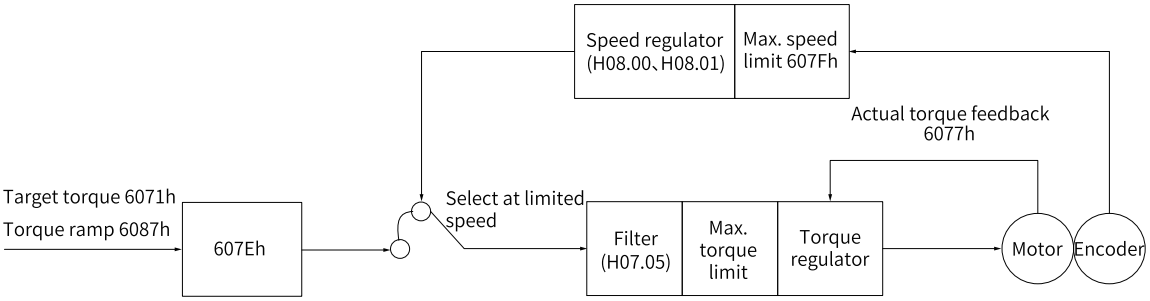
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882

11.7 Profile Torque (PT) Mode

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

11.7.1 Function Block Diagram



11.7.2 Recommended Configuration

The following table describes the basic configuration for the profile torque (PT) mode.

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
6071h: target torque	-	Mandatory
6087h: torque slope	-	Optional
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
-	6077h: torque actual value	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

11.7.3 Configuration Block Diagram

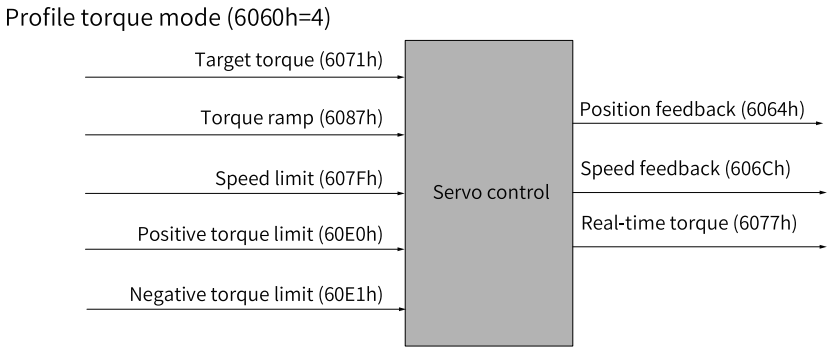


Figure 11-16 Configuration block diagram in PT mode

11.7.4 Related Parameters

6040h **Control word**

Communication address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

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

6041h **Status word**

Communication address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active, 0: Inactive
1	Switch on	Switch on	1: Active, 0: Inactive
2	Enable operation	Operation enabled	1: Active, 0: Inactive
3	Fault	Fault	1: Active, 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active, 0: Inactive
7	Warning	Warning	1: Active, 0: Inactive
8	Manufacturer specific	Manufacturer specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive
10	Target reach	Target reach	0: Target torque not reached 1: Target torque reached
11	Internal limit active	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12 to 14	No assignment	N/A	No assignment, always being 0
15	-	N/A	N/A

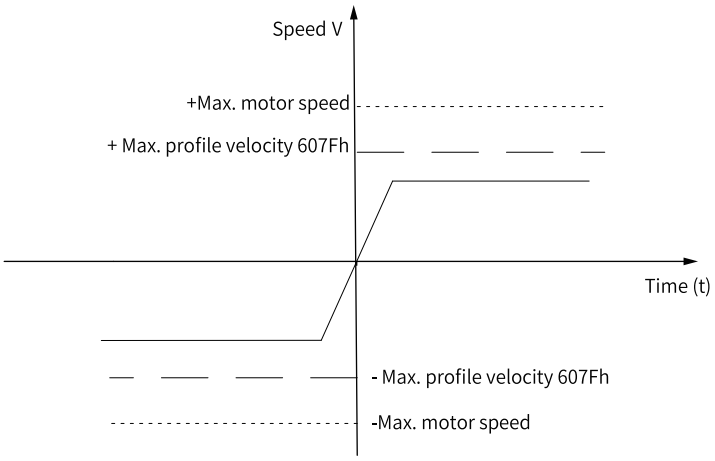
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT 2: H07.19 or H07.20 as defined by DI	0	-	Real time	"H07_en.17" on page 582
6060h	6060h	Servo drive mode	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 875
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 875
6071h	6071h	Target torque	-4000 to 4000	0	0.10%	Real time	"6071h" on page 879
6072h	6072h	Maximum torque reference	0 to 4000	3500	0.10%	Real time	"6072h" on page 880
6074h	6074h	Torque reference	-4000 to 4000	0	0.10%	Read-only	"6074h" on page 880
6077h	6077h	Torque actual value	-4000 to 4000	0	0.10%	Read-only	"6077h" on page 880
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882
6087h	6087h	Torque slope	0 to 4294967295	4294967295	0.1%/s	Real time	"6087h" on page 884
60E0h	60E0h	Positive torque limit	0 to 4000	3500	0.10%	Real time	"60E0h" on page 892
60E1h	60E1h	Negative torque limit	0 to 4000	3500	0.10%	Real time	"60E1h" on page 892

11.7.5 Related Function Settings

Speed limit in torque control mode

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

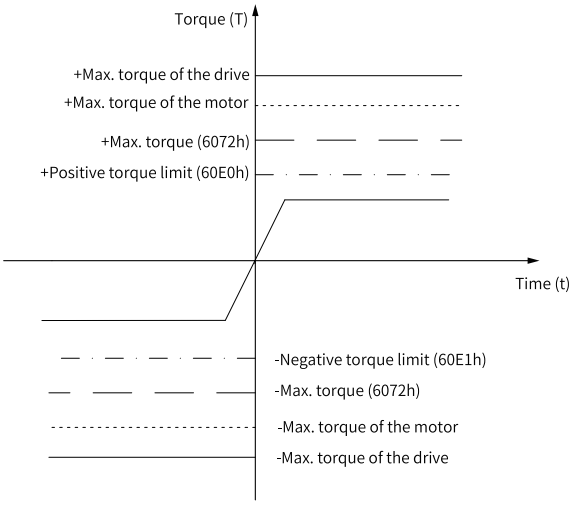


☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882

Torque limit

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



☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6072h	6072h	Maximum torque reference	0 to 4000	3500	0.10%	Real time	"6072h" on page 880
60E0h	60E0h	Positive torque limit	0 to 4000	3500	0.10%	Real time	"60E0h" on page 892
60E1h	60E1h	Negative torque limit	0 to 4000	3500	0.10%	Real time	"60E1h" on page 892

Torque reference polarity

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882

11.8 Homing Mode (HM)

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

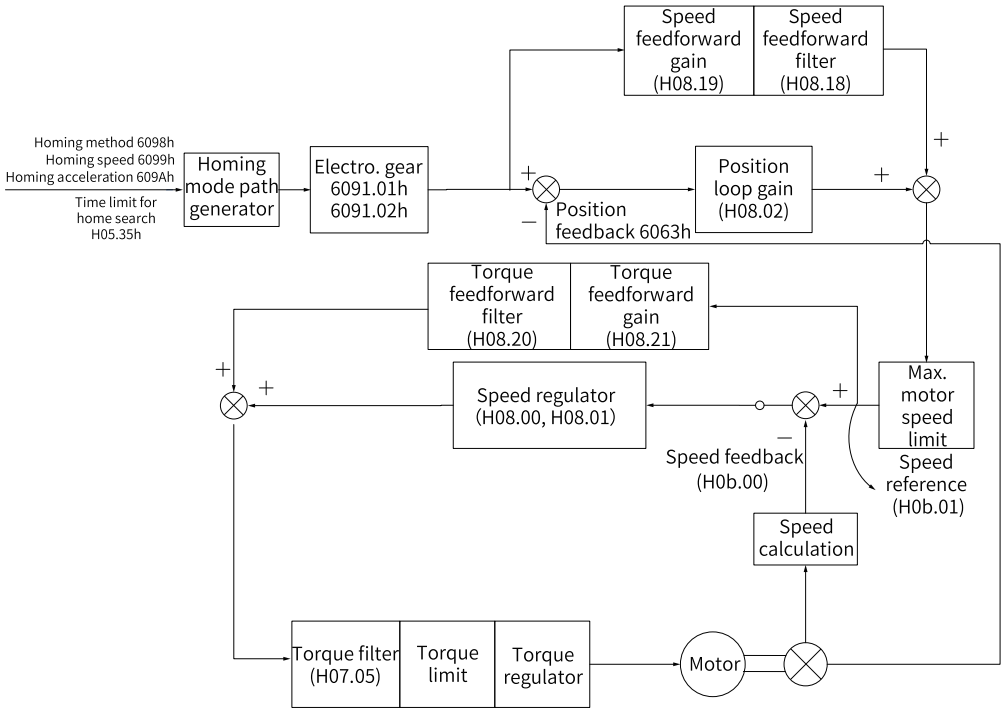
- Mechanical home: a fixed position on the machine, which corresponds to a certain home switch or the motor Z signal.
- Mechanical zero: absolute zero point on the machine

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

Mechanical home = Mechanical zero + 607C (home offset)

When 607Ch = 0. The zero is the same as the home.

11.8.1 Function Block Diagram



11.8.2 Recommended Configuration

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

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
6098h: homing method	-	Optional
6099.01h: speed during search for switch	-	Optional
6099.02h: speed during search for zero	-	Optional
609Ah: homing acceleration	-	Optional
-	6064h: position actual value	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

11.8.3 Configuration Block Diagram

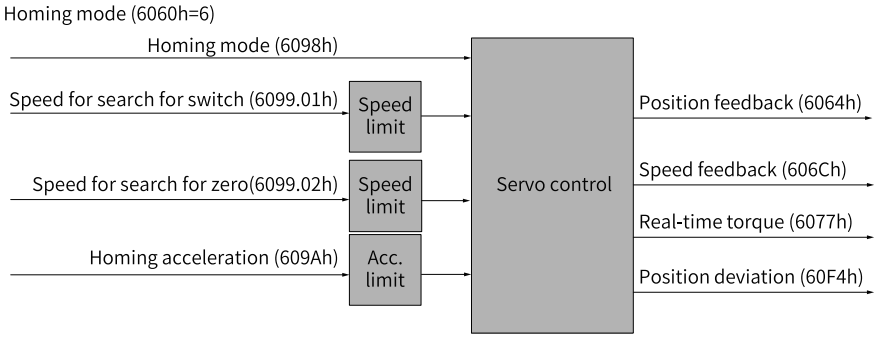


Figure 11-17 HM mode

11.8.4 Related Parameters

6040h **Control word**

Communication address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Switch on	Switch on	1: Active, 0: Inactive
1	Enable voltage	Enable voltage	1: Active, 0: Inactive
2	Quick stop	Quick stop	0: Active, 1: Inactive
3	Enable operation	Enable operation	1: Active, 0: Inactive
4[1]	Enable homing	Enable homing	0→1: Start, 1→0: Stop
8	Halt	Halt	0: Keep present operating state, 1: Halt

6041h **Status word**

Communication address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active, 0: Inactive
1	Switch on	Switch on	1: Active, 0: Inactive
2	Operation enabled	Operation enabled	1: Active, 0: Inactive
3	Fault	Fault	1: Active, 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active, 0: Inactive
7	Warning	Warning	1: Active, 0: Inactive
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive
10	Target reach	Target reach	1: Home is found or homing is interrupted or failed 0: Disabled or home is not found[1]
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Homing attained	Homing attained	0: Homing not attained 1: Homing attained
13	Homing error	Homing error	0: No error 1: Error is present
15	Home find	Home find	0: Home not found 1: Homing completed

Note

[1]: Set bit10 to 1 for N-type models.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 875
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 875
6065h	6065h	Position deviation threshold	0 to 4294967295	27486951	Reference unit	Real time	"6065h" on page 877
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 877
607Ch	607Ch	Home offset	-2147483648 to 2147483647	0	Reference unit	Real time	"607Ch" on page 881
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882
6098h	6098h	Homing method	-3 to 35	1	-	Real time	"6098h" on page 885
6099.01h	6099-01h	Speed during search for switch	0 to 4294967295	111848106	Reference unit/s	At stop	"6099_en.01h" on page 886
6099.02h	6099-02h	Speed during search for zero	0 to 4294967295	11184810	Reference unit/s	At stop	"6099_en.02h" on page 886
609Ah	609Ah	Homing acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"609Ah" on page 886
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"60C5h" on page 890

11.8.5 Related Function Settings

Homing timeout

When the homing duration exceeds the value defined by H05.35 (Homing time limit), the servo drive reports E601.0 (Homing timeout).

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.35	2005-24h	Home search time limit	0 to 65535	10000	-	Real time	"H05_en.35" on page 558

Actual position calculation method

After homing, the calculation method for current mechanical position can be set in 607Ch.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Ch	607Ch	Home offset	-2147483648 to 2147483647	0	Reference unit	Real time	"607Ch" on page 881

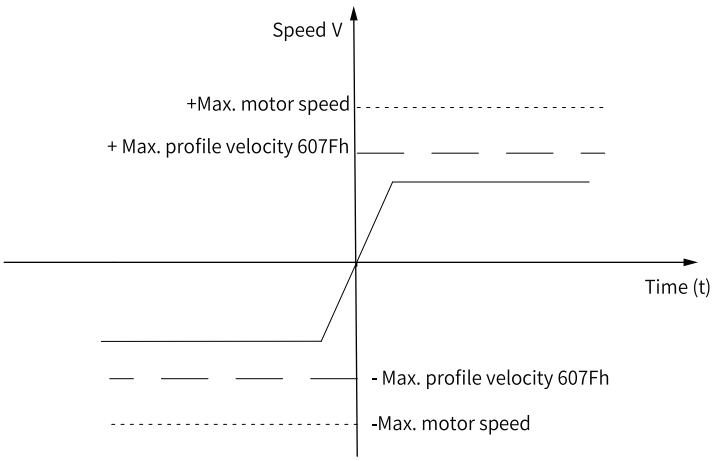
Position deviation monitoring function

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Following error window	0 to 4294967295	27486951	Reference unit	Real time	"6065h" on page 877
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 877

Speed limit

In torque mode, 607Fh can be used to limit the maximum speed in forward/reverse running, but its value must not exceed the maximum allowable speed of the motor.



☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882

Acceleration limit

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s2	Real time	"60C5h" on page 890

11.8.6 Homing Operation

Note

Threshold for torque homing:

- 6098h = 3: When the motor hits the hardware position limit, the torque feedback reaches the limit value (H05.58). After the motor stops, the first Z signal is searched in the reverse direction as the home.
- 6098h = -2/-1: The limit is the minimum value among H05.58 (Threshold in limit-triggered homing), 6072h (Maximum torque reference), 60E0h (Positive torque limit), and 60E1h (Negative torque limit).

Note: In the figure, "H" represents high speed 6099.01h, "L" represents low speed 6099.02h, and "-" represents reverse run.

6098h = 1

Mechanical home: motor Z signal

Deceleration point: negative limit switch

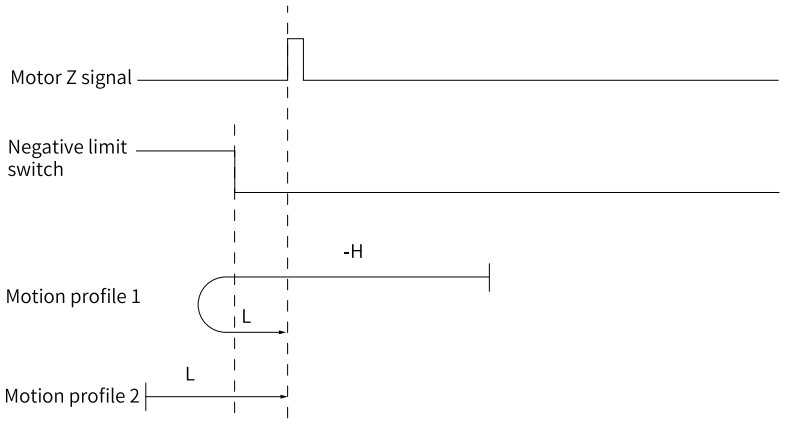


Figure 11-18 Motor running curve and speed in mode 1

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 2

Home: Z signal

Deceleration point: positive limit switch

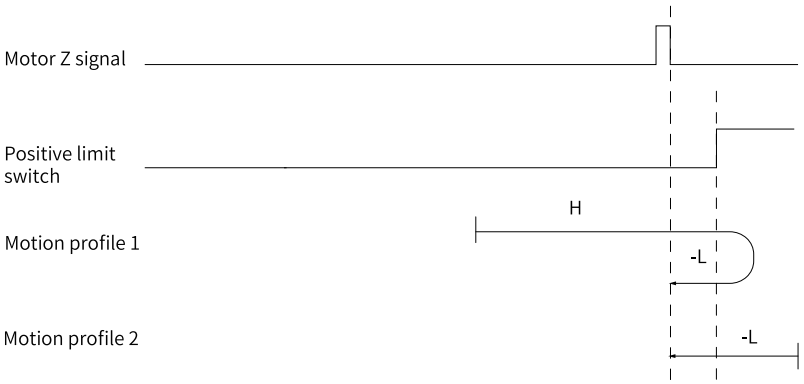


Figure 11-19 Motor running curve and speed in mode 2

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 3

Home: Z signal

Deceleration point: home switch (HW)

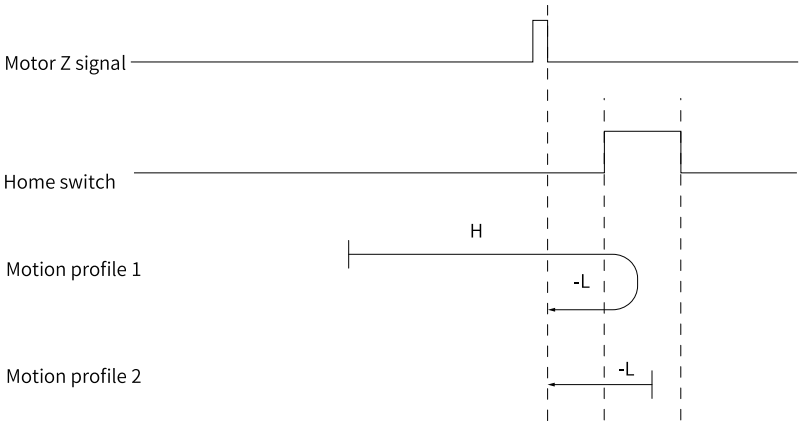


Figure 11-20 Motor running curve and speed in mode 3

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 4

Home: Z signal

Deceleration point: home switch (HW)

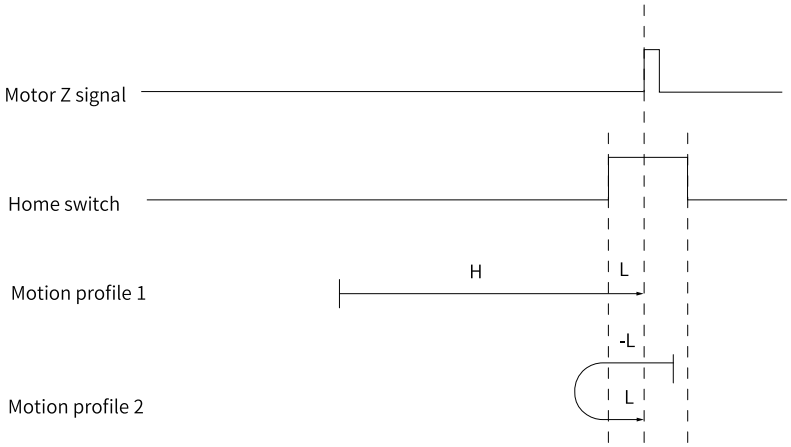


Figure 11-21 Motor running curve and speed in mode 4

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 5

Home: Z signal

Deceleration point: home switch (HW)

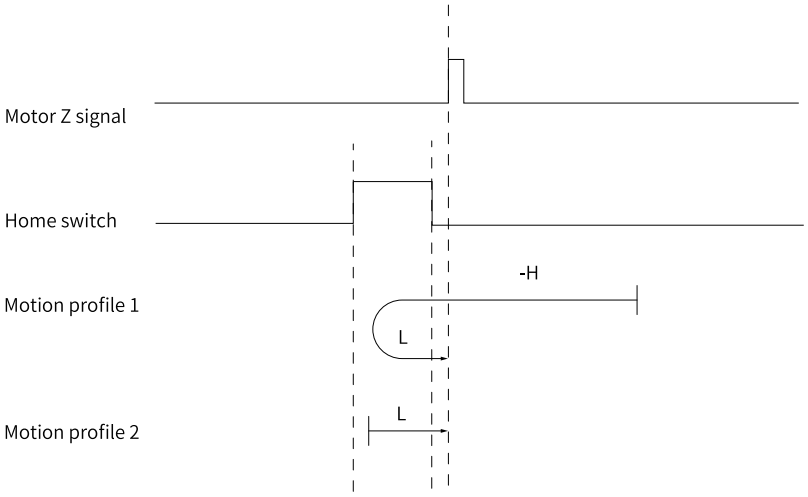


Figure 11-22 Motor running curve and speed in mode 5

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 6

Home: Z signal

Deceleration point: home switch (HW)

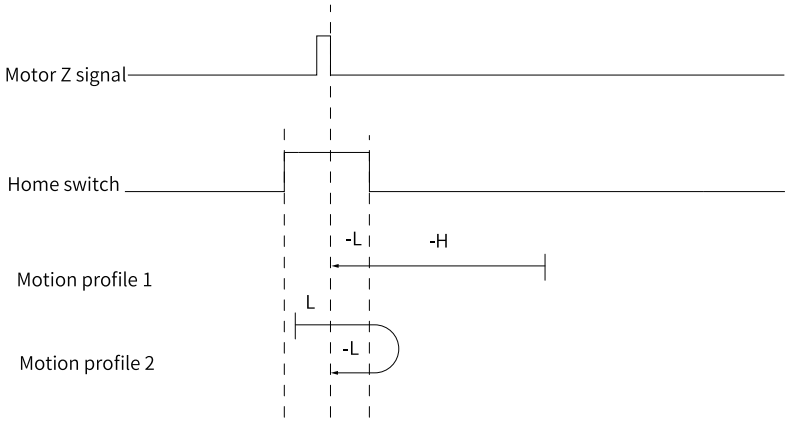


Figure 11-23 Motor running curve and speed in mode 6

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 7

Home: Z signal

Deceleration point: home switch (HW)

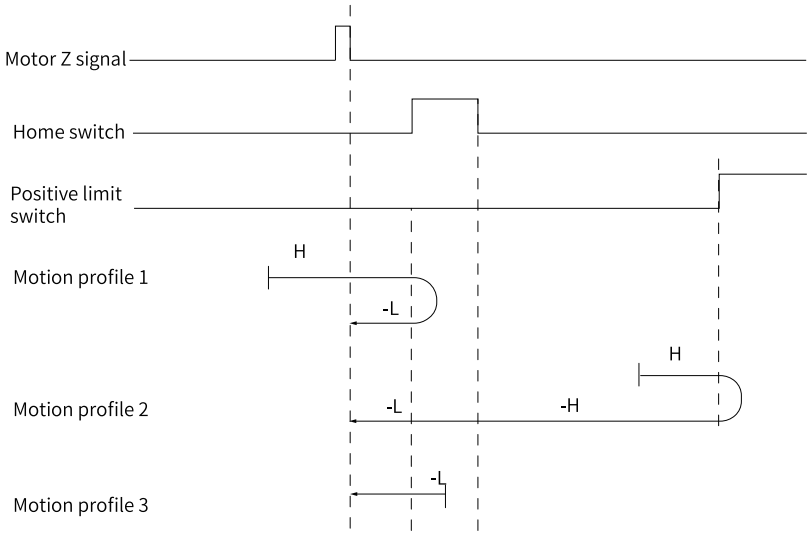


Figure 11-24 Motor running curve and speed in mode 7

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 8

Home: Z signal

Deceleration point: home switch (HW)

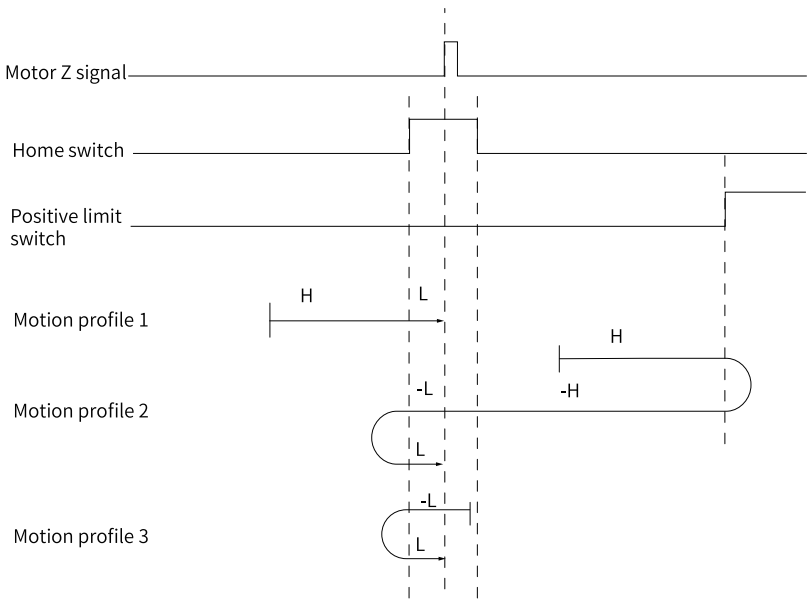


Figure 11-25 Motor running curve and speed in mode 8

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 9

Home: Z signal

Deceleration point: home switch (HW)

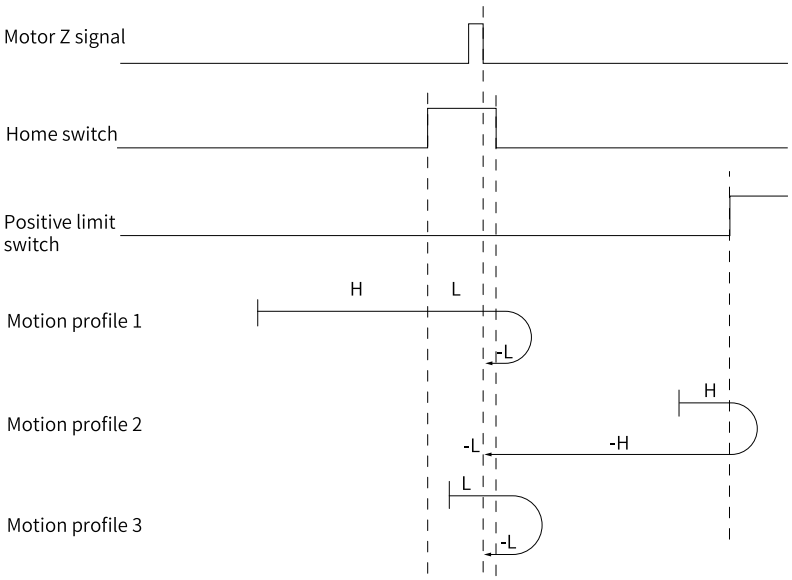


Figure 11-26 Motor running curve and speed in mode 9

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 10

Home: Z signal

Deceleration point: home switch (HW)

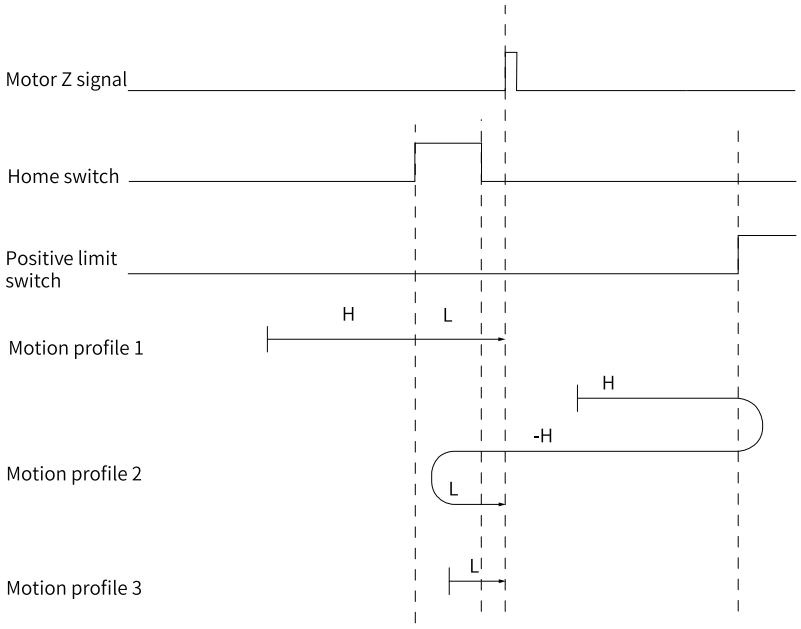


Figure 11-27 Motor running curve and speed in mode 10

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 11

Home: Z signal

Deceleration point: home switch (HW)

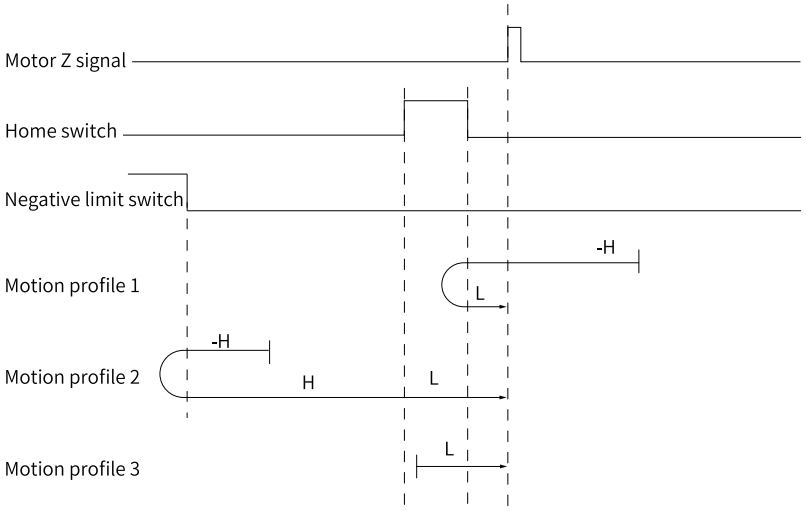


Figure 11-28 Motor running curve and speed in mode 11

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 12

Home: Z signal

Deceleration point: home switch (HW)

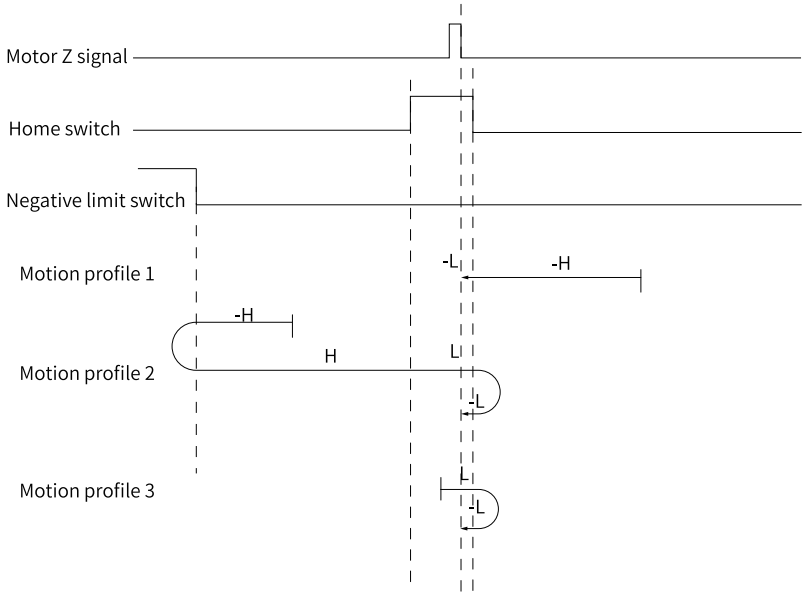


Figure 11-29 Motor running curve and speed in mode 12

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 13

Home: Z signal

Deceleration point: home switch (HW)

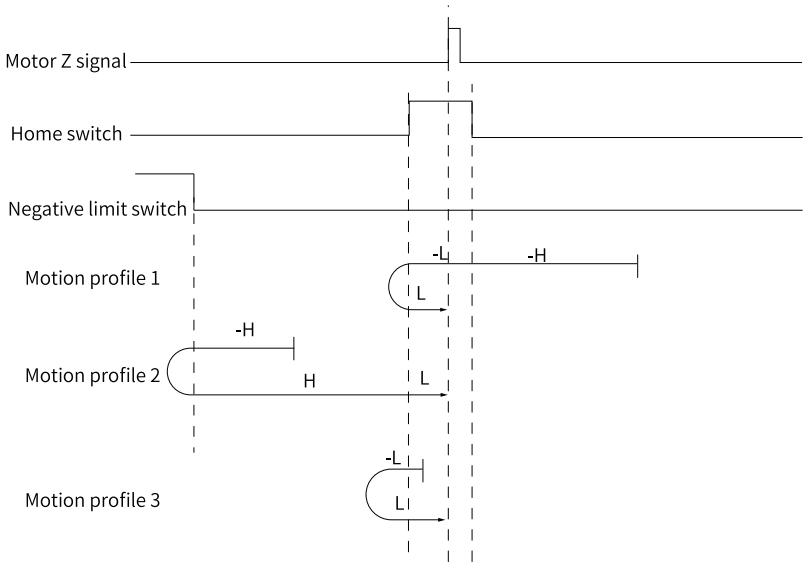


Figure 11-30 Motor running curve and speed in mode 13

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 14

Home: Z signal

Deceleration point: home switch (HW)

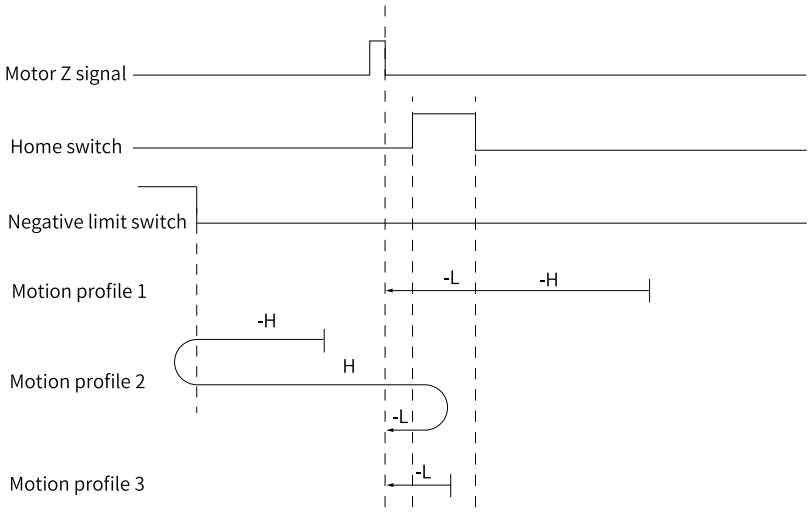


Figure 11-31 Motor running curve and speed in mode 14

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 17

Home: negative limit switch

Deceleration point: negative limit switch

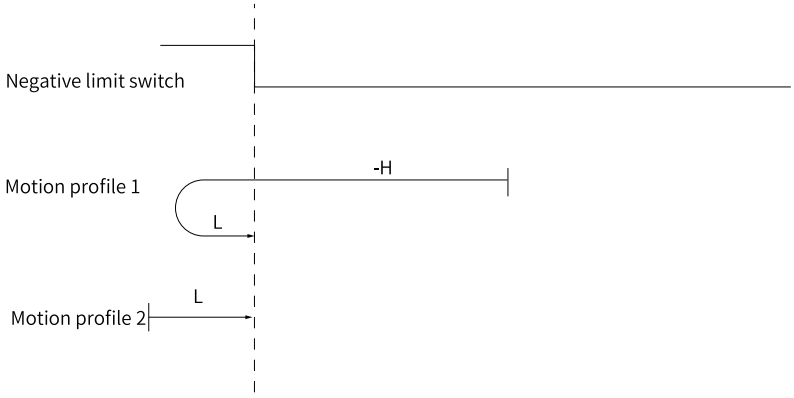


Figure 11-32 Motor running curve and speed in mode 17

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 18

Home: positive limit switch

Deceleration point: positive limit switch

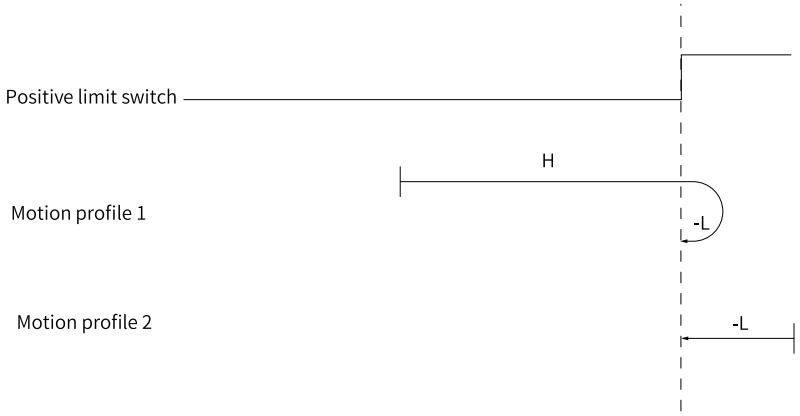


Figure 11-33 Motor running curve and speed in mode 18

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 19

Home: home switch (HW)

Deceleration point: home switch (HW)

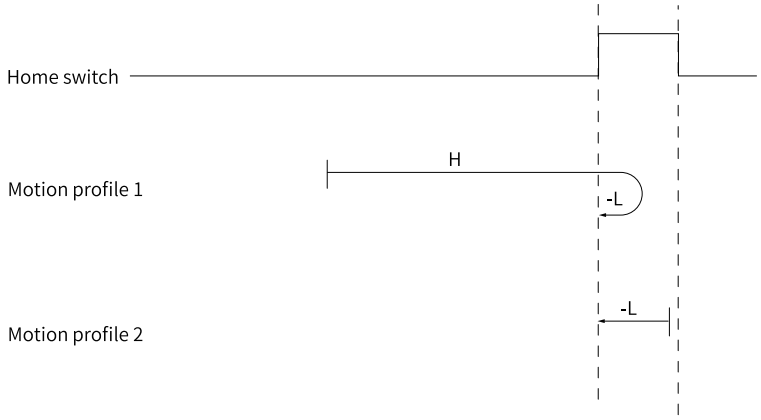


Figure 11-34 Motor running curve and speed in mode 19

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 20

Home: home switch (HW)

Deceleration point: home switch (HW)

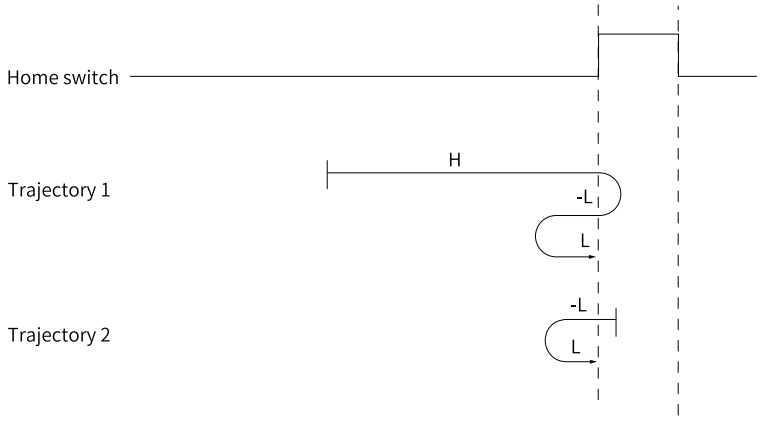


Figure 11-35 Motor running curve and speed in mode 20

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 21

Home: home switch (HW)

Deceleration point: home switch (HW)

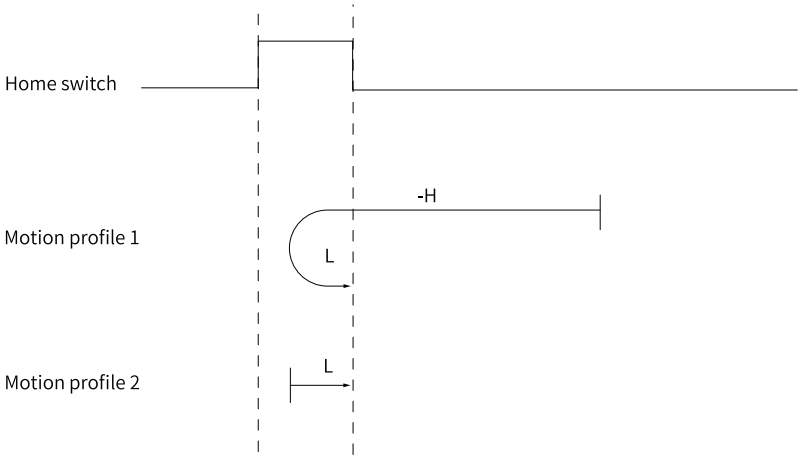


Figure 11-36 Motor running curve and speed in mode 21

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 22

Home: home switch (HW)

Deceleration point: home switch (HW)

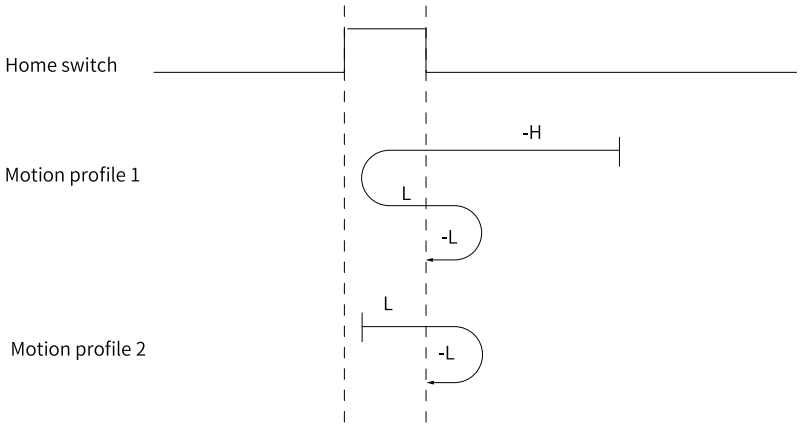


Figure 11-37 Motor running curve and speed in mode 22

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 23

Home: home switch (HW)

Deceleration point: home switch (HW)

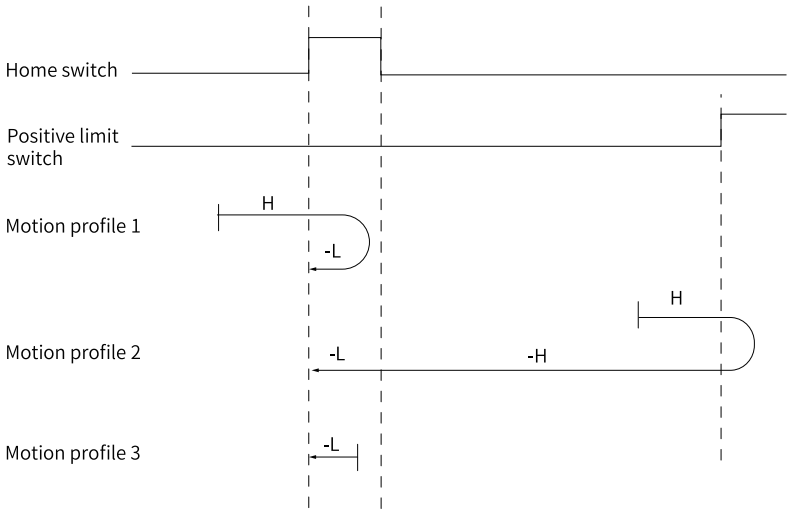


Figure 11-38 Motor running curve and speed in mode 23

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 24

Home: home switch (HW)

Deceleration point: home switch (HW)

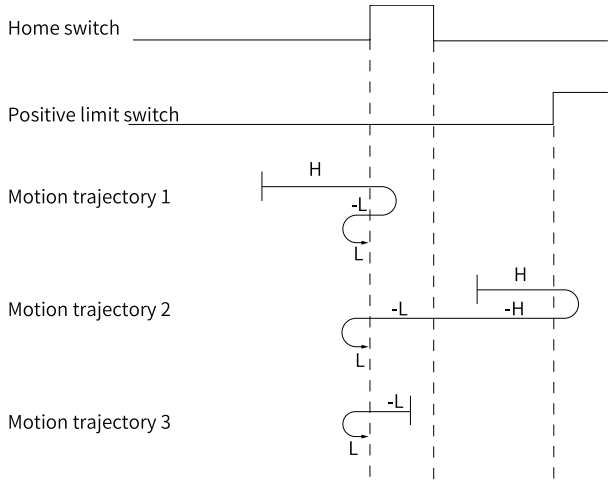


Figure 11-39 Motor running curve and speed in mode 24

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 25

Home: home switch (HW)

Deceleration point: home switch (HW)

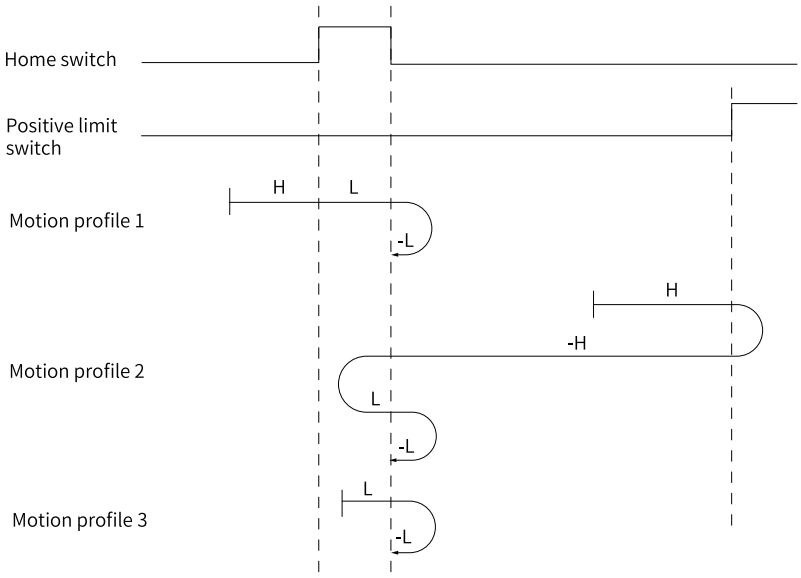


Figure 11-40 Motor running curve and speed in mode 25

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 26

Home: home switch (HW)

Deceleration point: home switch (HW)

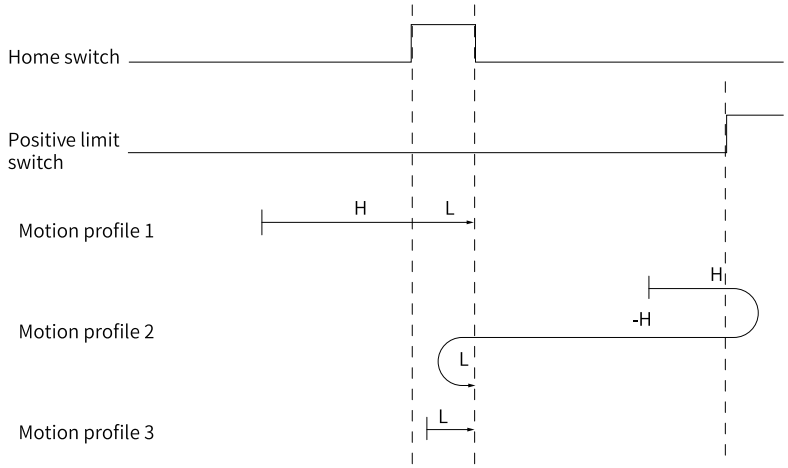


Figure 11-41 Motor running curve and speed in mode 26

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 27

Home: home switch (HW)

Deceleration point: home switch (HW)

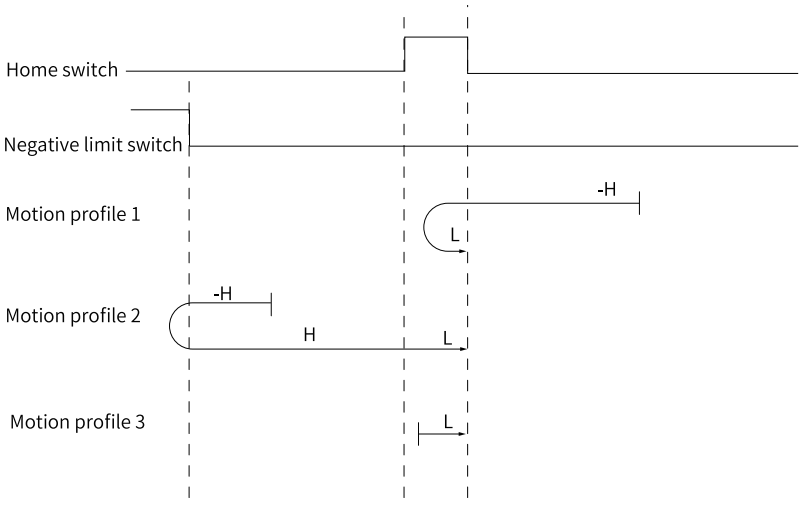


Figure 11-42 Motor running curve and speed in mode 27

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 28

Home: home switch (HW)

Deceleration point: home switch (HW)

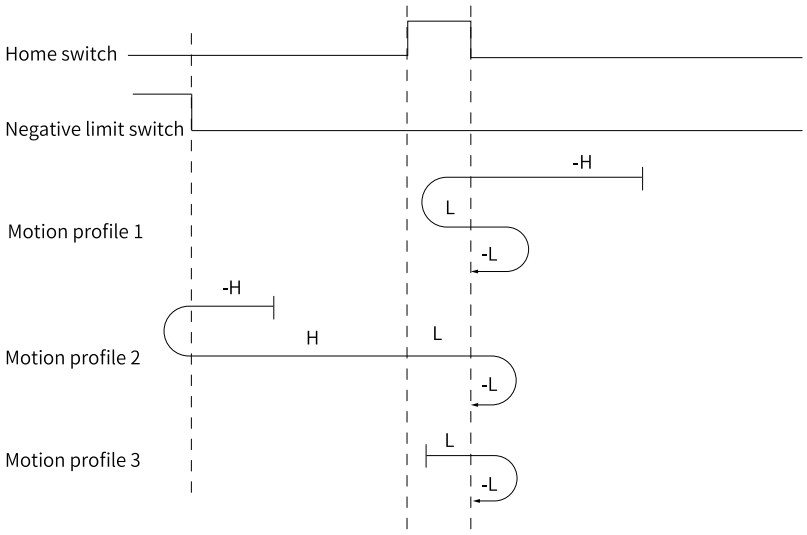


Figure 11-43 Motor running curve and speed in mode 28

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 29

Home: home switch (HW)

Deceleration point: home switch (HW)

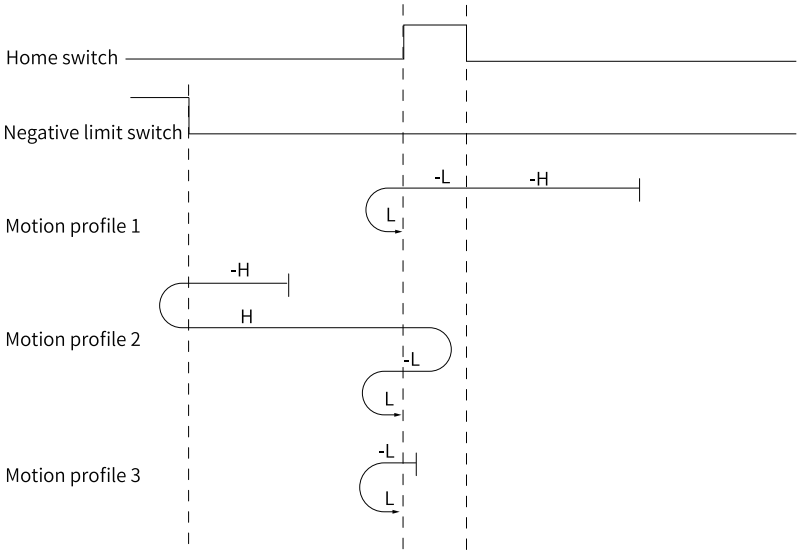


Figure 11-44 Motor running curve and speed in mode 29

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 30

Home: home switch (HW)

Deceleration point: home switch (HW)

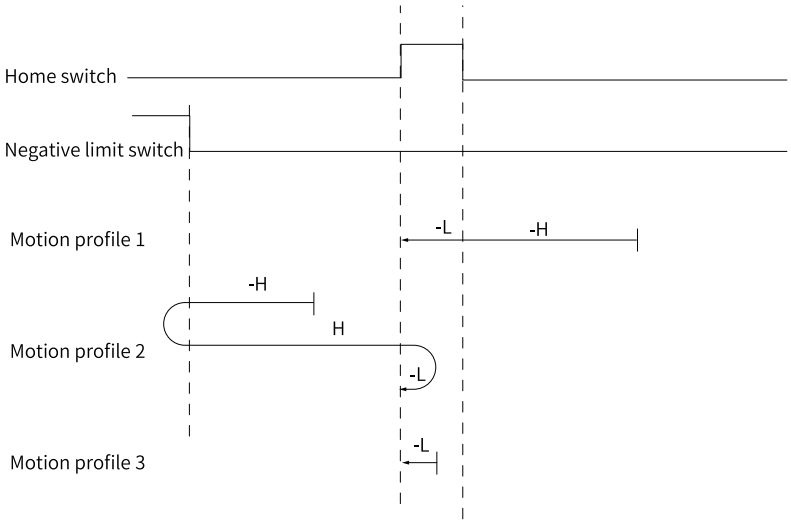


Figure 11-45 Motor running curve and speed in mode 30

- Motion profile 1: Deceleration point signal inactive at startup in homing mode, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at startup in homing mode, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at startup in homing mode.

6098h = 31 and 32

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

6098h = 33/34

Home: Z signal

Deceleration point: none

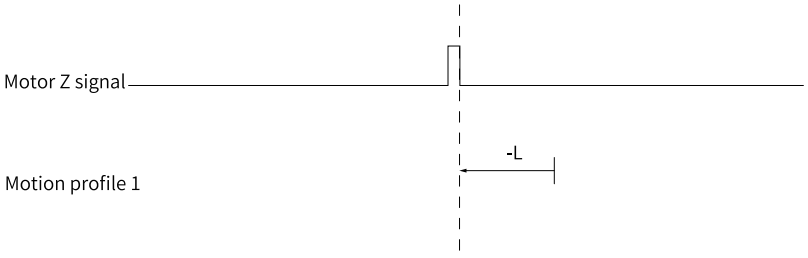


Figure 11-46 Motor running curve and speed in mode 33

- Motion profile 1: The motor runs in the reverse direction at low speed and stops at the first Z signal..

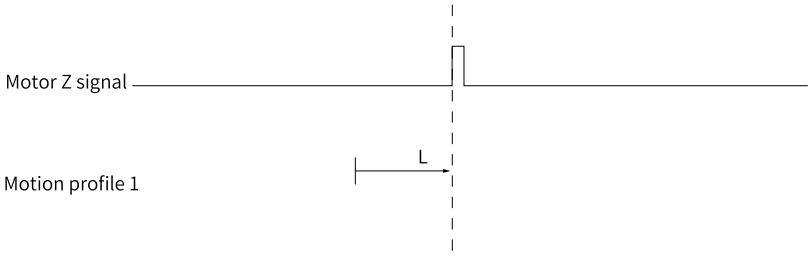


Figure 11-47 Motor running curve and speed in mode 34

- Motion profile 1: The motor runs in the forward direction at low speed and stops at the first Z signal..

6098h = 35

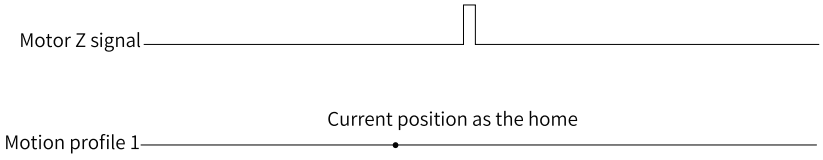


Figure 11-48 Motor running curve and speed in mode 35

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

6098h = -1

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

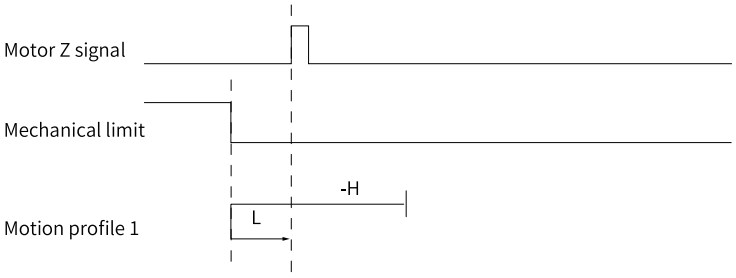


Figure 11-49 Motor running curve and speed in mode -1

6098h = -2

The servo motor runs in the forward direction at a high speed first. If the torque reaches the limit and the speed is near zero when the motor hits the mechanical limit, and such status persists, it indicates that the motor reaches the mechanical limit position. In this case, the motor runs in the reverse direction at a low speed and stops at the first Z signal after reaching the rising edge.

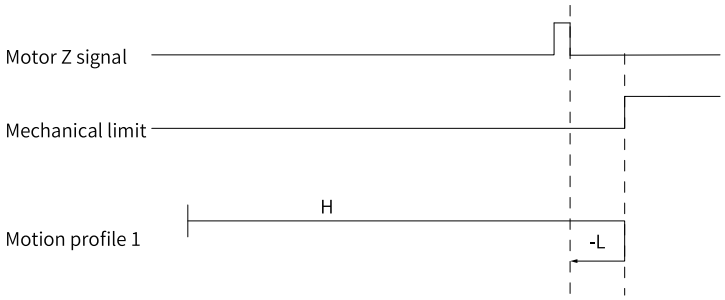


Figure 11-50 Motor running curve and speed in mode -2

6098h = -3

Home: Z signal

Deceleration point: none

- If the single-turn position is close to the reverse home, the homing profile is motion profile 1.
- If the single-turn position is close to the forward home, the homing profile is motion profile 2.

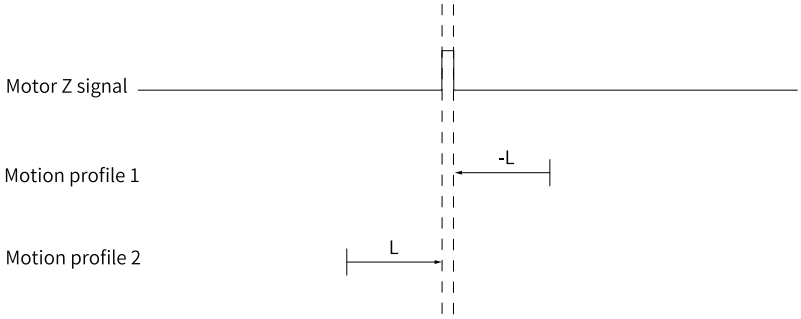


Figure 11-51 Motor running curve and speed in mode -3

- Motion profile 1: The motor runs in the reverse direction at a low speed and stops at the first Z signal.
- Motion profile 2: The motor runs in the forward direction at a low speed and stops at the first Z signal.

11.9 Position Control Mode

Note

In position control mode, model N only supports multi-position.

★Terms:

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

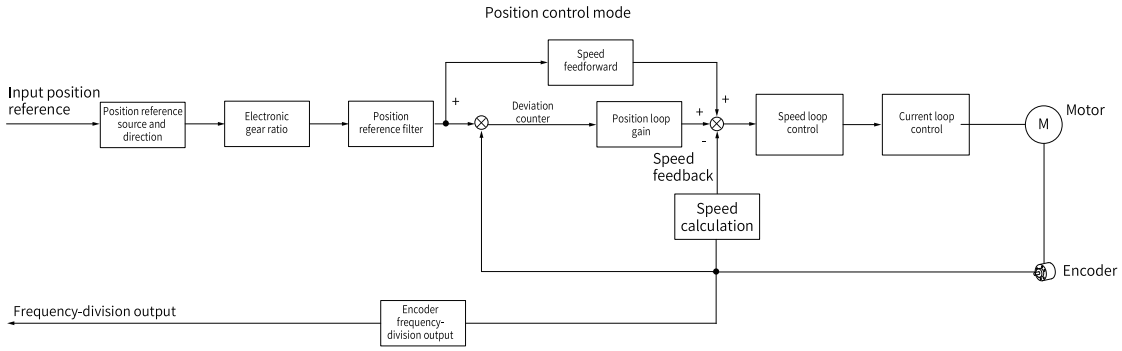


Figure 11-52 Position control diagram

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

In the following diagram, the basic parameter settings are used to describe the position control mode.

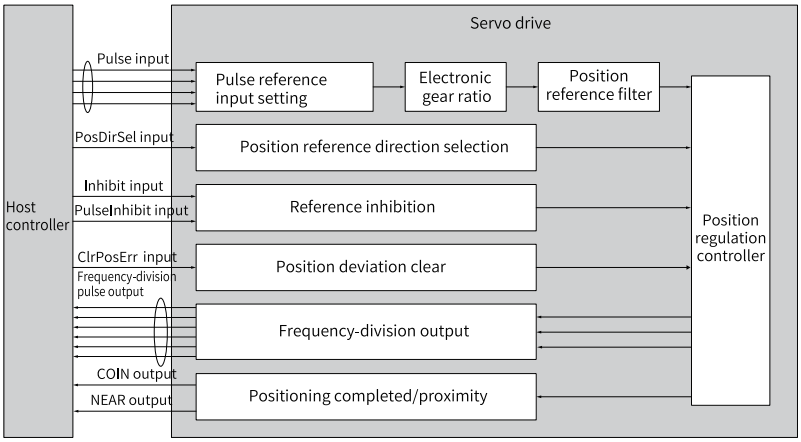


Figure 11-53 Signal exchange between the drive and the host controller

11.9.1 Function Block Diagram

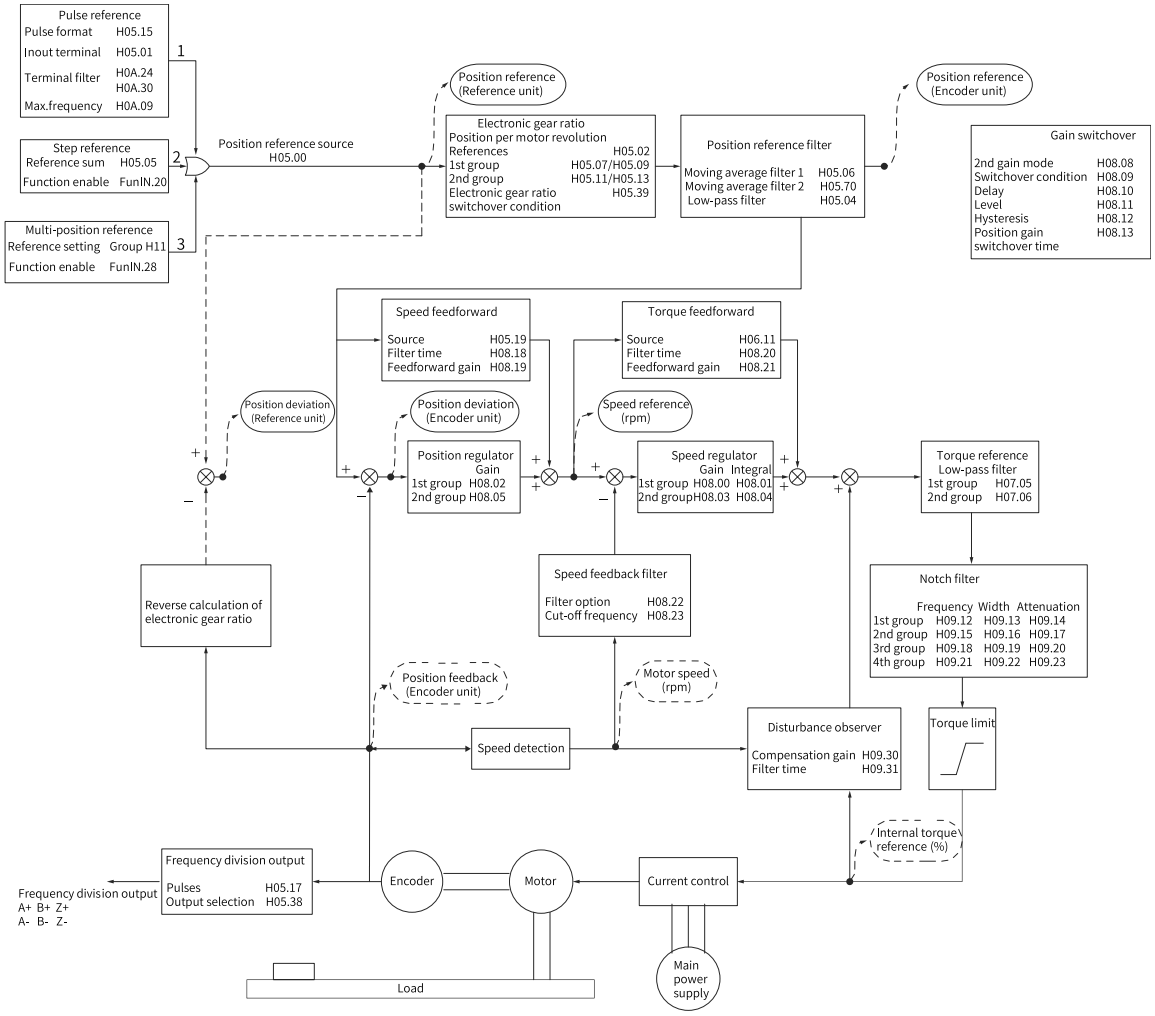


Figure 11-54 Block diagram of position control

11.9.2 Position Reference Input

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

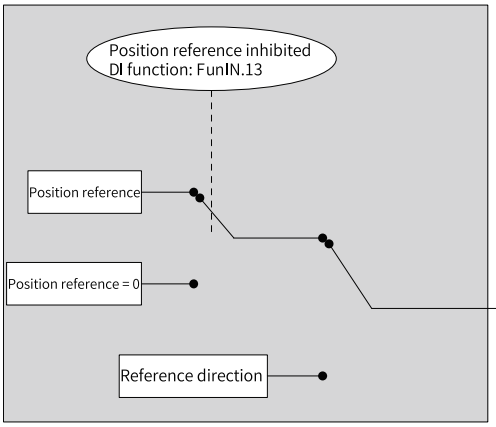


Figure 11-55 Block diagram of position reference input setting

Position reference source

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

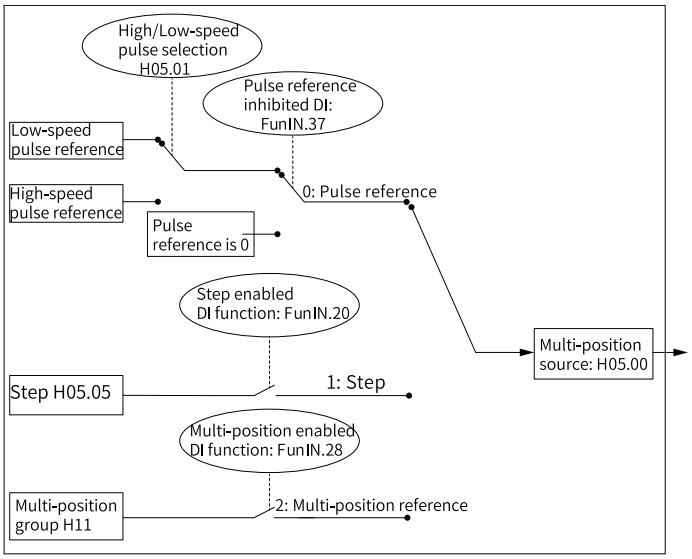


Figure 11-56 Setting of the position reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H05.00	2005-01h	Main position reference source	2: Multi-position reference	2	-	Real time	"H05_en.00" on page 553

- **Multi-position reference as the position reference source (H05.00 = 2)**
  The servo drive supports multi-position operation. It stores 16 position references. You can set the displacement, maximum running speed, and acceleration/deceleration time of each position. You can also set the time interval and switch mode between positions according to actual requirements. The setting flowchart is shown in the following figure.

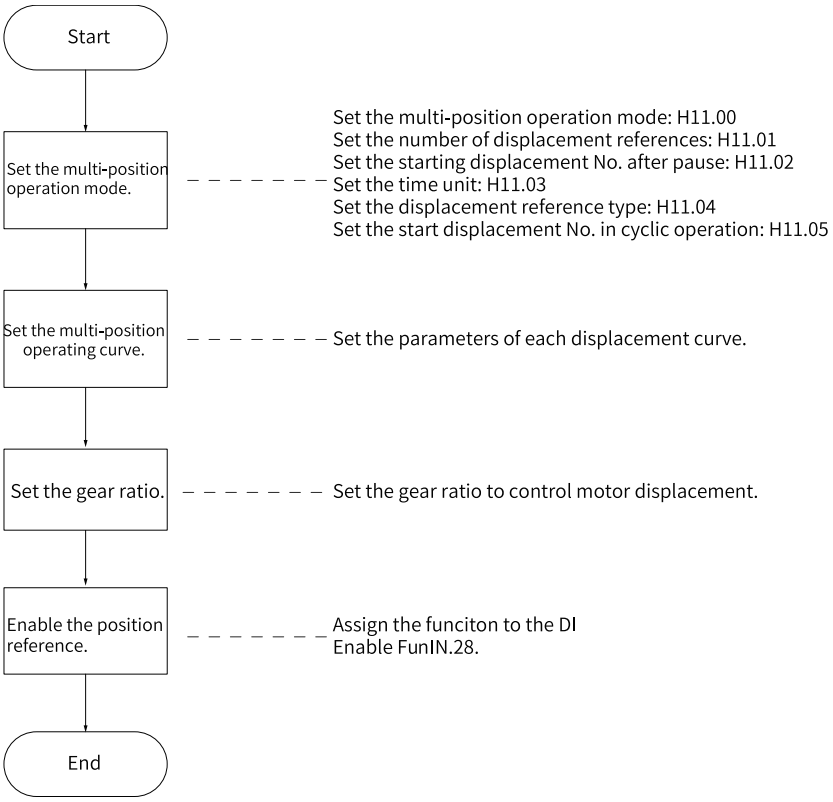


Figure 11-57 Flowchart of setting multi-position reference as the source

- Multi-position running mode

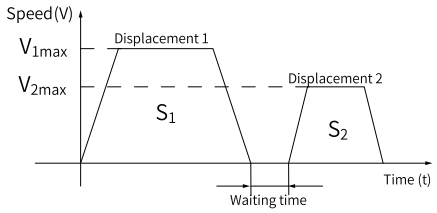
  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H11.00	2011-01h	Multi-position running mode	0: Individual operation (number of displacements defined by H11.01) 1: Cyclic operation (number of displacement defined by H11.01) 2: DI-based operation (defined by DI) 3: Sequential operation 5: Axis-controlled continuous operation	1	-	At stop	"H11_en.00" on page 672
H11.01	2011-02h	Number of position references in multi-position mode	1 to 16	1	-	At stop	"H11_en.01" on page 676
H11.02	2011-03h	Starting position number after pause	0: Continue to execute the remaining positions 1: Start from position 1	0	-	At stop	"H11_en.02" on page 676
H11.03	2011-04h	Waiting time unit	0: ms 1: s	0	-	At stop	"H11_en.03" on page 677

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H11.04	2011-05h	Displacement reference type	0: Relative displacement reference 1: Absolute displacement reference	0	-	Real time	"H11_en.04" on page 677
H11.05	2011-06h	Starting position number in sequential operation	0 to 16	0	-	At stop	"H11_en.05" on page 677

1. **Stop after running a single cycle (H11.00 = 0)**

Table 11–5 Description of individual operation

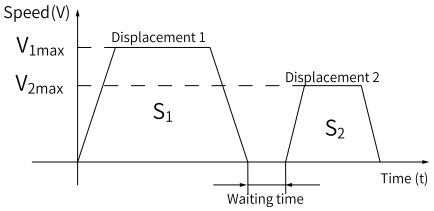
Mode description	Operating curve
• The drive stops after one cycle of operation. • The drive switches to the next position automatically. • The time interval between positions can be set as needed. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max}, V_{2max}: maximum values of the 1st and 2nd speeds. S_1, S_2: displacements of 1st and 2nd positions. • The positioning completed signal is active after each displacement is reached. • If the PoslnSen signal is switched off during running, the servo drive discards the uncompleted displacement and stops. After the stop process is completed, the positioning completion signal is active. • After the PoslnSen signal is enabled again, the drive executes the displacement 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.

★Terms:

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

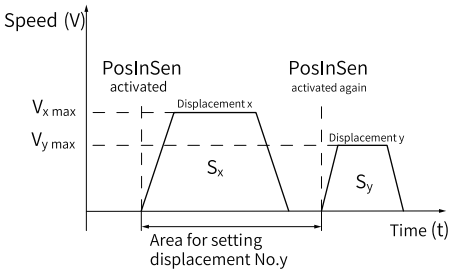
2. **Cyclic operation (H11.00 = 1)**

Table 11–6 Description of cyclic operation

Mode description	Operating curve
• The drive starts from position 1 again after each cycle of operation. • The drive switches to the next position automatically. • The time interval between positions can be set as needed. • The cyclic operation mode remains active when the FunIN.28 (Multi-position reference enable) is active. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds. S_1 , S_2 : displacements of 1st and 2nd positions. • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the drive discards the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • After the PoslnSen signal is enabled again, the drive executes the displacement 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.

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

Table 11–7 Descriptions of DI-based operation

Mode description	Operating curve
• When the servo drive runs the current position, you can set the next position No. After the position reference of the current number is completed, the servo motor stops. After the PoslnSen (position reference enable) signal is enabled again, the present displacement will be executed. • The speed No. is determined by the DI logic. • The time internal between positions is determined by the command delay of the host controller. • The PoslnSen (multi-position reference enable) signal is edge-triggered.	 V_{xmax} , V_{ymax} : maximum operating speeds at position x and position y S_x , S_y : displacements of xth and yth positions • The positioning completed signal is active after each displacement is reached. • If the PosInsen (multi-position reference enable) signal is switched off during operation, the drive continues to execute the unfinished displacement and outputs the COIN (positioning completed) signal. • The position No. is switched over according to the following sequence: a. Wait until displacement x is done executing before switching the displacement number. b. When displacement x is in progress or done, switch off the PoslnSen (multi-position reference enable) signal first, and then change the displacement No. from x to y. If x = y, the drive executes displacement x again. c. After displacement x is done executing, switch on the PoslnSen (multi-position reference enable) signal again to make the 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.

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

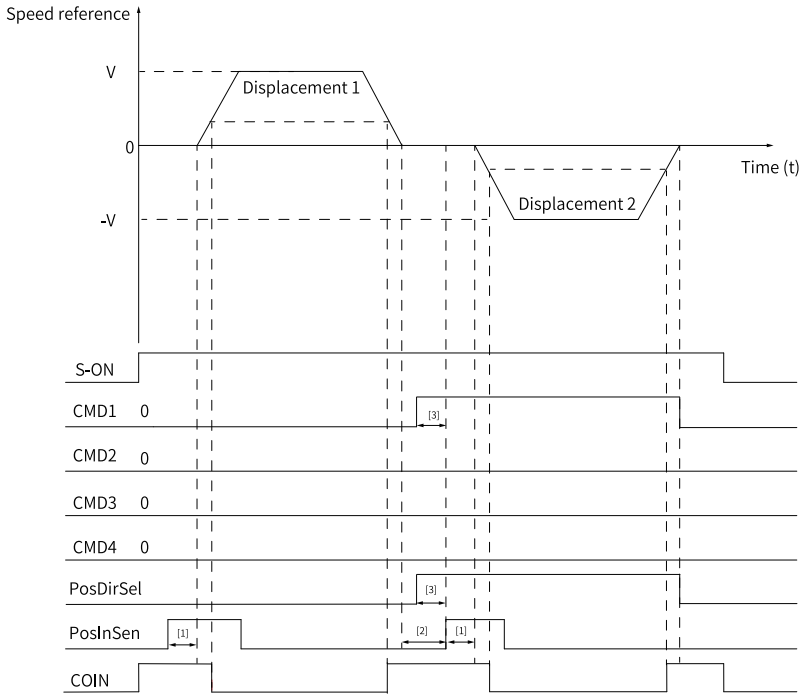


Figure 11-58 Multi-position time sequence

Note

- [1]: The PosInSen signal is edge-triggered. The minimum signal widths required by the normal DI and high-speed DI are 3 ms and 0.25 ms respectively.
- [2]: The area for switching the displacement number, which refers to the interval that starts from the time when the last position reference is transmitted to the time when the next PosInSen (multi-position reference enable) signal is activated again.
- [3]: When a normal DI is used, an effective signal width of 0.125 ms must be maintained.

☆ Related parameters:

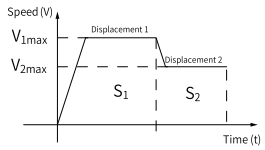
No.	Name	Function name	Description
FunIN.6	CMD1	Multi-reference switchover 1	The position No. is a 4-bit binary. The relationship between the position No. and CMD1 to CMD4 is shown in *"Table 11-8" on page 336*. The DI terminal logic is level-triggered. The signal is 1 when the input level is active, and 0 when the input level is inactive.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 11–8 Relationship between the position No. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Segment No.
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

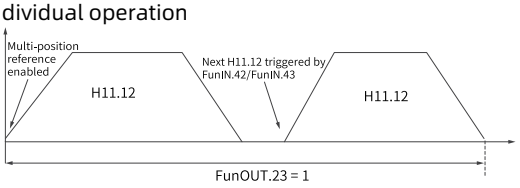
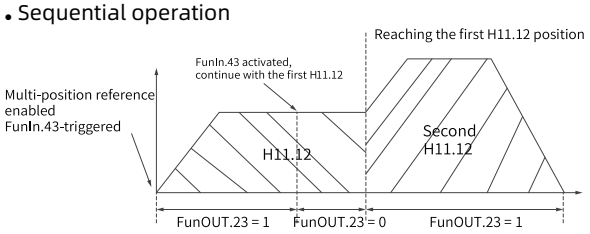
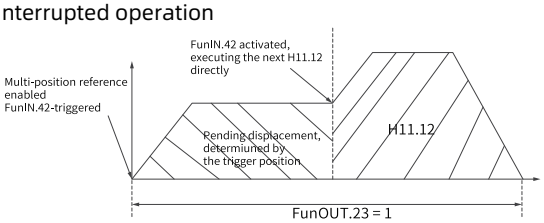
4. **Sequential operation (H11.00 = 3)**

Table 11–9 Description of sequential operation

Mode description	Operating curve
• The drive stops after one cycle of operation. • (H11.05 = 0 or H11.05 > H11.01). • The starting position after the first cycle of operation is defined by H11.05. • The drive switches to the next position automatically. • There is no waiting time between positions. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds. S_1 , S_2 : displacements of 1st and 2nd positions. • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the drive discards the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • After the PoslnSen signal is enabled again, the drive executes the displacement 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.

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

Table 11–10 Description of axis-controlled continuous operation

Mode description	Operating curve
• The drive executes only one displacement. • 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.43/42 triggered later). The drive stops after executing the distance defined by H11.12. • Sequential operation  • The PoslnSen (multi-position reference enable) signal is triggered only once. Write H11.12 again and activate FunIN.43 when the distance defined by the first H11.12 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.42 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 drive stops executing the first H11.12 and turns to executing the second H11.12.

☆ Related parameters:

No.	Name	Function name	Description
FunIN.42	MultiBlockTrig	Axis control command executed immediately	Active: Newly written command activated immediately Inactive: Newly written command not activated
FunIN.43	MultiBlockWr	Axis control command not executed immediately	Active: Newly written command activated after current displacement is done executing Inactive: Newly written command not activated
FunOUT.23	WrNextBlockEn	Command input	Active: Next command input allowed Inactive: Next command input inhibited

- Setting the multi-position operating curve

  The servo drive supports 16 position references. You can set the displacement, maximum running speed, and acceleration/deceleration time of each position. The following descriptions take the 1st position as an example.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H11.12	2011-0Dh	Displacement of position 1	-1073741824 to 1073741824	10000	Reference unit	Real time	"H11_en.11" on page 678
H11.14	2011-0Fh	Maximum running speed of position 1	1 to 10000	200	rpm	Real time	"H11_en.12" on page 678
H11.15	2011-10h	Acceleration/ Deceleration time of position 1	0 to 65535	10	ms	Real time	"H11_en.15" on page 679
H11.16	2011-11h	Waiting time after completion of position 1	0 to 10000	10	ms (s)	Real time	"H11_en.16" on page 679

The actual motor running curve according to the preceding setting is shown in the following figure.

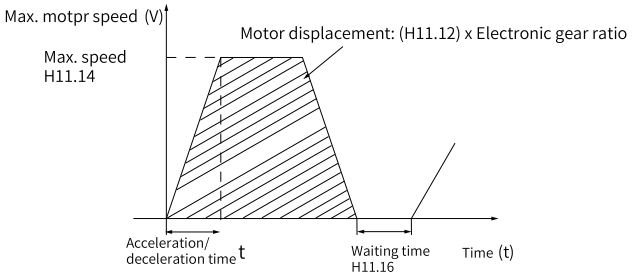


Figure 11-59 Motor running curve of 1st displacement

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

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

For the parameter settings of the other 15 displacements, see *" Parameter Descriptions" on page 525*.

- Setting the 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 drive, and set the active logic of this DI.

  ☆ Related function No.:

No.	Name	Function name	Description
FunIN.28	PosInSen	Multi-position reference signal enable	Active: The motor executes the multi-position reference. Inactive: Servo motor is in the locked state. Note: • When H11.00 is set to 0, 1, or 3, the logic of the DI assigned with the PosInSen signal is level-triggered. • When H11.00 is set to 2, the logic of the DI assigned with the PosInSen signal is edge-triggered.

Position reference inhibited

FunIN.13 (Inhibit) is used to inhibit position references.

- Position reference inhibited function
  The 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 position control mode. In this case, the servo drive can be switched to other control modes.

  To use FunIN.13(Inhibit, position reference), assign FunIN.13 to a certain DI and set the active logic of this DI. It is recommended to use the high-speed DI (DI7 or DI8) terminal.

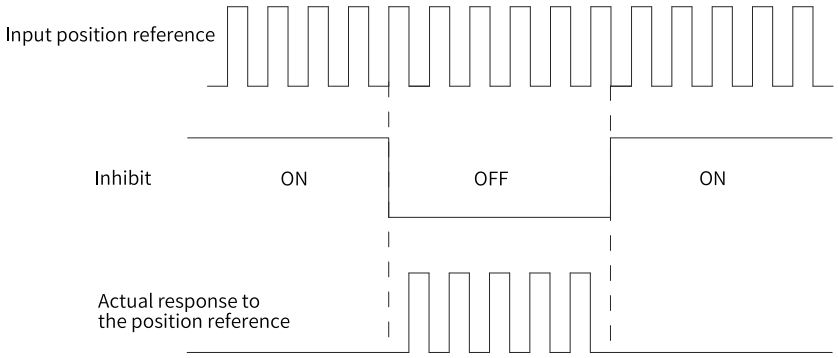


Figure 11-60 Waveform example of position reference inhibited

☆ Related function No.:

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

11.9.3 Reference Frequency Division/Multiplication (Electronic Gear Ratio)

Definition of the electronic gear ratio

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

★Terms:

- Reference unit: the minimum identifiable value input from the host controller to the drive.
- Encoder unit: 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 with the mechanical structure. Set the electronic gear ratio according to the following flowchart.

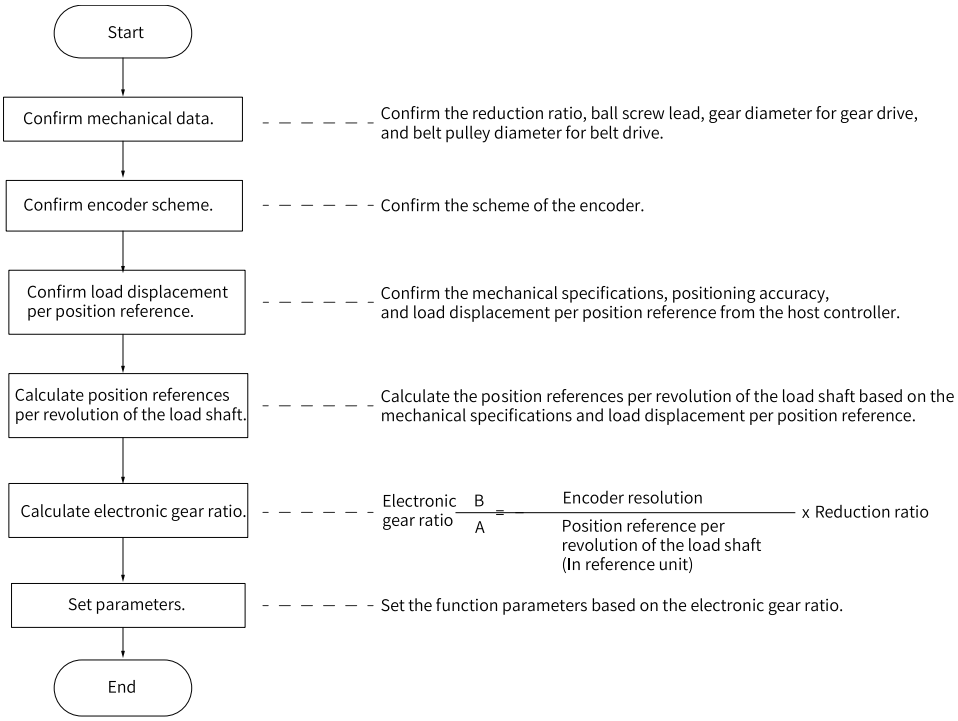


Figure 11-61 Procedure for setting the electronic gear ratio

See the following figure for how to set parameters.

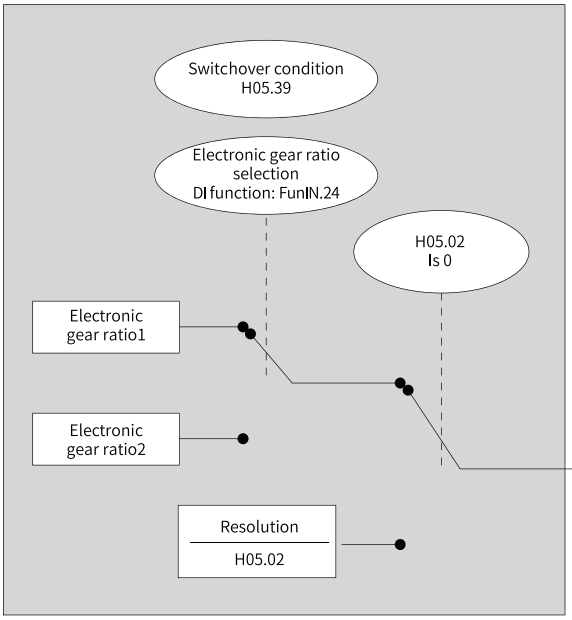


Figure 11-62 Procedure for setting the electronic gear ratio

Note

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

Electronic gear ratio $\frac{B}{A} = \frac{\text{Resolution}}{\text{H05.02}}$

. When H05-02 is set to 0, electronic gear ratios 1 and 2 are invalid.

Technical data

- Setting the electronic gear ratio parameters

  ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.02	2005-03h	Pulses per revolution	0 to 4294967295	0	PPR	At stop	"H05_en.02" on page 553
H05.07	2005-08h	Electronic gear ratio 1 (numerator)	1 to 1073741824	8388608	-	Real time	"H05_en.07" on page 554
H05.09	2005-0Ah	Electronic gear ratio 1 (denominator)	1 to 1073741824	10000	-	Real time	"H05_en.09" on page 554
H05.11	2005-0Ch	Electronic gear ratio 2 (numerator)	1 to 1073741824	8388608	-	Real time	"H05_en.11" on page 554
H05.13	2005-0Eh	Electronic gear ratio 2 (denominator)	1 to 1073741824	10000	-	Real time	"H05_en.13" on page 555

- 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 and 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 parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.39	2005-28h	Electronic gear ratio switchover condition	0: Switchover after position reference is kept 0 for 2.5 ms 1: Switched in real time	0	-	At stop	"H05_en.39" on page 559

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

☆Related parameters

Code	Name	Function	Description
FunIN.24	GEAR_SEL	Electronic gear ratio selection	Inactive: Electronic gear ratio 1 used in the position control mode Active: Electronic gear ratio 2 used 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	$\frac{H05.07}{H05.09}$
		Active	$\frac{H05.11}{H05.13}$
	1	Inactive	$\frac{H05.07}{H05.09}$
		Active	$\frac{H05.11}{H05.13}$
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 a 23-bit serial encoder is 2^{23} PPR, which is 8388608 PPR.

- Calculating the electronic gear ratio

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

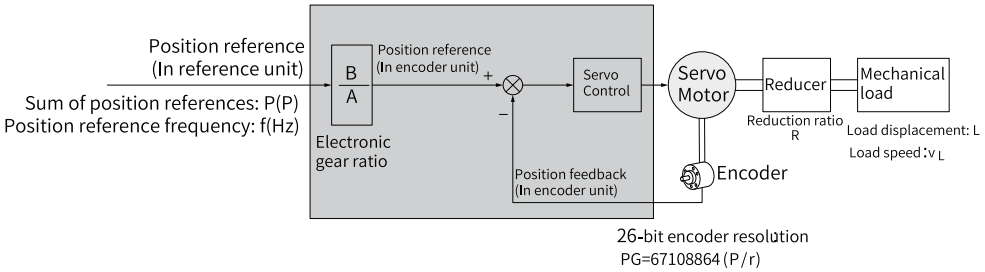


Figure 11-63 Relationship among the position reference (reference unit), load displacement, and electronic gear ratio

Take the 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.

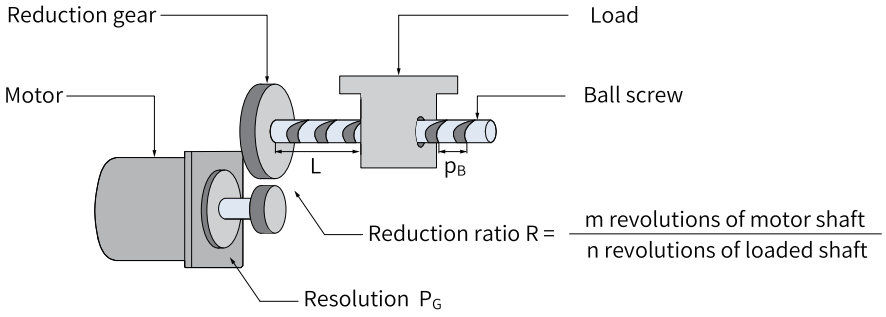


Figure 11-64 Ball screw

- When the load displacement per pulse ΔL (mm) 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 V_L (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 relationship among the position reference frequency, electronic gear ratio, and motor speed is as follows:

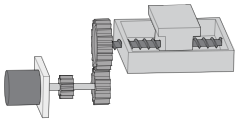
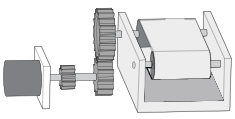
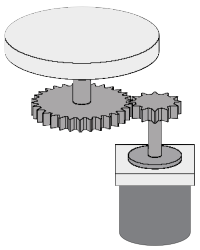
$$f \times \frac{B}{A} = v_M \times P_G$$

  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 11–11 Example for setting electronic gear ratio

Item	Name	Mechanical structure		
		Transmission with ball screw	Transmission with belt pulley	Rotary 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	23-bit = 8388608P/r	23-bit = 8388608P/r	23-bit = 8388608P/r

Item	Name	Mechanical structure		
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)	$\frac{0.01}{0.0001} = 100$	$\frac{0.628}{0.000005} = 125600$	$\frac{360}{0.01} = 36000$
5	Calculation	$\frac{B}{A} = \frac{8388608}{100} \times \frac{1}{1}$	$\frac{B}{A} = \frac{8388608}{125600} \times \frac{5}{1}$	$\frac{B}{A} = \frac{8388608}{36000} \times \frac{10}{1}$
6	Setting	H05.07 = 8388608 H05.09 = 100	H05.07 = 41943040 H05.09 = 125600	H05.07 = 83886080 H05.09 = 36000

11.9.4 Position Reference Filter

Position reference filter serves to filter the position references (in encoder unit) multiplied or divided by the electronic gear ratio, which includes first-order low-pass filtering and moving average filtering. It involves the first-order filter and moving average filter.

It is applicable to the following conditions:

- 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.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.04	2005-05h	First-order low-pass filter time constant	0.0 to 6553.5	0.0	ms	At stop	"H05_en.04" on page 554
H05.06	2005-07h	Moving average filter time constant 1	0.0 to 128.0	0.0	ms	At stop	"H05_en.06" on page 554

Note

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

An excessively high setpoint delays the responsiveness, so set a proper filter time constant based on actual conditions.

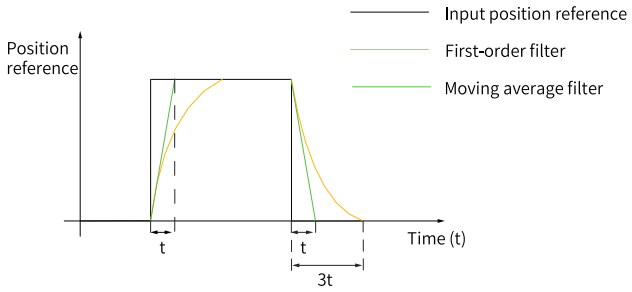


Figure 11-65 First-order filter and moving average filter for rectangular position references

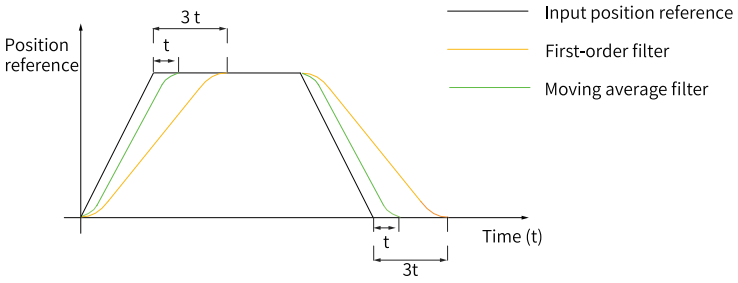


Figure 11-66 First-order filter and moving average filter for trapezoid position references

11.9.5 Frequency-division Output

Caution

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

Parameter	bit	Description
H05.41	Bit 0: Frequency-division Z signal output polarity	0: Positive (falling edge-triggered) 1: Negative (rising edge-triggered)
	Bit 1: OCZ signal output polarity	0: Positive (falling edge-triggered) 1: Negative (rising edge-triggered)

The frequency-division output function outputs the position reference pulses or encoder feedback position references as A/B phase quadrature pulses.

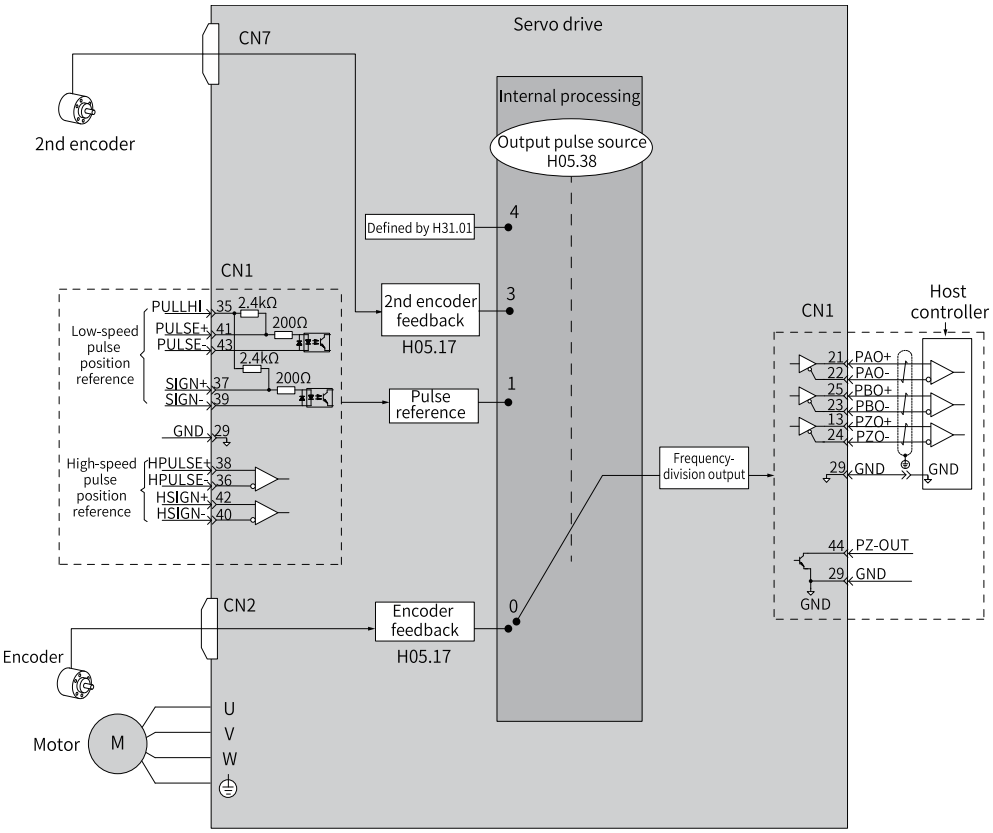


Figure 11-67 Schematic diagram of frequency-division output

- It is recommended to use synchronous output (H05.38 = 1) of pulse references in case of 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).
- When the host controller provides closed-loop feedback, it is recommended to use encoder frequency-division output (H05.38 = 3). When the host controller provides a set output frequency, it is recommended to use frequency-division output (H05.38 = 4).

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

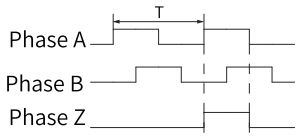
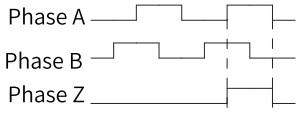
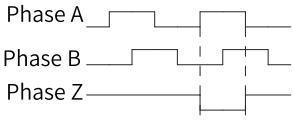
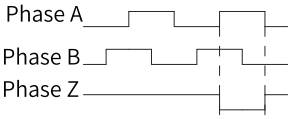
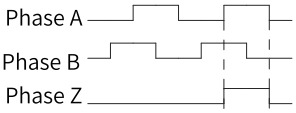
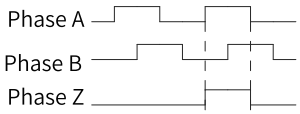
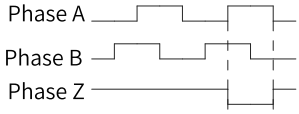
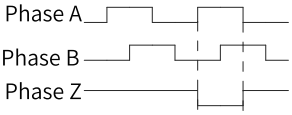
- Phase A pulses: PAO+ and PAO-, differential output, maximum output pulse frequency: 4 Mpps
- Phase B pulses: PBO+ and PBO-, differential output, maximum output pulse frequency: 4 Mpps
- Phase Z pulses: PZO+ and PZO-, differential output, maximum output pulse frequency: 4 Mpps
- PZ-OUT, GND, open-collector output, maximum output pulse frequency: 100 kpps

When using the frequency-division output function, set the output pulse source (H05.38), phase (H02.03), resolution (H05.17), and phase Z pulse polarity (H05.41) according to requirements.

When the output source is encoder frequency-division pulse (H05.38 = 0), the motor rotates one revolution and the phase A/B output pulses per motor revolution are determined by H05.17 (Encoder frequency-division pulses). The pulse width (T) of phase A/B is determined by the motor speed. The phase Z, whose width is also T, is synchronized with phase A. The Z signal is output once per motor revolution.

When the output source is set in H31.01 (H05.38 = 4), the output pulse frequency of phase A/B (quadrupled frequency) is determined by H31.01. In this case, no phase Z pulse is output.

Table 11–12 Pulse diagrams of encoder frequency-division (H05.38 = 0)

H02.03 (Output pulse phase)	H05.41 (Z pulse output polarity)	Pulse Output Diagram of Forward RUN	Pulse Output Diagram of 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:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.03	2002-04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	0	-	At stop	"H02_en.03" on page 534
H05.17	2005-12h	Number of encoder frequency-division pulses	0 to 4194303	2500	PPR	At stop	"H05_en.17" on page 555

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.38	2005-27h	Frequency-division output source	0: Encoder frequency-division output 2: Frequency-division output inhibited 3: 2nd encoder frequency-division output 4: H31.01 Reference frequency output	0	-		"H05_en.38" on page 559
H05.41	2005-2Ah	Z pulse output polarity	bit0: Frequency-division Z output polarity 0: Positive (high level upon active Z pulse) 1: Negative (low level upon active Z pulse) bit1: OCZ output polarity 0: Positive (high level upon active Z pulse) 1: Negative (low level upon active Z pulse) bit2: Inner loop probe Z signal source 0: Motor Z signal1: Frequency-division output Z signal	0x1	-	At stop	"H05_en.41" on page 560

11.9.6 Motion Control Completed, Internal Command Completed, Positioning Completed, Proximity

- "Motion control completed" refers to the completion of command transmission and positioning in the position control mode. In this case, the servo drive outputs a 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. In this case, 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. Homing is completed without using internal instructions.
- Positioning completed: When the position deviation fulfills the condition set by users (H05.20), it indicates the positioning in position control mode is completed. Meanwhile, the servo drive outputs the positioning completed (COIN) signal, and the host controller, after receiving this signal, confirms that positioning is completed.

The following figure shows the schematic diagram.

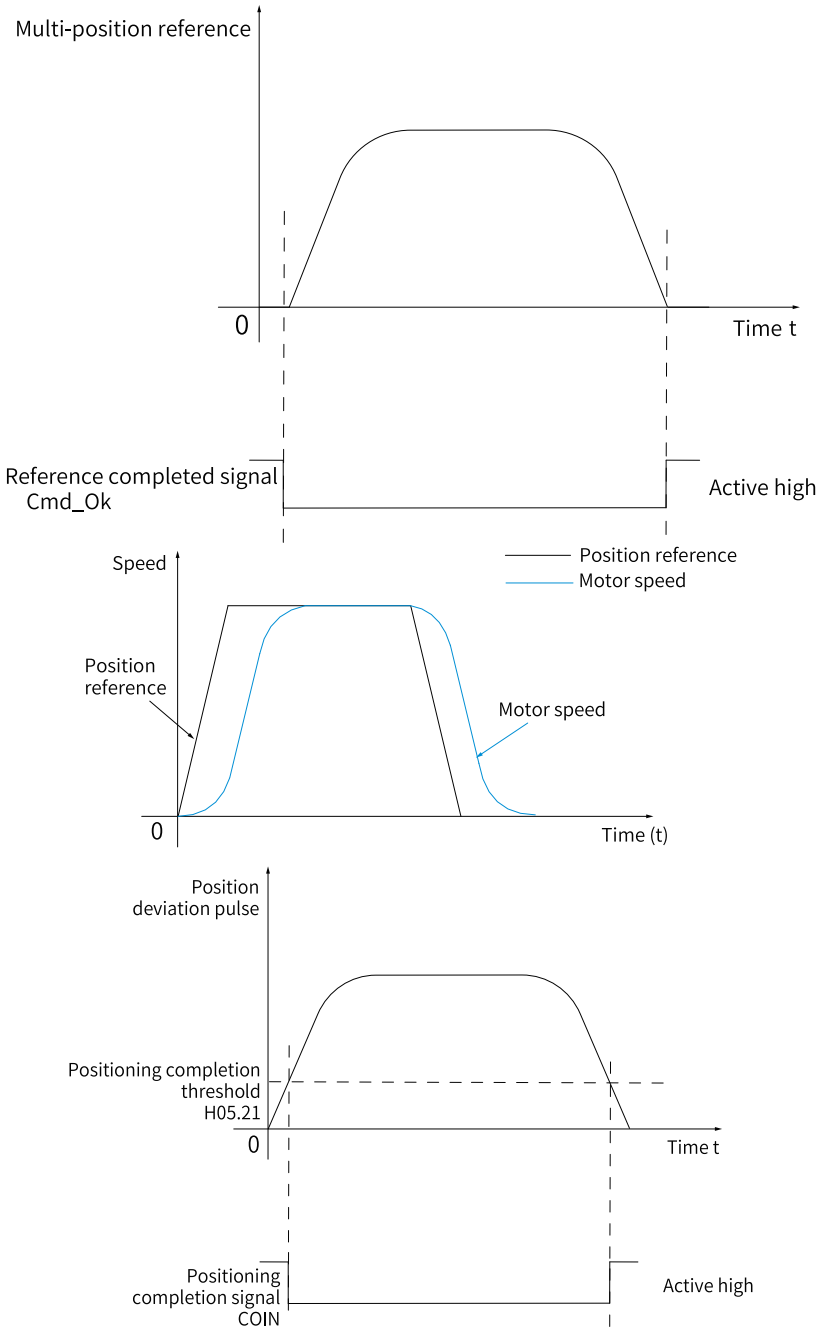


Figure 11-68 Description of positioning completed/proximity functions

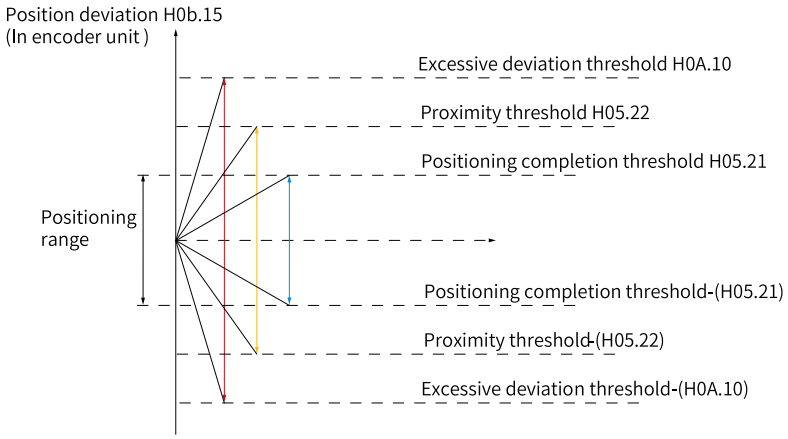
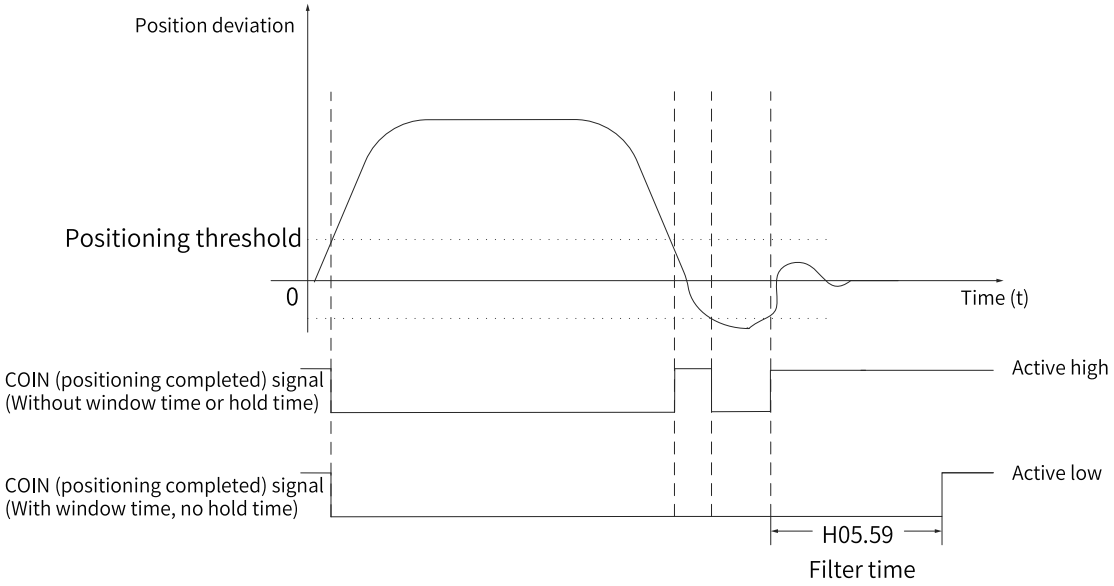


Figure 11-69 Signals related to position deviation

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 signal to prepare for positioning completed.

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 positioning completed signal is as follows.



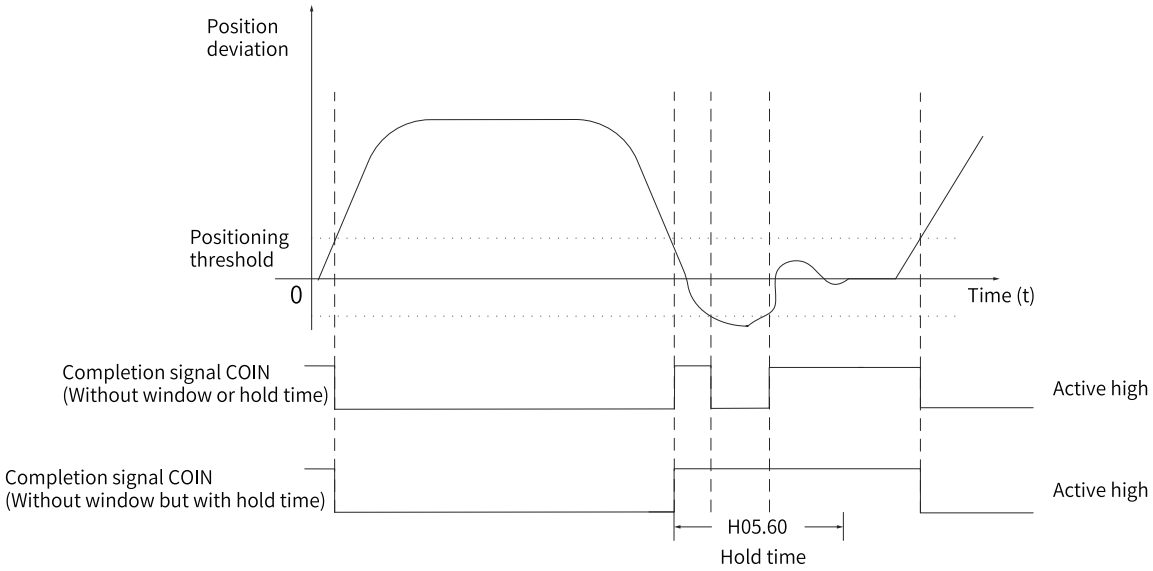


Figure 11-70 Schematic diagram for the window time (H05.59) and hold time (H05.60) of positioning completed signal

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.20	2005-15h	Condition for outputting the positioning completed signal	0: Absolute value of position deviation is smaller than the value of H05.21 1: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 2: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 3: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the unfiltered position reference and absolute value of position deviation. 4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the filtered position reference and absolute value of position deviation. 5: The positioning completion signal ON is output only when the unfiltered position reference is 0, the zero speed signal is ON, and the absolute value of position deviation is lower than H05.21. 6: The positioning completion signal is output only when the absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.	0	-	Real time	"H05_en.20" on page 556

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.20	2005-15h	Condition for outputting the positioning completed signal	7: Positioning completion judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0; position completion signal output when absolute position deviation being lower than H05.21 and unfiltered position reference being 0 The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21. 8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21. 9: Positioning completion is judged after the delay defined by H05.60 elapses and the unfiltered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21. 10: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.	0	-	Real time	
H05.21	2005-16h	Threshold of positioning completed	1 to 65535	5872	Encoder unit	Real time	"H05_en.21" on page 557
H05.22	2005-17h	Proximity threshold	1 to 65535	65535	Encoder unit	Real time	"H05_en.22" on page 558

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.59	2005-3Ch	Positioning window time	0 to 30000	0	ms	Real time	"H05_en.59" on page 563
H05.60	2005-3Dh	Hold time of positioning completed	0 to 30000	0	ms	Real time	"H05_en.60" on page 563
H0A.17	200A-12h	Reference pulse selection	0: Pulse unit 1: Reference unit	1	-	At stop	"H0A_en.17" on page 621

Caution

- Set H05.22 to a value higher than H05.21 in general cases.
- H05.21 only reflects the absolute threshold when the positioning completed signal is active. It is not related to the positioning precision.
- An excessively high speed feedforward gain (H08.19) or low-speed operation reduces the absolute position deviation. In this case, the COIN (positioning completed) signal may keep active if H05.21 is set to an excessively high value. To improve the positioning accuracy, decrease the value of H05.21.
- When H05.21 is set to a low value along with small position deviation, 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.
- The output of position proximity DO is not affected by H05.60 (positioning completion holding time) or H05.59 (positioning window time) and you need not to evaluate the change of the positioning command.

To apply motion control/internal command/positioning completion and the proximity function, allocate the corresponding terminals with FunOUT.24 (McOk, motion control completed), FunOUT.22 (CmdOk, internal command completed), FunOUT.5 (COIN, positioning completed), and FunOUT.6 (NEAR, proximity) respectively, and set the active logic of these terminals.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.60	2005-3Dh	Hold time of positioning completed	0 to 30000	0	ms	Real time	"H05_en.60" on page 563

☆ Related parameters

Code	Name	Function	Description
FunOUT.5	COIN	Positioning completed	Active: The absolute position deviation meets the threshold defined by H05.21 in the position control mode, indicating positioning is done. Inactive: The servo drive is in the process of completion in the position control mode.
FunOUT.6	NEAR	Target position approach	Active: The absolute position deviation meets the condition defined by H05.22, indicating the servo drive is close to the target position. 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.

11.10 Speed Control Mode

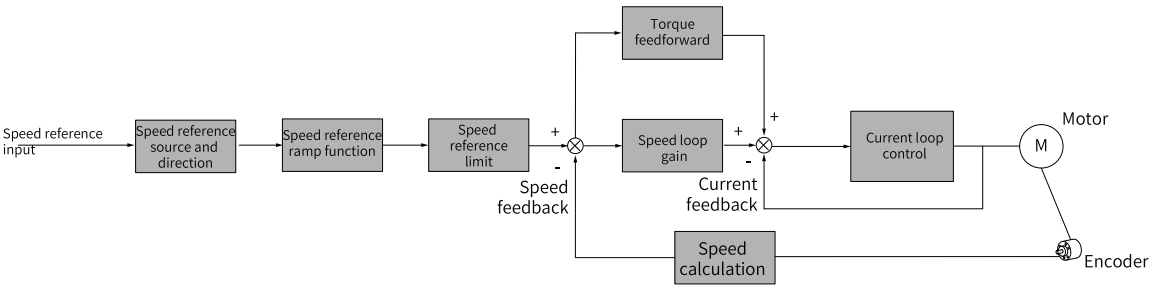


Figure 11-71 Block diagram of speed control

Set H02.00 (control mode selection) to 0 (speed control mode) through the keypad or the Inovance software tool to make the servo drive operate in speed control mode. Set the drive parameters based on the mechanical structure and technical specifications. In the following figure, the basic parameter settings are used to describe the speed control mode.

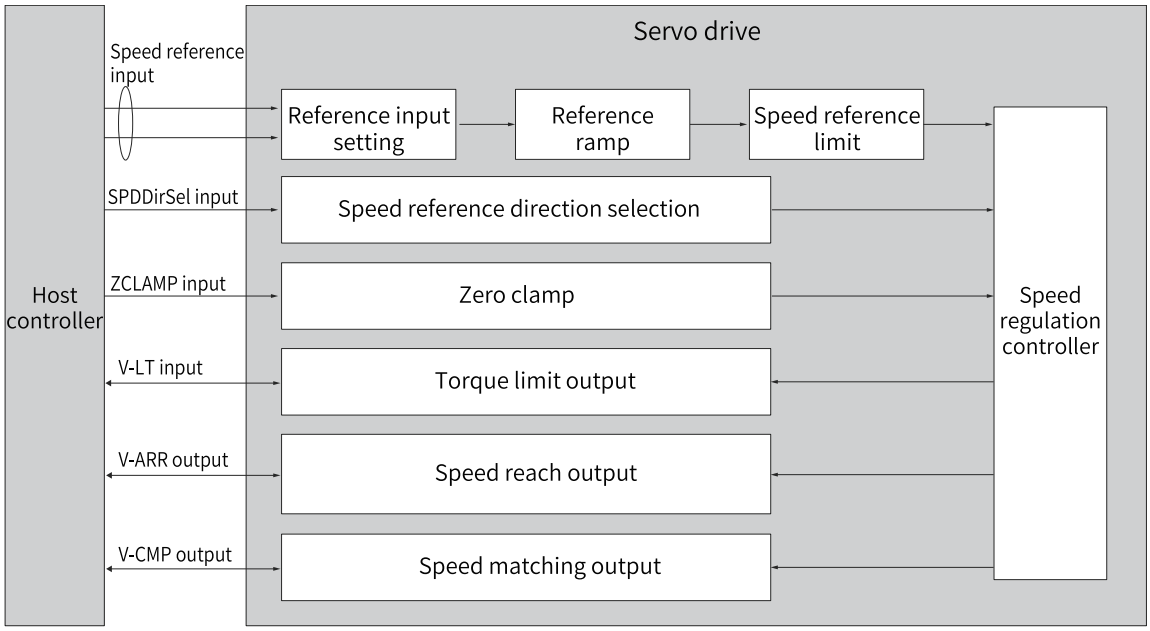


Figure 11-72 Signal exchange between the drive and the host controller

11.10.1 Function block diagram

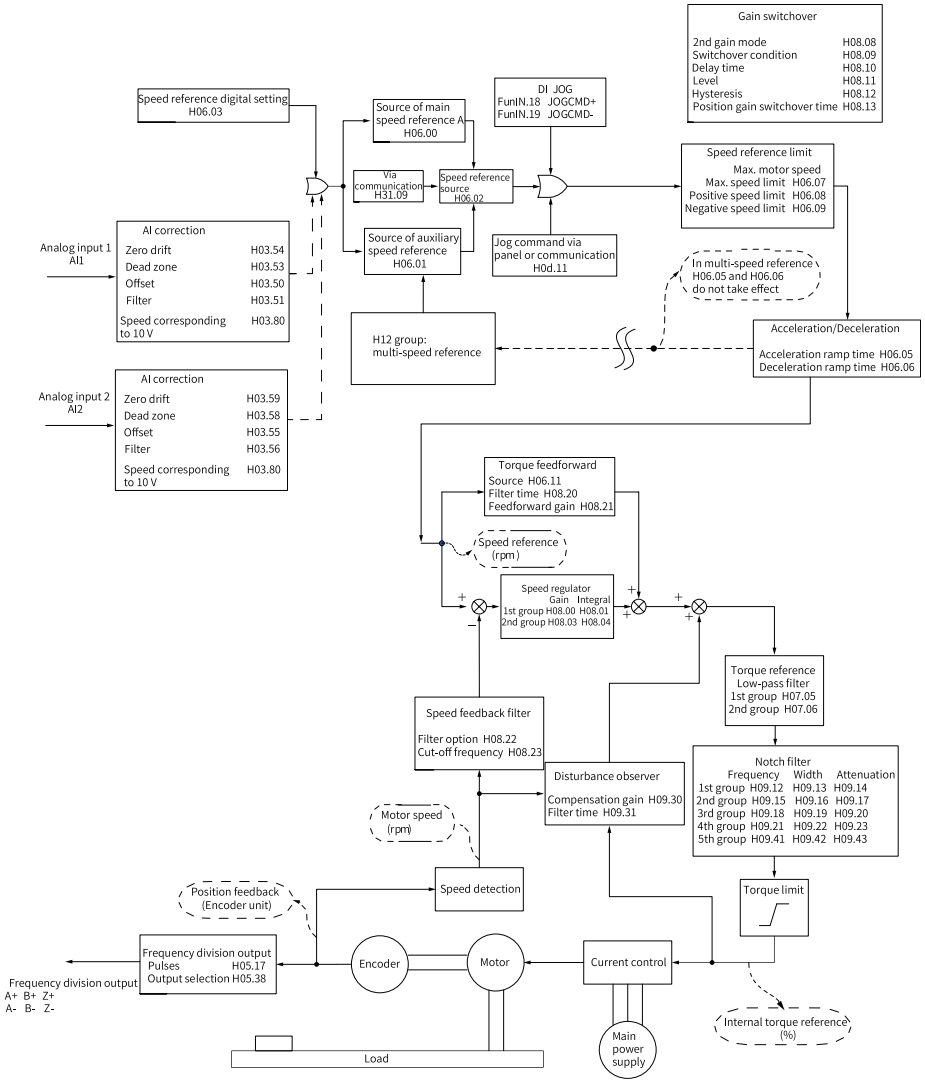


Figure 11-73 Block diagram of speed control parameters

11.10.2 Speed Reference Input

Speed reference source

Five speed reference sources are available in speed control mode, which can be set in H06.02.

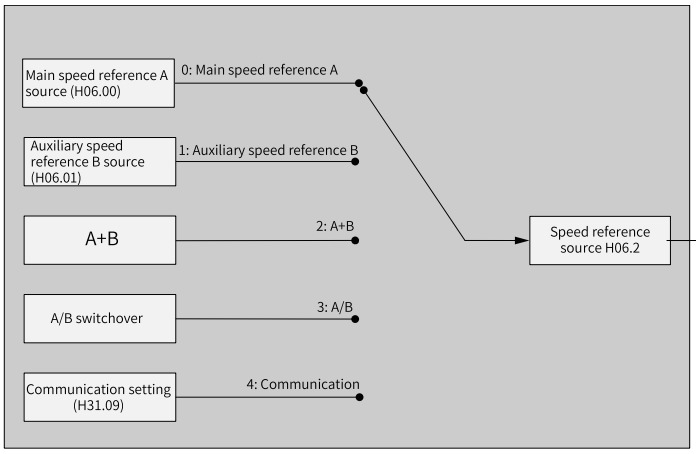


Figure 11-74 Speed reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H06.02	2006-03h	Speed reference source	0: Source of main speed reference A 1: Source of auxiliary speed reference B 2: A+B 3: Switchover between A and B 4: Communication	0	-	At stop	"H06_en.02" on page 565

- **Source of main speed reference A**

  The sources of main speed reference A include digital setting and analog voltage setting. Digital setting refers to the internal speed reference. Analog voltage setting refers to the external speed reference.

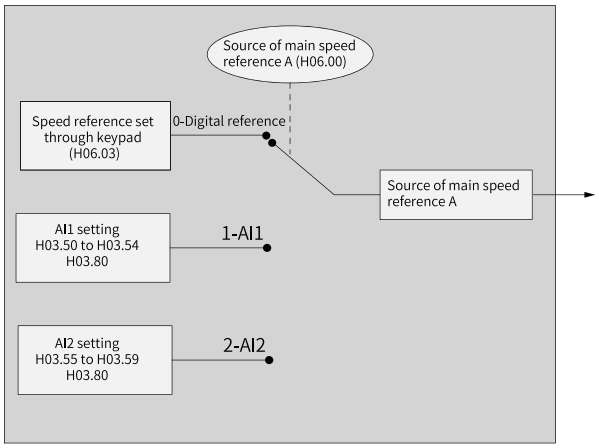


Figure 11-75 Source of main speed reference A

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H06.00	2006-01h	Source of main speed reference A	0: H06.03 1: AI1 2: AI2	0	-	At stop	"H06_en.00" on page 565

- **Digital setting**

  The speed reference is set in H06.03.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H06.03	2006-04h	Speed reference set through operating panel	-10000 to 10000	200	rpm	Real time	"H06_en.03" on page 566

- **Analog voltage setting**

  The analog voltage signal output by the host controller or other devices is processed and then used as the speed reference.

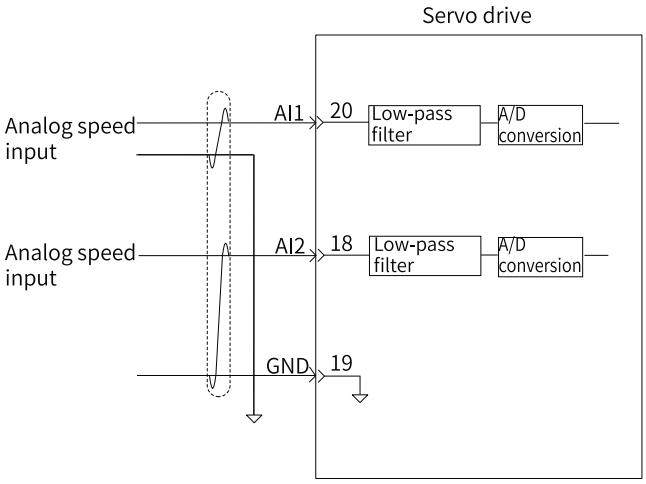
  Analog voltage input terminal:

  The servo drive provides two AIs: AI1 and AI2.

  AI1 voltage-type input: 12-bit, -10 V to +10 V; maximum allowable voltage: ± 12 VDC; input impedance: 74 kΩ.

  AI2 voltage-type input: 12-bit, -10 V to +10 V; maximum allowable voltage: ±12 VDC; input impedance: 74 kΩ.

  Analog input circuit:



Note

AI/DO terminals: AI1 uses pin 25, AI2 uses pin 17, and GND uses pin 8.

Procedure:

The following figure takes AI1 as an example to describe the analog setting of the speed reference.

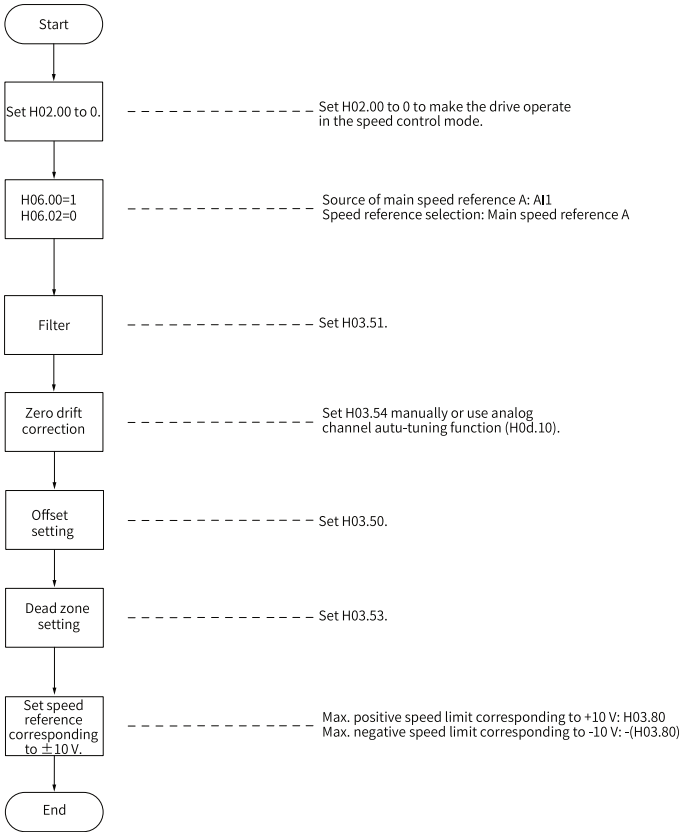


Figure 11-76 Flowchart of setting speed reference by analog voltage

Terms:

- Zero drift: the value of the servo drive sampling voltage relative to GND when the input voltage of the analog channel is zero.
- Offset: the input voltage value of the analog channel when the sampling voltage is zero after zero drift calibration.
- Dead zone: the input voltage range of the analog channel when the sampling voltage is zero.

In the following figure, y_1 represents the unprocessed AO voltage, y_6 represents the final speed reference after being processed by the servo drive.

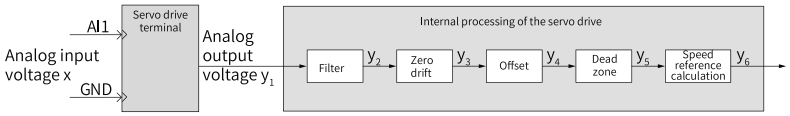


Figure 11-77 AI processing of servo drive

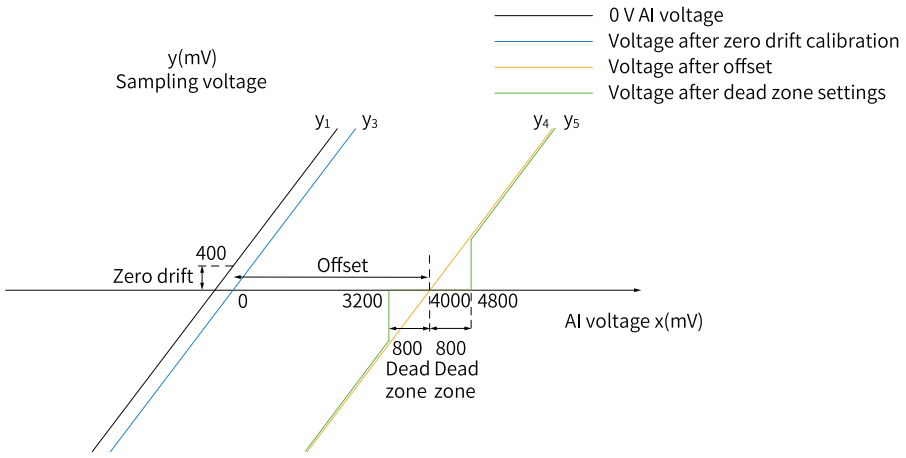


Figure 11-78 Example of sampling voltage and AI processing of servo drive

- **Filter:**
  The servo drive provides filter function for analog channels. Setting the filter time constant in H03.56 prevents motor reference fluctuation caused by unstable analog input voltage and eliminates motor malfunction caused by disturbing signals. The filter function cannot eliminate or suppress the zero drift or dead zone.

- **Zero drift calibration**
  It calibrates the analog output voltage offset relative to the actual input voltage 0 V.

  In the preceding figure, the analog output voltage without being processed by the servo drive is y_1. Take the filter time constant H03.51 = 0.00 ms as an example, and the sampling voltage after filter y_2 is the same as y_1.

  That is, when the actual input voltage x = 0, the output voltage y_1 = 400 mV. Therefore, the zero drift voltage is 400 mV.

  Set H03.54 to 400.0 (mV) manually. The sampling voltage after zero drift calibration is shown by y_3. $y_3 = y_1 - 400.0$

  Zero drift calibration can also be carried out by using the analog automatic tuning function in H0D-10.

- **Offset setting**
  It sets the actual input voltage corresponding to sampling voltage 0.

  Assume that the actual input voltage x = 4000 mV when the sampling voltage y_4 = 0. That is, the offset is 4000 mV.

  Set H03.50 to 4000 (mV). The sampling voltage after offset $y_4 = x - 4000 = y_3 - 4000$

- **Dead zone calibration**
  It sets the effective input voltage range when the sampling voltage of the servo drive is not 0.

  After the offset is set, if the sampling voltage is always 0 when the input voltage x is within 3200 mV to 4800 mV, the dead zone is 800 mV.

  Set H03.53 to 800.0 (mV). The sampling voltage after dead zone calibration is shown as y_5:

$$y_5 = \begin{cases} 0 & 3200 \leqslant x \leqslant 4800 \\ y_4 & 4800 < x \leqslant 10000 \text{ or } -10000 \leqslant x < 3200 \end{cases}$$

- **Speed reference calculation**

  After setting the zero drift, offset, and dead zone, set the speed reference corresponding to 10 V (10000 mV) in H03.80 (Speed corresponding to 10 V) to obtain the actual speed reference y_6:

  $$y_6 = \frac{y_5}{10000} \times (\text{H03.80})$$

  This value is used as the speed reference set via analog in the speed control mode.

  The left figure below applies when no offset exists. The right figure below applies when offset exists. After all setting is completed correctly, view the sampling voltage of AI1 in H0b.21 or the speed reference corresponding to analog input in H0b.01.

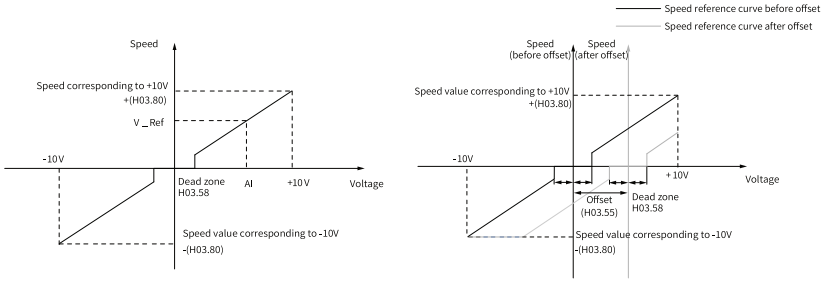


Figure 11-79 AI1 without offset (left) & AI1 after offset (right)

The relationship between the final speed reference y_6 and the input voltage x is:

$$y_6 = \begin{cases} 0 & B\text{-}C \leqslant x \leqslant B+C \\ x\text{-}B & B+C < x \leqslant 10000 \text{ or } -10000 \leqslant x < B\text{-}C \end{cases}$$

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H03.50	2003-33h	Voltage-type AI1 offset	-5000 to +5000	0	mV	Real time	"H03_en.50" on page 546
H03.51	2003-34h	Voltage-type AI1 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.51" on page 547
H03.53	2003-36h	Voltage-type AI1 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.53" on page 547
H03.54	2003-37h	Voltage-type AI1 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.54" on page 547
H03.55	2003-38h	Voltage-type AI2 offset	-5000 to +5000	0	mV	Real time	"H03_en.55" on page 547

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H03.56	2003-39h	Voltage-type AI2 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.56" on page 548
H03.58	2003-3Bh	Voltage-type AI2 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.58" on page 548
H03.59	2003-3Ch	Voltage-type AI2 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.59" on page 548
H03.80	2003-51h	Speed corresponding to analog 10 V	0 to 10000	3000	rpm	At stop	"H03_en.80" on page 550
H0d.10	200d-0Bh	Automatic tuning of analog channel	0: No operation 1: Adjust AI1 2: Adjust AI2	0	-	At stop	"H0d_en.10" on page 657

- **Source of auxiliary speed reference B**

  The auxiliary speed reference B sources include digital setting, analog setting, and multi-speed references. Digital setting and multi-speed references produce the internal speed reference, and analog setting produces the external speed reference.

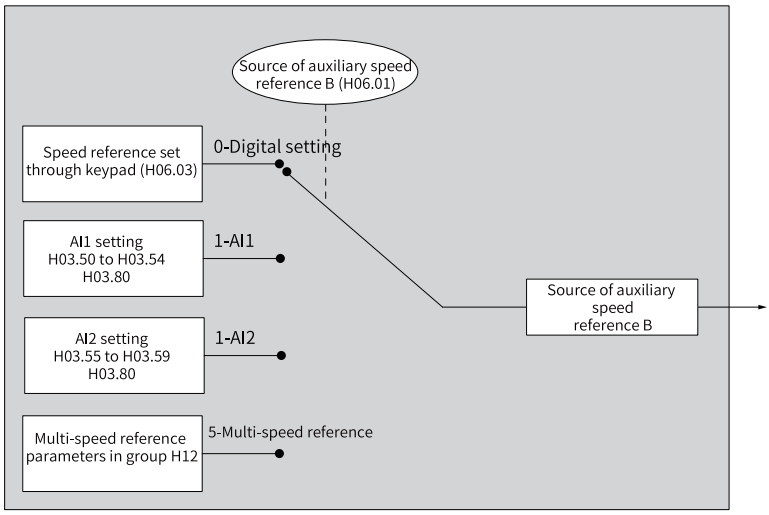


Figure 11-80 Source of auxiliary speed reference B

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H06.01	2006-02h	Source of auxiliary speed reference B	0: H06.03 1: AI1 2: AI2 5: Multi-speed reference	1	-	At stop	"H06_en.01" on page 565

The digital setting mode is the same as that of the main speed reference A source. The following part describes how to set auxiliary speed reference B via multi-speed reference.

The servo drive supports multi-speed running. The servo drive stores 16 speed references, and the maximum running speed and running time of each can be set. Four groups of acceleration/deceleration time are optional. The setting flowchart is shown in the following figure.

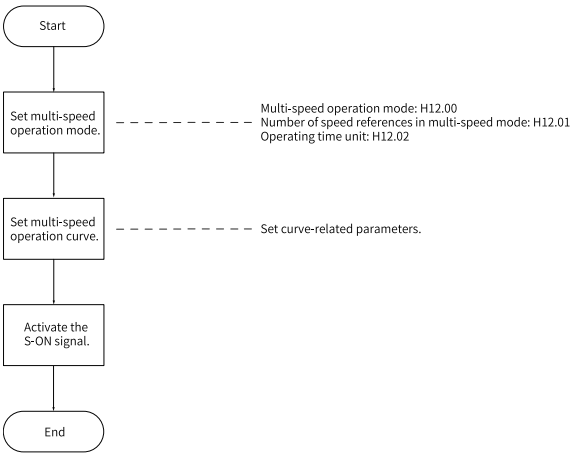


Figure 11-81 Multi-speed reference setting flowchart

1. Setting of multi-speed running mode

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H12.00	2012-01h	Multi-speed operation mode	0: Stop after running for one cycle (number of speeds defined by H12.01) 1: Cyclic operation (number of speeds defined by H12.01) 2: DI-based operation	1	-	At stop	"H12_en.00" on page 693
H12.01	2012-02h	Number of speed references in multi-speed mode	1 to 16	16	-	At stop	"H12_en.01" on page 694
H12.02	2012-03h	Operation time unit	0: s 1: min	0	-	At stop	"H12_en.02" on page 694

Assign an external DI terminal with FunIN.5: DIR-SEL to select the multi-speed running direction.

☆ Related parameters:

No.	Name	Function name	Description
FunIN.5	DIR-SEL	Multi-reference direction	Inactive: Reference direction by default Active: Opposite to the reference direction

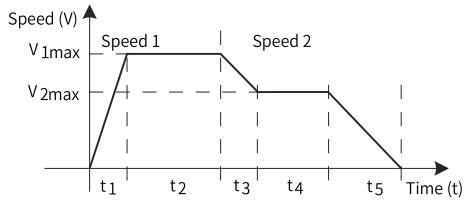
The following takes "H12.01 = 2" as an example to describe each mode.

- 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 drive executes multi-speed references in a sequence from speed 1 to speed N. After all the speeds are executed, the drive stops.

Table 11–13 Description of individual operation

Mode description	Operating curve
• The drive stops after one cycle of operation. • The drive switches to the next position automatically.	 • V_{1max} and V_{2max} : reference values of speed 1 and speed 2 • t_1 : actual acceleration/deceleration time of speed 1 • t_3 , t_5 : actual acceleration/deceleration time of 2nd speed • Operating time = Time taken in switching from the last speed to current speed + Duration of constant-speed operation at current speed (For example, the operating time of speed 1 is the sum of $t_1 + t_2$; the operating time of speed 2 is the sum of $t_3 + t_4$). • Do not set the operating time of a certain speed to 0. Otherwise, the drive skips this speed and switches to the next speed directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed. • If the servo ON signal becomes OFF during running of a certain speed, the servo motor stops according to the stop mode in H02.05.

★Terms:

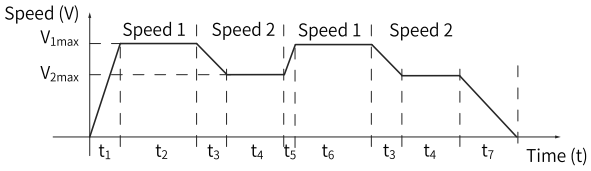
A complete operation cycle covers all the multi-speed references defined by H12.01.

- Cyclic running (H12.00 = 1)

  Set H12.00 to 1 to select the cyclic operation mode.

  Set H12.01 and H12.02 based on the number of speeds and the operating time unit. Then set the reference value, operating time and acceleration/deceleration time for each speed. The drive executes the set speeds in a sequence from speed 1 to speed N (last speed). After all the speeds are executed, the drive jumps to speed 1 and repeats the preceding process.

Table 11–14 Description of cyclic operation

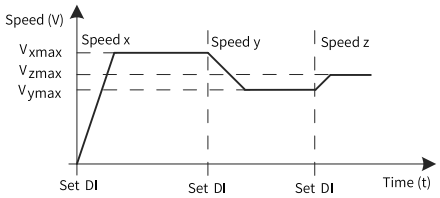
Mode description	Operating curve
• The drive starts from position 1 again after each cycle of operation. • The drive switches to the next position automatically. • The drive remains in the cyclic running state if the servo ON signal is active.	 • V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds. • Operating time = Time taken in switching from the last speed to current speed + Duration of constant-speed operation at this speed. For example, the operating time of speed 1 is the sum of t_1 and t_2 , and 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 drive skips this speed and switches to the next speed directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed. • If the servo ON signal becomes OFF during running of a certain speed, the servo motor stops according to the stop mode in H02.05.

- DI switchover (H12.00 = 2)

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

  Set H12.01 and H12.02 based on the number of speeds to be executed and the operating time unit. Then, set the reference value, operating time and acceleration/deceleration time for each speed. The drive executes the speed references according to ON/OFF combination of the external DIs (CMDx).

Table 11–15 Descriptions of DI-based operation

Mode description	Operating curve
• The drive operates continuously as long as the S-ON signal is active. • The speed No. is determined by the DI logic. • The operating time of each speed is determined only by the interval time of speed switchover.	 • x and y: speed number (The relationship between the speed number and the DI logic is described below.) • The operating time is independent of the parameter setpoint. If the speed No. changes during operation, the 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. • If the servo ON signal becomes OFF during running of a certain speed, the servo motor stops according to the stop mode in H02.05.

When the multi-speed operation mode is DI-based operation, assign DI functions 6 to 9 (multi-reference switchover) to four DIs and set the active logic of these DIs. In addition, assign FunIN.5 (DIR-SEL, direction selection in DI-based multi-speed operation) to a certain DI to switch the speed reference direction.

☆ Related parameters:

No.	Name	Function name	Description
FunIN.5	DIR-SEL	Setting of multi-speed DI switchover running direction	Switches over the speed reference direction in multi-speed DI switchover 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 relationship between the speed no. and CMD1 to CMD4 is shown in *"Table 11-16" on page 369*. The value of CMD is 1 upon active DI level and 0 upon inactive DI level.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 11–16 Relationship between the segment No. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Segment No.
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

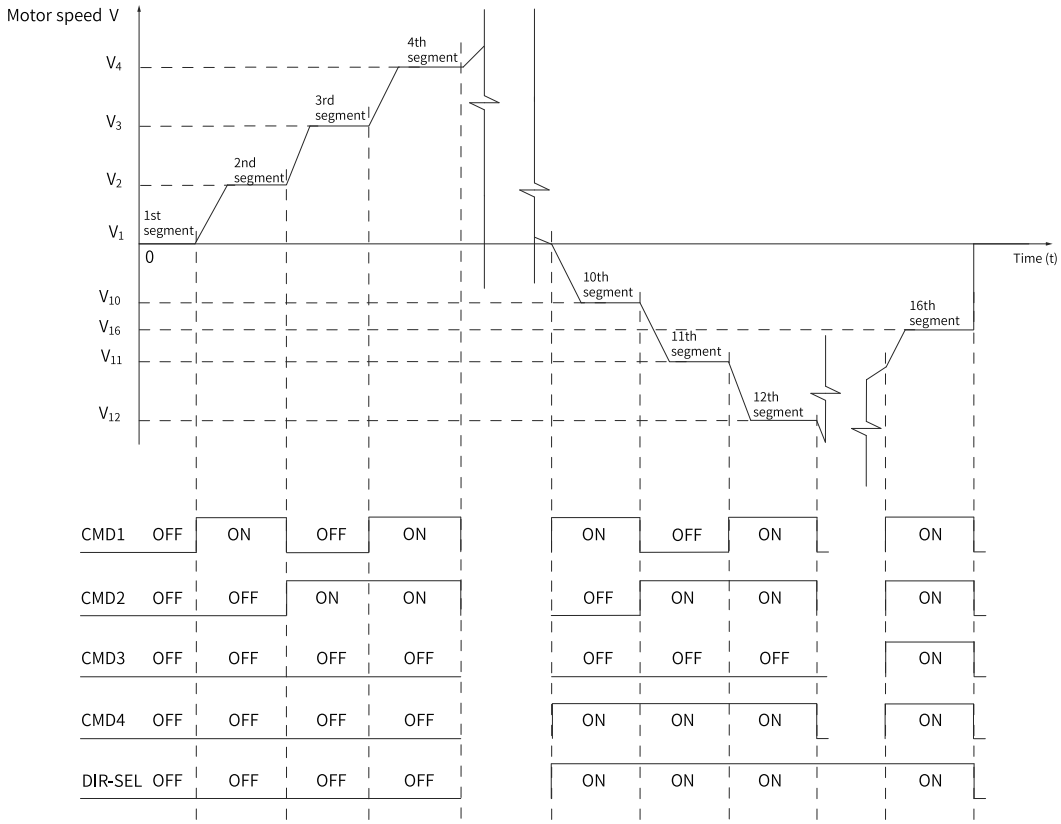


Figure 11-82 Example of multi-speed curve

2. Setting the multi-speed curve

The following takes the 1st speed as an example.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H12.03	2012-04h	Acceleration time 1	0 to 65535	10	ms	Real time	"H12_en.03" on page 694
H12.04	2012-05h	Deceleration time 1	0 to 65535	10	ms	Real time	"H12_en.04" on page 695
H12.09	2012-0Ah	Acceleration time 4	0 to 65535	150	ms	Real time	"H12_en.09" on page 696
H12.10	2012-0Bh	Deceleration time 4	0 to 65535	150	ms	Real time	"H12_en.10" on page 696
H12.20	2012-15h	1st speed reference	-10000 to 10000	0	[mm/s]/[rpm]	Real time	"H12_en.20" on page 697

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H12.21	2012-16h	Operation time of the 1st speed reference	0.0 to 6553.5	5.0	s(m)	Real time	"H12_en.21" on page 697
H12.22	2012-17h	Acceleration/ Deceleration and S-curve smoothing parameter time in speed 1	bit0 to bit7: Acceleration/deceleration time 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 bit8-bit15: S curve smoothing parameter 1: Smoothing parameter 1 2: Smoothing parameter 2 3: Smoothing parameter 3 4: Smoothing parameter 4 5: Smoothing parameter 5 6: Smoothing parameter 6 7: Smoothing parameter 7 8: Smoothing parameter 8	256	-	Real time	"H12_en.22" on page 697

For speed references in multi-speed operation mode, besides the reference value and operating time, four groups of acceleration/deceleration time options are also available. There is no acceleration/deceleration time by default.

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

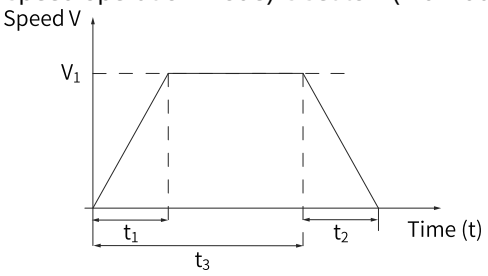


Figure 11-83 Example of multi-speed curve

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

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

The actual deceleration time t_2 is:

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

Operating time = Time taken in switching from the last speed to present speed + Duration of constant-speed operation at present speed (as shown by t_3 in the preceding figure)

- **A/B switchover**

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

☆ Related parameters:

No.	Name	Function name	Description
FunIN.4	CMD-SEL	Main/Auxiliary reference switchover	Inactive: Current reference being A Valid: Current running reference being B

- **Communication**

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H31.09	2031-0Ah	Speed reference set through communication	-9999.000 to 9999.000	0.000	rpm	Real time	*" H31_en.09" on page 825*

11.10.3 Ramp Function

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.

Note

- When the speed reference source is a digital setting, an analog voltage setting, or a jog speed, the acceleration time and deceleration time are set through parameters H06.05 and H06.06.
- When the speed reference source is a multi-speed reference, the acceleration time and deceleration time are set in parameter group H12. For details, see *" Parameter Descriptions" on page 525*.

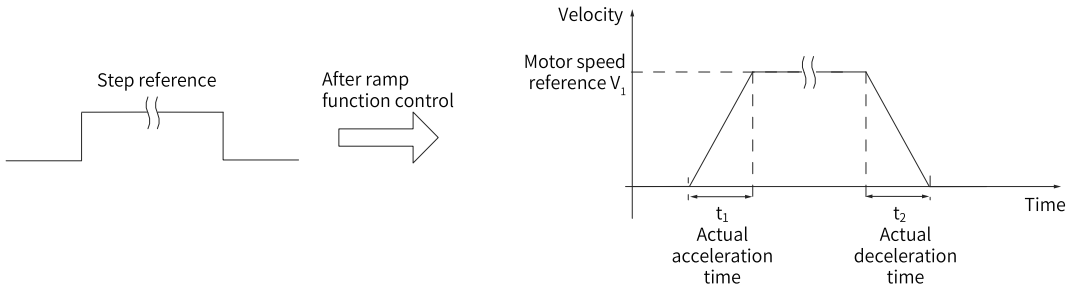


Figure 11-84 Ramp function definition

- H06.05 defines the time for the speed reference to change from 0 rpm to 1000 rpm.
- H06.06 defines the time for the speed reference to change from 1000 rpm to 0 rpm.

The formulas for calculating the actual acceleration/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 parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.05	2006-06h	Acceleration ramp time of speed reference	0 to 65535	0	ms	Real time	"H06_en.05" on page 566
H06.06	2006-07h	Deceleration ramp time of speed reference	0 to 65535	0	ms	Real time	"H06_en.06" on page 566

11.10.4 Zero Clamp

Caution

- The zero speed clamp function is used in the system in which the host controller does not construct the position loop in speed control mode.
- If servo motor oscillation occurs in zero speed clamp state, adjust the position loop gain.

In the speed control mode, if FunIN.12 (ZCLAMP) is enabled, and the speed reference amplitude is smaller than or equal to the value of H06.15, the motor enters zero position clamp state. In this case, a position loop is built inside the drive and the speed reference is invalid.

The motor is clamped the minimum quantization error of the encoder. Even if it rotates due to external force, it will return to the zero position and be clamped.

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

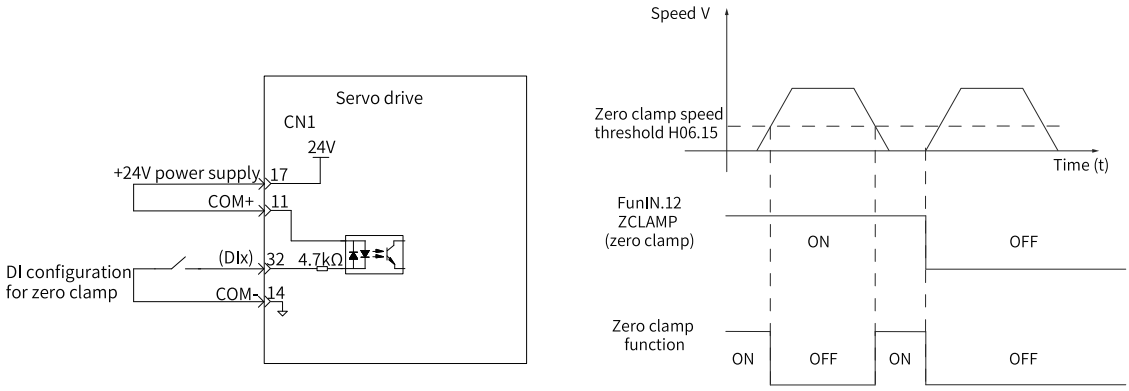


Figure 11-85 Wiring and waveform of zero clamp

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.15	2006-10h	Zero clamp speed threshold	0 to 10000	10	rpm	Real time	"H06_en.15" on page 569

☆Related parameters

Code	Name	Function	Description
FunIN.12	ZCLAMP	Zero speed clamp	Inactive: Zero clamp disabled Active: Zero clamp enabled

11.10.5 Speed Reference Limit

Note

When the actual speed of the motor exceeds H0A.08 (Overspeed threshold), E500.0 (Motor overspeed) occurs. For details of H0A.08, see "Parameter Descriptions" on page 525. The speed reference limit must be lower than H0A.08.

In speed control mode, the sources of speed reference limit include:

- 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 speed of the motor (default threshold): Depends on the motor model.

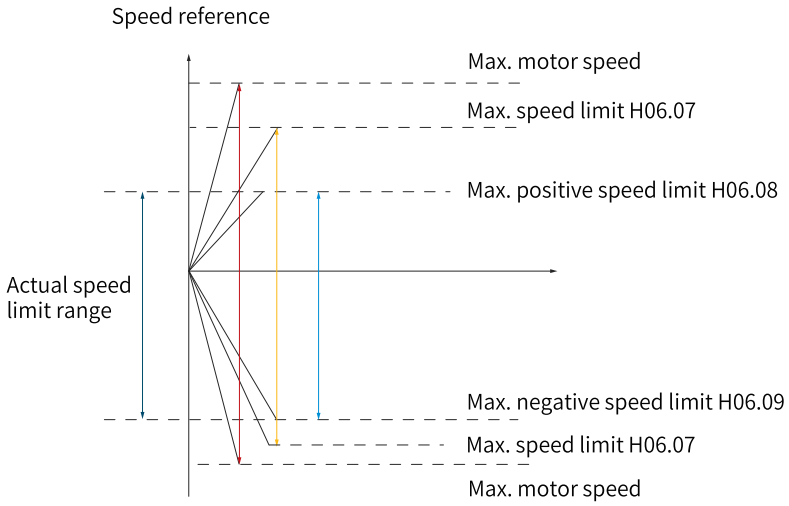


Figure 11-86 Example of speed reference limit

The actual motor speed limit meets the following requirements:

- |Forward speed limit| ≤ min {maximum motor speed, H06.07, H06.08}
- |Reverse speed limit| ≤ min {maximum speed of the motor, H06.07, H06.09}

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.07	2006-08h	Maximum speed limit	0 to 10000	7000	rpm	Real time	"H06_en.07" on page 567
H06.08	2006-09h	Forward speed threshold	0 to 10000	7000	rpm	Real time	"H06_en.08" on page 567
H06.09	2006-0Ah	Reverse speed threshold	0 to 10000	7000	rpm	Real time	"H06_en.09" on page 567

11.10.6 Speed-related DO

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

Motor rotation DO signal

When the absolute value of the filtered actual motor speed reaches the value of H06.16 (Threshold of TGON (motor rotation) signal), the motor is acknowledged to be rotating. In this case, the drive outputs the motor rotation signal (FunOUT.2: TGON) to acknowledge that the motor is rotating. When the absolute value of the filtered actual motor speed is lower than the value of H06.16, the motor is not rotating.

Judgment on the motor rotation signal (FunOUT.2, TGON) is not affected by the operating state or control mode of the drive.

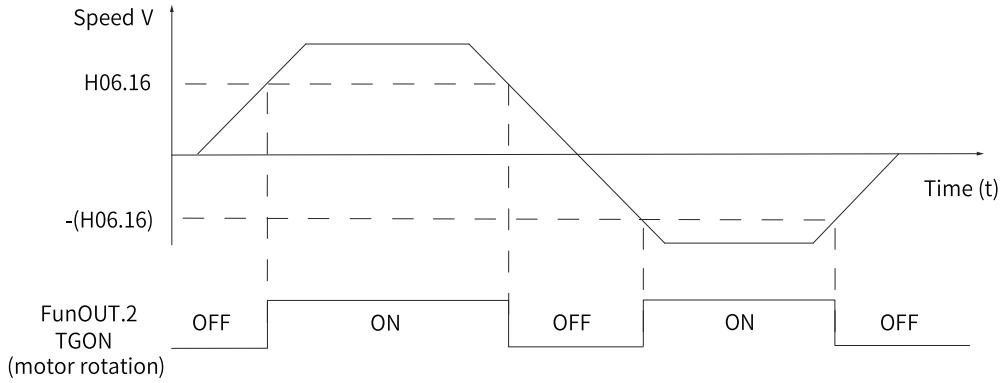


Figure 11-87 Waveform of motor rotation (TGON) signal

Note

In the preceding figure, ON indicates that the motor rotation DO signal is active. OFF indicates that the motor rotation DO signal is inactive.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.16	2006-11h	Threshold of TGON (motor rotation) signal	0 to 1000	20	rpm	Real time	"H06_en.16" on page 569

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

☆ Related parameters

Code	Name	Function	Description
FunOUT.2	TGon	Motor rotation	Inactive: The absolute value of filtered motor speed is lower than the setpoint of H06.16. Active. The absolute value of filtered motor speed reaches the setpoint of H06.16.

11.11 Torque Control Mode

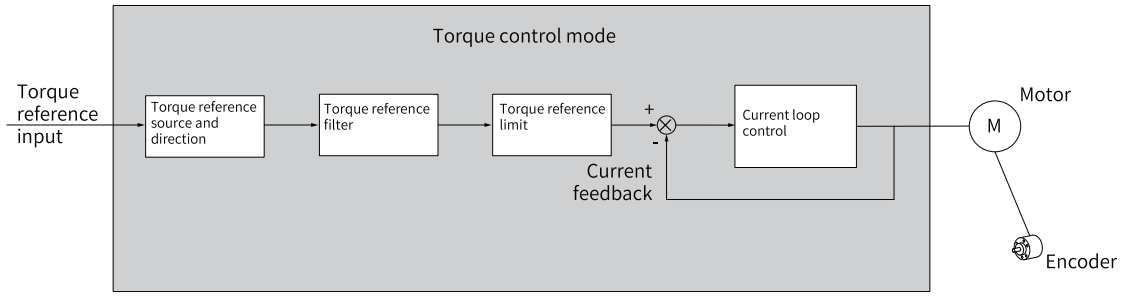


Figure 11-88 Block diagram of torque control mode

Set H02.00 (control mode selection) to 2 (torque control mode) through the keypad or the Inovance software tool to make the drive operate in the torque control mode. Set the drive parameters based on the mechanical structure and technical specifications. In the following diagram, the basic parameter settings are used to describe the torque control mode.

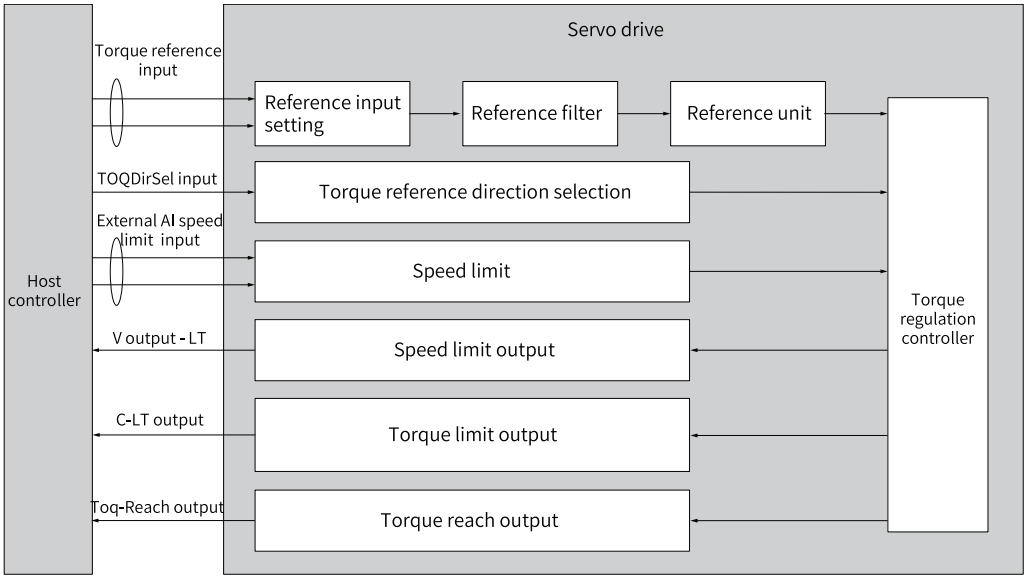


Figure 11-89 Signal exchange between the drive and the host controller

11.11.1 Function block diagram

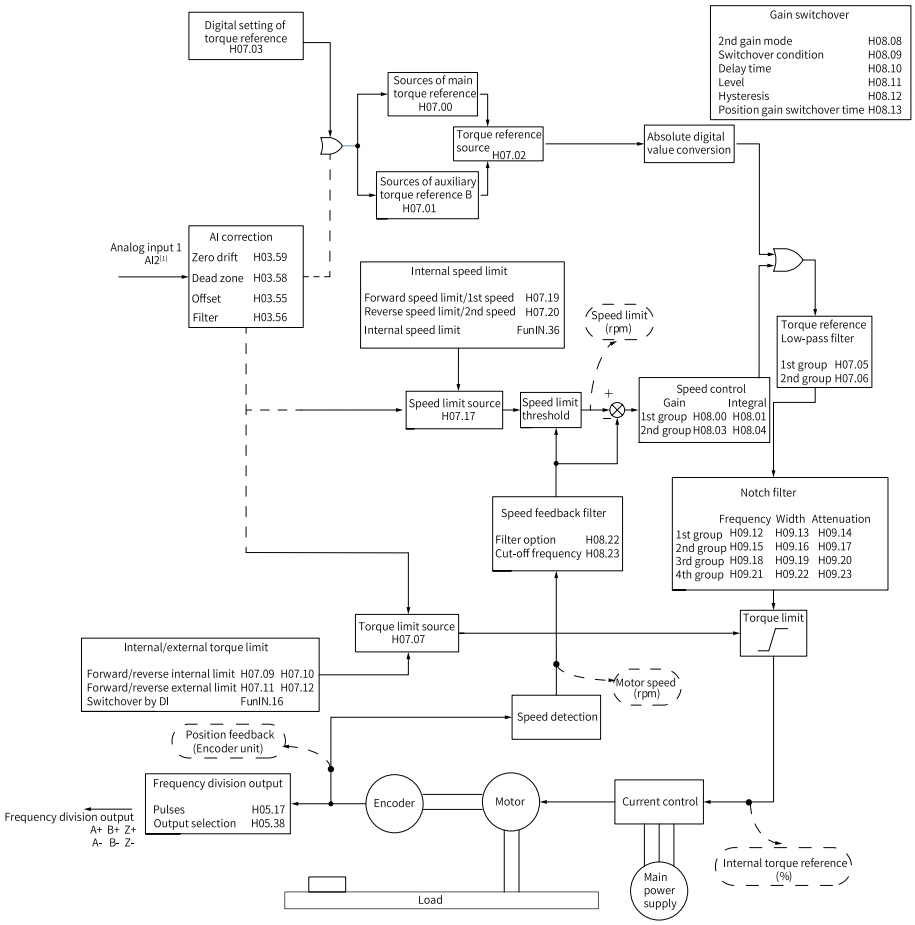


Figure 11-90 Block diagram of torque control

Note

[1]: When AI1 is used as the analog input, the corresponding parameters are H03.54 (zero drift), H03.53 (dead zone), H03.50 (offset), and H03.51 (filter).

11.11.2 Torque Reference Input

Torque reference source

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

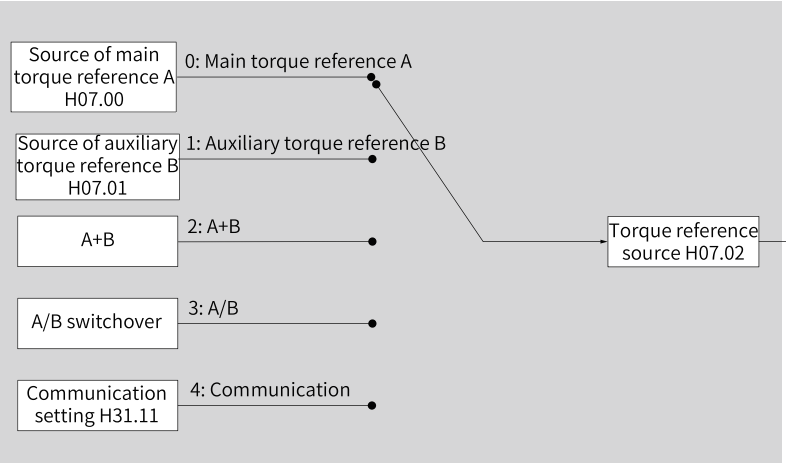


Figure 11-91 Selection of torque reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H07.02	2007-03h	Torque reference source	0: Source of main torque reference A 1: Source of auxiliary torque reference B 2: Source of A+B 3: Switched between A and B 4: Communication	0	-	At stop	"H07_en.02" on page 579

- **Sources of main torque reference A**

  The sources of main torque reference A include digital setting and analog voltage setting. Digital setting produces the internal speed reference, and the analog voltage setting produces the external speed reference.

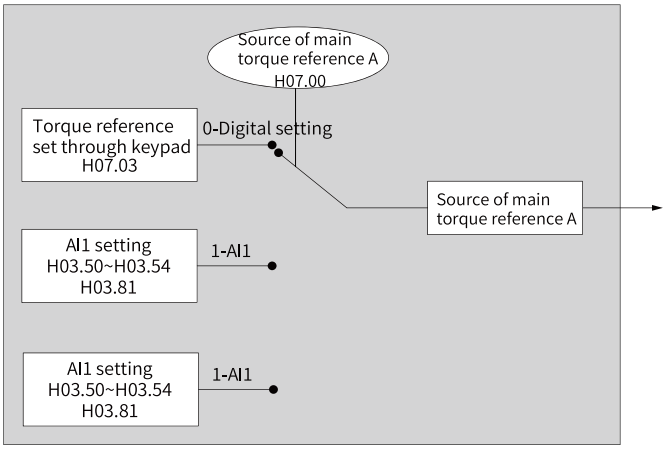


Figure 11-92 Description of main torque reference A sources

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H07.00	2007-01h	Sources of main torque reference A	0: H07.03 1: AI1 2: AI2	0	-	At stop	"H07_en.00" on page 579

- **Digital setting**

  In digital setting, the torque reference is set in H07.03, which defines the percentage of the torque reference to the rated torque of the motor.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H07.03	2007-04h	Torque reference set through operation panel	-400.0 to 400.0	0.0	%	Real time	"H07_en.03" on page 579

- **Analog voltage setting**

  The analog voltage signal output by the host controller or other devices is processed and then used as the torque reference.

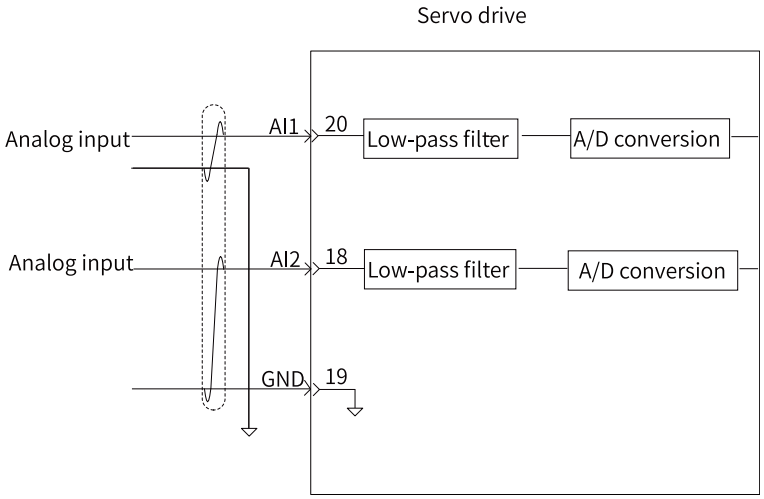
  Analog voltage input terminal:

  The servo drive provides two AIs: AI1 and AI2.

  AI1 voltage-type input: 12-bit, -10 V to +10 V; maximum allowable voltage: ± 12 VDC; input impedance: 74 kΩ.

  AI2 voltage-type input: 12-bit, -10 V to +10 V; maximum allowable voltage: ±12 VDC; input impedance: 74 kΩ.

  Analog input circuit:



Note

AI/DO terminals: AI1 uses pin 25, AI2 uses pin 17, and GND uses pin 8.

Procedure:

The following table takes AI1 as an example to describe the analog setting of the torque reference.

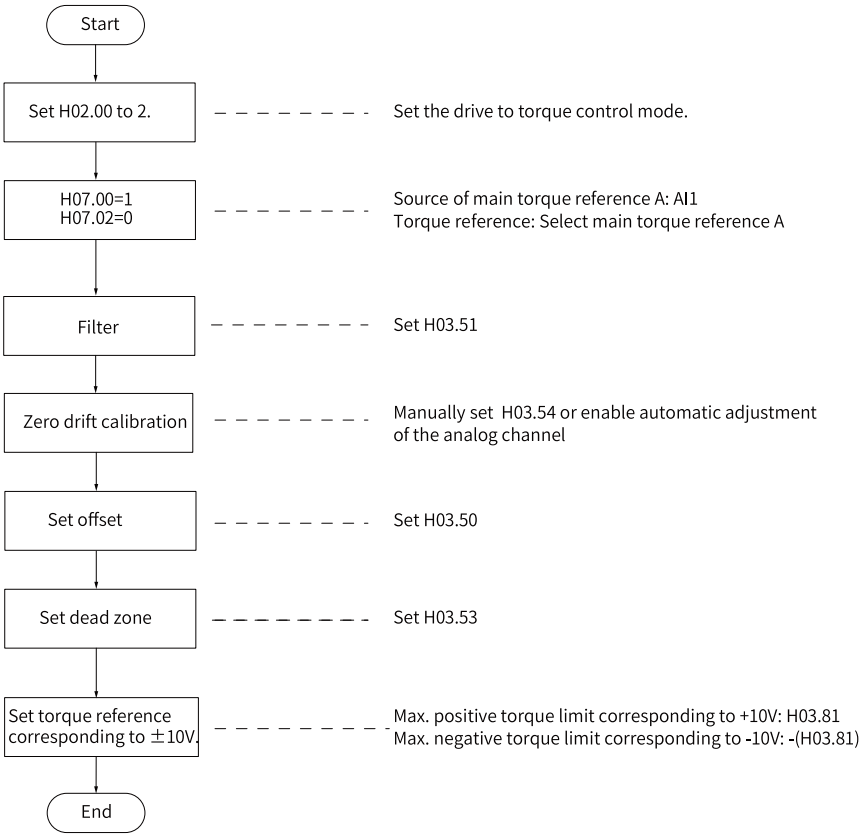


Figure 11-93 Flowchart of setting torque reference by analog voltage

★Terms:

- Zero drift: the value of the servo drive sampling voltage relative to GND when the input voltage of the analog channel is zero.
- Offset: the input voltage value of the analog channel when the sampling voltage is zero after zero drift calibration.
- Dead zone: the input voltage range of the analog channel when the sampling voltage is zero.

In the following figure, y_1 represents the unprocessed AO voltage, y_6 represents the final torque reference after being processed by the servo drive.

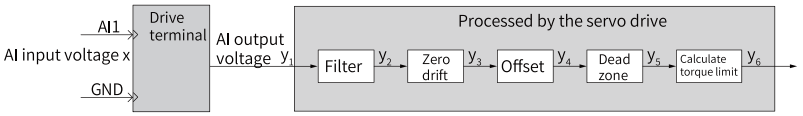


Figure 11-94 AI processing of servo drive

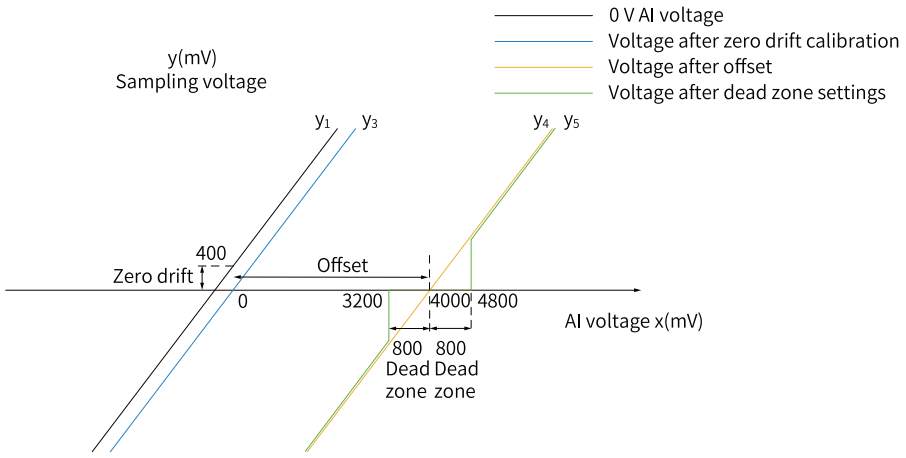


Figure 11-95 Example of sampling voltage and AI processing of servo drive

- **Filter:**
  The servo drive provides the analog channel filter function. Setting the filter time constant in H03.51 prevents motor reference fluctuation due to instable analog input voltage and eliminates motor malfunction due to signal interference. The filter function cannot eliminate or suppress the zero drift or dead zone.

- **Zero drift calibration**
  It calibrates the analog output voltage offset relative to the actual input voltage 0 V.

  In the preceding figure, the analog output voltage without being processed by the servo drive is y_1. Take the filter time constant H03.51 = 0.00 ms as an example, and the sampling voltage after filter y_2 is the same as y_1.

  That is, when the actual input voltage x = 0, the output voltage y_1 = 400 mV. Therefore, the zero drift voltage is 400 mV.

  Set H03.54 to 400.0 (mV) manually. The sampling voltage after zero drift calibration is shown by y_3. $y_3 = y_1 - 400.0$

  Zero drift can also be corrected automatically through H0d.10 (Automatic tuning of analog channels).

- **Offset setting**
  It sets the actual input voltage corresponding to sampling voltage 0.

  Assume that the actual input voltage x = 4000 mV when the sampling voltage y_4 = 0. That is, the offset is 4000 mV.

  Set H03.50 to 4000 (mV). The sampling voltage after offset $y_4 = x - 4000 = y_3 - 4000$

- **Dead zone calibration**
  It sets the effective input voltage range when the sampling voltage of the servo drive is not 0.

  After the offset is set, if the sampling voltage is always 0 when the input voltage x is within 3200 mV to 4800 mV, the dead zone is 800 mV.

  Set H03.53 to 800.0 (mV). The sampling voltage after dead zone calibration is shown as y_5:

$$y_5 = \begin{cases} 0 & 3200 \leqslant x \leqslant 4800 \\ y_4 & 4800 < x \leqslant 10000 \text{ or } -10000 \leqslant x < 3200 \end{cases}$$

- **Torque reference calculation**

  After setting the zero drift, offset, and dead zone, set the speed reference corresponding to 10 V (10000 mV) in H03.81 (Speed corresponding to 10 V) to obtain the actual torque reference y_6:

$$y_6 = \frac{y_5}{10000} \times (\text{H03.81})$$

  This value is used as the torque reference set via analog in the torque control mode.

  The left figure below applies when no offset exists. The right figure below applies when offset exists. After proper settings, you can view the AI1 sampling voltage value through H0b.21 in real time or view the torque reference value corresponding to the input analog value through H0b.01.

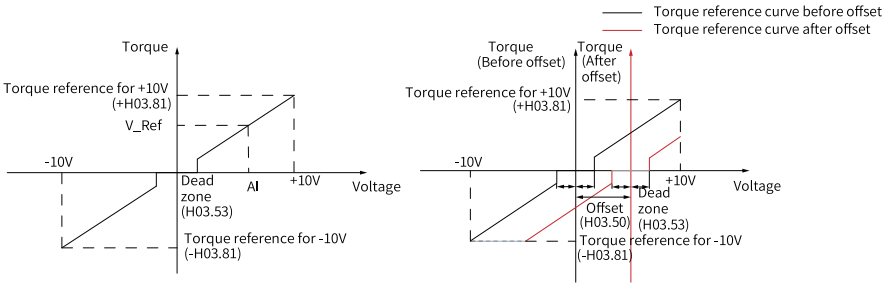


Figure 11-96 AI1 without offset (left) & AI1 after offset (right)

The relationship between the final torque reference y_6 and the input voltage x is:

$$y_6 = \begin{cases} 0 & B-C \leqslant x \leqslant B+C \\ x-B & B+C < x \leqslant 10000 \text{ or } -10000 \leqslant x < B-C \end{cases}$$

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H03.50	2003-33h	Voltage-type AI1 offset	-5000 to +5000	0	mV	Real time	"H03_en.50" on page 546
H03.51	2003-34h	Voltage-type AI1 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.51" on page 547
H03.53	2003-36h	Voltage-type AI1 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.53" on page 547
H03.54	2003-37h	Voltage-type AI1 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.54" on page 547

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H03.55	2003-38h	Voltage-type AI2 offset	-5000 to +5000	0	mV	Real time	"H03_en.55" on page 547
H03.56	2003-39h	Voltage-type AI2 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.56" on page 548
H03.58	2003-3Bh	Voltage-type AI2 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.58" on page 548
H03.59	2003-3Ch	Voltage-type AI2 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.59" on page 548
H03.81	2003-52h	Torque corresponding to analog 10 V	0.00 to 8.00	1.00	-	At stop	"H03_en.81" on page 550
H0d.10	200d-0Bh	Automatic tuning of analog channel	0: No operation 1: Adjust AI1 2: Adjust AI2	0	-	At stop	"H0d_en.10" on page 657

- **Sources of auxiliary torque reference B**
  The source of auxiliary torque reference B is set in the same way as the source of main torque reference A. For descriptions of related parameters, see "Parameter Descriptions" on page 525.

- **A/B switchover**
  When setting H07.02 (Torque reference source) to 3 (Switched between A and B), you need to assign FunIN.4 (DI-SEL) to the corresponding DI. The input signal of this DI determines which source (A or B) is active.

  ☆ Related parameters:

No.	Name	Function name	Description
FunIN.4	CMD-SEL	Running reference switchover	OFF: Active reference being A ON: Active reference being B

- **Communication**
  When H07.02 (Torque reference source) is set to 4 (Communication), the torque reference is the value of H31.11. H31.11 is not displayed on the panel, it can be set through communication only.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
H31.11	2031-0Ch	Torque reference set through communication	-100.000 to 100.000	0.000	%	Real time	"H31_en.11" on page 825

11.11.3 Torque Reference Filter

Caution

Pay attention to the responsiveness during setting as an excessively high setpoint lowers down the responsiveness.

The servo drive smoothens torque references through the low-pass filter to reduce vibration in all 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 H08.09 ≠ 0) and the condition defined by H08.09 is met.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"H07_en.05" on page 580
H07.06	2007-07h	Torque reference filter time constant 2	0.00 to 30.00	0.27	ms	Real time	"H07_en.06" on page 580

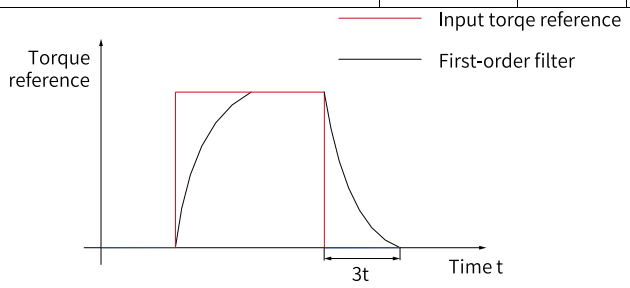


Figure 11-97 First-order filter for rectangular torque references

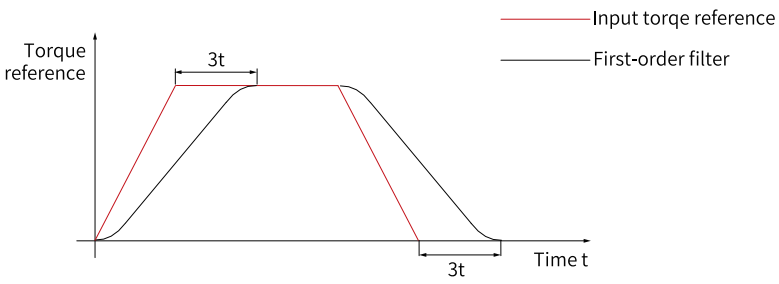


Figure 11-98 First-order filter for trapezoid torque references

Note

In the preceding figures, the letter "t" in "3t" refer to the torque reference filter time constant. Pay attention to the responsiveness when you set the constant because an excessively high setpoint decreases the responsiveness.

11.11.4 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.

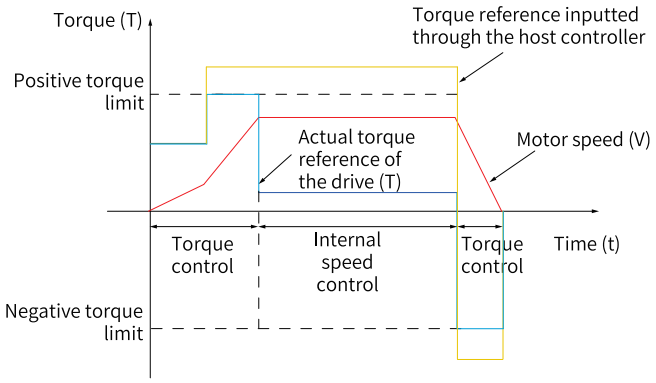


Figure 11-99 Torque reference and torque limit

When the absolute value of the torque reference input from the host controller or output by the speed regulator is higher than the absolute value of the torque reference limit, the actual torque reference of the drive is limited to the torque reference limit. Otherwise, the torque reference input from the host controller or output by the speed regulator is used.

Only one torque reference limit is valid at a moment. The positive/negative torque limit must be lower than or equal to the maximum torque of the drive and the motor and ±400.0% of the rated torque.

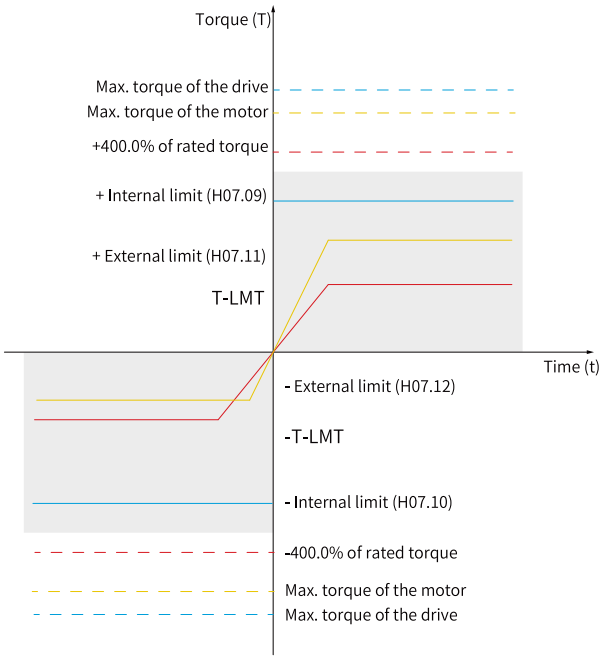


Figure 11-100 Example of torque limit

Torque limit source

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

After the torque limit is set, the torque limit applies when the torque reference exceeds the limit. The torque limit must be set according to the load conditions. An excessively low limit may weaken the acceleration/deceleration ability of the motor, causing the actual motor speed to fall below the required value during operating at a constant torque.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.07	2007-08h	Torque limit source	0: Positive/Negative internal torque limit 1: Internal or external limit as defined by DI 2: T_LMT 3: T_LMT or external limit as defined by DI (FunIN.16 or FunIN.17) 4: T_LMT or internal limit (FunIN.16 or FunIN.17) as defined by DI	0	-	Real time	"H07_en.07" on page 580

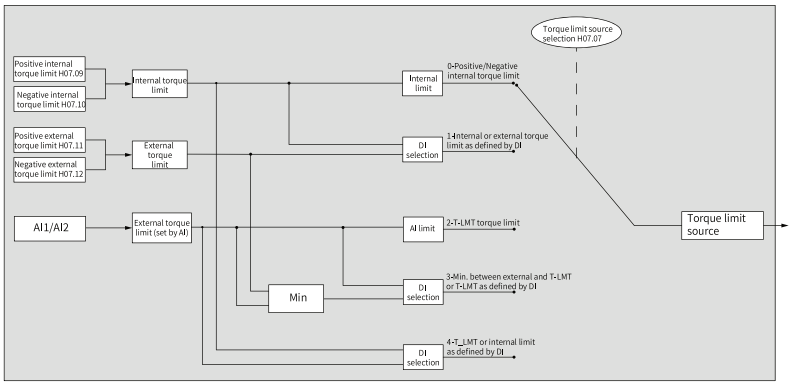


Figure 11-101 Torque limit source

The following figures show examples in which absolute values of torque references input from the host controller exceed the absolute value of the 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 and H07.10.

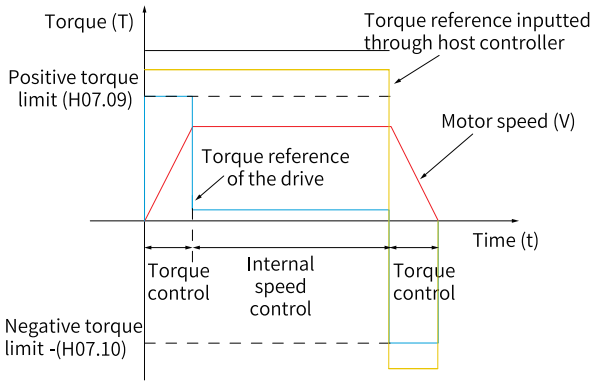


Figure 11-102 Torque limit curve (H07.07 = 0)

- H07.07 = 1 (internal or external limit as defined by DI)
  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).

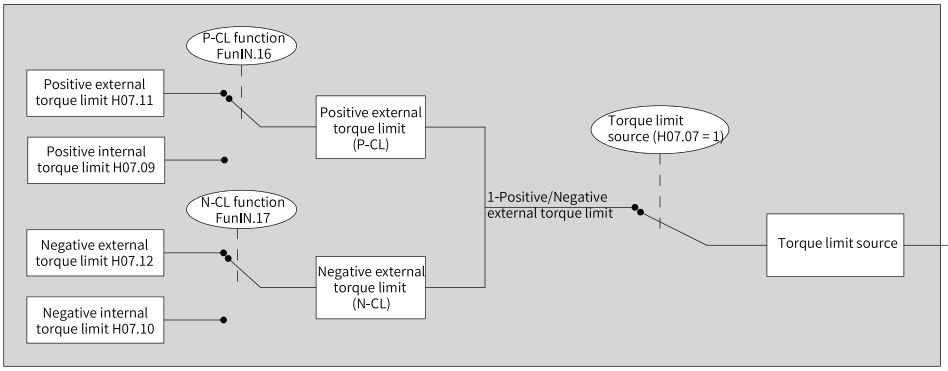
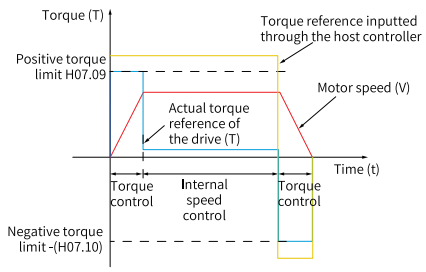
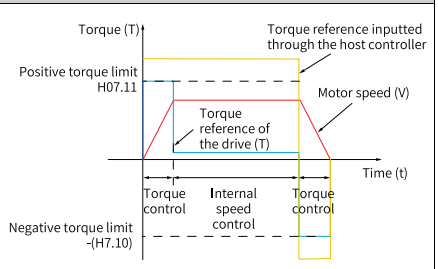
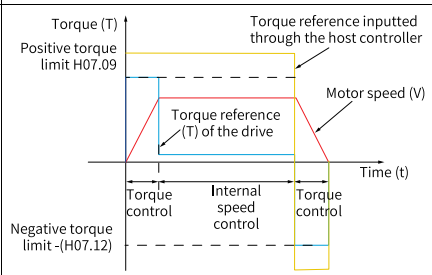
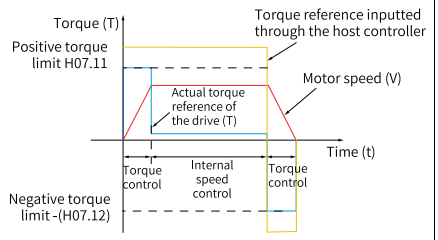


Figure 11-103 Torque limit source (H07.07 = 1)

Table 11–17 Description of H07.07 = 1

<table>
<tr><th colspan="2" rowspan="2">DI state</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 DI of the drive and set the active logic of these DIs.

☆ Related parameters

Code	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 parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.09	2007-0Ah	Positive internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.09" on page 581
H07.10	2007-0Bh	Negative internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.10" on page 581

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.11	2007-0Ch	Positive external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.11" on page 581
H07.12	2007-0Dh	Negative external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.12" on page 581

- H07.07 = 2 (T-LMT as torque limit)

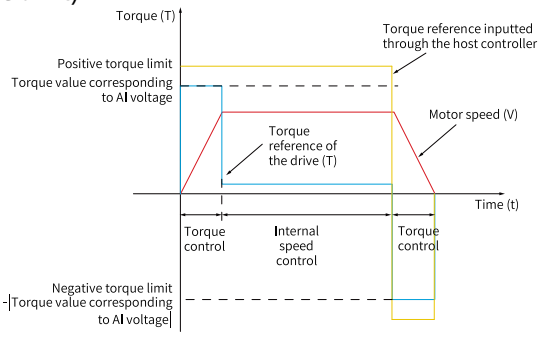


Figure 11-104 AI torque limit curve

- H07.07 = 3: T_LMT or external limit used as torque limit as defined by DI (FunIN.16 or 17)
  When the logic of the external DI signal (P-CL) is inactive, the positive torque limit is defined by the torque value corresponding to the input voltage of external AI. When the logic of the external DI signal (P-CL) is active, the positive torque limit is defined by the minimum of H07.11 and the AI value corresponding to the AI voltage.

  When the logic of the external DI signal (N-CL) is inactive, the negative torque limit is defined by the torque value corresponding to the external AI voltage. When the logic of the external DI signal (N-CL) is active, the negative torque limit is defined by the minimum of H07.12 and the torque value corresponding to the AI voltage.

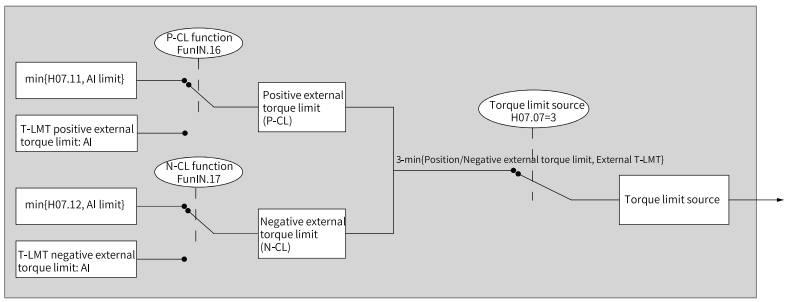
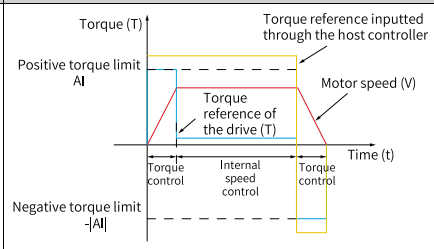
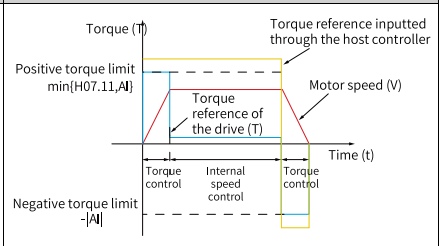
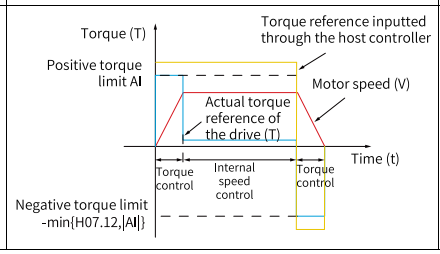
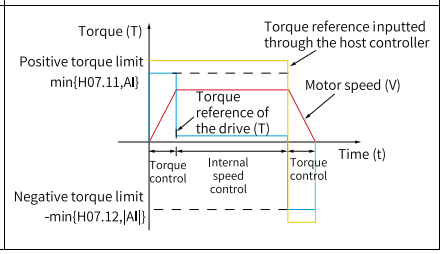


Figure 11-105 Torque limit source (H07.07 = 3)

Table 11–18 Description of H07.07 = 3

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<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>

- H07.07 = 4: T_LMT or internal limit used as torque limit as defined by DI

  When the logic of the external DI signal (P-CL) is inactive, the positive torque limit is defined by H07.09. When the logic of the external DI (P-CL) is active, the positive torque limit is defined by the torque value corresponding to the AI voltage.

  When the logic of the external DI signal (N-CL) is inactive, the negative torque limit is defined by H07.10. When the logic of the external DI-CL) is active, the negative torque limit is defined by the torque value corresponding to the AI voltage.

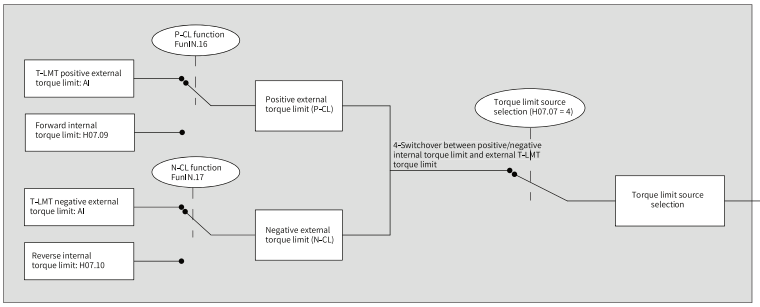
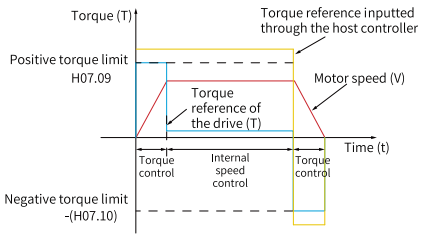
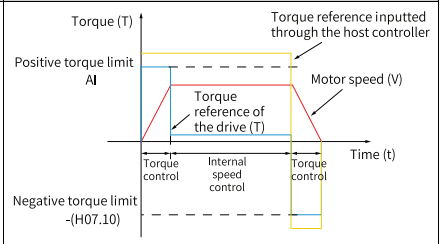
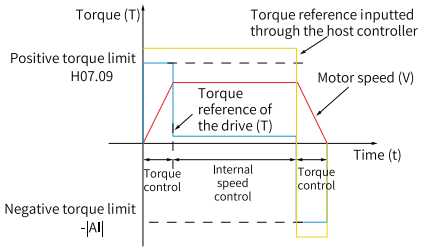
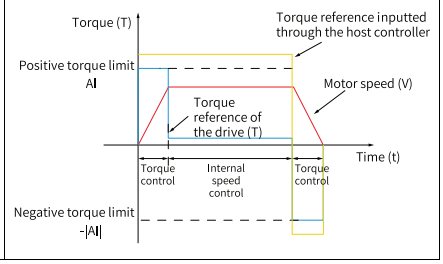


Figure 11-106 Torque limit source (H07.07 = 4)

Table 11–19 Description of H07.07 = 4

DI state		P-CL	
		OFF	ON
N-CL	OFF		
	ON		

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.09	2007-0Ah	Positive internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.09" on page 581
H07.10	2007-0Bh	Negative internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.10" on page 581
H07.11	2007-0Ch	Positive external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.11" on page 581
H07.12	2007-0Dh	Negative external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.12" on page 581

11.11.5 Speed limit in 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 lead to overspeed and damage the machine. A speed limit therefore must be set to protect the machine.

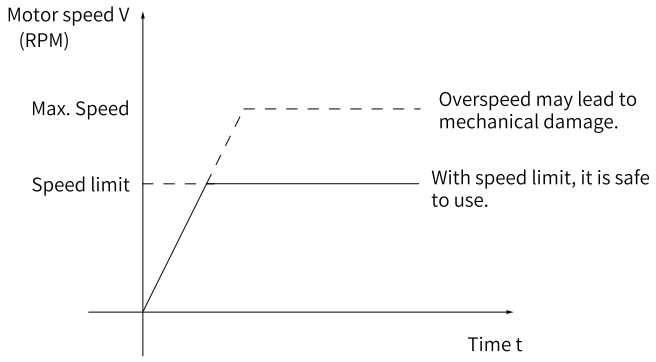


Figure 11-107 Speed limit in the torque control mode

Setting the speed limit source

In the torque control mode, you can set the speed limit source in H07.17. After the speed limit is set, the actual motor speed will be limited. After reaching the speed limit, the motor keeps operating at the speed limit constantly. Set the speed limit based on the operating requirements of the load.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT 2: H07.19 or H07.20 as defined by DI	0	-	Real time	"H07_en.17" on page 582

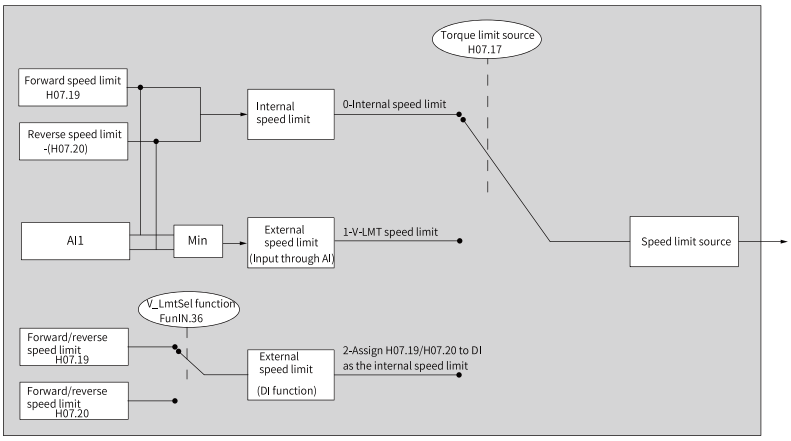


Figure 11-108 Speed limit source

- H07.17 = 0 (Internal speed limit)
  The speed limit is determined only by H07.19 (Positive speed limit) and H07.20 (Negative speed limit).

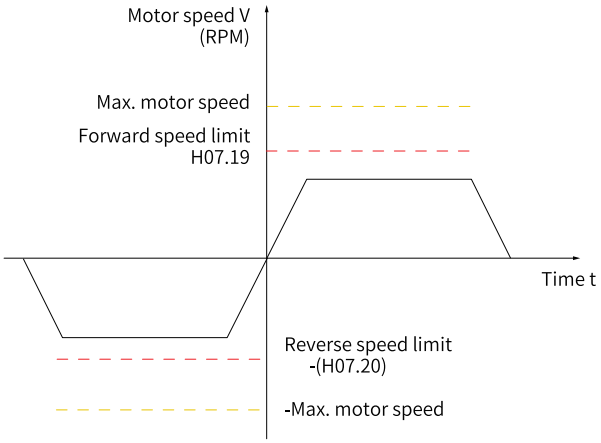


Figure 11-109 Speed limit curve (H07.17 = 0)

- H07.17 = 1 (V- LMT as speed limit)
  When the speed limit defined by AI is lower than the internal speed limit (H07.19/H07.20), the former applies. When the speed limit defined by AI is higher than the internal speed limit (H07.19/H07.20), the latter applies.

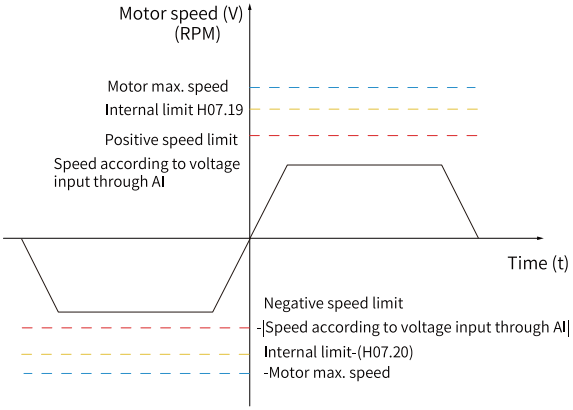


Figure 11-110 Speed limit curve (H07.17 = 1)

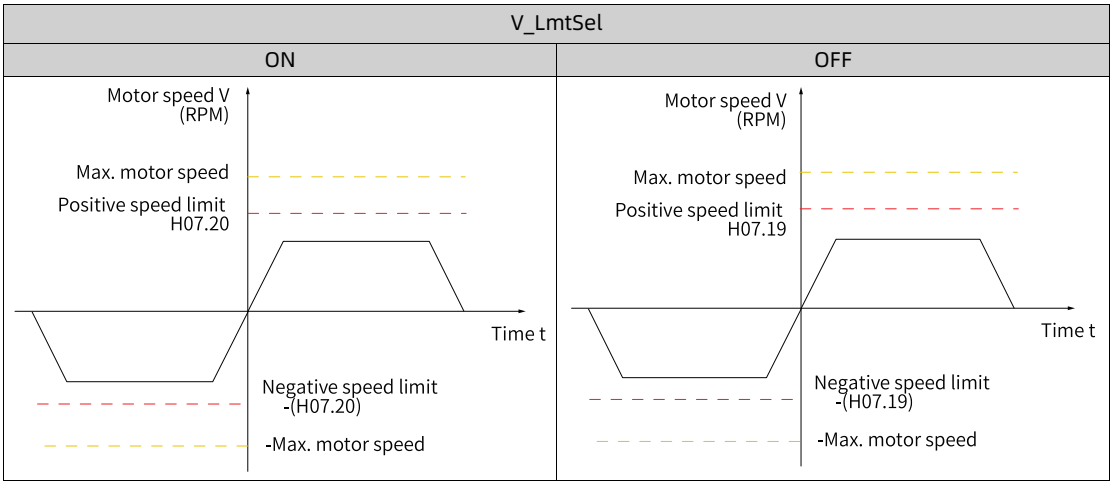
- H07.17 = 2 (H07.19 or H07.20 used as speed limit as defined by DI)
  H07.19 or H07.20 is used as the speed limit based on the logic of the DI.

  Before setting H107.17 to 2, assign FunIN.36 (V-LmtSel: internal speed limit source) to a DI first, and then set the active logic of this DI.

  ☆ Related parameters

Code	Name	Function	Description
FunIN.36	V_LmtSel	Internal speed limit source	Inactive: H07.19 used as positive/negative internal speed limit Active: H07.20 used as positive/negative internal speed limit

Table 11–20 Descriptions of speed limit



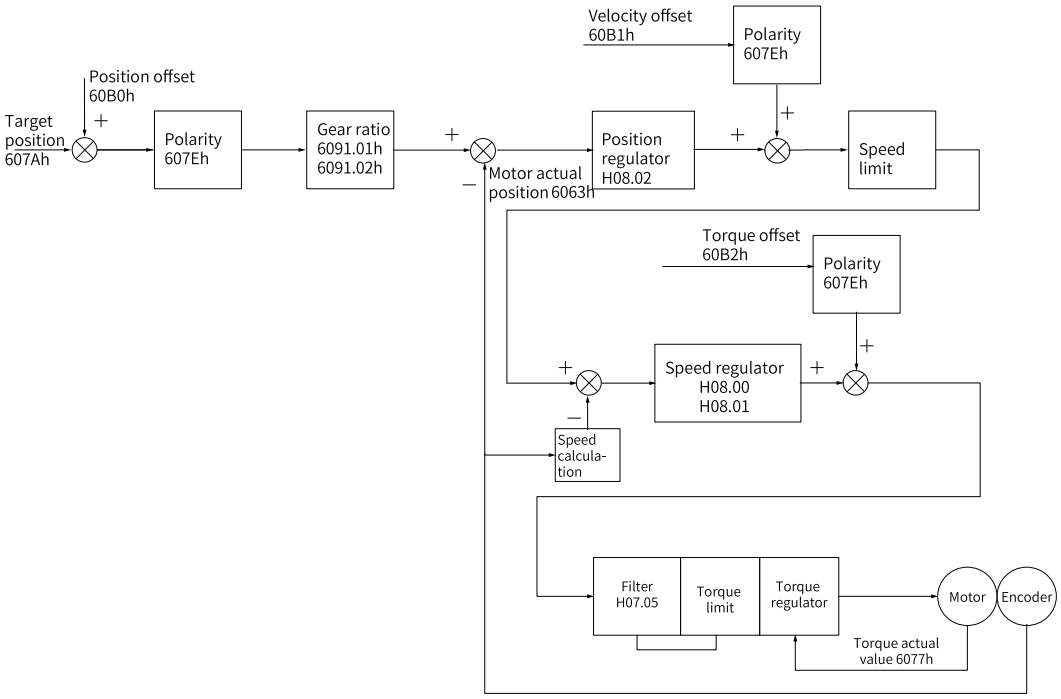
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.19	2007-14h	Positive speed limit/Speed limit 1 in torque control	0 to 10000	3000	rpm	Real time	"H07_en.19" on page 583
H07.20	2007-15h	Negative speed limit/Speed limit 2 in torque control	0 to 10000	3000	rpm	Real time	"H07_en.20" on page 583

11.12 Cyclic Synchronous Position (CSP) Mode

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

11.12.1 Function Block Diagram



11.12.2 Configuration Block Diagram

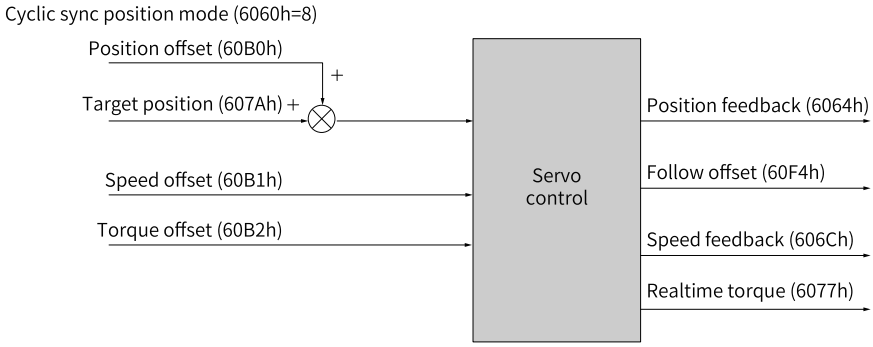


Figure 11-111 Cyclic synchronous position mode

11.12.3 Recommended Configuration

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
607Ah: target position	6064h: position actual value	Mandatory
6060h: modes of operation	6061h: modes of operation display	Optional

11.12.4 Related Parameters

6040h **Control word**

Hex: 6040h Effective mode: Real time

Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:
0x0 to 0xFFFF
Description:
For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Switch on	Switch on	1: Active; 0: Inactive
1	Enable voltage	Enable voltage	1: Active; 0: Inactive
2	Quick stop	Quick stop	0: Active; 1: Inactive
3	Enable operation	Enable operation	1: Active; 0: Inactive

The CSP mode only supports absolute position references.

6041h Status word

Hex:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:
0x0 to 0xFFFF
Description:
For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active; 0: Inactive
1	Switch on	Switch on	1: Active; 0: Inactive
2	Operation enabled	Operation enabled	1: Active; 0: Inactive
3	Fault	Fault	1: Active; 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active; 0: Inactive
7	Warning	Warning	1: Active; 0: Inactive
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Active, control word activated 0: Inactive
10	Target reach	Target reach	Not supported, always being 1
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follows the command value	Drive follows the command value	Not supported, always being 1

Bit	Parameter name		Description
13	Following error	Following error	0: EB00.0 (Excessive position deviation) not reported 1: EB00.0 (Excessive position deviation) reported
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	Home find	Home find	0: Home not found 1: Home found

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 875
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 875
6064h	6064h	Position actual value	-2147483648 to 2147483647	0	Reference unit	Read-only	"6064h" on page 876
6065h	6065h	Following error window	0 to 4294967295	27486951	Reference unit	Real time	"6065h" on page 877
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 877
606Ch	606Ch	Velocity actual value	-2147483648 to 2147483647	0	Reference unit/s	Read-only	"606Ch" on page 878
6077h	6077h	Torque actual value	-4000 to 4000	0	0.10%	Read-only	"6077h" on page 880
607Ah	607Ah	Target position	-2147483648 to 2147483647	0	Reference unit	Real time	"607Ah" on page 880
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882
60B0h	60B0h	Position offset	-2147483648 to 2147483647	0	Reference unit	Real time	"60B0h" on page 887
60B1h	60B1h	Velocity offset	-2147483648 to 2147483647	0	Reference unit/s	Real time	"60B1h" on page 887

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
60B2h	60B2h	Torque offset	-4000 to 4000	0	0.10%	Real time	"60B2h" on page 887
60F4h	60F4h	Following error actual value	-2147483648 to 2147483647	0	Reference unit	Read-only	"60F4h" on page 892

11.12.5 Related Function Settings

Position deviation monitoring function

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Following error window	0 to 4294967295	27486951	Reference unit	Real time	"6065h" on page 877
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 877

Position reference polarity

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

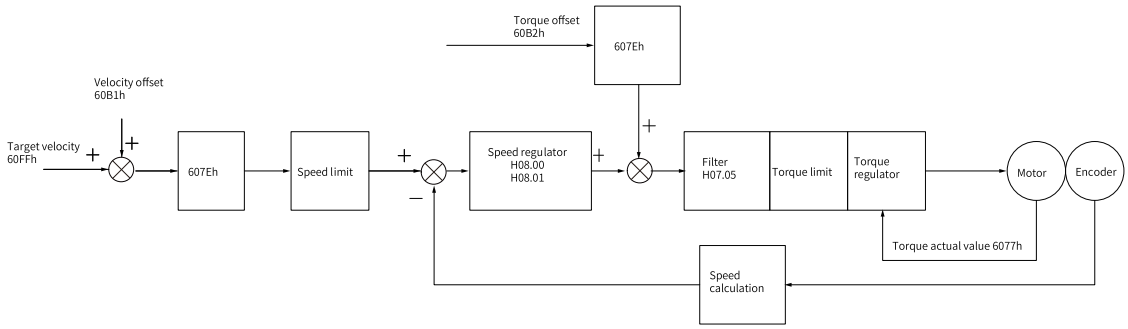
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882

11.13 Cyclic Synchronous Velocity Mode (CSV)

In CSV mode, the host controller sends the target speed to the servo drive through cyclic synchronization. The servo drive performs speed control and torque control.

11.13.1 Function Block Diagram



11.13.2 Configuration Block Diagram

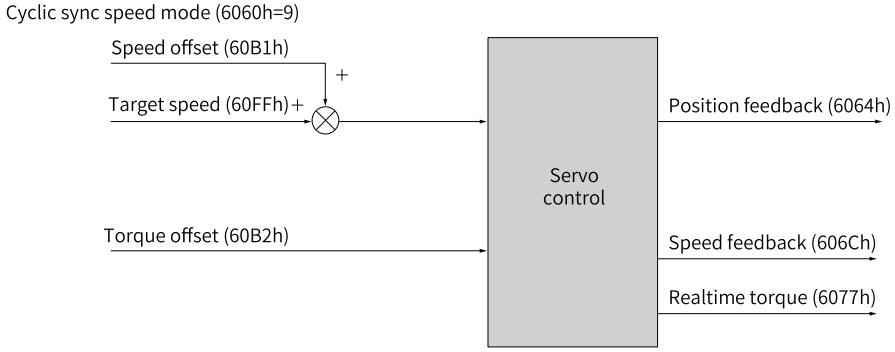


Figure 11-112 CSV mode

11.13.3 Recommended Configuration

Basic configurations:

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity	-	Mandatory
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

11.13.4 Related Parameters

6040h **Control word**

Hex:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Switch on	Switch on	1: Active; 0: Inactive
1	Enable voltage	Enable voltage	1: Active; 0: Inactive
2	Quick stop	Quick stop	0: Active; 1: Inactive
3	Enable operation	Enable operation	1: Active; 0: Inactive

6041h **Status word**

Hex:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 875
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 875
6064h	6064h	Position actual value	-2147483648 to 2147483647	0	Reference unit	Read-only	"6064h" on page 876
606Ch	606Ch	Velocity actual value	-2147483648 to 2147483647	0	Reference unit/s	Read-only	"606Ch" on page 878
6077h	6077h	Torque actual value	-4000 to 4000	0	0.10%	Read-only	"6077h" on page 880
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882
60B1h	60B1h	Velocity offset	-2147483648 to 2147483647	0	Reference unit/s	Real time	"60B1h" on page 887
60B2h	60B2h	Torque offset	-4000 to 4000	0	0.10%	Real time	"60B2h" on page 887
60FFh	60FFh	PV, CSV mode speed reference	-2147483648 to 2147483647	0	Reference unit/s	Real time	"60FFh" on page 893

11.13.5 Related Function Settings

Velocity reference polarity

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

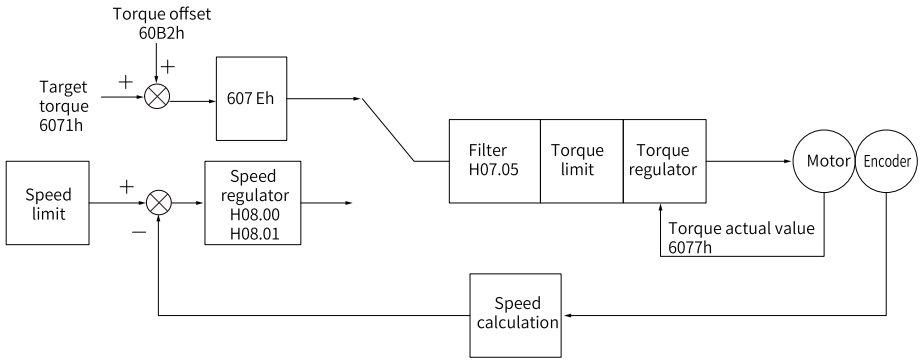
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882

11.14 Cyclic Synchronous Torque Mode (CST)

In CST mode, the host controller sends the target torque to the servo drive through cyclic synchronization. The servo drive performs torque control.

11.14.1 Function Block Diagram



11.14.2 Configuration Block Diagram

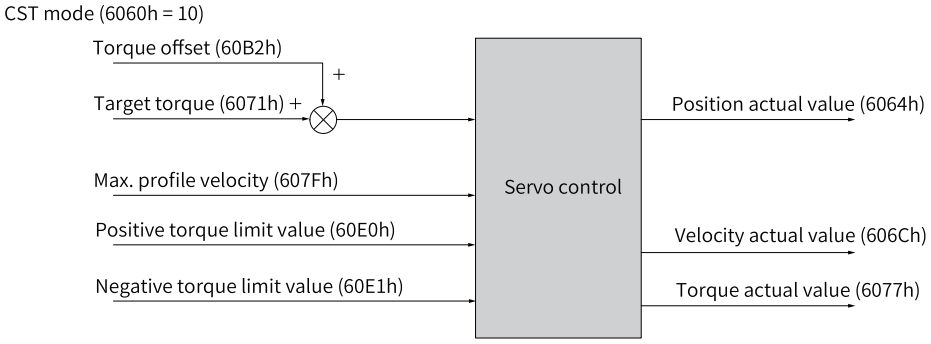


Figure 11-113 CST mode

11.14.3 Recommended Configuration

Basic configurations:

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
6071h: target torque	-	Mandatory
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
-	6077h: torque actual value	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

11.14.4 Related Parameters

6040h **Control word**

Hex:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Switch on	Switch on	1: Active; 0: Inactive
1	Enable voltage	Enable voltage	1: Active; 0: Inactive
2	Quick stop	Quick stop	0: Active; 1: Inactive
3	Enable operation	Enable operation	1: Active; 0: Inactive

6041h **Status word**

Hex:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access:	RO	Mapping:	TPDO

Value range:

0x0 to 0xFFFF

Description:

For details about the control word, see the Communication Guide.

Bit	Parameter name		Description
0	Ready to switch on	Ready to switch on	1: Active; 0: Inactive
1	Switch on	Switch on	1: Active; 0: Inactive
2	Enable operation	Operation enabled	1: Active; 0: Inactive
3	Fault	Fault	1: Active; 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active; 0: Inactive
7	Warning	Warning	1: Active; 0: Inactive
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Active, control word activated 0: Inactive
10	Target reach	Target reach	Not supported, always being 1

Bit	Parameter name		Description
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follows the command value	Drive follows the command value	Not supported, always being 1
13	-	N/A	N/A
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	-	N/A	N/A

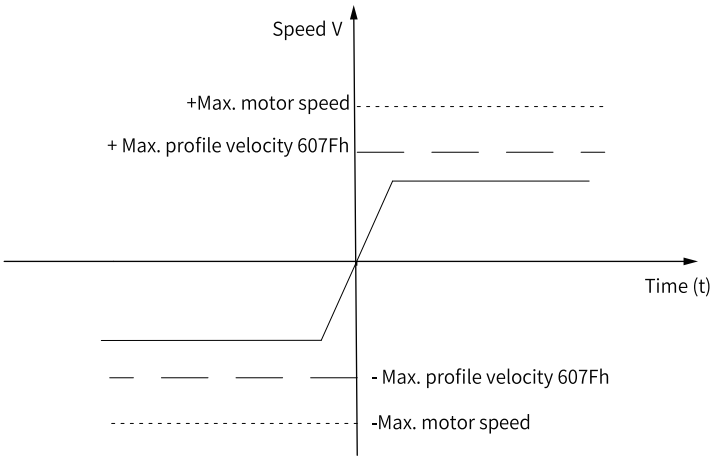
☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 875
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 875
6071h	6071h	Target torque	-4000 to 4000	0	0.10%	Real time	"6071h" on page 879
6072h	6072h	Maximum torque reference	0 to 4000	3500	0.10%	Real time	"6072h" on page 880
6074h	6074h	Torque reference	-4000 to 4000	0	0.10%	Read-only	"6074h" on page 880
6077h	6077h	Torque actual value	-4000 to 4000	0	0.10%	Read-only	"6077h" on page 880
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882
60B2h	60B2h	Torque offset	-4000 to 4000	0	0.10%	Real time	"60B2h" on page 887
60E0h	60E0h	Positive torque limit	0 to 4000	3500	0.10%	Real time	"60E0h" on page 892
60E1h	60E1h	Negative torque limit	0 to 4000	3500	0.10%	Real time	"60E1h" on page 892

11.14.5 Related Function Settings

Speed limit in torque control mode

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

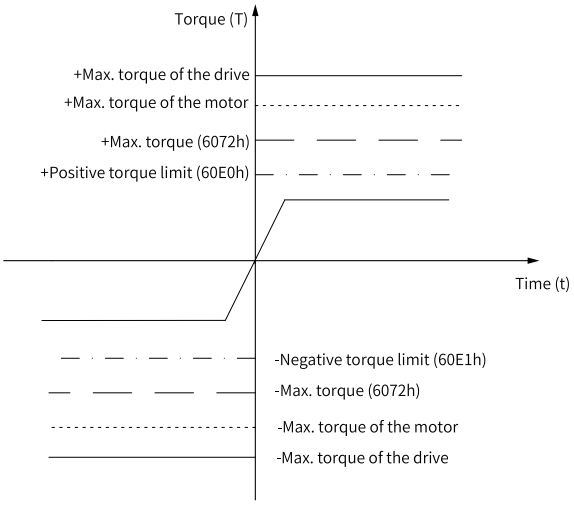


☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 882

Torque limit

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



☆Related parameters:

Parameter code	Communication Address	Parameter Name	Value range	Default value	Unit	Change mode	Page
6072h	6072h	Maximum torque reference	0 to 4000	3500	0.10%	Real time	"6072h" on page 880
60E0h	60E0h	Positive torque limit	0 to 4000	3500	0.10%	Real time	"60E0h" on page 892
60E1h	60E1h	Negative torque limit	0 to 4000	3500	0.10%	Real time	"60E1h" on page 892

Torque reference polarity

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 882

12 Common Functions

12.1 Absolute System

12.1.1 Overview

The absolute encoder detects the motor position within one revolution and counts the number of revolutions. For example, a 23-bit encoder whose resolution is 8388608 (2^{23}) PPR records the 23-bit multi-turn data. The absolute system integrated with the absolute encoder works in absolute position linear mode or absolute position rotating mode. These modes apply to position control, speed control, and torque control modes. The absolute encoder with a battery can back up data when the servo drive is powered off. This enables the servo drive to calculate the absolute mechanical position upon power-on again. Therefore, the homing operation is not required.

To match the absolute encoder with the SV670N-INT series servo drives, set H00.00 (Motor code) to 14101 (Inovance 23-bit absolute encoder). Set H02.01 (Absolute system selection) according to the actual condition. E731.0 (Encoder battery failure) will occur upon initial power-on of the battery. Set H0d.20 (Absolute encoder reset function) to 1 to reset E731.0 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 suddenly, causing the mechanical absolute position reference to change. In this case, perform the homing operation. After homing is done, the deviation between the mechanical absolute position and that recorded in the encoder will be calculated automatically and saved in the EEPROM of the servo drive.

Table 12–1 Absolute modes supported by the motor

Type	Incremental mode	Absolute position linear mode	Absolute position rotation mode	Single-turn absolute mode
DDL motor + ABZ Incremental encoder (with TTL signal)	√	×	×	×
DDL motor + Inovance incremental encoder	√	×	×	×
DDR motor + ABZ Incremental encoder (with TTL signal)	√	×	×	×
DDR motor + Inovance absolute encoder	√	√	√	√
Servo motor + ABZ incremental encoder (with TTL signal)	√	×	×	×
Servo motor + Inovance absolute encoder	√	√	√	√
Servo motor + Nikon absolute encoder	√	√	√	√
Servo motor + TAMAGAWA absolute encoder	√	√	√	√
Servo motor + SSI encoder	√	√	×	×

Note

When you set the H02.01 absolute value mode, refer to the preceding table. The E122.0 error will be reported in unsupported modes.

12.1.2 Related Parameters

Absolute encoder system settings

Set H00.00 to select the motor encoder to be used, and select the absolute position mode in H02.01.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H00.00	2000-01h	Motor SN	20000: Linear motor - Pulse-type encoder 14202: Linear motor - Inovance communication-type 23-bit encoder 20001: DDR motor - Pulse-type encoder 14201: DDR motor - Inovance communication-type 23-bit encoder 20002: Rotary motor - Pulse-type encoder 14000: Rotary motor - Inovance communication-type 20-bit encoder 14101: Rotary motor - Inovance communication-type 23-bit encoder 14020: Rotary motor - Harmonic 20-bit encoder - 2.5 M baud rate 14021: Rotary motor - Harmonic 17-bit encoder - 2.5 M baud rate 14022: Rotary motor - Harmonic 17-bit encoder - 4 M baud rate 14120: Rotary motor - Nikon 20-bit encoder - 2.5 M baud rate 14121: Rotary motor - Nikon 17-bit encoder - 2.5 M baud rate 14122: Rotary motor - Nikon 17-bit encoder - 4 M baud rate 14130: Rotary motor - TAMAGAWA 17-bit encoder 14131: Rotary motor - TAMAGAWA 23-bit encoder	14101	-	At stop	"H00_en.00" on page 525
H00.08	2000-09h	Serial encoder type	0 to 65535	0	-	At stop	"H00_en.08" on page 526
H02.01	2002-02h	Absolute system selection	0: Incremental mode 1: Absolute position linear mode 2: Absolute position rotation mode 3: Absolute position linear mode (without encoder overflow warning) 4: Absolute position single-turn mode	0	-	At stop	"H02_en.01" on page 534

Note

In the absolute position mode, the system detects the motor code automatically to check whether the motor used is configured with an absolute encoder. If not, E122.0 (Product mismatch in the absolute position mode) occurs.

Encoder feedback data

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0b.70	200b-47h	Number of absolute encoder revolutions	-32768 to 32767	0	Rev	Read-only	"H0b_en.70" on page 649
H0b.71	200b-48h	Single-turn position fed back by the absolute encoder	0 to 2147483647	0	Encoder unit	Read-only	"H0b_en.71" on page 649
H0b.77	200b-4Eh	Encoder position (low 32 bits)	0 to 4294967295	0	Encoder unit	Read-only	"H0b_en.77" on page 650
H0b.79	200b-50h	Encoder position (high 32 bits)	-2147483648 to 2147483647	0	Encoder unit	Read-only	"H0b_en.79" on page 650

Absolute position linear mode

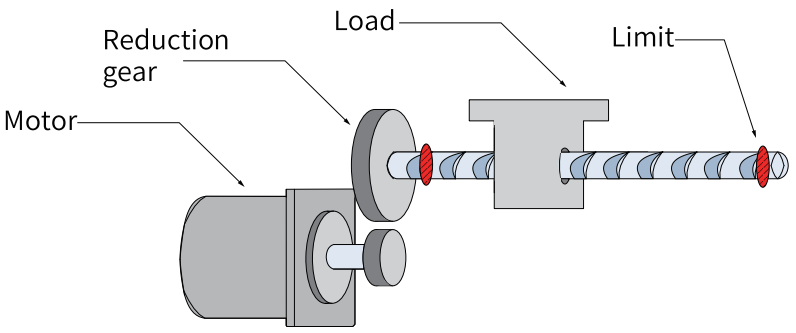


Figure 12-1 Application of the linear mode

If the electronic gear ratio is B/A and the mechanical absolute position (H0b.58 and H0b.60) is P_M, then the following formula applies: H0b.07 (Absolute position counter) = P_M/(B/A) H0b.07 indicates the present mechanical absolute position (in reference unit).

The data range of the number of revolutions for the absolute encoder is -32768 to 32767. If data overflows, E735.0 (Encoder multi-turn counting overflow) occurs. In this case, set H0d.20 to 2 (Reset

multi-turn data), and then perform homing again. In special occasions, you can set H0A.36 to 1 to mute E735.0 or use absolute position linear mode 2.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.36	2005-25h	Mechanical home offset	-2147483648 to 2147483647	0	Reference unit	Real time	"H05_en.36" on page 558
H05.46	2005-2Fh	DI selection of multi-turn frequency-division Z starting point	0: No operation 1: DI1 2: DI2 3: DI3 4: DI4 5: DI5	0	-	Real time	"H05_en.46" on page 561
H0b.07	200b-08h	Absolute position counter	-2147483648 to 2147483647	0	Reference unit	Read-only	"H0b_en.07" on page 638
H0b.58	200b-3Bh	Mechanical absolute position (low 32 bits)	0 to 4294967295	0	Encoder unit	Read-only	"H0b_en.58" on page 648
H0b.60	200b-3Dh	Mechanical absolute position (high 32 bits)	-2147483648 to 2147483647	0	Encoder unit	Read-only	"H0b_en.60" on page 648

Absolute position rotation mode

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

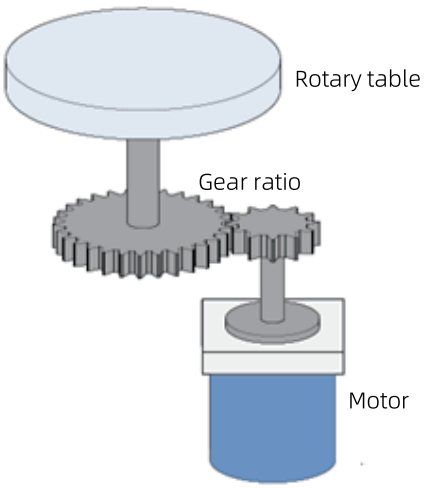
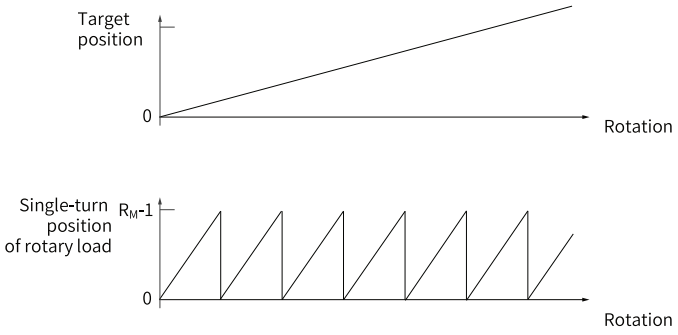
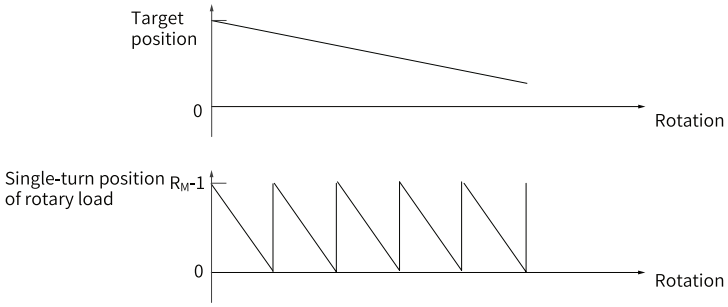


Figure 12-2 Application of the linear mode

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



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



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

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

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.50	2005-33h	Mechanical gear ratio in absolute position rotation mode (numerator)	1 to 65535	1	-	At stop	"H05_en.50" on page 562
H05.51	2005-34h	Mechanical gear ratio in absolute position rotation mode (denominator)	1 to 65535	1	-	At stop	"H05_en.51" on page 562

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.52	2005-35h	Pulses per revolution of the load in absolute position rotation mode (low 32 bits)	0 to 4294967295	0	Encoder unit	At stop	"H05_en.52" on page 562
H05.54	2005-37h	Pulses per revolution of the load in absolute position rotation mode (high 32 bits)	0 to 4294967295	0	Encoder unit	At stop	"H05_en.54" on page 563
H0b.81	200b-52h	Single-turn position of the rotary load (low 32 bits)	0 to 4294967295	0	Encoder unit	Read-only	"H0b_en.81" on page 650
H0b.83	200b-54h	Single-turn position of the rotary load (high 32 bits)	-2147483648 to 2147483647	0	Encoder unit	Read-only	"H0b_en.83" on page 650
H0b.85	200b-56h	Single-turn position of the rotary load (reference unit)	0 to 4294967295	0	Encoder unit	Unchangeable	"H0b_en.85" on page 651

Single-turn absolute mode

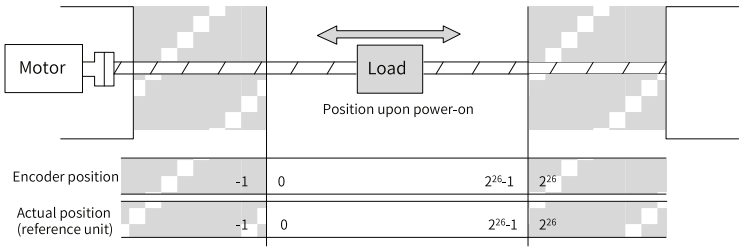
This mode applies to applications where the load travel range is within the single-turn range of the encoder. In this case, the absolute encoder needs no battery as it records the single-turn data only.

- Target position input range
  If a 26-bit absolute encoder is used in the single-turn absolute mode, the drive operates in the position control mode and the electronic gear ratio is 1:1, then:

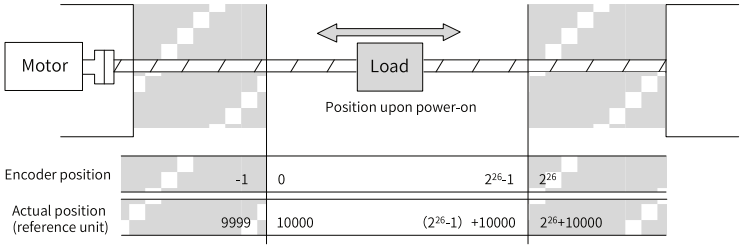
  When H05.36 (Mechanical home offset) is set to 0, the target position range is 0 to (2^{23} - 1).

  After homing is completed, the target position range is H05.36 to (2^{23} - 1 + H05.36).

- Example
  When the gear ratio is 1:1 and H05.36 is set to 0:



When the gear ratio is 1:1 and H05.36 is set to 10000:



12.1.3 Precautions for Using the Battery Box

This section applies only to Inovance servo motors.

E731.0 (Encoder battery fault) occurs when the battery is connected for the first time. Set H0d.20 to 1 to reset the fault and perform the homing operation.

When the battery voltage detected is lower than 3.0 V, E730.0 (Encoder battery alarm) occurs.

In this case, replace the battery according to the following steps.

1. Power on the servo drive and make it remain in the non-operational state.
2. Replace the battery.
3. After the servo drive automatically resets E730.0, if no other alarms occur, continue to operate the servo drive.

Note

- If you replace the battery after powering off the servo drive, E731.0 (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.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.20	200d-15h	Absolute encoder reset	0: No operation 1: Reset fault 2: Reset fault and multi-turn data 3: Reset Inovance 2nd encoder fault 4: Reset Inovance 2nd encoder fault and multi-turn data	0	-	At stop	"H0d_en.20" on page 659

Note

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

12.2 Full Closed-loop

Note

For fully closed-loop functions, the safety speed and position-related functions only support safety speed and position monitoring on the internal encoder. Safety speed and position monitoring on external encoders are not supported.

12.2.1 Fully Closed-loop Parameter Settings

After setting basic gain parameters, check that the servo drive operates properly without overshoot and stops without generating unexpected noise. When basic operating conditions are met, set the closed-loop parameters based on the following procedure.

1. **Set the external encoder feedback type.**

   Set H0F.03 based on the external encoder type.

Note

- SV670N-INT supports one type of 2nd encoder, which is the ABZ incremental encoder (TTL signal).
- After enabling the fully closed-loop function, enable the JOG function to observe whether the value of H0F.20 (external position pulse feedback display) changes. In the case of improper wiring, the value of H0F.20 does not change and a fully closed-loop fault will be reported. In this case, rectify the fault and perform a power cycling until the value of H0F.20 changes without fault alarms.
- If the feedback type of the external encoder is the ABZ incremental encoder with TTL signals but without Z signals, set H0F.22 to 1 to disable detection on phase Z.

2. **Confirm the operating direction of the external encoder.**

   Check whether the operating directions of the internal and external encoders are the same, if not, runaway can occur due to positive feedback.

   ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.01	200F-02h	External encoder usage mode	0: Standard operating direction 1: Reverse operating direction	0	-	Real time	"H0F_en.01" on page 668

   The following describes how to confirm the operating direction of the external encoder.

   Enter the JOG mode, and perform jogging at low speed in one direction. Observe the value of H0F.18 (Feedback pulse counter of internal encoder) and H0F.20 (Feedback pulse counter of

external). If these two values change in the same way (increase or decrease simultaneously), set H0F.01 to 0. Otherwise, set H0F.01 to 1.

Caution

- Perform necessary inspections before a motor trial run. For details, see "Pre-operation Inspection" in "Commissioning and Operation".
- Set this parameter properly. Improper settings may lead to runaway faults.

3. **Determine the resolution of external encoder (external encoder pulses per revolution).**

Rotate the motor and observe the value of H0F.18 (Feedback pulse counter of internal encoder) to confirm the motor has rotated for a full turn. Then calculate the variation of H0F.20 (Feedback pulse counter of external encoder), and incorporate this value into H0F.04.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.04	200F-05h	External encoder pulses per revolution	1 to 2147483647	10000	-	At stop	"H0F_en.04" on page 669

Caution

- Suppose the values of H0F.18 and H0F.20 before the motor rotates are X_1 and Y_1 respectively, and their values change to X_2 and Y_2 after the motor rotates, then the following formula applies:

$$\text{H0F.04} = \text{Number of encoder pulses per revolution} \times \frac{Y_2-Y_1}{X_2-X_1}$$

- The calculation result must be a positive value. If it is a negative value, it indicates H0F.01 is set improperly. In this case, check the value of H0F.01 again.
- Set H0F.04 properly. If H0F.04 is set to a wrong value, EB02.0 (Position deviation too large in fully closed-loop mode) may occur when the drive is operating.

4. **Set the electronic gear ratio of external encoder.**

If H0F.00 is set to 1, set H05.07/H05.09. If H0F.00 is set to 2, set H05.07/H05.09 for inner loop and H05.11/H05.13 for outer loop.

See "11.2 Conversion Factors" on page 265 for how to set the electronic gear ratio. Suppose for a fully closed-loop device, the external mechanical displacement corresponding to each X_1 pulse reference sent by the host controller is Y_1.

Then, perform the following operations:

a. Step 1: Set the electronic gear ratio to 1:1.

b. Step 2: Make the host controller send X_2 pulses. The external mechanical displacement measured is Y_2,

then the electronic gear ratio fulfills the needs.

Note

- To set the fully closed-loop electronic gear ratio in internal/external closed-loop position switchover mode, set the electronic gear switchover switch (Gear_Sel) to the external closed-loop state.
- This method also applies to internal closed-loop mode. In the internal closed-loop mode, ensure the present state is internal closed-loop state.
- Set the electronic gear ratio correctly. Failure to comply will result in mechanical deviation.

5. **Set the alarm threshold.**

Set H0F.08 and H0F.10 as follows:

- Set H0F.08 (Excessive deviation in compound control)

  Set H0F.08 (Excessive deviation in compound control) defines the position deviation threshold at which the servo drive detects fault EB02.0, indicating that the position deviation is excessive. The unit of H0F.08 is one reference unit (same as one external encoder unit).

  ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.08	200F-09h	Excessive deviation threshold in compound control mode	0 to 2147483647	1000	-	Real time	"H0F_en.08" on page 670

  For example, if H0F.08 is set to 1000, EB02.0 (Excessive position deviation in fully closed-loop mode) will be output if the deviation between the mechanical displacement driven by the motor and the mechanical displacement (compound deviation) measured by the external encoder exceeds the displacement corresponding to 1000 external encoder pulses.

Note

- If it is set to 0, EB02.0 (Position deviation too large in fully closed loop) will not be output.
- H0F.08 must be set to a value (such as H0F.04 x H0F.10 x 50%) lower than H0F.04 x H0F.10. Otherwise, EB02.0 cannot be outputted.

- Set H0F.10 (Clear deviation in compound control)

  The value of H0F.10 indicates the revolutions to be ran by the motor per deviation clear in the compound control mode.

  ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.10	200F-0Bh	Clear deviation in compound control mode	0 to 100	1	Rev	Real time	"H0F_en.10" on page 670

  If H0F.10 is set to 0, the deviation in compound control will not be cleared.

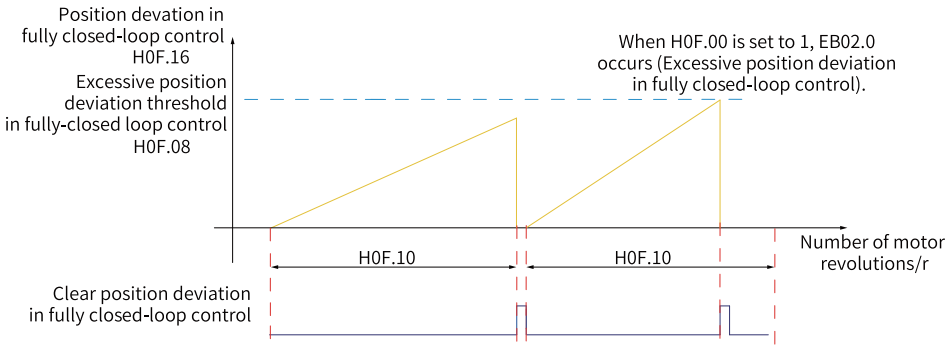


Figure 12-3 Description of position deviation clear in the fully closed-loop mode

The number of revolutions defined by H0F.10 is detected through internal encoder feedback pulses.

For example, if H0F.10 is set to 50, the servo drive detects whether the deviation in compound control exceeds the pulse unit defined by H0F.08 when the motor is in the process of rotating within 50 turns. If yes, EB02.0 will be reported. If not, the servo drive clears the deviation after the motor rotates for more than 50 revolutions, and then starts monitoring again.

- Set the first-order low-pass filter for deviation in compound control.
  ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.13	200F-0Eh	Compound vibration suppression filter time	0.0 to 6553.5	0.0	ms	At stop	"H0F_en.13" on page 670

The first-order filter time constant is used to filter vibration of the deviation in compound control, smoothening the speed in fully closed-loop mode.

- Set the source of touch probe Z signal in fully closed-loop mode.
  ☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.25	200F-1Ah	Set the source of touch probe Z signal in fully closed-loop mode.	0: Motor Z signal 1: External feedback Z signal	0	-	Real time	"H0F_en.25" on page 672

H0F.25 (Source of touch probe Z signal in fully closed-loop mode) defines the source of Z signal during homing in the fully closed-loop mode. The setpoint 0 indicates Z signal of inner loop of used as the source and the setpoint 1 indicates Z signal of the outer loop is used as the source. When the Z signal of outer loop is used as the source, ensure Z signal is wired correctly. Otherwise, Z signal may fail to be detected.

Caution

- Set H0F.10 properly for clearing deviation in compound control. Given the setpoint of H0F.08, if H0F.10 is set to an excessively low value, protection against excessive deviation in compound control can fail.
- Pay attention to encoder limit setting during use.
- Set this warning properly. Failure to comply may incur physical injuries due to runaway accident.

12.2.2 Enabling Fully Closed-loop Settings

After setting preceding fully closed-loop parameters, observe the internal/external encoder feedback through H0F.18 and H0F.20, and check whether the fully closed-loop wiring and the application mode of the external encoder are proper. If yes, enable the fully closed-loop function.

Set the following parameters while enabling the fully closed-loop function:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.02	2003-03h	DI1 function selection	0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 38: Touch probe 1 39: Touch probe 2 40: Multi-speed enable	14	-	Real time	"H03_en.02" on page 543
H0F.00	200F-01h	Encoder feedback mode	0: Internal encoder feedback 1: External encoder feedback 2: Inner/Outer loop switchover	0	-	Real time	"H0F_en.00" on page 668

Note

To switch between inner and outer loops, you need to set H0F.00 to 2, rather than changing it to 0 or 1 in realtime.

12.3 Soft Limit

Function description

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

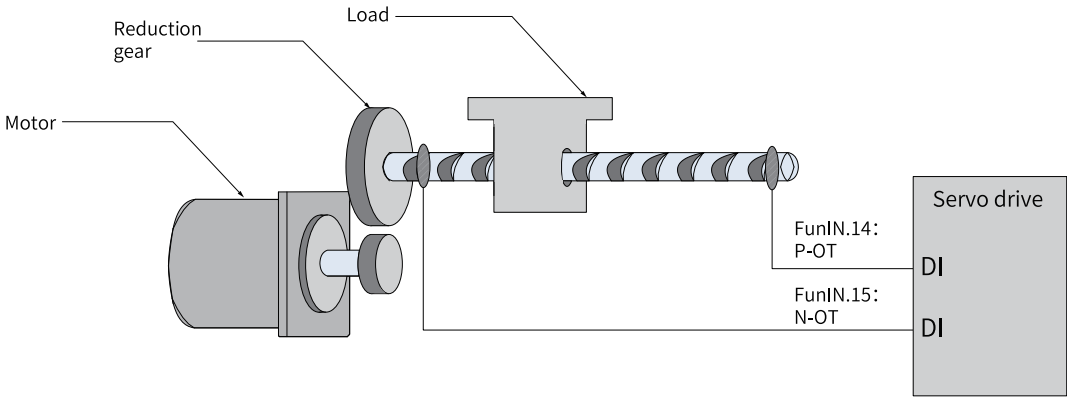


Figure 12-4 Installation of limit switches

Software position limit is implemented through a comparison between the internal position feedback and the specified limit value. If the specified limit value is exceeded, the servo drive reports a warning and stops immediately. Software position limit is available both in absolute position mode and incremental position mode. To use the software position limit in incremental position mode, set H0A.01 (Software position limit) to 2 (Enabled after homing) first, and then perform homing upon power-on before applying software position limit.

Table 12–2 Comparison between the hardware position limit and software position limit

Hardware Position Limit		Software position limit	
1	Restricted to linear motion and single-turn rotational motion.	1	Applicable to both the linear motion and the rotational motion.
2	Requires an external mechanical limit switch.	2	Hardware wiring is not required, preventing malfunction due to poor cable connection.
3	Suffered from the risk of mechanical slip.	3	Internal position comparison can prevent malfunction due to mechanical slip.
4	Unable to sense or detect an overtravel fault after power-off.		

Related objects

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.00	200A-01h	Power input phase loss protection	0: Enable 1: Disable	0	-	Real time	"H0A_en.00" on page 619
H0A.41	200A-2Ah	Forward position of software position limit	-2147483648 to 2147483647	2147483647	Encoder unit	At stop	"H0A_en.41" on page 626
H0A.43	200A-2Ch	Reverse position of software position limit	-2147483648 to 2147483647	-2147483648	Encoder unit	At stop	"H0A_en.43" on page 627

Communication mode:

- When H0A.01 is set to 0 (Disable absolute position limit), software position limit is disabled.
- When H0A.01 is set to 1 (Enable absolute position limit), software position limit is enabled immediately upon power-on. 607D.01h (Minimum position limit) and 607D.02h (maximum position limit) are used by the function. Ensure the value of 607D.01h (Minimum position limit) is lower than or equal to 607D.02h (Maximum position limit). If 607D.01h (Minimum position limit) is set to a value larger than 607D.02h (Maximum position limit), EE09.0 (Software position limit setting error) is reported.
- If H0A.01 is set to 2 (Enable absolute position limit after homing), software position limit is not enabled after homing upon power-on. When the value of the absolute position counter is larger than the value of 607D.02h (Maximum position limit) after homing, E950.0 (Forward overtravel warning) occurs and the drive stops accordingly. When the value of the absolute position counter is smaller than the value of 607D.01h (Minimum position limit) after homing, E952.0 (Reverse overtravel warning) occurs and the drive stops accordingly.

Non-communication mode:

- When H0A.01 is set to 0 (Disable absolute position limit), software position limit is disabled.
- When H0A.01 is set to 1 (Enable absolute position limit), 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, E950.0 (Forward overtravel warning) occurs and the drive stops accordingly.
  When the value of the absolute position counter (H0b.07) is lower than the value of H0A.43, E952.0 (Reverse overtravel warning) occurs and the drive stops accordingly.
- If H0A.01 is set to 2 (Enable absolute position limit after homing), software position limit is not 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, E950.0 (Forward overtravel warning) occurs and the drive stops accordingly. When the value of the absolute position counter (H0b.07) is lower than the value of H0A.43 after homing, E952.0 (Reverse overtravel warning) occurs and the drive stops accordingly.

Note

Ensure the value of 607Ch (Home offset) is within the software position limit. Otherwise, the servo drive reports EE09.1.

12.4 Software Reset

Function description

The software reset function applies when power cycling of the drive is not allowed on the application site.

Related objects

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.00	200d-01h	Software Reset	0: No operation 1: Enable	0	-	At stop	"H0d_en.00" on page 655

12.5 Motor Protection

Motor overload protection

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

The motor is compliant with NEC and CEC requirements and equipped with protective functions against overload and overtemperature.

Set the motor overload protection gain (H0A.04) to adjust the report time of fault E620.0. Use the default value of H0A.04 in general conditions, however, in case of one of the following situations, modify H0A.04 based on the actual heating condition.

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

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



Take caution when hiding the motor overload fault as it may damage the motor.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.04	200A-05h	Motor overload protection gain	50 to 300	100	-	Real time	"H0A_en.04" on page 620
H0A.26	200A-1Bh	Motor overload detection	0: Show motor overload warning (E909.0) and fault (E620.0) 1: Hide motor overload warning (E909.0) and fault (E620.0)	0	-	Real time	"H0A_en.26" on page 623

Locked rotor over-temperature protection

When the motor is stalled, the motor speed is nearly 0 rpm at high current input. In this case, the motor can be overheated significantly. The motor is capable of operating upon stall in an allowable period of time, exceeding of which can damage the motor due to overtemperature. To prevent such risks, the drive offers motor overtemperature protection to protect the motor from being damaged by overtemperature.

You can set the time for reporting E630.0 (Motor stall over-temperature fault) by setting the time threshold for motor overtemperature protection (H0A.32). The motor overtemperature protection function is enabled by default (H0A.33 = 1).

Caution

- To prevent damages to the motor, take caution when you use the motor stall over-temperature protection function.
- Use the dedicated motor for the drive. Failure to comply can result in short circuits caused by aging of insulation.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.32	200A-21h	Time threshold for locked motor overheat protection	10 to 65535	200	ms	Real time	"H0A_en.32" on page 624
H0A.33	200A-22h	Stall overtemperature protection	0: Disabled 1: Enabled	1	-	Real time	"H0A_en.33" on page 625

Motor overspeed protection

An excessively high speed may damage the motor or machine. Motor overspeed protection is used to protect the motor in case of overspeed, preventing the motor or machine from being damaged due to overtemperature.

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

Caution

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

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.08	200A-09h	Overspeed threshold	0 to 20000	0	rpm	Real time	"H0A_en.08" on page 620
H0A.12	200A-0Dh	Runaway protection enable	0: Disable 1: Enable runaway protection scheme 12: Enable runaway protection scheme 2	1	-	At stop	"H0A_en.12" on page 621

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

12.6 DI Filter Time

Function description

The drive provides eight physical DI terminals, in which DI1 to DI3 are normal DI terminals, and DI4 to DI5 are high-speed DI terminals. Assign the function of touch probe to DI4 or DI5 to guarantee precision.

When regular functions, excluding touch probes, are assigned to DIs, the filter time of these DIs is set in H03.60 to H03.64. Ensure the effective level hold time of the DI assigned with regular function is above 0.5 ms. Otherwise, the DI function may not be responded to.

When a high-speed DI is assigned with the touch probe function, the filter time of this DI is defined by H0A.19 and H0A.20. Ensure the effective level hold time of the high-speed DI is longer than the filter time.

Related objects

The drive provides two high-speed DIs with input signal frequency up to 4 kHz. When the DI signal is being disturbed, set the filter time in H0A.19 and H0A.20.

☆Related parameters:

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.60	2003-3Dh	DI1 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.60" on page 548
H03.61	2003-3Eh	DI2 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.61" on page 549
H03.62	2003-3Fh	DI3 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.62" on page 549
H03.63	2003-40h	DI4 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.63" on page 549

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.64	2003-41h	DI5 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.64" on page 549
H0A.19	200A-14h	Filter time constant of touch probe 1	0.00 to 6.30	2.00	μs	Real time	"H0A_en.19" on page 622
H0A.20	200A-15h	Filter time constant of touch probe 2	0.00 to 6.30	2.00	μs	Real time	"H0A_en.20" on page 622

12.7 EtherCAT-forced DO

Function description

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

1. Status unchanged in the non-OP status: The servo status switches to the non-OP status and the forced DO status stays unchanged.
2. Initialization status: No forced DO is generated when the servo drive is in the non-OP status. When the network switches to the operational (OP) status, the forced DO is determined by 60FE.01h and 60FE.02h.

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

Related objects

The following table describes some related parameter settings.

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H04.23	2004-18h	EtherCAT communication-forced DO logic in non-OP status	bit0: DO1 0: Status unchanged 1: No output bit1: DO2 0: Status unchanged 1: No output	0	-	Real time	"H04_en.23" on page 552

Descriptions for the setpoints are shown in the following "Table 12-3" on page 425*table*.

Table 12–3 Description of setpoints

Value range	DO function
0	Status of DO1 and DO2 is unchanged in the nonoperational status
1	No output in DO1 and status of DO2 unchanged in the non-operational status
2	No output in DO2 and status of DO1 unchanged in the non-operational status
3	No output in DO1 and DO2 in the nonoperational status

Setting method:

1. Assign DO function 31 (EtherCAT-forced DO) to the DO to be controlled forcibly by EtherCAT, and then set the bit of H04.23 as needed to select the forced DO status in the non-OP status.
2. Configure 60FE.01h/60FE.02h as RPDO, and operate on bit16 to bit18 to control the DO.

12.8 Position Comparison

Function description

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

Note

1. During position comparison, the position comparison function is executed again when any of the comparison start point, stop point, and comparison mode are modified.
2. When you use the position comparison output function, it is recommended to set the logic of position comparison DO to 0-Normally Open (NO).

- Set the DO logic to 0-NO (the corresponding DO optocoupler switches from OFF to ON upon position comparison traversal) to achieve a response of 10 μs.
- Set the DO logic to 1-Normally Closed (NC) (the corresponding DO optocoupler switches from ON to OFF upon position comparison traversal) to achieve a response within 300 μs.

The following table describes the specifications of position comparison output.

Specifications of position comparison output		Function description
Trigger output	Output terminal	DO or ABZ/OCZ signals.
	Logic	The effective level of DO is defined by the DO logic in group H04.
		The effective level of ABZ/OCZ output is defined by H18.06.
	Pulse width	The pulse output width is defined by H18.05.
	Delay compensation	Defined by H18.14 and used to compensate for hardware output delay.
Comparison source	Motor encoder feedback	Supported
	Pulse feedback fully closed-loop (ABZ)	Supported
	Communication-type fully closed-loop	Supported
Comparison value	Number of comparison points	40 points, signed 32-bit integer
Comparison attribute	Attribute of comparison point	Defines the attribute of the comparison point.
		Defines the output terminal for comparison.

Related objects

When position comparison is enabled, you can assign FunOUT.25 (Position comparison) to any one of the two DOs. The DO you select will be used to output the position comparison output signal. You can also use the ABZ/OCZ signal as the position comparison output terminal by setting H18.16.

Position comparison output parameters:

Parameter code	Parameter name	Description
H18: Position comparison output		
H18.00	Position comparison switch	0: Disable 1: Enable (rising edge-triggered)
H18.01	Position comparison output feedback source	0: Motor encoder feedback 1: Fully closed-loop position feedback
H18.02	Position comparison resolution[1]	Defines the number of pulses per revolution. For example, if H18.02 is set to 1, the number of pulses per revolution is 2^{23}. 0: 24-bit 1: 23-bit 2: 22-bit 3: 21-bit 4: 20-bit 5: 19bit 6: 18bit 7: 17bit
H18.03	Position comparison mode	0: Individual comparison 1: Cyclic comparison 2: Fixed cyclic comparison
H18.04	Current position as zero	0: Disable 1: Enable (rising edge-triggered) Note: This function needs to be used when the comparison state is inactive. Otherwise, the comparison logic may malfunction.
H18.05	Position comparison pulse output width	Defines the active pulse width of the DO when the comparison point is reached. The value range is 0.1 to 204.7 (in ms).
H18.06	Position comparison output ABZ polarity	bit0: OCZ output polarity bit1: Z output polarity bit2: A/B output polarity 0: Positive; 1: Negative
H18.07	Start point of position comparison	Activated when H18.00 is set to 1 again.
H18.08	End point of position comparison	Activated when H18.00 is set to 1 again.
H18.09	Current state of position comparison	0: No comparison; n: Waiting for the comparison point N
H18.10	Real-time position of position comparison	Displays the current comparison position value Value range: -2^{31} to (2^{31} - 1)
H18.12	Zero offset of position comparison	Defines the offset value after current position is taken as the zero point. Value range: -2^{31} to $+2^{31}$ - 1

Parameter code	Parameter name	Description
H18: Position comparison output		
H18.14	Position comparison output delay compensation	Comparison delay compensation time: -12 us to +12 us
H18.15	Number of cycles in fixed mode	1 to 65535
H18.16	ABZ output function setting	bit 0: OCZ function bit1: Z function bit2: A/B (0: Frequency-division output; 1: Position comparison)
H18.17	Number of completions in fixed mode	Value range: 0 to 65535

Note

[1]: When the source of position comparison is full closed-loop feedback, it is only effective for Inovance encoders.

Parameter code	Parameter name	Description
H19: Target position parameters		
H19.00	Target value of position comparison 1	Defines the target value of position comparison 1. Value range: -2^{31} to 2^{31} - 1
H19.02	Attribute value of position comparison 1	Defines the attribute value of position comparison 1. bit0: 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point; 0: Skip this point bit1: 1: Output DO active signal if current position changes from "more than" to "less than" the comparison point; 0: Skip this point bit2 to bit6: NA Bit7 to bit11: DO1 to DOX. For SV670N-INT, X is 2. Bit12: Frequency-division A output Bit13: Frequency-division B output Bit14: Frequency-division Z output Bit15: Frequency-division OCZ output
H19.03	Target value of position comparison 2	Defines the target value of position comparison 2. Value range: -2^{31} to 2^{31} - 1
H19.05	Attribute value of position comparison 2	Defines the attribute value of position comparison 2. Value range: Same as above
...	...	...
H19.117	Target value of position comparison 40	Defines the target value of position comparison 40. Value range: -2^{31} to 2^{31} - 1
H19.119	Attribute value of position comparison 40	Defines the attribute value of position comparison 40. Value range: Same as above

Function operation

1. How it works

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

- Position comparison switch
  When the value of H18.00 (Position comparison switch) changes from 0 to 1, position comparison starts and the value of H18.09 (Current state of position comparison) is updated to the start point of position comparison. When the value of H18.00 changes to 0, position comparison stops and the current comparison state will be cleared.
- Position comparison resolution
  The comparison resolution defines the number of pulses per revolution. Given the maximum and minimum limits on the target position (defined by group H19), you can reset the resolution when data overflow occurs on the comparison value. For example, when H18.02 is set to 7, the maximum value of the target position is 2^{31} - 1, and the motor rotates (2^{31} - 1)/2^{17} turns. The position comparison resolution (H18.02) of SV670-INT is invalid when a direct drive linear (DDL) motor is used.

Note

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

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

  The real-time position feedback in individual comparison mode is an absolute value, which means it is an accumulative value based on preceding comparison points and cannot be automatically cleared.
- Cyclic comparison mode
  In cyclic comparison mode, position comparison will not be switched off when the comparison end point is reached, and current position comparison value will be reset as the start point for position comparison. After comparison of each point is completed, the real-time position feedback (H18.10) will be cleared and counted again for cyclic comparison. In cyclic comparison mode, the target position is a relative (incremental) value. Each time a comparison point is reached, the real-time position feedback is cleared and counted again for comparison with the new target.
- Fixed cyclic comparison
  In fixed cyclic comparison mode, the comparison process works in the same way as the cyclic comparison mode. The number of cycles is defined by H18.15. After the set number of cycles are done executing, comparison will be automatically disabled.
- Position comparison output width

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

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

- Target value of position comparison
  There are 40 target values for position comparison. The target value and attribute value of position comparison must be updated to parameters in group H19 in advance.

Note

Set the target position properly. overflow comparison (H18.10) is not supported in the position comparison mode.

- Start point for comparison
  The start point indicates the position of the first comparison point. For example, if the start point is set to 5, the comparison starts from position comparison 5.
- End point for comparison
  The end point indicates the position of the last comparison point. For example, if the end point is set to 7, the comparison stops or restarts from the start point after position comparison 7 is reached.
- Zero offset of position comparison
  The value of H18.10 (Real-time position feedback) will be changed to the offset value defined by H18.12 (Zero offset of position comparison) at the rising edge (0 → 1) of H18.04 (Present position as zero).

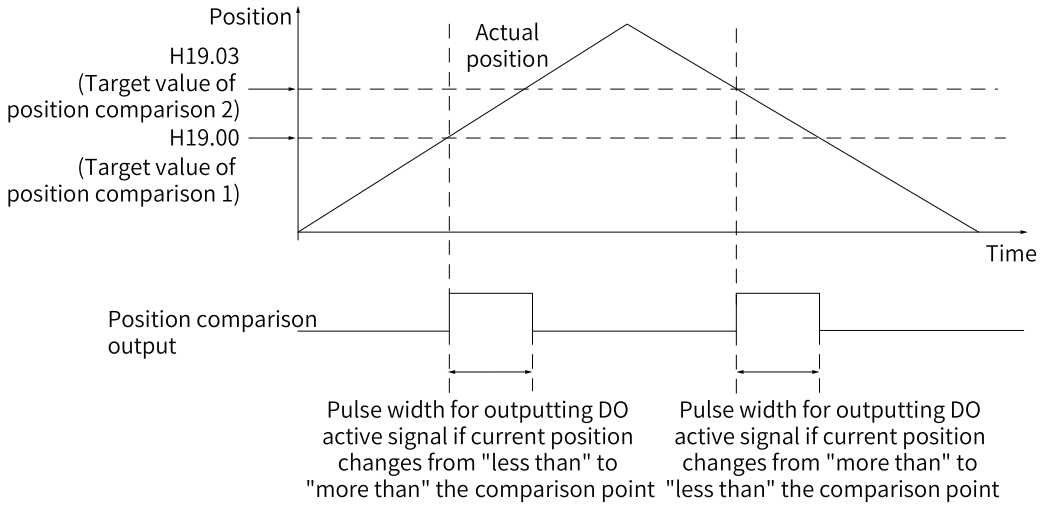
Note

Check whether zero offset needs to be set before enabling position comparison output. Otherwise, comparison error may occur.

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2. Function operation

- When the position feedback of the encoder passes the target position comparison points, the output width of the output terminal is defined by H18.05 (Position comparison output width).

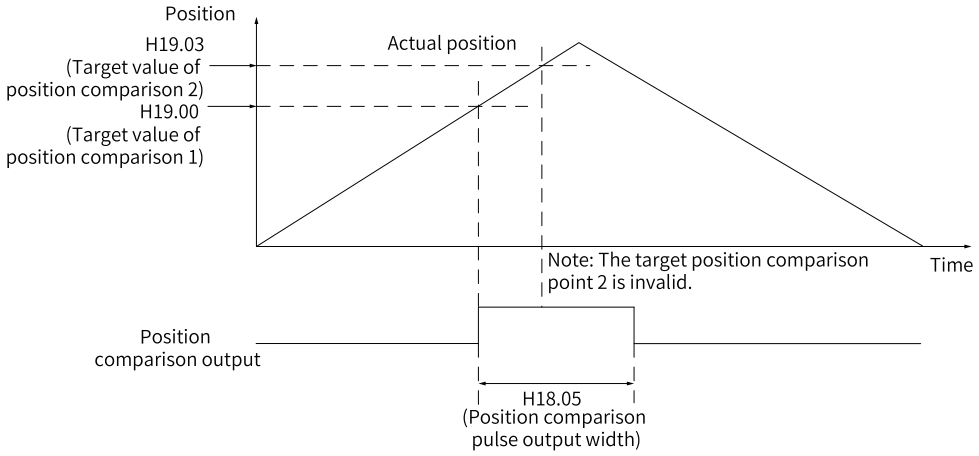


When the attribute of the comparison point is set to "bit0 = 1" (Output DO active signal if current position changes from "less than" to "more than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "less than" to "more than" the comparison point position.

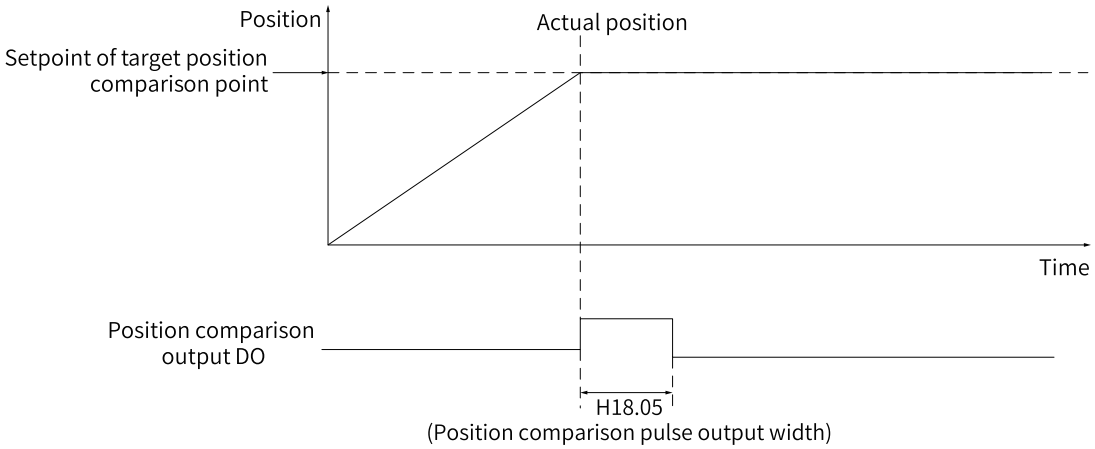
When the attribute of the comparison point is set to "bit1 = 1" (Output DO active signal if current position changing from "more than" to "less than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "more than" to "less than" the comparison point position.

When the attribute of the comparison point is set to "bit0/bit1 = 1" (Output DO active signal in both situations), the DO outputs the position comparison signal when the position feedback passes the target position comparison point.

- When multiple position comparison values are set, no comparison will be performed once the position comparison output terminal is active. Therefore, ensure the operating time between two position comparison points is larger than the pulse output width.
  As shown in the following figure, comparison is not performed when the position changing from "more than" to "less than" the comparison point position. This is because the operating time between the two comparison points is lower than the pulse output width.



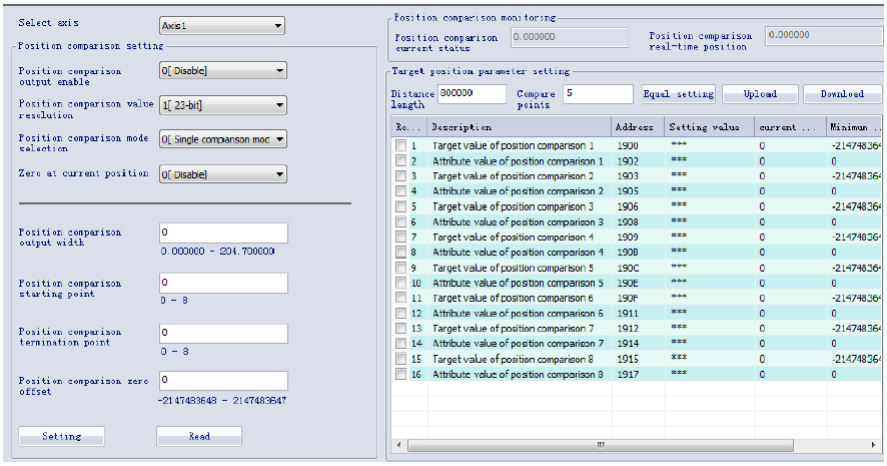
- Only one pulse will be outputted when the stop position is the same with the target value of position comparison, as shown below.



3. Interface of the software tool

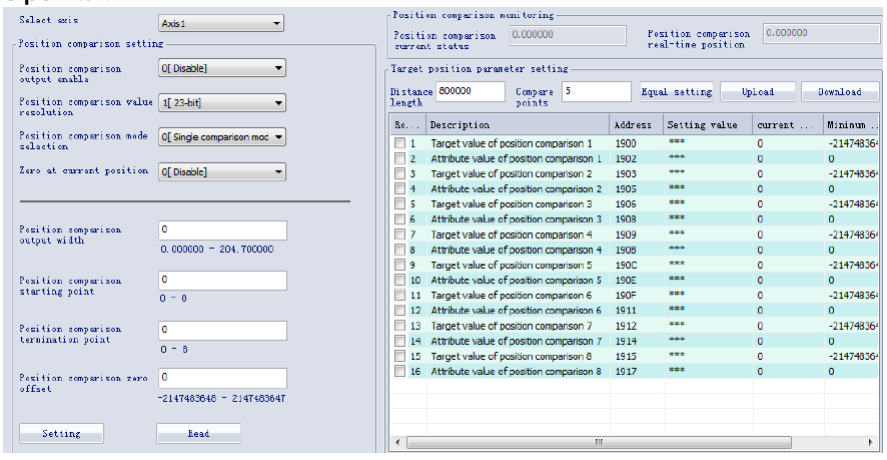
- Individual comparison mode

  a. Set H18.03 (Position comparison mode) to 0 (Individual position comparison).



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

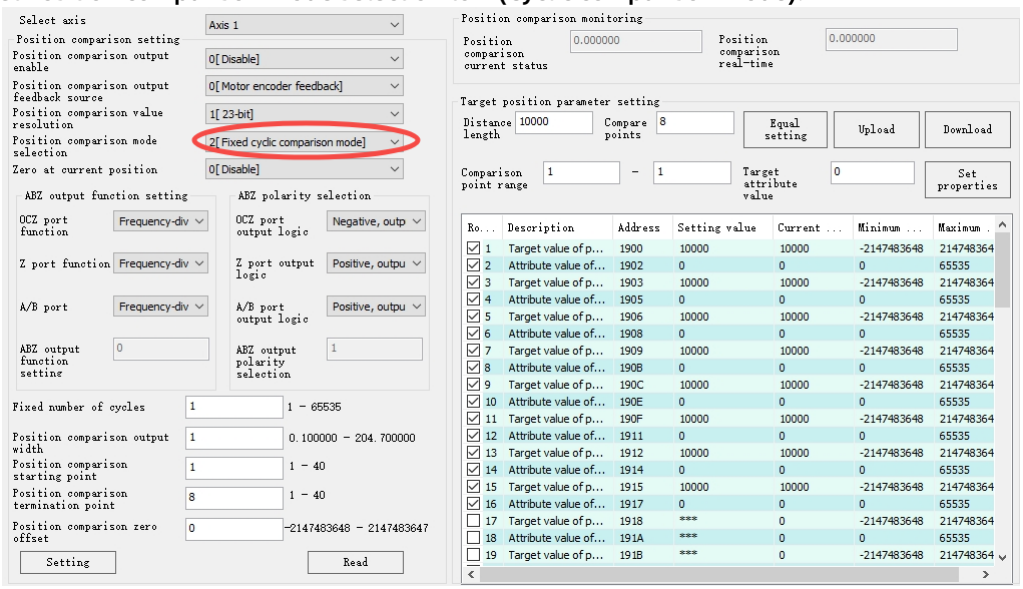
  c. After clicking **Equal setting**, the target value of the first point is updated to "**Distance length** x 1/**Compare points**", the target value of the second point is updated to "**Distance length** x 2/**Compare points**", and the target value of the Nth point is updated to "**Distance length**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



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

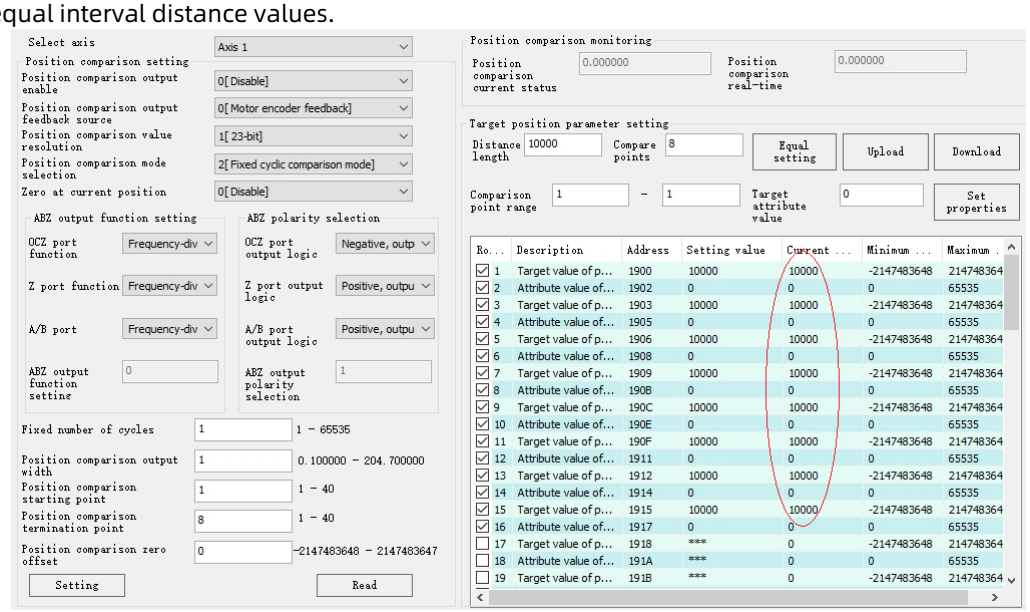
- Cyclic comparison mode/Fixed cyclic comparison mode

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



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

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



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

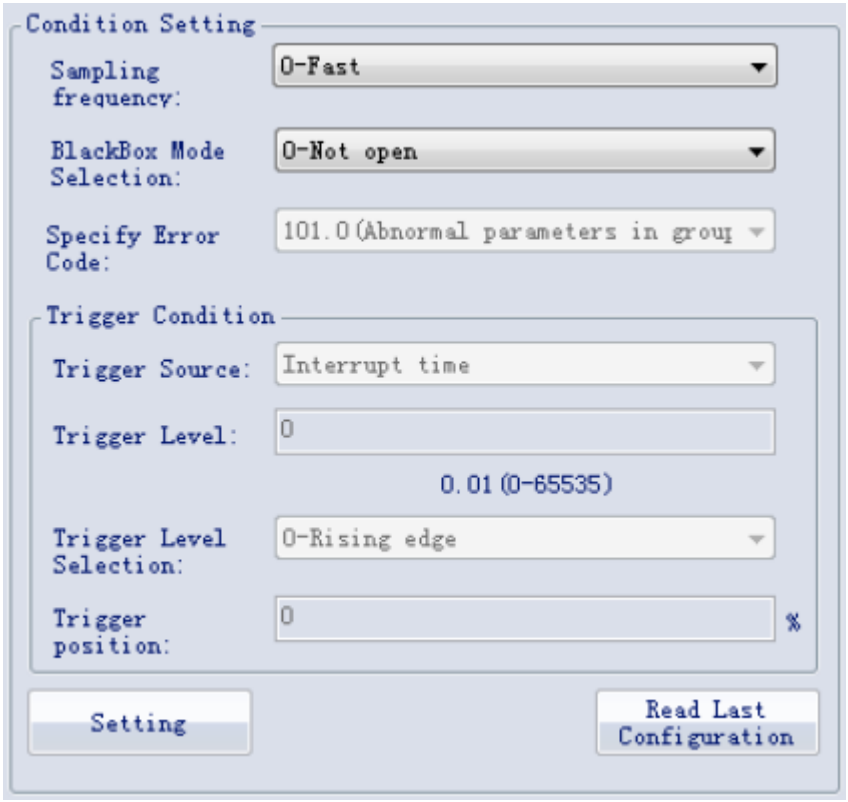
12.9 Black Box

Function description

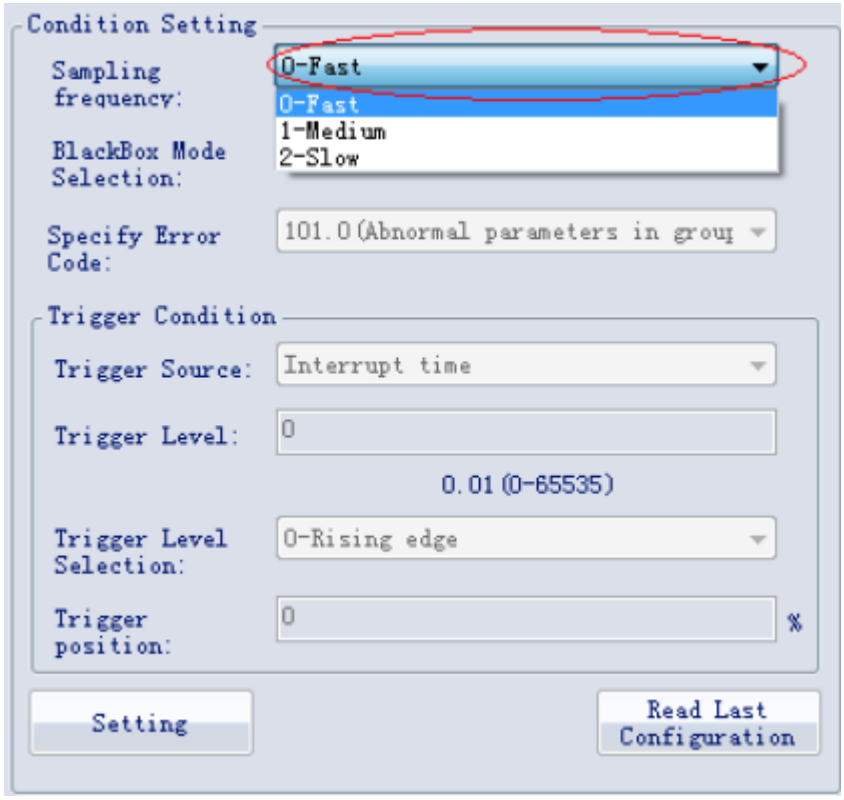
The black box function is used to capture and save the data generated upon occurrence of faults or under designated conditions. Such data can be read and uploaded by users through the software tool to facilitate troubleshooting. You can set H32.45 to configure the black box channel, facilitating root cause analysis for different types of issues. Assume that the real-time target speed (60FF)/ electrical angle channel is used. When H32.45 is set to 0, the real-time target absolute position (607A) is collected. When H32.45 is set to 1, the electrical angle is collected.

The black box is enabled by default for SV670N-INT series servo drives. It is triggered upon occurrence of a fault or a sampling frequency of 16k. The black box function will be automatically turned off after it is being triggered, and automatically turned on upon fault reset or power cycling.

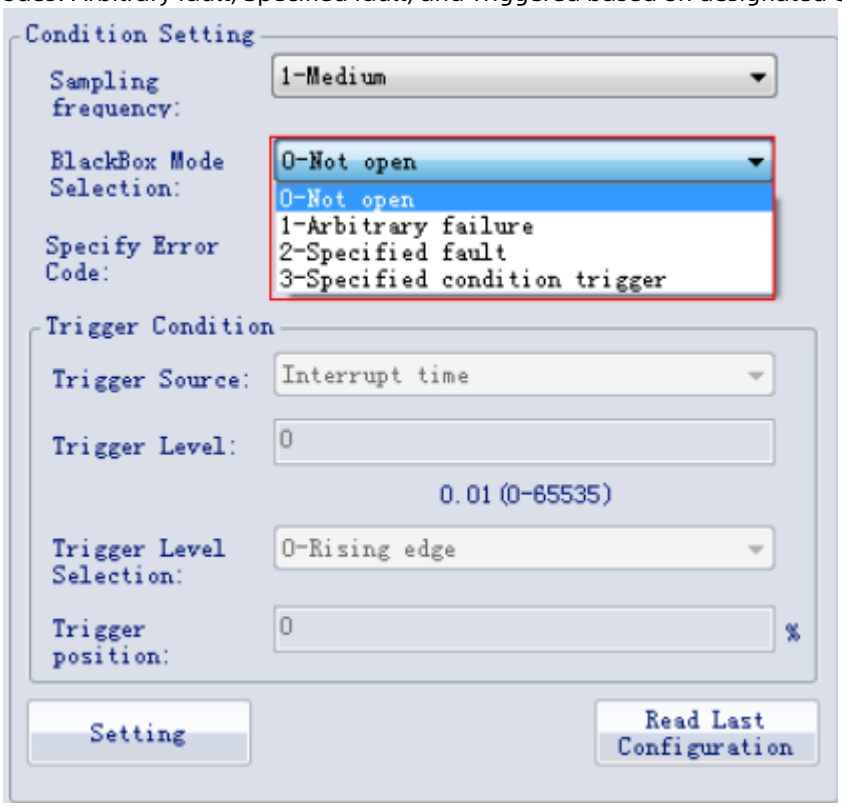
Triggering the black box



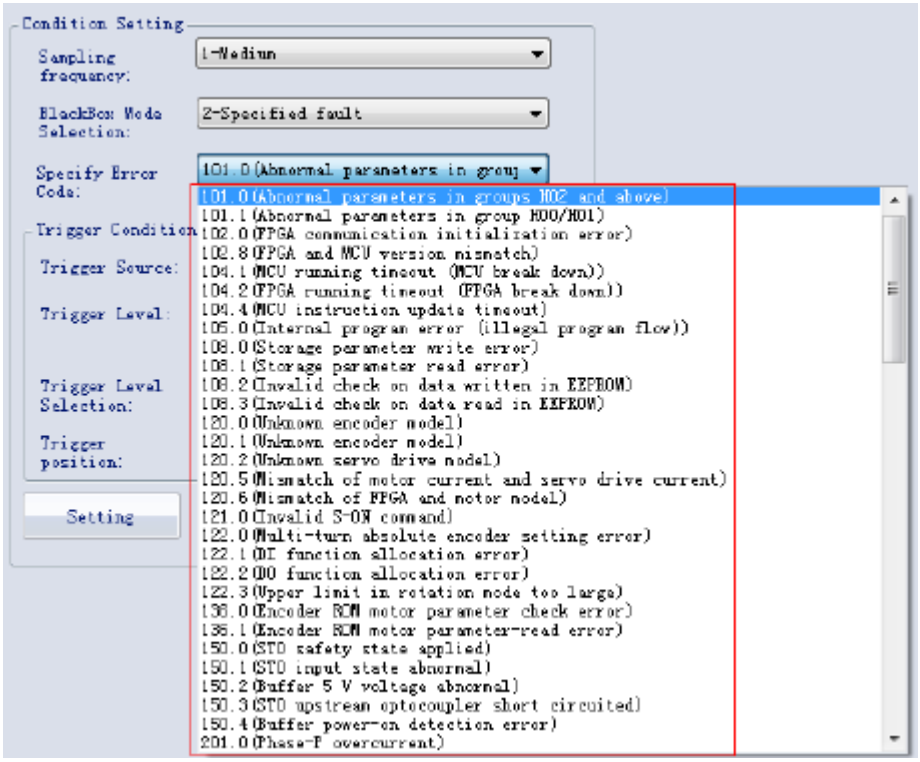
1. Sampling frequencies of SV670N-INT series servo drives: 16k (Fast), 4k (Medium), and 0.5k (Slow).



2. Black box modes: Arbitrary fault, Specified fault, and Triggered based on designated condition.



3. Select a fault from the drop-down list, as shown below.



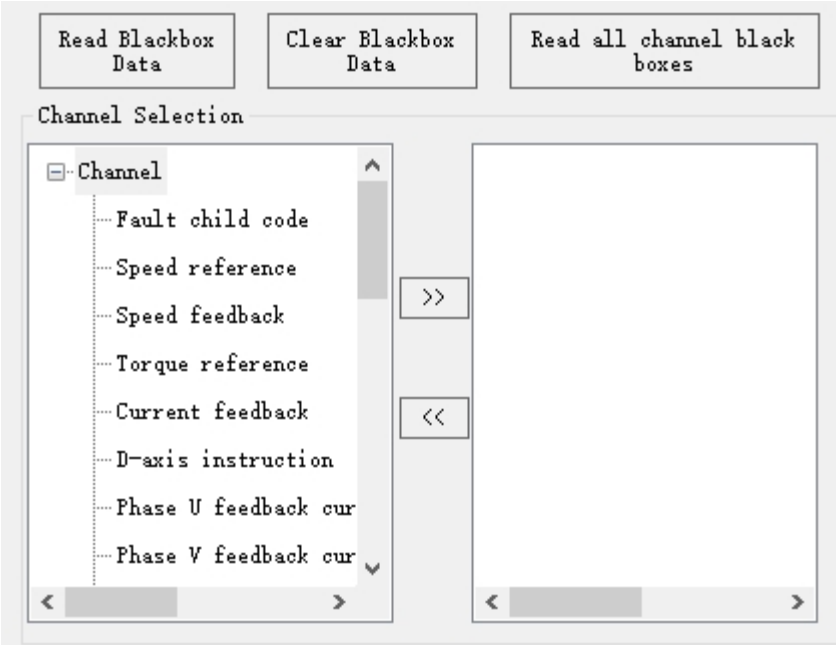
4. The Trigger Condition includes Trigger Source, Trigger Level, and Trigger Level Selection, as shown below.



5. Trigger position: used to set the position of the trigger time in the total sampling time, which is set to 75% by default.
6. After the black box is set, click **Setting** to download configuration parameters to the servo drive.

Reading black box data

You can select the black box channels (4 channels at most) by clicking **>>** or **<<**, or read data of all the channels by clicking **Read all**, then click **Save** to save the waveform files.



12.10 Touch Probe Function

Function overview

The touch probe function is the same as the position latch function. Position feedback sources include motor position and full closed-loop feedback. This feature latches the position information (reference unit) when an DI signal or Z signal changes.

SV670N-INT provides two touch probes for recording the positions of two probe signals at the rising edge and falling edge, which means four positions can be latched.

When a DI is used to trigger the touch probe, the relationship between the DI logic and the touch probe edge is shown in the following table. The touch probe is supported only by high-speed DIs.

Table 12–4 Description of bit3 of H0A.40

bit3 of H0A.40	Touch probe edge	DI logic	DI switch
0	Rising edge	Normally open (NO)	OFF→ON
		Normally closed (NC)	ON→OFF
	Falling edge	Normally open (NO)	ON→OFF
		Normally closed (NC)	OFF→ON
1	Rising edge	NO/NC	OFF→ON
	Falling edge	NO/NC	ON→OFF

When a DI is used to trigger the touch probe, you can set the filter window of the touch probe signal in H0A.19 and H0A.20.

The DI touch probe supports hardware action delay compensation to compensate for the precision loss incurred by ON/OFF delay of the DI. Related parameters are shown in the following table.

Parameter		Description
H0A.40	bit1	Touch probe rising edge compensation: 1: Enabled, 0: Disabled
	bit2	Touch probe falling edge compensation: 1: Enabled, 0: Disabled
H0A.53		DI probe DI ON compensation time (DI OFF→ON)
H0A.54		DI probe DI OFF compensation time (DI ON→OFF)

To shorten the hardware delay to about 7 μs, it is recommended to set the touch probe latch through the ON-edge of the DI.

There are three Z touch probe triggers: motor Z signal, frequency-division output Z signal, and fully closed-loop Z signal, as shown in the following table.

Feedback source	Parameter	Description
Motor encoder	H05.41.bit2 = 0, motor Z signal	The Z touch probe is triggered by the motor Z signal.
	H05.41.bit2 = 1, frequency-division output Z signal	The Z touch probe is triggered by the frequency-division output Z signal, including the multi-turn Z signal.
Fully closed-loop feedback	H0F.25 = 0, motor Z signal	When there is no Z signal input in the pulse-type fully closed-loop mode, you can trigger the touch probe through the motor Z signal to latch external position feedback.
	H0F.25 = 1, fully closed-loop Z signal	When there is Z signal input in the pulse-type fully closed-loop mode, you can trigger the touch probe latch function through the fully closed-loop Z signal.

Related objects

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
60B8h	60B8h	Touch probe mode	0x0 to 0xFFFF	0x0	-	Real time	"60B8h" on page 887
60B9h	60B9h	Probe status	0x0 to 0xFFFF	0x0	-	Read-only	"60B9h" on page 888
60BAh	60BAh	Position value at probe 1 rising edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BAh" on page 889
60BBh	60BBh	Position value at probe 1 falling edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BBh" on page 889
60BCh	60BCh	Position value of probe 2 rising edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BCh" on page 890
60BDh	60BDh	Position value of probe 2 falling edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BDh" on page 890
60D5h	60D5h	Touch probe 1 rising edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D5h" on page 891
60D6h	60D6h	Touch probe 1 falling edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D6h" on page 891

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
60D7h	60D7h	Touch probe 2 rising edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D7h" on page 891
60D8h	60D8h	Touch probe 2 falling edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D8h" on page 891

Procedure

Example:

Use DI5 to trigger the touch probe. Background: touch probe 1 rising edge, continuous latching

Perform the following steps:

1. Set the function of DI5 (H03.10 = 38). Set the DI5 logic to NO (H03.11 = 0).
2. Set the touch probe function in 60B8h.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
60B8h	60B8h	Touch probe mode	0x0 to 0xFFFF	0x0	-	Real time	"60B8h" on page 887

Assignment of each bit of the touch probe function (60B8h) is shown in the following table.

Bit	Name	Description
0	Touch probe 1 enable: 0: Disable 1: Enable	bit 0 to bit 5: settings related to touch probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn motor position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
5	Touch probe 1 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
6 to 7	N/A	-

Bit	Name	Description
8	Touch probe 2 enable: 0: Disable 1: Enable	bit 8 to bit 13: settings related to touch probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
13	Touch probe 2 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
14 to 15	N/A	-

In this example, 60B8h is set to 0x0013.

3. Read the touch probe status in 60B9h.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode	Page
60B9h	60B9h	Probe status	0x0 to 0xFFFF	0x0	-	Read-only	"60B9h" on page 888

Assignment of each bit of 60B9h is shown in the following table.

Bit	Name	Description
0	Touch probe 1 enable: 0: Disable 1: Enable	bit 0 to bit 2: status of touch probe 1.
1	Touch probe 1 latching on a rising edge 0: No rising edge value latched 1: Rising edge value latched	
2	Touch probe 1 latching on a falling edge 0: No falling edge value latched 1: Falling edge value latched	
3 to 5	N/A	-
6 to 7	Number of touch probe trigger events when touch probe 1 is set for continuous sampling	The total number of times (0 to 3) that the touch probe is triggered when the function of touch probe 1 is set for continuous sampling.

Bit	Name	Description
8	Touch probe 2 enable: 0: Disable 1: Enable	bit 8 to bit 10: status of touch probe 2.
9	Touch probe 2 latching on a rising edge 0: No rising edge value latched 1: Rising edge value latched	
10	Touch probe 2 latching on a falling edge 0: No falling edge value latched 1: Falling edge value latched	
11 to 13	N/A	-
14 to 15	Number of touch probe trigger events when touch probe 2 is set for continuous sampling	The total number of times (0 to 3) that the touch probe is triggered when the function of touch probe 2 is set for continuous sampling.

In this example, you can read bit1 of 60B9h to check whether the touch probe 1 rising edge value is latched.

4. Read the latch position of the touch probe

The four position values of the touch probe are recorded in 60BAh to 60BDh.

In this example, if the function of the position latch at the positive edge of touch probe 1 is executed, you can read the position value in 60Bah (Touch probe 1 positive edge, reference unit). The latching count can be read in 60D5h.

Illustration

The following figure shows touch probe function settings and status feedback sequence when DI5 is used as the trigger signal in case of latching at rising edge and continuous triggering.

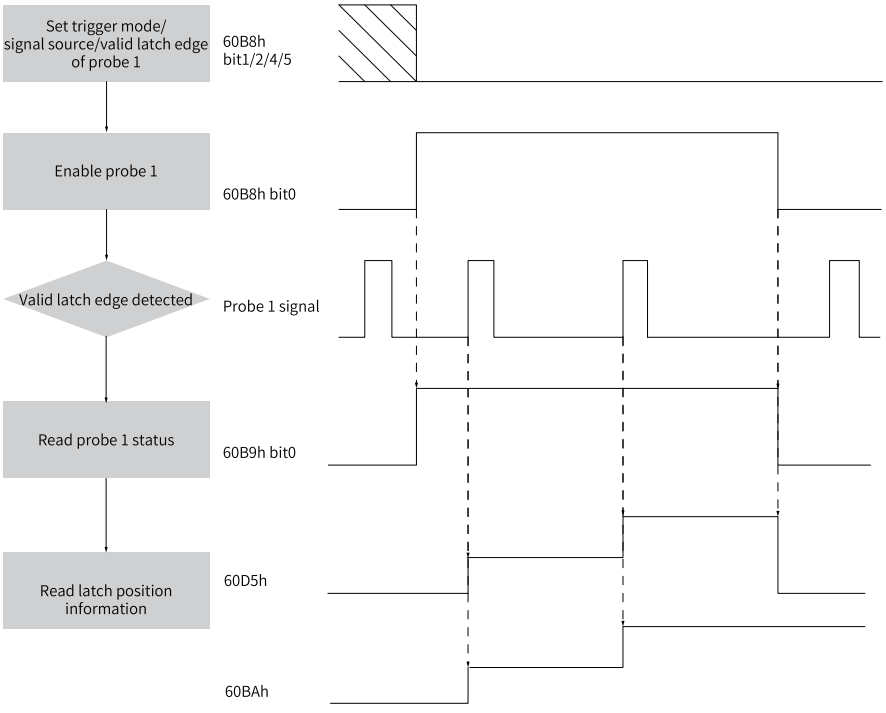


Figure 12-5 Procedure for using the touch probe

12.11 SEMI F47 Voltage Drop

Function description

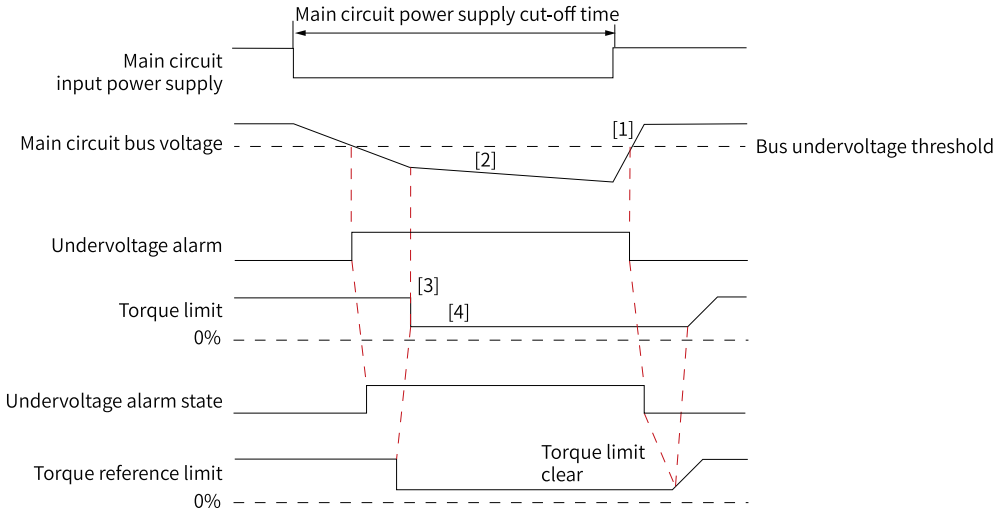
When the DC voltage of the main circuit of the drive is lower than the undervoltage threshold due to instantaneous power failure or temporary low power supply voltage of the main circuit, the E971.0 alarm is reported and the output current is limited. The E971.0 alarm can be muted by setting bit1 of H0A.88.

With combination of this function and H0A.84 (instantaneous power outage holding time), the drive can continue to run when the power supply voltage decreases, and it will not stop because of alarm.

Description

This function can be executed by the instruction issued by the host controller or the servo drive. You can choose through H0A.81 (enable voltage drop protection).

- **When executed by the host controller (H0A.81 = 1)**
  After receiving the warning of undervoltage E971.0, the host controller limits the torque, and removes torque limit after receiving E971.0 warning release signal.



Note

- [1]: After the main circuit power supply is restored, the bus voltage of the main circuit rises.
- [2]: By limiting the output torque, you can reduce the bus voltage of the main circuit gently.
- [3]: Torque limiting starts.
- [4]: Limit torque after an undervoltage warning is received.

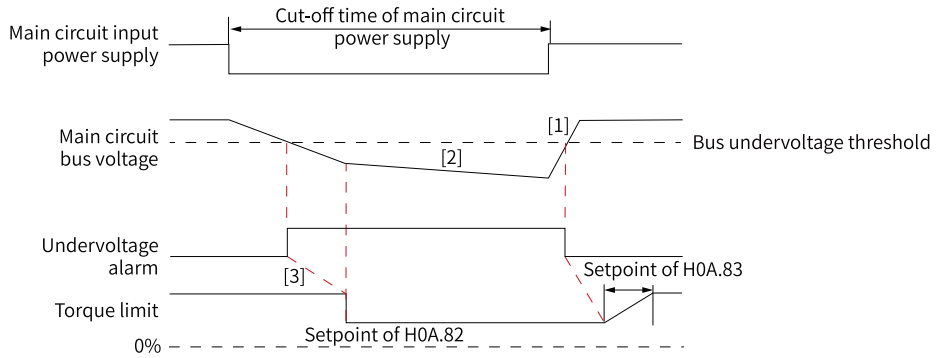
  - When H07.07 = 0:
    The forward torque limit is the smaller value between 60E0h and 6072h. The reverse torque limit is the smaller value between 60E1h and 6072h.
  - When H07.07 is set to 1, the torque reference limit is determined by the logic of the external DI signal.

The forward torque limit is selected between min{60E0h,6072h} and H07.11 (Forward external torque limit). The reverse torque limit is selected between min{60E1h ,6072h} and H07.12 (Reverse external torque limit).

- When H07.07=2, you select AI1 or AI2 as the torque limit input source for T-LMT through H07.08.
- When H07.07 = 3:
  DI-PCL (Forward external torque limit) is ineffective, and the forward limit is determined by AI input; DI-PCL (Forward external torque limit) is effective, and the forward limit is determined by the smaller one between H07.11 and the torque corresponding to AI input voltage;

  DI-NCL (Reverse external torque limit) is ineffective, and the reverse limit is determined by AI input; DI-NCL (Reverse external torque limit) is effective, and the reverse limit is determined by the smaller one between H07.12 and the torque corresponding to AI input voltage.
- When H07.07 = 4:
  - DI-PCL (Forward external torque limit) is ineffective, and the forward limit is determined by min{60E0h,6072h}. DI-PCL (Forward external torque limit) is effective, and the forward limit is determined by the AI input voltage.
  - DI-NCL (Reverse external torque limit) is ineffective, and the reverse limit is determined by {and 60E1h drives) H07.10; DI-PCL (Forward external torque limit) is effective, and the reverse limit is determined by AI input Battery.

- **When executed by the drive (H0A.81 = 2)**
  According to the undervoltage E971.0 alarm, apply the torque limit inside the servo drive; After receiving the undervoltage alarm clear signal, the torque limit value is controlled in the servo drive according to the set time.



Note

- [1]: After the main circuit power supply is restored, the bus voltage of the main circuit rises.
- [2]: By limiting the output torque, you can reduce the bus voltage of the main circuit gently.
- [3]: Torque limiting starts.

- **The E971.0 undervoltage alarm is not detected (H0A.81 = 0)**
  Voltage drop does not trigger the E971. 0 alarm, but the E410.0 alarm.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode
H0A.81	200A-52h	Voltage drop protection	0: No operation 1: Host controller executes torque limit 2: Servo executes torque limit	0	-	At stop
H0A.82	200A-53h	Voltage drop torque limit	0.0% to 100.0%	50.0	%	Real time
H0A.83	200A-54h	Torque limit cancellation time	0 ms to 1000 ms	100	ms	Real time
H0A.84	200A-55h	Instantaneous power failure hold time	20 ms to 50000 ms	1000	ms	Real time

Note

- This function is suitable for instantaneous power outage with the voltage and time specified by SEMI F47. If the voltage and time beyond this range, a standby power supply is needed.
- When the power supply of the main circuit is restored, use the torque limit of the host controller or servo drive to set the torque, so as to avoid the output torque being greater than the commanded acceleration torque.
- When used on vertical axes, do not limit the torque below the holding torque.
- This function is to limit the torque within the capacity of the powered off servo drive, and is not applicable to all load conditions or operating conditions. The parameter to be set may vary with the actual device.
- After you set H0A.84, the time from disconnecting the power supply to stopping the motor power will become longer. You can power off the motor immediately through the input and output of servo ON input signal.

12.12 Quadrant Friction Compensation

Function description

The quadrant friction compensation function is designed to compensate the large delay in motor speed feedback due to large static friction of the mechanical system when the motor changes its direction. In actual machining (such as circular machining), the system friction during motor direction change will cause quadrant protrusion, resulting in quadrant marks on the workpiece surface.

Note

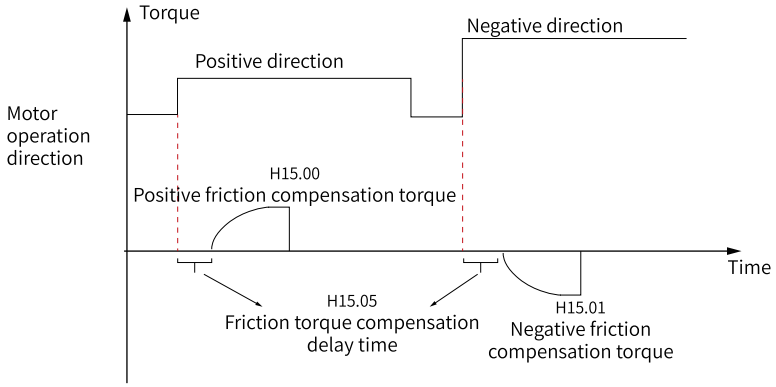
Quadrant friction compensation is effective only in position mode.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H15.00	2015-01h	Positive friction compensation torque	0.0 to 50.0	0.0	%	Real time	"*H15_en.00* *on page 714*
H15.01	2015-02h	Negative friction compensation torque	0.0 to 50.0	0.0	%	Real time	"*H15_en.01* *on page 714*

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H15.02	2015-03h	Positive friction torque filter time constant	0.10 to 100.00	0.10	ms	Real time	"H15_en.02" on page 714
H15.03	2015-04h	Negative friction torque filter time constant	0.10 to 100.00	0.10	ms	Real time	"H15_en.03" on page 715
H15.04	2015-05h	Friction torque compensation speed reference source	0: Speed reference 1: Model speed 2: Speed feedback 3: Observation speed 4: Speed reference	0x2	-	Real time	"H15_en.04" on page 715
H15.05	2015-06h	Friction torque compensation delay time	0.00 to 300.00	0.00	ms	Real time	"H15_en.05" on page 715
H15.06	2015-07h	Friction torque compensation effective speed threshold	0.0 to 20.0	0.1	rpm	Real time	"H15_en.06" on page 715

Function operation



Parameter settings:

H15.00 and H15.01 are used to set the friction compensation torque in the positive and negative directions.

H15.02 and H15.03 are used to set the filter time of the positive/negative friction compensation torque. The smaller the parameter value, the faster the friction compensation torque reaches the set friction torque.

H15.04 is used to set the position or speed signal for detecting motor direction change. H15.06 is used to set the minimum speed threshold when the speed signal is used as the signal source for detecting direction change. When H15.04 is set to 0x00 (Position reference), H15.06 can be skipped.

H15.05 is used to set the delay time between the time when motor detects the direction change and the start time of friction compensation torque output.

12.13 Backlash Compensation

Function description

The backlash compensation function is used to compensate poor positioning performance after the motor direction is reversed when the mechanic is loose or experiences backlash.

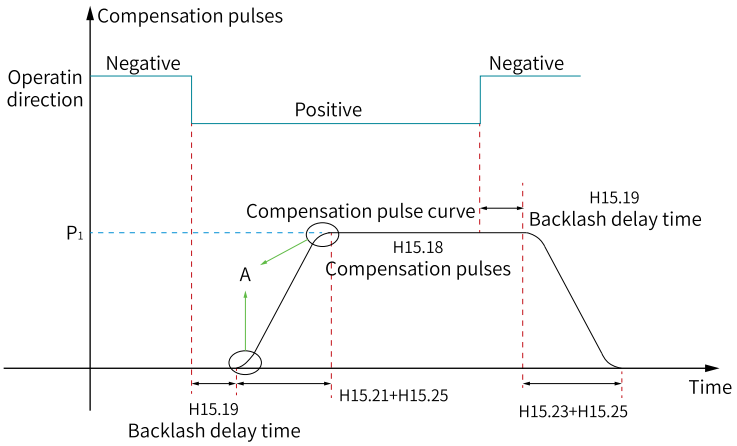
Note

Backlash compensation is effective only in position mode.

Related parameters

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H15.15	2015-10h	Backlash compensation	0: Disable 1: Ramp	0	-	Real time	*"H15_en.15" on page 716*
H15.16	2015-11h	Backlash compensation speed reference source	0: Speed reference 1: Model speed 2: Speed feedback 3: Observation speed 4: Speed reference	0x4	-	Real time	*"H15_en.16" on page 716*
H15.17	2015-12h	Minimum speed threshold of backlash compensation	0.0 to 20.0	2.0	rpm	Real time	*"H15_en.17" on page 716*
H15.18	2015-13h	Number of pulses of backlash compensation	0 to 65535	0	p	Real time	*"H15_en.18" on page 716*
H15.19	2015-14h	Backlash delay time	0.0 to 300.0	0.0	ms	Real time	*"H15_en.19" on page 717*
H15.21	2015-16h	Positive backlash compensation time	0.1 to 300.0	0.1	ms	Real time	*"H15_en.21" on page 717*
H15.23	2015-18h	Negative backlash compensation Date	0.1 to 300.0	0.1	ms	Real time	*"H15_en.23" on page 717*
H15.25	2015-1Ah	Filter time constant of average backlash compensation value	0.0 to 50.0	0.0	ms	At stop	*"H15_en.25" on page 717*

How it works



Parameter settings:

1. Set H15.15 to 1 to enable backlash compensation.
2. Set H15.16 and H15.17 to select the position or speed signal used to detect motor direction reverse and the minimum speed threshold for detecting direction reverse.
   Note: If H15.16 is set to 0x00 (Position reference), H15.17 can be skipped. Otherwise, H15.17 must be set.
3. Settings of H15.18, H15.19, H15.21, H15.23, and H15.25 are shown in the preceding figure. Where:

   H15.18 is used to set the number of backlash compensation pulses. Set the parameter according to the actual backlash.

   H15.19 is used to set the delay time between the time when direction reverse is detected by the servo and the start time of backlash compensation.

   H15.21 and H15.23 are used to set the time between the start time of backlash compensation in the positive and negative directions and the time when backlash compensation reaches the set number of pulses. The smaller the parameter value, the faster the backlash compensation speed.

   H15.25 is used to smooth the backlash compensation curve. For details, see the section marked by A in the preceding figure.

13 STO Integration

13.1 Precautions

Safety precautions

This chapter contains the warning symbols used in this guide and the safety instructions with which you must comply when you install or maintain safety modules of a drive or an inverter. If you ignore the safety instructions, injury, death or damage can occur. Read this chapter before you start the installation.

Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.

The products and specifications described in this guide or the content and presentation of the guide may be changed without notice to improve the product and/or the guide.

Table 13–1 Warnings, cautions, and notes

Label	Indication	Definition	Consequences of negligence
Examples  General hazards  Special hazards Electric shock	DANGER	Danger	Indicates that failure to comply with the notice can result in death or severe personal injury.
	WARNING	Warning	Indicates that failure to comply with the notice may result in death or severe personal injury.
	CAUTION	Caution	Indicates that failure to comply with the notice may result in minor or moderate personal injury or equipment damage.
	STOP	Inhibit	Indicates that failure to comply with the notice can result in equipment or environmental damage.

Caution

- Users must incorporate safety measures in system design and electrical installation for both normal operation and troubleshooting.
- System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience and read through all the operation instructions and safety information.
- For fully closed-loop functions, the safety speed-related functions (SS1-r, SLS, and SSM) and position-related functions (SS2, SOS, and SDI) only support safety speed and position monitoring on the internal encoder. Safety speed and position monitoring on external encoders is not supported.

It is the responsibility of the machine builder/OEM/system integrator to make sure that the essential health and safety function requirements specified in the Machinery Directive are met. The manufacturer or its authorized distributor is obliged to conduct a hazard analysis before placing a product on the market, take appropriate measures to reduce/eliminate the related hazards and ensure proper components are selected.

This section describes the information that needs to be noted before you begin. Read the following safety instructions, risk assessment information, and limitations before you begin.

Before using the safety function, properly understand all the related information. Incorrect use of safety functions or use of safety functions that do not meet the safety requirements of the site may result in personal injury.

Safety measures

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

- The safety torque off (STO) function is not a substitute for the emergency stop (E-stop) function. If only the STO function is triggered, with no extra measures taken, and the power supply cannot be cut off in emergency, high-voltage parts of the motor and drive are still energized. This may incur to take actions to prevent accidents when they notice any unexpected situations electric shock or other electricity-related risks. Therefore, maintenance work on electrical parts of the drive or motor can be performed only after the drive system is isolated from the main power supply.
- Depending on standards and requirements for particular applications, STO may be used as part of an E-stop system. However, the main purpose of STO in a dedicated safety control arrangement is to prevent risks without the use of an E-stop.
- An E-stop is often provided in a machine to allow for unexpected situations where an operator sees a hazard and can take actions to prevent accidents.
- The design requirement for an E-stop differs from that of a safety interlock. Generally, E-stop is required to be independent of any complex or intelligent control. It may use purely electromechanical devices to either disconnect the power or initiate a controlled rapid stop by using other measures such as dynamic or regenerative braking.

Note

- The design of safety-related systems requires specialist knowledge. To ensure that a complete control system is safe, it is necessary for the whole system to be designed according to recognized safety principles. The use of individual sub-systems such as drives with STO function, which are intended for safety-related applications, does not in itself ensure that the complete system is safe.
- The STO function can be used to stop the drive in emergency stop situations.
- In processes without personnel protection, it is recommended not to stop the drive by using the STO function. If a drive running is stopped by using STO, the drive performs a coast-to-stop. If this is not acceptable, the system should be stopped using the correct mode instead of the STO function.
- This publication is a guide to the application of safety functions, and also on the design of safety-related systems for machinery control.
- It is the responsibility of the designer of the end product or application to ensure that it is safe and in compliance with the relevant regulations.

Risk assessment

- When using safety functions, perform risk assessment on the servo system in advance. Make sure that the safety integrity level of the standards is met.
- The following residual risks may arise even when safety functions are operating. Therefore, safety must always be given consideration during risk assessment.
- If external force (such as gravitational force of a vertical axis) applies when the safety function is enabled, the motor will rotate. Therefore, you must use a separate mechanical brake to secure the motor.

Note

- In the case of failure of multiple IGBTs, no matter whether the STO function is enabled, the servo drive can generate an alignment torque. This torque can cause the motor shaft to rotate within a range of up to 180 ÷ Number of motor pole pairs (for a synchronous reluctance motor, the range is 180 ÷ 2 × Number of motor pole pairs).
- p indicates the number of pole pairs.

To ensure safety, you should determine all the risk assessments and residual risks in the entire machine equipment. A company and individual who constructed the safety related system must take full responsibility for installation and commissioning of the system. Additionally, when in compliance with a European machinery directive, the system must acquire safety standards certification as a whole.

Perform all risk assessments and safe level certification on the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.

The following section shows the residual risks concerning the safety observation function of this product.

Common residual risks

- At the shipment to end-users, check the settings of safety-related components by using programming tools and monitored/displayed contents on display and record and save the setting data concerning the safety observation function and the programming tools you used. Perform the checks by using a checklist.
- Safety will not be ensured such as in assembling machines until installation, wiring, and adjustment are completed properly. Install, wire, and adjust your system by referring to the installation guide for each unit.
- Only qualified personnel are authorized to install, perform trial runs, repair, or adjust the equipment in which these components are installed. Only trained engineers should install and operate the equipment.
- Separate the wiring of the safety observation function from other signal wiring.
- Protect the cables with appropriate measures, such as routing them in a cabinet by using a cable guard.
- We recommend that you use a switch, a relay, or a sensor that complies with safety standards. If you need to use a switch, a relay, or a sensor that does not comply with safety standards, perform safety checks.
- Keep a required clearance and creepage distance depending on the voltage that you use.

Residual risks in each function

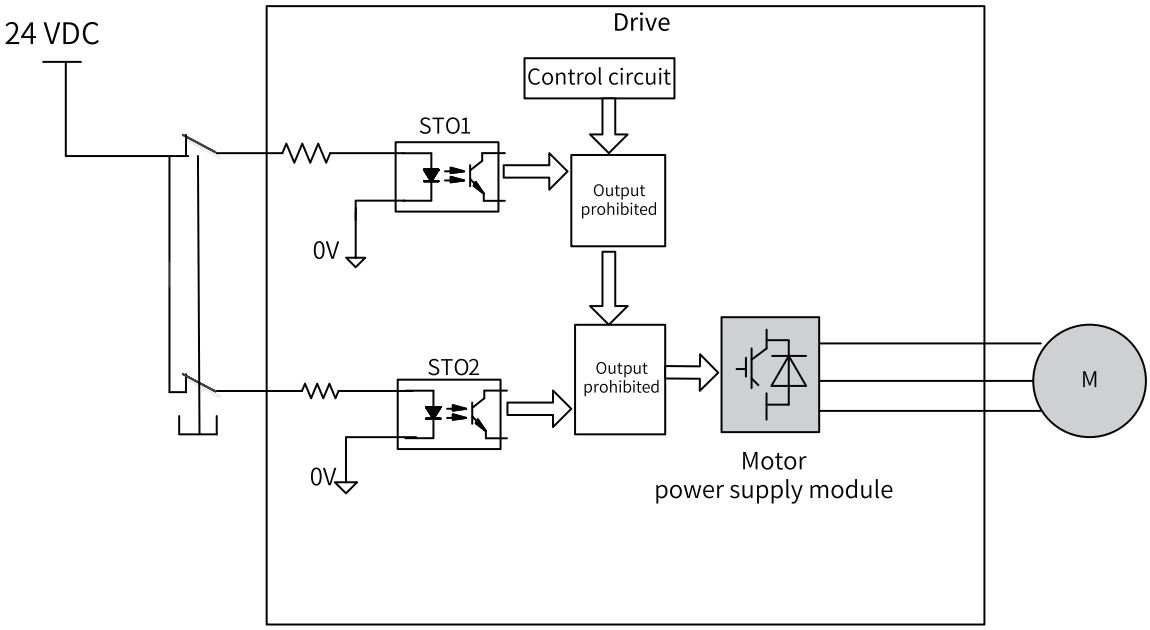
- **Safe torque off (STO)**
  This function only cuts off the torque of the motor, and does not cut off the power supply of the servo or inverter. Before servicing the servo/inverter, cut off the power supply and ensure that the servo/inverter are not energized.

Note

Perform STO function diagnosis at least once every three months. Run the STO function once to check whether the motor stops.

- **Safe brake control (SBC)**
  This function guarantees only that power to the mechanic break is properly supplied, but abrasion of the brake cannot be detected. Check this function regularly to ensure that the mechanic brake can operate. Evaluate whether the holding force of the mechanical brake meets the application requirements. Incorrect use may result in brake abrasion and personal injury.
- **Safely-limited speed (SLS)**
  - The speed monitoring function guarantees the servo motor speed but does not guarantee the actual machine safe speed. Set parameters so that the safe speed of the machine is the same as the safe speed of the specified motor.
  - Check whether the speed of the monitored servo axis is the same as the actual speed by using a tachometer or other tools. If not, evaluate whether the error is caused by the speed reference and encoder resolution.
  - Eliminate the risk of mechanical fractures before operation, such as shaft slippage and belt loss.
  - After the speed exceeds the limit, safety observation errors (OFF signal not triggered) do not occur within the velocity error detection time set by the parameter. Ensure safety during this period.
  - Adjust the speed limit based on the risk of speed ramp-up from an acceptable safe speed to an unacceptable speed due to the system response time.
- **Safe operating stop (SOS)**
  This function is used in scenarios with external loads, such as vertical axes. Servo drive failures can cause axis position hold failures. Evaluate the impact on the system and take hazard reduction or related control measures such as mechanical braking.
- **Safe speed monitor (SSM)**
  - The speed monitoring function guarantees the servo motor speed but does not guarantee the actual machine safe speed. Set parameters so that the safe speed of the machine is the same as the safe speed of the specified motor.
  - Check whether the speed of the monitored servo axis is the same as the actual speed by using a tachometer or other tools. If not, evaluate whether the error is caused by the speed reference and encoder resolution.
  - Eliminate the risk of mechanical fractures before operation, such as shaft slippage and belt loss.
  - After the speed exceeds the limit, safety observation errors (OFF signal not triggered) do not occur within the velocity error detection time set by the parameter. Ensure safety during this period.
  - Adjust the speed limit based on the risk of speed ramp-up from an acceptable safe speed to an unacceptable speed due to the system response time.

13.2 Overview



By cutting off the output of the motor supply module, the power supply current and torque of the motor is off.

Figure 13-1 Schematics of the STO function

Safe Torque Off (STO) is a safety function that complies with IEC 61800-5-2:2016. It is built into Inovance SV670NS-INT series servo drives. This function is triggered through the CN6 STO terminal.

Power off and on the drive every three months or trigger STO by disconnecting the 24 V input of CN6, so that STO can be reset regularly.

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

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

See the following table for the STO function.

STO1 input	STO2 Input	PWM signal
H	H	Normal
L	H	Inhibited
H	L	Inhibited
L	L	Inhibited

STO (safe torque off)	
Assignment	Cuts off the power of the motor.
Description	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start. When the STO function is activated, the drive stops according to the stop mode upon the level 1 fault (H02.08).
Safety state	Disables the PWM gating signal of the drive.
Operation mode	High demand mode or continuous mode

13.3 Functions and Monitoring

Functions

The keypad displays the STO function state and fault information. The following table describes the fault codes, causes, and solutions related to the STO function. Contact Inovance technical support if the fault persists after corrective actions listed in the following table are taken.

Fault code	Fault message	Fault mechanism	Cause	Solution
E150.0	STO safety state applied	The STO input protection applies (safety state).	One or two 24 V inputs are disconnected simultaneously, triggering the STO function.	There is no need to take any corrective actions. After the STO terminal is back to normal, clear the fault by using the fault reset function. Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected. Replace the servo drive.
E150.1	STO input state abnormal	The single-channel input of STO is ineffective.	1. The STO input power supply is abnormal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
			2. The STO input resistor is abnormal.	Replace the servo drive.
			3. The STO fails.	Replace the servo drive.
E150.2	Buffer 5 V voltage detection exception	The MCU monitors the 5 V power supply of the PWM Buffer to detect whether overvoltage or undervoltage occurs. If the voltage is abnormal, this fault code will be displayed.	The 5 V voltage supplied to the STOBuffer is abnormal due to undervoltage or overvoltage.	Replace the servo drive.
E150.3	STO input circuit hardware diagnosis failure	Short circuit occurs in the optocoupler in the upstream hardware circuit of STO. The drive displays E150.3.	Direct connection occurs on the upstream optocoupler of STO1 or STO2.	Replace the servo drive.
E150.4	STO activated	An error occurs on the PWM buffer integrated circuit during initialization detection upon power-on (the PWM signal cannot be blocked). The drive displays E150.4.	STOBuffer power-on detection error	Replace the servo drive.
E150.5	STO input signal interference	The STO signal is being disturbed, and the noise filtering condition defined by H0A.73 is not met.	The STO terminal is in poor contact or the external 24 V input voltage is unstable, which may lead to malfunction of STO.	Replace the 24 V power supply to ensure the STO terminal input voltage is stable.

Note

- For a motor with brake, if either STO1 or STO2 closes, the drive will be disabled within 30 ms (STO response time).
- For a motor without brake, if either STO1 or STO2 closes, the drive will be disabled within 5 ms (STO response time).

EDM signal DO output

When the 24 V voltage of STO1 and STO2 is cut off, the EDM DO signal is active. Otherwise, the EDM DO signal is inactive.

In this case, both STO1 and STO2 are filtered signals. When EDM is active, the PWM signal is blocked by the servo drive.

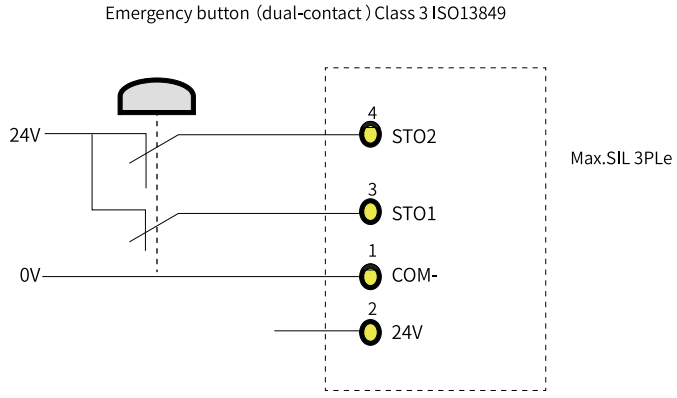
Signal name	Symbol	Optocoupler logic			
Safety input	STO1	ON	ON	OFF	OFF
	STO2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

Note

The DO output of this EDM is only a monitoring signal to detect whether a safety function is triggered, not a safety signal output.

The EDM state of the integrated STO can only be output through the non-safe DO output of the drive, not through the DO output on the safety module.

Example



13.4 Fault Reset

Fault reset means the normal operation can be recovered when the following conditions are met from the STO state to the ready state.

- The PWM buffer is disabled as the enable terminal is pulled up during power-on, so the PWM signal is inhibited.

- The PWM buffer is disabled as the enable terminal is pulled up during initialization of the MCU, so the PWM signal is inhibited. Such condition is cleared and servo drive works normally after initialization is done.
- When all of the following conditions are met, the servo system that enters the safe state through the STO function can be back to normal with the safe state cleared after auto-reset of the drive.
  - The input state of the STO request must be "high".
  - The servo ON or servo RUN command must be inactive.
  - No hazardous faults exist.

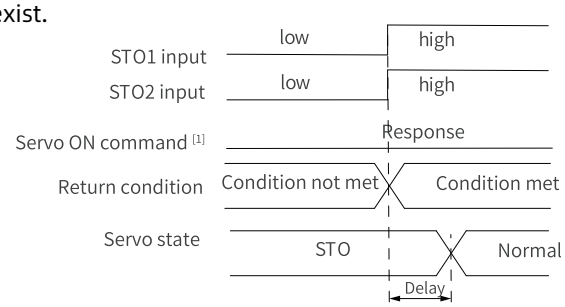


Figure 13-2 Return condition of external STO request state

Note

[1]: The servo ON command is a servo-enabled command, not an internal servo-enabled state.

- When STO_IN (STO1 or STO2 input) is restored to 24 V, the EDM and servo ready signals are immediately reset to 0. When both STO1 and STO2 are restored to 24 V at the same time, the servo ready output signal and the servo operation signal are activated after 400 ms. When the drive operates, the PWM drive signal is outputted.

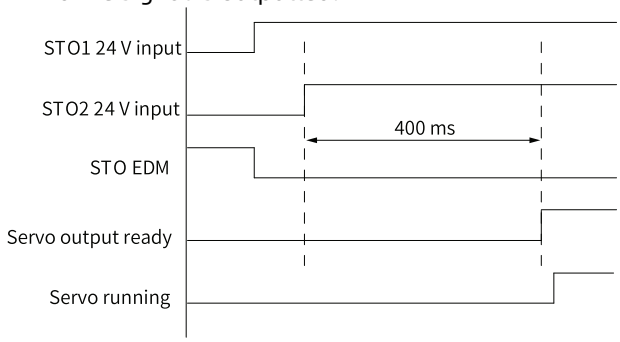
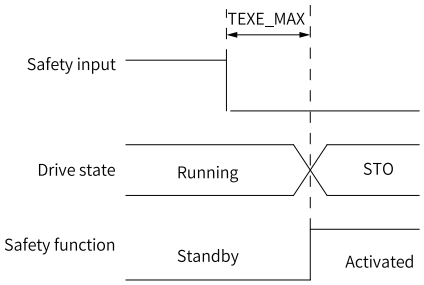


Figure 13-3 Servo drive reset sequence diagram

13.5 Safety Function Response Time

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

If either or both of them are at low level simultaneously, the PWM signal will be blocked in the next 30 ms [1].



Note

[1]: The typical response time is 30 ms. The maximum response time is 100 ms, given the discrete type of the electronic device.

13.6 Acceptance and Verification

Basic requirements

- Technicians must be trained to understand the requirements and principles of safety-related system design and commissioning.
- Maintenance personnel must be trained to understand the requirements and principles of safety-related system design and operation.
- Operators must be trained to understand the requirements and principles of safety-related system design and operation.
- The safety-related circuit on the control board that fails to operate must be replaced with a new one because the circuit is not repairable.

Commissioning checklist

- Start-up test and validation
  IEC 61508, EN/IEC 62061, and EN ISO 13849 require the final assembler of the equipment to verify the operation of the safety function through acceptance testing.

  The acceptance test must be performed at the following stages:

  - The initial start-up of the safety function.
  - After any changes related to the safety function, such as wiring, components, and settings.
  - After any maintenance work related to the safety function.

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

  Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentations of start-up activities and test results, fault reports, and troubleshooting. Any new acceptance tests that are performed due to changes or maintenance shall be recorded in the logbook.

- STO checklist

No.	Check item	Result
1	Ensure that the drive runs and stops freely during commissioning.	□
2	Stop the drive (if running), switch off the input power supply and isolate the drive from the power line by using a circuit breaker.	□
3	Check the STO circuit connections based on the circuit diagram.	□
4	Check whether the shield of the STO input cable is grounded to the drive frame.	□
5	Turn off the circuit breaker and switch on the power supply.	□
5.1	Test the STO signal #1 when the motor stops: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft reaches a standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1 and send a start command to the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays E150.1.	□
5.2	Set STO1 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
5.3	Test the STO signal #2 when the motor stops: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft reaches a standstill. Awake the STO function by de-energizing (low Level or open-circuit) the STO input signal 2 and send a start command to the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays E150.1.	□
5.4	Set STO2 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
6.1	Test the STO channel 1 #1 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
6.2	Set STO1 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	□

No.	Check item	Result
6.3	Test the STO channel 2 #1 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #2. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
6.4	Set STO2 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
7	Sign and document the acceptance test report which verifies that the safety function is safe and acceptable for operation.	□

Special requirements

You must conduct STO diagnosis every three month by powering off and powering on the drive once or running the STO function once.

Note

There are two ways to perform STO diagnosis:

- Power off and restart;
- Trigger and then cancel STO.

You can use either of them.

14 Communication

14.1 Communication via EtherCAT

14.1.1 Communication Overview

14.1.1.1 Communication Technical Data

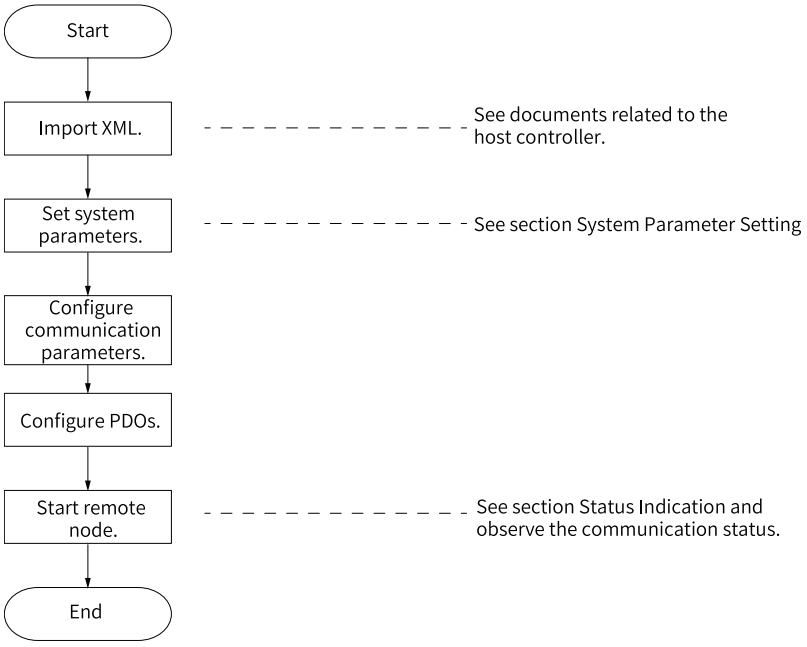
Item		Specification
Ether-CAT Basic per-for-mance of slave	Communication protocol	EtherCAT protocol
	Service supported	CoE (PDO, SDO)
	Synchronization mode	DC - Distributed clock FreeRun
	Physical layer	100Base-TX
	Baud rate	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Topology	Ring, linear, star, tree
	Transmission medium	Cat5e shielded cables or Cat6e cables
	Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
	Number of slaves	65535 by protocol
	EtherCAT frame length	44 bytes to 1498 bytes
	Process Data	Max. 1,486 bytes per Ethernet frame
	Synchronous jitter of two slaves	< 1 μs
	Communication code error rate	10^{-10} Ethernet standard
	Min. sync period	250μs
Ether-CAT config-uration unit	Number of FMMU units	8
	Number of storage synchronization management units	8
	Process data RAM	8 KB
	Distributed clock	64-bit
	EEPROM capacity	32 kbit

14.1.1.2 Communication Specifications

Item		Specification
Communication protocol		IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile
Application layer	SDO	SDO request, SDO response
	PDO	Variable PDO mapping, fixed PDO mapping
	CiA402	Profile Position Mode (PP)
		Profile Velocity Mode (PV)
		Profile Torque Mode (PT)
		Homing mode (HM)
		Cyclic synchronous position mode (CSP)
		Cyclic synchronous velocity mode (CSV)
		Cyclic synchronous torque mode (CST)
Physical layer	Transmission protocol	100Base-TX (IEEE802.3)
	Maximum distance	100 m
	Interface	RJ45 × 2 (IN, OUT)

14.1.1.3 Protocol Description

EtherCAT is an industrial Ethernet-based fieldbus system that features high performance, low cost, ease of use, and flexible topology. It is applicable to industrial applications requiring ultra-high speed I/O network. EtherCAT adopts standard Ethernet physical layer with twisted pairs or optical fibers (100Base-TX or 100Base-FX) used as the transmission media.



An EtherCAT system includes the master and the slaves. The master requires a common network adapter, and the slaves require a special slave control chip, such as ET1100, ET1200, and FPGA.

EtherCAT can process data at the I/O layer:

- No lower-layer sub-bus required
- Extremely low gateway latency

- One system covers all devices, including input and output devices, sensors, actuators, drives, and displays.
- Transmission rate: 2 × 100 Mbit/s (high-speed Ethernet, full duplex mode).
- Synchronization: synchronization jitter < 1 μs (number of nodes up to 300, cable length within 120 m)

Refresh time:

256 digital I/Os: 11 μs

1000 digital I/Os distributed in 100 nodes: 30 μs = 0.03 ms

200 analog I/Os (16-bit): 50 μs, sampling rate 20 kHz

100 servo axes (8 bytes IN + 8 bytes OUT for each): 100 μs = 0.1 ms

12000 DI/DOs: 350 μs

To support devices of various types and wider applications, the following EtherCAT-based application protocols are established:

- CANopen over EtherCAT (CoE)
- Safety over EtherCAT (SoE, servo drive safety compliant with IEC 61800-7-204)
- Ethernet over EtherCAT (EoE)
- File over EtherCAT (FoE)

The slave device only needs to support the suitable application protocol.

Note

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

14.1.2 Hardware Configuration

14.1.2.1 Communication Terminals CN3 and CN4

Terminal layout

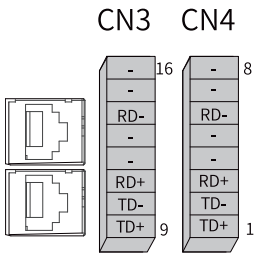


Figure 14-1 Communication terminal pin layout of the servo drive

Table 14–1 EtherCAT communication terminal pins

Pin No.	Assignment	Description
1	TD+	Transmits data (+)
2	TD-	Transmits data (-)
3	RD+	Receives data (+)

Pin No.	Assignment	Description
4 and 5	-	-
6	RD-	Receives data (-)
7 and 8	-	-
9	TD+	Transmits data (+)
10	TD-	Transmits data (-)
11	RD+	Receives data (+)
12 and 13	-	-
14	RD-	Receives data (-)
15 and 16	-	-

Terminal description

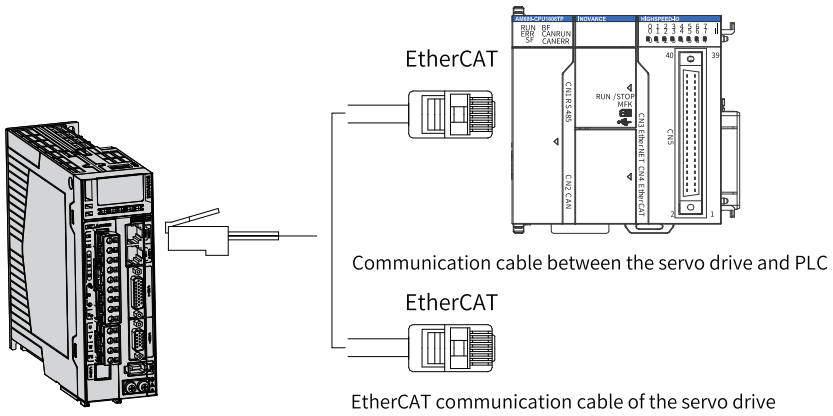


Figure 14-2 Wiring of communication cables

CN3 and CN4 are EtherCAT connectors. Connect CN4 (IN) to the communication port of the master and CN3 (OUT) to the next slave. For details about the CN3 and CN4 terminal pins, see *"Table 14-1 EtherCAT communication terminal pins" on page 461*.

Topology

The communication topology of EtherCAT is flexible without any limit, as shown in *"Figure 14-3 Communication network topology" on page 463*. The drive carries IN and OUT ports.

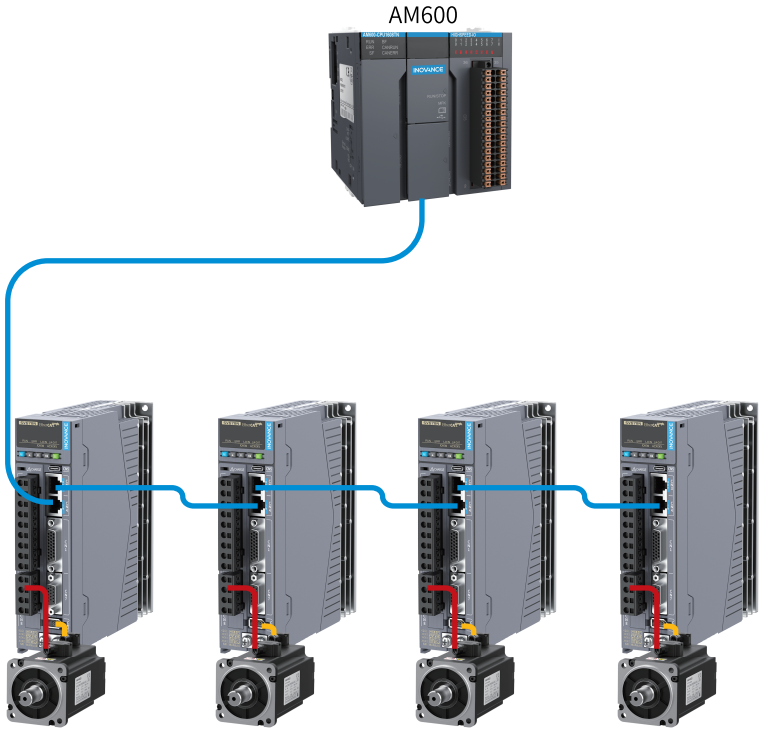
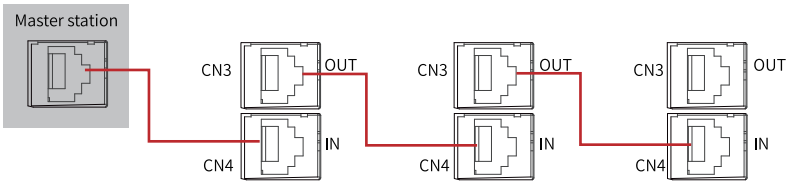
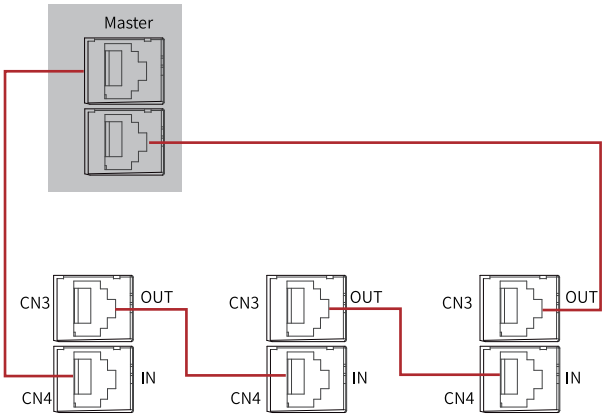


Figure 14-3 Communication network topology

Linear topology:



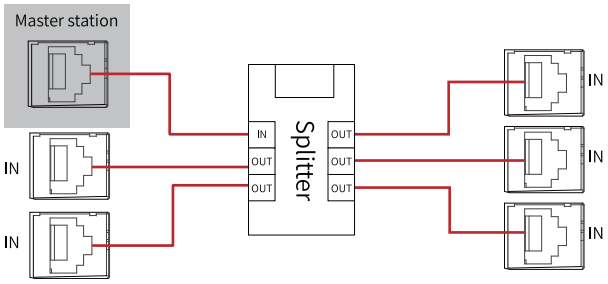
Ring topology



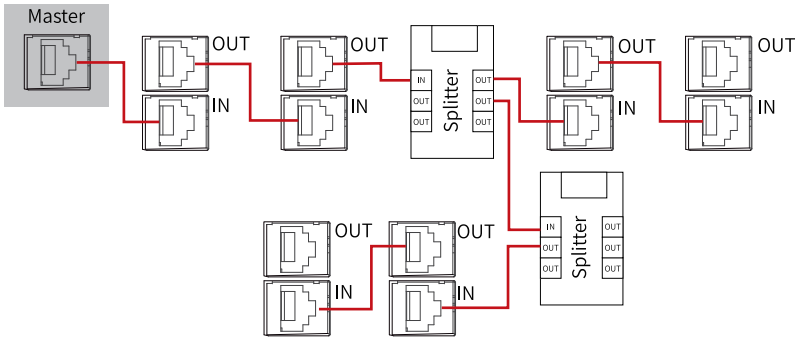
Note

When using the redundant ring, set H0E.36 (EtherCAT AL enhanced link) to 1 (Enable). Power on the drive so that the setting become effective.

Star topology:



Tree topology:



Cable specifications

Table 14–2 Cable specifications

Material code	Cable model	Length (m)	Cable specifications
15040261	S6-L-T04-0.3	0.3	Cat 5e four-conductor cable
15040262	S6-L-T04-3.0	3.0	
15041960	S6-L-T04-0.2	0.2	
15041961	S6-L-T04-0.5	0.5	
15041962	S6-L-T04-1.0	1.0	
15041963	S6-L-T04-2.0	2.0	
15041964	S6-L-T04-5.0	5.0	
15041965	S6-L-T04-10.0	10.0	
1504QV45	S6-L-T07-0.3	0.3	Cat 6a four-conductor cable
1504QV46	S6-L-T07-1.0	1.0	
1504QV47	S6-L-T07-3.0	3.0	
1504QV49	S6-L-T08-0.3	0.3	Cat 7 four-conductor cable
1504QV50	S6-L-T08-1.0	1.0	
1504QV51	S6-L-T08-3.0	3.0	

Rules

EtherCAT cables are connected to the network ports (IN and OUT) equipped with metal shield. The electrical characteristics comply with standards IEEE 802.3 and ISO 8877.

Communication cable specifications

Table 14–3 Specifications

Item	Description
UL certification	Compliant with UL certification.

Cat.5e cable	Cat.5e four-conductor cable.
Cat 6a cable	Cat 6a four-conductor cable.
Cat 7 cable	Cat 7 four-conductor cable.
Double-shielded	Braided shield (coverage: 85%), and aluminum foil shield (coverage: 100%).
Ambient temperature	-40℃ to +60℃.

Cable shield

The EtherCAT communication cable must be an Ethernet Category 5 (100BASE-TX) network cable or a high-strength shielded network cable. The network cable for the servo drive must be shielded, with a length no longer than 100 m. The shielded network cable enhances the anti-interference capacity of the system.

14.1.3 Communication Transmission Mode

14.1.3.1 Structure of EtherCAT Communication

Multiple types of application protocols are available for EtherCAT communication. SV670N-INT series servo drives use the IEC 61800-7 (CiA 402)-CANopen motion control profile. The following figure shows the EtherCAT communication structure at the CANopen application layer.

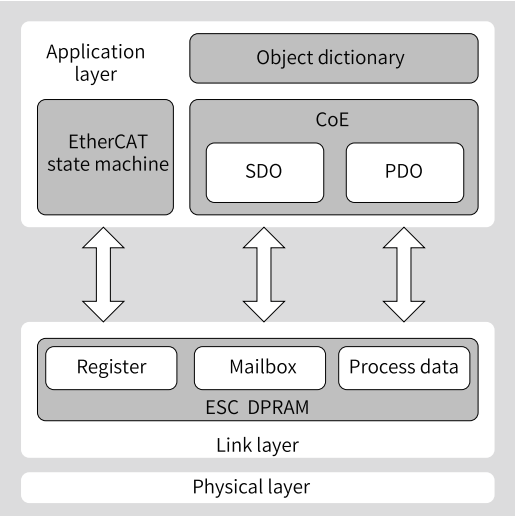


Figure 14-4 EtherCAT communication structure at CANopen application layer

The object dictionary at the application layer contains communication parameters, application data, and mapping data of the process data object (PDO). The PDO includes the real-time data generated during operation, which is cyclically read and written. During Service Data Object (SDO) mailbox communication, the communication parameter objects and PDO objects are acyclically accessed and modified.

14.1.3.2 Communication State Machine

The following figure shows the state transition diagram of EtherCAT.

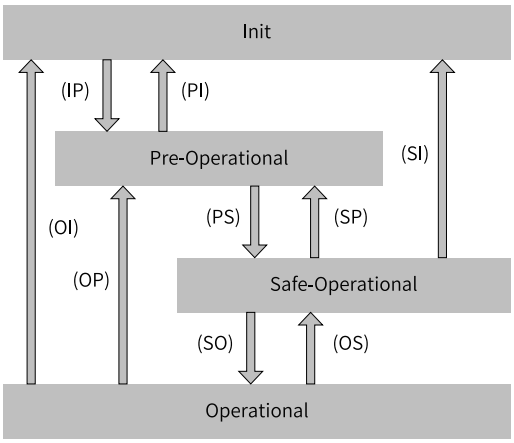


Figure 14-5 EtherCAT state machine

The EtherCAT device must support four states and coordinate the state relation between the master and slave applications during initialization and operation.

- Init: initialization, shortened as I
- Pre-Operational: pre-operational, shortened as P
- Safe-Operational: safe-operational, shortened as S
- Operational: operational, shortened as O

Transition from the Init state to the Operational state must be in the sequence of Init→Pre-Operational→Safe→Operational step by step. In transition from the Operational state to the Init state, certain steps can be skipped. The following table lists the state transition and the initialization process.

State	SDO	RPDO	TPDO	Description
Init (I)	×	×	×	Communication initialization No communication available in the application layer, EtherCAT slave controller (ESC) register can only be read/ written by the master
IP	×	×	×	The master configures the slave addresses, mailboxes, and distributed clocks (DCs). Request the Pre-Operational state.
Pre-Operational (P)	√	×	×	Service Data Object (SDO) at the application layer.
PS	√	×	×	The master uses process data mapping of SDO initialization. The master configures the Sync Manager channel used during process data communication. The master configures the FMMU. Request the Safe-Operational state.
Safe-Operational (S)	√	×	√	SDO, TPDO, and distributed clock mode can be used.
SO	√	×	√	The master sends valid output data to request the Operational state.

State	SDO	RPDO	TPDO	Description
Operational (O)	√	√	√	Normal operational state Both the input and output are active. SDO communication remains available.

14.1.3.3 Distributed Clock

The distributed clock (DC) enables all EtherCAT devices to use the same system time and allows tasks to be executed synchronously among all the devices. A slave device produces synchronization signals according to the synchronized system time. The SV670N-INT drive supports only the DC sync mode. The synchronization period, which is controlled by SYNC, varies with different motion modes.

Note

- The SYNC signal can be used to synchronize all the salves with an error less than 1 μs. The master must synchronize all the slaves to the same clock and continues doing so during operation to prevent clock skew caused by the difference in the crystal oscillator. This is usually achieved by synchronizing the 0x910 register in ESC.
- SYNC starting time = 0x990 register (ESC) - 0x920 Note that the DC mode (0x98 = 0x03) can be enabled only after 0x910 reaches the starting time. If the starting time of SYNC is incorrect, the 0x134 status register of ESC will report the error code of 0x2D.

14.1.3.4 Status Indicators

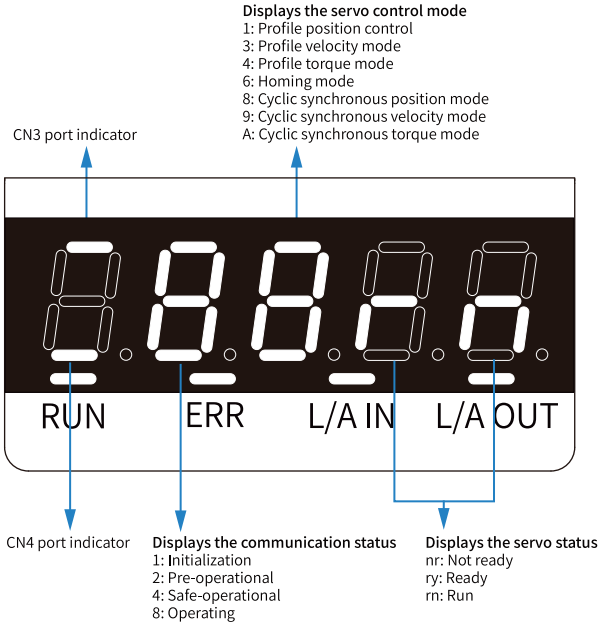


Figure 14-6 Status indicators

If a value of 0 is displayed, no value is written or a value of 0 is written to 6060h, or H02.00 (control mode) is set to 0, 1, or 2.

Communication connection status

The connection status of the two RJ45 ports are indicated by "-" on the upper and lower part of the leftmost LED on the panel. The upper "-" indicates the status of CN3:PORT1, and the lower "-" indicates the status of CN4:PORT0.

OFF: no communication connection is detected in the physical layer.

ON: communication connection is detected in the physical layer.

Communication status

The 2nd LED indicates the status of the EtherCAT state machine of the slave in the form of characters, as described in the following table.

Status of the EtherCAT state machine

State	SDO	RPDO	TPDO	Description	Panel display
Initialization	No	No	No	Communication initialization	1: Steady ON
Pre-operation	Yes	No	No	Network configuration initialization SDO available	2: Blinking at an interval of 400 ms
Safe-operation	Yes	No	Yes	SDO, TPDO, and distributed clock mode available	4: Flashing at an interval of 1200 ms (ON for 200 ms and OFF for 1000 ms)
In operation	Yes	Yes	Yes	Normal operating state	8: Steady ON

Display of control modes

The 3rd LED indicates the operation mode of the drive in the form of hexadecimal without flashing, as described in the following table.

The operation modes include the following:

Modes of operation (6060h)	Panel display
1: Profile position mode	1
3: Profile velocity mode	3
4: Profile torque mode	4
6: Homing mode	6
8: Cyclic synchronous position mode	8
9: Cyclic synchronous velocity mode	9
10: Cyclic synchronous torque mode	A

Display of servo status

The 4th and 5th LEDs indicate the servo status of the slave in the form of characters.

Servo states include:

State	Description	Panel display
Reset	Initialization	reset
Not ready	Initialization is completed. The control circuit is switched on but the main circuit is not switched on. Not ready	nr

State	Description	Panel display
Ready	The main circuit is switched on, but the S-ON signal is inactive. Ready	ry When the absolute speed value is higher than the value of H06.16, the character "y" blinks. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of character "2" or "4". For details, see *" Communication status" on page 468*. When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.
In operation	The S-ON signal is active and the motor is energized. Run	rn When the absolute speed value is higher than the value of H06.16, the character "n" blinks. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of character "2" or "4". For details, see *" Communication status" on page 468*. When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.

Description of indicators

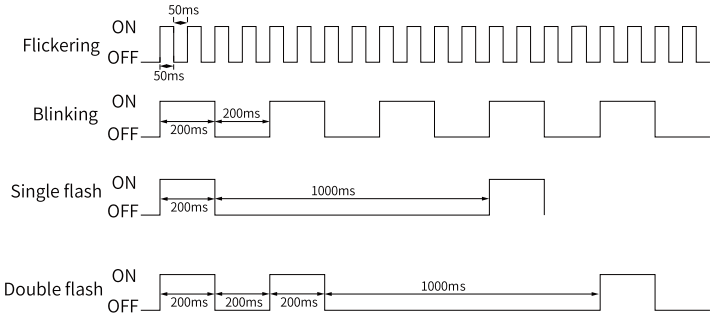


Figure 14-7 Description of indicators

Indicator	State	Status Indicators
RUN	OFF	INIT
	Blinking (ON for 200 ms/ OFF for 200 ms)	Pre-operational
	Single flashing (ON for 200 ms/OFF for 1000 ms)	Safe-operational
	ON	Operational
ERR indicator	OFF	No network fault occurs.
	Blinking (ON for 200 ms/ OFF for 200 ms)	Communication setting error.
	Single flashing (ON for 200 ms/OFF for 1000 ms)	Sync event error
	Double flashing (ON for 200 ms and OFF for 200 ms, and then ON for 200 ms and OFF for 1000 ms)	Watchdog timeout
L/A IN indicator[1] L/A OUT indicator	OFF	Link is not established.
	Flickering (ON for 50 ms/ OFF for 50 ms)	Link is established. Data transceiving signals are generated.
	ON	Link is established. No data transceiving signal is generated.

[1]: L/A IN and L/A OUT indicate the LINK state and operation state of the physical layer of each port.

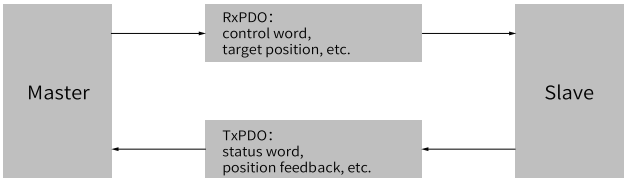
The color of the ERR indicator is red, and the other three indicators are green.

14.1.4 Communication Data Frame Structure

14.1.4.1 Process Data

The real-time data transmission of EtherCAT is achieved through the process data (Process data Object). PDOs can be divided into RPDOs (Receive PDO) and TPDOs (Transmit PDO) based on the data transmission direction. RPDOs transmit the master data to the slave, and TPDOs returns the slave data to the master.

According to section "EtherCAT Specification - Part 5: Application Layer Service Definition" of the international EtherCAT Specification <ETG.1000.5 S(R)V1.0.4>, the master station must ignore input data before the slave station acknowledges that it has entered the SafeOP state. Therefore, process data is considered valid only after the slave has entered the SafeOP state. Reading and using process data in during the Init or PreOP state may result in undefined behaviors, such as receiving anomalous feedback or inconsistent axis positions.



The SV670N-INT servo drive allows users to assign the PDO list and define the PDO mapping object.

PDO mapping

The PDO mapping indicates the mapping for application objects (realtime process data) between the object dictionary and PDO. 1600h to 17FFh are RPDOs, and 1A00h to 1BFFh are TPDOs. SV670N-INT provides 7 RPDOs and 6 TPDOs, as listed in the following table.

RPDO (7)	1600h, 1601h	Mutable mapping
	1701h-1705h	Fixed mapping
TPDO (6)	1A00h, 1A01h	Mutable mapping
	1B01h-0x1B04h	Fixed mapping

Fixed PDO mapping

SV670N-INT provides five fixed RPDOs and four fixed TPDOs.

The following table lists the typical instances of RPDOs and TPDOs.

Supported servo mode	PP/CSP
1701h (Outputs)	Mapping objects (4 mapping objects, 12 bytes)
	6040h (Control word)
	607Ah (Target position)
	60B8h (Touch probe function)
	60FEh sub-index 1 (Forced physical outputs)
1B01h (Inputs)	Mapped objects (9 mapped objects, 28 bytes)
	603Fh (error code)
	6041h (Status word)
	6064h (Position actual value)
	6077h (Torque actual value)
	60F4h (Following error actual value)
	60B9h (Touch probe status)
	60BAh (Probe 1 rising edge position value)
	60BCh (Probe 2 rising edge position value)
	60FDh (DI state)

Supported servo mode	PP, PV, PT, CSP, CSV, and CST
1702h (Outputs)	Mapped objects (7 mapped objects, 19 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6071h (Target torque)
	6060h (Mode selection)
	60B8h (Touch probe function)
	607Fh (Max. profile velocity)

1B02h (Inputs)	Mapped objects (9 mapped objects, 25 bytes)
	603Fh (error code)
	6041h (Status word)
	6064h (Position actual value)
	6077h (Torque actual value)
	6061h (Mode display)
	60B9h (Touch probe status)
	60BAh (Probe 1 rising edge position value)
	60BCh (Probe 2 rising edge position value)
	60FDh (DI state)

Supported servo mode	PP, PV, CSP, and CSV
1703h (Outputs)	Mapped objects (7 mapped objects, 17 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6060h (Mode selection)
	60B8h (Touch probe function)
	60E0h (Positive torque limit value)
	60E1h (Negative torque limit value)
1B03h (Inputs)	Mapping objects (10 mapping objects, 29 bytes)
	603Fh (error code)
	6041h (Status word)
	6064h (Position actual value)
	6077h (Torque actual value)
	60F4 (following error actual value)
	6061h (Mode display)
	60B9h (Touch probe status)
	60BAh (Probe 1 rising edge position value)
	60BCh (Probe 2 rising edge position value)
	60FDh (DI state)

Supported servo mode	PP, PV, PT, CSP, CSV, and CST
1704h (Outputs)	Mapping objects (9 mapping objects, 23 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6071h (Target torque)
	6060h (Mode selection)
	60B8h (Touch probe function)
	607Fh (Max. profile velocity)
	60E0h (Positive torque limit value)
	60E1h (Negative torque limit value)

Supported servo mode	PP, PV, CSP, and CSV
1705h (Outputs)	Mapped objects (8 mapped objects, 19 bytes)
	6040h (Control word) 607Ah (Target position) 60FFh (Target velocity) 6060h (Mode selection) 60B8h (Touch probe function) 60E0h (Positive torque limit value) 60E1h (negative torque limit value) 60B2h (Torque offset)

Variable PDO mapping

SV670N-INT provides two variable RPDOs and two variable TPDOs.

Variable PDO	Index	Maximum number of bytes	Default mapping object
RPDO1	1600h 1601h	40	6040h (Control word) 607Ah (Target position) 60B8h (Touch probe function)
TPDO1	1A00h 1A01h	40	603Fh (error code) 6041h (Status word) 6064h (Position actual value) 60BCh (Probe 2 rising edge position value) 60B9h (Touch probe status) 60BAh (Probe 1 rising edge position value) 60FDh (DI state)

Sync Manager PDO assignment

The process data can contain multiple PDO mapping data objects during cyclic EtherCAT data communication. The CoE protocol defines the PDO mapping object list of the Sync Manager that uses data objects 1C10 to 1C2Fh. Multiple PDOs can be mapped to different sub-indexes. The SV670N-INT drive supports assignment of one RPDO and one TPDO, as described in the following table.

Index	Sub-index	Description
1C12h	01h	One of 1600h, 1601h, and 1701h to 1705h used as the actual RPDO.
1C13h	01h	One of 1A00h, 1A01h, and 1B01h to 1B04h used as the actual TPDO.

PDO configuration

PDO mapping parameters include the indicators of process data for PDOs, including indexes, sub-indexes, and the mapping object length. Sub-index 0 indicates the number (N) of mapping objects in the PDO, and the maximum length of each PDO is 4 × N bytes. One or multiple objects can be mapped simultaneously. Sub-indexes 1 to N indicate the mapping content, defined as follows.

bit	31	...	16	15	...	8	7	...	0
Definition	Index			Sub-index			Object length		

The index and sub-index together define the position of an object in the object dictionary. The object length indicates the bit length of the object in hexadecimal, as shown below.

Object length	Bit length
08h	8-bit
10h	16-bit
20h	32-bit

For example, the mapping parameter of the 16-bit control word 6040.00h is 60400010h.

- Procedure for configuring PDO mappings:
  Perform the following procedure to configure PDO mappings:

  1. Configure the mapping group of PDO. Write 0 to sub-index 00h of 1C12h (or 1C13h).

     a. Clear the original mapping group. Write 0 to sub-index 00h of 1C12h (or 1C13h) to clear the original mapping group.
     b. Write the PDO mapping group. Write the value of 1600h or any of 1701h to 1705h in 1C12h, or write the value of 1A00h or any of 1B01h to 1B04h in 1C13h, depending on the scenario. Note: Only 1600h and 1A00h, and 1601h and 1A01h are configurable mapping groups.
     c. Write the total number of this PDO mapping group to sub-index 0 of 1C12h (or 1C13h).

  2. Configure the mapping objects of PDO. Write 0 to sub-index 00h of 1600h (or 1A00h) and 1601h (or 1A01h).

     a. Clear the original mapping objects. Write 0 to sub-index 00h of 1600h (or 1A00h) and 1601h (or 1A01h) to clear the original mapping objects.
     b. Write the PDO mapping content. Write the mapping content to sub-indexes 1-10 of the mapping parameter based on object parameter definitions in XML file. Only mappable objects can be configured as PDO mapping content.
     c. Write the total number of mapping objects. Write the number of mapping objects in step b to sub-index 0.

Note

- Configure the PDO only when the EtherCAT state machine is in Pre-operation state ("2" displayed on the keypad). Otherwise, an error is reported.
- Do not save the PDO configuration parameters in EEPROM. Configure the mapping objects again each time upon power-on. Otherwise, the mapping objects are the default parameters of the servo drive.

An SDO fault code is returned when the following operations are performed:

- Modify PDO parameters in non pre-operational state.
- Write a value outside the range of 1600h/1601h/1701h...1705h to 1C12h. Write a value outside the range of 1A00h/1A01h/1B01h...1B04h to 1C13h.

14.1.4.2 SDO

The EtherCAT Service Data Object (SDO) is used to transfer non-cyclic data, such as communication parameter configuration and servo drive parameter configuration. The CoE service types of EtherCAT include:

- Emergency message
- SDO request
- SDO response
- TxPDO
- RxPDO
- Remote TxPDO transmission request
- Remote RxPDO transmission request
- SDO information

The SV670N-INT servo drive supports SDO requests and SDO responses.

14.1.5 Communication Parameters

Parameter address structure

Parameter access address: index+subindex, both of which are in hexadecimal.

CiA402 protocol establishes the following restrictions on the parameter address:

Index (Hex)	Description
0000h to 0FFFh	Data type description
1000h to 1FFFh	CoE communication object
2000h to 5FFFh	Manufacturer-specific object
6000h to 9FFFh	Profile object
A000h–FFFFh	Reserved

System Parameter Settings

To connect the servo drive to the EtherCAT fieldbus network, set the required parameters.

Parameter code	Communication address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.00	2002-01h	Control mode	0: Velocity mode 1: Position mode 2: Torque mode 9: EtherCAT mode	9	-	At stop	"H02_en.00" on page 533
H0E.01	200E-02h	Save objects written through communication to EEPROM	0: Not save 1: Save parameters 2: Save object dictionaries 3: Save parameters and object dictionaries 4: Save object dictionaries written before communication (OP) 255: Determined by H0E.03 and H0E.04	4	-	Real time	"H0E_en.01" on page 660
H0E.21	200E-16h	EtherCAT slave alias	0 to 65535	0	-	At stop	"H0E_en.21" on page 661

Note

Before saving parameters to EEPROM, set H0E.01 to a proper value. Otherwise, parameters will be restored to default values at next power-on. It is recommended to set H0E.01 to 0 after parameters are set properly. This is to prevent damage to the EEPROM device caused by prolonged writing process.

14.2 EtherCAT Communication Configuration Examples

14.2.1 AM600 Series Controller as the Host Controller

This topic describes how to configure the SV670N-INT series servo drive for working with the AM600 series controller.

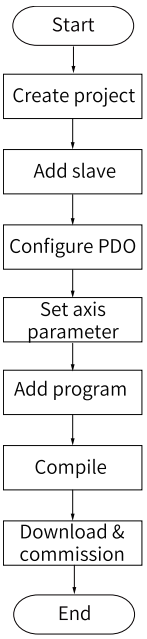
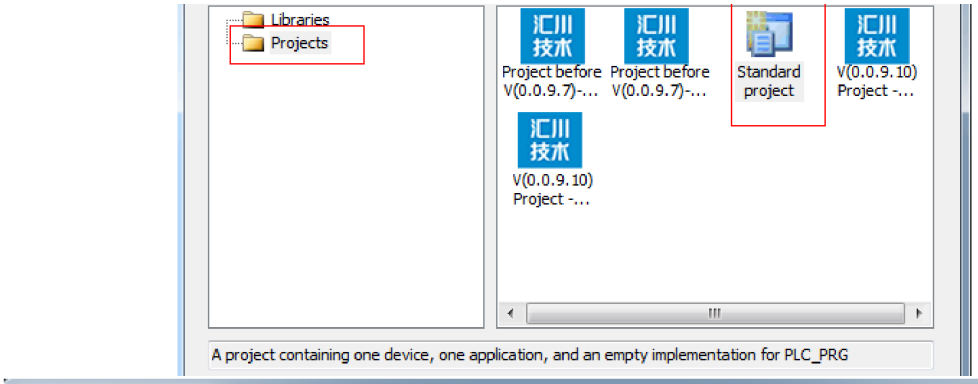
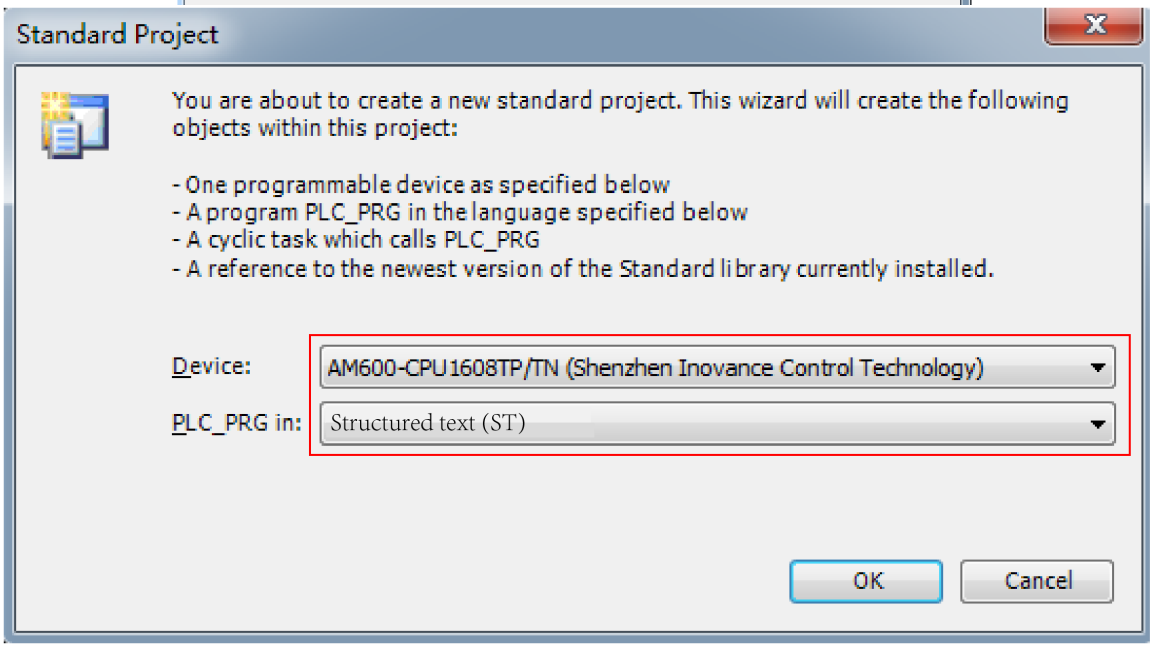


Figure 14-8 Configuration flowchart

Open the software and create an AM600 project.

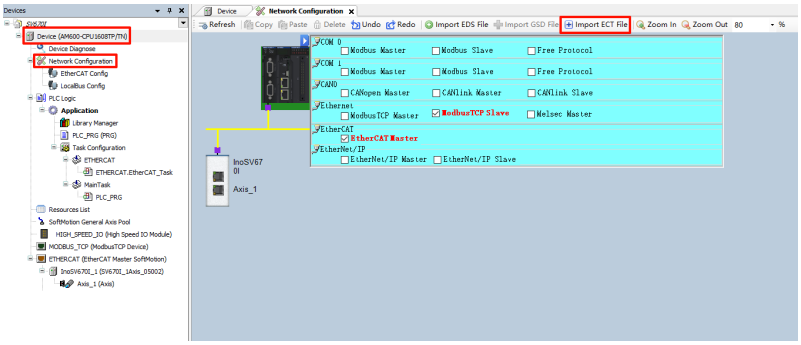
Select **AM600-CPU1608TP**, as shown in the following figure.





Adding the SV670N-INT servo drive as slave

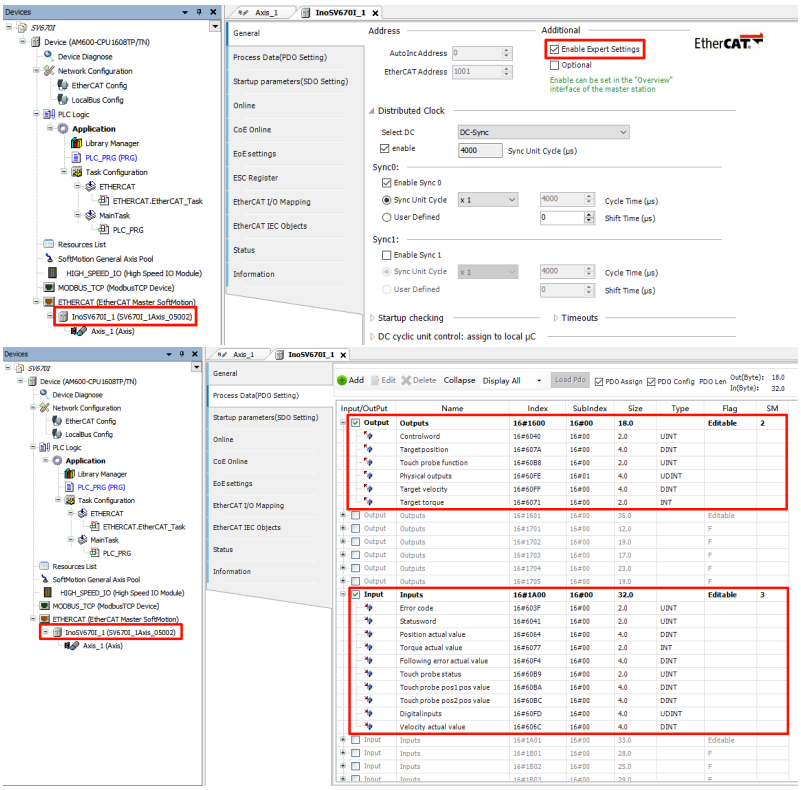
Open network configuration and import the ECT file of SV670N-INT. Add an SV660N servo drive as a slave, as shown in the following figure.





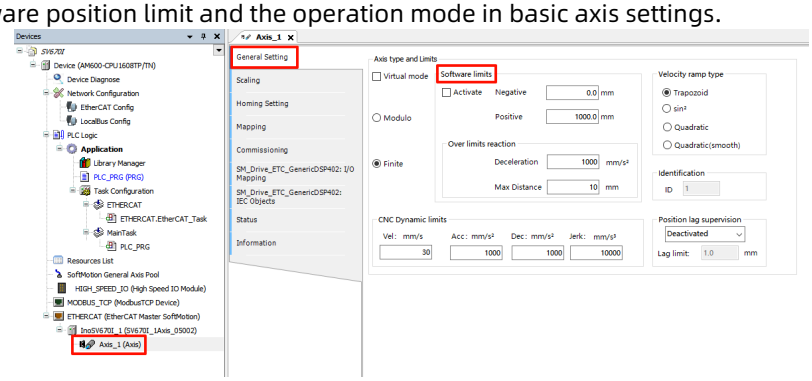
Configuring the PDO

Select **Enable Expert Settings** and configure PDOs in the process data as needed. In this case, CSP is used as the control mode and the default values of 1600 and 1A00 are used for PDO parameters.

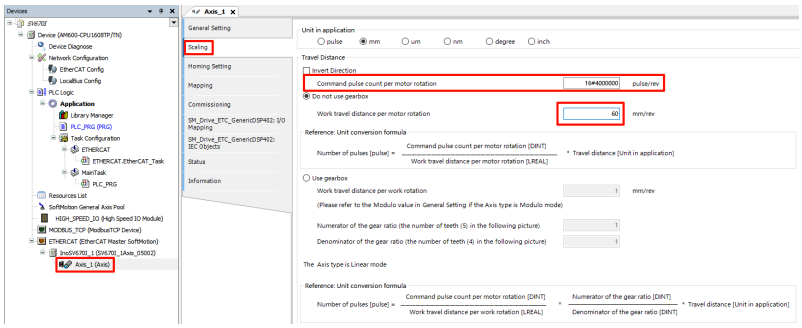


Configuring axis parameters

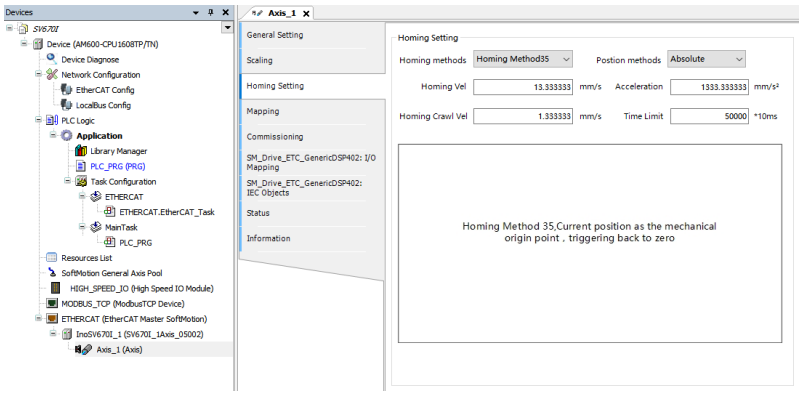
1. Set the software position limit and the operation mode in basic axis settings.



2. Select 16#4000000 for the 26-bit encoder, 16#800000 for the 23-bit encoder and 16#100000 for the 20-bit encoder during unit conversion. In this case, the single-turn travel distance is set to 60 mm. 1 mm/s equals 1 rpm of the motor.

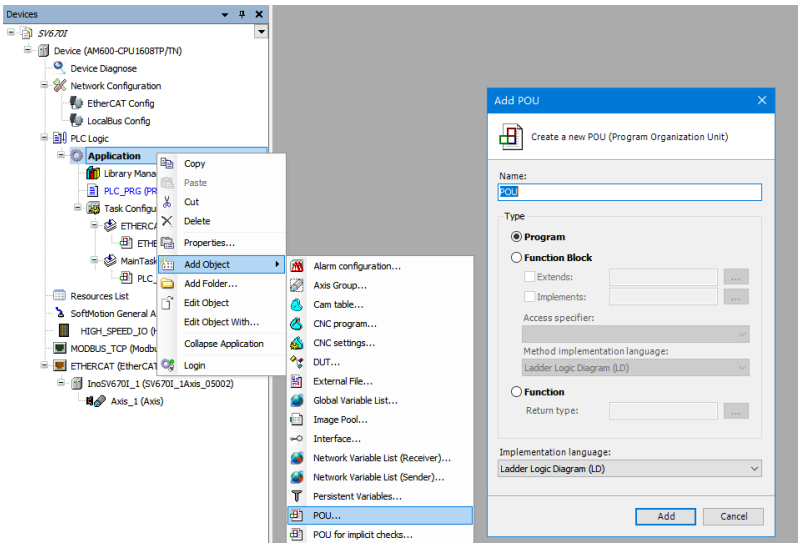


3. Select the homing mode according to actual needs. For details, see section "Introduction to the Homing mode" in *SV670N-INT Series Servo Drive Function Guide*.

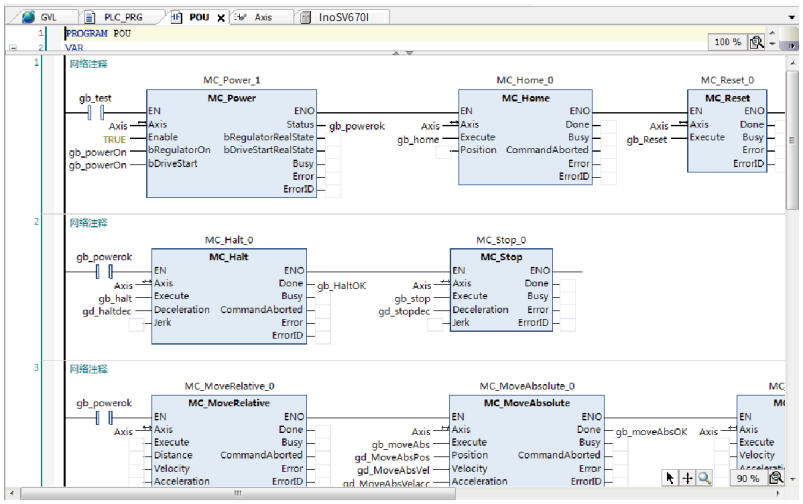


Adding a program

Add a program to control the servo axis position, as shown in the following figure.

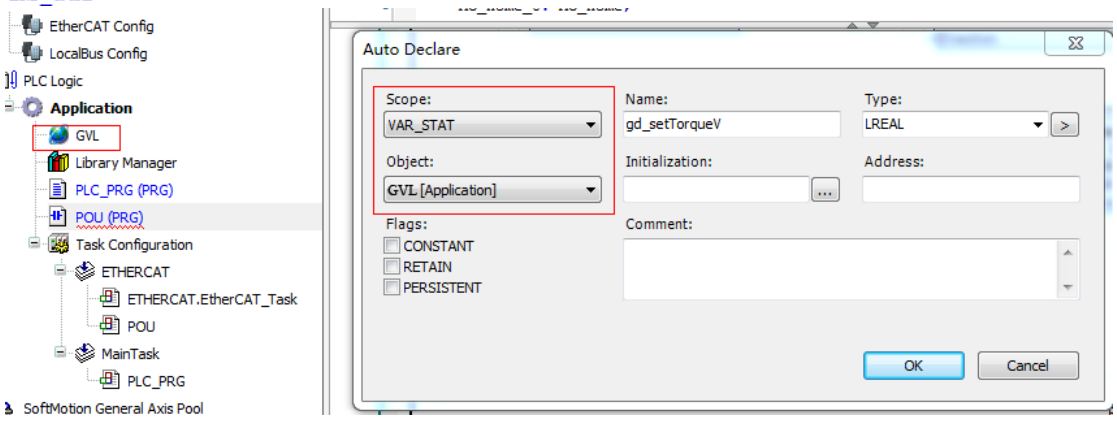


- Implement basic functions such as enabling, homing, and positioning by adding function blocks to the PLC.



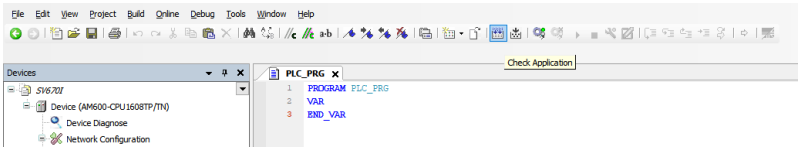
- If you implement directed motion by using the logic program, some variables may need to be called to different POUs. Therefore, set the variables as global variables.

```
CASE iStatus OF
    10:
    gb_powerOn:=TRUE;
    IF gb_powerok THEN
    iStatus:=20;
    END_IF
    20:
    gd_MoveAbsPos:=1000;gd_MoveAbsVel:=200;gd_MoveAbsVelacc:=200;gd_MoveAbsVeldec:=200;gb_moveAbs:=TRUE;
    IF gb_moveAbsOK THEN
    gb_moveAbs:=FALSE;iStatus:=30;
    END_IF
    30:
    gd_MoveAbsPos:=2000;gd_MoveAbsVel:=400;gd_MoveAbsVelacc:=400;gd_MoveAbsVeldec:=400;gb_moveAbs:=TRUE;
    IF gb_moveAbsOK THEN
    gb_moveAbs:=FALSE;iStatus:=40;
    END_IF
    40:
    gd_MoveAbsPos:=0;gd_MoveAbsVel:=1000;gd_MoveAbsVelacc:=1000;gd_MoveAbsVeldec:=1000;gb_moveAbs:=TRUE;
    IF gb_moveAbsOK THEN
    gb_moveAbs:=FALSE;iStatus:=50;
    END_IF
    50:
    gb_powerOn:=FALSE;
    iStatus:=0;
END_CASE
```



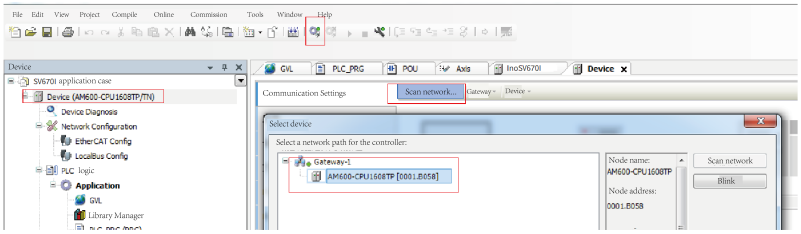
Compiling the program

After compiling the program, click the icon marked by the red box in the following figure to check whether the program is correct.

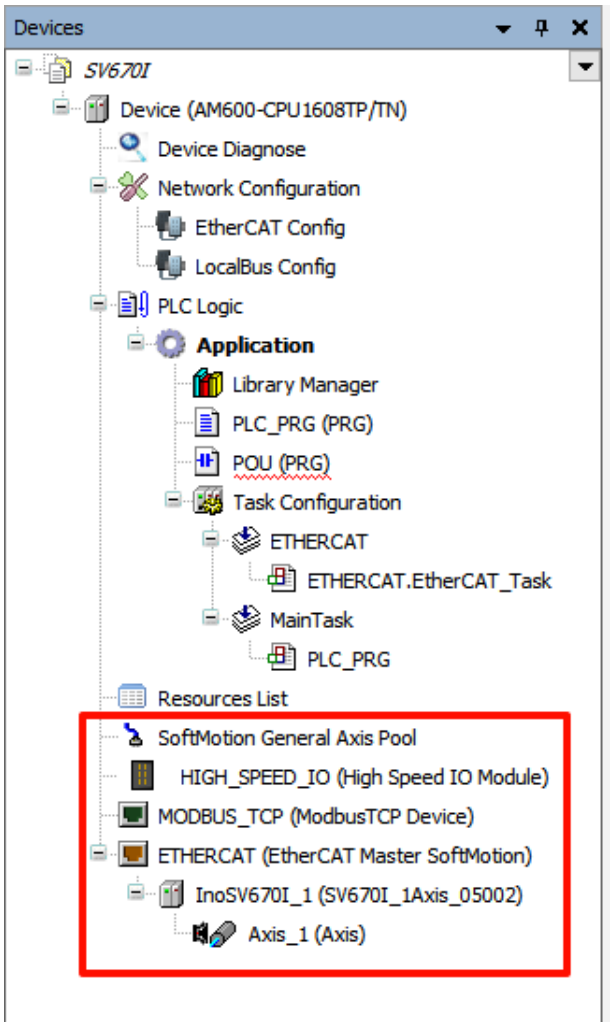


Downloading and commissioning the program

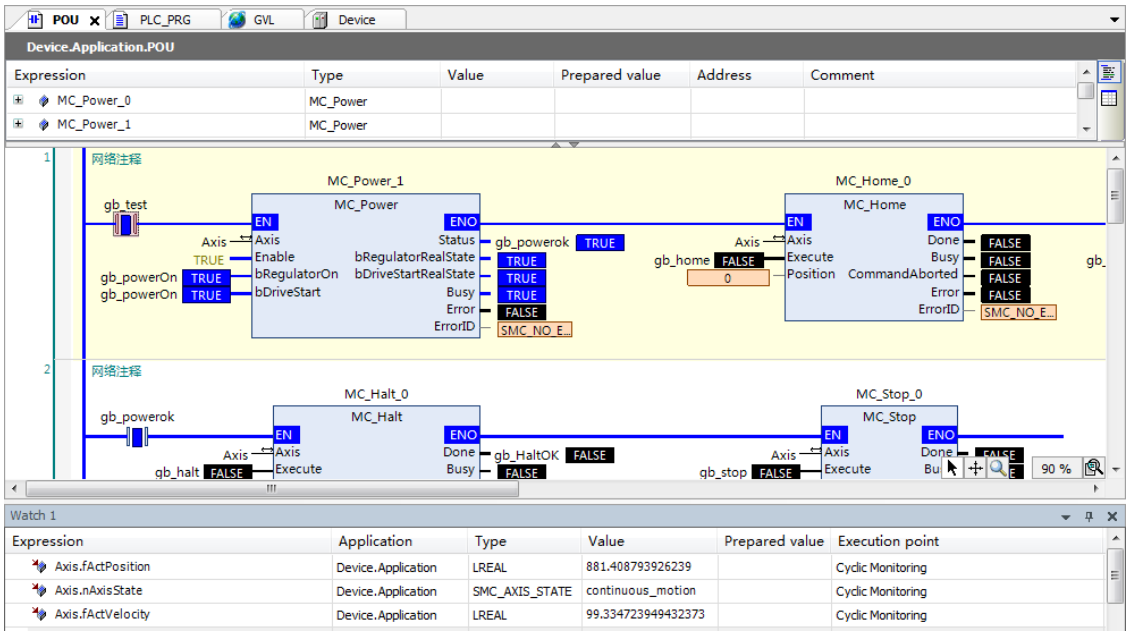
1. After verifying that the program is correct, download the program to PLC. The program can be activated after running. Before downloading, scan the PLCs first to select the PLC to be downloaded, and then click the download icon, as shown in the following figure.



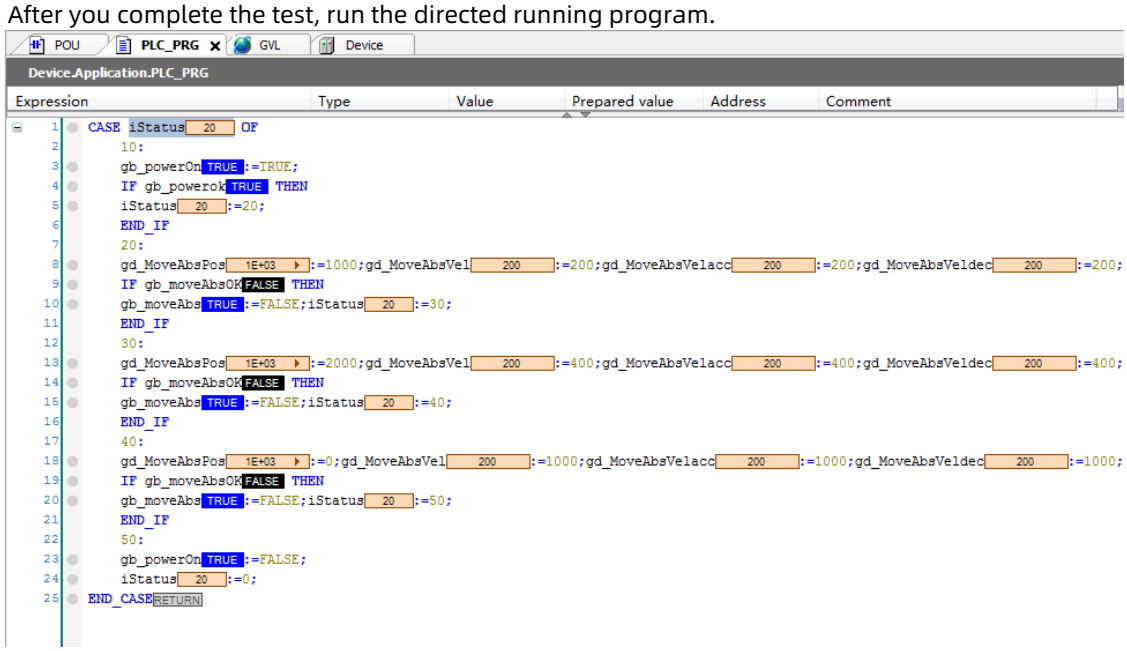
2. After log-in, ensure that the servo drive and axis are in a normal state.



3. Monitor critical parameters through the monitoring function. Start the testing program to perform basic tests such as enabling, homing, and positioning.



4. After you complete the test, run the directed running program.



14.2.2 Omron Controller as the Host Controller

This topic describes how to configure the SV670N-INT series servo drive for working with the Omron NX701 controller.

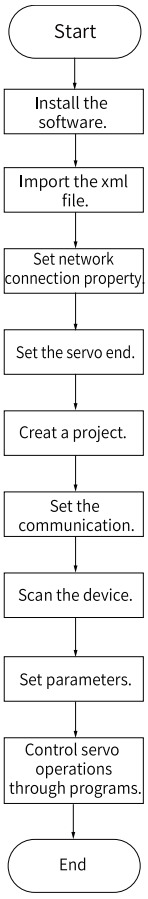


Figure 14-9 Configuration flowchart

Note

When more than 25 SV670N-INT drives are networked with Omron NX701, you need to modify the cable length defined in the Omron master station. The cable length is calculated based on the fact that one drive requires a length of 36 m.

Installing the Sysmac Studio software

Install the Sysmac Studio software.

It is recommended to install Sysmac Studio V1.10 or later.

Importing the XML device description file

Import the device description file. V2.5 or later recommended.

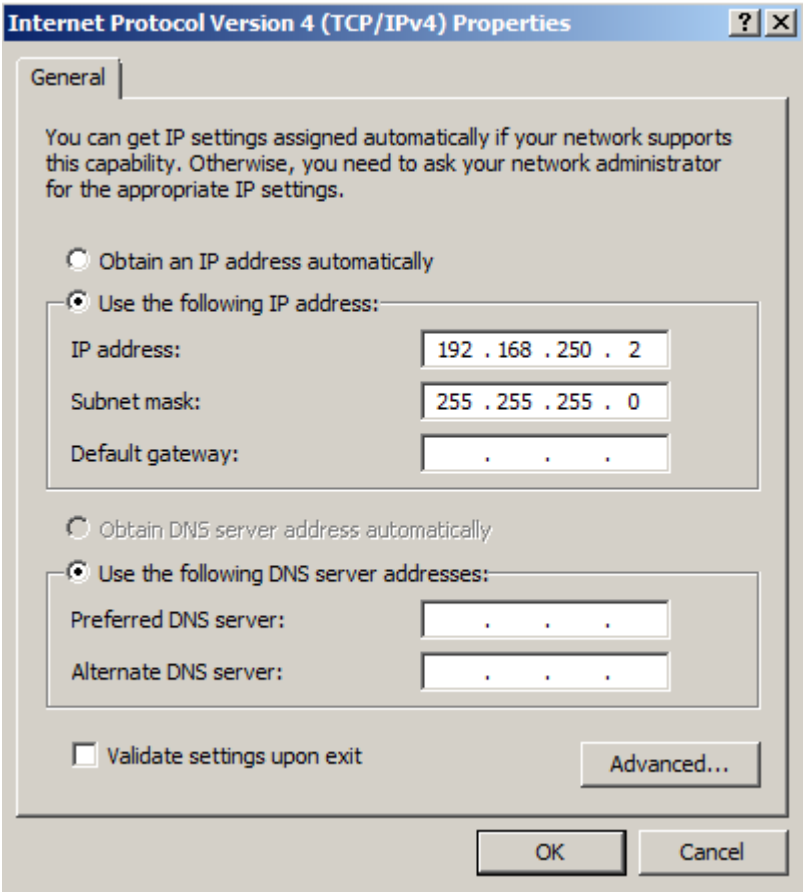
It is recommended to import the device description file of "SV670_INT_EOE_1Axis_02002_240110.00.xml" or a later version. The file path is as follows: OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles.

If the file is stored in this path for the first time, the Sysmac Studio software must be restarted.

Setting the network connection attributes

- If your computer is connected to the controller through an USB, skip this step.

- If your computer is connected to the controller through the Ethernet, set the TCP/IP attribute of the computer, as shown below.



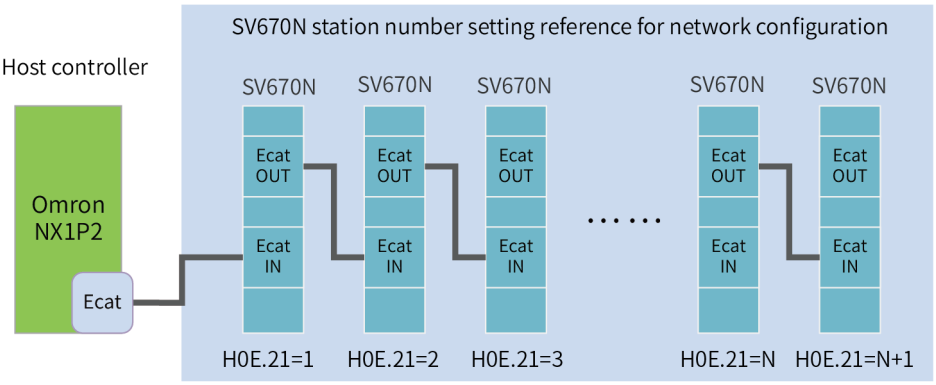
Configuring the servo drive

Recommended versions:

Pay attention to the setting of H0E.21.

Parameter code	Parameter name	Value range	Unit	Initial value	Related mode	Setting mode	Effective time	Setpoint
H0E.21	EtherCAT slave alias	0 to 65535	-	0	-	At stop	Real time	Values other than 0

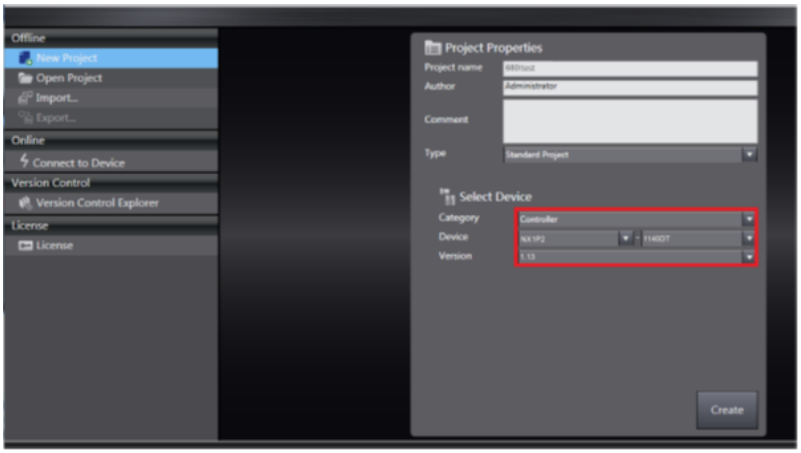
When an Omron controller is used, set the EtherCAT communication station number in H0E.21. It is recommended to set the station number according to the actual connection sequence for the convenience of configuration management.



Creating a project

Device: Select the actual controller model.

Version: 1.09 or later. NX1P2-1140DT supports only version 1.13.



Configuring communication

Enter the main interface and choose **Controller** > **Communications Setup** to set the connection mode for the computer and controller.

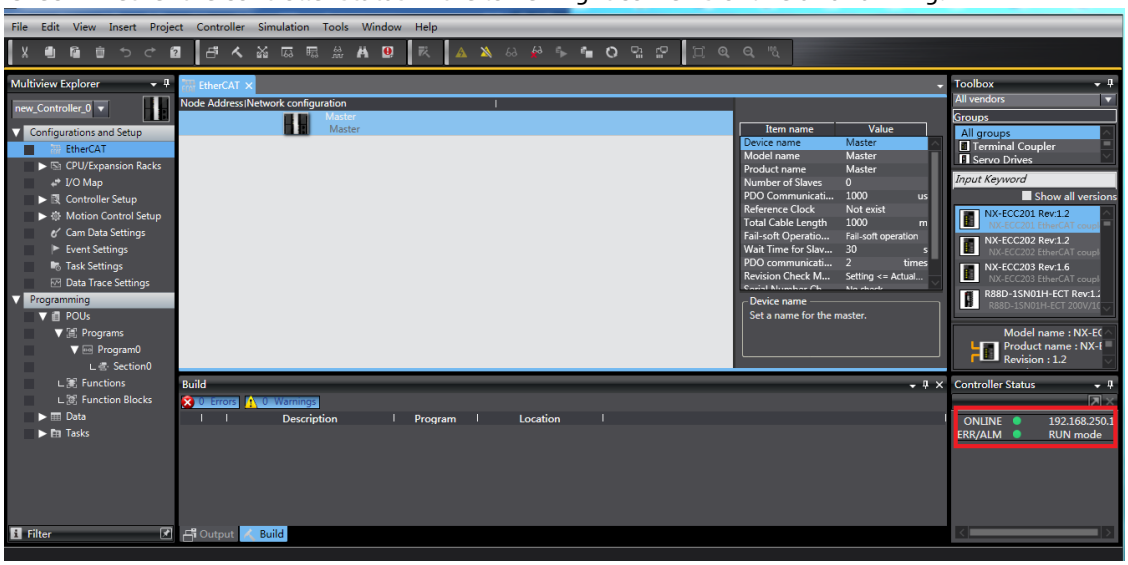
- Select **Remote connection via USB** to perform **USB Communication Test** directly. If the test is succeeded, proceed to the next step.
- Select **Ethernet connection via a hub**, set the IP address to 192.168.250.1 (controlled by NX), and then click **Ethernet Communication Test**. If the test is succeeded, proceed to the next step.



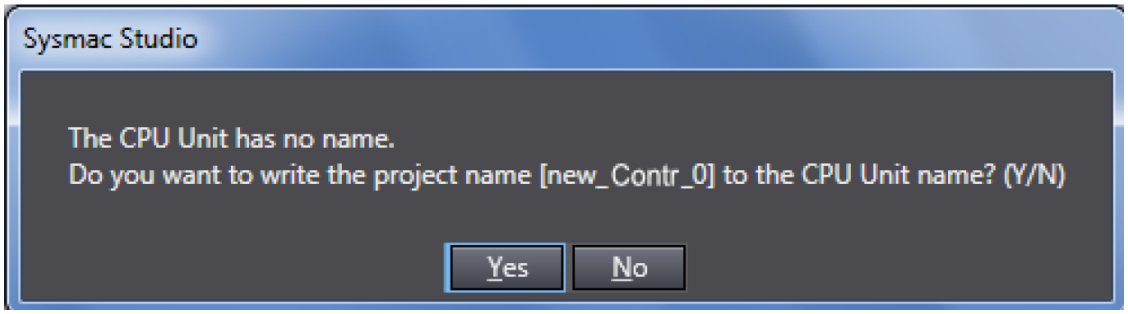
Scanning the device

Switch the controller to the online and running mode.

1. Check whether the controller status in the lower-right corner is online and running.

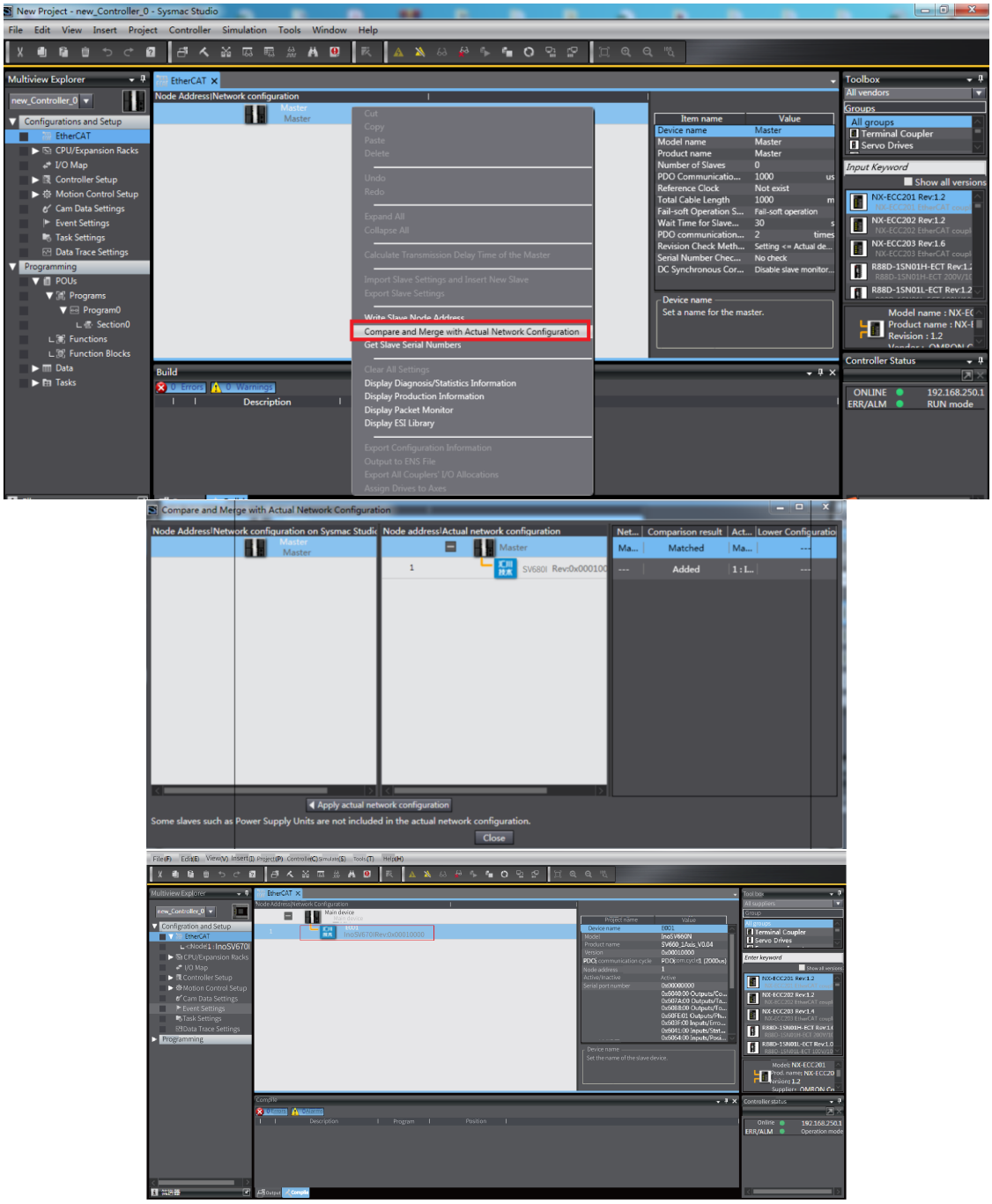


2. A prompt window appears if it is a new controller.



3. Click **Yes** in the window. The name shown in the window is the project name.
   Scan for devices and add slaves.

   Click **Configurations and Setup** and right-click **EtherCAT** → **Master**, and then select **Compare and Merge with Actual Network Configuration**. The controller scans all the slaves in the network (error will be reported if the station number is 0). After scanning, click **Apply actual network configuration** in the pop-up window to add the slave. You can view the added slaves on the main interface.

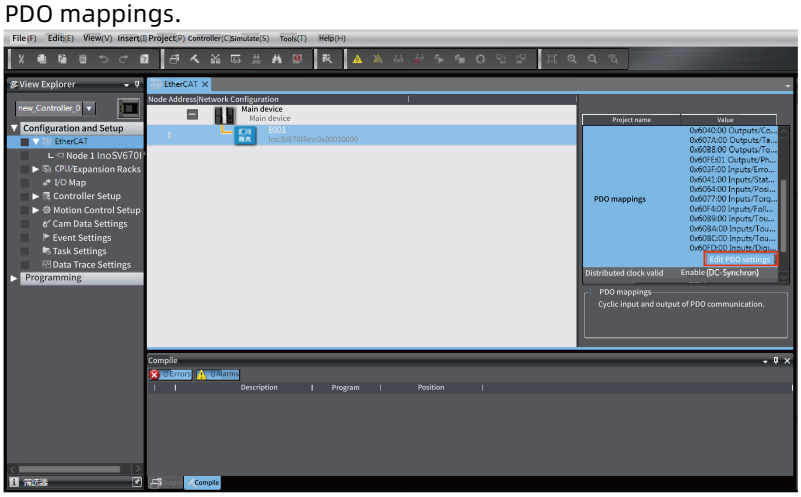


Configuring parameters

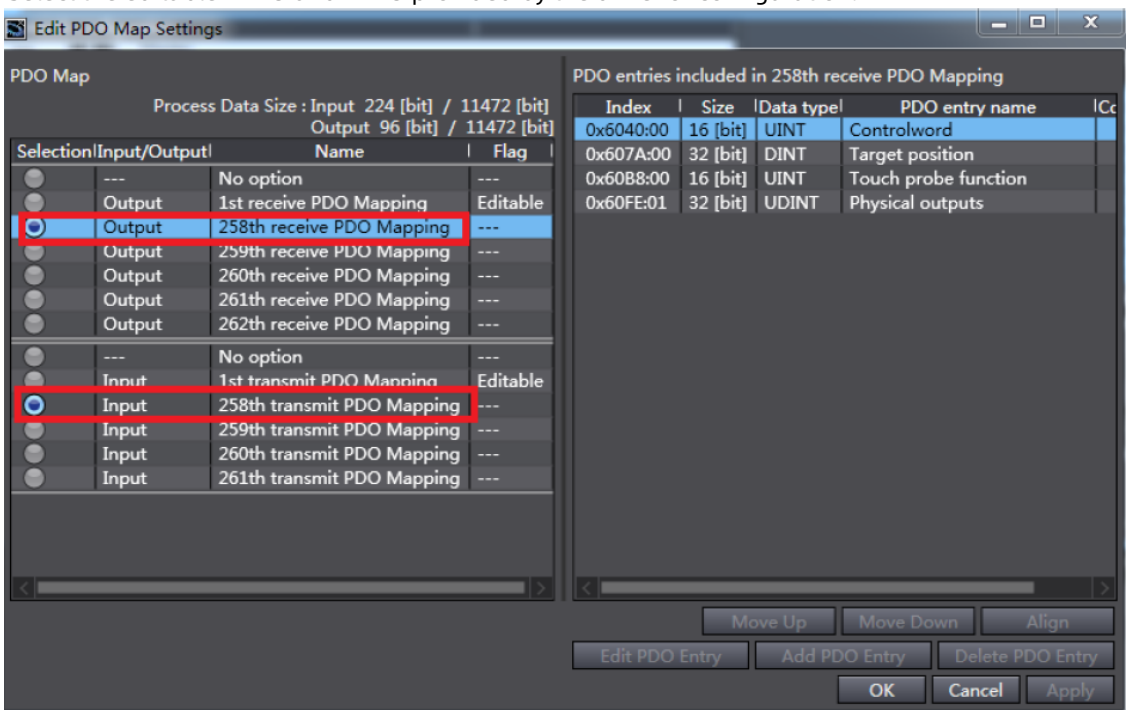
Switch the controller to the offline mode and set PDO mapping, axis parameters, and the DC clock.

Configuring PDO mapping

1. Configure the PDO mappings.



2. Select the editable RPDO and TPDO provided by the drive for configuration.

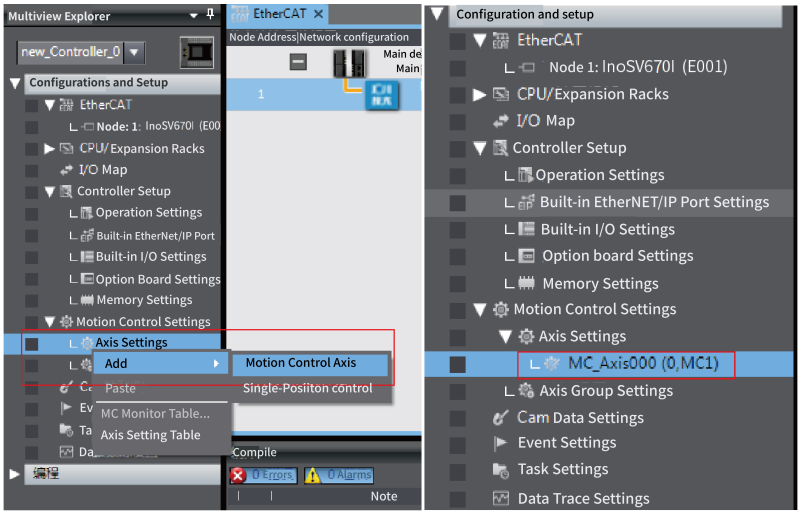


3. Modify the PDO mapping object by clicking **Add PDO Entry** or **Delete PDO Entry**. The frequently used mapping parameters are shown in the following figure.

Index	Size	Data type	PDO entry name
0x603F:00	16 [bit]	UINT	Error code
0x6041:00	16 [bit]	UINT	Statusword
0x6064:00	32 [bit]	DINT	Position actual value
0x6077:00	16 [bit]	INT	Torque actual value
0x60F4:00	32 [bit]	DINT	Following error actual value
0x60B9:00	16 [bit]	UINT	Touch Probe Status
0x60BA:00	32 [bit]	DINT	Touch Probe pos 1 pos value
0x60BC:00	32 [bit]	DINT	Touch Probe pos 2 pos value
0x60FD:00	32 [bit]	UDINT	Digital inputs

Configuring axis parameters

1. Right-click **Motion Control Setup** and choose **Axis settings** → **Motion Control Axis**, as shown in the following figure.



2. You can click **MC_Axis000** to rename it. For example, if it is named "Rewind axis", the axis variable "Rewind axis" used in the NX program represents control on this SV670N-INT servo axis.
3. Double-click **MC_Axis000** and configure an SV670N-INT device at the corresponding station on the**Axis Basic Settings** wizard page.

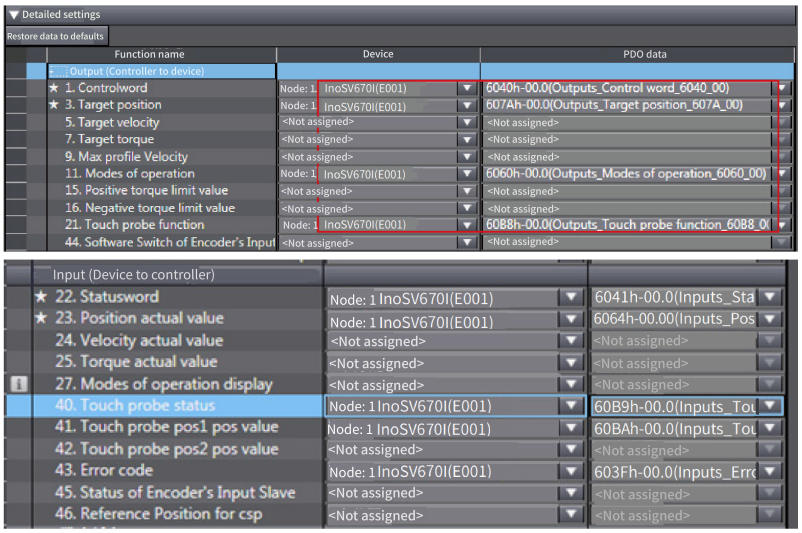
a. Assign axises



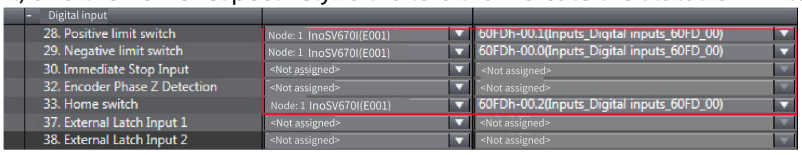
- **Axis number**: Ethernet the communication station number of the servo drive, which is also the value of H0E.21.
- **Axis use**: the axis in use.
- **Axis type**: the servo axis.
- **Output device 1**: Select the SV660N servo drive.

b. Complete detailed settings

- Select the PDO mapping objects configured in Step to assign output parameters (controller to device) and input parameters (device to controller). Note that the object name, node number, and index number must be set correctly. Each mapping object selected in step "Configuring parameters" must be assigned correctly. Otherwise, an error will be reported.



- 60FDh must be mapped to the same as that in the Omron controller, as shown in the following figure. bit0 to bit2 of SV670N indicate the negative position limit, the positive position limit, and the home respectively. bit16 to bit20 indicate the status of DI1 to DI5.

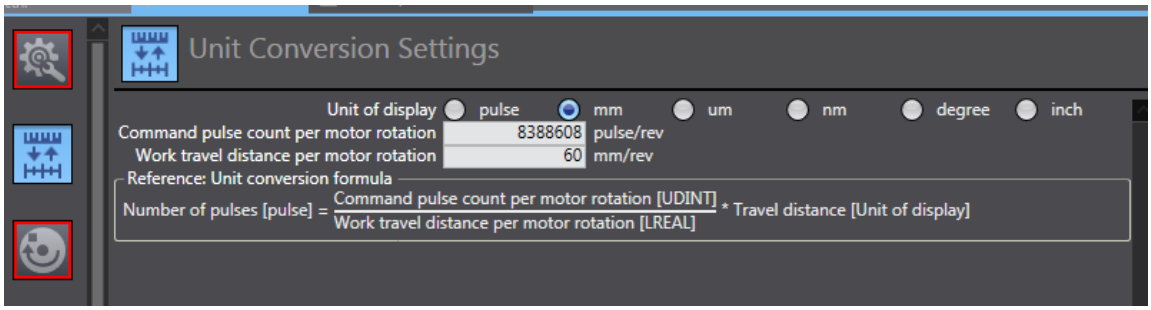


Note

As restricted by configurations of Omron software tool, axis configuration for the drive needs to be manually performed.

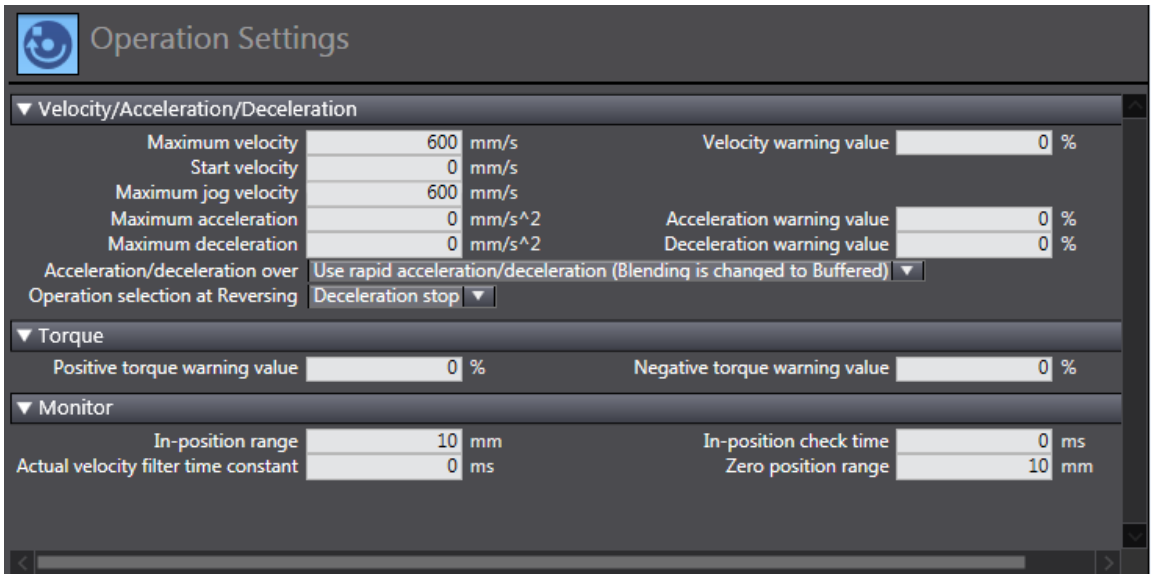
Unit conversion settings

Set **Command pulse count per motor rotation** based on the resolution of the motor encoder. For example, specify 67108864 PPR for a motor equipped with a 26-bit encoder. To facilitate commissioning, set **Work travel distance per motor rotation** to 60 mm/rev, which indicates that 1 mm/s equals to 1 rpm of the motor.



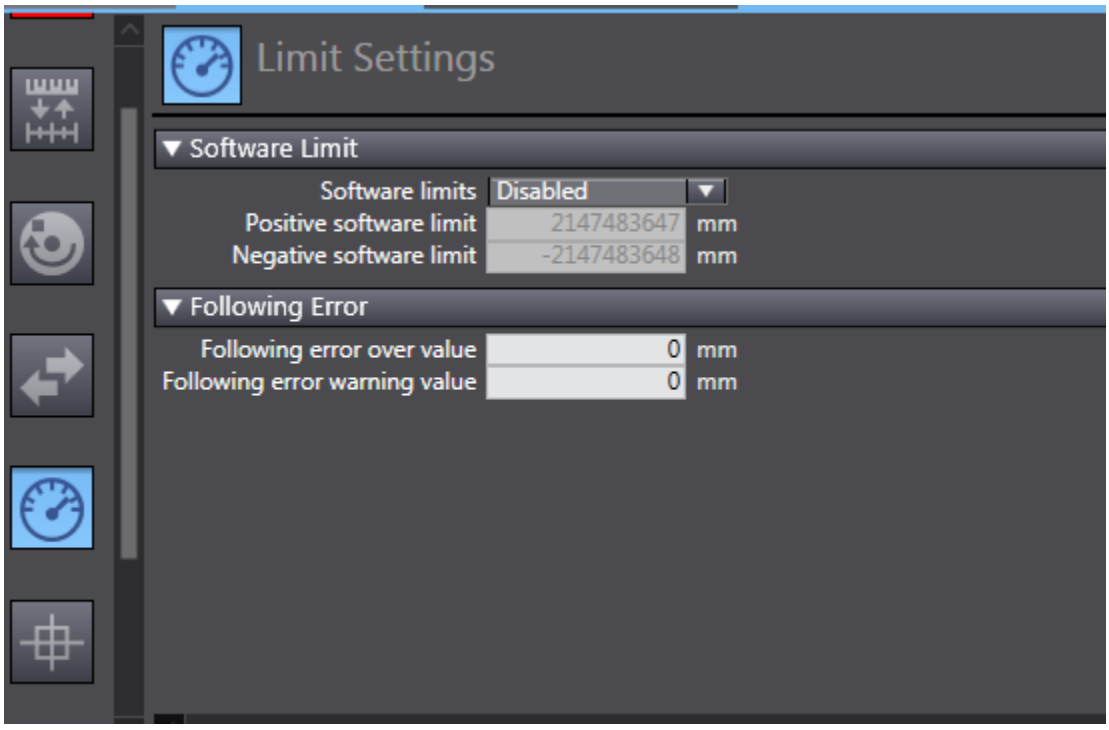
Set **Display Unit** based on the actual running unit when setting the gear ratio. All the position-type parameters in the host controller will be displayed in this unit.

Operation settings



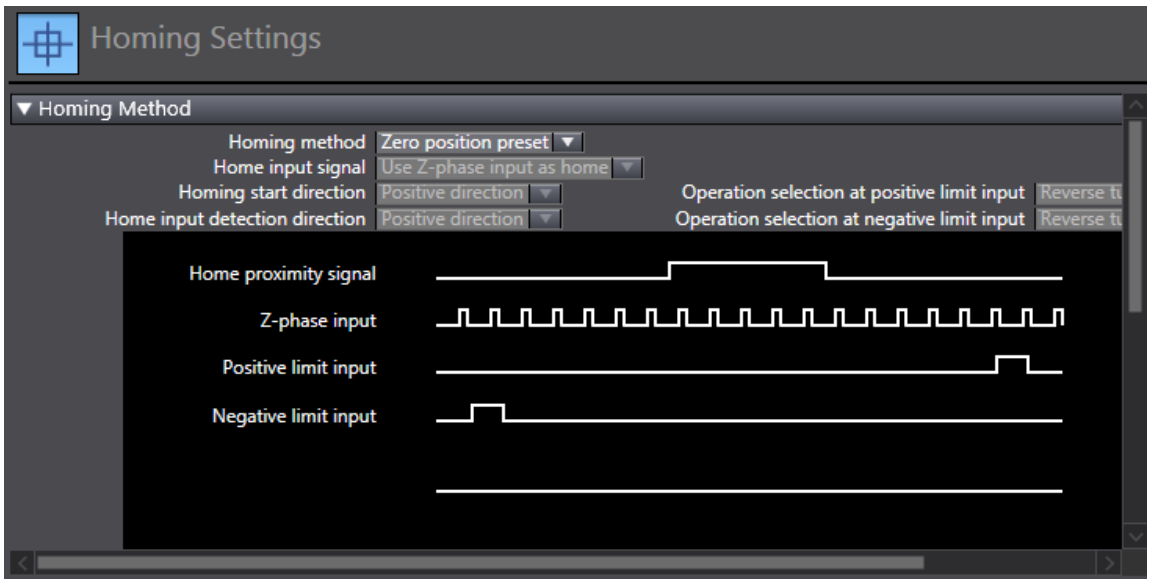
- **Velocity/Acceleration/Deceleration**: Set the maximum speed of the load according to actual conditions. If the motor speed converted exceeds 6,000 rpm, a parameter setting error marked by a red box will be reported by the host controller software. If the acceleration or deceleration rate is 0, the motion profile will be generated based on the maximum acceleration or deceleration rate. The acceleration and deceleration rates do not need to be set in most cases, unless required.
- **Torque**: If the warning value is 0, no warning will be reported. The warning value does not need to be set in most cases, unless required.
- **Monitor**: Set **Positioning Range** and **Zero Position Range** based on actual motor and mechanical conditions. If the specified value is excessively small, positioning or homing may fail.

Position limit settings



You can enable the function of software position limit as needed. The software position limit will be activated after homing.

Homing settings



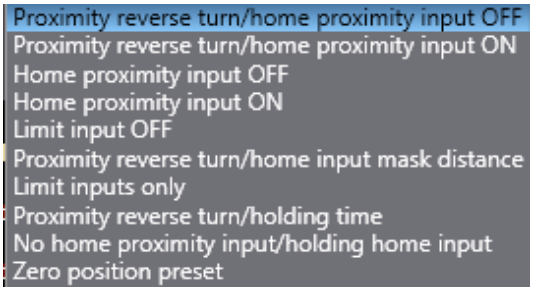
The homing mode involves cooperation between the servo drive and host controller. Set the homing mode according to the following table.

NX software description	Servo drive function	Terminal configuration
Home proximity signal	Home switch (FunIN.31)	-
Positive limit input	P-OT (FunIN.14)	DI1
Negative limit input	N-OT (FunIN.15)	DI2

Select the homing mode of the host controller and set the homing speed, acceleration, and home offset based on actual mechanical conditions.

- Introduction to homing
  Function blocks: MC_Home and MC_HomeWithParameter.

  1. Set MC_Home as shown in the preceding figure. Set MC_HomeWithParameter in the function block.
  2. The two function blocks both include 10 types of homing modes.

MC_Home	MC_HomeWithParameter
	Specify the homing action to be modified. 0: Proximity reverse turn/Home proximity input OFF 1: Proximity reverse turn/Home proximity input ON 4: Home proximity input OFF 5: Home proximity input ON 8: Limit input OFF 9: Proximity reverse turn/Home input mask distance 11: Limit inputs only 12: Proximity reverse turn/Holding time 13: No home proximity input/Holding home input 14: Zero position preset

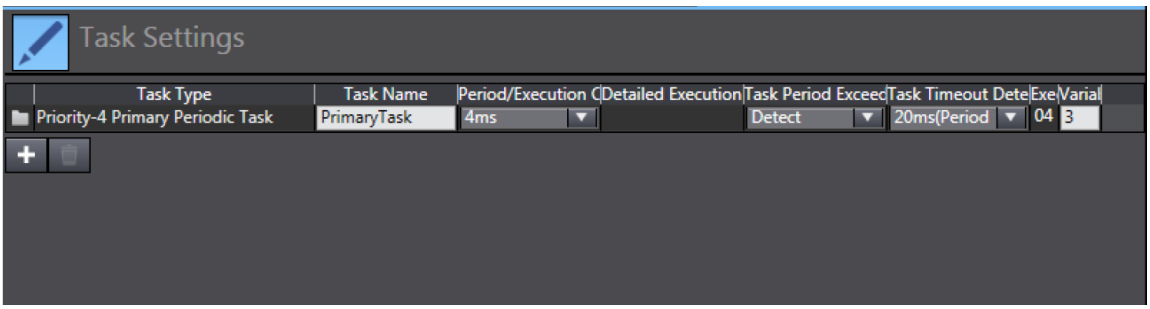
- **Home proximity input OFF**: The search for the home signal starts after the falling edge of the home proximity switch is reached.
- **Home proximity input ON**: The search for the home signal starts after the rising edge of the home proximity switch is reached.
- **Proximity reverse turn**: The home proximity signal is ON when homing starts, and reverse running applies after the falling edge of the home proximity signal is reached.
- **Home input mask distance**: The home signal is masked by the host controller within the set distance after the homing signal (for example, edge change of home proximity) is received, and the home signal is received only after the specified distance passes.
- **Holding time**: The home signal is masked by the host controller within the specified period of time after the homing signal (for example, edge change of home proximity) is received, and the home signal is received only after the specified period of time ends.
- **Zero position preset**: The home offset is being written to the position reference/position feedback in the host controller with current position as the home and motor at a standstill.

Note

The low-speed searching for the home signal applies in all homing modes. In case of operations at a high speed, the home signal is hidden during deceleration from the high speed to a low speed.

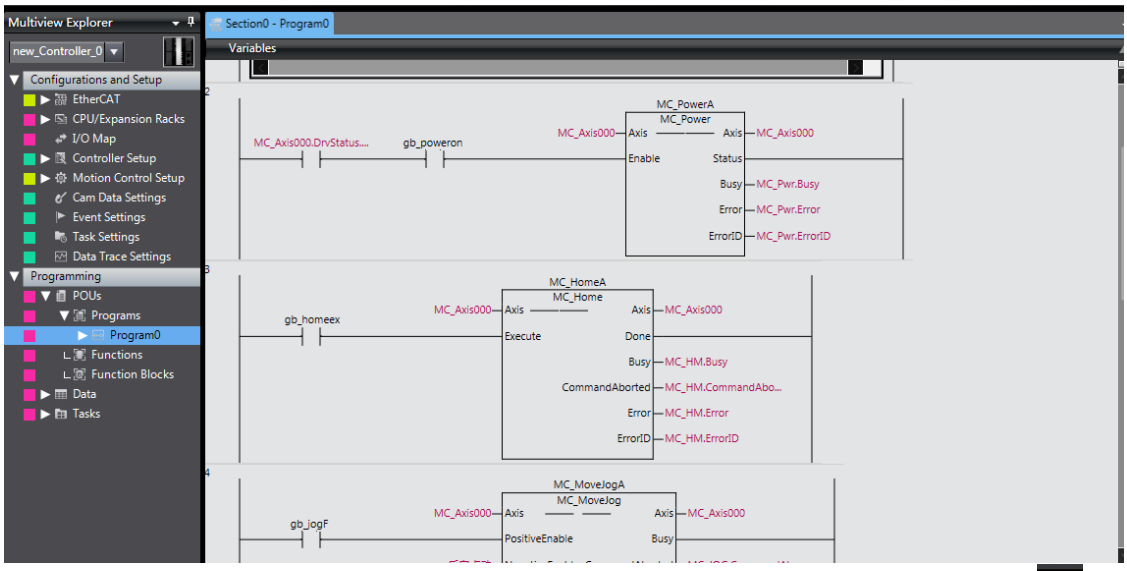
Distributed clock settings

The default clock is 1 ms. The synchronization clock (cycle of primary fixed-cycle tasks) named "PDO communication cycle" can be modified in **Task Settings**. The modification takes effect after the drive switches to the online status at next power-on.



Program-controlled servo operations

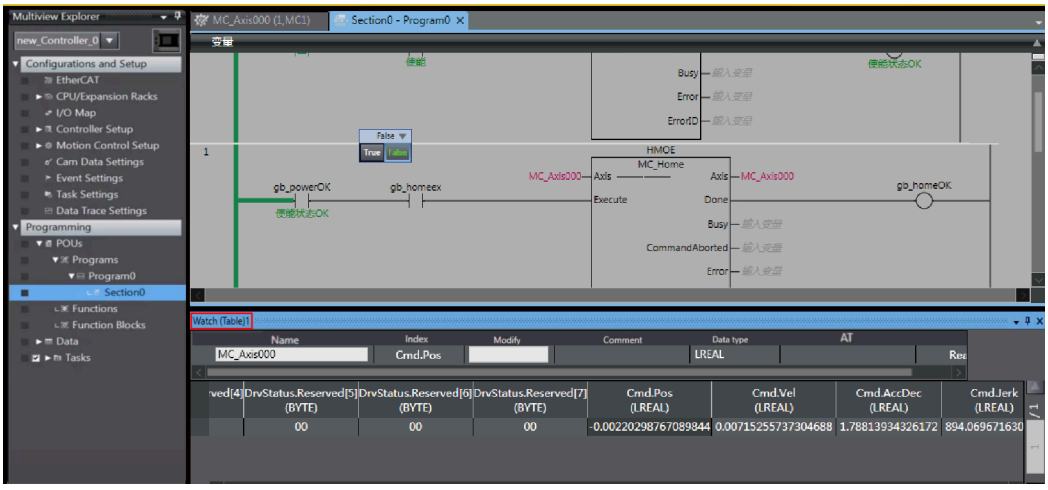
1. After configurations are completed, you can control the servo drive operations through the PLC program.
   If the MC_POWER module is used, it is recommended to add the servo status bit MC_Axis000. DrvStatus.Ready. MC_Axis000 is the axis name. This is to prevent the situation where the PLC program starts running before the communication configuration is completed.

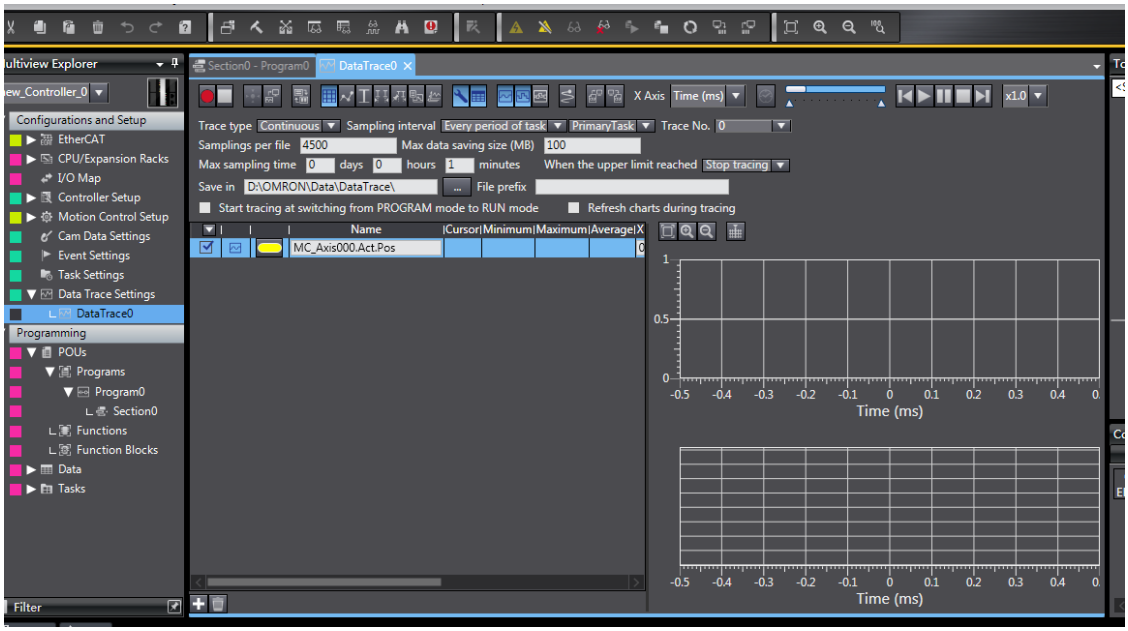


2. After all the settings and programming are completed, switch to the online state, and click  to download the program to the controller.

   Click  to use the synchronization function. This function compares the difference between the current program and the program in the controller, allowing users to determine whether to download the program to the controller, upload it from the controller "", or leave it unchanged based on the differences.

   You can monitor the data through the monitoring list or collect the data waveform by using the data tracking function during operation.





14.2.3 Beckhoff Controller as the Host Controller

This topic describes how to configure the SV670N-INT servo drive for working with Beckhoff TwinCAT3.

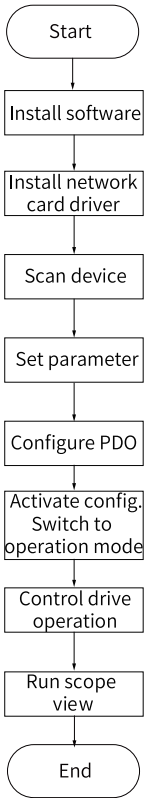


Figure 14-10 Configuration flowchart

Installing the TwinCAT software

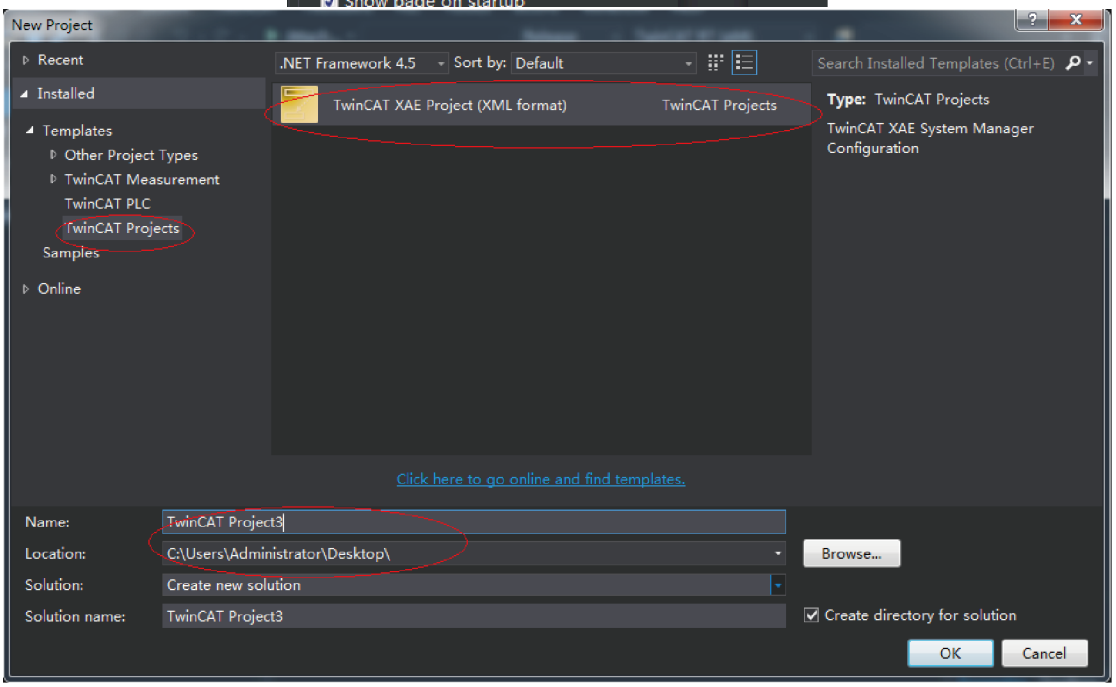
The TwinCAT3 software, which can be downloaded from the official website of Beckhoff, supports 32/64-bit WIN7 systems.

Note

Use Fast Ethernet Card with Intel chip. Use of network cards of other brands may result in the risk of EtherCAT operation failure.

1. Copy the SV670N EtherCAT configuration file (SV670_1Axis_V0.04-0506) to the TwinCAT installation directory: TwinCAT\3.1\Config\Io\EtherCAT.
2. Open TwinCAT3 and click **New TwinCat Project**.

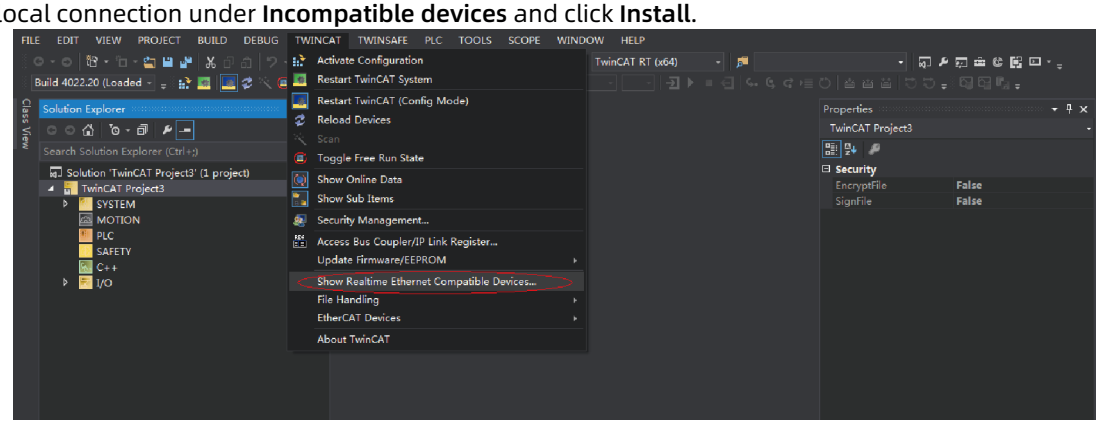




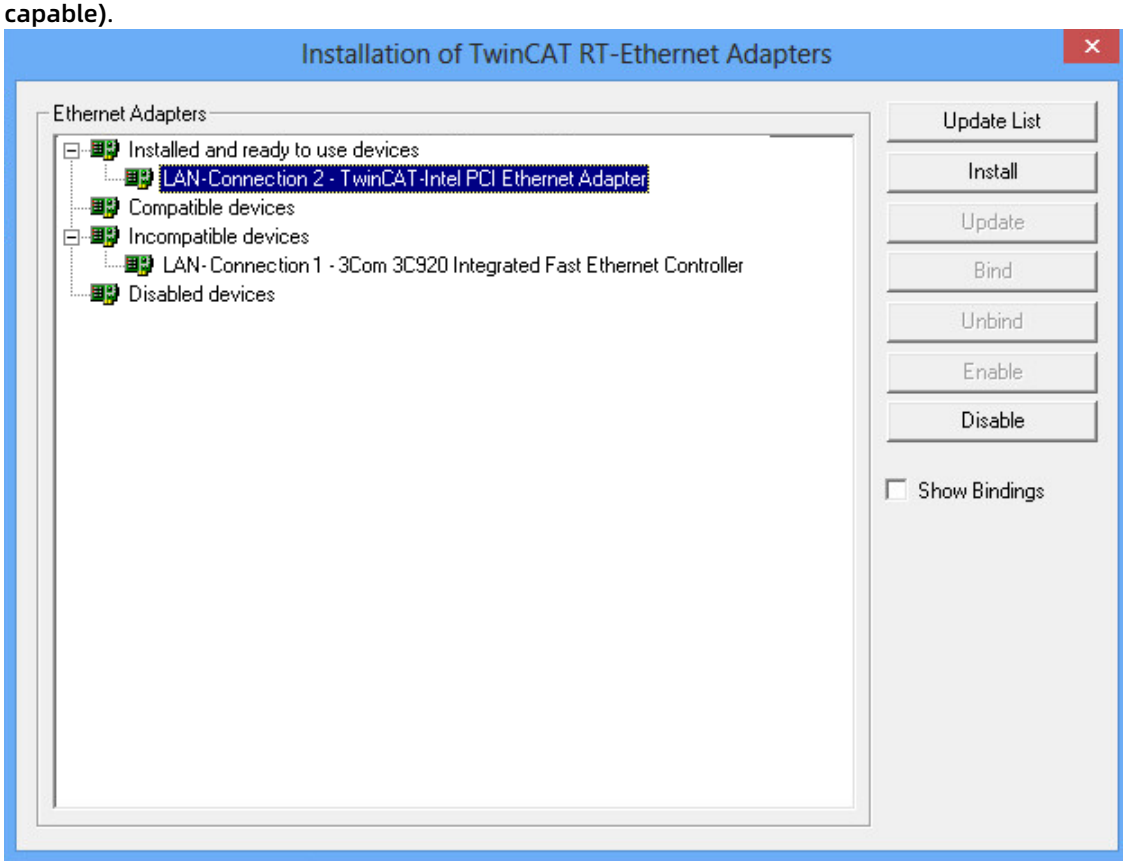
Installing the network adapter driver

Install the TwinCAT network card driver.

1. Click **TwinCAT** in the top menu bar and select **Show Real Time Ethernet Compatible Devices...**, as shown in the following figure. In the **Installed and ready to use devices** dialog box, select the local connection under **Incompatible devices** and click **Install**.



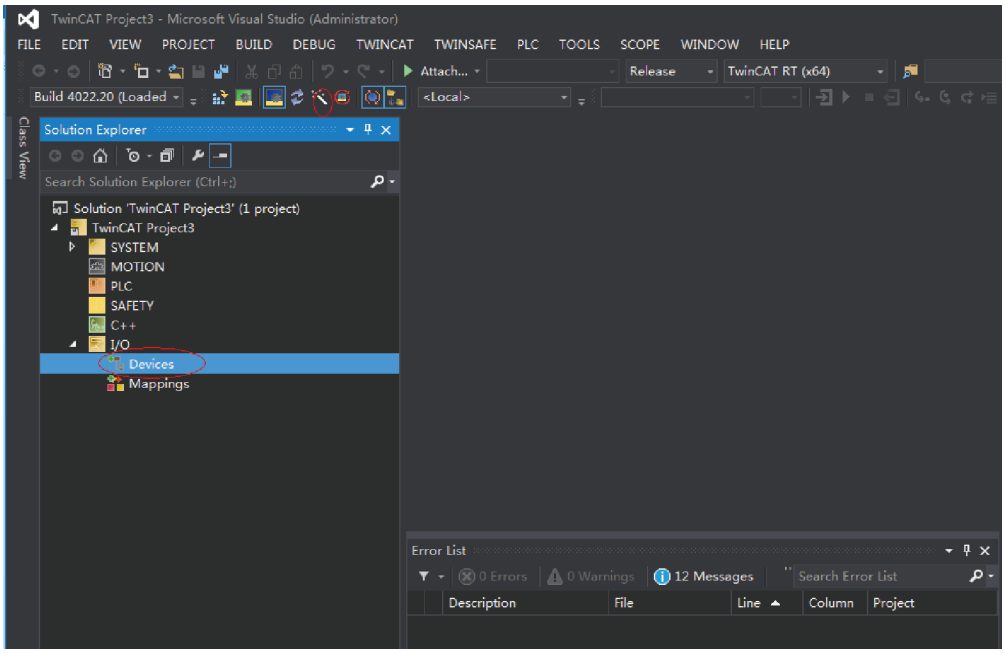
2. After the driver is installed, it is displayed under **Installed and ready to use devices(realtime capable)**.



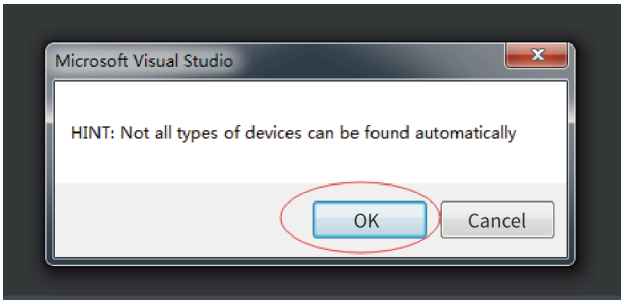
Scanning for devices

1. Create a project and scan for devices. Select 

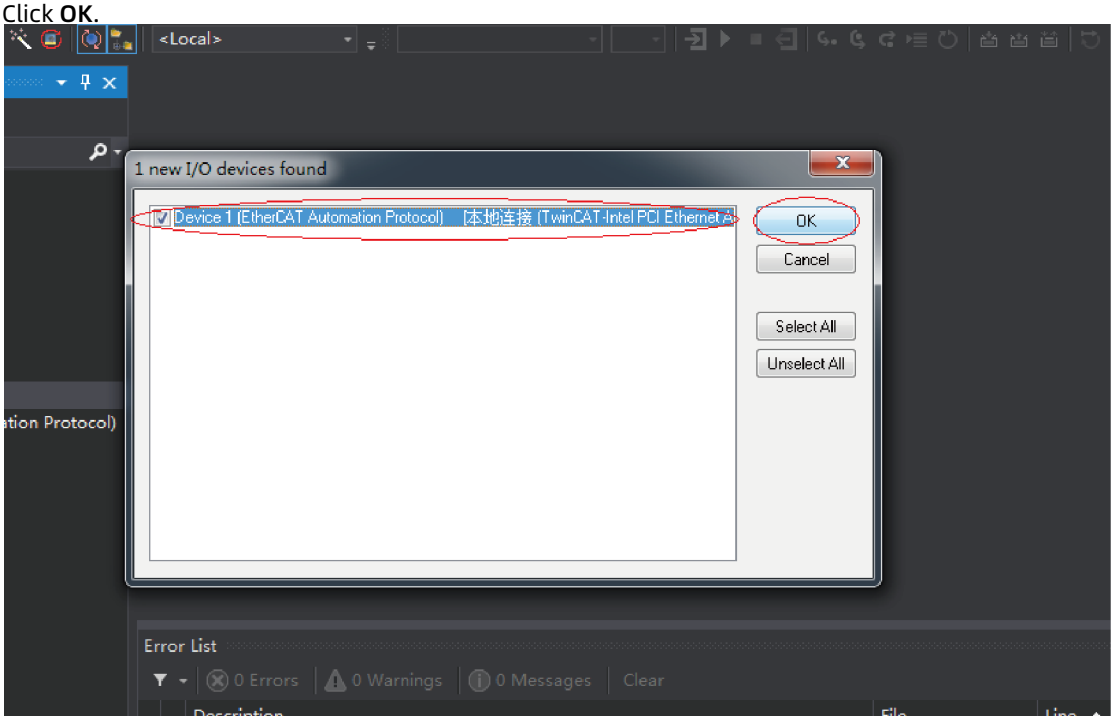
, and click , as shown in the following figure.



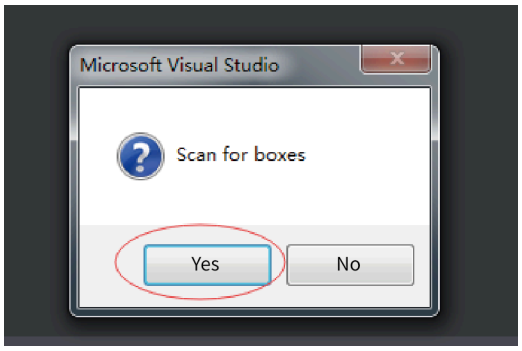
2. Click **OK**.



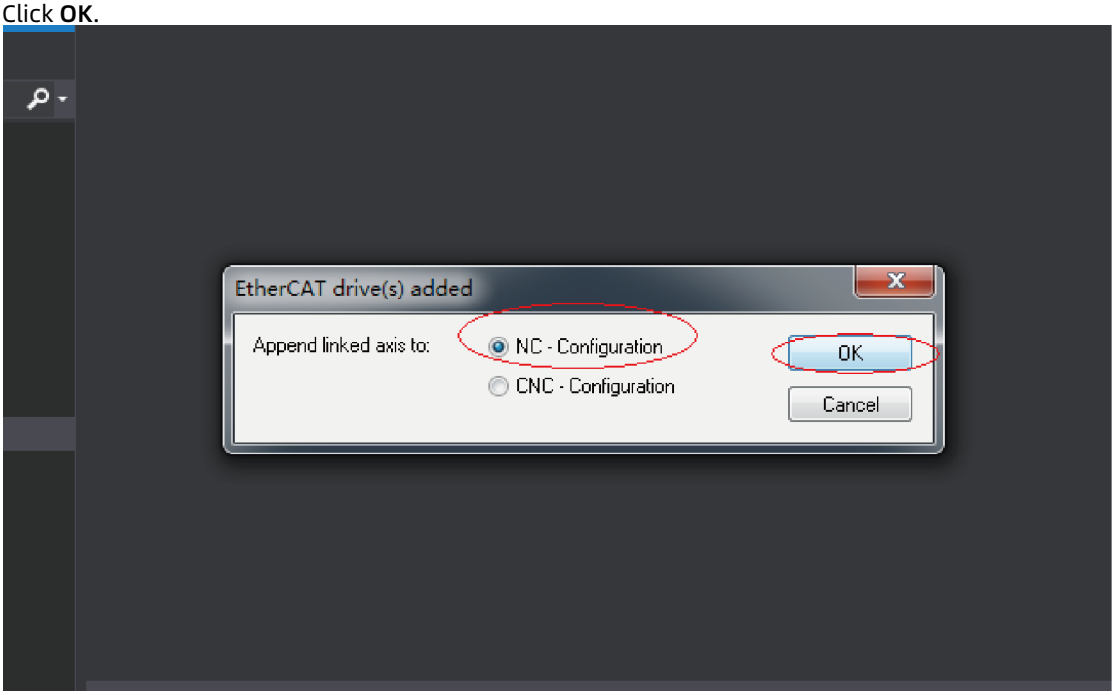
3. Click **OK**.



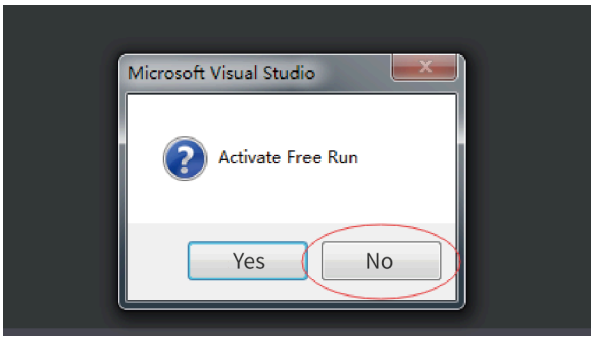
4. Click **Yes**.



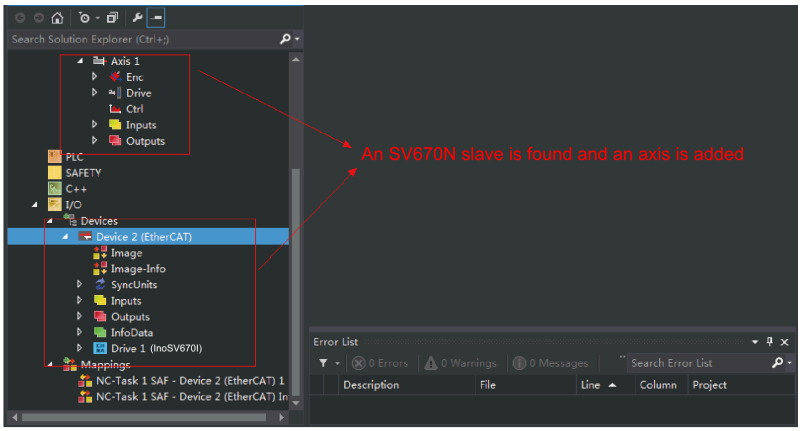
5. Click **OK**.



6. Click **No**.

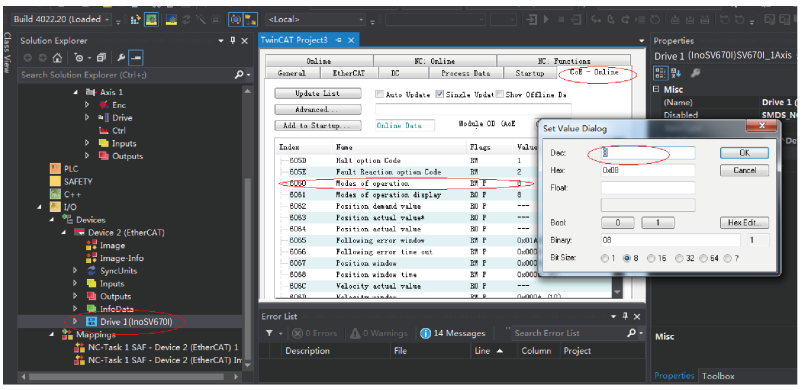


7. Devices are scanned, as shown in the following figure.



Configuring servo drive parameters

Configure parameters through SDO communication on the **CoE - Online** tab. When H0E.01 (200E-02h) is set to 3, the parameter values modified through SDO communication will be saved upon power failure. To set 6060h to the CSP mode (8), follow the procedure shown in the following figure.

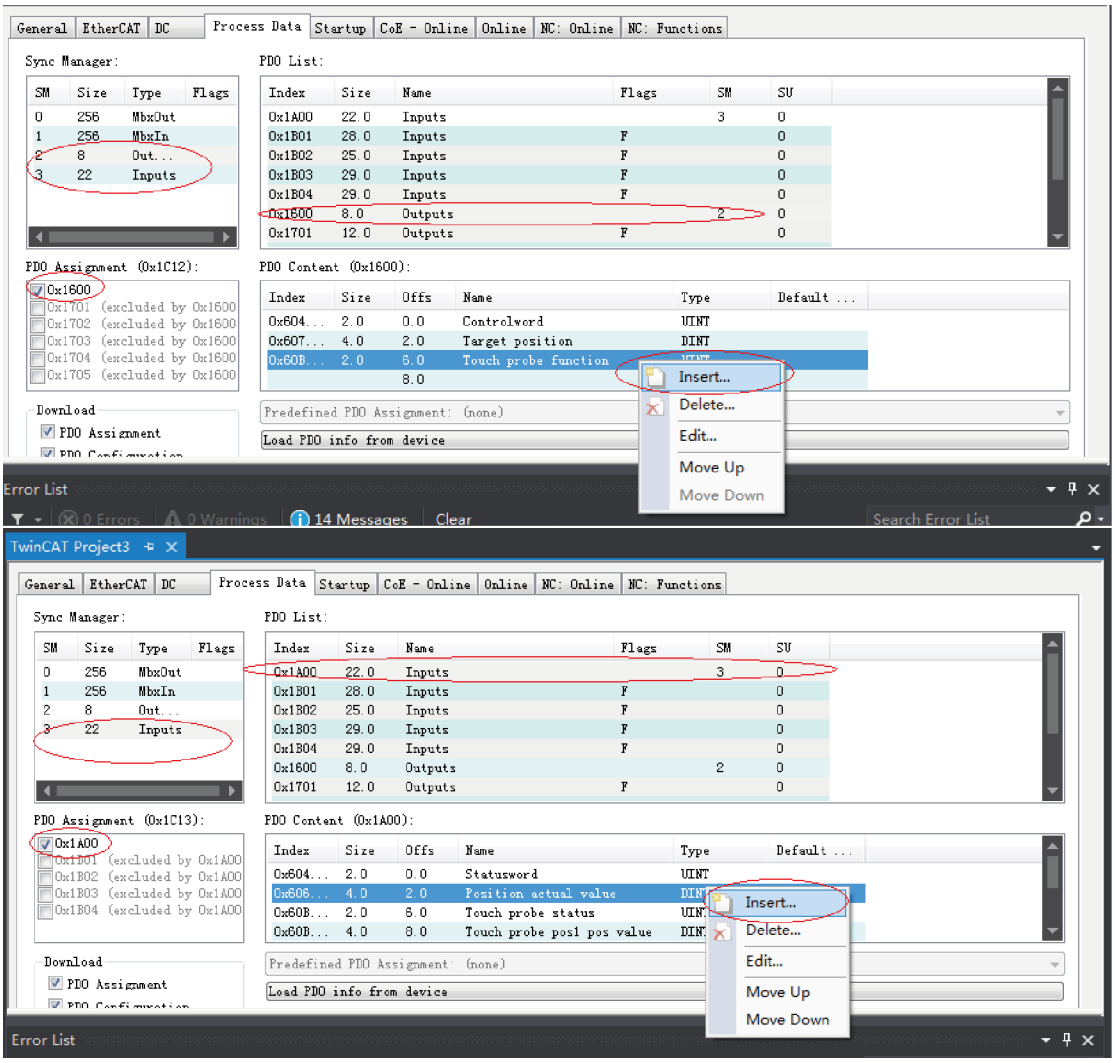


Note

This operation is available only when H02.00 is set to 9.

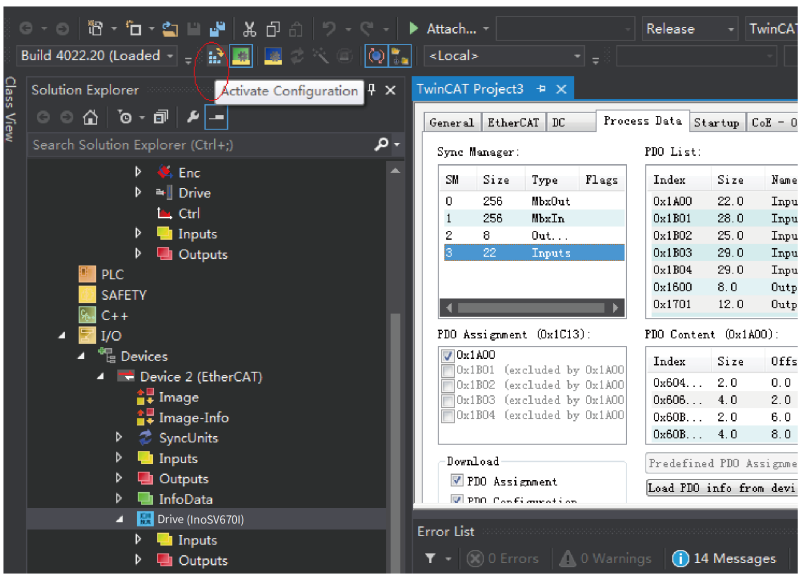
Configuring the PDO

Select 0x1600 and 0x1A00 as shown in the following figure. Change the current PDO only if it does not fulfill your needs. To modify the PDO, right click the PDO Content window, click **Delete** to delete the redundant PDO or click **Insert** to add the PDO needed. To modify the PDO, right-click in the **PDO Content** section, and click **Delete** to delete the redundant PDO or click **Insert** to add the PDO that you need to use.

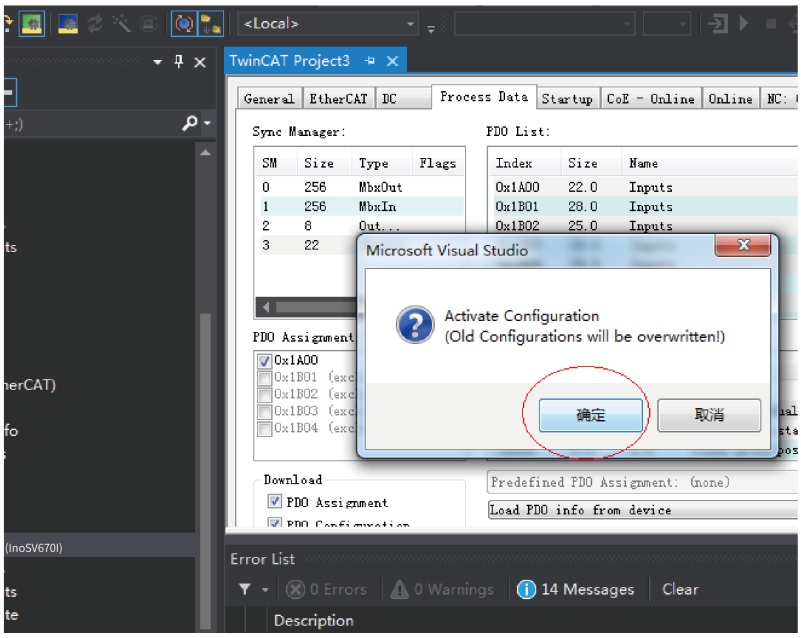


Activating the configuration and switching to the running mode

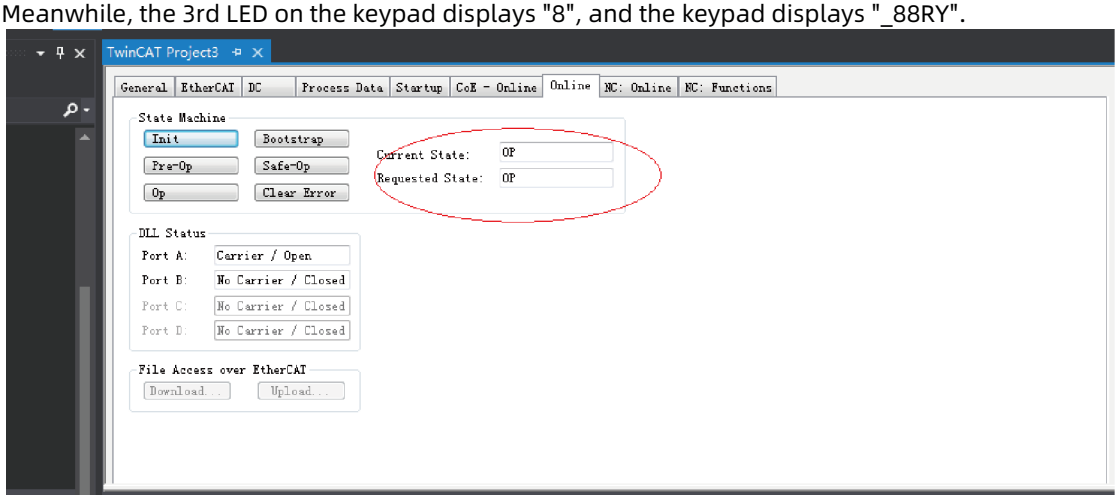
1. Click "".



2. Click **OK**.



3. After you click **OK**, go to the **Online** tab. You can view that the device enters the OP status. Meanwhile, the 3rd LED on the keypad displays "8", and the keypad displays "_88RY".



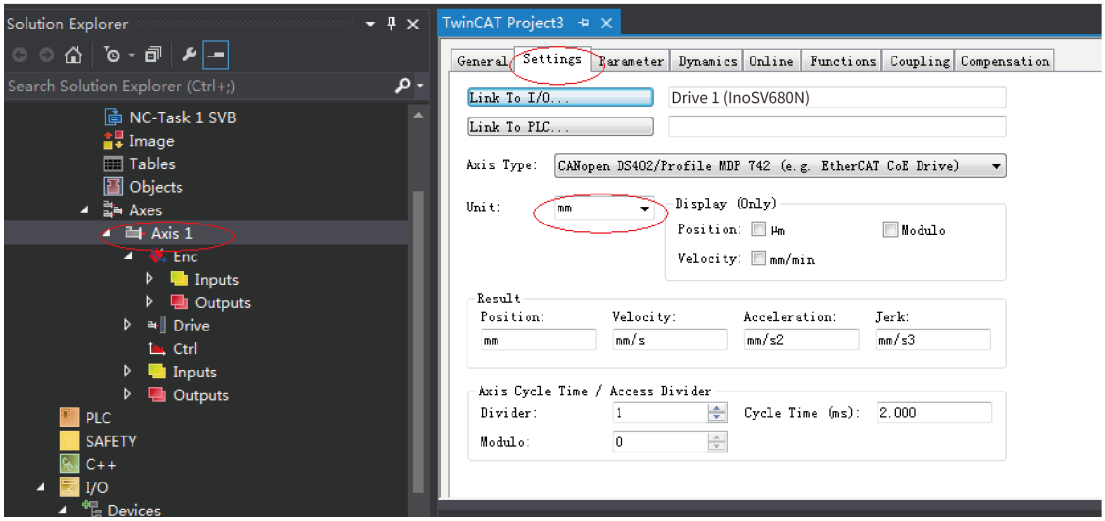
Controlling servo drive operation

Control the servo drive through NC or PLC programs.

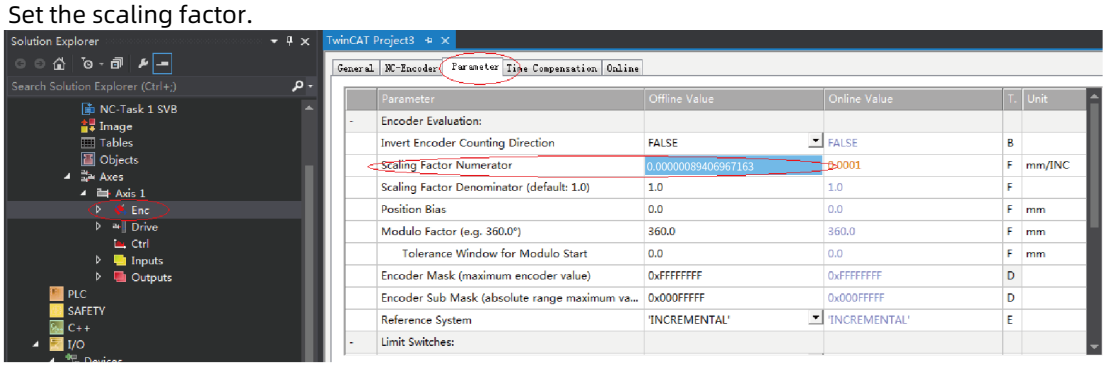
1. Servo operating in CSP mode

   a. Set the unit.

   Set the unit to "mm" during the test.



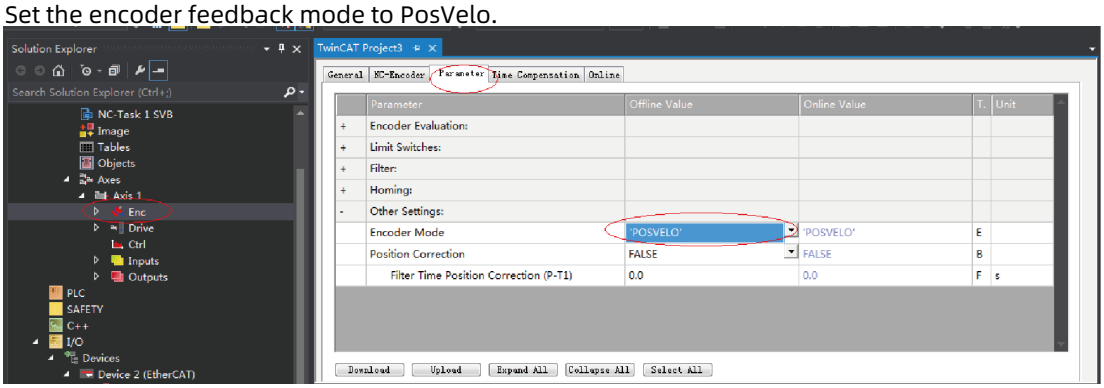
b. Set the scaling factor.



Scaling factor: the distance corresponding to the encoder pulses per position feedback.

For example, 67108864 PPR corresponds to a distance of 60 mm, and the scaling factor is: 60/67108864 = 0.00000089406967163 mm/Inc.

c. Set the encoder feedback mode to PosVelo.



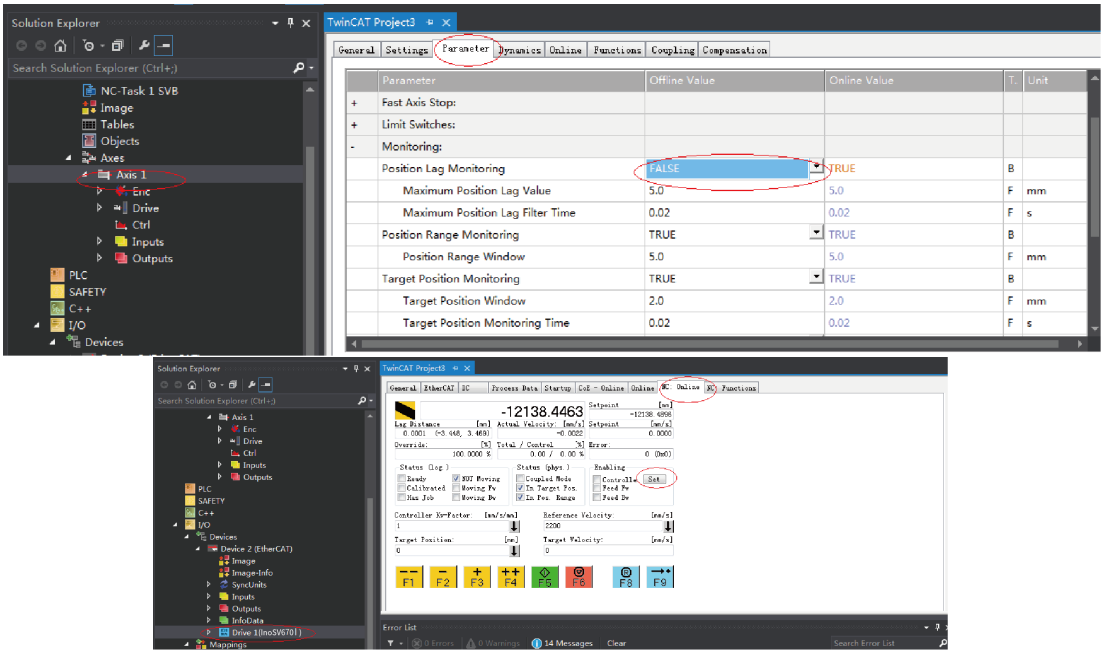
Descriptions for Other Settings:

Encoder Mode: There are three encoder modes: POS, POSVELO, and POSVELOACC.

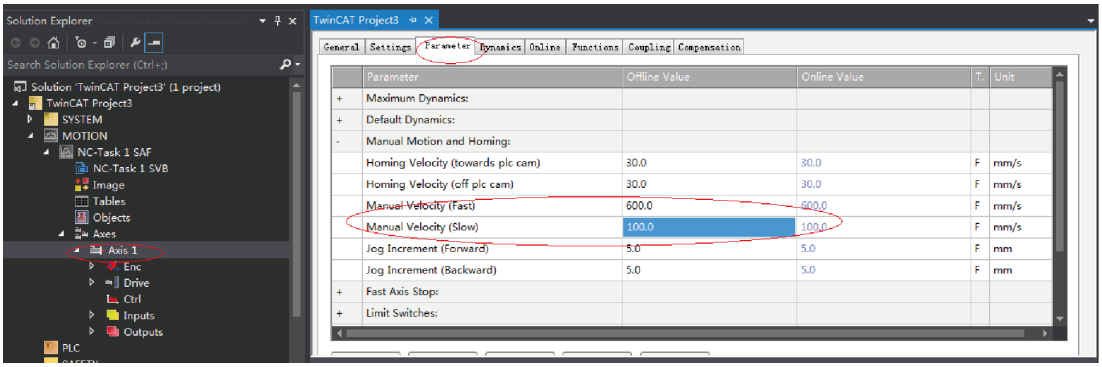
- POS: The encoder only calculates the position, which is used when the position loop is in the servo drive.
- POSVELO: The encoder only calculates the position, which is used when the position loop is in TWinCAT NC.
- POSVELOACC: The TWinCAT NC uses the encoder to determine the position, speed, and acceleration.

d. Run jogging tests.

Temporarily hide the system deviation.

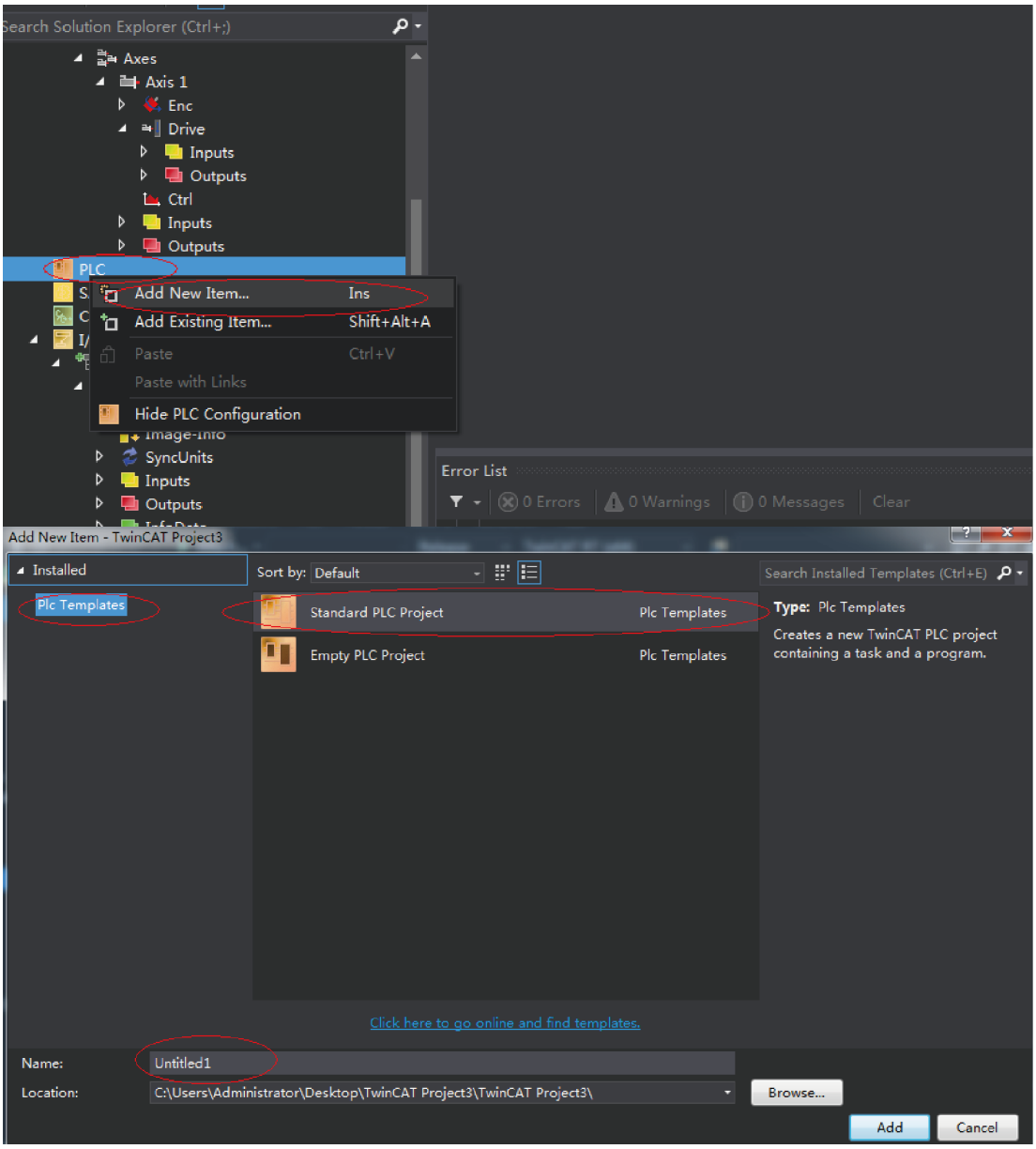


Click **Set**. In the dialog box that appears, click **All** to enable the servo drive. Perform jogging through F1 to F4. The jog speed is set as shown in the following figure.

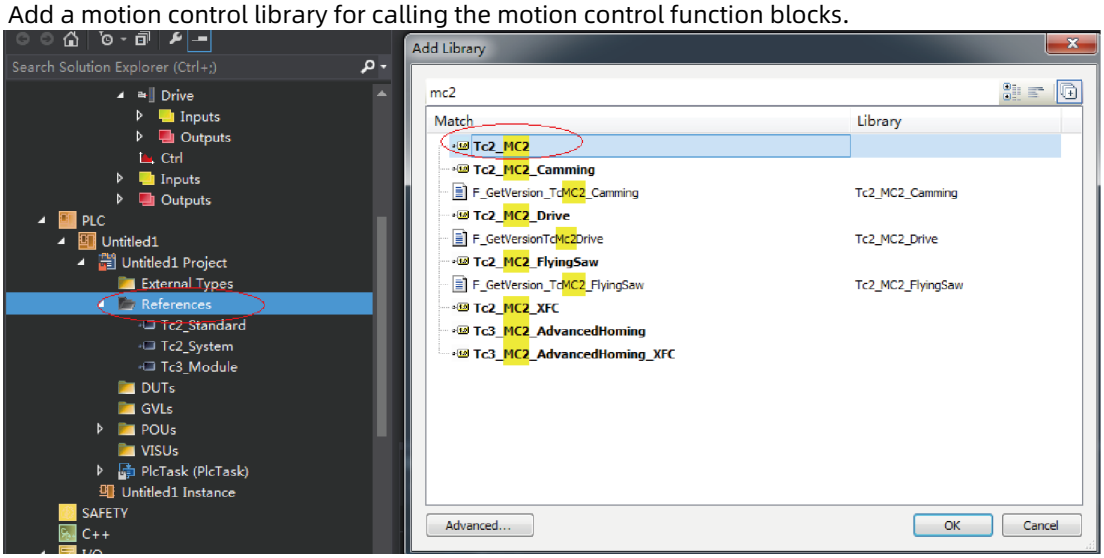


2. Controlling the servo drive operations through the PLC

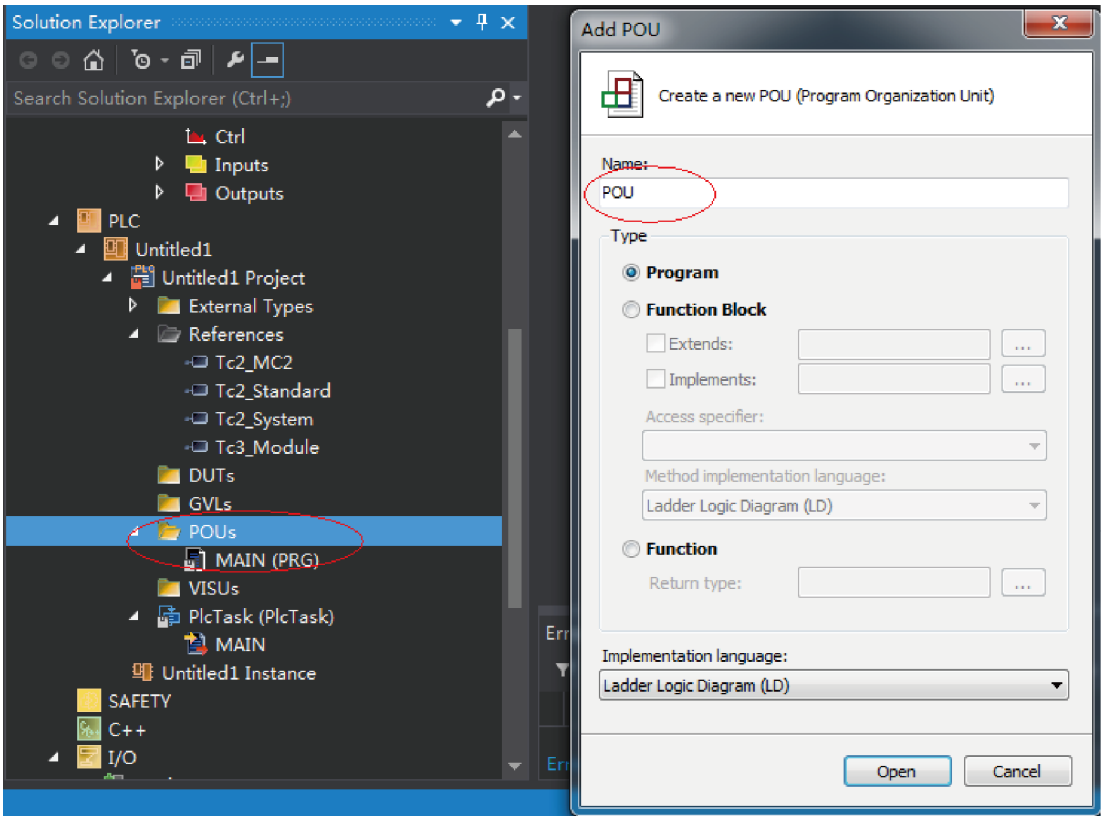
a. Create a PLC program.



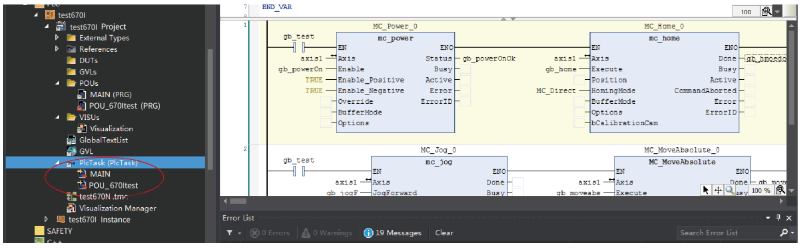
b. Add a motion control library for calling the motion control function blocks.



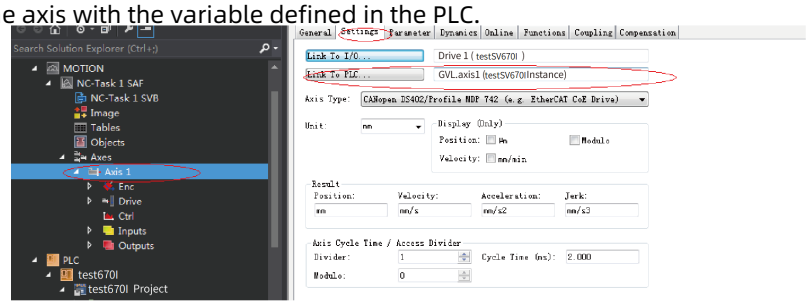
c. Create a POU program.



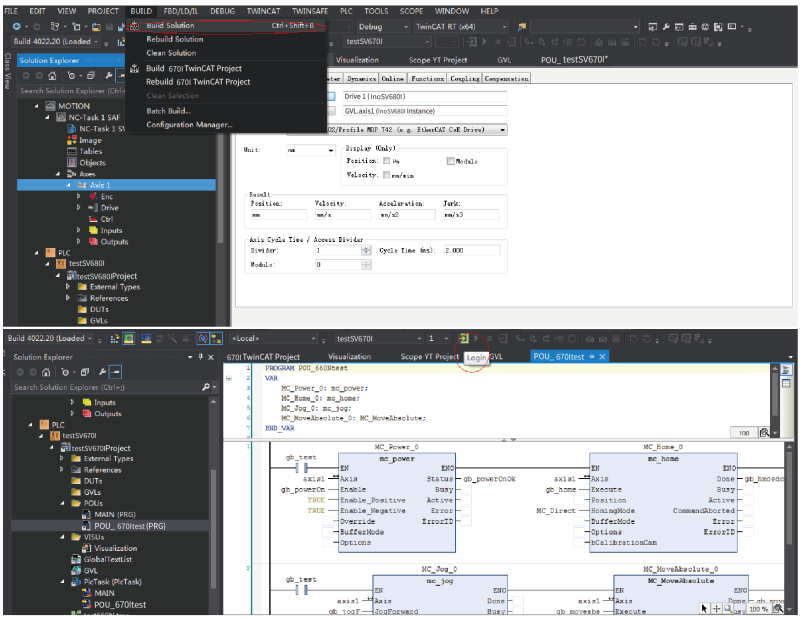
d. Call the motion module to implement some simple actions and input the final program to PLCtask.



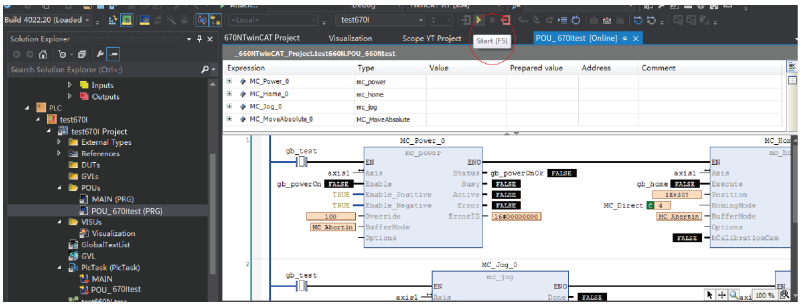
e. Associate the axis with the variable defined in the PLC.



f. Compile the program. Make sure that no fault exists, activate the configuration, and then log in to the PLC.

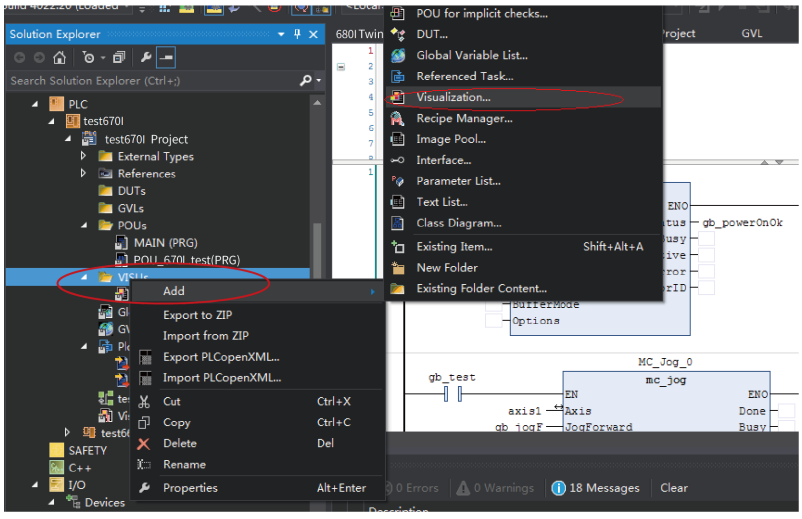


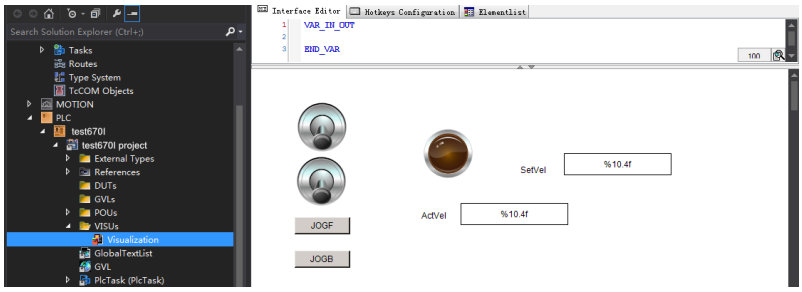
g. Click **Start** to run the servo drive.



3. Controlling the servo drive operations through the HMI

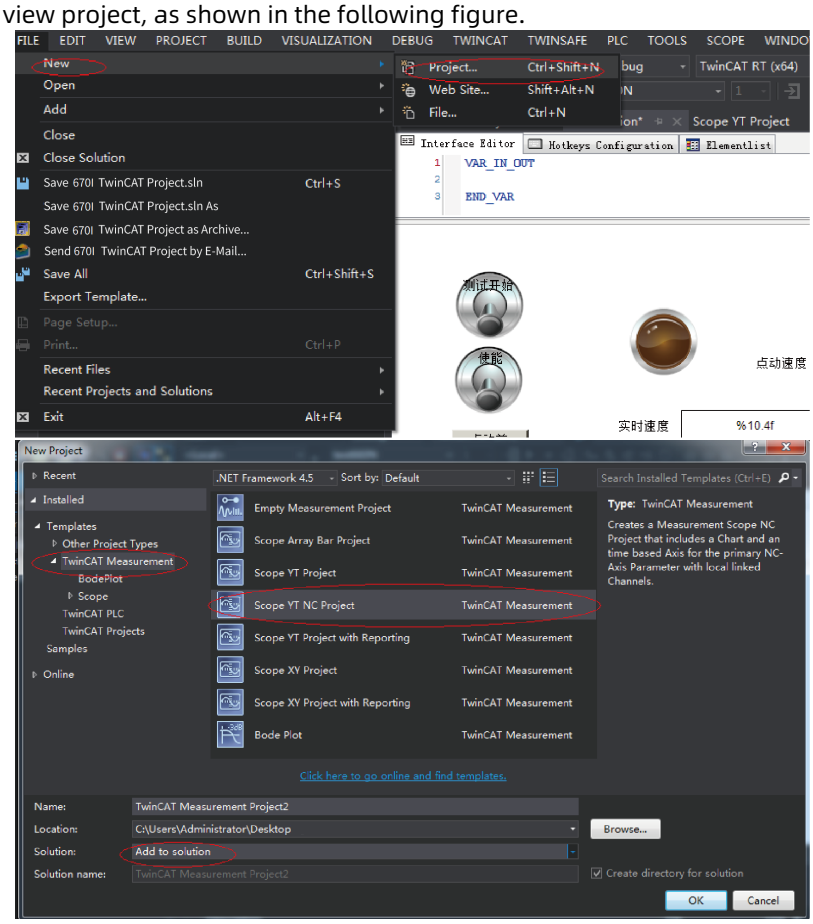
Add the HMI interface to control the servo drive through the HMI interface.



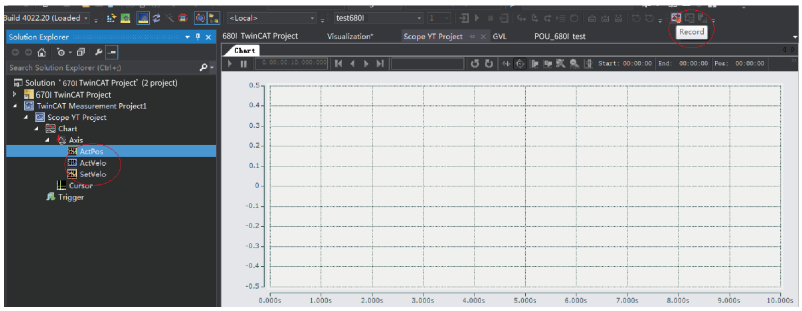


Use the scope view function.

1. Add a scope view project, as shown in the following figure.



2. Add the parameters to be monitored and monitor these parameters during the operation of the PLC.



14.2.4 KEYENCE KV7500 as the Host Controller

14.2.4.1 Configuring the Servo Drive

- Servo drive version
  It is recommended to use the device description file "SV670N-Ecat_v0.09.xml" or above for trial run.
- Related parameters
  bit0: negative limit; bit1: positive limit; bit2: home switch; bit16 to bit20 correspond to DI1 to DI5 respectively.

14.2.4.2 Configuring KEYENCE KV7500 Software Tool

As software tool versions earlier than KV STUDIO 9.45 do not support the extension of KEYENCE EtherCAT module "KV-XH16EC", the version of the KEYENCE software tool that you use must be KV STUDIO 9.45 or later.

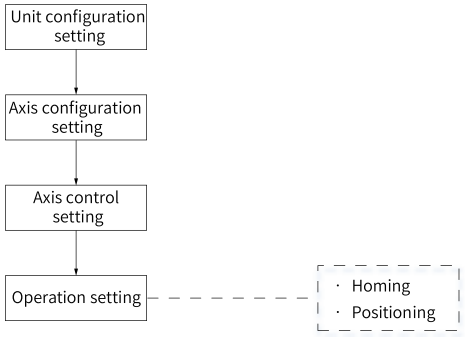
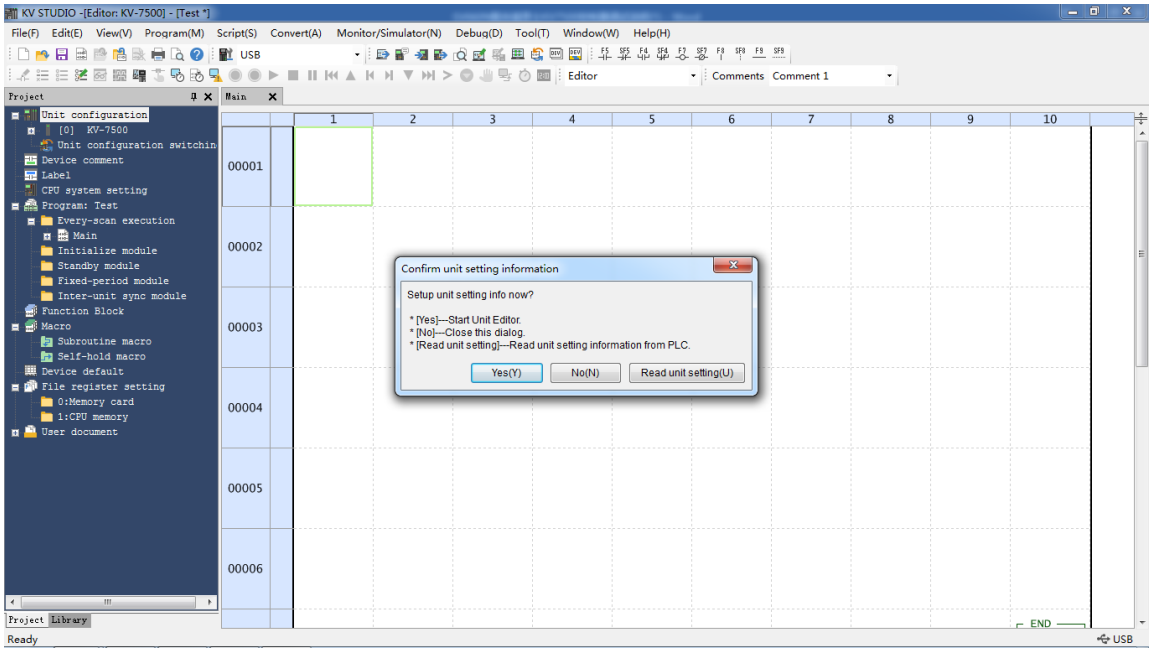


Figure 14-11 Configuration flowchart

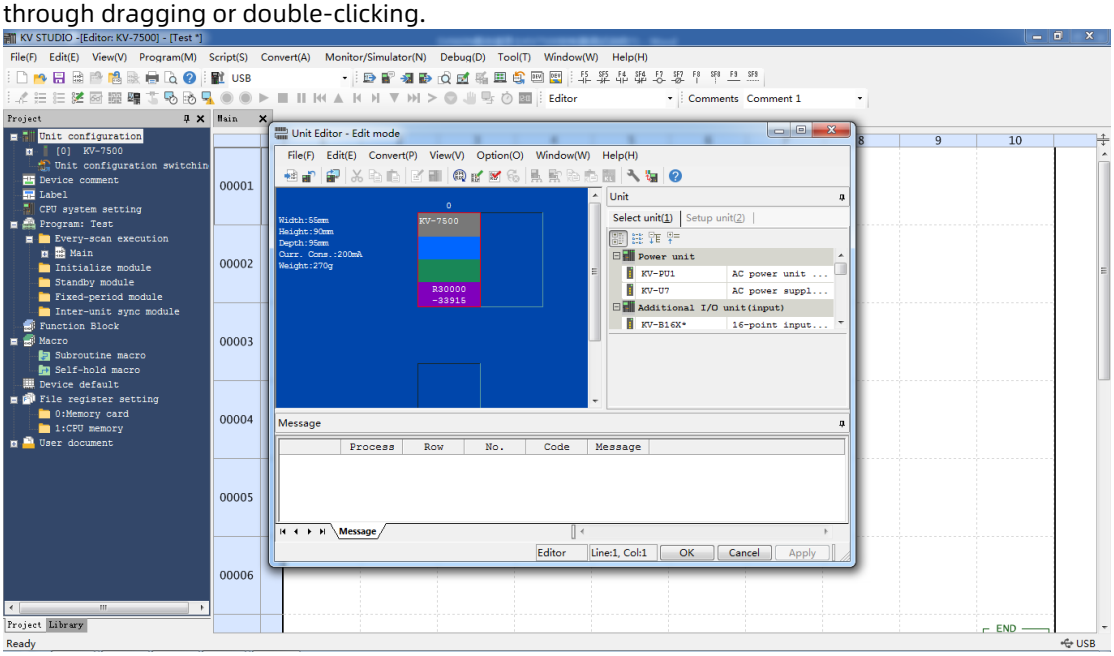
Unit configuration setting

Create a project and click **OK** to display the following dialog box.

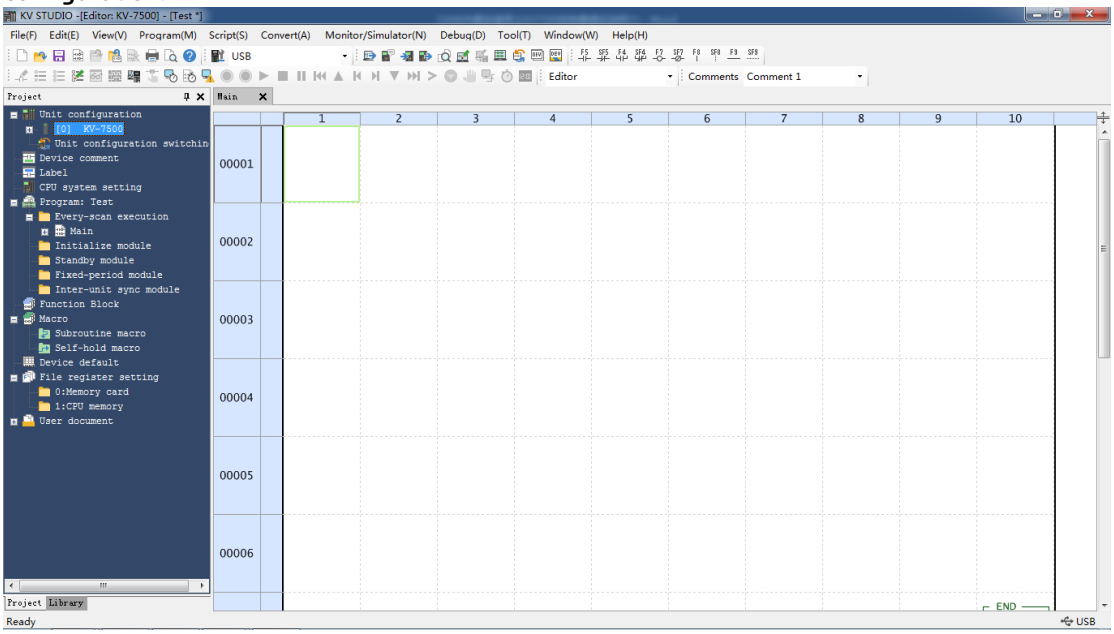


Click **Yes**, **No**, or **Read unit setting** as needed.

- Click **Read unit setting** when the physical PLC unit is connected properly and able to communicate with the software tool. The software tool obtains unit configurations automatically according to the physical connection.
- If you click **Yes**, the **Unit editor** dialog box opens, allowing you to select units for configuration through dragging or double-clicking.

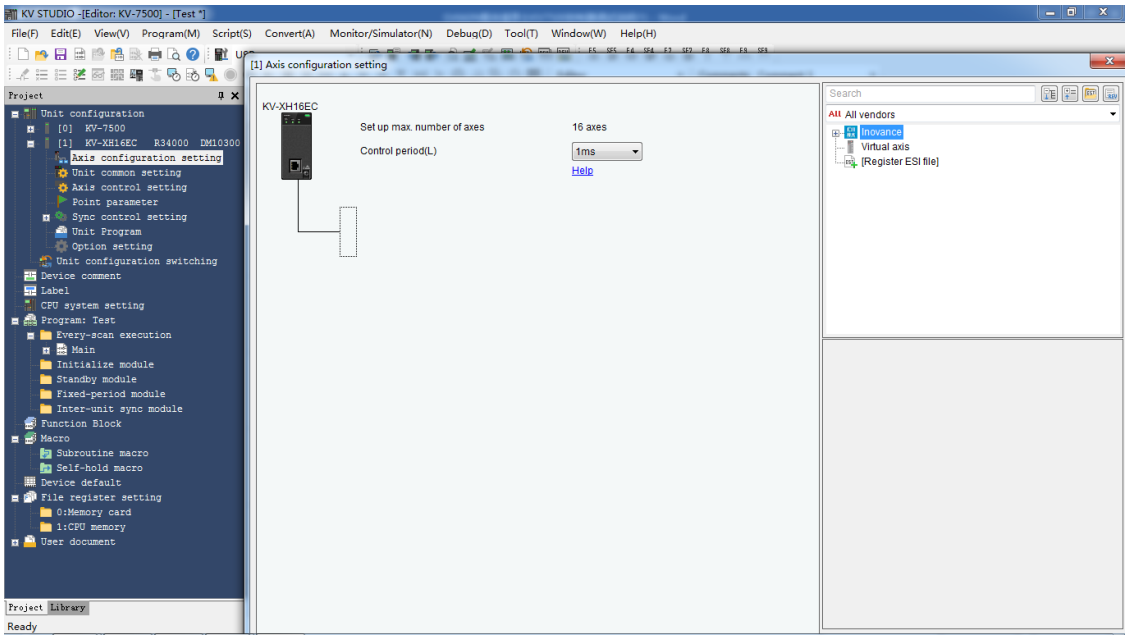


- If you click **No**, you can click **Tool** > **Unit editor** or double-click **[0] KV7500** under **Unit configuration**.

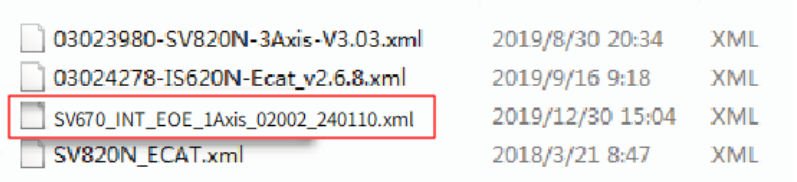


Axis configuration setting

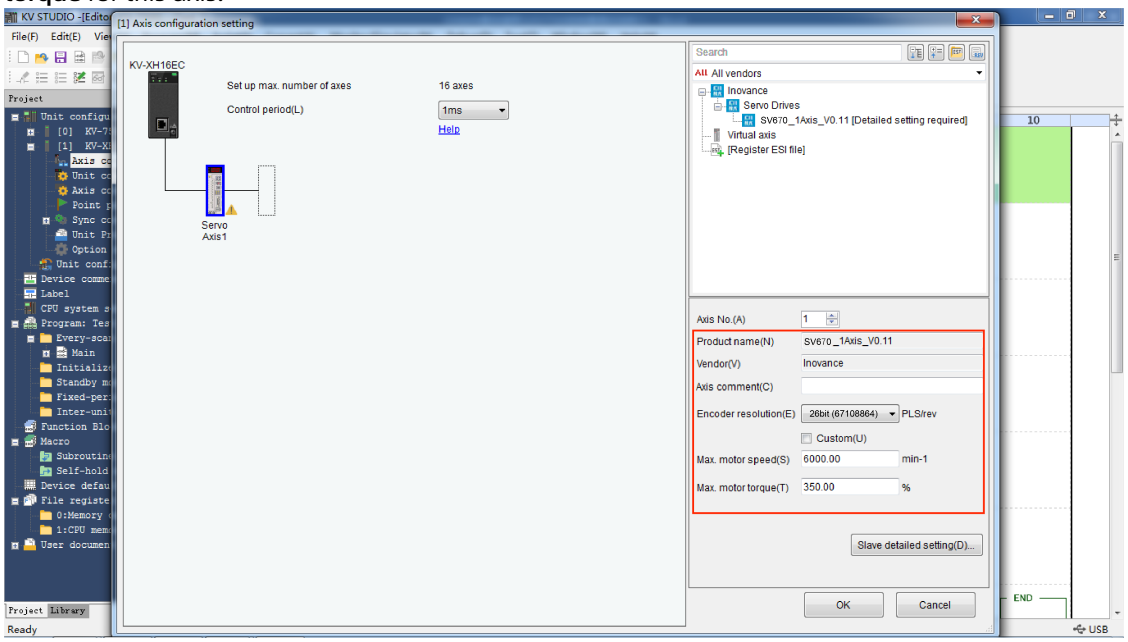
1. Click **Axis configuration setting**.
2. Double-click **Register ESI file**.



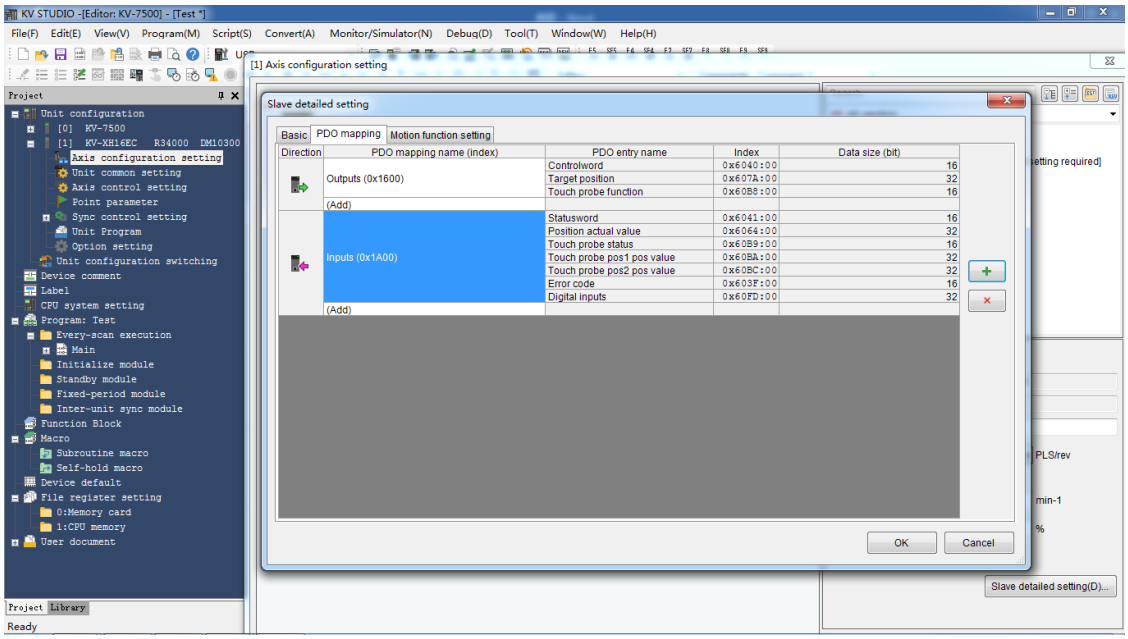
3. Find and open the storage directory of the device description file ".xml".
4. Importing the .xml file.



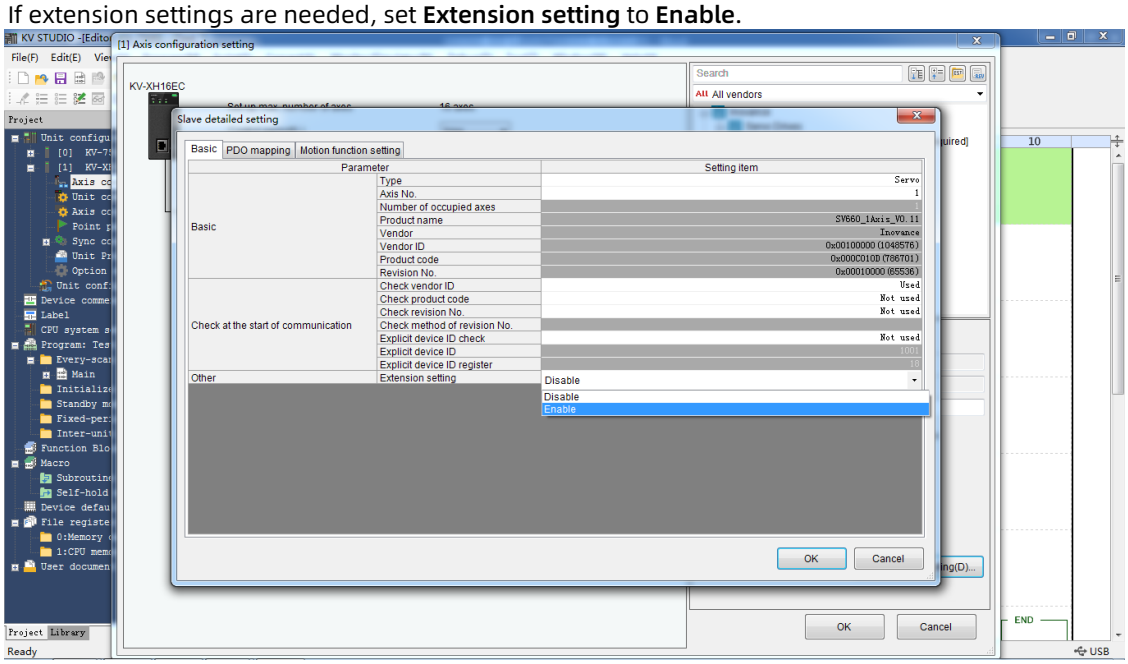
5. After the device description file is imported, you can start to add axes. You can also set the control period in **Axis configuration setting**. The default control cycle is 1 ms and the minimum control cycle is 250 us.
6. You can add the axes needed through dragging or double-clicking. Select the corresponding axis and set critical information such the **Encoder resolution**, **Max. motor speed**, and **Max. motor torque** for this axis.



7. You can add PDO settings in the detailed settings of the slave.

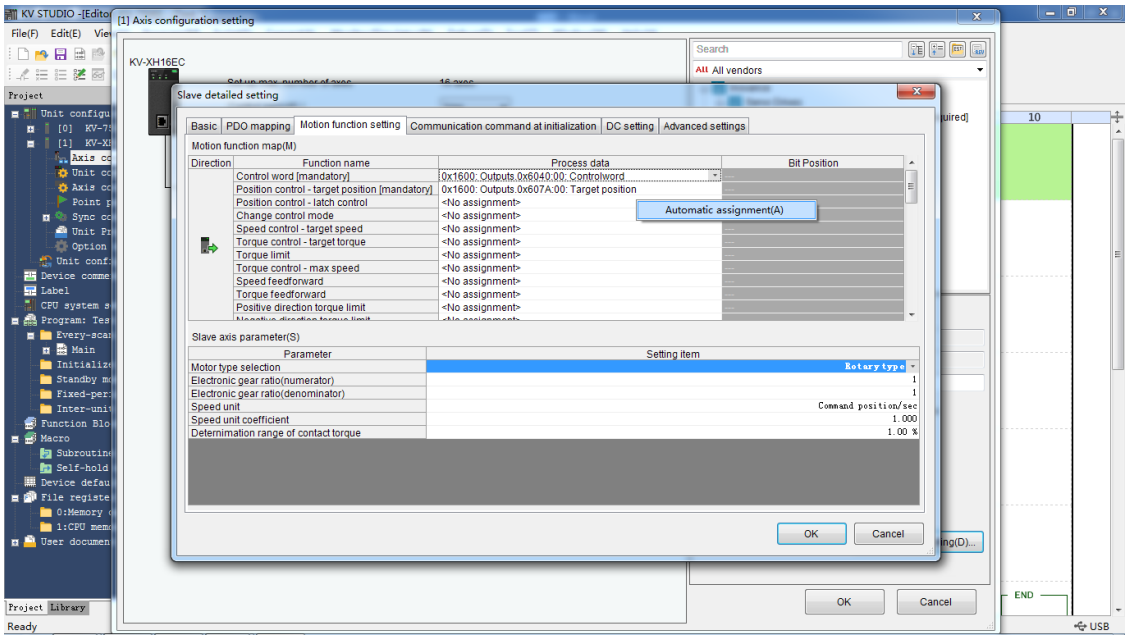


8. If extension settings are needed, set **Extension setting** to **Enable**.

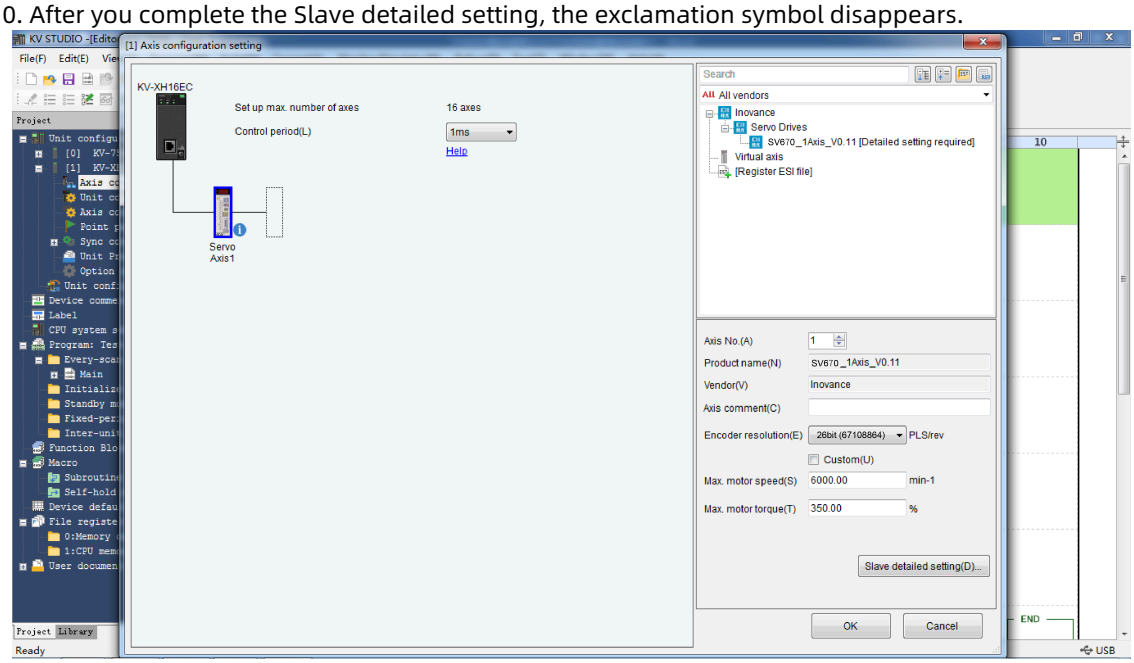


9. For motion function settings, you can double-click or click on the combo box (small triangle icon) to select the PDO configuration needed from the drop-down list.
   You can also right-click and choose **Automatic assignment** > **Yes**. This way, the assigned contents will automatically correspond to the preceding PDO content.

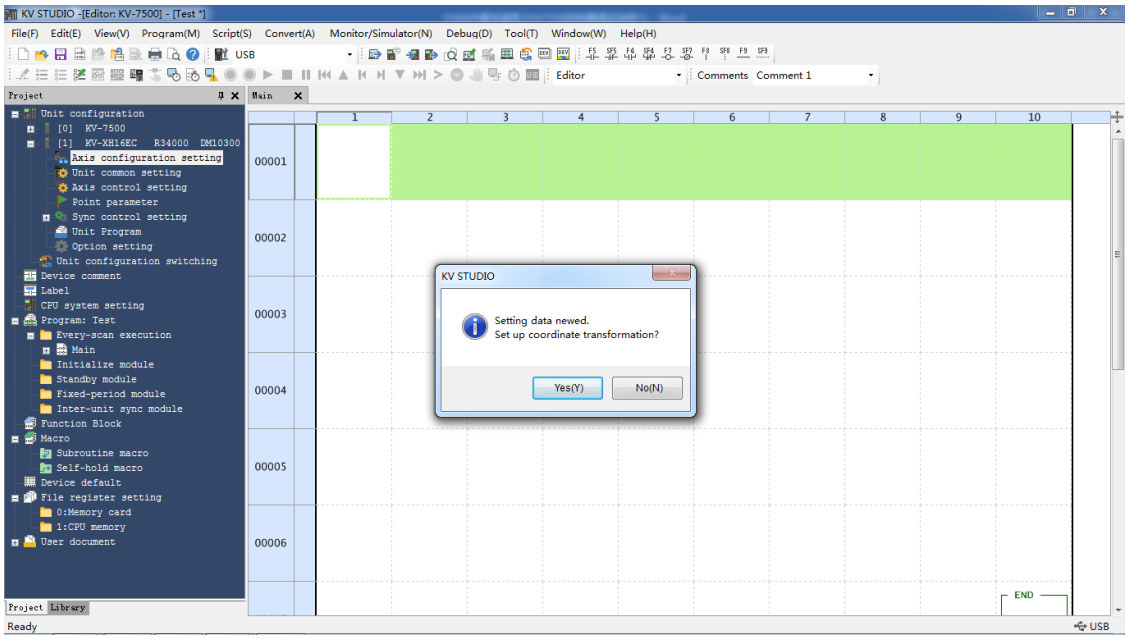
   During manual assignment, do not neglect any content in the PDO mapping. Otherwise, a pop-up window will be displayed to remind you of the missing content when you click **OK**. Retain the default values for **Communication command at initialization**, **DC setting**, and **Advanced settings**. After you complete the settings, click **OK**.



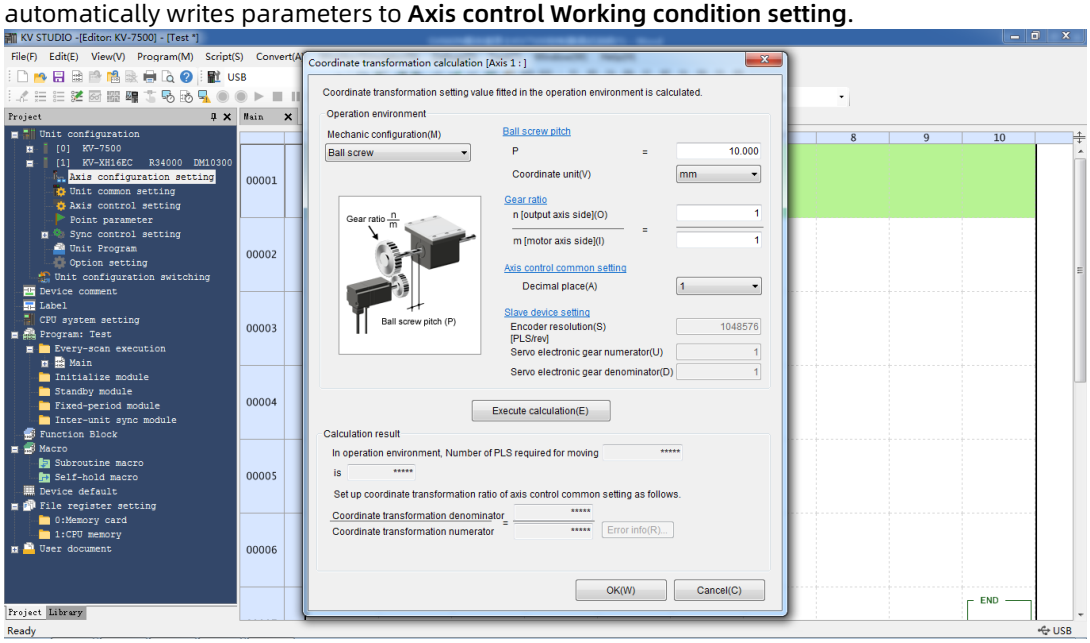
10. After you complete the Slave detailed setting, the exclamation symbol disappears.



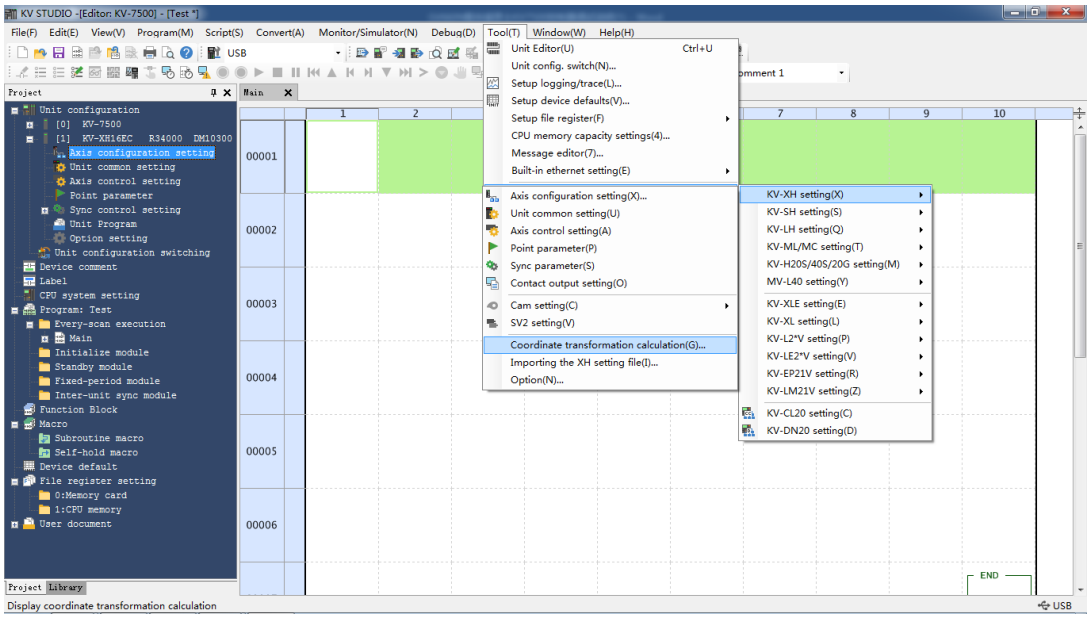
11. After you add the axes, click **OK**. Then, the following dialog box appears, prompting you whether to set up coordinate (namely electronic gear ratio) transformation.



- Click **Yes.** The coordinate transformation dialog box appears. Set the mechanical parameters and the coordinate unit based on actual conditions and click **Execute calculation**. The software automatically calculates the denominator and numerator for coordinate transformation and automatically writes parameters to **Axis control Working condition setting**.

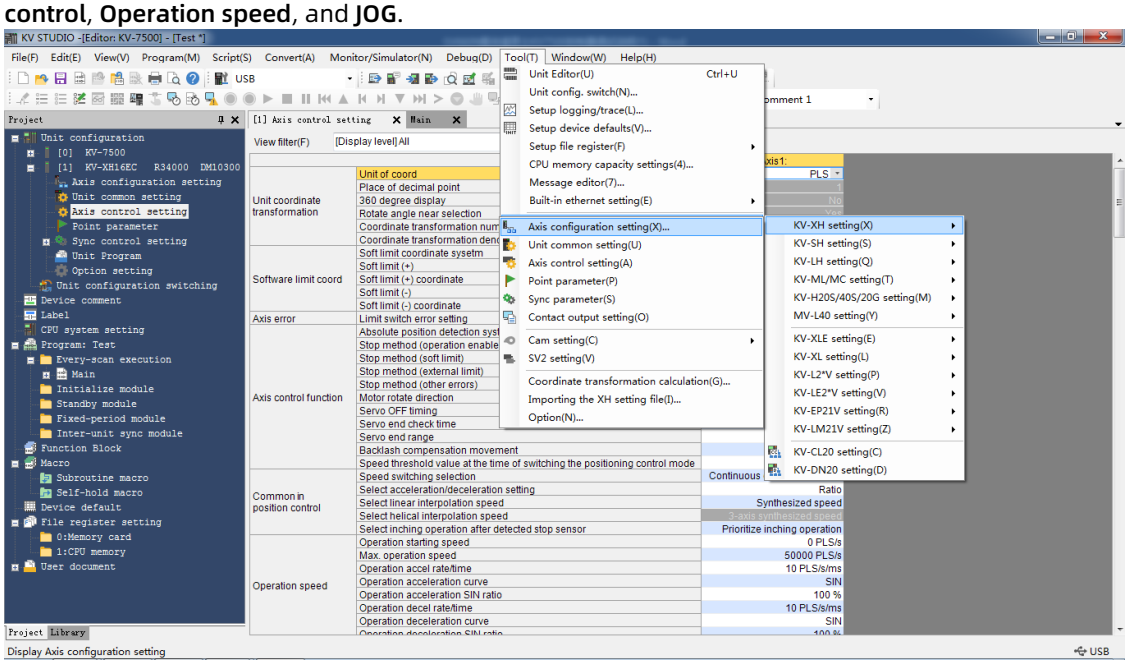


- If you click **No**, you can choose **Tool** > **Coordinate transformation calculation** > **KV-XH setting** > **Coordinate transformation calculation** to enable coordinate transformation later.



Axis control setting

1. To open axis control settings, choose **Tool** > **Axis configuration setting** > **KV-XH setting** > **Axis control setting** or click **Axis control setting** under **Project**.
2. In the axis control settings, you can configure parameters including **Unit coordinate transformation**, **Software limit coord**, **Axis error**, **Axis control function**, **Common in position control**, **Operation speed**, and **JOG**.



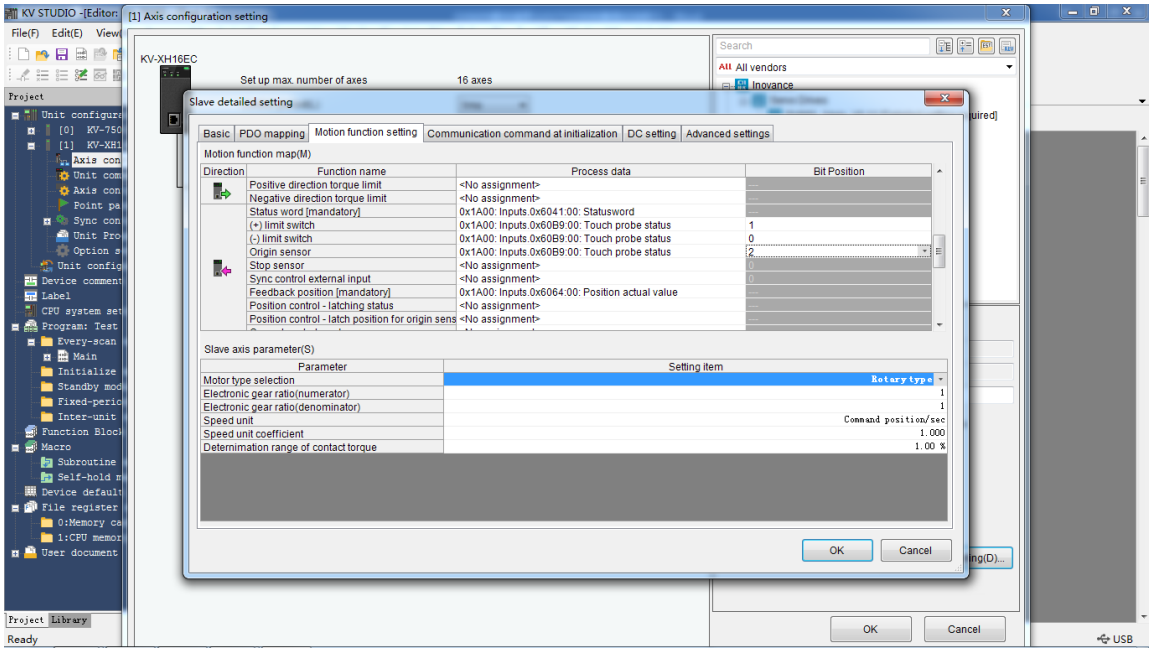
Running setting

Homing

Before performing homing, assign **(+) limit switch**, **(-) limit switch**, and **Origin sensor** in **Motion function setting** under **Axis configuration setting** to each bit of 60FDh. 60FDh is defined as follows:

bit0: negative limit; bit1: positive limit; bit2: home switch; bit16 to bit20 correspond to DI1 to DI5 respectively.

In automatic assignment, you need to manually assign **(+) limit switch**, **(-) limit switch**, and **Origin sensor**, you can assign them to corresponding bits of 60FDh based on the relation shown in the following figure or to bit16 to bit20. In this case, you also need to assign them to corresponding DIs of the servo drive.



Set the restriction parameters for homing in **Axis control setting** > **Origin return**. The following homing methods are available. For detailed trajectories, see KEYENCE instruction manual > positioning/motion control unit KV-XH16EC.

Default value	Value range	Description
DOG type (with phase Z)	DOG type (with phase Z)	Decelerating upon DOG signal input and homing through phase Z signal.
	DOG type (without phase Z)	Decelerating upon DOG signal input and homing through falling edge of DOG signal.
	DOG-type jogging (with phase Z)	Pause after moving based on Dog ON upon DOG signal input. Then, move to the homing direction through position-type speed control and homing with phase Z signal.
	DOG-type jogging (without phase Z)	Move based on Dog ON upon DOG signal input before homing.
	DOG type (contact)	Homing executed when the ON duration of the torque limit signal becomes longer than the compression torque time upon DOG signal input.
	Origin sensor and phase Z	Homing executed in the initial phase Z position after the origin sensor is ON.
	Rising edge of origin sensor	Homing executed through the rising edge of the origin sensor.
	Middle point of origin sensor (without phase Z)	Taking the middle point of the ON range of origin sensor as the origin and comparing it with that in "Rising edge of origin sensor". Even if the light-receptive performance of the origin sensor degrades, the homing position can hardly change with time.
	Rising edge of limit switch	Homing executed with the limit switch in the negative direction (direction in which the current coordinate decreases) acting as the origin sensor.
	Immediate homing of phase Z	Homing executed with phase Z signal
	Data setting type	Taking current coordinate as the origin coordinate.

The following homing methods are available in IS620N and SV670N-INT series servo drives.

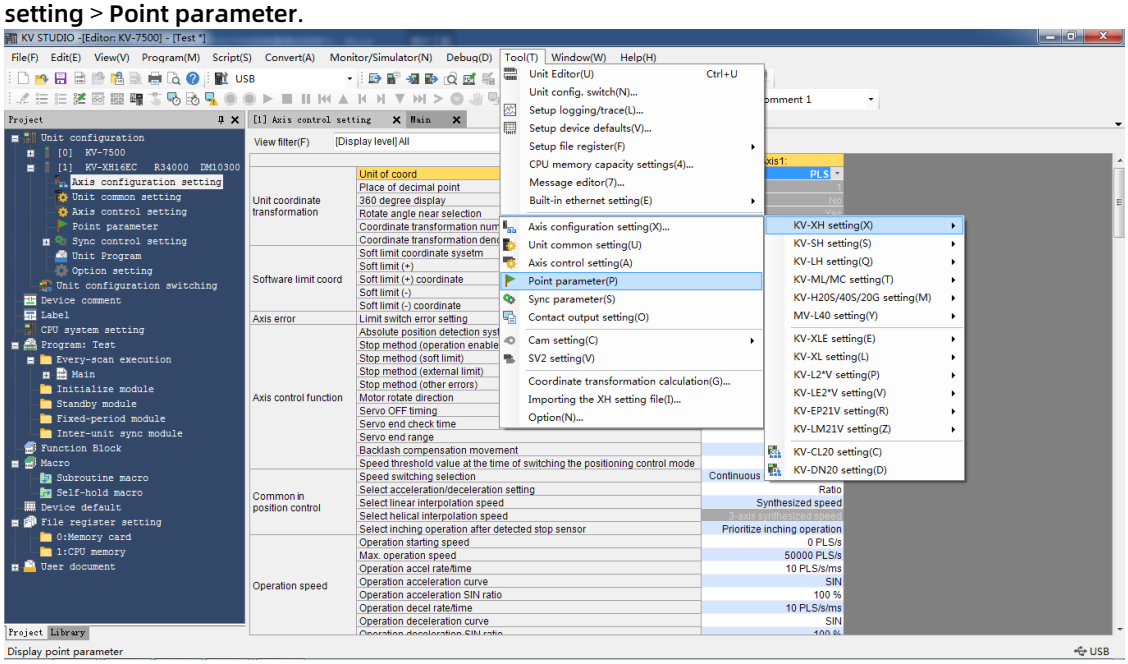
No.	Homing mode	SV670N-INT
1	DOG type (with phase Z)	OK
2	DOG type (without phase Z)	OK
3	DOG-type jogging (with phase Z)	NO
4	DOG-type jogging (without phase Z)	NO
5	DOG type (contact)	Homing is available, but the reference coordinate after homing is not 0. Updating to the xml coordinate of IS620N zeros out the reference coordinate.
6	Origin sensor and phase Z	OK
7	Rising edge of origin sensor	OK
8	Middle point of origin sensor	NO
9	Rising edge of limit switch	Homing is available, but the reference coordinate after homing is not 0.
10	Immediate homing of phase Z	OK

Positioning

Set the unit coordinate transformation properly before positioning. The unit coordinate transformation is "PLS" by default, which allows no modification on the numerator or denominator. If N revolutions are required by the servo drive, the number of commands that need to be sent by the host controller is N x Pulses per revolution. If coordinate transformation calculation has been

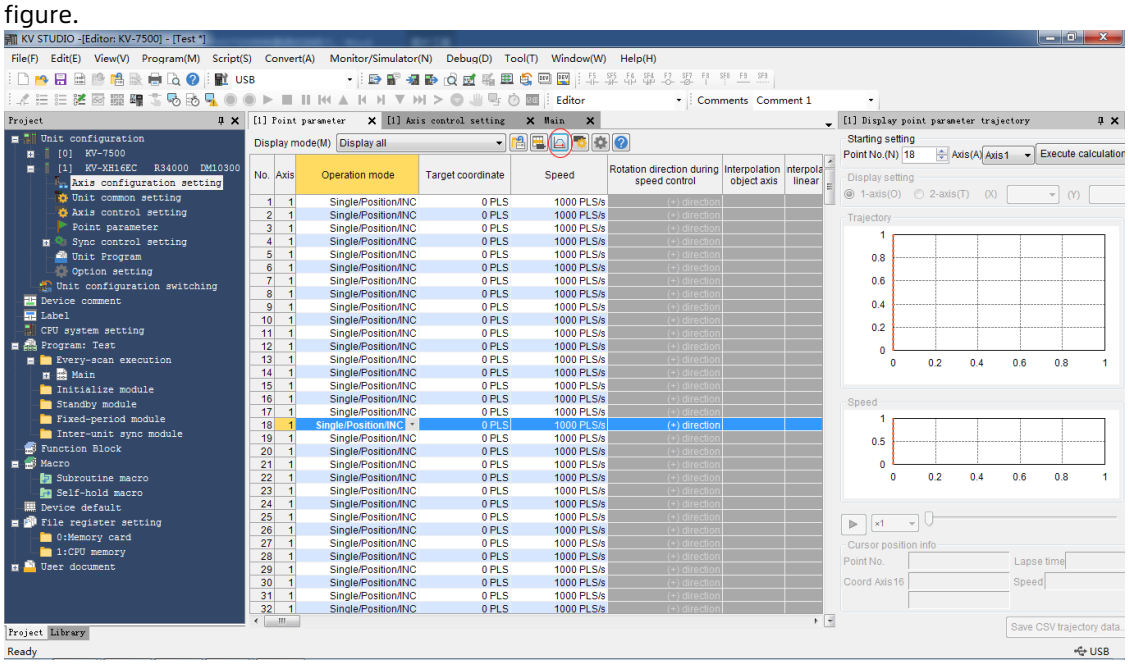
executed, the unit coordinate transformation parameters will correspond to the unit transformation results automatically.

1. To set the motion profile of the servo drive, choose **Tool** > **Axis configuration setting** > **KV-XH setting** > **Point parameter**.



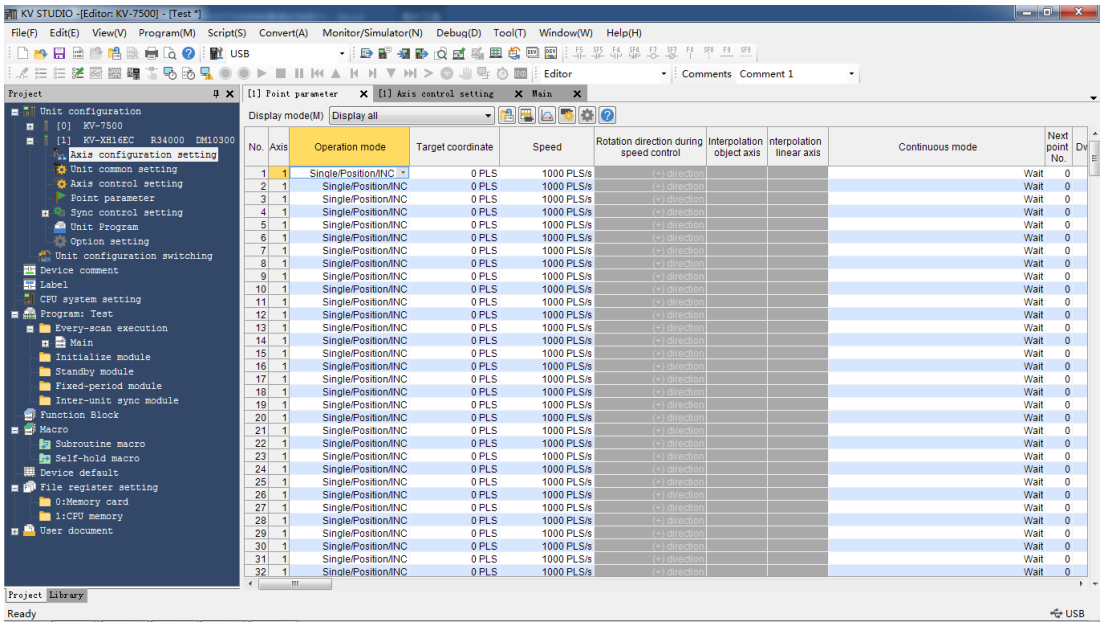
Set the target coordinate and speed per positioning segment as needed. After settings are completed, you can call the corresponding point number through the program to start operation.

2. You can preview the parameter trajectory by clicking the short-cut icon shown in the following figure.

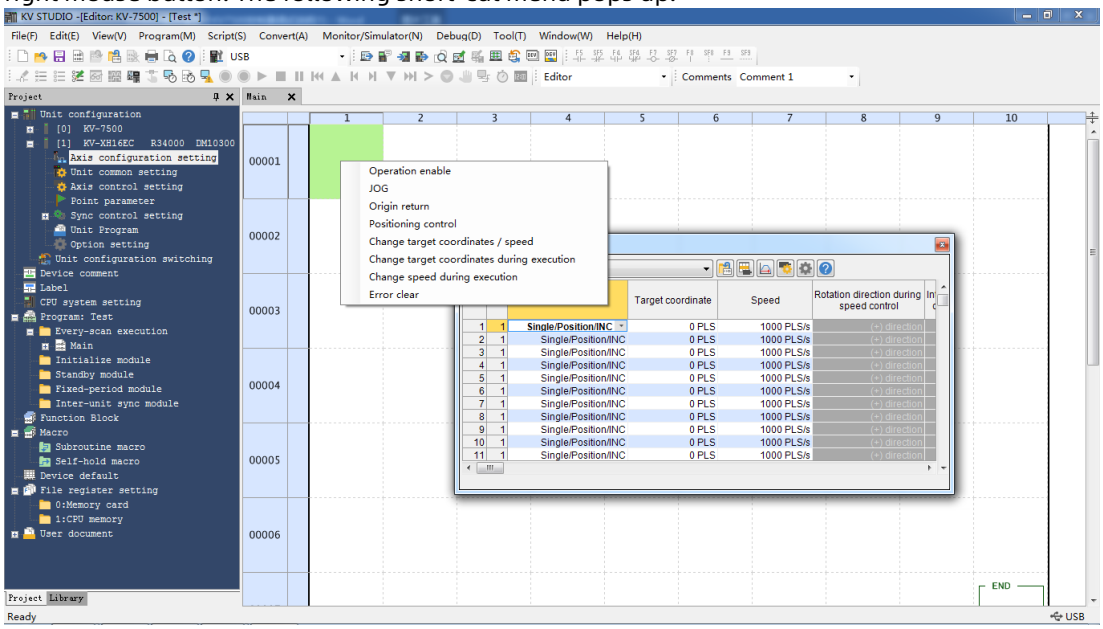


3. You can write ladder diagrams through regular methods. You can also use the following short-cut method provided by KEYENCE.

   a. Drag down the **Point parameter** window while pressing the left mouse button, and zoom out the window to place it in a proper area.

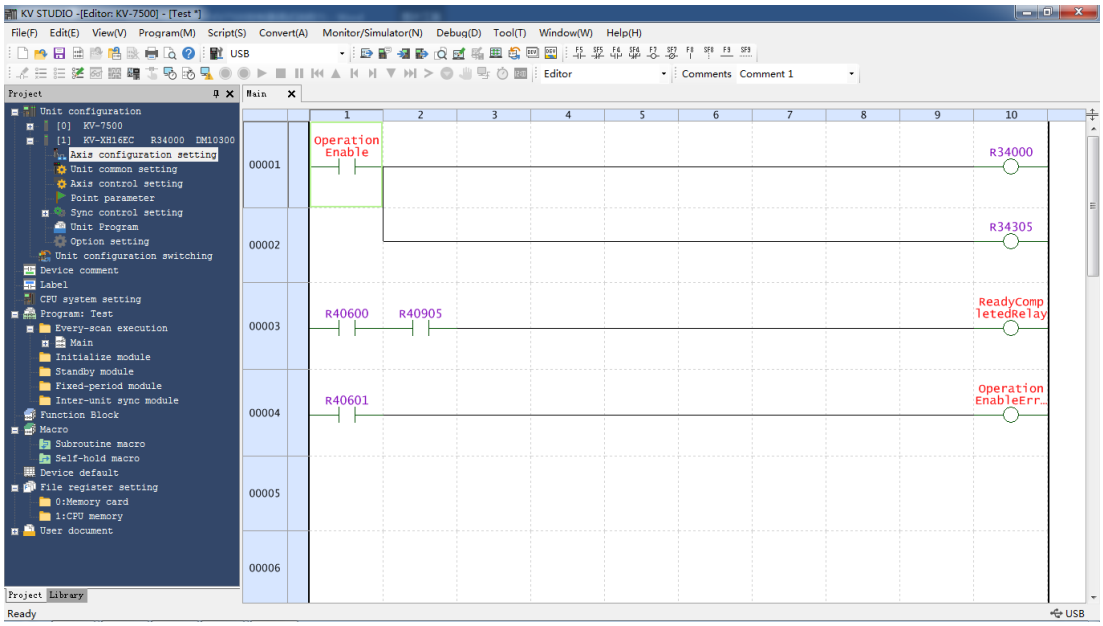


b. Move the mouse to the point parameter, such as **No.1-Axis1**, and wait until the mouse pointer changes from an arrow to a hand. Then, drag towards the program editor while pressing the right mouse button. The following short-cut menu pops up.



c. Select the desired function.

If the operation is enabled, click it to automatically generate a DEMO program. Then, designate the part in red as the required relay. After you complete these operations, this function is compiled.

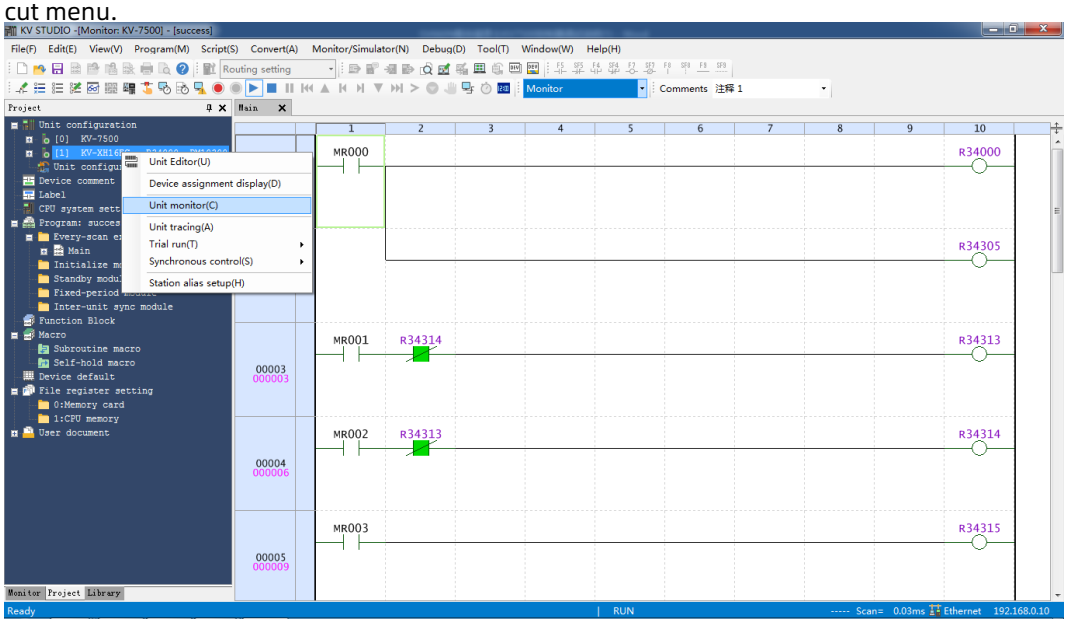


4. Configure the unit monitor.

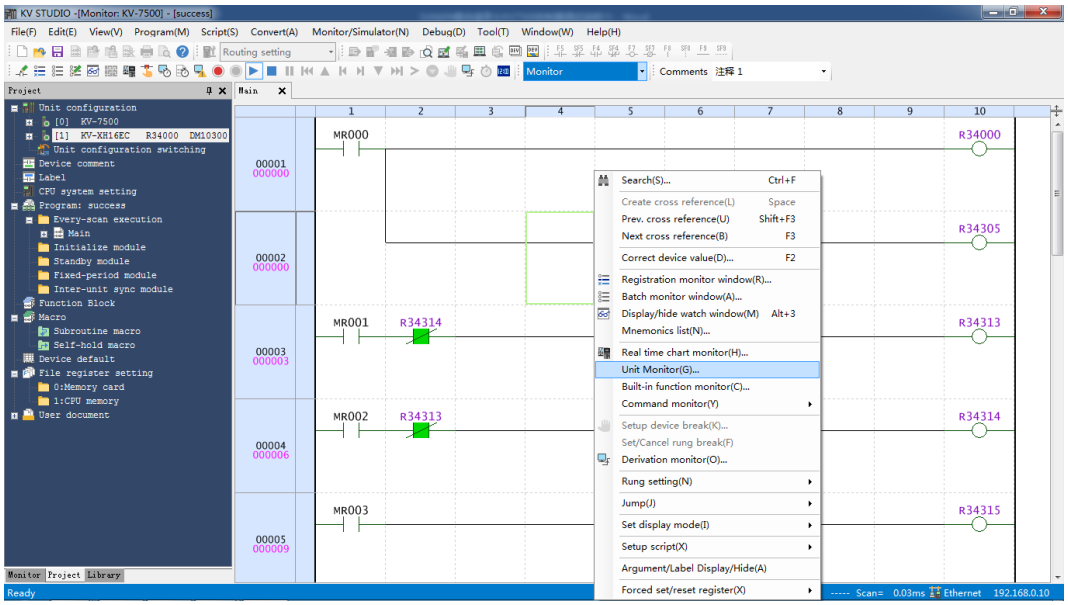
   The unit monitor supports monitoring on the operating state of KV-XH16EC or the internal data.

   a. You can open **Unit monitor** in the following three ways:

   - Click the unit to be monitored, right-click the unit, and then select **Unit monitor** in the short-cut menu.

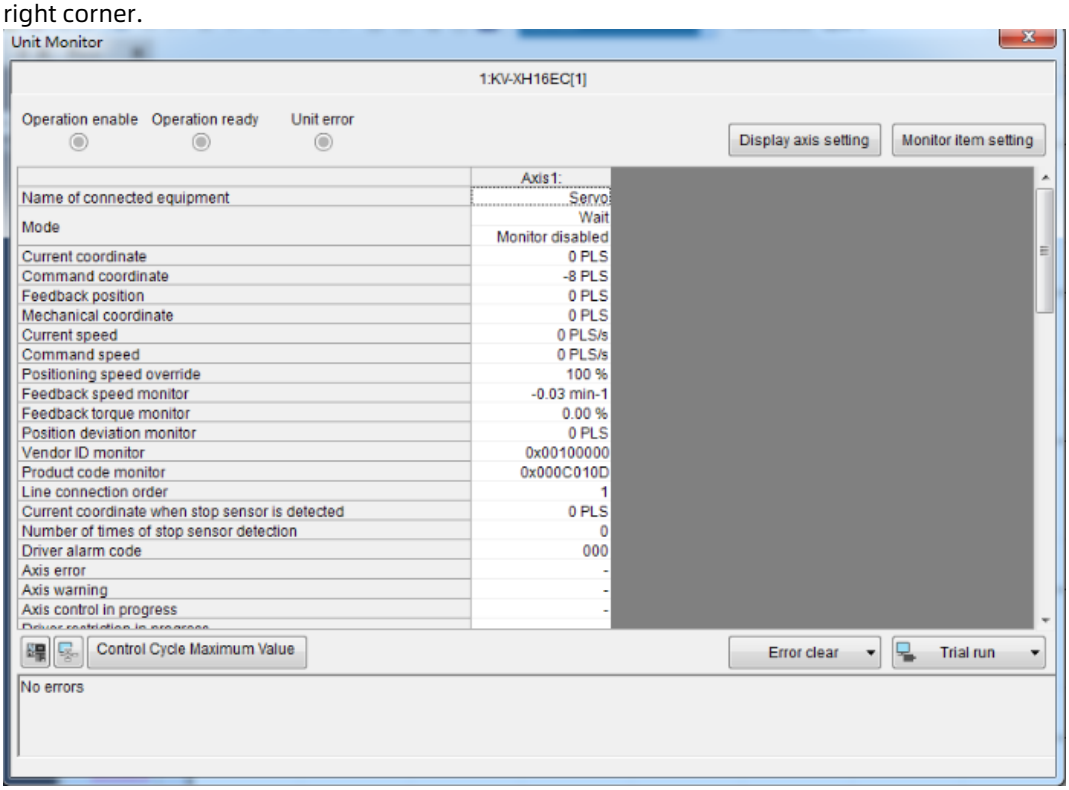


   - Double-click the unit to open the unit monitor.
   - Right-click in a blank section of the **main** program and select **Unit monitor** in the pop-up menu.

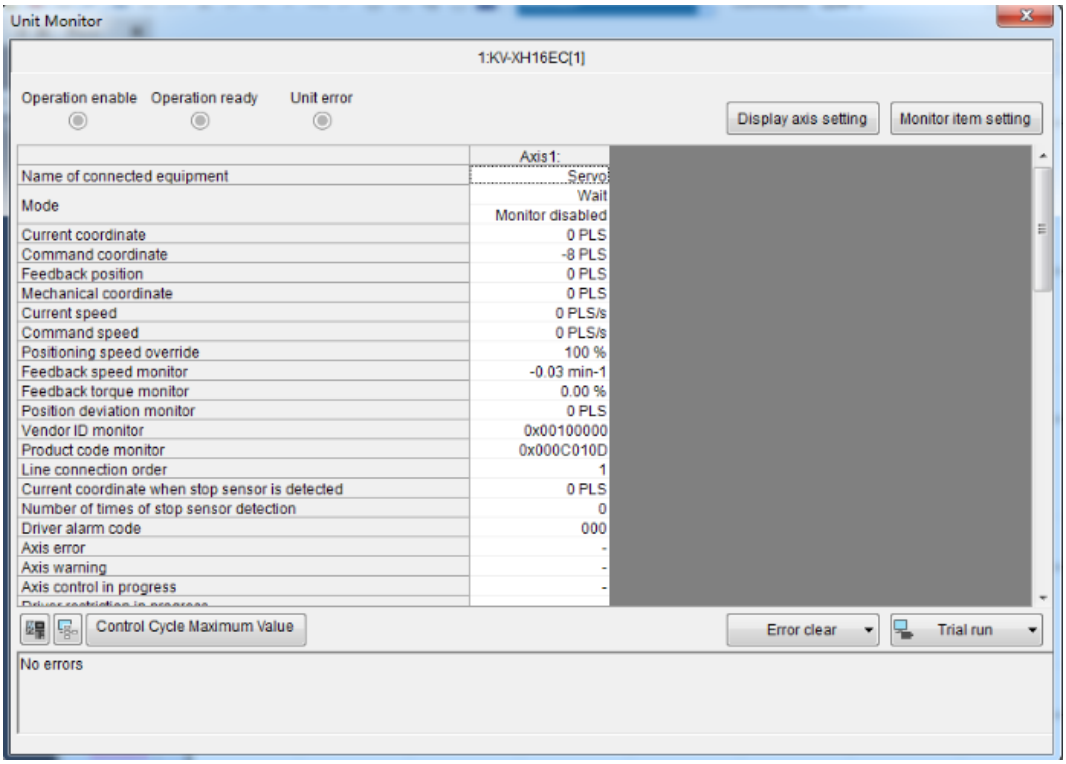


b. The unit monitor displays the operating state of each axis.

1). To change the operating state of the monitor item, click **Monitor item setting** in the upper-right corner.



2). To check whether I/O signals such as limit switch signals and origin sensor signals are normal, open the unit monitor and find the corresponding monitoring position.
If the corresponding message is received, a small black circle will be displayed.



The error state of the unit can also be displayed in the unit monitor. The axis error can be cleared using the Error clear button in the bottom right.

14.2.4.3 Trial Run

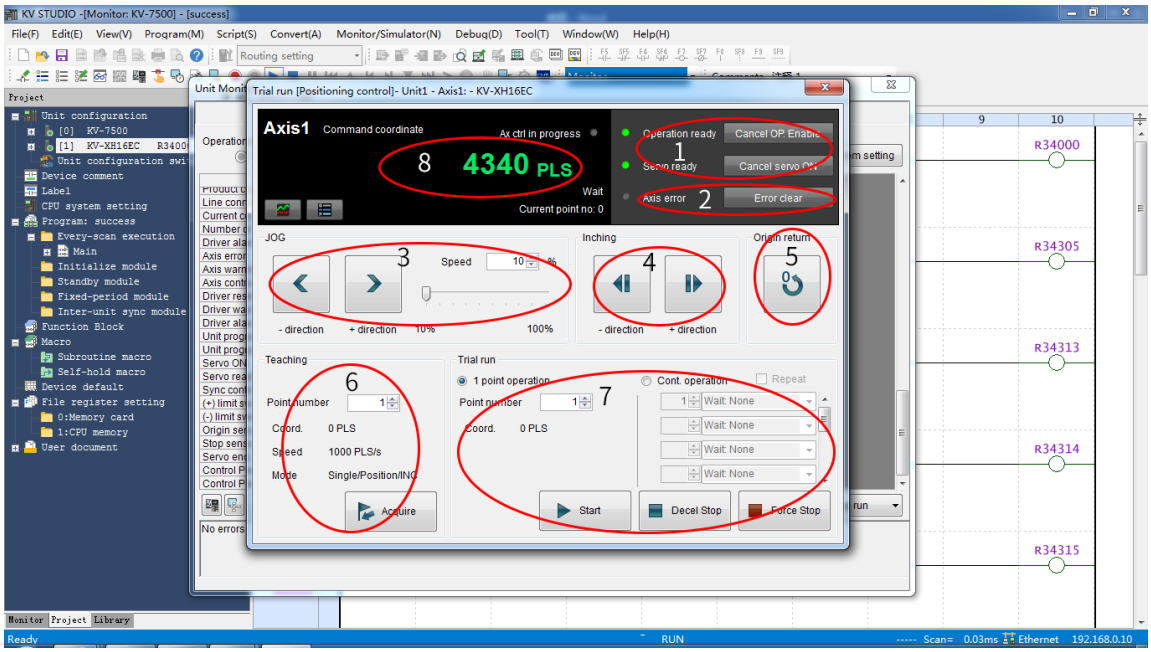
During a trial run, actions can be directly acknowledged, without the need to program ladder diagrams.

1. You can find the **Trial run** button at the bottom right of the unit monitor interface.
2. Select **Position mode** from the **Control mode selection** drop-down list.
3. Select the axis for the trial run.

Note

If a trial run is executed in speed control mode or torque control mode, an alarm will be reported. To execute a trial run, set the control mode to position control.

The following example shows how to perform a trial run in positioning control mode.



1. Set the equipment to **OP enable** and **Servo ON**.

   The status of the ladder diagram program is irrelevant. You can perform commissioning to set the equipment to **OP enable** and **Servo ON**. After you complete the preceding operations, the **Operation ready** and **Servo ready** indicators turn green. To ensure safety, set the CPU unit to the PROG mode and perform the operations again after stopping the ladder diagram program.

   Confirm the following items if the Servo ready indicator is not in green:

   - Whether an error occurs on the axis.
   - Whether an alarm is reported by the servo drive.
   - Whether the main circuit power supply of the servo drive is switched on.
   - Whether the Ethernet cable is connected.

2. Axis error: Click **Clear** to clear errors.

   Check the error details and clear the error. After troubleshooting errors, click **Clear** to clear the errors.

3. JOG: Configure jogging.

   Click the **FWD** and **REV** button to perform jogging in forward and reverse directions respectively. The jogging speed is the value in **General Axis Control Settings** → **JOG High Speed** multiplied by a ratio. You can set the ratio at a 1% increment between 10% and 100%.

4. Inching: Configure inching.

   Click the **FWD** and **REV** buttons to perform inching in forward and reverse directions respectively. The inching runs at the speed specified in **General Axis Control Settings** → **JOG Start Speed**. The equipment inches with the movement specified in **General Axis Control Settings** → **JOG Inch Movement**.

5. Configure homing.

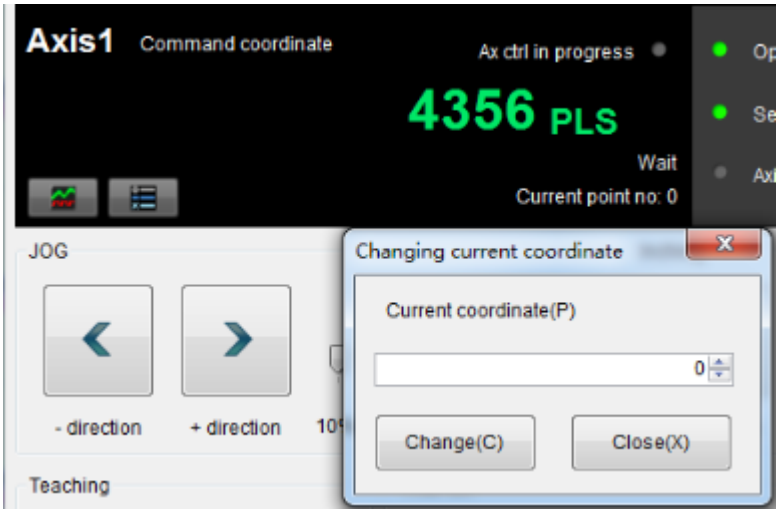
   Click **Origin return** to perform homing.

6. Configure teaching

Click **Acquire** to save the current command coordinate value to the buffer memory of the target coordinate of the designated point number. The teaching function is available only in online edit mode. The teaching value will also be updated to the buffer memory and the point parameter.

7. Perform a trial run.
   Specify a point number and click **Start** to perform point positioning. To stop the trial run, click **Decel Stop** or **Force Stop** to stop smoothly with the speed gradually reduced to zero or stop immediately with shock being incurred. Clicking **1 point operation** enables the servo drive to perform positioning of one point. Clicking **Cont. operation** enables the servo drive to perform positioning of ten points at most. Clicking **Repeat** enables the servo drive to return to the point in the first row and perform positioning repeatedly after positioning of the point in the last row is completed. The time interval between points can be set to a value within 0.1s to 20.0s.

8. Change the current coordinate.
   Click **Command coordinate** and the **Changing current coordinate** dialog box opens. Enter the coordinate that you want to change and click **Change** to change the current coordinate of the axis in trial run, and then close the **Changing current coordinate** dialog box. If you click **Close** after changing the current coordinate, the **Changing current coordinate** dialog box will be closed with the current coordinate unchanged.



15 Parameter Descriptions

15.1 H00 Servo Motor Parameters

H00.00 **Motor SN**

Hex:	2000-01h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	14101	Change mode	At stop

Range:

20000: Linear motor - Pulse-type encoder 14202: Linear motor - Inovance communication-type 23-bit encoder 20001: DDR motor - Pulse-type encoder 14201: DDR motor - Inovance communication-type 23-bit encoder 20002: Rotary motor - Pulse-type encoder 14000: Rotary motor - Inovance communication-type 20-bit encoder 14101: Rotary motor - Inovance communication-type 23-bit encoder 14020: Rotary motor - Harmonic 20-bit encoder - 2.5 M baud rate 14021: Rotary motor - Harmonic 17-bit encoder - 2.5 M baud rate 14022: Rotary motor - Harmonic 17-bit encoder - 4 M baud rate 14120: Rotary motor - Nikon 20-bit encoder - 2.5 M baud rate 14121: Rotary motor - Nikon 17-bit encoder - 2.5 M baud rate 14122: Rotary motor - Nikon 17-bit encoder - 4 M baud rate 14130: Rotary motor - TAMAGAWA 17-bit encoder 14131: Rotary motor - TAMAGAWA 23-bit encoder

Parameter descriptions:

20000: Linear motor - Pulse-type encoder 14202: Linear motor - Inovance communication-type 23-bit encoder 20001: DDR motor - Pulse-type encoder 14201: DDR motor - Inovance communication-type 23-bit encoder 20002: Rotary motor - Pulse-type encoder 14000: Rotary motor - Inovance communication-type 20-bit encoder 14101: Rotary motor - Inovance communication-type 23-bit encoder 14020: Rotary motor - Harmonic 20-bit encoder - 2.5 M baud rate 14021: Rotary motor - Harmonic 17-bit encoder - 2.5 M baud rate 14022: Rotary motor - Harmonic 17-bit encoder - 4 M baud rate 14120: Rotary motor - Nikon 20-bit encoder - 2.5 M baud rate 14121: Rotary motor - Nikon 17-bit encoder - 2.5 M baud rate 14122: Rotary motor - Nikon 17-bit encoder - 4 M baud rate 14130: Rotary motor - TAMAGAWA 17-bit encoder 14131: Rotary motor - TAMAGAWA 23-bit encoder

H00.02 **Customized No.**

Hex:	2000-03h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	42949672.95	Data type:	UInt32
Default value:	0.00	Change mode:	Read-only

Range:

0.00 to 42949672.95

Parameter descriptions:

Used to differentiate the customized MCU version, which is not applicable to standard models.

H00.04 **Encoder version**

Hex:	2000-05h	Effective mode:	-
Min. value:	0.0	Unit:	-

Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Saved in the encoder and used to differentiate the encoder software version.

H00.05 **Serial-type motor code**

Hex:	2000-06h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the code of the serial-type motor, which is determined by the motor model and unchangeable.

H00.06 **FPGA customized No.**

Hex:	2000-07h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Range:
0.00 to 655.35
Parameter descriptions:
Differentiates the customized FPGA software version, which is not applicable to standard models.

H00.07 **STO version**

Hex:	2000-08h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the software version of the STO function.

H00.08 **Serial encoder type**

Hex:	2000-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
14100: Multi-turn absolute encoder
Others: Single-turn absolute encoder

H00.40 **Motor control type**

Hex:	2000-29h	Effective mode:	None
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	2	Change mode:	Read-only

Value range:
0: General-purpose rotary motor (ROT)
1: Direct drive rotary motor (DDR)
2: Direct drive linear motor (DDL)
3: Voice coil motor (VOL)
Parameter description
Supported motor types:
0: General-purpose rotary motor (ROT)
1: Direct drive rotary motor (DDR)
2: Direct drive linear motor (DDL)
3: Voice coil motor (VOL)

H00.45 **Encoder pitch 1**

Hex:	2000-2Eh	Effective mode:	Upon the next power-on
Min. value:	0.00	Unit:	[Mm]/[deg]
Max. value:	655.35	Data type:	UInt16
Default value:	2.00	Change mode:	At stop

Range:
0.00 to 655.35
Parameter descriptions:
Defines the encoder pitch characteristics, which should be used together with encoder pitch fluctuation suppressor 1 (see details in H08.90).

H00.46 **Encoder pitch 2**

Hex:	2000-2Fh	Effective mode:	Upon the next power-on
Min. value:	0.00	Unit:	[Mm]/[deg]
Max. value:	655.35	Data type:	UInt16
Default value:	0.50	Change mode:	At stop

Range:
0.00 to 655.35
Parameter descriptions:
Defines the encoder pitch characteristics, which should be used together with encoder pitch fluctuation suppressor 2 (see details in H08.90).

H00.47 **Encoder type**

Hex:	2000-30h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Optical scale 1: Magnetic scale
Parameter descriptions:
Pulse encoder type:
0: Optical scale 1: Magnetic scale

H00.48 **Linear motor pole pitch (N-S)**

Hex:	2000-31h	Effective mode:	Upon the next power-on
Min. value:	0.01	Unit:	mm
Max. value:	655.35	Data type:	UInt16
Default value:	16.00	Change mode:	At stop

Range:
0.01 to 655.35
Parameter descriptions:
Defines the distance between N-S of the linear motor.

H00.49 **Direct drive encoder resolution**

Hex:	2000-32h	Effective mode:	Upon the next power-on
Min. value:	0.001	Unit:	um/p
Max. value:	65.535	Data type:	UInt16
Default value:	1.000	Change mode:	At stop

Range:
0.001 to 65.535
Parameter descriptions:
Defines the resolution of the linear motor read head.

H00.55 **Rated torque (Uint32)**

Hex:	2000-38h	Effective mode:	Upon the next power-on
Min. value:	0.00	Unit:	[N]/[N·m]
Max. value:	42949672.95	Data type:	UInt32
Default value:	2.00	Change mode:	At stop

Range:
0.00 to 42949672.95
Parameter descriptions:
Defines the rated motor torque.

H00.57 **Max. torque (Uint32)**

Hex:	2000-3Ah	Effective mode:	Upon the next power-on

Min. value:	0.00	Unit:	[N]/[N·m]
Max.value:	42949672.95	Data type:	UInt32
Default value:	7.00	Change mode:	At stop

Range:
0.00 to 42949672.95
Parameter descriptions:
Defines the max. motor torque.

H00.59 **Encoder counting direction**

Hex:	2000-3Ch	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max.value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Forward 1: Reverse
Parameter descriptions:
Motor phase sequence:
0: Forward 1: Reverse

15.2 H01 Drive Parameters

H01.00 **MCU version**

Hex:	2001-01h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the MCU software version.

H01.01 **FPGA software version**

Hex:	2001-02h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max.value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the FPGA software version.

H01.02 **Servo drive series No.**

Hex:	2001-03h	Effective mode:	-

Min. value:	0	Unit:	-
Max.value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the servo drive series No..

H01.06 **Board software version**

Hex:	2001-07h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the board card software version.

H01.10 **Drive series No.**

Hex:	2001-0Bh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max.value:	65535	Data type:	UInt16
Default value:	3	Change mode:	At stop

Range:
2: S1R6
3: S2R8
5: S5R5
6: S7R6
7: S012
8: S018
9: S022
10: S027
10001: T3R5
10002: T5R4
10003: T8R4
10004: T012
10005: T017
10006: T021
10007: T026
Parameter descriptions:

Displays the drive series No.
2: S1R6
3: S2R8
5: S5R5
6: S7R6
7: S012
8: S018
9: S022
10: S027
10001: T3R5
10002: T5R4
10003: T8R4
10004: T012
10005: T017
10006: T021
10007: T026

H01.11 **DC-AC voltage class**

Hex:	2001-0Ch	Effective mode:	-
Min. value:	0	Unit:	V
Max.value:	65535	Data type:	UInt16
Default value:	220	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the DC-AC voltage class.

H01.12 **Drive rated power**

Hex:	2001-0Dh	Effective mode:	-
Min. value:	0.00	Unit:	kW
Max.value:	42949672.95	Data type:	UInt32
Default value:	0.40	Change mode:	Read-only

Range:
0.00 to 42949672.95
Parameter descriptions:
Displays the rated power of the drive.

H01.14 **Max. output power of the drive**

Hex:	2001-0Fh	Effective mode:	-
Min. value:	0.00	Unit:	kW
Max.value:	42949672.95	Data type:	UInt32
Default value:	0.40	Change mode:	Read-only

Range:
0.00 to 42949672.95

Parameter descriptions:
Displays the maximum output power of the drive.

H01.16 **Rated output current of the drive**

Hex:	2001-11h	Effective mode:	-
Min. value:	0.00	Unit:	A
Max.value:	42949672.95	Data type:	UInt32
Default value:	2.80	Change mode:	Read-only

Range:
0.00 to 42949672.95
Parameter descriptions:
Displays the rated output current of the drive.

H01.18 **Max. output current of the drive**

Hex:	2001-13h	Effective mode:	-
Min. value:	0.00	Unit:	A
Max.value:	42949672.95	Data type:	UInt32
Default value:	10.10	Change mode:	Read-only

Range:
0.00 to 42949672.95
Parameter descriptions:
Displays the maximum output current of the drive.

H01.40 **DC bus overvoltage protection threshold**

Hex:	2001-29h	Effective mode:	Real time
Min. value:	0	Unit:	V
Max.value:	2000	Data type:	UInt16
Default value:	420	Change mode:	Real time

Range:
0 to 2000
Parameter descriptions:
Displays DC bus overvoltage protection threshold.

H01.75 **Current loop amplification factor**

Hex:	2001-4Ch	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Range:
0.00 to 655.35
Parameter descriptions:
Displays the current loop amplification factor.

H01.88 **Junction temperature parameter version 1**

Hex:	2001-59h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max.value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the version 1 of the junction temperature parameter.

H01.89 **Junction temperature parameter version 2**

Hex:	2001-5Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max.value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the version 2 of the junction temperature parameter.

H01.90 **Motor attribute mask code**

Hex:	2001-5Bh	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Parameter description
The setpoint 1 indicates that the bit function of H00.60 is being masked.

15.3 H02 Basic Control Parameters

H02.00 **Control mode**

Hex:	2002-01h	Effective mode:	Real time
Min.value:	0	Unit:	-
Max.value:	9	Data type:	UInt16
Default value:	9	Change mode:	At stop

Range:
0: Velocity mode
1: Position mode
2: Torque mode
9: EtherCAT mode

Parameter descriptions:

0: Velocity mode

1: Position mode

2: Torque mode

9: EtherCAT mode

H02.01 **Absolute system selection**

Hex:	2002-02h	Effective mode:	Upon the next power-on
Min.value:	0	Unit:	-
Max.value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Incremental mode

1: Absolute position linear mode

2: Absolute position rotation mode

3: Absolute position linear mode (without encoder overflow warning)

4: Absolute position single-turn mode

Parameter descriptions:

Absolute System

0: Incremental mode

1: Absolute position linear mode

2: Absolute position rotation mode

3: Absolute position linear mode (without encoder overflow warning)

4: Absolute position single-turn mode

H02.02 **Rotation direction selection**

Hex:	2002-03h	Effective mode:	Upon the next power-on
Min.value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Counterclockwise (CCW) as forward direction

1: Clockwise (CW) as forward direction

Parameter descriptions:

Defines the forward direction of the motor when viewed from the motor shaft side.

0: Counterclockwise (CCW) as forward direction

1: Clockwise (CW) as forward direction

H02.03 **Output pulse phase**

Hex:	2002-04h	Effective mode:	Upon the next power-on
Min.value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Phase A leads phase B

1: Phase A lags behind phase B

Parameter descriptions:

Defines the relation between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.

0: Phase A leads phase B

1: Phase A lags behind phase B

H02.05 **Stop mode at S-ON OFF**

Hex:	2002-06h	Effective mode:	At stop
Min. value:	-4	Unit:	-
Max. value:	2	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state

-3: Stop at zero speed, keeping dynamic braking state

-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Dynamic braking stop, keeping de-energized state

Parameter descriptions:

Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state

-3: Stop at zero speed, keeping dynamic braking state

-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Dynamic braking stop, keeping de-energized state Note: After the brake is enabled, H02.05 will be forcibly set to -4 (Ramp to stop as defined by 6085h, keeping dynamic braking state).

H02.06 **Stop mode at No.2 fault**

Hex:	2002-07h	Effective mode:	At stop
Min. value:	-5	Unit:	-
Max. value:	4	Data type:	Int16
Default value:	2	Change mode:	Real time

Range:

-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Ramp to stop as defined by 6085h, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
4: Dynamic braking stop, keeping de-energized state

Parameter descriptions:

Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 2 fault occurs.

-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Ramp to stop as defined by 6085h, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency-stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state Note: After the brake is enabled, H02.06 will be forcibly set to -3 (Stop at emergency-stop torque as defined by 6085h, keeping de-energized state).

H02.07 **Stop mode at overtravel**

Hex:	2002-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

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
3: Ramp to stop as defined by 6085h, keeping de-energized state
4: Ramp to stop as defined by 6085h, keeping position lock state
5: Dynamic braking stop, keeping de-energized state
6: Dynamic braking stop, keeping dynamic braking state
7: Not responding to overtravel

Parameter descriptions:

Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when overtravel occurs.

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 3: Stop based on the ramp defined by 6085h, keeping de-energized state 4: Stop based on the ramp defined by 6085h keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel Note: Set H02.07 to 7 (Not responding to overtravel). After hitting the limit signal, some PLC can stop sending position references even if the drive does not respond, so the drive may stop.
Note: After the brake function is enabled, H02.07 will be forcibly set to 4 (Ramp to stop as defined by 6085h, keeping position lock state).

H02.08 **Stop mode at No.1 fault**

Hex:	2002-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	2	Change mode:	At stop

Range:
0: Coast to stop, keeping de-energized state
1: Dynamic braking stop, keeping de-energized state
2: Dynamic braking stop, keeping dynamic braking state
Parameter descriptions:
Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No.1 fault occurs.
0: Coast to stop, keeping de-energized state 1: Dynamic braking stop, keeping de-energized state 2: Dynamic braking stop, keeping dynamic braking state Note: After the brake is enabled, H02.08 will be forcibly set to 2 (Dynamic braking stop, keeping dynamic braking state).

H02.09 **Delay from brake output ON to command received**

Hex:	2002-0Ah	Effective mode:	At stop
Min. value:	0	Unit:	ms
Max. value:	500	Data type:	UInt16
Default value:	250	Change mode:	Real time

Range:
0 to 500
Parameter descriptions:
Defines the delay from the moment the brake output signal is ON to the moment the servo drive starts to receive commands after power-on.

H02.10 **Delay from brake output OFF to motor de-energized**

Hex:	2002-0Bh	Effective mode:	Real time
Min. value:	50	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	150	Change mode:	Real time

Range:
50 to 1000

Parameter descriptions:

Defines the delay from the moment brake output is OFF to the moment when the motor at standstill enters the de-energized status.

H02.11 Motor speed threshold at brake output OFF in rotation state

Hex:	2002-0Ch	Effective mode:	Real time
Min. value:	20	Unit:	rpm
Max. value:	3000	Data type:	UInt16
Default value:	30	Change mode:	Real time

Range:

20 to 3000

Parameter descriptions:

Defines the motor speed threshold when brake (BK) output is OFF in the rotating state.

H02.12 Delay from S-ON OFF to brake output OFF in rotation state

Hex:	2002-0Dh	Effective mode:	Real time
Min. value:	1	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Range:

1 to 65535

Parameter descriptions:

Sets the delay time from BK OFF to S-ON OFF when the motor is in rotating state.

H02.15 LED alarm display

Hex:	2002-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output alarm information immediately

1: Not output alarm information

Parameter descriptions:

Defines whether to switch the keypad to the fault display mode when a No. 3 fault occurs.

0: Output alarm information immediately

1: Not output alarm information

H02.17 Stop mode upon main circuit power failure

Hex:	2002-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:

0: Keep current action

1: Stop upon fault as defined by H02.06

2: Stop at S-ON OFF as defined by H02.05

3: Stop quickly as defined by H02.18

Parameter descriptions:

Defines the stop mode of the motor for stopping rotating upon main circuit power failure.

0: Keep current action

1: Stop upon fault as defined by H02.06

2: Stop at S-ON OFF as defined by H02.05

3: Stop quickly as defined by H02.18

H02.18 **Quick stop mode**

Hex:	2002-13h	Effective mode:	At stop
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Ramp to stop as defined by 6085h, keeping de-energized state

3: Stop at emergency stop torque, keeping de-energized state

5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state

6: Ramp to stop as defined by 6085h, keeping position lock state

7: Stop at emergency stop torque, keeping position lock state

Parameter descriptions:

Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor status after stop.

0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state 6: Ramp to stop as defined by 6085h, keeping position lock state 7: Stop at emergency stop torque, keeping position lock state Note: If the setpoint of H02.18 is lower than 4 after the braking is enabled, 605Ah will be forcibly set to 2 (Ramp to stop as defined by 6085h, keeping de-energized state).

H02.21 **Permissible minimum resistance of braking resistor**

Hex:	2002-16h	Effective mode:	-
Min. value:	1	Unit:	Ω
Max. value:	1000	Data type:	UInt16
Default value:	40	Change mode:	Read-only

Range:

1 to 1000

Parameter descriptions:

The permissible minimum resistance of the regenerative resistor is only related to the servo drive model.

H02.22 **Power of built-in braking resistor**

Hex:	2002-17h	Effective mode:	-
Min. value:	0	Unit:	W
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The power of the built-in regenerative resistor is only related to the servo drive model, which is unmodifiable.

H02.23 **Resistance of built-in braking resistor**

Hex:	2002-18h	Effective mode:	-
Min. value:	0	Unit:	Ω
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The resistance of the built-in regenerative resistor is only related to the servo drive model, which is unmodifiable.

H02.24 **Resistor heat dissipation coefficient**

Hex:	2002-19h	Effective mode:	Real time
Min. value:	10	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	30	Change mode:	Real time

Range:
10 to 100
Parameter descriptions:
Defines the heat dissipation coefficient of the regenerative resistor, which is applicable to both external and built-in regenerative resistors.
Set this parameter properly according to actual heat dissipation conditions of the resistor.
Recommendations:
Generally, the value of H02.24 cannot exceed 30% for natural cooling.
The value of H02.24 cannot exceed 50% for forced air cooling.

H02.25 **Braking resistor type**

Hex:	2002-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	3	Change mode:	Real time

Range:

0: Built-in

1: External, natural cooling

2: External, forced air cooling

3: No resistor needed

Parameter descriptions:

Defines the resistor type and the mode of absorbing and releasing the braking energy.

0: Built-in

1: External, natural cooling

2: External, forced air cooling

3: No resistor needed

H02.26 **Power of external regenerative resistor**

Hex:	2002-1Bh	Effective mode:	Real time
Min. value:	1	Unit:	W
Max. value:	65535	Data type:	UInt16
Default value:	40	Change mode:	Real time

Range:

1 to 65535

Parameter descriptions:

Defines the power of external regenerative resistor.

H02.27 **Resistance of external regenerative resistor**

Hex:	2002-1Ch	Effective mode:	Real time
Min. value:	15	Unit:	Ω
Max. value:	1000	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:

15 to 1000

Parameter descriptions:

Defines the resistance of the external braking resistor.

H02.28 **Parameter initialization**

Hex:	2002-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Parameters in group H02 and above initialized 1: Parameters in group H00, H02 and above initialized 2: All parameters initialized (default values used for model-related parameters)

Parameter descriptions:

Defines the option for restoring default settings.

0: Parameters in group H02 and above initialized 1: Parameters in group H00, H02 and above initialized 2: All parameters initialized (default values used for model-related parameters)

H02.30 **User password**

Hex:	2002-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Sets the user password.

H02.31 **System parameter initialization**

Hex:	2002-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: No operation
1: Restore the default settings
2: Clear fault records
Parameter descriptions:
Restores default values or clears fault records.
0: No operation
1: Restore the default settings
2: Clear fault records

H02.32 **Selection of parameters in group H0b**

Hex:	2002-21h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
0 to 99
Parameter descriptions:
Sets the offset of the parameter to be displayed on the operating panel.
For example, the setpoint 0 indicates the value of H0b.00 (Motor speed actual value) is displayed on the keypad.
The setpoint 1 indicates the value of H0b.01 is displayed on the operating panel.

H02.35 **Keypad data update frequency**

Hex:	2002-24h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 20

Parameter descriptions:

Defines the keypad data refresh frequency.

H02.38 **Overload time of external resistor**

Hex:	2002-27h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	s
Max. value:	200	Data type:	UInt16
Default value:	40	Change mode:	Real time

Range:

0 to 200

Parameter descriptions:

Set the overload time threshold of the external braking resistor.

H02.41 **Manufacturer password**

Hex:	2002-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Enter the manufacturer password to enable the factory protection parameters.

H02.47 **Delay time from power cable breakage to brake OFF**

Hex:	2002-30h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 1000

Parameter descriptions:

Sets the delay time from power cable breakage to brake OFF.

15.4 H03 Terminal Input Parameters

H03.02 **DI1 function selection**

Hex:	2003-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	14	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 38: Touch probe 1 39: Touch probe 2 40: Multi-speed enable

Parameter descriptions:

Defines the function of DI1.

H03.03 **DI1 logic selection**

Hex:	2003-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter descriptions:

Defines the level logic of DI1 when the function assigned to DI1 is active.

H03.04 **DI2 function selection**

Hex:	2003-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	15	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 38: Touch probe 1 39: Touch probe 2 40: Multi-speed enable

Parameter descriptions:

Defines the function of DI2.

H03.05 **DI2 logic selection**

Hex:	2003-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter descriptions:
Defines the level logic of DI2 when the function assigned to DI2 is active.

H03.06 **DI3 function selection**

Hex:	2003-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	31	Change mode:	Real time

Range:
0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 38: Touch probe 1 39: Touch probe 2 40: Multi-speed enable
Parameter descriptions:
Defines the function of DI3.

H03.07 **DI3 logic selection**

Hex:	2003-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Normally open
1: Closed
Parameter descriptions:
Defines the level logic of DI3 when the function assigned to DI3 is active.

H03.08 **DI4 function selection**

Hex:	2003-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	34	Change mode:	Real time

Range:
0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 38: Touch probe 1 39: Touch probe 2 40: Multi-speed enable
Parameter descriptions:
Defines the function of DI4.

H03.09 **DI4 logic selection**

Hex:	2003-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter descriptions:

Defines the level logic of DI4 when the function assigned to DI4 is active.

H03.10 **DI5 function selection**

Hex:	2003-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	40	Data type:	UInt16
Default value:	38	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 38: Touch probe 1 39: Touch probe 2 40: Multi-speed enable

Parameter descriptions:

Defines the function of DI5.

H03.11 **DI5 logic selection**

Hex:	2003-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter descriptions:

Defines the level logic of DI5 when the function assigned to DI5 is active.

H03.50 **Voltage-type AI1 offset**

Hex:	2003-33h	Effective mode:	Real time
Min. value:	-5000	Unit:	mV
Max.value:	5000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:
-5000 to 5000
Parameter descriptions:
Defines the actual AI1 input voltage when the drive sampling voltage is 0 after zero drift correction.

H03.51 **Voltage-type AI1 input filter time constant**

Hex:	2003-34h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max.value:	655.35	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:
0.00 to 655.35
Parameter descriptions:
Defines the filter time constant of voltage signal input from AI1.
Set this parameter properly to avoid motor reference fluctuation caused by unstable analog voltage input and reduce motor misoperation caused by interference signals.
The filter function cannot eliminate or suppress zero drift or dead zone.

H03.53 **Voltage-type AI1 dead zone**

Hex:	2003-36h	Effective mode:	Real time
Min. value:	0.0	Unit:	mV
Max.value:	1000.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:
0.0 to 1000.0
Parameter descriptions:
Defines the AI1 input voltage range when the drive sampling voltage is 0.

H03.54 **Voltage-type AI1 zero drift**

Hex:	2003-37h	Effective mode:	Real time
Min. value:	-500.0	Unit:	mV
Max.value:	500.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-500.0 to 500.0
Parameter descriptions:
Zero drift refers to the value of the drive sampling voltage relative to GND upon zero AI voltage.
Set H0d.10 (Automatic adjustment of analog channels) to 1 to perform automatic adjustment on AI2 zero drift. The AI2 zero drift after adjustment will be saved into H03.54.

H03.55 **Voltage-type AI2 offset**

Hex:	2003-38h	Effective mode:	Real time
Min. value:	-5000	Unit:	mV
Max.value:	5000	Data type:	Int16

Default value:	0	Change mode:	Real time

Range:
-5000 to 5000
Parameter descriptions:
Defines the actual AI2 input voltage when the drive sampling voltage is 0 after zero drift correction.

H03.56 **Voltage-type AI2 input filter time constant**

Hex:	2003-39h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max.value:	655.35	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:
0.00 to 655.35
Parameter descriptions:
Defines the filter time constant of voltage signal input from AI2.
Set this parameter properly to avoid motor reference fluctuation caused by unstable analog voltage input and reduce motor misoperation caused by interference signals.
The filter function cannot eliminate or suppress zero drift or dead zone.

H03.58 **Voltage-type AI2 dead zone**

Hex:	2003-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	mV
Max.value:	1000.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:
0.0 to 1000.0
Parameter descriptions:
Defines the AI2 input voltage range when the drive sampling voltage is 0.

H03.59 **Voltage-type AI2 zero drift**

Hex:	2003-3Ch	Effective mode:	Real time
Min. value:	-500.0	Unit:	mV
Max.value:	500.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-500.0 to 500.0
Parameter descriptions:
Zero drift refers to the value of the drive sampling voltage relative to GND upon zero AI voltage.
Set H0d.10 (Automatic adjustment of analog channels) to 2 to perform automatic adjustment on AI2 zero drift. The AI2 zero drift after adjustment will be saved into H03.54.

H03.60 **DI1 filter time**

Hex:	2003-3Dh	Effective mode:	Real time

Min. value:	0.00	Unit:	ms
Max.value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 to 500.00
Parameter descriptions:
Defines the filter time of DI1. The DI function is active only after the effective level is kept within the time defined by H03.60.

H03.61 **DI2 fitter time**

Hex:	2003-3Eh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max.value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 to 500.00
Parameter descriptions:
Defines the filter time of DI2. The DI function is active only after the effective level is kept within the time defined by H03.61.

H03.62 **DI3 fitter time**

Hex:	2003-3Fh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max.value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 to 500.00
Parameter descriptions:
Defines the filter time of DI3. The DI function is active only after the effective level is kept within the time defined by H03.62.

H03.63 **DI4 fitter time**

Hex:	2003-40h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max.value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 to 500.00
Parameter descriptions:
Defines the filter time of DI4. The DI function is active only after the effective level is kept within the time defined by H03.63.

H03.64 **DI5 fitter time**

Hex:	2003-41h	Effective mode:	Real time

Min. value:	0.00	Unit:	ms
Max.value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 to 500.00
Parameter descriptions:
Defines the filter time of DI5. The DI function is active only after the effective level is kept within the time defined by H03.64.

H03.80 **Speed corresponding to analog 10 V**

Hex:	2003-51h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	At stop

Range:
0 to 10000
Parameter descriptions:
Defines the corresponding motor speed when the sampling voltage is 10 V.
Speed reference value = Sampling voltage/10 x H03.80

H03.81 **Torque corresponding to analog 10 V**

Hex:	2003-52h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	8.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:
0.00 to 8.00
Parameter descriptions:
Defines the motor torque corresponding to a sampling voltage of 10 V.
Torque reference value = Sampling voltage ÷ 10 × H03.81

15.5 H04 Terminal Output Parameters

H04.00 **DO1 function selection**

Hex:	2004-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	32	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 25: Comparison output DO 26: Closed-loop state 31: Communication-forced DO 32: EDM output

Parameter descriptions:
Defines the function of DO1.

H04.01 **DO1 logic selection**

Hex:	2004-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Normally open
1: Closed
Parameter descriptions:
Defines the level logic of DO1 when the function assigned to DO1 is active.

H04.02 **DO2 function selection**

Hex:	2004-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	32	Data type:	UInt16
Default value:	9	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 25: Comparison output DO 26: Closed-loop state 31: Communication-forced DO 32: EDM output
Parameter descriptions:
Defines the function of DO2.

H04.03 **DO2 logic selection**

Hex:	2004-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Normally open
1: Closed
Parameter descriptions:
Defines the level logic of DO2 when the function assigned to DO2 is active.

H04.22 **DO source selection**

Hex:	2004-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

Bit	Name	Function
0	DO1 output source	0: DO1 function output
		1: Bit 0 of H31.04 set through communication
1	DO2 output source	0: DO1 function output
		1: Bit 1 of H31.04 set through communication

Parameter descriptions:

Defines whether the logic of a physical DO terminal is defined by the actual state of the drive or by communication.

H04.23 EtherCAT communication-forced DO logic in non-OP status

Hex:	2004-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

Bit	Name	Function
0	DO1	0: Status unchanged
		1: No output
1	DO2	0: Status unchanged
		1: No output

Parameter descriptions:

Sets DO state upon ECAT communication failure.

H04.50 AO1 signal selection

Hex:	2004-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Motor speed (1 V/1000 rpm)

1: Speed reference (1 V/1000 rpm)

2: Torque reference (1 V/100% × rated torque)

3: Position deviation (0.5 mV/1 reference unit)

4: Position deviation (0.5 mV/1 encoder unit)

5: Position reference speed (1 V/1000 rpm)

6: Positioning completed

8: AI1 voltage

9: AI2 voltage

10: Defined by H31.05

Parameter description

Defines the physical value source of AO1.

H04.51 **AO1 offset voltage**

Hex:	2004-34h	Effective mode:	Real time
Min. value:	-10000	Unit:	mV
Max.value:	10000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:
-10000 to 10000
Parameter descriptions:
Defines the actual AO1 output voltage after offset when the output voltage is 0 V in theory.

H04.52 **AO1 ratio**

Hex:	2004-35h	Effective mode:	Real time
Min. value:	-99.99	Unit:	-
Max. value:	99.99	Data type:	Int16
Default value:	1.00	Change mode:	Real time

Range:
-99.99 to 99.99
Parameter descriptions:
Defines the actual AO1 output voltage after amplification when the output voltage is 1V in theory.

15.6 H05 Position Control Parameters

H05.00 **Main position reference source**

Hex:	2005-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	2	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
2: Multi-position reference
Parameter descriptions:
Defines the position reference source in position control mode.

H05.02 **Pulses per revolution**

Hex:	2005-03h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	PPR
Max.value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Range:
0 to 4294967295
Parameter descriptions:
Defines the number of pulses required per revolution of the motor.

H05.04 **First-order low-pass filter time constant**

Hex:	2005-05h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max.value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Range:
0.0 to 6553.5
Parameter descriptions:
Defines the first-order low pass filter time constant of position references.

H05.06 **Moving average filter time constant 1**

Hex:	2005-07h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max.value:	128.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Range:
0.0 to 128.0
Parameter descriptions:
Defines the moving average filter time constant for the first group of position references.

H05.07 **Electronic gear ratio 1 (numerator)**

Hex:	2005-08h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	1	Change mode:	Real time

Range:
1 to 1073741824
Parameter descriptions:
Defines the numerator of electronic gear ratio 1 for encoder unit conversion to user unit.

H05.09 **Electronic gear ratio 1 (denominator)**

Hex:	2005-0Ah	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	1	Change mode:	Real time

Range:
1 to 1073741824
Parameter descriptions:
Defines the denominator of electronic gear ratio 1 for encoder unit conversion to user unit.

H05.11 **Electronic gear ratio 2 (numerator)**

Hex:	2005-0Ch	Effective mode:	Real time
Min. value:	1	Unit:	-

Max. value:	1073741824	Data type:	UInt32
Default value:	1	Change mode:	Real time

Range:
1 to 1073741824
Parameter descriptions:
Defines the numerator of electronic gear ratio 2 for encoder unit conversion to user unit.

H05.13 **Electronic gear ratio 2 (denominator)**

Hex:	2005-0Eh	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	1	Change mode:	Real time

Range:
1 to 1073741824
Parameter descriptions:
Defines the denominator of electronic gear ratio 2 for encoder unit conversion to user unit.

H05.17 **Number of encoder frequency-division pulses**

Hex:	2005-12h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	PPR
Max.value:	4194303	Data type:	UInt32
Default value:	2500	Change mode:	At stop

Range:
0 to 4194303
Parameter descriptions:
Defines the number of pulses output by PAO or PBO per revolution.
Pulse output resolution per revolution = (H05.17) x 4

H05.19 **Speed feedforward control**

Hex:	2005-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	3	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: No speed feedforward
1: Internal speed feedforward
2: H05.72
3: Zero phase
Parameter descriptions:
Defines the source of the speed loop feedforward signal.
0: No speed feedforward 1: Internal speed feedforward 2: External speed feedforward H05.72 3: Zero phase Note: When setting external speed feedforward, the feedforward source is set through H05.72.

H05.20 **Condition for positioning completed signal output**

Hex:	2005-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Absolute value of position deviation is smaller than the value of H05.21

1: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0

2: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0

3: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the unfiltered position reference and absolute value of position deviation.

4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the filtered position reference and absolute value of position deviation.

5: The positioning completion signal ON is outputted when the non-filtered position reference is 0, the zero speed signal is ON, and the absolute value of position deviation is lower than H05.21.

6: The positioning completion signal is outputted only when the absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.

7: Positioning completion judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0; position completion signal outputted when absolute position deviation being lower than H05.21 and unfiltered position reference being 0 The positioning completion signal ON is outputted when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.

8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.

9: Positioning completion is judged after the delay defined by H05.60 elapses and the unfiltered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the unfiltered position reference is 0 and the absolute position deviation is lower than H05.21.

10: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.

Parameter descriptions:

Defines the condition for outputting positioning completed/proximity signal. In the position control mode, if the absolute value of the position deviation during operation is within the setpoint of H05.21, the drive outputs the positioning completed/proximity signal. You can set the condition for outputting the positioning completed/proximity signal in H05.20.
0: Absolute value of position deviation is smaller than the value of H05.21
1: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0
2: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0
3: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the unfiltered position reference and absolute value of position deviation.
4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the filtered position reference and absolute value of position deviation.
5: The positioning completion signal ON is outputted when the non-filtered position reference is 0, the zero speed signal is ON, and the absolute value of position deviation is lower than H05.21.
6: The positioning completion signal is outputted only when the absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.
7: Positioning completion judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0; position completion signal outputted when absolute position deviation being lower than H05.21 and unfiltered position reference being 0 The positioning completion signal ON is outputted when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
9: Positioning completion is judged after the delay defined by H05.60 elapses and the unfiltered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the unfiltered position reference is 0 and the absolute position deviation is lower than H05.21.
10: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
Note: This parameter is active only when H02.00 is not set to 9.

H05.21 **Threshold of positioning completed**

Hex:	2005-16h	Effective mode:	Real time
Min. value:	1	Unit:	Encoder unit
Max.value:	65535	Data type:	UInt16
Default value:	5872	Change mode:	Real time

Range:
1 to 65535
Parameter descriptions:
Defines the threshold of the absolute value of position deviation when the drive outputs the positioning completed signal.
Note: This parameter is active only when H02.00 is not set to 9.

H05.22 **Proximity threshold**

Hex:	2005-17h	Effective mode:	Real time
Min. value:	1	Unit:	Encoder unit
Max.value:	65535	Data type:	UInt16
Default value:	65535	Change mode:	Real time

Range:
1 to 65535
Parameter descriptions:
Defines the threshold of the absolute value of position deviation when the drive outputs the proximity signal.
Note: This parameter is active only when H02.00 is not set to 9.

H05.30 **Homing enable selection**

Hex:	2005-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	6	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disabled
6: Current position as the home
Parameter descriptions:
Defines the homing mode and the trigger signal source.
0: Disable 6: Current position as the home Note: When H05.30 is set to 6, the position feedback is H05.36 regardless of the setting of H05.40.

H05.35 **Home search time limit**

Hex:	2005-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	10000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the maximum homing time. Unit H05.66.

H05.36 **Mechanical home offset**

Hex:	2005-25h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit

Max.value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the absolute position of the motor after homing.

H05.38 Frequency-division output source

Hex:	2005-27h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Encoder frequency-division output 2: Frequency-division output inhibited 3: 2nd encoder frequency-division output 4: H31.01 Reference frequency output
Parameter descriptions:
Defines the output source of the pulse output terminal.
0: Encoder frequency-division output 2: Frequency-division output inhibited 3: Second encoder frequency-division output 4: H31.01

H05.39 Electronic gear ratio switchover condition

Hex:	2005-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Switchover after position reference is kept 0 for 2.5 ms
1: Switched in real time
Parameter descriptions:
Defines the condition for switching the electronic gear ratio. After the fully closed-loop function is enabled and H0F.00 is set to 2, the setpoint is forcibly set to 0.
When H0F.00 is set to 2, the switchover condition is 0 after the position reference is 0 and positioning has been completed for 2.5 ms. When H0F.00 is not 2, The switchover condition is when the position reference is 0 and lasts 2.5 ms

H05.40 Mechanical home offset and action upon overtravel

Hex:	2005-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: H05.36 as the coordinate after homing, reverse homing applied after homing triggered again on overtravel

1: H05.36 as the relative offset after homing, reverse homing applied after homing triggered again on overtravel

2: H05.36 as the coordinate after homing, reverse homing auto-applied on overtravel

3: H05.36 as the relative offset after homing, reverse homing auto-applied on overtravel

Parameter descriptions:

Defines the offset relation between the mechanical home and mechanical zero point upon homing, as well as the action upon overtravel during homing.

0: H05.36 as the coordinate after homing, reverse homing applied after homing triggered again on overtravel

1: H05.36 as the relative offset after homing, reverse homing applied after homing triggered again on overtravel

2: H05.36 as the coordinate after homing, reverse homing auto-applied on overtravel

3: H05.36 as the relative offset after homing, reverse homing auto-applied on overtravel

H05.41 **Z pulse output polarity**

Hex:	2005-2Ah	Effective mode:	Upon the next power-on
Min. value:	0x0	Unit:	-
Max.value:	0xFFFF	Data type:	UInt16
Default value:	0x1	Change mode:	At stop

Range:

bit0: Frequency-division Z output polarity

0: Positive (high level upon active Z pulse)

1: Negative (low level upon active Z pulse)

bit1: OCZ output polarity

0: Positive (high level upon active Z pulse)

1: Negative (low level upon active Z pulse)

bit2: Inner loop probe Z signal source

0: Motor Z signal

1: Frequency-division output Z signal

Parameter descriptions:

Defines the output level when the Z pulse of pulse output terminal is active.

bit0: Frequency-division Z output polarity

0: Positive (high level upon valid Z pulse) 1: Negative (low level upon valid Z pulse) bit1: OCZ output polarity bit1: OCZ output polarity

0: Positive (high level upon valid Z pulse) 1: Negative (low level upon valid Z pulse) bit2: Inner loop probe Z signal source

0: Motor Z signal 1: Frequency-division output Z signal

H05.44 **Numerator of frequency-division output reduction ratio**

Hex:	2005-2Dh	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	16383	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
1 to 16383
Parameter descriptions:
Defines the numerator of frequency-division output reduction ratio.

H05.45 **Denominator of frequency-division output reduction ratio**

Hex:	2005-2Eh	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	8191	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
1 to 8191
Parameter descriptions:
Defines the denominator of frequency-division output reduction ratio.

H05.46 **DI selection of multi-turn frequency-division Z starting point**

Hex:	2005-2Fh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max.value:	5	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No operation
1: DI1
2: DI2
3: DI3
4: DI4
5: DI5
Parameter descriptions:
Sets the start point for frequency-division output. It is only effective when the frequency division ratio is greater than 1.
0: No operation
1: DI1
2: DI2
3: DI3
4: DI4
5: DI5

H05.47 **Frequency-division Z pulse width**

Hex:	2005-30h	Effective mode:	Real time
Min. value:	0	Unit:	μs
Max.value:	400	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 400

Parameter descriptions:

Defines the minimum output width (us) of frequency-division output PZ. When the pulse signal is used as master encoder and fully closed-loop encoder, the setpoint 0 indicates the original Z signal will be outputted. Other setpoints indicate the frequency-division Z signal will be outputted.

H05.48 Frequency-division output dead zone setting threshold

Hex:	2005-31h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 255

Parameter descriptions:

Defines the dead zone threshold of frequency-division output to prevent frequency-division output caused by encoder jitter.

Note: When this function is enabled, the frequency-division output pulse may not be sequential at constant low speed. Set this parameter properly.

H05.50 Mechanical gear ratio in absolute position rotation mode (numerator)

Hex:	2005-33h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

1 to 65535

Parameter descriptions:

Defines the mechanical gear ratio (numerator) in absolute position rotation mode

H05.51 Mechanical gear ratio in absolute position rotation mode (denominator)

Hex:	2005-34h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

1 to 65535

Parameter descriptions:

Defines the mechanical gear ratio (denominator) in absolute position rotation mode

H05.52 Pulses per revolution of the load in absolute position rotation mode (low 32 bits)

Hex:	2005-35h	Effective mode:	Real time
Min. value:	0	Unit:	Encoder unit
Max.value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Range:
0 to 4294967295
Parameter descriptions:
Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode (low 32 bits).

H05.54 **Pulses per revolution of the load in absolute position rotation mode (high 32 bits)**

Hex:	2005-37h	Effective mode:	Real time
Min. value:	0	Unit:	Encoder unit
Max.value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Range:
0 to 4294967295
Parameter descriptions:
Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode (high 32 bits).

H05.58 **Torque threshold in homing upon hit-and-stop**

Hex:	2005-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max.value:	400.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the maximum positive/negative torque limit in homing upon hit-and-stop.

H05.59 **Positioning window time**

Hex:	2005-3Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max.value:	30000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 30000
Parameter descriptions:
If the positioning deviation is less than the time threshold of positioning completed, the positioning completed signal is active only if the set time threshold is exceeded.

H05.60 **Hold time of positioning completed**

Hex:	2005-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max.value:	30000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 30000

Parameter descriptions:

Defines the hold time of an active positioning completed signal.

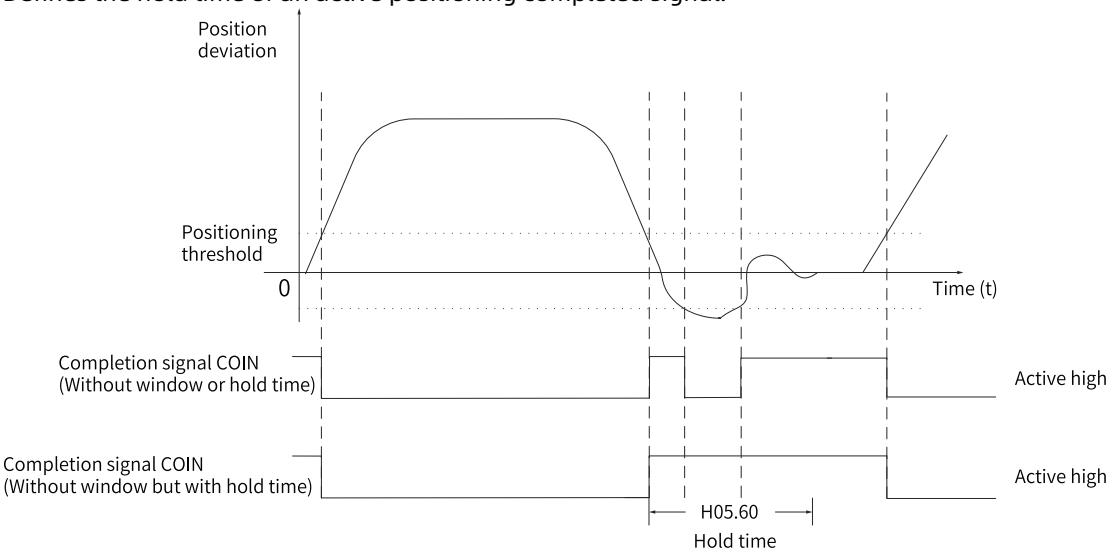


Figure 15-1 Schematic diagram for the window time (H05.59) and hold time (H05.60) of positioning completed signal

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

H05.66 **Homing time unit**

Hex:	2005-43h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	2	Change mode:	At stop

Range:

0: 1 ms

1: 10 ms

2: 100 ms

Parameter descriptions:

Defines the homing time unit.

0: 1 ms 1: 10 ms 2: 100 ms Note: The actual timeout is H05.35 x H05.66 (ms).

H05.71 **Motor Z signal width**

Hex:	2005-48h	Effective mode:	Real time
Min. value:	1	Unit:	ms
Max.value:	100	Data type:	UInt16
Default value:	4	Change mode:	Real time

Range:

1 to 100

Parameter descriptions:

Defines the pulse width output upon active motor Z signal.

H05.72 **External speed feedforward source selection**

Hex:	2005-49h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: 60B1 1: AI1 2: AI2
Parameter descriptions:
External speed feedforward source selection
0: 60B1 1: AI1 2: AI2

15.7 H06 Speed Control Parameters

H06.00 **Source of main speed reference A**

Hex:	2006-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: H06.03 1: AI1 2: AI2
Parameter descriptions:
Defines the source of main speed reference A.
0: H06.03 1: AI1 2: AI2

H06.01 **Source of auxiliary speed reference B**

Hex:	2006-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	5	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: H06.03 1: AI1 2: AI2 5: Multi-speed reference
Parameter descriptions:
Defines the source of auxiliary speed reference B.
0: H06.03 1: AI1 2: AI2 5: Multi-speed reference

H06.02 **Speed reference source**

Hex:	2006-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max.value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Source of main speed reference A 1: Source of auxiliary speed reference B 2: A+B 3: Switchover between A and B 4: Communication

Parameter descriptions:
Defines the source of speed references.
0: Source of main speed reference A 1: Source of auxiliary speed reference B 2: A+B 3: Switchover between A and B 4: Communication

H06.03 **Speed reference set through keypad**

Hex:	2006-04h	Effective mode:	Real time
Min. value:	-10000	Unit:	rpm
Max.value:	10000	Data type:	Int16
Default value:	200	Change mode:	Real time

Range:
-10000 to 10000
Parameter descriptions:
Defines the speed reference value set through the keypad.

H06.04 **DI jog speed reference**

Hex:	2006-05h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	150	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the DI jog speed reference.

H06.05 **Acceleration ramp time of speed reference**

Hex:	2006-06h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max.value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines acceleration ramp time of speed reference.
H06.05 defines the time for the speed reference to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm].
The formulas for calculating the actual acceleration and deceleration time are as follows:
Actual acceleration time (t) = (Speed reference/1000) x Acceleration ramp time of speed reference

H06.06 **Deceleration ramp time of speed reference**

Hex:	2006-07h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max.value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the deceleration ramp time of speed reference.
H06.06 defines the time for the speed reference to change from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm].
The formulas for calculating the actual acceleration and deceleration time are as follows:
Actual deceleration time (t) = (Speed reference/1000) x Deceleration ramp time of speed reference

H06.07 **Maximum speed limit**

Hex:	2006-08h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	7000	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the maximum speed limit.

H06.08 **Forward speed threshold**

Hex:	2006-09h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	7000	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the forward speed threshold.

H06.09 **Reverse speed threshold**

Hex:	2006-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	7000	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the reverse speed threshold.

H06.10 **Deceleration unit in emergency stop**

Hex:	2006-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Multiplied by 1
1: Multiplied by 10
2: Multiplied by 100
Parameter descriptions:
Defines the deceleration unit in emergency stop.
0: Multiplied by 1
1: Multiplied by 10
2: Multiplied by 100

H06.11 **Torque feedforward control**

Hex:	2006-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
0: No torque feedforward 1: Internal torque feedforward 2: 60B2h as external torque feedforward 3: Torque feedforward in STune mode 5
Parameter descriptions:
Defines the source for torque feedforward control.
0: No torque feedforward 1: Internal torque feedforward 3: Torque feedforward of STune mode 5

H06.12 **Acceleration/Deceleration ramp time of speed JOG**

Hex:	2006-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max.value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the acceleration/deceleration ramp time of speed JOG.
It indicates the time for the speed reference to accelerate from 0 rpm to 1000 rpm or decelerate from 1000 rpm to 0 rpm.
The formulas for calculating the actual acceleration and deceleration time are as follows:
Actual acceleration/Deceleration time t = Speed reference/1000 x Acceleration ramp time of speed reference

H06.13 **Speed feedforward smoothing filter**

Hex:	2006-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	μs
Max.value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535

Parameter descriptions:
Defines the speed feedforward smoothing filter time.

H06.15 **Zero clamp speed threshold**

Hex:	2006-10h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the zero clamp speed threshold.

H06.16 **Threshold of TGON (motor rotation) signal**

Hex:	2006-11h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	1000	Data type:	UInt16
Default value:	20	Change mode:	Real time

Range:
0 to 1000
Parameter descriptions:
Defines the threshold of TGON (motor rotation) signal.

H06.17 **Threshold of V-Cmp (speed matching) signal**

Hex:	2006-12h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max.value:	100	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 100
Parameter descriptions:
Defines the threshold of speed match signal.

H06.18 **Threshold of speed reach signal**

Hex:	2006-13h	Effective mode:	Real time
Min. value:	20	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Range:
20 to 10000
Parameter descriptions:
Defines the threshold of speed reached signal.

H06.19 **Threshold of zero speed output signal**

Hex:	2006-14h	Effective mode:	Real time
Min. value:	1	Unit:	rpm
Max.value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Defines the threshold of zero speed output signal.

H06.50 **Speed S-curve enable switch**

Hex:	2006-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: Disable
1: Enable
Parameter descriptions:
0: Accelerate/Decelerate at fixed acceleration rate
1: Accelerate/Decelerate based on the S-curve

H06.51 **Increasing acceleration 1 of speed S-curve acceleration segment**

Hex:	2006-34h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.52 **Decreasing acceleration 1 of speed S-curve acceleration segment**

Hex:	2006-35h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.53 **Increasing deceleration 1 of speed S-curve deceleration segment**

Hex:	2006-36h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.54 **Decreasing deceleration 1 of speed S-curve deceleration segment**

Hex:	2006-37h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.55 **Increasing acceleration 2 of speed S-curve acceleration segment**

Hex:	2006-38h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.56 **Decreasing acceleration 2 of speed S-curve acceleration segment**

Hex:	2006-39h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:

8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.57 **Increasing deceleration 2 of speed S-curve deceleration segment**

Hex:	2006-3Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.58 **Decreasing deceleration 2 of speed S-curve deceleration segment**

Hex:	2006-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.59 **Increasing acceleration 3 of speed S-curve acceleration segment**

Hex:	2006-3Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.60 **Decreasing acceleration 3 of speed S-curve acceleration segment**

Hex:	2006-3Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.61 **Increasing deceleration 3 of speed S-curve deceleration segment**

Hex:	2006-3Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.62 **Decreasing deceleration 3 of speed S-curve deceleration segment**

Hex:	2006-3Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.63 **Increasing acceleration 4 of speed S-curve acceleration segment**

Hex:	2006-40h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.64 **Decreasing acceleration 4 of speed S-curve acceleration segment**

Hex:	2006-41h	Effective mode:	Real time

Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.65 **Increasing deceleration 4 of speed S-curve deceleration segment**

Hex:	2006-42h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.66 **Decreasing deceleration 4 of speed S-curve deceleration segment**

Hex:	2006-43h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.67 **Increasing acceleration 5 of speed S-curve acceleration segment**

Hex:	2006-44h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.68 **Decreasing acceleration 5 of speed S-curve acceleration segment**

Hex:	2006-45h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.69 **Increasing deceleration 5 of speed S-curve deceleration segment**

Hex:	2006-46h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.70 **Decreasing deceleration 5 of speed S-curve deceleration segment**

Hex:	2006-47h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.71 **Increasing acceleration 6 of speed S-curve acceleration segment**

Hex:	2006-48h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:

8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.72 **Decreasing acceleration 6 of speed S-curve acceleration segment**

Hex:	2006-49h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.73 **Increasing deceleration 6 of speed S-curve deceleration segment**

Hex:	2006-4Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.74 **Decreasing deceleration 6 of speed S-curve deceleration segment**

Hex:	2006-4Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.75 **Increasing acceleration 7 of speed S-curve acceleration segment**

Hex:	2006-4Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.76 **Decreasing acceleration 7 of speed S-curve acceleration segment**

Hex:	2006-4Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.77 **Increasing deceleration 7 of speed S-curve deceleration segment**

Hex:	2006-4Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.78 **Decreasing deceleration 7 of speed S-curve deceleration segment**

Hex:	2006-4Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

H06.79 **Increasing acceleration 8 of speed S-curve acceleration segment**

Hex:	2006-50h	Effective mode:	Real time

Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: Indicates the ratio of motor increasing acceleration time to the selected acceleration time.

H06.80 **Decreasing acceleration 8 of speed S-curve acceleration segment**

Hex:	2006-51h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: Indicates the ratio of the motor decreasing acceleration time to the selected acceleration time.

H06.81 **Increasing deceleration 8 of speed S-curve deceleration segment**

Hex:	2006-52h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.82 **Decreasing deceleration 8 of speed S-curve deceleration segment**

Hex:	2006-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Range:
0.0 to 100.0
Parameter descriptions:
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing deceleration time at deceleration segment: Indicates the ratio of motor decreasing deceleration time to the selected deceleration time.

15.8 H07 Torque Control Parameters

H07.00 **Source of main torque reference A**

Hex:	2007-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: H7.03 1: AI1 2: AI2
Parameter descriptions:
Defines the source of main torque reference A.
0: H7.03 1: AI1 2: AI2

H07.01 **Source of auxiliary torque reference B**

Hex:	2007-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: H7.03 1: AI1 2: AI2
Parameter descriptions:
Defines the source of auxiliary torque references.
0: H7.03 1: AI1 2: AI2

H07.02 **Torque reference source**

Hex:	2007-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Source of main torque reference A 1: Source of auxiliary torque reference B 2: Source of A+B 3: Switched between A and B 4: Communication
Parameter descriptions:
Selects torque reference.
0: Source of main torque reference A 1: Source of auxiliary torque reference B 2: Source of A+B 3: Switched between A and B 4: Communication

H07.03 **Torque reference set through keypad**

Hex:	2007-04h	Effective mode:	Real time
Min. value:	-400.0	Unit:	%
Max. value:	400.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-400.0 to 400.0

Parameter descriptions:
Defines the torque reference.

H07.05 **Torque reference filter time constant 1**

Hex:	2007-06h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	30.00	Data type:	UInt16
Default value:	0.50	Change mode:	Real time

Range:
0.00 to 30.00
Parameter descriptions:
Defines the torque reference filter time constant 1.

H07.06 **Torque reference filter time constant 2**

Hex:	2007-07h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	30.00	Data type:	UInt16
Default value:	0.27	Change mode:	Real time

Range:
0.00 to 30.00
Parameter descriptions:
Defines the torque reference filter time constant 2.

H07.07 **Torque Limit source**

Hex:	2007-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Positive/Negative internal torque limit
1: Internal or external limit as defined by DI
2: T_LMT
3: T_LMT or external limit as defined by DI (FunIN.16 or FunIN.17)
4: T_LMT or internal limit (FunIN.16 or FunIN.17) as defined by DI
Parameter descriptions:
Defines the torque limit source.
0: Positive/Negative internal torque limit
1: Internal or external limit as defined by DI
2: T_LMT
3: T_LMT or external limit as defined by DI (FunIN.16 or FunIN.17)
4: T_LMT or internal limit (FunIN.16 or FunIN.17) as defined by DI

H07.08 **T-LMT selection**

Hex:	2007-09h	Effective mode:	Real time

Min. value:	1	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
1: AI1
2: AI2
Parameter descriptions:
Sets the AI as the torque limit.
1: AI1
2: AI2

H07.09 **Positive internal torque limit**

Hex:	2007-0Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the positive internal torque limit.

H07.10 **Negative internal torque limit**

Hex:	2007-0Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the negative internal torque limit.

H07.11 **Positive external torque limit**

Hex:	2007-0Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines positive external torque limit.

H07.12 **Negative external torque limit**

Hex:	2007-0Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	%

Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines negative external torque limit.

H07.15 **Emergency-stop torque**

Hex:	2007-10h	Effective mode:	At stop
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the torque upon emergency stop.

H07.17 **Speed limit source**

Hex:	2007-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Internal speed limit
1: V-LMT
2: H07.19 or H07.20 as defined by DI
Parameter descriptions:
Defines the speed limit source.
0: Internal speed limit 1: V-LMT 2: H07.19 or H07.20 as defined by DI Note: This parameter is active only when H02.00 is not set to 9.

H07.18 **V-LMT selection**

Hex:	2007-13h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
1: AI1
2: AI2
Parameter descriptions:
Sets the AI as the speed limit.
1: AI1
2: AI2

H07.19 **Positive speed limit/Speed limit 1 in torque control**

Hex:	2007-14h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the positive speed limit/Speed limit 1 in torque control.

H07.20 **Negative speed limit/Speed limit 2 in torque control**

Hex:	2007-15h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the negative speed limit/speed limit 2 in torque control.

H07.21 **Reference value for torque reach**

Hex:	2007-16h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the reference value for torque reach.

H07.22 **Torque reach valid value**

Hex:	2007-17h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	20.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the threshold of valid torque reach.

H07.23 **Torque reach invalid value**

Hex:	2007-18h	Effective mode:	Real time
Min. value:	0.0	Unit:	%

Max. value:	400.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the threshold of invalid torque reach.

H07.24 Field weakening depth

Hex:	2007-19h	Effective mode:	Real time
Min. value:	60	Unit:	%
Max. value:	115	Data type:	UInt16
Default value:	115	Change mode:	Real time

Range:
60 to 115
Parameter descriptions:
Defines the field weakening depth.

H07.25 Max. permissible demagnetizing current

Hex:	2007-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	300	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 300
Parameter descriptions:
Defines the maximum allowable demagnetization current.

H07.26 Field weakening selection

Hex:	2007-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Disable
1: Enable
Parameter descriptions:
Field weakening selection
0: Disable
1: Enable

H07.27 Field weakening gain

Hex:	2007-1Ch	Effective mode:	Real time
Min. value:	0.001	Unit:	Hz
Max. value:	1.000	Data type:	UInt16

Default value:	0.030	Change mode:	Real time

Range:
0.001 to 1.000
Parameter descriptions:
Defines the field weakening gain.

H07.28 **Speed of flux weakening point**

Hex:	2007-1Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Defines the speed of field weakening point.

H07.35 **Torque non-standard feature enable**

Hex:	2007-24h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
bit0: Motor output correction enable
bit1: Shield compensation data enable
Parameter descriptions:
Torque non-standard feature enable switch
bit0: Enable motor torque output correction
bit1: Enable compensation data shielding

H07.36 **Time constant of low-pass filter 2**

Hex:	2007-25h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	10.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Range:
0.00 to 10.00
Parameter descriptions:
Defines the time constant of low-pass filter 2.

H07.37 **Torque reference filter selection**

Hex:	2007-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: First-order filter
1: Second-order filter
Parameter descriptions:
Torque reference filter selection
0: First-order filter 1: Second-order filter Note: When second-order filter is selected, the filter structure is biquad filter for ROT motors, and the filter parameters are set through H07.38. For DDR/DDL motors, the filter structure is biquad low-pass filter, and the filter parameters are set through H07.42.

H07.38 Biquad filter attenuation ratio

Hex:	2007-27h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	50	Data type:	UInt16
Default value:	16	Change mode:	Real time

Range:
0 to 50
Parameter descriptions:
Defines the attenuation ratio of biquad filter.

H07.40 Speed limit threshold in torque control mode

Hex:	2007-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	300	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 300
Parameter descriptions:
Defines the speed limit time window in the torque control mode.

H07.42 Damping coefficient of biquad low-pass filter

Hex:	2007-2Bh	Effective mode:	Real time
Min. value:	0.001	Unit:	-
Max. value:	10.000	Data type:	UInt16
Default value:	1.000	Change mode:	Real time

Range:
0.001 to 10.000
Parameter descriptions:
Defines the damping coefficient of biquad low-pass filter.

15.9 H08 Gain Parameters

H08.00 Speed loop gain

Hex:	2008-01h	Effective mode:	Real time

Min. value:	0.0	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	40.0	Change mode:	Real time

Range:
0.0 to 2000.0
Parameter descriptions:
Defines the responsiveness of the speed loop. The higher the setpoint, the faster the speed loop response is. Note that an excessively high setpoint may cause vibration.
In the position control mode, the position loop gain must be increased together with the speed loop gain.

H08.01 **Speed loop integral time constant**

Hex:	2008-02h	Effective mode:	Real time
Min. value:	0.15	Unit:	ms
Max. value:	512.00	Data type:	UInt16
Default value:	19.89	Change mode:	Real time

Range:
0.15 to 512.00
Parameter descriptions:
Defines the integral time constant of the speed loop.
The lower the setpoint, the better the integral action, and the quicker will the deviation value be close to 0.
Note:
There is no integral action when H08.01 is set to 512.00.

H08.02 **Position loop gain**

Hex:	2008-03h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	64.0	Change mode:	Real time

Range:
0.0 to 2000.0
Parameter descriptions:
Defines the proportional gain of the position loop.
Defines the responsiveness of the position loop. A high setpoint shortens the positioning time. Note that an excessively high setpoint may cause vibration.
The 1st group of gain parameters include H08.00 (Speed loop gain), H08.01 (Speed loop integral time constant), H08.02, and H07.05 (Filter time constant of torque reference).

H08.03 **2nd speed loop gain**

Hex:	2008-04h	Effective mode:	Real time
Min. value:	0.1	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	75.0	Change mode:	Real time

Range:

0.1 to 2000.0

Parameter descriptions:

Defines the 2nd speed loop gain.

H08.04 2nd speed loop integral time constant

Hex:	2008-05h	Effective mode:	Real time
Min. value:	0.15	Unit:	ms
Max. value:	512.00	Data type:	UInt16
Default value:	10.61	Change mode:	Real time

Range:

0.15 to 512.00

Parameter descriptions:

Defines the 2nd speed loop integral time constant.

H08.05 2nd position loop gain

Hex:	2008-06h	Effective mode:	Real time
Min. value:	0.1	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	120.0	Change mode:	Real time

Range:

0.1 to 2000.0

Parameter descriptions:

Defines the second gain set of the position loop and speed loop. The 2nd group of gain parameters include H08.03 (Speed loop gain), H08.04 (Speed loop integral time constant), H08.05, and H07.06 (Torque reference filter time constant 2).

H08.08 2nd gain mode setting

Hex:	2008-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: Fixed to the 1st gain, switched between P and PI as defined by bit26 of external 60FEh

1: Switched between the 1st and 2nd gain sets as defined by H08.09

Parameter descriptions:

Defines the mode for switching to the 2nd gain set.

0: Fixed to the 1st gain, switched between P and PI as defined by bit26 of external 60FEh

1: Switched between the 1st and 2nd gain sets as defined by H08.09

H08.09 Gain switchover condition

Hex:	2008-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Fixed to the 1st gain set (PS)

1: Switched as defined by bit26 of 60FEh

2: Torque reference too large (PS)

3: Speed reference too large (PS)

4: Speed reference change rate too large (PS)

5: Speed reference low/high speed threshold (PS)

6: Position deviation too large (P)

7: Position reference available (P)

8: Positioning unfinished (P)

9: Actual speed (P)

10: Position reference + Actual speed (P)

Parameter descriptions:

Defines the gain switchover condition.

0: Fixed to the 1st gain set (PS)

1: Switched as defined by bit26 of 60FEh

2: Torque reference too large (PS)

3: Speed reference too large (PS)

4: Speed reference change rate too large (PS)

5: Speed reference low/high speed threshold (PS)

6: Position deviation too large (P)

7: Position reference available (P)

8: Positioning unfinished (P)

9: Actual speed (P)

10: Position reference + Actual speed (P)

H08.10 **Gain switchover delay**

Hex:	2008-0Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 1000.0

Parameter descriptions:

Defines the delay when the drive switches from the 2nd gain set to the 1st gain set.

H08.11 **Gain switchover level**

Hex:	2008-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20000	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:

0 to 20000

Parameter descriptions:

Defines the gain switchover level.
Gain switchover is affected by both the level and the dead time, as defined by H08.09. The unit of gain switchover level varies with the switchover condition.

H08.12 Gain switchover hysteresis

Hex:	2008-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20000	Data type:	UInt16
Default value:	30	Change mode:	Real time

Range:
0 to 20000
Parameter descriptions:
Defines the dead time for gain switchover.
Gain switchover is affected by both the level and the dead time, as defined by H08.09. The unit of gain switchover hysteresis varies with the switchover condition.
Note:
The value of H08.11 (Gain switchover level) must be no less than that of H08.12. Otherwise, H08.11 will be automatically set to the value of H08.12.

H08.13 Position gain switchover time

Hex:	2008-0Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	3.0	Change mode:	Real time

Range:
0.0 to 1000.0
Parameter descriptions:
In position control, if H08.05 (2nd position loop gain) is much higher than H08.02 (Position loop gain), set the time for switching from H08.02 to H08.05.
This parameter can be used to reduce the impact caused by an increase in the position loop gain.

H08.15 Load moment of inertia ratio

Hex:	2008-10h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	120.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Range:
0.00 to 120.00
Parameter descriptions:
Defines the mechanical load inertia ratio relative to the motor moment of inertia.

When H08.15 is set to 0, it indicates the motor carries no load; if it is set to 1.00, it indicates the mechanical load inertia is the same as the motor moment of inertia.

H08.17 **Zero phase delay**

Hex:	2008-12h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	4.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 4.0
Parameter descriptions:
Defines the zero phase delay.

H08.18 **Time constant of speed feedforward filter**

Hex:	2008-13h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	64.00	Data type:	UInt16
Default value:	0.50	Change mode:	Real time

Range:
0.00 to 64.00
Parameter descriptions:
Defines the filter time constant of speed feedforward.

H08.19 **Speed feedforward gain**

Hex:	2008-14h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 100.0
Parameter descriptions:
In position control and full closed-loop control, speed feedforward is the product of speed feedforwad signal multiplied by H08.19 and is part of the speed reference.
Increasing the setpoint improves the responsiveness to position references and reduces the position deviation during operation at a constant speed.
Set H08.18 to a fixed value first, and then increase the value of H08.19 gradually from 0 to a certain value at which speed feedforward achieves the desired effect.
Adjust H08.18 and H08.19 repeatedly until a balanced performance is achieved.
Note:
For how to enable the speed feedforward function and select the speed feedforward signal, see H05.19 (Speed feedforward control).

H08.20 **Torque feedforward filter time constant**

Hex:	2008-15h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	64.00	Data type:	UInt16
Default value:	0.50	Change mode:	Real time

Range:
0.00 to 64.00
Parameter descriptions:
Defines the filter time constant of torque feedforward.

H08.21 **Torque feedforward gain**

Hex:	2008-16h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
In control modes other than torque control, torque feedforward is the product of torque feedforwad signal multiplied by H08.21 and is part of the torque reference.
Increasing the setpoint improves the responsiveness to variable speed references.
Increasing the setpoint improves the responsiveness to position references and reduces the position deviation during operation at a constant speed.
During parameter adjustment, set H08.20 (Torque feedforward filter time constant) to the default value first, and then increase H08.21 gradually to enhance the effect of torque feedforward.
When speed overshoot occurs, keep H08.21 unchanged and increase the value of H08.20. Adjust H08.20 and H08.21 repeatedly until a balanced performance is achieved.
Note:
For how to enable the torque feedforward function and select the torque feedforward signal, see H06.11 (Torque feedforward control).

H08.22 **Speed feedback filtering option**

Hex:	2008-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Inhibited
1: 2 times
2: 4 times
3: 8 times
4: 16 times
Parameter descriptions:
Defines the moving average filtering times for speed feedback.
0: Disable 1: 2 times 2: 4 times 3: 8 times 4: 16 times Note: The higher the number of filtering times, the lower the speed feedback fluctuation, but the longer the feedback delay will be.

H08.23 **Cutoff frequency of speed feedback low-pass filter**

Hex:	2008-18h	Effective mode:	Real time
Min. value:	100	Unit:	Hz
Max. value:	8000	Data type:	UInt16

Default value:	8000	Change mode:	Real time

Range:
100 to 8000
Parameter descriptions:
Defines the cutoff frequency for first-order low-pass filtering on the speed feedback.
Note:
The lower the setpoint, the weaker the speed feedback fluctuation, and the longer the feedback delay will be.
Setting this parameter to 8000 Hz negates the filtering effect.

H08.24 **PDFF control coefficient**

Hex:	2008-19h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	200.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Range:
0.0 to 200.0
Parameter descriptions:
Defines the control mode of the speed loop.
When this parameter is set to 100.0, the speed loop adopts PI control (default) with quick dynamic response.
When this parameter is set to 0.0, speed loop integral action is enhanced, which filters out low-frequency interference but also slows down the dynamic response.
H08.24 can be used to keep a good responsiveness of the speed loop, with the anti-interference capacity in low-frequency bands improved and the speed feedback overshoot unaffected.

H08.25 **Speed measurement method**

Hex:	2008-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: M-method
1: MT-method
Parameter descriptions:
Speed measurement method
0: M-method 1: MT-method Note: It is active only with setpoint 1 and a pulse encoder.

H08.27 **Speed observer cutoff frequency**

Hex:	2008-1Ch	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max. value:	600	Data type:	UInt16
Default value:	170	Change mode:	Real time

Range:
50 to 600

Parameter descriptions:
Defines the cutoff frequency of the speed observer. Note that an excessively high setpoint may incur resonance. Decrease the setpoint properly in case of loud speed feedback noise.

H08.28 **Speed observer inertia correction coefficient**

Hex:	2008-1Dh	Effective mode:	Real time
Min. value:	1	Unit:	%
Max. value:	1600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
1 to 1600
Parameter descriptions:
Defines the speed observer inertia correction coefficient. If H08.15 is set based on the actual inertia, there is no need to adjust this parameter.

H08.29 **Speed observer filter time**

Hex:	2008-1Eh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	10.00	Data type:	UInt16
Default value:	0.80	Change mode:	Real time

Range:
0.00 to 10.00
Parameter descriptions:
Defines the speed observer filter time. It is recommended to set this parameter to a value equal to the sum of H07.05 plus 0.2 ms.

H08.31 **Disturbance cutoff frequency**

Hex:	2008-20h	Effective mode:	Real time
Min. value:	1	Unit:	Hz
Max. value:	4000	Data type:	UInt16
Default value:	600	Change mode:	Real time

Range:
1 to 4000
Parameter descriptions:
Defines the cutoff frequency of the disturbance observer. Increasing the setpoint improves the responsiveness of the disturbance observer and the compensation effect. Note that an excessively high setpoint may incur resonance.

H08.32 **Disturbance compensation gain**

Hex:	2008-21h	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 100

Parameter descriptions:

Defines the compensation gain of the disturbance observer. The setpoint 100% indicates full compensation.

H08.33 Disturbance observer inertia correction coefficient

Hex:	2008-22h	Effective mode:	Real time
Min. value:	1	Unit:	%
Max. value:	1600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:

1 to 1600

Parameter descriptions:

Defines the disturbance observer inertia correction coefficient. If H08.15 is set based on the actual inertia, there is no need to adjust this parameter.

H08.37 Phase modulation for medium-frequency jitter suppression 2

Hex:	2008-26h	Effective mode:	Real time
Min. value:	-90	Unit:	°
Max. value:	90	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:

-90 to 90

Parameter descriptions:

Defines the compensation phase of medium-frequency jitter suppression 2.

H08.38 Medium-frequency suppression 2 frequency

Hex:	2008-27h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	1000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 1000

Parameter descriptions:

Set this parameter based on actual resonance frequency. The valid suppression frequency range for medium-frequency jitter suppression 2 is 100 Hz to 1000 Hz.

H08.39 Compensation gain of medium-frequency jitter suppression 2

Hex:	2008-28h	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	300	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 300

Parameter descriptions:
Defines the compensation gain for medium-frequency jitter suppression 2. Set this parameter to 40%...55% in general cases. Setting this parameter to 0 negates the effect of medium-frequency jitter suppression 2.

H08.40 **Speed observer selection**

Hex:	2008-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disable
1: Enable
Parameter descriptions:
Used to set the enable bit for speed observer.
0: Disable
1: Enable

H08.42 **Model control selection**

Hex:	2008-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disable
1: Enable
2: Reserved
3: New model tracking
4: Model tracking B
Parameter descriptions:
Used to enable model tracking control.

H08.43 **Model gain**

Hex:	2008-2Ch	Effective mode:	Real time
Min. value:	0.1	Unit:	-
Max. value:	2000.0	Data type:	UInt16
Default value:	40.0	Change mode:	Real time

Range:
0.1 to 2000.0
Parameter descriptions:
Defines the single inertia model gain. The higher the gain, the faster the position response. Note that an excessively high setpoint may incur excessive overshoot.

H08.46 **Feedforward value**

Hex:	2008-2Fh	Effective mode:	Real time

Min. value:	0.0	Unit:	-
Max. value:	102.4	Data type:	UInt16
Default value:	95.0	Change mode:	Real time

Range:
0.0 to 102.4
Parameter descriptions:
Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.

H08.48 **Model torque feedforward positive compensation coefficient**

Hex:	2008-31h	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	204.8	Data type:	UInt16
Default value:	102.4	Change mode:	Real time

Range:
0.0 to 204.8
Parameter descriptions:
Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.

H08.49 **Model torque feedforward negative compensation coefficient**

Hex:	2008-32h	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	204.8	Data type:	UInt16
Default value:	102.4	Change mode:	Real time

Range:
0.0 to 204.8
Parameter descriptions:
Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.

H08.53 **Medium- and low-frequency jitter suppression frequency 3**

Hex:	2008-36h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.

H08.54 **Medium- and low-frequency jitter suppression compensation 3**

Hex:	2008-37h	Effective mode:	Real time

Min. value:	0	Unit:	%
Max. value:	200	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 200
Parameter descriptions:
Defines the compensation gain for medium- and low-frequency suppression compensation 3. The setpoint 200% indicates full compensation.

H08.56 **Medium- and low-frequency jitter suppression phase modulation 3**

Hex:	2008-39h	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 600
Parameter descriptions:
Adjust this parameter based on the actual compensation effect.

H08.59 **Medium- and low-frequency jitter suppression frequency 4**

Hex:	2008-3Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.

H08.60 **Medium- and low-frequency jitter suppression compensation 4**

Hex:	2008-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	200	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 200
Parameter descriptions:
Defines the compensation gain for medium- and low-frequency suppression compensation 4. The setpoint 200% indicates full compensation.

H08.61 **Medium- and low-frequency jitter suppression phase modulation 4**

Hex:	2008-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	%

Max. value:	600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 600
Parameter descriptions:
Adjust this parameter based on the actual compensation effect.

H08.62 Position loop integral time constant

Hex:	2008-3Fh	Effective mode:	Real time
Min. value:	0.15	Unit:	-
Max. value:	512.00	Data type:	UInt16
Default value:	512.00	Change mode:	Real time

Range:
0.15 to 512.00
Parameter descriptions:
Defines the position loop integral time constant.

H08.63 2nd position loop integral time constant

Hex:	2008-40h	Effective mode:	Real time
Min. value:	0.15	Unit:	-
Max. value:	512.00	Data type:	UInt16
Default value:	512.00	Change mode:	Real time

Range:
0.15 to 512.00
Parameter descriptions:
Defines the 2nd position loop integral time constant.

H08.64 Speed observer feedback source

Hex:	2008-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Observer speed output value
1: Observer speed observation value
Parameter descriptions:

0: Observer speed output value
1: Observer speed observation value

H08.65 Zero deviation control selection

Hex:	2008-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16

Default value:	0	Change mode:	Real time

Range:
0: Disable
1: Enable
Parameter descriptions:
Enables/disables zero deviation control
0: Disable
1: Enable

H08.66 **Zero deviation control position average filter**

Hex:	2008-43h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	320.0	Data type:	UInt16
Default value:	5.0	Change mode:	At stop

Range:
0.0 to 320.0
Parameter descriptions:
Defines the average filter time of zero deviation control position. It is recommended to increase the setpoint in case of large noise caused by low command resolution.

H08.68 **Speed feedforward of zero deviation control**

Hex:	2008-45h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Range:
0.0 to 100.0
Parameter descriptions:
Defines the speed feedforward of zero deviation control.

H08.69 **Torque feedforward of zero deviation control**

Hex:	2008-46h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Range:
0.0 to 100.0
Parameter descriptions:
Defines the torque feedforward of zero deviation control.

H08.90 **Encoder pitch fluctuation suppression device**

Hex:	2008-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	6	Data type:	UInt16

Default value:	0	Change mode:	Real time

Range:

0: Inhibited 1: 1st group activated only-adaptive mode 2: 1st group activated only-hysteresis mode 3: Two groups activated-adaptive mode 4: Two groups activated-hysteresis mode

Parameter descriptions:

Used to enable the encoder pitch fluctuation suppression function.

0: Disable 1: 1st group activated only-adaptive mode This mode is used to suppress or eliminate the control loop torque fluctuation caused by encoder pitch fluctuation, which can help alleviate speed fluctuation and operation noise. 2: 1st group activated only-hysteresis mode This mode is used in scenarios featuring a long travel distance and slow speed changes (such as digital printing industry). 3: Two groups activated-adaptive mode Note that the number of suppressors used depend on the magnitude of torque fluctuation caused by encoder pitch fluctuation. 4. Two groups activated-hysteresis mode Note that the hysteresis mode is only applicable to scenarios requiring reciprocating movement. The adaptive mode is applicable to scenarios with slow speed changes.

15.10 H09 Auto-tuning Parameters

H09.00 **Auto-tuning mode**

Hex:	2009-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	4	Change mode:	Real time

Range:

0: Disabled, manual gain tuning required 1: Enabled, gain parameters generated automatically based on the stiffness level 2: Positioning mode, gain parameters generated automatically based on the stiffness level 3: Interpolation mode+Inertia auto-tuning 4: Normal mode+Inertia auto-tuning 5: STune mode 5 6: Quick positioning mode+Inertia auto-tuning 8: New model tracking+Inertia auto-tuning 9: Model tracking B+Inertia auto-tuning+Friction compensation

Parameter descriptions:

Defines different gain tuning modes. Related gain parameters can be set manually or automatically according to the stiffness level.

0: Disabled, manual gain tuning required 1: Enabled, gain parameters generated automatically based on the stiffness level 2: Positioning mode, gain parameters generated automatically based on the stiffness level 3: Interpolation mode+Inertia auto-tuning 4: Normal mode+Inertia auto-tuning 5: STune mode 5 6: Quick positioning mode+Inertia auto-tuning 8: New model tracking+Inertia auto-tuning 9: Model tracking B+Inertia auto-tuning+Friction compensation

H09.01 **Stiffness level selection**

Hex:	2009-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	41	Data type:	UInt16
Default value:	15	Change mode:	Real time

Range:
0 to 41
Parameter descriptions:
Defines the stiffness level of the servo system. The higher the stiffness level, the stronger the gains and the quicker the response will be. But an excessively high stiffness level will cause vibration.
The setpoint 0 indicates the weakest stiffness and 41 indicates the strongest stiffness.

H09.02 **Adaptive notch mode**

Hex:	2009-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Adaptive notch no longer updated
1: One adaptive notch activated (3rd notch)
2: Two adaptive notches activated (3rd and 4th notches)
3: Resonance point tested only (displayed in H09.24)
4: Adaptive notch cleared, values of 3rd and 4th notches restored to default
Parameter descriptions:
Defines the operation mode of the adaptive notch.
0: Adaptive notch no longer updated
1: One adaptive notch activated (3rd notch)
2: Two adaptive notches activated (3rd and 4th notches)
3: Resonance point tested only (displayed in H09.24)
4: Adaptive notch cleared, values of 3rd and 4th notches restored to default

H09.03 **Online inertia auto-tuning mode**

Hex:	2009-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disabled
1: Enabled, changing slowly
2: Enabled, changing normally
3: Enabled, changing quickly
Parameter descriptions:
Defines whether to enable online inertia auto-tuning and the inertia ratio update speed during online inertia auto-tuning.
0: Disabled
1: Enabled, changing slowly
2: Enabled, changing normally
3: Enabled, changing quickly

H09.05 **Offline inertia auto-tuning mode**

Hex:	2009-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Bi-directional

1: Unidirectional

Parameter descriptions:

Defines the offline inertia auto-tuning mode. The offline inertia auto-tuning function can be enabled through H0d.02.

0: Bi-directional

1: Unidirectional

H09.06 **Max. speed of inertia auto-tuning**

Hex:	2009-07h	Effective mode:	Real time
Min. value:	100	Unit:	rpm
Max. value:	1000	Data type:	UInt16
Default value:	500	Change mode:	At stop

Range:

100 to 1000

Parameter descriptions:

Defines the maximum permissible speed reference in offline inertia auto-tuning mode.
During inertia auto-tuning, the higher the speed, the more accurate the auto-tuned values. Use the default setpoint in general cases.

H09.07 **Time constant for accelerating to max. speed during inertia auto-tuning**

Hex:	2009-08h	Effective mode:	Real time
Min. value:	10	Unit:	ms
Max. value:	5000	Data type:	UInt16
Default value:	125	Change mode:	At stop

Range:

10 to 5000

Parameter descriptions:

Defines the time for the motor to accelerate from 0 rpm to the maximum speed of inertia auto-tuning (H09.06) during offline inertia auto-tuning.

H09.08 **Interval time after an individual inertia auto-tuning**

Hex:	2009-09h	Effective mode:	Real time
Min. value:	50	Unit:	ms
Max. value:	10000	Data type:	UInt16
Default value:	800	Change mode:	At stop

Range:

50 to 10000

Parameter descriptions:
Defines the interval time between two consecutive speed references when H09.05 (Offline inertia auto-tuning mode) is set to 1 (Positive/Negative triangular wave mode).

H09.09 **Motor movement distance per inertia auto-tuning**

Hex:	2009-0Ah	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	100.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Range:
0.00 to 100.00
Parameter descriptions:
Defines the motor revolutions per inertia auto-tuning when H09.05 (Offline inertia auto-tuning mode) is set to 1 (Positive/Negative triangular wave mode).
Note:
When using the offline inertia auto-tuning function, check that the travel distance of the motor at the stop position is larger than the value of H09.09. If not, decrease the value of H09.06 (Maximum speed for inertia auto-tuning) or H09.07 (Time constant of accelerating to max. speed during inertia auto-tuning) properly until the motor travel distance fulfills the requirement.

H09.11 **Vibration threshold**

Hex:	2009-0Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:
0.0 to 100.0
Parameter descriptions:
Defines the alarm threshold for current feedback vibration.

H09.12 **Frequency of the 1st notch**

Hex:	2009-0Dh	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
50 to 8000
Parameter descriptions:
Defines the center frequency of the notch, which is the mechanical resonance frequency.
In the torque control mode, setting the notch frequency to 8000 Hz deactivates the notch function.

H09.13 **Width level of the 1st notch**

Hex:	2009-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
0 to 20
Parameter descriptions:
Defines the width level of the notch. Use the default setpoint in general cases.
Width level is the ratio of the notch width to the notch center frequency.

H09.14 **Depth level of the 1st notch**

Hex:	2009-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 99
Parameter descriptions:
Defines the depth level of the notch.
The depth level of the notch is the ratio between the input to the output at the notch center frequency.
The higher the setpoint, the lower the notch depth and the weaker the mechanical resonance suppression will be. Note that an excessively high setpoint may cause system instability.

H09.15 **Frequency of the 2nd notch**

Hex:	2009-10h	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
50 to 8000
Parameter descriptions:
Defines the frequency of the 2nd notch.

H09.16 **Width level of the 2nd notch**

Hex:	2009-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
0 to 20
Parameter descriptions:
Defines the width level of the 2nd notch.

H09.17 **Depth level of the 2nd notch**

Hex:	2009-12h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 99
Parameter descriptions:
Defines the depth level of the 2nd notch.

H09.18 **Frequency of the 3rd notch**

Hex:	2009-13h	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
50 to 8000
Parameter descriptions:
Defines the frequency of the 3rd notch.

H09.19 **Width level of the 3rd notch**

Hex:	2009-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
0 to 20
Parameter descriptions:
Defines the width level of the 3rd notch.

H09.20 **Depth level of the 3rd notch**

Hex:	2009-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 99
Parameter descriptions:
Defines the depth level of the 3rd notch.

H09.21 **Frequency of the 4th notch**

Hex:	2009-16h	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
50 to 8000
Parameter descriptions:
Defines the frequency of the 4th notch.

H09.22 **Width level of the 4th notch**

Hex:	2009-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
0 to 20
Parameter descriptions:
Defines the width level of the 4th notch.

H09.23 **Depth level of the 4th notch**

Hex:	2009-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 99
Parameter descriptions:
Defines the depth level of the 4th notch.

H09.24 **Auto-tuned resonance frequency**

Hex:	2009-19h	Effective mode:	-
Min. value:	0	Unit:	Hz
Max. value:	5000	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 5000
Parameter descriptions:
When H09.02 (Adaptive notch mode) is set to 3, the current mechanical resonance frequency is displayed.

H09.32 **Gravity compensation value**

Hex:	2009-21h	Effective mode:	Real time
Min. value:	-100.0	Unit:	%
Max. value:	100.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-100.0 to 100.0

Parameter descriptions:
Defines the gravity compensation value. Setting this parameter properly in vertical axis applications can reduce the falling amplitude upon start.

H09.33 **Positive friction compensation value**

Hex:	2009-22h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 100.0
Parameter descriptions:
Defines the forward friction compensation value.

H09.34 **Negative friction compensation value**

Hex:	2009-23h	Effective mode:	Real time
Min. value:	-100.0	Unit:	%
Max. value:	0.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-100.0 to 0.0
Parameter descriptions:
Defines the reverse direction friction compensation value.

H09.35 **Friction compensation speed**

Hex:	2009-24h	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	20.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Range:
0.0 to 20.0
Parameter descriptions:
Defines the friction compensation speed.

H09.36 **Friction compensation speed**

Hex:	2009-25h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x13	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:

0: Slow mode+Speed reference
1: Slow mode+Model speed
2: Slow mode+Speed feedback
3: Slow mode+Observe speed
16: Quick mode +Speed reference
17: Quick mode +Model speed
18: Quick mode +Speed feedback
19: Quick mode+Observe speed

Parameter descriptions:

Friction compensation speed

0: Slow mode+Speed reference
1: Slow mode+Model speed
2: Slow mode+Speed feedback
3: Slow mode+Observe speed
16: Quick mode +Speed reference
17: Quick mode +Model speed
18: Quick mode +Speed feedback
19: Quick mode+Observe speed

H09.37 Vibration monitoring time

Hex:	2009-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	300	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

The resonance detection suppression function is turned off automatically after the time defined by this parameter elapses. To suppress the resonance suppression function, set this parameter to 0.

H09.38 Frequency of low-frequency resonance suppression 1 at the mechanical end

Hex:	2009-27h	Effective mode:	Real time
Min. value:	1.0	Unit:	Hz
Max. value:	100.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Range:

1.0 to 100.0

Parameter descriptions:

Set this parameter based on the actual jitter frequency.

H09.39 Low-frequency resonance suppression 1 at the mechanical end

Hex:	2009-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16

Default value:	2	Change mode:	At stop

Range:
0 to 3
Parameter descriptions:
Defines different low-frequency resonance suppression types at the mechanical load. Type 1 features the shortest delay.

H09.41 **Frequency of the 5th notch**

Address:	2009-2Ah	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
50 to 8000
Parameter descriptions:
Defines the frequency of the 5th notch.

H09.42 **Width level of the 5th notch**

Address:	2009-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
0 to 20
Parameter descriptions:
Defines the width level of the 5th notch.

H09.43 **Depth level of the 5th notch**

Address:	2009-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 99
Parameter descriptions:
Defines the depth level of the 5th notch.

H09.44 **Frequency of low-frequency resonance suppression 2 at mechanical load end**

Hex:	2009-2Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Range:

0.0 to 200.0

Parameter descriptions:

Set this parameter based on the actual jitter frequency.

H09.45 Responsiveness of low-frequency resonance suppression 2 at mechanical load end

Hex:	2009-2Eh	Effective mode:	Real time
Min. value:	0.01	Unit:	-
Max. value:	10.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:

0.01 to 10.00

Parameter descriptions:

Use the default setpoint in general cases. To increase the setpoint, reduce the delay time.

H09.47 Width of low-frequency resonance suppression 2 at mechanical load end

Hex:	2009-30h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	2.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:

0.00 to 2.00

Parameter descriptions:

Use the default setpoint in general cases. To increase the setpoint, increase the delay time.

H09.49 Frequency of low-frequency resonance suppression 3 at mechanical load end

Hex:	2009-32h	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Range:

0.0 to 200.0

Parameter descriptions:

Defines the frequency of low-frequency resonance suppression 3 at mechanical load end.

H09.50 Responsiveness of low-frequency resonance suppression 3 at mechanical load end

Hex:	2009-33h	Effective mode:	Real time
Min. value:	0.01	Unit:	-
Max. value:	10.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:

0.01 to 10.00

Parameter descriptions:

Defines the responsiveness of low-frequency resonance suppression 3 at mechanical load end.

H09.52 **Width of low-frequency resonance suppression 3 at mechanical load end**

Hex:	2009-35h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	2.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:
0.00 to 2.00
Parameter descriptions:
Defines the width of low-frequency resonance suppression 3 at mechanical load end.

H09.54 **Resonance detection torque threshold**

Hex:	2009-37h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
If the torque fluctuation exceeds the setpoint, an error will be reported. Setting this parameter to 0 hides the resonance detection function.

H09.56 **Max. overshoot allowed by ETune**

Hex:	2009-39h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	2936	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the maximum overshoot value allowed during ETune adjustment.

H09.57 **STune resonance suppression switchover frequency**

Hex:	2009-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	4000	Data type:	UInt16
Default value:	650	Change mode:	Real time

Value range:
0 to 4000
Parameter description
If the resonance frequency is lower than the setpoint, use medium-frequency resonance suppression 2 to suppress resonance. Otherwise, use the notch to suppress resonance. When H09.57 exceeds the frequency upper limit (1000 Hz) of medium frequency suppression 2, the medium frequency suppression is inactive.

H09.58 **STune resonance suppression reset selection**

Hex:	2009-3Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter descriptions:

Used to enable STune resonance suppression reset to clear parameters related to resonance suppression, medium-frequency resonance suppression 2 and notches 3 and 4.

0: Disable

1: Enable

H09.62 **STune stop delay judgment**

Hex:	2009-3Fh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	50.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Range:

0.00 to 50.00

Parameter descriptions:

Defines the judgment time for STune stop delay.

H09.63 **STune quick convergence speed**

Hex:	2009-40h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	50.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Range:

0.00 to 50.00

Parameter descriptions:

Defines the quick convergence speed of STune.

H09.71 **Starting frequency**

Hex:	2009-48h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	15	Change mode:	Real time

Range:

0 to 8000

Parameter descriptions:

Defines the starting sweeping frequency for high-performance tuning.

H09.72 **End frequency**

Hex:	2009-49h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
0 to 8000
Parameter descriptions:
Defines the ending sweeping frequency for high-performance tuning.

H09.73 **Frequency subdivision**

Hex:	2009-4Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	500	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
0 to 500
Parameter descriptions:
Defines the frequency resolution of high-performance tuning in the low frequency range (starting frequency to starting frequency 2). The higher the setpoint, the lower the resolution will be.

H09.74 **Excitation amplitude**

Hex:	2009-4Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	15.0	Change mode:	Real time

Range:
0.0 to 400.0
Parameter descriptions:
Defines the excitation amplitude of the sweeping frequency in high-performance tuning.

H09.75 **Starting frequency 2**

Hex:	2009-4Ch	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	500	Change mode:	Real time

Range:
0 to 8000
Parameter descriptions:
Defines the starting frequency of medium- and high-frequency range in high performance tuning.

H09.76 **Frequency subdivision 2**

Hex:	2009-4Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1000	Data type:	UInt16
Default value:	500	Change mode:	Real time

Range:
0 to 1000
Parameter descriptions:
Defines the frequency resolution of high-performance tuning at low frequency range (starting frequency 2 to ending frequency). The higher the set value, the lower the resolution is.

H09.77 **Biquad filter mode**

Hex:	2009-4Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	6	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disable 1: First-order low-pass 2: Second-order low-pass 3: Notch 4: Lead-lag 5: User-defined
Parameter descriptions:
Used to select biquad filter mode.
0: Disable 1: First-order low-pass 2: Second-order low-pass 3: Notch 4: Lead-lag 5: User-defined

H09.78 **Biquad filter numerator frequency**

Hex:	2009-4Fh	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	16000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
0 to 16000
Parameter descriptions:
Defines the biquad filter numerator frequency.

H09.79 **Damping coefficient of biquad filter numerator**

Hex:	2009-50h	Effective mode:	Real time
Min. value:	0.001	Unit:	-
Max. value:	10.000	Data type:	UInt16
Default value:	1.000	Change mode:	Real time

Range:
0.001 to 10.000
Parameter descriptions:
Defines the damping coefficient of biquad filter numerator.

H09.80 **Biquad filter denominator frequency**

Hex:	2009-51h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	16000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Range:
0 to 16000
Parameter descriptions:
Defines the biquad filter denominator frequency.

H09.81 **Damping coefficient of biquad filter denominator**

Hex:	2009-52h	Effective mode:	Real time
Min. value:	0.001	Unit:	-
Max. value:	10.000	Data type:	UInt16
Default value:	1.000	Change mode:	Real time

Range:
0.001 to 10.000
Parameter descriptions:
Defines the damping coefficient of biquad filter denominator.

H09.82 **Vibration frequency 1**

Hex:	2009-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
Defines the vibration frequency 1.

H09.83 **Resonance frequency 1**

Hex:	2009-54h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
Defines the resonance frequency 1.

H09.84 **Vibration damping 1**

Hex:	2009-55h	Effective mode:	Real time
Min. value:	0.00	Unit:	-

Max. value: 0.50
Default value: 0.05
Data type: UInt16
Change mode: Real time

Range:
0.00 to 0.50
Parameter descriptions:
Defines the vibration damping 1.

H09.85 **Resonance damping 1**

Hex: 2009-56h
Min. value: 0.00
Max. value: 0.50
Default value: 0.05
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Range:
0.00 to 0.50
Parameter descriptions:
Defines resonance damping 1.

H09.86 **Vibration frequency 2**

Hex: 2009-57h
Min. value: 0.0
Max. value: 300.0
Default value: 0.0
Effective mode: Real time
Unit: Hz
Data type: UInt16
Change mode: Real time

Range:
0.0 to 300.0
Parameter descriptions:
Defines the vibration frequency 2.

H09.87 **Resonance frequency 2**

Hex: 2009-58h
Min. value: 0.0
Max. value: 300.0
Default value: 0.0
Effective mode: Real time
Unit: Hz
Data type: UInt16
Change mode: Real time

Range:
0.0 to 300.0
Parameter descriptions:
Defines the resonance frequency 2.

H09.88 **Vibration damping 2**

Hex: 2009-59h
Min. value: 0.00
Max. value: 0.50
Default value: 0.05
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Range:

0.00 to 0.50

Parameter descriptions:

Defines the vibration damping 2.

H09.89 **Resonance damping 2**

Hex:	2009-5Ah	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	0.50	Data type:	UInt16
Default value:	0.05	Change mode:	Real time

Range:

0.00 to 0.50

Parameter descriptions:

Defines resonance damping 2.

H09.92 **Model friction compensation**

Hex:	2009-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter descriptions:

Model friction compensation

H09.93 **Model friction compensation coefficient**

Hex:	2009-5Eh	Effective mode:	Real time
Min. value:	0.00	Unit:	%/1000 rpm
Max. value:	50.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Range:

0.00 to 50.00

Parameter descriptions:

Defines the model friction compensation coefficient.

H09.94 **Proportion coefficient of STune model tracking gain**

Hex:	2009-5Fh	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	30.00	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:

0.00 to 30.00

Parameter descriptions:

Adjust H08.43 (model gain). Gain adjustment is available only in STune8.

H09.95 **Jitter suppression auto-tuning at mechanical end**

Hex:	2009-60h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

2: Clear resonance suppression parameters

Parameter descriptions:

-

H09.98 **Auto-tuning of advanced vibration suppression**

Hex:	2009-63h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disabled 1: Auto-tuning of fast vibration suppression 2: Auto-tuning of slow vibration suppression

Parameter descriptions:

0: Disabled 1: Auto-tuning of fast vibration suppression 2: Auto-tuning of slow vibration suppression

15.11 H0A Fault and Protection Parameters

H0A.00 **Power input phase loss protection**

Hex:	200A-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0:

Enable1: Disable

Parameter description

Inovance provides servo drives of single-phase 200 V, three-phase 200 V, and three-phase 400 V. When the input voltage fluctuates violently or phase loss occurs, the servo drive flexibly selects the protection mode according to the setting of H0A.00.

0:

Enable1: Disable

H0A.01 **Absolute position limit**

Hex:	200A-02h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disabled

1: Enabled

2: Enabled after homing

Parameter descriptions:

Used to set the activation condition for enabling the software position limit function and the software limit.

0: Disabled

1: Enabled

2: Enabled after homing

H0A.04 **Motor overload protection gain**

Hex:	200A-05h	Effective mode:	Real time
Min. value:	50	Unit:	-
Max. value:	300	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:

50 to 300

Parameter descriptions:

Determines the motor overload duration before E620.0 is detected when H32.70 is set to 0. Change the value to advance or delay the overload protection time based on the motor heating condition. The value 50% indicates half of the base time, and 150% indicates 1.5 times of the base time.

Set this parameter based on the actual heating condition of the motor.

H0A.08 **Overspeed threshold**

Hex:	200A-09h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	20000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 20000

Parameter descriptions:

Defines the overspeed threshold of the motor.

H0A.10 **Threshold of excessive local position deviation**

Hex:	200A-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	27486951	Change mode:	Real time

Range:

0 to 4294967295

Parameter descriptions:
Defines the threshold for excessive position deviation in the position control mode. The unit is defined by H0A.17.
When the position deviation exceeds the value, the servo drive detects EB00.0.

H0A.12 **Runaway protection switch**

Hex:	200A-0Dh	Effective mode:	At stop
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: Disable
1: Enable runaway protection scheme 1
2: Enable runaway protection scheme 2
Parameter descriptions:
Specifies whether to enable runaway protection.
0: Hide E234 when the motor drives a vertical axis or is driven by the load 1: Enable runway protection scheme 1 2: Enable runway protection scheme 2

H0A.13 **Angle auto-tuning mode**

Hex:	200A-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Angle auto-tuning through pre-positioning
1: Angle auto-tuning through inching
6: Angle auto-tuning through static Hall
8: Angle auto-tuning through closed-loop pre-positioning
9: Angle auto-tuning through position lock
Parameter descriptions:
Motor angle auto-tuning mode
0: Angle auto-tuning through pre-positioning
1: Angle auto-tuning through inching
6: Angle auto-tuning through static Hall
8: Angle auto-tuning through closed-loop pre-positioning
9: Angle auto-tuning through position lock

H0A.17 **Reference pulse selection**

Hex:	200A-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

0: Pulse unit

1: Reference unit

Parameter descriptions:

Used to set the unit for determining the threshold of excessive position deviation, positioning completion, and positioning proximity.

0: Pulse unit

1: Reference unit

H0A.18 **IGBT over-temperature threshold**

Hex:	200A-13h	Effective mode:	Real time
Min. value:	120	Unit:	℃
Max. value:	175	Data type:	UInt16
Default value:	140	Change mode:	Real time

Range:

120 to 175

Parameter descriptions:

Defines the threshold for reporting E640.0 and E640.1.

H0A.19 **Filter time constant of touch probe 1**

Hex:	200A-14h	Effective mode:	Real time
Min. value:	0.00	Unit:	μs
Max. value:	6.30	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:

0.00 to 6.30

Parameter descriptions:

Defines the filter time of touch probe 1.

H0A.20 **Filter time constant of touch probe 2**

Hex:	200A-15h	Effective mode:	Real time
Min. value:	0.00	Unit:	μs
Max. value:	6.30	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:

0.00 to 6.30

Parameter descriptions:

Defines the filter time of touch probe 2.

H0A.21 **STO function selection switch**

Hex:	200A-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

bit0: Show E150.0 fault

bit1: Inverting 60FD

bit2: Mask E150.5 fault

Parameter description

STO function selection switch

bit0: STO display selection 0: The panel displays "sto_" after the STO function is triggered. In this case, no fault is reported and the corresponding DO has no output. 1: The panel displays "E150.0" after the STO function is triggered. In this case, the dive reports the fault and the corresponding DO outputs the fault signal.

bit1: Display selection of bit27 and bit28 of 60FDh 0: After the STO is triggered, bit27 and bit28 of 60FDh = 1; 1: After the STO is triggered, bit27 and bit28 of 60FDh = 0.

bit2: E150.5 fault mask selection 0: Not masked; 1: Masked

H0A.23 **TZ signal filter time**

Hex:	200A-18h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	25 ns
Max. value:	31	Data type:	UInt16
Default value:	15	Change mode:	At stop

Range:

0 to 31

Parameter descriptions:

Defines the TZ signal filter time.

H0A.25 **Speed display DO low-pass filter time**

Hex:	200A-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	5000	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 5000

Parameter descriptions:

Defines the low-pass filter time constant of the speed information for speed feedback and position references.

H0A.26 **Motor overload detection**

Hex:	200A-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Show motor overload warning (E909.0) and fault (E620.0)

1: Hide motor overload alarm (E909.0) and fault (E620.0)

Parameter descriptions:

Defines whether to enable motor overload detection

0: Show motor overload warning (E909.0) and fault (E620.0)

1: Hide motor overload alarm (E909.0) and fault (E620.0)

H0A.27 **Average filter time for speed display DO**

Hex:	200A-1Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	50	Change mode:	At stop

Range:
0 to 100
Parameter descriptions:
Defines the average filter time constant of the speed information for speed feedback and position references.

H0A.28 **ABZ encoder pulse signal filter time**

Hex:	200A-1Dh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	25 ns
Max. value:	255	Data type:	UInt16
Default value:	2	Change mode:	At stop

Range:
0 to 255
Parameter descriptions:
Defines the pulse signal filter time of the ABZ encoder that is used as the master encoder.

H0A.29 **Fully closed-loop encoder (ABZ) filter time**

Hex:	200A-1Eh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	25 ns
Max. value:	65535	Data type:	UInt16
Default value:	4111	Change mode:	At stop

Range:
bit0-bit7: Fully closed loop encoder (ABZ) pulse signal filtering time
bit8-bit15: Fully closed loop encoder (ABZ) wire breakage filter time
Parameter descriptions:
Bit0 to bit7: Fully closed-loop encoder (ABZ) pulse signal filter time.
Bit8 to bit15: Fully closed-loop encoder (ABZ) disconnection filter time.

H0A.32 **Time threshold for locked motor over-temperature protection**

Hex:	200A-21h	Effective mode:	Real time
Min. value:	10	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
10 to 65535
Parameter descriptions:
Defines the over-temperature duration before E630.0 (motor stall) is detected by the servo drive. H0A.32 can be used to adjust the sensitivity of motor stall over-temperature detection.

H0A.33 **Locked rotor over-temperature protection**

Hex:	200A-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: Disabled

1: Enabled

Parameter descriptions:

Defines whether to enable detection for E630.0 (Locked rotor over-temperature protection).

0: Disabled

1: Enabled

H0A.36 **Encoder multi-turn overflow fault selection**

Hex:	200A-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Not hide

1: Hide

Parameter descriptions:

When H02.01 is set to 1 and the multi-turn overflow fault need not be detected, set H0A.36 to 1 to hide this fault.

0: Not hide

1: Hide

H0A.37 **Filter time for ABZ encoder open-circuit detection**

Hex:	200A-26h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	25 ns
Max. value:	255	Data type:	UInt16
Default value:	200	Change mode:	At stop

Range:

0 to 255

Parameter descriptions:

Defines the disconnection detection filter time of the ABZ encoder that is used as the master encoder.

H0A.40 **Compensation function enable**

Hex:	200A-29h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x1F	Data type:	UInt16
Default value:	0x6	Change mode:	At stop

Value range:

bit0: Overtravel compensation

0: Enable

1: Disable

bit1: Touch probe rising edge compensation

0: Disable

1: Enable

bit2: Touch probe falling edge compensation

0: Disable

1: Enable

bit3: Touch probe logic

0: Probe edge trigger coupled with DI logic

1: Probe edge trigger not coupled with DI logic

bit4: Touch probe 2 independent compensation

0: Disable

1: Enable

Parameter description

Selects overtravel and probe compensation functions.

Bit	Name	Description
0	Overtravel compensation	0: Enable
		1: Disable
1	Probe rising edge compensation	0: Disable
		1: Enable
2	Probe falling edge compensation	0: Disable
		1: Enable
3	Touch probe logic	0: Probe edge trigger coupled with DI logic
		1: Probe edge trigger not coupled with DI logic
4	Touch probe 2 function selection	0: Disable
		1: Enable

H0A.41 **Forward position of software position limit**

Hex:	200A-2Ah	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	2147483647	Change mode:	At stop

Range:
-2147483648 to 2147483647
Parameter descriptions:
When the absolute position counter (H0b.07) is larger than H0A.41, the drive reports E950.0 (Forward overtravel) and stops accordingly.

H0A.43 **Reverse position of software position limit**

Hex:	200A-2Ch	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	-2147483648	Change mode:	At stop

Range:
-2147483648 to 2147483647
Parameter descriptions:
When the absolute position counter (H0b.07) is smaller than H0A.43, the drive reports E952.0 (Reverse overtravel) and stops accordingly.

H0A.49 **Regenerative resistor overtemperature threshold**

Hex:	200A-32h	Effective mode:	Real time
Min. value:	100	Unit:	℃
Max. value:	175	Data type:	UInt16
Default value:	140	Change mode:	Real time

Range:
100 to 175
Parameter descriptions:
Defines the temperature threshold for braking resistor overload.

H0A.50 **Encoder communication fault tolerance threshold**

Hex:	200A-33h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	31	Data type:	UInt16
Default value:	31	Change mode:	Real time

Range:
0 to 31
Parameter descriptions:
When the number of communication failures between the encoder and the drive exceeds the number defined by H0A.50, the communication between the encoder and the drive fails.

H0A.51 **Phase loss detection filter times**

Hex:	200A-34h	Effective mode:	Real time
Min. value:	3	Unit:	55 ms
Max. value:	36	Data type:	UInt16
Default value:	20	Change mode:	Real time

Range:

3 to 36

Parameter descriptions:

Phase loss fault is reported when phase loss keeps active for a period longer than H0A.51.

H0A.52 **Encoder temperature protection threshold**

Hex:	200A-35h	Effective mode:	Real time
Min. value:	0	Unit:	℃
Max. value:	175	Data type:	UInt16
Default value:	120	Change mode:	Real time

Range:

0 to 175

Parameter descriptions:

Defines the temperature threshold for encoder overtemperature protection.

H0A.53 **Probe DI ON compensation time**

Hex:	200A-36h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	200	Change mode:	Real time

Range:

-3000 to 3000

Parameter descriptions:

Used to compensate for the action time when the touch probe is switched on.

H0A.54 **Probe DI OFF compensation time**

Hex:	200A-37h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	1512	Change mode:	Real time

Range:

-3000 to 3000

Parameter descriptions:

Used to compensate for the action time when the touch probe is switched off.

H0A.55 **Runaway current threshold**

Hex:	200A-38h	Effective mode:	Real time
Min. value:	100.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	200.0	Change mode:	Real time

Range:

100.0 to 400.0

Parameter descriptions:

Defines the current threshold for runaway protection detection.

H0A.56 **Fault reset delay**

Hex:	200A-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	60000	Data type:	UInt16
Default value:	10000	Change mode:	Real time

Range:
0 to 60000
Parameter descriptions:
Defines the fault reset delay.

H0A.57 **Runaway speed threshold**

Hex:	200A-3Ah	Effective mode:	Real time
Min. value:	1	Unit:	rpm
Max. value:	1000	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
1 to 1000
Parameter descriptions:
Defines the overspeed threshold for runaway protection detection.

H0A.58 **Runaway speed filter time**

Hex:	200A-3Bh	Effective mode:	Upon the next power-on
Min. value:	0.1	Unit:	ms
Max. value:	100.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Range:
0.1 to 100.0
Parameter descriptions:
Defines the speed feedback filter time for runaway protection detection.

H0A.59 **Runaway protection detection time**

Hex:	200A-3Ch	Effective mode:	Real time
Min. value:	10	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	30	Change mode:	Real time

Range:
10 to 1000
Parameter descriptions:
The runaway fault will be reported when the runaway state keeps active for a period longer than H0A.59.

H0A.60 **Black box function mode**

Hex:	200A-3Dh	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: Disable

1: Any fault

2: Designated fault

3: Triggered based on designated condition

Parameter descriptions:

Defines the condition for triggering black box sampling.

0: Disable

1: Any fault

2: Designated fault

3: Triggered based on designated condition

H0A.61 **Designated fault code**

Hex:	200A-3Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Defines the fault code for triggering the black box function.

H0A.62 **Trigger source**

Hex:	200A-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	27	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 27

Parameter descriptions:

Defines the fault code for triggering the black box function through designated channel.

H0A.63 **Trigger level**

Hex:	200A-40h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Defines the trigger level for triggering the black box function through designated channel.

H0A.65 **Trigger level**

Hex:	200A-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Rising edge

1: Equal

2: Falling edge

3: Edge-triggered

Parameter descriptions:

Defines the trigger mode for triggering the black box function through H0A.63.

0: Rising edge

1: Equal

2: Falling edge

3: Edge-triggered

H0A.66 **Trigger position**

Hex:	200A-43h	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	75	Change mode:	Real time

Range:

0 to 100

Parameter descriptions:

Defines the pre-trigger position for triggering black box sampling.

H0A.67 **Sampling frequency**

Hex:	200A-44h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Current loop

1: Position loop

2: Main cycle

Parameter descriptions:

Defines the frequency sampling mode during black box sampling.

0: Current loop

1: Position loop

2: Main cycle

H0A.70 **Overspeed threshold 2**

Hex:	200A-47h	Effective mode:	Real time

Min. value:	0	Unit:	rpm
Max. value:	20000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 20000
Parameter descriptions:
Defines the speed threshold for reporting E500.2 (Position feedback pulse overspeed).

H0A.71 **Internal function switchover switch**

Hex:	200A-48h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	4098	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:

Bit	Name	Description
0	Motor overload curve selection	0: New 1: Old
1	Power failure bleeder switch	0: Enable 1: Enable
2	Forced brake motor stop	0: Enable 1: Disable
3	Multi-speed control DI mode	0: Old characteristic 1: New characteristic
4	E120.3 mask switch	0: Enabled 1: Disabled
5	Prohibit software reading function code	0: Disabled 1: Enabled
6	E108.4 mask switch	0: Disabled 1: Enabled
7	CSV instruction interpolation method	0: Sync interrupt interpolation 1: IRQ interrupt interpolation
8	The data type that is used for the rated motor current, inertia, and back EMF coefficient.	0: 16-bit 1: 32-bit
9	Disconnection detection	0: Enable 1: Disable
10	Torque limit source	0: Auto switch according to H02.00 1: H07.09 and H07.10
11	Ultra-accurate speed feedback	0: Disable 1: Enable
12	Homing completion flag retained upon power failure	0: Disable 1: Enable

Bit	Name	Description
13	STO status word switch	0: Switch on disable 1: Fault
14	Encoder adaptive function	0: Enable 1: Disable
15	Interrupt positioning	0: Interrupt positioning determined by current motor running direction 1: Interrupt positioning determined by parameter

H0A.72 **Maximum stop time in ramp-to-stop**

Hex:	200A-49h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10000	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the time for the motor to decelerate from the maximum speed to 0 [mm/s]/[rpm] during ramp-to-stop.

H0A.73 **STO 24 V disconnection filter time**

Hex:	200A-4Ah	Effective mode:	Real time
Min. value:	1	Unit:	ms
Max. value:	5	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
1 to 5
Parameter descriptions:
Defines the delay from the moment when 24 V is disconnected to the moment when the STO state applies.

H0A.74 **Filter time for two inconsistent STO channels**

Hex:	200A-4Bh	Effective mode:	Real time
Min. value:	1	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
1 to 1000
Parameter descriptions:
Defines the delay from the moment the inconsistent 24V is input to the drive through two channels to the moment when the STO state applies.

H0A.75 **Servo OFF delay after STO triggered**

Hex:	200A-4Ch	Effective mode:	Real time

Min. value:	0	Unit:	ms
Max. value:	25	Data type:	UInt16
Default value:	20	Change mode:	Real time

Range:
0 to 25
Parameter descriptions:
Defines the delay from the moment the STO state is triggered to the moment the S-ON signal is switched off.

H0A.81 **Voltage drop protection enable**

Comm. address:	200 A-52h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation1
: Host controller executes torque limit
2: Servo executes torque limit
Parameter description
Defines whether to enable voltage drop protection.
0: No operation1
: Host controller executes torque limit
2: Servo executes torque limit

H0A.82 **Voltage drop torque limit**

Comm. address:	200 A-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Value range:
0.0 to 100.0
Parameter description
Defines the voltage drop torque limit.

H0A.83 **Torque limit cancellation time**

Comm. address:	200 A-54h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 1000
Parameter description
Defines the torque limit deactivation time.

H0A.84 **Hold time of instantaneous power failure**

Comm. address:	200 A-55h	Effective mode:	Real time
Min. value:	20	Unit:	ms
Max. value:	50000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
20 to 50000
Parameter description
Defines the instantaneous power failure hold time.

H0A.85 **Open circuit detection torque reference**

Comm. address:	200A-56h	Effective mode:	Real time
Min. value:	4.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	5.0	Change mode:	At stop

Value range:
4.0 to 400.0
Parameter description
Defines the open circuit detection torque reference.

H0A.86 **Open circuit detection filter time**

Comm. address:	200A-57h	Effective mode:	Real time
Min. value:	5	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	30	Change mode:	At stop

Value range:
5 to 1000
Parameter description
Defines the open circuit detection filter time.

H0A.87 **Number of Hall status fault filtering times**

Hex:	200A-58h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1000	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
0 to 1000
Parameter descriptions:
Defines the number of hall status fault filtering times.

H0A.90 **Speed display low-pass filter time**

Hex:	200A-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 100
Parameter descriptions:
Defines the low-pass filter time constant for displayed speed values.

H0A.91 **Moving average filter time for torque display values**

Hex:	200A-5Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 100
Parameter descriptions:
Defines the moving average filter time constant for displayed torque values.

H0A.92 **Moving average filter time for position display values**

Hex:	200A-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 100
Parameter descriptions:
Defines the moving average filter time constant for displayed position values.

H0A.93 **Low-pass filter time for displayed voltage values**

Hex:	200A-5Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	250	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 250
Parameter descriptions:
Defines the low-pass filter time constant for displayed voltage values.

H0A.94 **Low-pass filter time for displayed thermal values**

Hex:	200A-5Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	250	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 250

Parameter descriptions:

Defines the low-pass filter time constant for displayed thermal values.

15.12 H0b Monitoring Parameters

H0b.00 **Actual motor speed**

Hex:	200b-01h	Effective mode:	-
Min. value:	-32767	Unit:	rpm
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:

-32767 to 32767

Parameter descriptions:

Indicates the actual motor speed after round-off, which is accurate to 1 (mm/s)/rpm.

You can set in H0A.25 the filter time constant for H0b.00.

H0b.01 **Speed reference**

Hex:	200b-02h	Effective mode:	-
Min. value:	-32767	Unit:	rpm
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:

-32767 to 32767

Parameter descriptions:

Indicates the present speed reference (accurate to 1 [mm/s]/[rpm]) of the drive in the position and speed control modes.

H0b.02 **Internal torque reference**

Hex:	200b-03h	Effective mode:	-
Min. value:	-3276.7	Unit:	%
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Range:

-3276.7 to 3276.7

Parameter descriptions:

Displays the current torque reference in unit of 0.1%. The value 100.0% corresponds to the rated motor torque.

H0b.03 **Input (DI) signal monitoring**

Hex:	200b-04h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16

Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the level status of 5 DI terminals without filtering.
Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0")

H0b.05 Output (DO) signal monitoring

Hex:	200b-06h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the level status of 2 DO terminals without filtering.
Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0")

H0b.07 Absolute position counter

Hex:	200b-08h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays current absolute position of the motor in reference unit.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.09 Mechanical angle

Hex:	200b-0Ah	Effective mode:	-
Min. value:	0.0	Unit:	°
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 360.0
Parameter descriptions:
Displays present mechanical angle in encoder unit of the motor. The setpoint 0 indicates the mechanical angle is 0°.
Actual mechanical angle = 360° x H0b.09/(Maximum value of H0b.09 + 1)

Maximum value of H0b.09 for an absolute encoder is 65535.

H0b.10 **Electrical angle**

Hex:	200b-0Bh	Effective mode:	-
Min. value:	0.0	Unit:	°
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 360.0
Parameter descriptions:
Indicates the present electrical angle of the motor, which is accurate to 0.1°.
The electrical angle variation range is ±360.0° during rotation. If the motor has four pairs of poles, each revolution generates four rounds of angle change from 0° to 359°. Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle change from 0° to 359°.

H0b.12 **Average load ratio**

Hex:	200b-0Dh	Effective mode:	-
Min. value:	0.0	Unit:	%
Max. value:	800.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 800.0
Parameter descriptions:

H0b.15 **Position following error (encoder unit)**

Hex:	200b-10h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Used to count and display the position deviation value after being divided or multiplied by the electronic gear ratio in the position control mode.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
Note:
H0b.15 can be cleared when the condition defined in H05.16 (Clear action) is met.

H0b.17 **Feedback pulse counter**

Hex:	200b-12h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:

-2147483648 to 2147483647

Parameter descriptions:

Used to count the position pulses fed back by the encoder in any control mode.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.19 Total power-on time

Hex:	200b-14h	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Range:

0.0 to 429496729.5

Parameter descriptions:

Used to record the total operating time of the servo drive.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
Note:
If the servo drive is switched on and off repeatedly within a short period of time, a deviation within 1h may be present in the total power-on time record.

H0b.21 Displayed AI1 voltage

Hex:	200b-16h	Effective mode:	-
Min. value:	-327.67	Unit:	V
Max. value:	327.67	Data type:	Int16
Default value:	0.00	Change mode:	Read-only

Range:

-327.67 to 327.67

Parameter descriptions:

Displays the actual sampling voltage of AI1.

H0b.22 Displayed AI2 voltage

Hex:	200b-17h	Effective mode:	-
Min. value:	-327.67	Unit:	V
Max. value:	327.67	Data type:	Int16
Default:	0.00	Change mode:	Read-only

Range:

-327.67 to 327.67

Parameter descriptions:

Displays the actual sampling voltage of AI2.

H0b.24 Phase current RMS value

Hex:	200b-19h	Effective mode:	-
Min. value:	0.0	Unit:	A
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the RMS value of the phase current of the motor in unit of 0.1 A.

H0b.25 Angle obtained upon voltage injection auto-tuning

Hex:	200b-1Ah	Effective mode:	-
Min. value:	0.0	Unit:	°
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 360.0
Parameter descriptions:
Displays the angle obtained upon voltage injection auto-tuning.

H0b.26 Bus voltage

Hex:	200b-1Bh	Effective mode:	-
Min. value:	0.0	Unit:	V
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the DC bus voltage of the main circuit input voltage after rectification, which is accurate to 0.01 V.

H0b.27 Module temperature

Hex:	200b-1Ch	Effective mode:	-
Min. value:	-20	Unit:	℃
Max. value:	200	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-20 to 200
Parameter descriptions:
Indicates the temperature of the module inside the servo drive, which can be used as a reference for estimating the actual temperature of the drive.

H0b.28 Absolute encoder fault information given by FPGA

Hex:	200b-1Dh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF

Parameter descriptions:
Displays the absolute encoder fault information given by FPGA.

H0b.29 Axis status information given by FPGA

Hex:	200b-1Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the axis status information given by FPGA.

H0b.30 Axis fault information given by FPGA

Hex:	200b-1Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the axis fault information given by FPGA.

H0b.31 Encoder fault information

Hex:	200b-20h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the internal fault information of the encoder.

H0b.33 Fault log

Hex:	200b-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	19	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Present fault
1: Last fault
2: 2nd to last fault
3: 3rd to last fault
4: 4th to last fault
5: 5th to last fault 6: 6th to last fault
7: 7th to last fault
8: 8th to last fault
9: 9th to last fault
10: 10th to last fault
11: 11th to last fault
12: 12th to last fault
13: 13th to last fault
14: 14th to last fault
15: 15th to last fault
16: 16th to last fault
17: 17th to last fault
18: 18th to last fault
19: 19th to last fault

Parameter descriptions:

Used to view the latest 20 faults of the drive.

0: Present fault
1: Last fault
2: 2nd to last fault
3: 3rd to last fault
4: 4th to last fault
5: 5th to last fault 6: 6th to last fault
7: 7th to last fault
8: 8th to last fault
9: 9th to last fault
10: 10th to last fault
11: 11th to last fault
12: 12th to last fault
13: 13th to last fault
14: 14th to last fault
15: 15th to last fault
16: 16th to last fault
17: 17th to last fault
18: 18th to last fault
19: 19th to last fault

H0b.34 **Fault code of selected fault**

Hex:	200b-23h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the fault code of the selected fault.

H0b.35 Timestamp of the selected fault

Hex:	200b-24h	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 429496729.5
Parameter descriptions:
Displays the time stamp of the selected fault.

H0b.37 Motor speed upon when the selected fault occurred

Hex:	200b-26h	Effective mode:	-
Min. value:	-32767	Unit:	rpm
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-32767 to 32767
Parameter descriptions:
Displays the motor speed upon occurrence of the selected fault.

H0b.38 Motor phase U current when the selected fault occurred

Hex:	200b-27h	Effective mode:	-
Min. value:	-3276.7	Unit:	A
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Range:
-3276.7 to 3276.7
Parameter descriptions:
Displays the motor phase U current upon occurrence of the selected fault.

H0b.39 Motor phase V current when the selected fault occurred

Hex:	200b-28h	Effective mode:	-
Min. value:	-3276.7	Unit:	A
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Range:
-3276.7 to 3276.7
Parameter descriptions:
Displays the motor phase V current upon occurrence of the selected fault.

H0b.40 **Bus voltage upon occurrence of the selected fault**

Hex:	200b-29h	Effective mode:	-
Min. value:	0.0	Unit:	V
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the bus voltage upon occurrence of the selected fault.

H0b.41 **Input terminal state when the selected fault occurred**

Hex:	200b-2Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the input terminal state upon occurrence of the selected fault.

H0b.43 **Output terminal status when the selected fault occurred**

Hex:	200b-2Ch	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the output terminal status upon occurrence of the selected fault.

H0b.45 **Internal fault code**

Hex:	200b-2Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the internal fault code.

H0b.46 **Absolute encoder fault information given by FPGA upon occurrence of the selected fault**

Hex:	200b-2Fh	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the absolute encoder fault information given by FPGA upon occurrence of the selected fault.

H0b.47 System status information given by FPGA upon occurrence of the selected fault

Hex:	200b-30h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the system status information given by FPGA upon occurrence of the selected fault.

H0b.48 System fault information given by FPGA upon occurrence of the selected fault

Hex:	200b-31h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the system fault information given by FPGA upon occurrence of the selected fault.

H0b.49 Encoder fault information upon occurrence of the selected fault

Hex:	200b-32h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the encoder fault information upon occurrence of the selected fault.

H0b.51 Internal fault code upon occurrence of the selected fault

Hex:	200b-34h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the internal fault code upon occurrence of the selected fault.

H0b.52 FPGA timeout fault standard bit upon occurrence of the selected fault

Hex:	200b-35h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the FPGA timeout fault standard bit upon occurrence of the selected fault.

H0b.53 Position following error (reference unit)

Hex:	200b-36h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Indicates the position deviation value which has not been divided or multiplied by the electronic gear ratio in the position control mode.
Position deviation (reference unit) is the value obtained after encoder position deviation calculation. The precision is compromised during division.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.55 Actual motor speed 2

Hex:	200b-38h	Effective mode:	-
Min. value:	-214748364.8	Unit:	rpm
Max. value:	214748364.7	Data type:	Int32
Default value:	0.0	Change mode:	Read-only

Range:
-214748364.8 to 214748364.7
Parameter descriptions:
Indicates the actual value of motor speed, which is accurate to 0.1 [mm/s]/[rpm].
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
H0A.25 defines the filter time for the speed feedback.

H0b.57 Control circuit bus voltage

Hex:	200b-3Ah	Effective mode:	-
Min. value:	0.0	Unit:	V
Max. value:	6553.5	Data type:	UInt16

Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 6553.5
Parameter descriptions:
Displays the bus voltage of the control circuit.

H0b.58 Mechanical absolute position (low 32 bits)

Hex:	200b-3Bh	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 4294967295
Parameter descriptions:
Displays the low 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.

H0b.60 Mechanical absolute position (high 32 bits)

Hex:	200b-3Dh	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the high 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.

H0b.63 NotRdy state

Hex:	200b-40h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0: Normal 1: Control circuit error 2: Main circuit input error 3: Bus undervoltage 4: Soft start failed 5: Encoder initialization not done 6: Short circuit to ground failed 7: Others 8: STO9: Initialization of fully closed-loop encoder not done
Parameter descriptions:
Displays the reason for the NRD state.
0: Normal 1: Control circuit error 2: Main circuit input error 3: Bus undervoltage 4: Soft start failed 5: Encoder initialization not done 6: Short circuit to ground failed 7: Others 8: STO9: Initialization of fully closed-loop encoder not done

H0b.66 **Encoder temperature**

Hex:	200b-43h	Effective mode:	-
Min. value:	-32768	Unit:	℃
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-32768 to 32767
Parameter descriptions:
Indicates the encoder temperature.

H0b.67 **Load rate of regenerative resistor**

Hex:	200b-44h	Effective mode:	-
Min. value:	0.0	Unit:	%
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 200.0
Parameter descriptions:
Displays the load rate of the braking resistor.

H0b.70 **Number of absolute encoder revolutions**

Hex:	200b-47h	Effective mode:	-
Min. value:	-32768	Unit:	Rev
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-32768 to 32767
Parameter descriptions:
Indicates the number of revolutions of the absolute encoder.

H0b.71 **Single-turn position fed back by the absolute encoder**

Hex:	200b-48h	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	2147483647	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 2147483647
Parameter descriptions:
Displays the position feedback of the absolute encoder within one turn.

H0b.74 **System fault information given by FPGA**

Hex:	200b-4Bh	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the system fault information given by FPGA.

H0b.77 Encoder position (low 32 bits)

Hex:	200b-4Eh	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 4294967295
Parameter descriptions:
Displays the low 32-bit value of the position feedback of the absolute encoder.

H0b.79 Encoder position (high 32 bits)

Hex:	200b-50h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the high 32-bit value of the position feedback of the absolute encoder.

H0b.81 Single-turn position of the rotary load (low 32 bits)

Hex:	200b-52h	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 4294967295
Parameter descriptions:
Displays the low 32-bit value of the position feedback of the rotary load when the absolute system works in the rotation mode.

H0b.83 Single-turn position of the rotary load (high 32 bits)

Hex:	200b-54h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the high 32-bit value of the position feedback of the rotary load when the absolute system works in the rotation mode.

H0b.85 Single-turn position of the rotary load (reference unit)

Hex:	200b-56h	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 4294967295
Parameter descriptions:
Displays the high 32-bit value of the position feedback of the rotary load when the absolute system works in the rotation mode.

H0b.87 IGBT junction temperature

Hex:	200b-58h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	200	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 200
Parameter descriptions:
Displays the IGBT junction temperature.

H0b.90 Group No. of the abnormal parameter

Hex:	200b-5Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the group No. of the abnormal parameter.

H0b.91 Offset within the group of the abnormal parameter

Hex:	200b-5Ch	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535

Parameter descriptions:
Displays the offset within the group of the abnormal parameter.

H0b.92 Hall state check

Hex:	200b-5Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the Hall state.

H0b.93 Closed loop state

Hex:	200b-5Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0: Half closed loop
1: Fully closed loop
Parameter descriptions:
Displays the closed loop state in position control mode.
0: Half closed loop
1: Fully closed loop

H0b.94 Individual power-on time

Hex:	200b-5Fh	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 429496729.5
Parameter descriptions:
Display the individual power-on time of the drive.

H0b.96 Individual power-on time upon occurrence of the selected fault

Hex:	200b-61h	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 429496729.5

Parameter descriptions:
Displays the individual power-on time upon occurrence of the selected fault.

H0b.98 **Dynamic braking resistor load rate**

Hex:	200b-63h	Effective mode:	-
Min. value:	0.0	Unit:	%
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 200.0
Parameter descriptions:
Display dynamic braking resistor load rate.

15.13 H0C Fault and Protection Parameters 2

H0C.53 **Probe DI ON compensation time 2**

Hex:	200C-36h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	200	Change mode:	Real time

Range:
-3000 to 3000
Parameter descriptions:
Used to compensate for the action time when the touch probe 2 is switched on. (Active when H0A.40bit4=1)

H0C.54 **Probe DI OFF compensation time 2**

Hex:	200C-37h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	1512	Change mode:	Real time

Value range:
-3000 to 3000
Parameter description
Compensates for the action time when touch probe 2 is switched off. (active when bit4 of H0A.40 = 1)

H0C.71 **Internal function switchover switch 2**

Hex:	200C-48h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	512	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Bit9: FPGA encoder feedback overspeed threshold shield switch

H0C.72 **Internal function switchover switch 3**

Hex:	200C-49h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
bit6: Fault level switchover
0: Supported
1: Not supported
bit10: Whether to upload the E08.7 error frame signal to the host controller
0: Upload
1: Not upload

H0C.73 **Internal function switch 4**

Hex:	200C-4Ah	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Parameter description
bit1: Anti-voltage dip function, which automatically switches to the baud rate of 2 M at power-on, preventing E136 and E740 (Voltage dip) alarms.
0: ON
1: OFF
bit2: Overcurrent detection scheme switchover
0: New scheme 202/203
1: Old scheme 201
bit4: Whether E601.3 is enabled after E740.0 is reported and homing is completed in incremental mode
0: ON
1: OFF

H0C.80 **Fault level register**

Hex:	200C-51h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

Bit0 to bit3: E234.0

0: Default

1: No.1 non-resettable

2: No.1 resettable

Bit4 to bit7: EB00.0 0

: Default

2: No.1 resettable

4: No.2 resettable

Bit8 to bit11: EB00.1

0: Default

2: No.1 resettable

4: No.2 resettable

Bit12 to bit15: E234.1

0: Default

1: No.1 non-resettable

2: No.1 resettable

Parameter descriptions:

Bit0 to bit3: E234.0 supports No.1 non-resettable and No.1 resettable fault escalation and de-escalation

Bit4 to bit7: EB00.0 supports No.1 resettable and No.2 resettable fault escalation and de-escalation

Bit8 to bit11: EB00.1 supports No.1 resettable and No.2 resettable fault escalation and de-escalation

Bit12 to bit15: E234.1 supports No.1 non-resettable and No.1 resettable fault escalation and de-escalation

15.14 H0d Auxiliary Function Parameters

H0d.00 **Software reset**

Hex:	200d-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: No operation

1: Enable

Parameter descriptions:

0: No operation 1: Enable Programs in the drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.

H0d.01 **Fault reset**

Hex:	200d-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16

Default value:	0	Change mode:	At stop

Range:
0: No operation
1: Enable
Parameter descriptions:
0: No operation 1: Enable When a No. 1 or No. 2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause, stopping the keypad from displaying the fault and allowing the drive to enter the "rdy" state.
When a No. 3 alarm occurs, you can enable the fault reset function directly, regardless of the servo drive status.

H0d.02 **Inertia auto-tuning**

Hex:	200d-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65
Parameter descriptions:
Used to enable offline inertia auto-tuning through the keypad. In the parameter display mode, switch to H0d.02 and press the SET key to enable offline inertia auto-tuning.

H0d.04 **Read/write in encoder ROM**

Hex:	200d-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: No operation
1: Write ROM
2: Read ROM
3: ROM failure
Parameter descriptions:
For Inovance encoders, to activate parameters, disconnect the USB and control circuit after writing in ROM. Ensure that the drive is powered on during parameter writing.
0: No operation
1: Write ROM
2: Read ROM
3: ROM failure

H0d.05 **Emergency stop**

Hex:	200d-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: No operation
1: Emergency stop
Parameter description
Enable emergency stop through parameters.
0: No operation
1: Enable
Note: The stop mode corresponding to H0d.05 is defined by H02.05 or 605Ch.

H0d.06 Current loop auto-tuning test

Hex:	200d-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	6	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: No operation 1: Enable current loop auto-tuning 2: Enable current loop step test (static) 3: Enable current loop step test
Parameter descriptions:
0: No operation 1: Enable current loop auto-tuning 2: Enable current loop step test (static) 3: Enable current loop step test

H0d.10 Auto-tuning of analog channel

Hex:	200d-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: No operation 1: Adjust AI1 2: Adjust AI2
Parameter descriptions:
When automatic adjustment of the analog channel is enabled, the drive automatically corrects the zero drift voltage of the analog channel to improve signal detection accuracy.
0: No operation 1: Adjust AI1 2: Adjust AI2

H0d.12 Phase U/V current balance correction

Hex:	200d-0Dh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Disable
1: Enable
Parameter descriptions:
Phase U/V current balance correction
0: Disable
1: Enable

H0d.17 Forced DI/DO enable switch

Hex:	200d-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Forced DI enable switch

0: Disable

1: Enable

bit1: Forced DO enable switch

0: Disable

1: Enable

Parameter descriptions:

Defines whether to enable forced DI/DO.

Bit0: defines whether to enable forced DI.

0: Disable

1: Enable

bit1: Defines whether to enable forced DO

0: Disable

1: Enable

H0d.18 Forced DI value

Hex:	200d-13h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x1F	Data type:	UInt16
Default value:	0x1F	Change mode:	Real time

Range:

0x0 to 0x1F

Parameter descriptions:

Defines whether the DI functions set in group H03 is active when forced DI is activated (H0d.17 = 1 or 3).

H0d.18 is displayed in hex on the keypad. In the converted binary value, bit(n) = 1 indicates that the DI is active high, and bit(n) = 0 indicates that the DI is active low.

H0d.19 Forced DO value

Hex:	200d-14h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x3	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:

0x0 to 0x3

Parameter descriptions:

Defines whether the DO functions assigned in group H04 are active when forced DO is active (H0d.17 = 2 or 3).

H0d.19 is displayed in hex on the keypad. In the converted binary value, bit(n) = 1 indicates that the DO function is active, and bit(n) = 0 indicates that the DO function is inactive.

H0d.20 **Absolute encoder reset**

Hex:	200d-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: No operation

1: Reset fault

2: Reset fault and multi-turn data

3: Reset Inovance 2nd encoder fault

4: Reset Inovance 2nd encoder fault and multi-turn data

Parameter descriptions:

Set H0d.20 to determine whether to reset the encoder internal faults and encoder feedback multi-turn data.

0: No operation

1: Reset fault

2: Reset fault and multi-turn data

3: Reset Inovance 2nd encoder fault

4: Reset Inovance 2nd encoder fault and multi-turn data

H0d.29 **Motor parameter auto-tuning**

Hex:	200d-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: No operation

1: Enabled

Parameter descriptions:

Resistor inductance auto-tuning

0: No operation

1: Enabled

15.15 H0E Communication Function Parameters

H0E.00 **Node address**

Hex:	200E-01h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	127	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

1 to 127

Parameter descriptions:

CAN Indicates the slave node address. Ensure this parameter is consistent with the configuration of the host controller.

H0E.01 **Save data written through communication to EEPROM**

Hex:	200E-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	4	Change mode:	Real time

Value range:

0: Not save

1: Save parameters

2: Save object dictionaries

3: Save parameters and object dictionaries

4: Save object dictionaries written before communication (OP)

255: Determined by H0E.03 and H0E.04

Parameter description

Defines whether to save parameters and object dictionaries written through the serial port or SDO communication.

0: Not save

1: Save parameters

2: Save object dictionaries

3: Save parameters and object dictionaries

4: Save object dictionaries written before communication (OP)

255: Determined by H0E.03 and H0E.04

H0E.03 **Save objects written through software tool (commissioning protocol) to EEPROM**

Hex:	200E-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: Not save 1: Save

Parameter descriptions:

Saves objects written through software (commissioning protocol) EEPROM, including the parameter and object dictionary.

0: Parameters not saved to EEPROM

1: Parameters saved to EEPROM

H0E.04 **Save objects written through communication to EEPROM (excluding commissioning protocol)**

Hex:	200E-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Not save

1: Save

Parameter description

You can use this parameter to determine whether to save communication-written data in EEPROM (excluding the commissioning protocol) (CANopen, CANLink, Ethernet COE, and ModBus485). The data includes the function code and object dictionary.

0: Parameters not saved to EEPROM

1: Parameters saved to EEPROM

H0E.07 **Object dictionary unit selection**

Hex:	200E-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Reference unit system (p/s, p/s²) 1: User unit system (0.01 [mm/s]/[rpm], ms)

Parameter descriptions:

Servo unit system switching:

0: Reference unit system. The unit for the speed-type object dictionary is p/s and the acceleration-type object dictionary is p/s².

1: User unit system. The unit for the speed-type object dictionary is 0.01 [mm/s]/[rpm], and the unit for the acceleration-type object dictionary is the time (ms) taken to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm].

H0E.20 **EtherCAT slave name**

Hex:	200E-15h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 65535

Parameter descriptions:

Defines the EtherCAT slave name.

H0E.21 **EtherCAT slave alias**

Hex:	200E-16h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the EtherCAT slave alias.

H0E.22 **Number of synchronous loss events allowed by EtherCAT**

Hex:	200E-17h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	8	Change mode:	Real time

Range:
1 to 20
Parameter descriptions:
Defines the number of sync loss errors allowed by EtherCAT.

H0E.24 **Sync loss count**

Hex:	200E-19h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Defines the number of sync loss errors.

H0E.25 **Max. error value and invalid frames of EtherCAT port 0 per unit time**

Hex:	200E-1Ah	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Defines the maximum error value and invalid frames of EtherCAT port 0 per unit time.

H0E.26 **Max. error value and invalid frames of EtherCAT port 1 per unit time**

Hex:	200E-1Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Defines the maximum error value and invalid frames of EtherCAT port 1 per unit time.

H0E.27 **Max. transfer error of EtherCAT port per unit time**

Hex:	200E-1Ch	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Defines the maximum EtherCAT port forwarding errors per unit time.

H0E.28 **Max. EtherCAT data frame processing unit error per unit time**

Hex:	200E-1Dh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFF
Parameter descriptions:
Defines the maximum EtherCAT data frame processing unit error per unit time.

H0E.29 **Max. link loss value of EtherCAT port 0 per unit time**

Hex:	200E-1Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Defines the maximum EtherCAT port 0 link losses per unit time.

H0E.31 **EtherCAT synchronization mode setting**

Hex:	200E-20h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	2	Change mode:	At stop

Range:
0 to 3
Parameter descriptions:
Defines the EtherCAT synchronization mode.

H0E.32 **EtherCAT synchronization error threshold**

Hex:	200E-21h	Effective mode:	Real time
Min. value:	100	Unit:	ns
Max. value:	8000	Data type:	UInt16
Default value:	4000	Change mode:	At stop

Range:

100 to 8000

Parameter descriptions:

Defines the EtherCAT synchronization error threshold.

H0E.33 **EtherCAT state machine status and port connection status**

Hex:	200E-22h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter descriptions:

Defines the EtherCAT state machine status and port connection status.

H0E.34 **Number of excessive CSP position reference increment events**

Hex:	200E-23h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	30	Data type:	UInt16
Default value:	20	Change mode:	Real time

Range:

1 to 30

Parameter descriptions:

Defines the number of excessive CSP position reference increment events.

H0E.35 **AL fault code**

Hex:	200E-24h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter descriptions:

Displays the AL fault code.

H0E.36 **EtherCAT enhanced link enable**

Hex:	200E-25h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter descriptions:

Defines whether to enable the EtherCAT enhanced link.
0: Disable
1: Enable

H0E.37 **EtherCAT XML reset selection**

Hex:	200E-26h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disable
1: Enable
Parameter descriptions:
Defines whether to enable EtherCAT XML reset.
0: Disable
1: Enable

H0E.73 **EtherCAT port control mode and status display**

Hex:	200E-4Ah	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Defines the EtherCAT port control mode and status display.

H0E.80 **Modbus baud rate**

Hex:	200E-51h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	9	Change mode:	Real time

Range:
0: 300 bps
1: 600 bps
2: 1200 bps
3: 2400 bps
4: 4800 bps
5: 9600 bps
6: 19200 bps
7: 38400 bps
8: 57600 bps
9: 115200 bps
Parameter descriptions:

Defines the communication rate between the servo drive and the host controller. The baud rate set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.

0: 300 bps

1: 600 bps

2: 1200 bps

3: 2400 bps

4: 4800 bps

5: 9600 bps

6: 19200 bps

7: 38400 bps

8: 57600 bps

9: 115200 bps

H0E.81 **Modbus data format**

Hex:	200E-52h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	3	Change mode:	Real time

Range:

0: No parity, 2 stop bits (N-2)

1: Even parity, 1 stop bit (E-1)

2: Odd parity, 1 stop bit (O-1)

3: No parity, 1 stop bit (N-1)

Parameter descriptions:

Defines the data check mode between the servo drive and the host controller during communication.

0: No parity, 2 stop bits

1: Even parity, 1 stop bit

2: Odd parity, 1 stop bit

3: No parity, 1 stop bit

The data format of the servo drive must be the same as that of the host controller. Otherwise, communication will fail.

H0E.82 **Modbus response delay**

Hex:	200E-53h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 20

Parameter descriptions:

Defines the delay from the moment when the slave receives a command from the host controller to the moment when the slave returns a response.

H0E.83 **Modbus communication timeout**

Hex:	200E-54h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	600	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 600
Parameter descriptions:
Defines the Modbus communication timeout period.

H0E.84 **Modbus communication data sequence**

Hex:	200E-55h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
0: High bits before low bits
1: Low bits before high bits
Parameter descriptions:
Defines the 32-bit data transmission format of Modbus communication.
0: High 16 bits before low 16 bits
1: Low 16 bits before high 16 bits

H0E.90 **Communication version**

Hex:	200E-5Bh	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Range:
0.00 to 655.35
Parameter descriptions:
Displays the communication version.

H0E.96 **XML version information**

Hex:	200E-61h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Range:
0.00 to 655.35
Parameter descriptions:
Displays the XML version information.

15.16 H0F Fully Closed-loop Parameters

H0F.00 **Encoder feedback mode**

Hex:	200F-01h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Internal encoder feedback

1: External encoder feedback

2: Inner/Outer loop switchover

Parameter descriptions:

Defines the encoder feedback signal source in fully closed-loop control.

0: Internal encoder feedback (Position feedback signals come from the built-in encoder). 1: External encoder feedback (Position feedback signals come from the fully closed-loop external encoder). Electronic gear ratio 1 is used.

2: Inner/Outer loop switchover: The DI assigned with FunIN.24 (GEAR_SEL, electronic gear ratio switchover) is switch between the inner and outer position closed loops. FunIN.24

: Inactive, internal encoder feedback, with electronic gear ratio 1 used

Active: external encoder feedback, with electronic gear ratio 2 used

H0F.01 **External encoder usage mode**

Hex:	200F-02h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Standard operating direction

1: Reverse operating direction

Parameter descriptions:

Defines the feedback pulse counting direction of internal and external encoders when the motor rotates in the fully closed-loop mode.

0: Standard operating direction: The pulse feedback counter of the internal encoder (H0F.18) is in the same direction as that of the external encoder (H0F.20) during rotation of the motor.

1: Reverse operating direction: The pulse feedback counter of the internal encoder (H0F.18) is in the opposite direction as that of the external encoder (H0F.20) during rotation of the motor.

H0F.02 **Fully closed-loop encoder absolute value**

Hex:	200F-03h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	0	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Incremental mode

Parameter descriptions:

Defines the fully closed-loop encoder absolute value.
0: Incremental mode

H0F.03 **Fully closed-loop encoder feedback type**

Hex:	200F-04h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	0	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Quadrature pulse
Parameter descriptions:
Defines the fully closed-loop encoder feedback type.
0: Quadrature pulse

H0F.04 **External encoder pulses per revolution**

Hex:	200F-05h	Effective mode:	Upon the next power-on
Min. value:	1	Unit:	-
Max. value:	2147483647	Data type:	UInt32
Default value:	10000	Change mode:	At stop

Range:
1 to 2147483647
Parameter descriptions:
Defines the pulses fed back by the external encoder per revolution of the motor.
Defines the quantity relation between feedback pulses from the external encoder and those from the internal encoder.
Calculate the value of this parameter through analyzing mechanical parameters. When rigid connection is applied between the motor and the external encoder (scale), you can also set this parameter using the following method:
1. Manually rotate the motor and observe H0F.18 (Feedback pulse counter of internal encoder) at the same time. After ensuring that the motor rotates for one revolution (H0F.18 = Servo motor resolution), calculate the change value of H0F.20 (Feedback pulse counter of external encoder). The absolute value of the change value is the value of H0F.04.
2. If H0F.18 = X1, H0F.20 = Y1 before rotating the motor, and H0F-18 = X2, H0F.20 = Y2 after rotating the motor: H0F.04 = Servo motor resolution x (Y2 - Y1)/(X2 - X1) The calculated result must be positive; if not, perform step 1 again.
For non-rigid connection, an error may exist in the calculation result.
Note:
Make sure that H0F.04 is set correctly. Failure to comply may result in EB02.0 (Excessive position deviation in fully closed-loop mode).

H0F.06 **Fully closed-loop encoder interface**

Hex:	200F-07h	Effective mode:	Upon the next power-on
Min. value:	1	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
1: CN7
Parameter descriptions:
Defines the drive interface used by the fully closed-loop encoder.
1: CN7

H0F.08 **Excessive deviation threshold in compound control mode**

Hex:	200F-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2147483647	Data type:	UInt32
Default value:	1000	Change mode:	Real time

Range:
0 to 2147483647
Parameter descriptions:
Defines the position deviation threshold at which the servo drive detects fault EB02.0, indicating that the position deviation is excessive.
When H0F.08 = 0, the servo drive does not detect EB02.0 and always clears the full closed-loop position deviation.

H0F.10 **Clear deviation in compound control mode**

Hex:	200F-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	Rev
Max. value:	100	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
0 to 100
Parameter descriptions:
Defines the number of revolutions rotated by the motor per a clear of the fully closed-loop position deviation during operation. The number of revolutions is expressed by the internal encoder feedback pulses in H0F.18. The number of motor revolutions is not cleared when the drive is not in the operational state.

H0F.13 **Compound vibration suppression filter time**

Hex:	200F-0Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 6553.5
Parameter description
Defines the time constant for compound vibration suppression in fully closed-loop control when external encoder feedback (H0F.00 = 1 or 2) is used.

Increase the setpoint gradually and check the response change in fully closed-loop mode.
When the stiffness of the transmission mechanism between fully closed loop and internal loop is insufficient, set the time constant properly to improve system stability, which is to generate the effect of internal loop temporarily and form a fully closed loop again after the system is stabilized. Ignore this parameter if the stiffness is sufficient.

If H0F.13 is set to 0, no EB02.1 alarms are detected.

H0F.16 **Pulse deviation display in compound control mode**

Hex:	200F-11h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Used to count and display the position deviation absolute value in fully closed loop control.
Pulse deviation in compound control = Absolute position feedback of external encoder - Absolute position feedback conversion value of internal encoder
Align the inner and outer loop feedback each time the deviation is cleared.

H0F.18 **Internal position pulse feedback display**

Hex:	200F-13h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Counts and displays the number of feedback pulses of the internal encoder (after being divided or multiplied by electronic gear ratio, in internal encoder unit).

H0F.20 **External position pulse feedback display**

Hex:	200F-15h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Used to count and display the number of feedback pulses of the external encoder (after being divided or multiplied by electronic gear ratio, in external encoder unit).

H0F.22 **External encoder phase Z detection invalid (quadrature pulse feedback)**

Hex:	200F-17h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Detected

1: Not detected

Parameter descriptions:

Quadrature pulse phase Z detection in fully closed-loop mode

0: Detected

1: Not detected

H0F.25 **Set the source of touch probe Z signal in fully closed-loop mode.**

Hex:	200F-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Motor Z signal

1: External feedback Z signal

Parameter descriptions:

Defines the source of touch probe Z signal in fully closed-loop mode.

0: Motor Z signal

1: External feedback Z signal

H0F.45 **Positioning completion/Position deviation threshold in fully closed-loop mode**

Hex:	200F-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Threshold scaled to outer loop unit

1: Same threshold used for inner and outer loops

Parameter description

0: Fully closed-loop positioning completion threshold 6067h/Excessive position deviation threshold 6065h (scaled to the outer loop unit)

1: Same threshold used for inner and outer loops

15.17 H11 Multi-position Parameters

H11.00 **Multi-position operation mode**

Hex:	2011-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	5	Data type:	UInt16

Default value: 1 Change mode: At stop

Range:

0: Single run (number of displacements selected in H11.01)

1: Cyclic operation (number of displacement selected in H11.01)

2: DI-based operation (selected by DI)

3: Sequential operation

5: Axis-controlled continuous operation

Parameter descriptions:

Defines the multi-position operation mode when the main position reference source is multi-position references (H05.00 = 2) in the position control mode.

0: Individual operation (stop after one cycle of operation)

Switching to the next displacement automatically

You can set the waiting time between displacements.

Multi-position enabled as active-at-level.

1: Cyclic operation (start from displacement 1 again at next operation)

Switching to the next displacement automatically

You can set the waiting time between displacements.

Multi-position enabled as active-at-level.

2: DI-based operation (continue if displacement No. updated)

The displacement No is determined by the DI logic.

The waiting time between displacements is determined by the command delay of the host controller.

Multi-position enabled as edge valid.

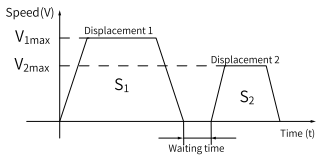
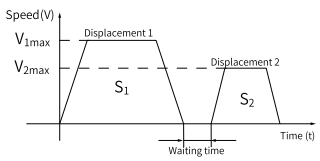
3: Sequential operation (stop after one cycle of operation); cyclic operation available (starting displacement No. defined by H11.05 after the 1st cycle of operation)

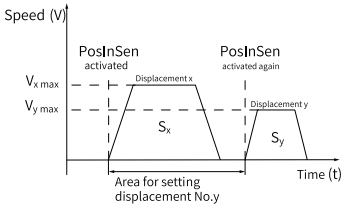
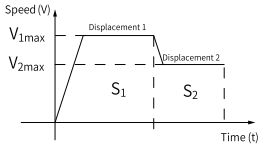
Switching to the next displacement automatically

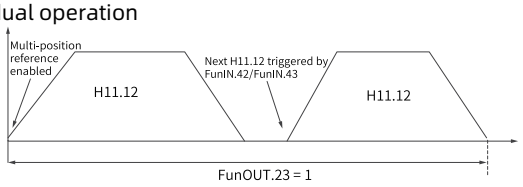
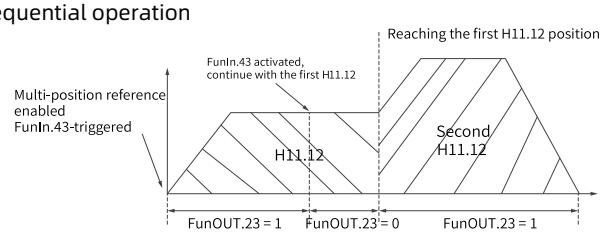
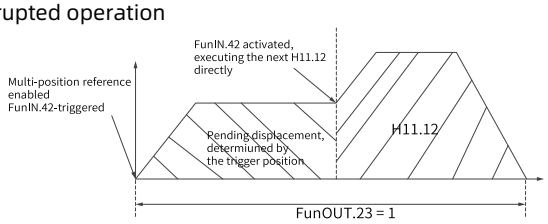
There is no waiting time between displacements.

Multi-position enabled as active-at-level.

5: Axis-controlled continuous operation (used together with CANlink)

Setpoint	Operation mode	Description	Operation curve
0	Stop after operating for one cycle	The drive stops after one cycle of operation. The drive automatically switches to the next speed. You can set the waiting time between displacements. The multi-position reference is level-triggered.	 V1max, V2max: maximum operating speeds in displacement 1 and displacement 2 S1, S2: displacement 1 and displacement 2
1	Cyclic operation	The starting displacement after the first cycle is displacement 1. The drive automatically switches to the next speed. You can set the waiting time between displacements. The multi-position reference is level-triggered.	 V1max, V2max: maximum operating speeds in displacement 1 and displacement 2 S1, S2: displacement 1 and displacement 2

Setpoint	Operation mode	Description	Operation curve
2	DI-based operation	The drive continues operating when the displacement No. is updated. The speed No. is determined by the DI logic. The waiting time between displacements is determined by the command delay of the host controller. The multi-position reference is edge-triggered.	 Vxmax, Vymax: maximum operating speeds in displacement x and displacement y Sx, Sy: displacement x and displacement y
3	Sequential operation	The drive stops after one cycle of operation. The starting displacement after the first cycle is defined by H11.05. The drive automatically switches to the next speed. There is no waiting time between displacements. The multi-position reference is level-triggered.	 V1max, V2max: maximum operating speeds in displacement 1 and displacement 2 S1, S2: displacement 1 and displacement 2

Setpoint	Operation mode	Description	Operation curve
5	Axis-controlled continuous operation	The 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.43/42 triggered later). The drive stops after executing the distance defined by H11.12. • Sequential operation  • The PoslnSen (multi-position reference enable) signal is triggered only once. Write H11.12 again and activate FunIN.43 when the distance defined by the first H11.12 is still in progress.• After receiving the new distance (or speed), which is the second H11.12, the drive continues executing the first H11.12 until the distance defined by the first H11.12 is done. 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.42 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 drive stops executing the first H11.12 and turns to executing the second H11.12.

To use the multi-position function, assign FunIN.28 (PosInSen, multi-position reference enable) to a DI first. See "Group H03: Terminal input parameters" for the setting mode.

Positioning completed (COIN) will be valid when the displacement operation of each position is done. Determine whether the operation is done through DO function5 (FunOUT.5, COIN, positioning completed). For details about the configuration method, see "H04 Terminal Output Parameters".

Ensure the S-ON signal is active during operation of each displacement. Otherwise, the drive stops immediately as defined by H02.05 (Stop mode at S-ON OFF) and the positioning completed (COIN) signal in inactive. In modes other than DI-based operation, if the S-ON signal is active but multi-position is disabled during operation of a certain displacement, the drive abandons the unsent displacement reference and stops, with the positioning completed (COIN) signal being active. If the multi-position function is enabled again, the displacement to be executed is defined by H11.02.

H11.01 **Number of displacement references in multi-position mode**

Hex:	2011-02h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

1 to 16

Parameter descriptions:

Defines the total number of displacement references in the multi-position mode. You can set different displacements, operating speeds, and acceleration/deceleration time for each displacement.

H11.00 ≠ 2: Displacements are switched automatically in a sequence from 1 to H11.01.

When H11.00 = 2: Assign four DIs (Hardware DI or VDI) with DI functions 6 to 9 (FunIN.6: CMD1 to FunIN.9: CMD4) and control the DI logic through the host controller to switch between different speeds. The segment No. is a 4-bit binary value. Bit0 to bit3 correspond to CMD1 to CMD4.

The displacement No. is a 4-bit binary value. The relationship between the displacement numbers and CMD1 to CMD4 is shown in the following table.

FunIN.9	FunIN.8	FunIN.7	FunIN.6	Segment No.
CMD4	CMD3	CMD2	CMD1	
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

H11.02 **Starting displacement No. after pause**

Hex:	2011-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Continue to execute the unexecuted displacements

1: Start from displacement 1

Parameter descriptions:

Defines the starting displacement No. when the multi-position operation recovers from a pause.

0: Continue to execute the unexecuted displacements: For example, if H11.01 is set to 16 and the drive pauses at displacement 2, after the drive recovers from the pause, it will start from displacement 3.

1: Start from displacement 1: For example, if H11.01 is set to 16 and the drive pauses at displacement 2, after the drive recovers from the pause, it will start from displacement 1.

Causes of pause:

1. The servo drive switches to another control mode or the interrupt positioning function is enabled during multi-position operation.
2. The internal multi-position enable signal (FunIN.28:PosInSen) changes from "active" to "inactive".

H11.03 **Waiting time unit**

Hex:	2011-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: ms
1: s
Parameter descriptions:
Defines the unit of acceleration/deceleration time and the waiting time during multi-position operation.
Acceleration/Deceleration time: The time for the motor to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed.
Waiting time: The waiting time that starts from the end of the last reference to the beginning of the next reference.

H11.04 **Displacement reference type**

Hex:	2011-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Relative displacement reference
1: Absolute displacement reference
Parameter descriptions:
Relative displacement: position increment of the target position relative to the current motor position
Absolute displacement: position increment of the target position relative to the motor home.

H11.05 **Starting displacement No. in sequential operation**

Hex:	2011-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 16
Parameter descriptions:
Defines whether to perform cyclic operation and the starting displacement No. after the first cycle of operation in the sequential operation mode (H11.00 = 3).
0: The drive executes the displacements defined by H11.01 only once and then stops. The motor is in the locked state.
1–16: The drive operates cyclically, with the starting displacement No. defined by H11.05 after the first cycle of operation. The value of H11.05 should be lower than or equal to H11.01.

H11.09 **Deceleration upon axis control OFF**

Hex:	2011-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	65535	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the deceleration rate upon axis control OFF.

H11.10 **Starting speed of displacement 1**

Hex:	2011-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	(mm/s)/RPM
Max. value:	6000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 6000
Parameter descriptions:
Defines the starting speed of displacement 1.

H11.11 **Stop speed of displacement 1**

Hex:	2011-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	(mm/s)/RPM
Max. value:	6000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 6000
Parameter descriptions:
Defines the stop speed of displacement 1.

H11.12 **Displacement 1**

Hex:	2011-0Dh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Defines displacement 1 (reference unit) in multi-position operation.

H11.14 **Max. speed of displacement 1**

Hex:	2011-0Fh	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM

Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Defines the maximum speed of displacement 1 in multi-position operation.
The maximum speed is the average operating speed when the motor is not in the acceleration/deceleration process. If H11.12 is set to a too low value, the actual motor speed will be lower than H11.14.

H11.15 Acceleration/deceleration time of displacement 1

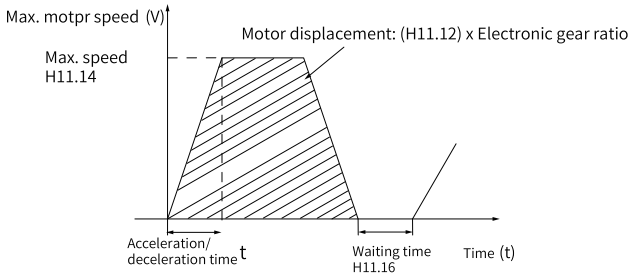
Hex:	2011-10h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the time for the motor to change from 0 [mm/s]/[rpm] 1000 rpm[mm/s]/[rpm] at a constant speed during displacement 1.

H11.16 Waiting time after displacement 1

Hex:	2011-11h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Defines the waiting time that starts from the end of displacement 1 to the beginning of the next displacement.



H11.17 Displacement 2

Hex:	2011-12h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.19 **Max. speed of displacement 2**

Hex:	2011-14h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.20 **Acceleration/deceleration time of displacement 2**

Hex:	2011-15h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.21 **Waiting time after displacement 2**

Hex:	2011-16h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.22 **Displacement 3**

Hex:	2011-17h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.24 **Maximum speed of displacement 3**

Hex:	2011-19h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.25 **Acceleration/deceleration time of displacement 3**

Hex:	2011-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.26 **Waiting time after displacement 3**

Hex:	2011-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.27 **Displacement 4**

Hex:	2011-1Ch	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.29 **Maximum speed of displacement 4**

Hex:	2011-1Eh	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM

Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.30 **Acceleration/deceleration time of displacement 4**

Hex:	2011-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.31 **Waiting time after displacement 4**

Hex:	2011-20h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.32 **Displacement 5**

Hex:	2011-21h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.34 **Maximum speed of displacement 5**

Hex:	2011-23h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:

1 to 10000

Parameter descriptions:

Same as the max. speed of displacement 1

H11.35 **Acceleration/deceleration time of displacement 5**

Hex:	2011-24h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Same as the acceleration/deceleration time of displacement 1

H11.36 **Waiting time after displacement 5**

Hex:	2011-25h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 10000

Parameter descriptions:

Same as the waiting time after displacement 1

H11.37 **Displacement 6**

Hex:	2011-26h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:

-1073741824 to 1073741824

Parameter descriptions:

Same as displacement 1

H11.39 **Maximum speed of displacement 6**

Hex:	2011-28h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:

1 to 10000

Parameter descriptions:

Same as the max. speed of displacement 1

H11.40 **Acceleration/deceleration time of displacement 6**

Hex:	2011-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.41 **Waiting time after displacement 6**

Hex:	2011-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.42 **Displacement 7**

Hex:	2011-2Bh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.44 **Maximum speed of displacement 7**

Hex:	2011-2Dh	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.45 **Acceleration/deceleration time of displacement 7**

Hex:	2011-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.46 Waiting time after displacement 7

Hex:	2011-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.47 Displacement 8

Hex:	2011-30h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.49 Maximum speed of displacement 8

Hex:	2011-32h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.50 Acceleration/deceleration time of displacement 8

Hex:	2011-33h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Same as the acceleration/deceleration time of displacement 1

H11.51 **Waiting time after displacement 8**

Hex:	2011-34h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 10000

Parameter descriptions:

Same as the waiting time after displacement 1

H11.52 **Displacement 9**

Hex:	2011-35h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:

-1073741824 to 1073741824

Parameter descriptions:

Same as displacement 1

H11.54 **Maximum speed of displacement 9**

Hex:	2011-37h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:

1 to 10000

Parameter descriptions:

Same as the max. speed of displacement 1

H11.55 **Acceleration/deceleration time of displacement 9**

Hex:	2011-38h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Same as the acceleration/deceleration time of displacement 1

H11.56 **Waiting time after displacement 9**

Hex:	2011-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.57 **Displacement 10**

Hex:	2011-3Ah	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.59 **Maximum speed of displacement 10**

Hex:	2011-3Ch	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.60 **Acceleration/deceleration time of displacement 10**

Hex:	2011-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.61 **Waiting time after displacement 10**

Hex:	2011-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)

Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.62 **Displacement 11**

Hex:	2011-3Fh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.64 **Maximum speed of displacement 11**

Hex:	2011-41h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.65 **Acceleration/deceleration time of displacement 11**

Hex:	2011-42h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.66 **Waiting time after displacement 11**

Hex:	2011-43h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 10000

Parameter descriptions:

Same as the waiting time after displacement 1

H11.67 **Displacement 12**

Hex:	2011-44h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:

-1073741824 to 1073741824

Parameter descriptions:

Same as displacement 1

H11.69 **Maximum speed of displacement 12**

Hex:	2011-46h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:

1 to 10000

Parameter descriptions:

Same as the max. speed of displacement 1

H11.70 **Acceleration/deceleration time of displacement 12**

Hex:	2011-47h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Same as the acceleration/deceleration time of displacement 1

H11.71 **Waiting time after displacement 12**

Hex:	2011-48h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 10000

Parameter descriptions:

Same as the waiting time after displacement 1

H11.72 **Displacement 13**

Hex:	2011-49h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.74 **Maximum speed of displacement 13**

Hex:	2011-4Bh	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.75 **Acceleration/deceleration time of displacement 13**

Hex:	2011-4Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.76 **Waiting time after displacement 13**

Hex:	2011-4Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.77 **Displacement 14**

Hex:	2011-4Eh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit

Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:
-1073741824 to 1073741824
Parameter descriptions:
Same as displacement 1

H11.79 **Maximum speed of displacement 14**

Hex:	2011-50h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.80 **Acceleration/deceleration time of displacement 14**

Hex:	2011-51h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.81 **Waiting time after displacement 14**

Hex:	2011-52h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

H11.82 **Displacement 15**

Hex:	2011-53h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:

-1073741824 to 1073741824

Parameter descriptions:

Same as displacement 1

H11.84 **Maximum speed of displacement 15**

Hex:	2011-55h	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:

1 to 10000

Parameter descriptions:

Same as the max. speed of displacement 1

H11.85 **Acceleration/deceleration time of displacement 15**

Hex:	2011-56h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Same as the acceleration/deceleration time of displacement 1

H11.86 **Waiting time after displacement 15**

Hex:	2011-57h	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 10000

Parameter descriptions:

Same as the waiting time after displacement 1

H11.87 **Displacement 16**

Hex:	2011-58h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Range:

-1073741824 to 1073741824

Parameter descriptions:

Same as displacement 1

H11.89 **Maximum speed of displacement 16**

Hex:	2011-5Ah	Effective mode:	Real time
Min. value:	1	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
1 to 10000
Parameter descriptions:
Same as the max. speed of displacement 1

H11.90 **Acceleration/deceleration time of displacement 16**

Hex:	2011-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as the acceleration/deceleration time of displacement 1

H11.91 **Waiting time after displacement 16**

Hex:	2011-5Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms (s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 10000
Parameter descriptions:
Same as the waiting time after displacement 1

15.18 H12 Multi-speed Parameters

H12.00 **Multi-speed operation mode**

Hex:	2012-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: Individual operation (number of speeds selected in H12.01)
1: Cyclic operation (number of speeds selected in H12.01)
2: DI-based operation
Parameter descriptions:

Defines the multi-speed operation mode when the speed reference source is multi-speed reference (H06.01 = 5, H06.02 = 1/2/3) in the speed control mode.
0: Stop after one run, and the segment No. is auto incremented and switched
1: Cyclic. The starting segment number of each run is 1, and the segment number is auto incremented and switched. If the servo drive is enabled, the cyclic operation state is maintained all the time.
2. The drive can run continuously when it is enabled. The segment number is determined by DI terminal logic. The running time of each speed reference is only determined by the waiting time of segment number switching. FunIN.5 (DlR-SEL) can be used to switch the direction of the speed reference.
The S-ON signal must be active during running of each speed reference; otherwise, the servo drive will stop immediately as defined by H02.05 (Stop mode at S-ON off).
Speed arrival (FunOUT.19: V-Arr) signal is valid when a certain speed reference reaches the set value.

H12.01 **Number of speed references in multi-speed mode**

Hex:	2012-02h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	16	Change mode:	At stop

Range:
1 to 16
Parameter descriptions:
Defines the total number of speed references in the multi-speed mode. Different speed references, operating time, and acceleration/deceleration time (four groups optional) can be set for each speed.
H12.00 ≠ 2: Speeds are switched automatically in a sequence from 1 to H12.01.
When H12.00 = 2: Assign four DIs (Hardware DI or VDI) with DI functions 6 to 9 (FunIN.6: CMD1 to FunIN.9: CMD4) and control the DI logic through the host controller to switch between different speeds. The segment No. is a 4-bit binary value. Bit0 to bit3 correspond to CMD1 to CMD4.

H12.02 **Operating time unit**

Hex:	2012-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: s
1: min
Parameter descriptions:
Defines the time unit of multi-speed operation.
0: s
1: min

H12.03 **Acceleration time 1**

Hex:	2012-04h	Effective mode:	Real time

Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.04 **Deceleration time 1**

Hex:	2012-05h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.05 **Acceleration time 2**

Hex:	2012-06h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.06 **Deceleration time 2**

Hex:	2012-07h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.07 **Acceleration time 3**

Hex:	2012-08h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.08 **Deceleration time 3**

Hex:	2012-09h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.09 **Acceleration time 4**

Hex:	2012-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	150	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Four groups of acceleration/deceleration time can be set for each speed reference.
Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.10 **Deceleration time 4**

Hex:	2012-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	150	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:

Four groups of acceleration/deceleration time can be set for each speed reference.
Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.20 **Speed reference 1**

Hex:	2012-15h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/RPM
Max. value:	10000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:
-10000 to 10000
Parameter descriptions:
Defines speed reference 1.

H12.21 **Operating time of speed 1**

Hex:	2012-16h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:
0.0 to 6553.5
Parameter descriptions:
Defines the operating time of speed 1.
The operating time is the sum of the speed variation time from previous speed reference to present speed reference plus the average operating time of present speed reference.
If the operating time is set to 0, the drive skips this speed reference automatically.
As long as H12.00 (Multi-speed operation mode) is set to 2 (DI-based operation) and the speed No. determined by the external DI does not change, the drive continues operating at the speed defined by this speed reference, without being affected by the reference operating time.

H12.22 **1st speed rise/drop and curve smoothing parameter time**

Hex:	2012-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time

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

bit8-bit15: S curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter descriptions:

Bit0 to bit7: Acceleration/deceleration time

Defines the acceleration/deceleration time of speed 1:

0: Zero acceleration/deceleration time: Acceleration time: 0; Deceleration time: 0

1: Acceleration/Deceleration time 1: Acceleration time: H12.03; Deceleration time: H12.04

2: Acceleration/Deceleration time 2: Acceleration time: H12.05; Deceleration time: H12.06

3: Acceleration/Deceleration time 3: Acceleration time: H12.07; Deceleration time: H12.08

4: Acceleration/Deceleration time 4: Acceleration time: H12.09; Deceleration time: H12.10

Bit8 to bit15: S curve smoothing parameters

1: Smoothing parameter 1: Increasing acceleration time of acceleration segment: H06.51

Decreasing acceleration time of acceleration segment: H06.52

Decreasing deceleration time of deceleration segment: H06.53

Increasing acceleration time of acceleration segment: H06.54

2: Smoothing parameter 2: Increasing acceleration time of acceleration segment: H06.55

Decreasing acceleration time of acceleration segment: H06.56

Decreasing deceleration time of deceleration segment: H06.57

Decreasing acceleration time of acceleration segment: H06.58

3: Smoothing parameter 3: Increasing acceleration time of acceleration segment: H06.59

Decreasing acceleration time of acceleration segment: H06.60

Decreasing deceleration time of deceleration segment: H06.61

Decreasing acceleration time of acceleration segment: H06.62

4: Smoothing parameter 4: Increasing acceleration time of acceleration segment: H06.63

Decreasing acceleration time of acceleration segment: H06.64

Decreasing deceleration time of deceleration segment: H06.65

Decreasing acceleration time of acceleration segment: H06.66

5: Smoothing parameter 5: Increasing acceleration time of acceleration segment: H06.67

Decreasing acceleration time of acceleration segment: H06.68

Decreasing deceleration time of deceleration segment: H06.69

Decreasing acceleration time of acceleration segment: H06.70

6: Smoothing parameter 6: Increasing acceleration time of acceleration segment: H06.71

Decreasing acceleration time of acceleration segment: H06.72

Decreasing deceleration time of deceleration segment: H06.73

Decreasing acceleration time of acceleration segment: H06.74

7: Smoothing parameter 7: Increasing acceleration time of acceleration segment: H06.75

Decreasing acceleration time of acceleration segment: H06.76

Decreasing deceleration time of deceleration segment: H06.77
Decreasing acceleration time of acceleration segment: H06.78
8: Smoothing parameter 8: Increasing acceleration time of acceleration segment: H06.79
Decreasing acceleration time of acceleration segment: H06.80
Decreasing deceleration time of deceleration segment: H06.81
Decreasing acceleration time of acceleration segment: H06.82

H12.23 **Reference 2**

Hex:	2012-18h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	100	Change mode:	Real time

Range:
-10000 to 10000
Parameter descriptions:
Same as reference 1.

H12.24 **Operating time of speed 2**

Hex:	2012-19h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:
0.0 to 6553.5
Parameter descriptions:
Same as the operating time of speed 1.

H12.25 **2nd speed rise/drop time and curve smoothing parameter time**

Hex:	2012-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time

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

bit8-bit15: S curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.26 **Reference 3**

Hex:	2012-1Bh	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	300	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.27 **Operating time of speed 3**

Hex:	2012-1Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.28 **3rd speed rise/drop time and curve smoothing parameter time**

Hex:	2012-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.29 **Reference 4**

Hex:	2012-1Eh	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	500	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.30 **Operating time of speed 4**

Hex:	2012-1Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.31 **4th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time

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

bit8-bit15: S curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.32 **Reference 5**

Hex:	2012-21h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	700	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.33 **Operating time of speed 5**

Hex:	2012-22h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.34 **5th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-23h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.35 **Reference 6**

Hex:	2012-24h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	900	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.36 **Operating time of speed 6**

Hex:	2012-25h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.37 **6th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.38 **Reference 7**

Hex:	2012-27h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	600	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.39 **Operating time of speed 7**

Hex:	2012-28h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.40 **7th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.41 **Reference 8**

Hex:	2012-2Ah	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	300	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.42 **Operating time of speed 8**

Hex:	2012-2Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.43 **8th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.44 **Reference 9**

Hex:	2012-2Dh	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	100	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.45 **Operating time of speed 9**

Hex:	2012-2Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.46 **9th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.47 **Reference 10**

Hex:	2012-30h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-100	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.48 **Operating time of speed 10**

Hex:	2012-31h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.49 **10th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.50 **Reference 11**

Hex:	2012-33h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-300	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.51 **Operating time of speed 11**

Hex:	2012-34h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.52 **11th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-35h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.53 **Reference 12**

Hex:	2012-36h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-500	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.54 **Operating time of speed 12**

Hex:	2012-37h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.55 **12th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-38h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.56 **Reference 13**

Hex:	2012-39h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-700	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.57 **Operating time of speed 13**

Hex:	2012-3Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.58 **13th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-3Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.59 **Reference 14**

Hex:	2012-3Ch	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-900	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.60 **Operating time of speed 14**

Hex:	2012-3Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.61 **14th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.62 **Reference 15**

Hex:	2012-3Fh	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-600	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.63 **Operating time of speed 15**

Hex:	2012-40h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.64 **15th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

H12.65 **Reference 16**

Hex:	2012-42h	Effective mode:	Real time
Min. value:	-10000	Unit:	(mm/s)/rpm
Max. value:	10000	Data type:	Int16
Default value:	-300	Change mode:	Real time

Range:

-10000 to 10000

Parameter descriptions:

Same as reference 1.

H12.66 **Operating time of speed 16**

Hex:	2012-43h	Effective mode:	Real time
Min. value:	0.0	Unit:	s (m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter descriptions:

Same as the operating time of speed 1.

H12.67 **16th speed rise/drop time and curve smoothing parameter time**

Hex:	2012-44h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Range:

Bit0 to bit7: Acceleration/deceleration time
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
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8

Parameter descriptions:

Same as the acceleration/deceleration time of speed 1

15.19 H15 Machine Tool Parameters

H15.00 **Positive friction compensation torque**

Hex:	2015-01h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	50.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:

0.0 to 50.0

Parameter descriptions:

-

H15.01 **Negative friction compensation torque**

Hex:	2015-02h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	50.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:

0.0 to 50.0

Parameter descriptions:

-

H15.02 **Positive friction torque filter time constant**

Hex:	2015-03h	Effective mode:	Real time
Min. value:	0.10	Unit:	ms

Max. value:	100.00	Data type:	UInt16
Default value:	0.10	Change mode:	Real time

Range:
0.10 to 100.00
Parameter descriptions:
-

H15.03 **Negative friction torque filter time constant**

Hex:	2015-04h	Effective mode:	Real time
Min. value:	0.10	Unit:	ms
Max. value:	100.00	Data type:	UInt16
Default value:	0.10	Change mode:	Real time

Range:
0.10 to 100.00
Parameter descriptions:
-

H15.04 **Friction torque compensation speed reference source**

Hex:	2015-05h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x4	Data type:	UInt16
Default value:	0x2	Change mode:	Real time

Range:
0: Speed reference
1: Model speed
2: Speed feedback
3: Observation speed
4: Speed reference
Parameter descriptions:
-

H15.05 **Friction torque compensation delay time**

Hex:	2015-06h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	300.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Range:
0.00 to 300.00
Parameter descriptions:
-

H15.06 **Friction torque compensation effective speed threshold**

Hex:	2015-07h	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm

Max. value:	20.0	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Range:
0.0 to 20.0
Parameter descriptions:
-

H15.15 **Backlash compensation**

Hex:	2015-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disable 1: Ramp
Parameter descriptions:
-

H15.16 **Backlash compensation speed reference source**

Hex:	2015-11h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x4	Data type:	UInt16
Default value:	0x4	Change mode:	Real time

Range:
0: Speed reference
1: Model speed
2: Speed feedback
3: Observation speed
4: Speed reference
Parameter descriptions:
-

H15.17 **Minimum speed threshold of backlash compensation**

Hex:	2015-12h	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	20.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Range:
0.0 to 20.0
Parameter descriptions:
-

H15.18 **Number of pulses of backlash compensation**

Hex:	2015-13h	Effective mode:	Real time
Min. value:	0	Unit:	p

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Note: The values of H15.18 and H15.21/H15.23 must meet the following requirements: H15.18/H15.21 (H15.23) > 16.

H15.19 **Backlash delay time**

Hex:	2015-14h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:
0.0 to 300.0
Parameter descriptions:
-

H15.21 **Positive backlash compensation time**

Hex:	2015-16h	Effective mode:	Real time
Min. value:	0.1	Unit:	ms
Max. value:	300.0	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Range:
0.1 to 300.0
Parameter descriptions:
Note: The values of H15.18 and H15.21/H15.23 must meet the following requirements: H15.18/H15.21 (H15.23) > 16.

H15.23 **Negative backlash compensation Date**

Hex:	2015-18h	Effective mode:	Real time
Min. value:	0.1	Unit:	ms
Max. value:	300.0	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Range:
0.1 to 300.0
Parameter descriptions:
Note: The values of H15.18 and H15.21/H15.23 must meet the following requirements: H15.18/H15.21 (H15.23) > 16.

H15.25 **Filter time constant of average backlash compensation value**

Hex:	2015-1Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	50.0	Data type:	UInt16

Default value:	0.0	Change mode:	At stop

Range:
0.0 to 50.0
Parameter descriptions:
Defines the moving average filter time constant of position references.

15.20 H16 Variable Monitoring

H16.43 **Error frame alarm switch/threshold**

Hex:	2016-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt8
Default value:	4	Change mode:	At stop

Range:
0 to 255
Parameter descriptions:
Error frame alarm switch/threshold.
0: Disable error frame alarm
1 to 255: Enable error frame alarm and the alarm threshold (when the number of error frames reaches this threshold, an alarm is triggered).

H16.44 **Sampling interval of error frames**

Hex:	2016-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Sampling interval of error frames.

H16.46 **Total duration of the last link down event**

Hex:	2016-2Fh	Effective mode:	-
Min. value:	0	Unit:	ms
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 4294967295
Parameter descriptions:
Records the total duration of the last link down event.

H16.52 **Error register on port 0 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP)**

Hex:	2016-35h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Records the maximum number of error frames and invalid frames of EtherCAT port 0 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP).

H16.53 **Error register on port 1 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP)**

Hex:	2016-36h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Records the maximum number of error frames and invalid frames of EtherCAT port 1 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP).

H16.54 **Forwarding error register when the equipment switches from Safe-operational (SAFEOP) to Operational (OP)**

Hex:	2016-37h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Records the maximum number of error frames of EtherCAT port forwarding when the equipment switches from Safe-operational (SAFEOP) to Operational (OP).

H16.55 **Processing unit error register when the equipment switches from Safe-operational (SAFEOP) to Operational (OP)**

Hex:	2016-38h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt8
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFF

Parameter descriptions:

Records the maximum number of error frames of the EtherCAT data frame processing unit when the equipment switches from Safe-operational (SAFEOP) to Operational (OP).

H16.56 **Disconnection error register when the equipment switches from Safe-operational (SAFEOP) to Operational (OP)**

Hex:	2016-39h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter descriptions:

Records the maximum number of disconnections on EtherCAT port 0 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP).

H16.66 **Attribute settings of fault record monitoring variables**

Hex:	2016-43h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt8
Default value:	0x0	Change mode:	Real time

Range:

0x0 to 0xFF

Parameter descriptions:

Attributes bit0 to bit3 correspond to the data type of test variable 1. bit4 to bit7 correspond to the data type of test variable 2. bit8 to bit11 correspond to the data type of test variable 3. bit12 to bit15 correspond to the data type of test variable 4.

Data type mappings: Int8: 1; Uint8: 2; Int16: 3; Uint16: 4; Int32: 5; Uint32: 6; Float32: 7.

H16.67 **Fault log variable 1 address**

Hex:	2016-44h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Enter the address of test variable 1 of the E08 fault record.

H16.69 **Fault log variable 2 address**

Hex:	2016-46h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32

Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Enter the address of test variable 2 of the E08 fault record.

15.21 H17 VDI/DO Parameters

H17.90 **Communication VDI enable**

Hex:	2017-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Disable
1: Enable
Parameter descriptions:
To use the VDI function:
1. Set H17.90 to enable VDI.
2. Set the default level after power-on through H17.91.
3. Set the DI function of the VDI terminal through parameters in group H17.
4. Set VDI output through H31.00.

H17.91 **VDI default value after power-on**

Hex:	2017-5Ch	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
bit0: VDI1 bit1: VDI2 bit2: VDI3 bit3: VDI4 bit4: VDI5 bit5: VDI6 bit6: VDI7 bit7: VDI8 bit8: VDI9 bit9: VDI10 bit10: VDI11 bit11: VDI12 bit12: VDI13 bit13: VDI14 bit14: VDI15 bit15: VDI16
Parameter descriptions:
Configures the initial value of VDI upon power-on.
bit0 corresponds to VDI1.
bit1 corresponds to VDI2.
...
bit15 corresponds to VDI16.

H17.00 **VDI1 function selection**

Hex:	2017-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable
Parameter descriptions:
Defines the VDI1 function.

H17.01 **VDI1 logic level**

Hex:	2017-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Parameter descriptions:
Defines the active level of VDI1.

H17.02 **VDI2 function selection**

Hex:	2017-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable
Parameter descriptions:
Same as H17.00.

H17.03 **VDI2 logic level selection**

Hex:	2017-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1

Parameter descriptions:
Same as H17.01.

H17.04 **VDI3 function selection**

Hex:	2017-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable
Parameter descriptions:
Same as H17.00.

H17.05 **VDI3 logic level selection**

Hex:	2017-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Parameter descriptions:
Same as H17.01.

H17.06 **VDI4 function selection**

Hex:	2017-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable
Parameter descriptions:
Same as H17.00.

H17.07 **VDI4 logic level selection**

Hex:	2017-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.08 **VDI5 function selection**

Hex:	2017-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.09 **VDI5 logic level selection**

Hex:	2017-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.10 **VDI6 function selection**

Hex:	2017-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.11 VDI6 logic level selection

Hex:	2017-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.12 VDI7 function selection

Hex:	2017-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.13 VDI7 logic level selection

Hex:	2017-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.14 **VDI8 function selection**

Hex:	2017-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.15 **VDI8 logic level selection**

Hex:	2017-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.16 **VDI9 function selection**

Hex:	2017-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.17 **VDI9 logic level selection**

Hex:	2017-12h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.18 VDI10 function selection

Hex:	2017-13h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.19 VDI10 logic level selection

Hex:	2017-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.20 VDI11 function selection

Hex:	2017-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.21 **VDI11 logic level selection**

Hex:	2017-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.22 **VDI12 function selection**

Hex:	2017-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.23 **VDI12 logic level selection**

Hex:	2017-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.24 **VDI13 function selection**

Hex:	2017-19h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.25 **VDI13 logic level selection**

Hex:	2017-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.26 **VDI14 function selection**

Hex:	2017-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.27 **VDI14 logic level selection**

Hex:	2017-1Ch	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.28 VDI15 function selection

Hex:	2017-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.29 VDI15 logic level selection

Hex:	2017-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.30 VDI16 function selection

Hex:	2017-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference enable 31: Home switch 34: Emergency stop 36: Internal speed limit source 40: Multi-speed enable

Parameter descriptions:

Same as H17.00.

H17.31 VDI16 logic level selection

Hex:	2017-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Active when the written value is 1

1: Active when the written value changes from 0 to 1

Parameter descriptions:

Same as H17.01.

H17.92 Communication VDO enable

Hex:	2017-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter descriptions:

To use the VDO function:

1. Enable VDO through H17.92.
2. Set the default level after power-on through H17.93.
3. Set the DO function of the VDO terminal through parameters in group H17.
4. Read the output level of the VDO in H17.32.

H17.93 VDO default value after power-on

Hex:	2017-5Eh	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	At stop

Range:

bit0: VDO1 bit1: VDO2 bit2: VDO3 bit3: VDO4 bit4: VDO5 bit5: VDO6 bit6: VDO7 bit7: VDO8 bit8: VDO9 bit9: VDO10 bit10: VDO11 bit11: VDO12 bit12: VDO13 bit13: VDO14 bit14: VDO15 bit15: VDO16

Parameter descriptions:

Configures the initial value of VDO upon power-on.
bit0 corresponds to VDO1.
bit1 corresponds to VDO2.
...
bit15 corresponds to VDO16.

H17.32 VDO virtual level

Hex:	2017-21h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the VDO virtual level.

H17.33 VDO1 function selection

Hex:	2017-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Defines the function of VDO1.

H17.34 VDO1 logic level selection

Hex:	2017-23h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Defines the active level of VDO1.

H17.35 VDO2 function selection

Hex:	2017-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.36 VDO2 logic level selection

Hex:	2017-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.37 VDO3 function selection

Hex:	2017-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.38 VDO3 logic level selection

Hex:	2017-27h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.39 VDO4 function selection

Hex:	2017-28h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.40 VDO4 logic level selection

Hex:	2017-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

H17.41 VDO5 function selection

Hex:	2017-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.42 VDO5 logic level selection

Hex:	2017-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

H17.43 **VDO6 function selection**

Hex:	2017-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.44 **VDO6 logic level selection**

Hex:	2017-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

H17.45 **VDO7 function selection**

Hex:	2017-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.46 **VDO7 logic level selection**

Hex:	2017-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:
Same as H17.34.

H17.47 **VDO8 function selection**

Hex:	2017-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.48 **VDO8 logic level selection**

Hex:	2017-31h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.49 **VDO9 function selection**

Hex:	2017-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.50 **VDO9 logic level selection**

Hex:	2017-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

H17.51 VDO10 function selection

Hex:	2017-34h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.52 VDO10 logic level selection

Hex:	2017-35h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

H17.53 VDO11 function selection

Hex:	2017-36h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.54 VDO11 logic level selection

Hex:	2017-37h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16

Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.55 **VDO12 function selection**

Hex:	2017-38h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.56 **VDO12 logic level selection**

Hex:	2017-39h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.57 **VDO13 function selection**

Hex:	2017-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.58 **VDO13 logic level selection**

Hex:	2017-3Bh	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.59 VDO14 function selection

Hex:	2017-3Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.60 VDO14 logic level selection

Hex:	2017-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Parameter descriptions:
Same as H17.34.

H17.61 VDO15 function selection

Hex:	2017-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output
Parameter descriptions:
Same as H17.33.

H17.62 **VDO15 logic level selection**

Hex:	2017-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

H17.63 **VDO16 function selection**

Hex:	2017-40h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment 1: Servo ready 2: Motor rotation signal 5: Positioning completed 6: Positioning proximity 9: Brake 10: Alarm 11: Fault 22: Internal command completed 24: Internal motion completed 26: Closed-loop state 32: EDM output

Parameter descriptions:

Same as H17.33.

H17.64 **VDO16 logic level selection**

Hex:	2017-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Parameter descriptions:

Same as H17.34.

15.22 H18 Position Comparison Output Parameters

H18.00 **Position comparison output selection**

Hex:	2018-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable (rising edge-triggered)

Parameter descriptions:

0: Disable

1: Enable (rising edge-triggered)

H18.01 **Position comparison output feedback source**

Hex:	2018-02h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Motor encoder feedback

1: Fully closed-loop position feedback

Parameter descriptions:

Used to select position comparison output feedback source.

0: Motor encoder feedback

1: Fully closed-loop position feedback

H18.02 **Position comparison resolution**

Hex:	2018-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: 24-bit

1: 23-bit

2: 22-bit

3: 21-bit

4: 20-bit

5: 19-bit

6: 18-bit

7: 17-bit

Parameter descriptions:

Defines the position comparison resolution.

0: 24-bit

1: 23-bit

2: 22-bit

3: 21-bit

4: 20-bit

5: 19-bit

6: 18-bit

7: 17-bit

H18.03 **Position comparison mode**

Hex:	2018-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Individual comparison mode

1: Cyclic comparison mode

2: Fixed cyclic comparison mode

Parameter descriptions:

Defines the position comparison mode.

0: Individual comparison mode

1: Cyclic comparison mode

2: Fixed cyclic comparison mode

H18.04 **Current position as zero**

Hex:	2018-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable (rising edge-triggered)

Parameter descriptions:

Current position as zero

H18.05 **Position comparison output width**

Hex:	2018-06h	Effective mode:	Real time
Min. value:	0.1	Unit:	ms
Max. value:	204.7	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Range:

0.1 to 204.7

Parameter descriptions:

Defines the effective pulse width of the DO when the comparison point is reached. The value: ms).

H18.06 **Position comparison output ABZ port polarity**

Hex:	2018-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: OCZ output logic

0: Positive, output high level upon active logic

1: Negative, output low level upon active logic

bit1: Z port output logic

0: Positive, output high level upon active logic

1: Negative, output low level upon active logicbit2: A/B output logic

0: Positive, output high level upon active logic

1: Negative, output low level upon active logic

Parameter descriptions:

Bit	Name	Function
0	OCZ output logic	0: Positive, output high level upon active logic
		1: Negative, output low level upon active logic
1	Z output logic	0: Positive, output high level upon active logic
		1: Negative, output low level upon active logic
2	A/B output logic	0: Positive, output high level upon active logic
		1: Negative, output low level upon active logic

H18.07 Position comparison start point

Hex:	2018-08h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

1 to 40

Parameter descriptions:

Defines the starting point of position comparison.

H18.08 Position comparison end point

Hex:	2018-09h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

1 to 40

Parameter descriptions:

Defines the end point of position comparison.

H18.09 Current state of position comparison

Hex:	2018-0Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1024	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 1024
Parameter descriptions:
Displays current state of position comparison.

H18.10 **Real-time position of position comparison**

Hex:	2018-0Bh	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the real-time position of position comparison.

H18.12 **Zero offset of position comparison**

Hex:	2018-0Dh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the zero offset of position comparison.

H18.14 **Position comparison output delay compensation**

Hex:	2018-0Fh	Effective mode:	Upon the next power-on
Min. value:	-12.00	Unit:	μs
Max. value:	12.00	Data type:	Int16
Default value:	0.00	Change mode:	Real time

Range:
-12.00 to 12.00
Parameter descriptions:
Compensates the delay caused by hardware signal output.

H18.15 **Fixed cyclic comparison**

Hex:	2018-10h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:
1 to 65535
Parameter descriptions:
Defines the number of fixed mode cycles.

H18.16 **ABZ output function setting**

Hex:	2018-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

Bit	Name	Function
0	OCZ signal output function	0: Frequency-division output
		1: Position comparison
1	Z signal output function	0: Frequency-division output
		1: Position comparison
2	A/B signal output function	0: Frequency-division output
		1: Position comparison

Parameter descriptions:

Defines the ABZ output function.

bit0: OCZ output setting. 0: Frequency-division output; 1: Position comparison

bit1: Z output setting. 0: Frequency-division output; 1: Position comparison

bit2: A/B output setting. 0: Frequency-division output; 1: Position comparison

H18.17 **Number of fixed mode cycles**

Hex:	2018-12h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 65535

Parameter descriptions:

Displays the number of times that the fixed mode has been completed.

15.23 H19 Target Position Parameters

H19.00 **Target value of position comparison 1**

Hex:	2019-01h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:
Defines the target value of position comparison 1.

H19.02 **Attribute value of position comparison 1**

Hex:	2019-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

Bit	Description
0	Output DO active signal if current position changes from "less than" to "more than" the comparison point
1	Output DO active signal if current position changes from "more than" to "less than" the comparison point
2 to 6	Reserved
7	DO1 output
8	DO2 output
9 to 11	Reserved
12	Frequency-division A output
13	Frequency-division B output
14	Frequency-division Z output
15	Frequency-division OCZ output

Parameter description
Defines the attribute setting of position comparison point 1.
bit0: 1: Current position changing from "less than" to "more than" the comparison point enabled; 0: Disable.
bit1: 1: Current position changing from "more than" to "less than" the comparison point enabled; 0: Disable.
bit2 to bit6: N/A.
bit7: 1: Enable DO1 output; 0: Disable.
bit8: 1: Enable DO2 output; 0: Disable
bit9 to bit11:N/A
bit12: 1: Enable frequency-division A output; 0: Disable
bit13: 1: Enable frequency-division B output; 0: Disable.
bit14: 1: Enable frequency-division C output; 0: Disable.
bit15: 1: Enable Frequency-division OCZ output; 0: Disable.

H19.03 **Target value of position comparison 2**

Hex:	2019-04h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Same as H19.00.

H19.05 **Attribute value of position comparison 2**

Hex:	2019-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point

bit1: Current position changes from "more than" to "less than" the comparison point

bit2: N/A

bit3: N/A

bit4: N/A

bit5: N/A

bit6: N/A

bit7: DO1 output

bit8: DO2 output

bit9: Nabit10:

bit10: N/A

bit11: N/A

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.06 **Target value of position comparison 3**

Hex:	2019-07h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.08 **Attribute value of position comparison 3**

Hex:	2019-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.09 **Target value of position comparison 4**

Hex:	2019-0Ah	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.11 **Attribute value of position comparison 4**

Hex:	2019-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.12 Target value of position comparison 5

Hex:	2019-0Dh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.14 Attribute value of position comparison 5

Hex:	2019-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.15 **Target value of position comparison 6**

Hex:	2019-10h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.17 **Attribute value of position comparison 6**

Hex:	2019-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.18 **Target value of position comparison 7**

Hex:	2019-13h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.20 **Attribute value of position comparison 7**

Hex:	2019-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.21 **Target value of position comparison 8**

Hex:	2019-16h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.23 **Attribute value of position comparison 8**

Hex:	2019-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.24 **Target value of position comparison 9**

Hex:	2019-19h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.26 **Attribute value of position comparison 9**

Hex:	2019-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.27 **Target value of position comparison 10**

Hex:	2019-1Ch	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.29 **Attribute value of position comparison 10**

Hex:	2019-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.30 Target value of position comparison 11

Hex:	2019-1Fh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.32 Attribute value of position comparison 11

Hex:	2019-21h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.33 **Target value of position comparison 12**

Hex:	2019-22h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.35 **Attribute value of position comparison 12**

Hex:	2019-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.36 **Target value of position comparison 13**

Hex:	2019-25h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.38 **Attribute value of position comparison 13**

Hex:	2019-27h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.39 **Target value of position comparison 14**

Hex:	2019-28h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.41 **Attribute value of position comparison 14**

Hex:	2019-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.42 **Target value of position comparison 15**

Hex:	2019-2Bh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.44 **Attribute value of position comparison 15**

Hex:	2019-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.45 **Target value of position comparison 16**

Hex:	2019-2Eh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.47 **Attribute value of position comparison 16**

Hex:	2019-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.48 **Target value of position comparison 17**

Hex:	2019-31h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.50 **Attribute value of position comparison 17**

Hex:	2019-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.51 **Target value of position comparison 18**

Hex:	2019-34h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.53 **Attribute value of position comparison 18**

Hex:	2019-36h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.54 **Target value of position comparison 19**

Hex:	2019-37h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.56 **Attribute value of position comparison 19**

Hex:	2019-39h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.57 Target value of position comparison 20

Hex:	2019-3Ah	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.59 Attribute value of position comparison 20

Hex:	2019-3Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.60 **Target value of position comparison 21**

Hex:	2019-3Dh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.62 **Attribute value of position comparison 21**

Hex:	2019-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.63 **Target value of position comparison 22**

Hex:	2019-40h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.65 **Attribute value of position comparison 22**

Hex:	2019-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.66 **Target value of position comparison 23**

Hex:	2019-43h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.68 **Attribute value of position comparison 23**

Hex:	2019-45h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.69 **Target value of position comparison 24**

Hex:	2019-46h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.71 **Attribute value of position comparison 24**

Hex:	2019-48h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.72 **Target value of position comparison 25**

Hex:	2019-49h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.74 **Attribute value of position comparison 25**

Hex:	2019-4Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.75 **Target value of position comparison 26**

Hex:	2019-4Ch	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.77 **Attribute value of position comparison 26**

Hex:	2019-4Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.78 **Target value of position comparison 27**

Hex:	2019-4Fh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.80 **Attribute value of position comparison 27**

Hex:	2019-51h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.81 **Target value of position comparison 28**

Hex:	2019-52h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.83 **Attribute value of position comparison 28**

Hex:	2019-54h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.84 **Target value of position comparison 29**

Hex:	2019-55h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.86 **Attribute value of position comparison 29**

Hex:	2019-57h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.87 **Target value of position comparison 30**

Hex:	2019-58h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.89 **Attribute value of position comparison 30**

Hex:	2019-5Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.90 **Target value of position comparison 31**

Hex:	2019-5Bh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.92 **Attribute value of position comparison 31**

Hex:	2019-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.93 **Target value of position comparison 32**

Hex:	2019-5Eh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.95 **Attribute value of position comparison 32**

Hex:	2019-60h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.96 **Target value of position comparison 33**

Hex:	2019-61h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.98 **Attribute value of position comparison 33**

Hex:	2019-63h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.99 **Target value of position comparison 34**

Hex:	2019-64h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.101 **Attribute value of position comparison 34**

Hex:	2019-66h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.102 **Target value of position comparison 35**

Hex:	2019-67h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.104 **Attribute value of position comparison 35**

Hex:	2019-69h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.105 **Target value of position comparison 36**

Hex:	2019-6Ah	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.107 **Attribute value of position comparison 36**

Hex:	2019-6Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.108 **Target value of position comparison 37**

Hex:	2019-6Dh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.110 **Attribute value of position comparison 37**

Hex:	2019-6Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.111 **Target value of position comparison 38**

Hex:	2019-70h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.113 **Attribute value of position comparison 38**

Hex:	2019-72h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.114 **Target value of position comparison 39**

Hex:	2019-73h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.116 **Attribute value of position comparison 39**

Hex:	2019-75h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

H19.117 Target value of position comparison 40

Hex:	2019-76h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Same as H19.00.

H19.119 Attribute value of position comparison 40

Hex:	2019-78h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: Nabit10:
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter descriptions:

See H19.02.

15.24 H1E Oscilloscope Variables

H1E.61 **Black box state**

Hex:	201E-3Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

-

H1E.69 **Sampling frequency**

Hex:	201E-46h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 65535

Parameter descriptions:

-

H1E.80 **Black box function mode**

Hex:	201E-51h	Effective mode:	-

Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	Read-only

Range:

0: Disable

1: Any fault

2: Designated fault

3: Triggered based on designated condition

Parameter descriptions:

Defines the condition for triggering black box sampling.

H1E.81 **Designated fault code**

Hex:	201E-52h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Range:

0.0 to 6553.5

Parameter descriptions:

Defines the fault code for triggering the black box function.

H1E.82 **Trigger source**

Hex:	201E-53h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	22	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 22

Parameter descriptions:

Defines the fault code for triggering the black box function through designated channel.

H1E.83 **Trigger level**

Hex:	201E-54h	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:

-2147483648 to 2147483647

Parameter descriptions:

Defines the trigger level for triggering the black box function through designated channel.

H1E.85 **Trigger level**

Hex:	201E-56h	Effective mode:	-
Min. value:	0	Unit:	-

Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0: Rising edge
1: Equal
2: Falling edge
3: Edge-triggered
Parameter descriptions:
Defines the trigger mode for triggering the black box function through H0A.63.

H1E.86 **Trigger position**

Hex:	201E-57h	Effective mode:	-
Min. value:	0	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	75	Change mode:	Read-only

Range:
0 to 100
Parameter descriptions:
Defines the pre-trigger position for triggering black box sampling.

H1E.87 **Sampling frequency**

Hex:	201E-58h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0: Current loop
1: Position loop
2: Main cycle
Parameter descriptions:
Defines the frequency sampling mode during black box sampling.

H1E.88 **Triggering offset calculation for the black box**

Hex:	201E-59h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The waveform offset when the fault is recorded by the black box.

H1E.89 **Pre-triggering the black box**

Hex:	201E-5Ah	Effective mode:	-

Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The position for pre-triggering the black box.

H1E.90 **Servo drive operation time**

Hex:	201E-5Bh	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 429496729.5
Parameter descriptions:
Servo drive operation time

H1E.92 **Black box record**

Hex:	201E-5Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 20
Parameter descriptions:
The fault record is mapped as information recorded in the black box.

H1E.93 **The fault record is mapped as information recorded in the black box.**

Hex:	201E-5Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 20
Parameter descriptions:
Black box record

H1E.94 **Read records from the black box**

Hex:	201E-5Fh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Read records from the black box

15.25 H21 Current Loop Gain Switchover Parameters

H21.00 **Current loop gain switchover**

Hex:	2021-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No operation
1: Enabled
Parameter descriptions:
Defines whether to enable the current loop gain function.
0: Disable 1: Enabled

15.26 H22 Process Segment Parameters

H22.00 **Process segment command trigger**

Hex:	2022-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 1000
Parameter descriptions:
Used to trigger the process segment. The process segment can be triggered through the keypad or communication.
The homing function is triggered when 0 is written to H22.00.
Process segments 1 to 15 are triggered when 1 to 15 are written to H22.00.
The process segment pauses when 1000 is written to H22.00.
E126.0 (Process segment number error) will be reported when 16 to 999 are written to H22.00.

H22.01 **Process segment triggered by the event rising edge**

Hex:	2022-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 65535

Parameter description

DI: ProceEvTri (OFF to ON, rising edge-triggered).

bit0 to bit3: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri1 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri1 is triggered.

bit4 to bit7: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri2 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri2 is triggered.

bit8 to bit11: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri3 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri3 is triggered.

bit12 to bit15: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri4 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri4 is triggered.

H22.02 **Process segment triggered by the event falling edge**

Hex:	2022-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 65535

Parameter description

DI: ProceEvTri (ON to OFF, falling edge-triggered).

bit0 to bit3: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri1 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri1 is triggered.

bit4 to bit7: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri2 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri2 is triggered.

bit8 to bit11: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri3 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri3 is triggered.

bit12 to bit15: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri4 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri4 is triggered.

H22.03 **Acceleration/Deceleration time upon technology segment pause**

Hex:	2022-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Acceleration/Deceleration time
1: Acceleration/Deceleration time 1
2: Acceleration/Deceleration time 2
3: Acceleration/Deceleration time 3
4: Acceleration/Deceleration time 4
5: Acceleration/Deceleration time 5
6: Acceleration/Deceleration time 6
7: Acceleration/Deceleration time 7

Parameter descriptions:

When the process segment is paused, the motor ramps to stop based on the deceleration time defined by H22.03. Setpoints 0 to 7 correspond to parameters H22.35 to H22.42.

H22.04 **Positive software position limit**

Hex:	2022-05h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	2147483647	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

E956.0 can occur when the motor operates forwardly with position reference exceeding the setpoint of H22.04 during positioning in the process segment mode.

H22.06 **Negative software position limit**

Hex:	2022-07h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	-2147483648	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

E958.0 can occur when the motor operates reversely with position reference exceeding the setpoint of H22.06 during positioning in the process segment mode.

H22.08 **Process segment number**

Hex:	2022-09h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 65535

Parameter descriptions:

Indicates the process segment number in progress in the process segment mode.

H22.09 **Process segment function switch**

Hex:	2022-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
bit0:
0: Keep interrupt positioning state 1: Cancel interrupt positioning state when triggering process segment

H22.10 **Process segment state**

Hex:	2022-0Bh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Used for process segment state feedback.
The process segment number will be read back when commands in the positioning mode are not done executing.
The process segment number + 10000 will be read back when commands in the positioning mode are done executing.
The process segment number + 20000 will be read back when commands in the positioning mode are done executing and positioning has been completed.

H22.19 **Target speed**

Hex:	2022-14h	Effective mode:	Real time
Min. value:	0.1	Unit:	rpm
Max. value:	6000.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Range:
0.1 to 6000.0
Parameter descriptions:
Eight groups of target speed are available for each process segment command.
Target speed refers to the constant operating speed when the motor is not in the acceleration/deceleration process. If the displacement is too small in the positioning mode, the actual motor speed will be lower than the setpoint of H22.19.

H22.20 **Target speed 1**

Hex:	2022-15h	Effective mode:	Real time
Min. value:	0.1	Unit:	rpm
Max. value:	6000.0	Data type:	UInt16

Default value: 200.0 | Change mode: Real time

Range:
0.1 to 6000.0
Parameter descriptions:
See H22.19.

H22.21 Target speed 2

Hex: 2022-16h | Effective mode: Real time
Min. value: 0.1 | Unit: rpm
Max. value: 6000.0 | Data type: UInt16
Default value: 500.0 | Change mode: Real time

Range:
0.1 to 6000.0
Parameter descriptions:
See H22.19.

H22.22 Target speed 3

Hex: 2022-17h | Effective mode: Real time
Min. value: 0.1 | Unit: rpm
Max. value: 6000.0 | Data type: UInt16
Default value: 1000.0 | Change mode: Real time

Range:
0.1 to 6000.0
Parameter descriptions:
See H22.19.

H22.23 Target speed 4

Hex: 2022-18h | Effective mode: Real time
Min. value: 0.1 | Unit: rpm
Max. value: 6000.0 | Data type: UInt16
Default value: 1500.0 | Change mode: Real time

Range:
0.1 to 6000.0
Parameter descriptions:
See H22.19.

H22.24 Target speed 5

Hex: 2022-19h | Effective mode: Real time
Min. value: 0.1 | Unit: rpm
Max. value: 6000.0 | Data type: UInt16
Default value: 2000.0 | Change mode: Real time

Range:
0.1 to 6000.0

Parameter descriptions:
See H22.19.

H22.25 **Target speed 6**

Hex:	2022-1Ah	Effective mode:	Real time
Min. value:	0.1	Unit:	rpm
Max. value:	6000.0	Data type:	UInt16
Default value:	2500.0	Change mode:	Real time

Range:
0.1 to 6000.0
Parameter descriptions:
See H22.19.

H22.26 **Target speed 7**

Hex:	2022-1Bh	Effective mode:	Real time
Min. value:	0.1	Unit:	rpm
Max. value:	6000.0	Data type:	UInt16
Default value:	3000.0	Change mode:	Real time

Range:
0.1 to 6000.0
Parameter descriptions:
See H22.19.

H22.35 **Acceleration/deceleration time**

Hex:	2022-24h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Eight groups of acceleration/deceleration time are available for each process segment command.
Acceleration/Deceleration time refers to the time for the motor to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed.

H22.36 **Acceleration/Deceleration time 1**

Hex:	2022-25h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
0 to 65535

Parameter descriptions:
Same as H22.35.

H22.37 **Acceleration/Deceleration time 2**

Hex:	2022-26h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.35.

H22.38 **Acceleration/Deceleration time 3**

Hex:	2022-27h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.35.

H22.39 **Acceleration/Deceleration time 4**

Hex:	2022-28h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1500	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.35.

H22.40 **Acceleration/Deceleration time 5**

Hex:	2022-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	2000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.35.

H22.41 **Acceleration/Deceleration time 6**

Hex:	2022-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	2500	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.35.

H22.42 **Acceleration/Deceleration time 7**

Hex:	2022-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.35.

H22.51 **Delay after completion of the process segment**

Hex:	2022-34h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Eight groups of delay time are available for each process segment command.
The delay time refers to the delay that starts from the end of the current command to the operation of the next command in the process segment. For details, see "Process segment mode" in the user guide.

H22.52 **Delay time 1 after completion of the process segment**

Hex:	2022-35h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.53 **Delay time 2 after completion of the process segment**

Hex:	2022-36h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	200	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.54 **Delay time 3 after completion of the process segment**

Hex:	2022-37h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.55 **Delay time 4 after completion of the process segment**

Hex:	2022-38h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.56 **Delay time 5 after completion of the process segment**

Hex:	2022-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1500	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.57 **Delay time 6 after completion of the process segment**

Hex:	2022-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	2000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.58 Delay time 7 after completion of the process segment

Hex:	2022-3Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Same as H22.51.

H22.70 Homing mode of process segment

Hex:	2022-47h	Effective mode:	Real time
Min. value:	-32768	Unit:	-
Max. value:	32767	Data type:	Int16
Default value:	-2	Change mode:	Real time

Range:
-32768 to 32767
Parameter descriptions:
Defines the default motor direction of rotation, deceleration point, and home during homing.
When H22.70 is set to a value from -2 to +35, 402 homing is used (6098h set to a value from -2 to +35). For details, see "Homing Mode" in the user guide.
When H22.70 is set to a value lower than or equal to -200, local homing is used (H22.70 set to (-200 + H05.31). For details, see "Homing Function" in the user guide.

H22.71 Speed of high-speed search for home switch signal

Hex:	2022-48h	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	3000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 3000
Parameter descriptions:
Defines the motor speed for searching for the deceleration point signal during homing.

H22.72 Speed of low-speed search for home switch signal

Hex:	2022-49h	Effective mode:	Real time
Min. value:	0	Unit:	rpm

Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 1000
Parameter descriptions:
Defines the motor speed for searching for the home signal during homing.

H22.73 Acceleration/Deceleration time during homing

Hex:	2022-4Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Range:
0 to 1000
Parameter descriptions:
Defines the time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed during homing.

H22.74 Home search time limit

Hex:	2022-4Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10000	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the maximum homing time.

H22.75 Mechanical home offset

Hex:	2022-4Ch	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the absolute position of the motor after homing.

H22.79 Relative/Absolute homing

Hex:	2022-50h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the offset relation between the mechanical home and mechanical zero point upon homing, as well as the action upon overtravel during homing.
When H22.79 is set to 0, the value of H05.40 is 2.
When H22.79 is set to 1, the value of H05.40 is 3.

H22.83 **Jump count threshold**

Hex:	2022-54h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65534
Parameter descriptions:
Eight groups of process segment jump count are available for each process segment command.
Jump count threshold: Two jumpable process segments are available for the jump reference.
When the accumulative number of jumps executed by the jump reference is lower than the jump count threshold, process segment A applies. Otherwise, process segment B applies. For details, see "Process segment mode" in the user guide.

H22.84 **Jump count threshold 1**

Hex:	2022-55h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	20	Change mode:	Real time

Range:
0 to 65534
Parameter descriptions:
Same as H22.83.

H22.85 **Jump count threshold 2**

Hex:	2022-56h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	40	Change mode:	Real time

Range:
0 to 65534
Parameter descriptions:
Same as H22.83.

H22.86 **Jump count threshold 3**

Hex:	2022-57h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value: 65534
Default value: 80
Data type: UInt16
Change mode: Real time

Range:
0 to 65534
Parameter descriptions:
Same as H22.83.

H22.87 **Jump count threshold 4**

Hex: 2022-58h
Min. value: 0
Max. value: 65534
Default value: 160
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Range:
0 to 65534
Parameter descriptions:
Same as H22.83.

H22.88 **Jump count threshold 5**

Hex: 2022-59h
Min. value: 0
Max. value: 65534
Default value: 320
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Range:
0 to 65534
Parameter descriptions:
Same as H22.83.

H22.89 **Jump count threshold 6**

Hex: 2022-5Ah
Min. value: 0
Max. value: 65534
Default value: 640
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Range:
0 to 65534
Parameter descriptions:
Same as H22.83.

H22.90 **Jump count threshold 7**

Hex: 2022-5Bh
Min. value: 0
Max. value: 65534
Default value: 1280
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Range:

0 to 65534

Parameter descriptions:

Same as H22.83.

15.27 H23 Process Segment Parameters

H23.00 **Definition of homing**

Hex:	2023-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Value range:

0 to 4294967295

Parameter description

For details, see the description of homing methods in each process segment mode in "Home Mode".

H23.02 **Homing data**

Hex:	2023-03h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Not used.

H23.04 **Definition of process segment 1**

Hex:	2023-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Value range:

0 to 4294967295

Parameter description

bit0 to bit3: Mode (process segment operation mode option)

Mode = 1: The fixed speed mode applies.Mode = 2: The positioning mode applies, which stops after positioning is done. Mode = 3: The next segment is executed automatically after positioning is done. Mode = 7: The jump mode applies, which is used to jump to the designated process segment. Mode = 8: The parameter-write mode applies, which allows you to write specific parameters.

For details about the functions in each mode, see the description of each process segment mode in "Process Segment Mode".

H23.06 **Data of process segment 1**

Hex:	2023-07h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Parameter description
Different modes selected in process segment 1 correspond to different process segment data.
For details, see the description of each process segment mode in "Process Segment Mode".

H23.08 **Definition of process segment 2**

Hex:	2023-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.10 **Data of process segment 2**

Hex:	2023-0Bh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.12 **Definition of process segment 3**

Hex:	2023-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.14 **Data of process segment 3**

Hex:	2023-0Fh	Effective mode:	Real time

Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.16 **Definition of process segment 4**

Hex:	2023-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.18 **Data of process segment 4**

Hex:	2023-13h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.20 **Definition of process segment 5**

Hex:	2023-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.22 **Data of process segment 5**

Hex:	2023-17h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.24 **Definition of process segment 6**

Hex:	2023-19h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.26 **Data of process segment 6**

Hex:	2023-1Bh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.28 **Definition of process segment 7**

Hex:	2023-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.30 **Data of process segment 7**

Hex:	2023-1Fh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.32 **Definition of process segment 8**

Hex:	2023-21h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
See definition of technology segment 1.

H23.34 **Data of process segment 8**

Hex:	2023-23h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Same as segment 1.

H23.36 **Definition of process segment 9**

Hex:	2023-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Same as segment 1.

H23.38 **Data of process segment 9**

Hex:	2023-27h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Same as segment 1.

H23.40 **Definition of process segment 10**

Hex:	2023-29h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Same as segment 1.

H23.42 **Data of process segment 10**

Hex:	2023-2Bh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.44 **Definition of process segment 11**

Hex:	2023-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Same as segment 1.

H23.46 **Data of process segment 11**

Hex:	2023-2Fh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.48 **Definition of process segment 12**

Hex:	2023-31h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:

0 to 4294967295

Parameter descriptions:

Same as segment 1.

H23.50 **Data of process segment 12**

Hex:	2023-33h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

See that of technology segment 1.

H23.52 **Definition of process segment 13**

Hex:	2023-35h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:

0 to 4294967295

Parameter descriptions:

Same as segment 1.

H23.54 **Data of process segment 13**

Hex:	2023-37h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

See that of technology segment 1.

H23.56 **Definition of process segment 14**

Hex:	2023-39h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:

0 to 4294967295

Parameter descriptions:

Same as segment 1.

H23.58 **Data of process segment 14**

Hex:	2023-3Bh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

H23.60 **Definition of process segment 15**

Hex:	2023-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Same as segment 1.

H23.62 **Data of process segment 15**

Hex:	2023-3Fh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
See that of technology segment 1.

15.28 H30 Variables Read Through Communication

H30.00 **Servo state read through communication**

Hex:	2030-01h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the current operating state of the servo for interaction with the background.

H30.01 **DO function status 1 read through communication**

Hex:	2030-02h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
bit0 corresponds to DO function 1.
Bit 1 corresponds to DO function 2.
Bit 2 corresponds to DO function 3.
...
By analogy

H30.02 **DO function status 2 read through communication**

Hex:	2030-03h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
bit0 corresponds to DO function 17.
Bit 1 corresponds to DO function 18.
Bit 2 corresponds to DO function 19.
...
By analogy

H30.12 **1st encoder accumulative communication timeout upon occurrence of the selected fault**

Hex:	2030-0Dh	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the number of 1st encoder rising-edge triggered communication timeouts upon occurrence of the selected fault.

H30.13 **1st encoder accumulative communication CRC or frame stop errors upon occurrence of the selected fault**

Hex:	2030-0Eh	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the number of 1st encoder communication CRC errors upon occurrence of the selected fault.

H30.14 **1st encoder rising-edge triggered communication timeouts upon occurrence of the selected fault**

Hex:	2030-0Fh	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 255
Parameter descriptions:
Displays the number of 1st encoder rising-edge triggered communication timeouts upon occurrence of the selected fault.

H30.15 **Drive 5 V voltage monitoring value upon the occurrence of selected fault**

Hex:	2030-10h	Effective mode:	/
Min. value:	0.00	Unit:	V
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Range:
0.00 to 655.35
Parameter descriptions:
Displays the drive internal 5 V voltage monitoring value upon the occurrence of the selected fault.

H30.16 **1St encoder accumulative communication timeout**

Hex:	2030-11h	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Records the number of communication timeout errors of the first encoder upon power-on.

H30.17 **1st encoder accumulative communication CRC or frame stop errors**

Hex:	2030-12h	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Records the number of communication CRC errors of the 1st encoder upon power-on.

H30.18 **Peak value among 1st encoder consecutive communication timeouts**

Hex:	2030-13h	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Records the peak value among 1st encoder consecutive communication timeouts.

H30.28 **1st encoder rising-edge triggered communication timeouts**

Hex:	2030-1Dh	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Records the number of 1st encoder rising-edge triggered communication timeouts upon the current power-on.

H30.29 **Drive 5 V voltage monitoring value**

Hex:	2030-1Eh	Effective mode:	/
Min. value:	0.00	Unit:	V
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Range:
0.00 to 655.35
Parameter descriptions:
Displays the drive internal 5 V voltage monitoring value.

H30.30 **Number of error frame alarms**

Hex:	2030-1Fh	Effective mode:	/
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535

Parameter descriptions:
Displays the number of E08.7 alarms.

H30.31 **E08 fault log**

Hex:	2030-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	19	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Present fault
1: Last E08 fault
2: 2nd to last E08 fault
3: 3rd to last E08 fault
4: 4th to last E08 fault
5: 5th to last E08 fault
6: 6th to last E08 fault
7: 7th to last E08 fault
8: 8th to last E08 fault
9: 9th to last E08 fault
10: 10th to last E08 fault
11: 11th to last E08 fault
12: 12th to last E08 fault
13: 13th to last E08 fault
14: 14th to last E08 fault
15: 15th to last E08 fault
16: 16th to last E08 fault
17: 17th to last E08 fault
18: 18th to last E08 fault
19: 19th to last E08 fault
Parameter descriptions:

Used to view the latest 20 E08 faults of the drive.
0: Present fault
1: Last fault
2: 2nd to last fault
3: 3rd to last fault
4: 4th to last fault
5: 5th to last fault 6: 6th to last fault
7: 7th to last fault
8: 8th to last fault
9: 9th to last fault
10: 10th to last fault
11: 11th to last fault
12: 12th to last fault
13: 13th to last fault
14: 14th to last fault
15: 15th to last fault
16: 16th to last fault
17: 17th to last fault
18: 18th to last fault
19: 19th to last fault

H30.32 **E08 fault code of fault selected by H30.31**

Hex:	2030-21h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Display E08 fault code of fault selected by H30.31

H30.33 **Timestamp of the selected E08 fault**

Hex:	2030-22h	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Range:
0.0 to 429496729.5
Parameter descriptions:
Display the timestamp of the selected E08 fault.

H30.35 **Error register on port 0 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP) due to E08 fault**

Hex:	2030-24h	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the error register on port 0 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP) due to E08 fault.

H30.36 **Error register on port 1 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP) due to E08 fault**

Hex:	2030-25h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the error register on port 1 when the equipment switches from Safe-operational (SAFEOP) to Operational (OP) due to E08 fault.

H30.37 **Forwarding error register when the equipment switches from SAFEOP to OP due to E08 fault**

Hex:	2030-26h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the forwarding error register when the equipment switches from SAFEOP to OP due to E08 fault.

H30.38 **Error register on the processing unit when the equipment switches from SAFEOP to OP due to E08 fault**

Hex:	2030-27h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt8
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFF
Parameter descriptions:
Displays the error register on the processing unit when the equipment switches from SAFEOP to OP due to E08 fault.

H30.39 **Disconnection register when the equipment switches from SAFEOP to OP due to E08 fault**

Hex:	2030-28h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Display the disconnection register when the equipment switches from SAFEOP to OP due to E08 fault.

H30.40 **Error register on port 0 upon E08 fault**

Hex:	2030-29h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the error register on port 0 upon E08 fault.

H30.41 **Error register on port 1 upon E08 fault**

Hex:	2030-2Ah	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the error register on port 1 upon E08 fault.

H30.42 **Forwarding error register upon E08 fault**

Hex:	2030-2Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the forward error register upon the selected E08 fault

H30.43 **Error register on the processing unit upon E08 fault**

Hex:	2030-2Ch	Effective mode:	-

Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt8
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFF
Parameter descriptions:
Display the error register on the processing unit upon E08 fault.

H30.44 **Disconnection register upon E08 fault**

Hex:	2030-2Dh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the disconnection register upon E08 fault.

H30.45 **SYNC signal cycle upon E08 fault**

Hex:	2030-2Eh	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the SYNC signal cycle upon E08 fault.

H30.47 **Phase difference between SYNC signal and IRQ signal upon E08 fault**

Hex:	2030-30h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Range:
0 to 4294967295
Parameter descriptions:
Displays the phase difference between the SYNC signal and the IRQ signal upon E08 fault.

H30.49 **Fault record variable 1 upon E08 fault**

Hex:	2030-32h	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the fault record variable 1 upon E08 fault.

H30.51 **Fault record variable 2 upon E08 fault**

Hex:	2030-34h	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Displays the fault record variable 2 upon E08 fault.

H30.53 **Read/write the ESC/PHY register switch**

Hex:	2030-36h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x101	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0x101
Parameter descriptions:
The ESC/PHY register read/write function switch.
Low 8 bits: 0: Disable the ESC register 1: Enable the ESC register
High 8 bits: 0: Disable reading/writing of the PHY register 1: Enable reading/writing of the PHY registers

H30.54 **ESC register read/write attributes**

Hex:	2030-37h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x4	Data type:	UInt8
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0x4
Parameter descriptions:
Used to set the ESC register read/write attributes.
0: Invalid 1: Read 4: Write (Locked in OP state)

H30.55 **ESC register address**

Hex:	2030-38h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter descriptions:
Used to set the ESC register address.

H30.56 **ESC register data**

Hex:	2030-39h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter descriptions:
Used to set/display the ESC register data.

H30.57 **PHY register read/write attributes**

Hex:	2030-3Ah	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x4101	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0x4101
Parameter descriptions:
The high 8 bits are used to set the read/write attributes.
The high 4 bits (bit12 to bit115) indicate the register type: 1: Standard register 4: Extended register
The low 4 bits (bit8 to bit11) indicate read/write attributes: 0: Invalid 1: Read
The low 8 bits are used to set the PHY address (bit0 to bit7).
PHY address: 0: IN port 1: OUT port

H30.58 **PHY register address**

Hex:	2030-3Bh	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter descriptions:
Used to set the PHY register address.

H30.59 **PHY register data**

Hex:	2030-3Ch	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter descriptions:
Displays the value of the corresponding PHY register.

H30.60 **PHY MII-ERR monitoring selection**

Hex:	2030-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: Disable MII-ERR monitoring
1: Enable MII-ERR monitoring
Parameter descriptions:
0: Disable MII-ERR monitoring
1: Enable MII-ERR monitoring

H30.61 **Read the PHY address upon MII receive (RX) error**

Hex:	2030-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: IN port
1: OUT port
Parameter descriptions:
Defines the PHY address.
0: IN port
1: OUT port

H30.62 **MII RX error, 64 <= length <= 1518**

Hex:	2030-3Fh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The MII interface receives a data frame error. The length of the data frame is 64 <= length <= 1518.

H30.63 **MII RX error, length > 1518**

Hex:	2030-40h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16

Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The MII interface receives a data frame error. The length of the data frame is > 1518.

H30.64 **MII RX error, length < 64**

Hex:	2030-41h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The MII interface receives a data frame error. The length of the data frame is < 64.

H30.65 **SFD error**

Hex:	2030-42h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Data frame SFD error

H30.66 **Total number of frames receive by MII per second**

Hex:	2030-43h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
The total number of frames interface receive by MII per second.

H30.67 **MDI RX error, 64 ≤ length ≤ 1518**

Comm. address:	2030-44h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535

Parameter description
Indicates data frame RX error on the MDI interface, data frame length: 64 ≤ length ≤ 1518.

H30.68 **MDI RX error, length > 1518**

Comm. address:	2030-45h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Indicates data frame RX error of MDI interface, data frame length: > 1518.

H30.69 **MDI RX error, length < 64**

Comm. address:	2030-46h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Indicates data frame RX error on the MDI interface, data frame length: < 64.

H30.70 **MDI RX error, SFD error**

Comm. address:	2030-47h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Indicates data frame SFD errors.

H30.71 **Number of frames received by MDI**

Comm. address:	2030-48h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Defines the total number of frames interface receive by MDI per second.

H30.74 **OUT port error frame alarm count**

Comm. address:	2030-4Bh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Displays the number of E08.8 alarms.

H30.75 **Number of IN port RX errors**

Comm. address:	2030-4Ch	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Number of IN port RX errors

H30.76 **Number of OUT port RX errors**

Comm. address:	2030-4Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Number of OUT port RX errors

H30.77 **Number of IN port error frames**

Comm. address:	2030-4Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Defines the number of invalid IN port frames.

H30.78 **Number of OUT port error frames**

Comm. address:	2030-4Fh	Effective mode:	-
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Parameter description
Defines the number of invalid OUT port frames.

15.29 H31 References Set Through Communication

H31.00 **VDI virtual level set through communication**

Hex:	2031-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
When H17.90 is set to 1, the VDI state is defined by H31.00.
The VDI logic is determined by H17.91 (Default VDI virtual level value upon (power-on) upon initial power-on. Then, H31.00 is determined by the VDI logic.
"bit(n) = 1" of H31.00 indicates the logic of VDI (n+1) is "1". "bit(n)=0" indicates the logic of VDI (n +1) is "0".

H31.01 **Frequency-division output frequency that set through communication**

Hex:	2031-02h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	16000000	Data type:	UInt32
Default value:	0	Change mode:	Real time

Range:
0 to 16000000
Parameter descriptions:
When H05.38 is set to 4, H31.01 sets the frequency (after frequency quadrupled) of the frequency-division output port.

H31.04 **DO status set through communication**

Hex:	2031-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the DO output status source through H04.22.

H31.05 **AO status set through communication**

Hex:	2031-06h	Effective mode:	Real time
Min. value:	-10000	Unit:	mV
Max. value:	10000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:
-10000 to 10000
Parameter descriptions:
Set H04.50 to 10 to define AO through H31.05 (in mV).

H31.09 **Speed reference set through communication**

Hex:	2031-0Ah	Effective mode:	Real time
Min. value:	-9999.000	Unit:	rpm
Max. value:	9999.000	Data type:	Int32
Default value:	0.000	Change mode:	Real time

Range:
-9999.000 to 9999.000
Parameter descriptions:
Set H06.02 to 4 to define H31.09 as the source of the speed reference in the speed control mode (unit: 0.001 rpm).

H31.11 **Torque reference set through communication**

Hex:	2031-0Ch	Effective mode:	Real time
Min. value:	-100.000	Unit:	%
Max. value:	100.000	Data type:	Int32
Default value:	0.000	Change mode:	Real time

Range:
-100.000 to 100.000
Parameter descriptions:
Set H07.02 to 4 to define the torque reference in the torque control mode through this parameter (unit: 0.001%). The setpoint 100.000% corresponds to the rated torque of the motor.

15.30 H32 Direct Drive Parameters

H32.00 **Encoder interpolater mismatch alarm (E124)**

Hex:	2032-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0: Disable
1: Enable

Parameter descriptions:

The T2 interpolator matches the HipFace encoder. The power-on check switch is turned on by default.

0: Disable

1: Enable

H32.02 **Angle auto-tuning upon power-on**

Hex:	2032-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disabled

1: Enabled

Parameter descriptions:

Angle auto-tuning starts after the drive switches to the rdy state and the time defined by H32.41 elapses.

0: Disabled

1: Enabled

H32.03 **Angle auto-tuning switch controlled by control word**

Hex:	2032-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable 1: Control word 6 2: Control word 7

Parameter descriptions:

Used to enable the angle auto-tuning switchover switch through the control word.

0: Disable 1: Control word 6 2: Control word 7

H32.04 **Angle auto-tuning state display**

Hex:	2032-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

bit0: bit7 of 6041

bit1: E602.9

Parameter description

When angle auto-tuning is not performed on the incremental encoder, the related alarm or status bit is generated based on the setting.

bit0: bit7 of 6041h

bit1: E602.9

H32.05 **Retract by pre-positioning**

Hex:	2032-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disabled

1: Enabled

Parameter descriptions:

Used to retract by a certain distance after auto-tuning through pre-positioning is done.

0: Disabled

1: Enabled

H32.06 **Position feedback**

Hex:	2032-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disabled

1: Enabled

Parameter descriptions:

Used to align the position feedback to the position before angle auto-tuning for incremental encoders.

0: Disabled

1: Enabled

H32.07 **Incremental homing mode**

Hex:	2032-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

0: Z signal short-circuited 1: Short-circuited only at the first time

Parameter descriptions:

Incremental communication encoder, Z signal selection upon homing

0: Z signal short-circuited 1: Position latched after the first short circuit Note: The Z signal width needs to be set by H3208.

H32.08 **Homing signal width**

Hex:	2032-09h	Effective mode:	Real time
Min. value:	100	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	800	Change mode:	At stop

Range:
100 to 65535
Parameter descriptions:
The setpoint is active after the position is latched by Z signal.

H32.10 **Max. reference current in angle auto-tuning through inching**

Hex:	2032-0Bh	Effective mode:	At stop
Min. value:	10.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Range:
10.0 to 300.0
Parameter descriptions:
Defines the maximum reference current during auto-tuning.

H32.13 **Motor action threshold (ROT/DDR) in angle auto-tuning through inching**

Hex:	2032-0Eh	Effective mode:	At stop
Min. value:	0.001	Unit:	deg
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Range:
0.001 to 20.000
Parameter descriptions:
Defines the threshold for determining motor action during auto-tuning.
The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.14 **Motor standstill threshold (ROT/DDR) in angle auto-tuning through inching**

Hex:	2032-0Fh	Effective mode:	At stop
Min. value:	0.1	Unit:	(mm/s)/rpm
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 100.0
Parameter descriptions:
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most of applications.

H32.15 **Motor action threshold (DDL) in angle auto-tuning through inching**

Hex:	2032-10h	Effective mode:	At stop
Min. value:	0.001	Unit:	mm
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Range:
0.001 to 20.000
Parameter descriptions:
Defines the threshold for determining motor action during auto-tuning.
The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.16 Motor standstill threshold (DDL) in angle auto-tuning through inching

Hex:	2032-11h	Effective mode:	At stop
Min. value:	0.1	Unit:	mm/s
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 100.0
Parameter descriptions:
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most of applications.

H32.18 Motor standstill threshold in angle auto-tuning through inching

Hex:	2032-13h	Effective mode:	At stop
Min. value:	0.1	Unit:	s
Max. value:	10.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 10.0
Parameter descriptions:
Defines the time for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.20 Max. reference current in angle auto-tuning through pre-positioning (closed-loop)

Hex:	2032-15h	Effective mode:	At stop
Min. value:	10.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Range:
10.0 to 300.0
Parameter descriptions:
Defines the maximum reference current during auto-tuning.

H32.22 Electrical angle reference in angle auto-tuning through pre-positioning (closed-loop)

Hex:	2032-17h	Effective mode:	At stop
Min. value:	0.0	Unit:	deg
Max. value:	360.0	Data type:	UInt16

Default value:	0.0	Change mode:	At stop

Range:
0.0 to 360.0
Parameter descriptions:
Defines the electrical angle during auto-tuning through pre-positioning.

H32.23 Electrical angle reference change range in angle auto-tuning through pre-positioning (closed-loop)

Hex:	2032-18h	Effective mode:	At stop
Min. value:	10.0	Unit:	deg
Max. value:	170.0	Data type:	UInt16
Default value:	90.0	Change mode:	At stop

Range:
10.0 to 170.0
Parameter descriptions:
Defines the electrical angle change range during auto-tuning.

H32.24 Motor stop threshold (ROT/DDR) in angle auto-tuning through pre-positioning (closed-loop)

Hex:	2032-19h	Effective mode:	At stop
Min. value:	0.1	Unit:	(mm/s)/rpm
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 100.0
Parameter descriptions:
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most of applications.

H32.25 Motor stop threshold (DDL) in angle auto-tuning through pre-positioning (closed-loop)

Hex:	2032-1Ah	Effective mode:	At stop
Min. value:	0.1	Unit:	mm/s
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 100.0
Parameter descriptions:
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most of applications.

H32.26 Damping in angle auto-tuning through pre-positioning (closed-loop)

Hex:	2032-1Bh	Effective mode:	At stop
Min. value:	0.00	Unit:	[N/(m/s)]/[N·m/rpm]
Max. value:	655.35	Data type:	UInt16

Default value:	0.00	Change mode:	At stop

Range:
0.00 to 655.35
Parameter descriptions:
Defines the damping coefficient during auto-tuning. A proper coefficient ensures a smooth and impact-free operation process.
1. The setpoint is related to the load characteristics. The higher the load, the higher the coefficient.
2. Violent impact may be present during auto-tuning in case of an excessively low setpoint, which is normal. The motor action may be delayed in case of an excessively high setpoint, which is also normal unless a timeout alarm is reported.

H32.29 **Motor standstill threshold in angle auto-tuning through pre-positioning (closed-loop)**

Hex:	2032-1Eh	Effective mode:	At stop
Min. value:	0.1	Unit:	s
Max. value:	10.0	Data type:	UInt16
Default value:	0.5	Change mode:	At stop

Range:
0.1 to 10.0
Parameter descriptions:
Defines the time for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.30 **Max. reference current in angle auto-tuning through position lock**

Hex:	2032-1Fh	Effective mode:	At stop
Min. value:	10.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Range:
10.0 to 300.0
Parameter descriptions:
Defines the maximum reference current during auto-tuning.

H32.33 **Motor action threshold (ROT/DDR) in angle auto-tuning through position lock**

Hex:	2032-22h	Effective mode:	At stop
Min. value:	0.001	Unit:	deg
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Range:
0.001 to 20.000
Parameter descriptions:
Defines the threshold for determining motor action during auto-tuning.
The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.34 **Motor standstill threshold (ROT/DDR) in angle auto-tuning through position lock**

Hex:	2032-23h	Effective mode:	At stop
Min. value:	0.1	Unit:	(mm/s)/rpm
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 100.0
Parameter descriptions:
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.35 **Motor action threshold (DDL) in angle auto-tuning through position lock**

Hex:	2032-24h	Effective mode:	At stop
Min. value:	0.001	Unit:	mm
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Range:
0.001 to 20.000
Parameter descriptions:
Defines the threshold for determining motor action during auto-tuning.
The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.36 **Motor standstill threshold (DDL) in angle auto-tuning through position lock**

Hex:	2032-25h	Effective mode:	At stop
Min. value:	0.1	Unit:	mm/s
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 100.0
Parameter descriptions:
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.37 **Angle gain in angle auto-tuning through position lock**

Hex:	2032-26h	Effective mode:	At stop
Min. value:	0	Unit:	deg/(p/s)
Max. value:	10000	Data type:	UInt16
Default value:	1000	Change mode:	At stop

Range:
0 to 10000

Parameter descriptions:
Defines the angle gain during auto-tuning. A proper setpoint improves the auto-tuning angle accuracy. The default value applies to most of applications.

H32.38 Inertia ratio in angle auto-tuning through position lock

Hex:	2032-27h	Effective mode:	At stop
Min. value:	0.00	Unit:	-
Max. value:	120.00	Data type:	UInt16
Default value:	0.00	Change mode:	At stop

Range:
0.00 to 120.00
Parameter descriptions:
Defines the inertia ratio gain used during auto-tuning. A proper setpoint ensures a smooth and jitter-free auto-tuning process and reduces the auto-tuning action range.
1. The setpoint is related to the load characteristics. The actual inertia ratio applies to most of applications.
2. An excessively low setpoint can lead to a large movement value during auto-tuning, which is normal. An excessively high setpoint can lead to oscillation caused by gain mismatch.

H32.39 Gain class in angle auto-tuning through position lock

Hex:	2032-28h	Effective mode:	At stop
Min. value:	4	Unit:	level
Max. value:	31	Data type:	UInt16
Default value:	12	Change mode:	At stop

Range:
4 to 31
Parameter descriptions:
Defines the loop stiffness level gain for auto-tuning. A proper setpoint ensures a smooth and jitter-free auto-tuning process and reduces the auto-tuning action range.
1. An excessively low setpoint can lead to a large movement value during auto-tuning, which is normal. An excessively high setpoint can lead to oscillation caused by gain mismatch.

H32.40 Left/Right limit function

Hex:	2032-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
1. Left limit being positive 2. Left limit being negative
Parameter descriptions:
Motors with left and right limits are supported. After the parameter is set, the left and right limit is enabled.
1. Left limit being positive 2. Left limit being negative

H32.41 **Angle auto-tuning timeout upon power-on**

Hex:	2032-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	s
Max. value:	65535	Data type:	UInt16
Default value:	3	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Used to set automatic angle auto-tuning delay upon power-on.

H32.45 **Black box channel 26 function selection**

Hex:	2032-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Real-time target speed (60FFh) 1: Electrical angle
Parameter descriptions:
Used to switch the function of the black box monitoring channel 21.
0: Real-time target position (607Ah) 1: Electrical angle

H32.50 **32-bit range compatibility enable**

Hex:	2032-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
0 to 99
Parameter descriptions:
Used to enable 32-bit range compatibility.

H32.51 **Hall auto-tuning mode**

Hex:	2032-34h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Open-loop Hall auto-tuning 1: Closed-loop Hall auto-tuning
Parameter descriptions:
Defines the Hall auto-tuning mode.

H32.52 **Maximum current for Hall auto-tuning**

Hex:	2032-35h	Effective mode:	Real time

Min. value:	10	Unit:	%
Max. value:	300	Data type:	UInt16
Default value:	100	Change mode:	At stop

Range:
10 to 300
Parameter descriptions:
Defines the maximum auto-tuning current of dynamic Hall auto-tuning.

H32.53 **Motor standstill threshold in angle auto-tuning through position lock**

Hex:	2032-36h	Effective mode:	At stop
Min. value:	0.1	Unit:	s
Max. value:	10.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Range:
0.1 to 10.0
Parameter descriptions:
Defines the time for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.54 **Hall auto-tuning selection**

Hex:	2032-37h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
When this parameter is enabled, the Hall auto-tuning will be started automatically after basic angle auto-tuning is done.

H32.55 **Manual tuning of Hall signal U/V/W**

Hex:	2032-38h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 7
Parameter descriptions:
Defines the Hall level state.

H32.56 **U/V/W filter time of Hall signal**

Hex:	2032-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	10	Data type:	UInt16

Default value:	5	Change mode:	Real time

Range:
0 to 10
Parameter descriptions:
Defines the U/V/W filter time of Hall signals.

H32.57 **Hall closed-loop stall speed**

Hex:	2032-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	(mm/s)/rpm
Max. value:	65535	Data type:	UInt16
Default value:	2	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the stall threshold upon hitting the limit during closed-loop angle auto-tuning of hall position.

H32.58 **Hall closed-loop stall current**

Hex:	2032-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	120.0	Change mode:	At stop

Range:
0.0 to 300.0
Parameter descriptions:
Defines the stall current upon hitting the limit during closed-loop angle auto-tuning of hall position.

H32.59 **Hall closed-loop stall window time**

Hex:	2032-3Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	2000	Data type:	UInt16
Default value:	10	Change mode:	At stop

Range:
0 to 2000
Parameter descriptions:
Defines the stall window time upon hitting the limit during closed-loop angle auto-tuning of hall position.

H32.60 **Hall closed-loop inertia ratio**

Hex:	2032-3Dh	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	120.00	Data type:	UInt16

Default value:	0.00	Change mode:	At stop

Range:
0.00 to 120.00
Parameter descriptions:
Defines the inertia ratio in closed-loop angle auto-tuning of Hall position.

H32.61 **Hall closed-loop stiffness**

Hex:	2032-3Eh	Effective mode:	Real time
Min. value:	4	Unit:	-
Max. value:	31	Data type:	UInt16
Default value:	12	Change mode:	At stop

Range:
4 to 31
Parameter descriptions:
Defines the stiffness level of Hall position closed-loop angle auto-tuning.

H32.62 **Electrical angle save flag**

Hex:	2032-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Automatic reset will be performed after the electrical angle is saved when dynamic Hall auto-tuning is done.

H32.63 **Electrical angle of Hall 1**

Hex:	2032-40h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the hall 1 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.64 **Electrical angle of Hall 2**

Hex:	2032-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the hall 2 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.65 **Electric angle of Hall 3**

Hex:	2032-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the hall 3 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.66 **Electrical angle of Hall 4**

Hex:	2032-43h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the hall 4 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.67 **Electrical angle of Hall 5**

Hex:	2032-44h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the hall 5 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.68 **Electric angle of Hall 6**

Hex:	2032-45h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the hall 6 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.70 **Motor overload protection mode**

Hex:	2032-47h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: Internal motor overload curve 1: External motor overload curve 2: Current limit overload protection 3: Hide motor overload protection
Parameter descriptions:
Defines the motor overload protection mode.
0: Internal motor overload curve 1: External motor overload curve 2: Current limit overload protection 3: Hide motor overload protection

H32.73 **Overload current limit thermal threshold current**

Hex:	2032-4Ah	Effective mode:	Next power-on
Min. value:	10.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	115.0	Change mode:	At stop

Value range:
10.0 to 750.0
Parameter description
This parameter takes effect when the motor overload current limit is enabled. It is the rated motor current percentage. When this value is exceeded, the motor keeps heating up. The default value 115% applies to Inovance motors. It is recommended to set this parameter to 100% for third-party motors. If the overload characteristics of the motor is of poor performance, it is recommended to reduce the values of H32.73, H32.74, H32.75, and H32.76 when motor current limit protection is enabled.

H32.74 **Peak current of overload current limit**

Hex:	2032-4Bh	Effective mode:	Upon the next power-on
Min. value:	100.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	300.0	Change mode:	At stop

Range:
100.0 to 750.0
Parameter descriptions:
Defines the ratio of the peak current that can be reached by the motor to the rated current of the motor.

H32.75 **Max. current duration of overload protection**

Hex:	2032-4Ch	Effective mode:	Real time
Min. value:	0.01	Unit:	s
Max. value:	655.35	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:
0.01 to 655.35
Parameter descriptions:
Calculate the maximum heat that can be reached by the motor based on the maximum current continuous time, and take this value as the motor overload alarm threshold.

H32.76 **Current limit time constant of overload protection**

Hex:	2032-4Dh	Effective mode:	Real time
Min. value:	0.01	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:
0.01 to 655.35
Parameter descriptions:
It is related to the maximum current continuous time. The higher the setpoint, the longer the maximum current continuous time will be.

H32.77 **Current limit alarm threshold of overload protection**

Hex:	2032-4Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Range:
0.0 to 750.0
Parameter descriptions:
An alarm will be reported when the limited current falls below this threshold.

H32.78 **Current limit fault threshold of overload protection**

Hex:	2032-4Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Range:
0.0 to 750.0
Parameter descriptions:
A fault will be reported when the limited current falls below this threshold.

H32.79 **Thermal threshold current of overload**

Hex:	2032-50h	Effective mode:	Upon the next power-on

Min. value:	10.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	115.0	Change mode:	At stop

Range:
10.0 to 750.0
Parameter descriptions:
Defines the thermal threshold current of overload.

H32.80 **Thermal current interval of overload**

Hex:	2032-51h	Effective mode:	Upon the next power-on
Min. value:	0.1	Unit:	%
Max. value:	204.8	Data type:	UInt16
Default value:	6.4	Change mode:	At stop

Range:
0.1 to 204.8
Parameter descriptions:
Defines the thermal current interval of overload.

H32.81 **Overload heat dissipation current interval**

Hex:	2032-52h	Effective mode:	Upon the next power-on
Min. value:	0.1	Unit:	%
Max. value:	204.8	Data type:	UInt16
Default value:	6.4	Change mode:	At stop

Range:
0.1 to 204.8
Parameter descriptions:
Defines overload heat dissipation current interval.

H32.82 **Length of overload heat dissipation curve**

Hex:	2032-53h	Effective mode:	Upon the next power-on
Min. value:	1	Unit:	-
Max. value:	200	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
1 to 200
Parameter descriptions:
Defines the length of overload heat dissipation curve.

H32.83 **Length of overload heat dissipation curve**

Hex:	2032-54h	Effective mode:	Upon the next power-on
Min. value:	1	Unit:	-
Max. value:	200	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:
1 to 200
Parameter descriptions:
Defines the length of overload heat dissipation curve.

15.31 H33 Compensation Parameters

H33.00 **Compensation data BUFFER0**

Hex:	2033-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER0.

H33.01 **Compensation data BUFFER1**

Hex:	2033-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER1.

H33.02 **Compensation data BUFFER2**

Hex:	2033-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER2.

H33.03 **Compensation data BUFFER3**

Hex:	2033-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER3.

H33.04 **Compensation data BUFFER4**

Hex:	2033-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER4.

H33.05 **Compensation data BUFFER5**

Hex:	2033-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER5.

H33.06 **Compensation data BUFFER6**

Hex:	2033-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER6.

H33.07 **Compensation data BUFFER7**

Hex:	2033-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER7.

H33.08 **Compensation data BUFFER8**

Hex:	2033-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER8.

H33.09 **Compensation data BUFFER9**

Hex:	2033-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER9.

H33.10 **Compensation data BUFFER10**

Hex:	2033-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER10.

H33.11 **Compensation data BUFFER11**

Hex:	2033-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER11.

H33.12 **Compensation data BUFFER12**

Hex:	2033-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER12.

H33.13 Compensation data BUFFER13

Hex:	2033-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER13.

H33.14 Compensation data BUFFER14

Hex:	2033-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER14

H33.15 Compensation data BUFFER15

Hex:	2033-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER15.

H33.16 Compensation data BUFFER16

Hex:	2033-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER16.

H33.17 **Compensation data BUFFER17**

Hex:	2033-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER17.

H33.18 **Compensation data BUFFER18**

Hex:	2033-13h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER18.

H33.19 **Compensation data BUFFER19**

Hex:	2033-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER19.

H33.20 **Compensation data BUFFER20**

Hex:	2033-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER20.

H33.21 **Compensation data BUFFER21**

Hex:	2033-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER21.

H33.22 **Compensation data BUFFER22**

Hex:	2033-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER22.

H33.23 **Compensation data BUFFER23**

Hex:	2033-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER23.

H33.24 **Compensation data BUFFER24**

Hex:	2033-19h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER24.

H33.25 **Compensation data BUFFER25**

Hex:	2033-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER25.

H33.26 **Compensation data BUFFER26**

Hex:	2033-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER26.

H33.27 **Compensation data BUFFER27**

Hex:	2033-1Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER27.

H33.28 **Compensation data BUFFER28**

Hex:	2033-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER28.

H33.29 **Compensation data BUFFER29**

Hex:	2033-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER29.

H33.30 Compensation data BUFFER30

Hex:	2033-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER30.

H33.31 Compensation data BUFFER31

Hex:	2033-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER31.

H33.32 Compensation data BUFFER32

Hex:	2033-21h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER32.

H33.33 Compensation data BUFFER33

Hex:	2033-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 65535

Parameter descriptions:

Defines the compensation data BUFFER33.

H33.34 **Compensation data BUFFER34**

Hex:	2033-23h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER34.

H33.35 **Compensation data BUFFER35**

Hex:	2033-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER35.

H33.36 **Compensation data BUFFER36**

Hex:	2033-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER36.

H33.37 **Compensation data BUFFER37**

Hex:	2033-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER37.

H33.38 **Compensation data BUFFER38**

Hex:	2033-27h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER38.

H33.39 Compensation data BUFFER39

Hex:	2033-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the compensation data BUFFER39.

H33.40 Current compensation BUFFER group number

Hex:	2033-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Current compensation BUFFER group number

H33.41 Compensation data count

Hex:	2033-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32767	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 32767
Parameter descriptions:
Defines the sum of the compensation data.

H33.44 Data command

Hex:	2033-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

0 to 1

Parameter descriptions:

Defines the data command.

H33.45 Data storage position

Hex:	2033-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

0: Servo RAM 1: Servo FLASH 2: Encoder FLASH

Parameter descriptions:

Defines the data storage position.

0: Servo RAM 1: Servo FLASH 2: Encoder FLASH

H33.46 Clear data

Hex:	2033-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 3

Parameter descriptions:

Used to clear data.

H33.47 Software tool writing status

Hex:	2033-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0 to 2

Parameter descriptions:

Displays the write status of the software tool. 0: Idle 1: Writing BUFFER 2: Writing BUFFER completed

H33.48 Servo reading status

Hex:	2033-31h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 65535

Parameter descriptions:
Displays the read status of the servo. 0: Idle 1: Reading BUFFER 2: Reading BUFFER completed

H33.49 **Software tool reading status**

Hex:	2033-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 2
Parameter descriptions:
Displays the read status of the software tool. 0: Idle 1: Reading BUFFER 2: Reading BUFFER completed

H33.50 **Servo writing status**

Hex:	2033-33h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Displays the write status of the servo. 0: Idle 1: Writing BUFFER 2: Writing BUFFER completed

H33.51 **Data transmission completion flag**

Hex:	2033-34h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 1
Parameter descriptions:
Software tool data transmission completion flag 0: Not completed 1: Completed

H33.52 **Servo data transfer completion flag**

Hex:	2033-35h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Servo data transmission completion flag 0: Not completed 1: Completed

H33.60 **Accuracy compensation function**

Hex:	2033-3Dh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 1
Parameter descriptions:
Used to enable accuracy compensation.

H33.61 **Accuracy compensation sum**

Hex:	2033-3Eh	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	count
Max. value:	2048	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 2048
Parameter descriptions:
Total accuracy compensation points

H33.62 **Starting offset address of accuracy compensation**

Hex:	2033-3Fh	Effective mode:	Upon the next power-on
Min. value:	-21474836.48	Unit:	[Mm]/[deg]
Max. value:	21474836.47	Data type:	Int32
Default value:	0.00	Change mode:	At stop

Range:
-21474836.48 to 21474836.47
Parameter descriptions:
The direct-drive motor compensation home of incremental encoder is the home of the mechanical system coordinate.

H33.64 **Accuracy compensation data interval**

Hex:	2033-41h	Effective mode:	Upon the next power-on
Min. value:	-327.67	Unit:	[Mm]/[deg]
Max. value:	327.67	Data type:	Int16
Default value:	0.00	Change mode:	At stop

Range:
-327.67 to 327.67
Parameter descriptions:
Clearance of adjacent compensation points of accuracy compensation

H33.65 **Phase sequence for generating accuracy compensation table**

Hex:	2033-42h	Effective mode:	Upon the next power-on

Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	At stop

Range:
0x0 to 0xFFFF
Parameter descriptions:
Records the phase sequence during generating accuracy compensation table.

H33.66 **Reference direction for generating accuracy compensation table**

Hex:	2033-43h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 1
Parameter descriptions:
Records the reference direction for generating accuracy compensation table.

H33.67 **Servo homing completed**

Hex:	2033-44h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Accuracy compensation homing completed signal

H33.68 **Current acting index of accuracy compensation**

Hex:	2033-45h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:
0 to 65535
Parameter descriptions:
Current compensation position of accuracy compensation

H33.69 **Forced homing start**

Hex:	2033-46h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0 to 1
Parameter descriptions:
Used to start accuracy compensation homing forcibly.

H33.70 Forced homing mode

Hex:	2033-47h	Effective mode:	Upon the next power-on
Min. value:	-32768	Unit:	-
Max. value:	32767	Data type:	Int16
Default value:	-2	Change mode:	At stop

Range:
-32768 to 32767
Parameter descriptions:
Records homing mode in accuracy compensation generation.

H33.71 Forced homing at low speed

Hex:	2033-48h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	(mm/s)/RPM
Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	At stop

Range:
0 to 1000
Parameter descriptions:
Records homing speed in accuracy compensation generation.

H33.72 Single-turn absolute position of accuracy compensation home of absolute encoder

Hex:	2033-49h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Range:
0 to 4294967295
Parameter descriptions:
Defines the single-turn absolute value of direct-drive motor compensation home of absolute encoder.

H33.74 Min. pulse width of frequency-division output accuracy compensation

Hex:	2033-4Bh	Effective mode:	Upon the next power-on
Min. value:	2	Unit:	count
Max. value:	7	Data type:	UInt16
Default value:	3	Change mode:	At stop

Range:
2 to 7

Parameter descriptions:
Defines the minimum pulse width of accuracy compensation frequency-division output.

H33.75 **Accuracy compensation data unit**

Hex:	2033-4Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:
0: [um]/[arcsec] 1: [mm]/[mrad]
Parameter descriptions:
Defines the accuracy compensation data unit.
For DDL: 0: um; 1: mm
For DDR: 0: arcsec; 2: mrad

H33.81 **Defines the motor cogging torque fluctuation compensation sum.**

Hex:	2033-52h	Effective mode:	Real time
Min. value:	0	Unit:	count
Max. value:	65535	Data type:	UInt16
Default value:	2000	Change mode:	At stop

Range:
0 to 65535
Parameter descriptions:
Defines the motor cogging torque fluctuation compensation sum.

15.32 1000h Object Dictionary

1000.00h **Device type**

Hex:	1000-00h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The device type.

1001.00h **Error Register**

Hex:	1001-00h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt8
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFF
Parameter descriptions:
The error register.

1018.01h **Vendor ID**

Hex:	1018-01h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The vendor ID.

1018.02h **Product code**

Hex:	1018-02h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The product code.

1018.03h **Revision**

Hex:	1018-03h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The revision.

1018.04h **Serial number**

Hex:	1018-04h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The serial number.

1600.00h Number of valid mapped objects in RPDO1

Hex:	1600-00h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt8
Default value:	0	Change mode:	Read-only

Range:
0 to 20
Parameter descriptions:
This object can be modified only when PDO is inactive. When 0 is written, the mapping objects of other sub-indexes are cleared.

1600.01h Mapped object 1 in RPDO1

Hex:	1600-01h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The total length of a mapping object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The indexes and sub-indexes of mapping objects must exist in the object dictionary list. The attribute of mapping objects is readable and the objects can be mapped.
Sub-indexes are written in the following format:
bit31 to bit16: index
bit15 to bit8:
Object length
bit7 to bit0:
Sub-index

1600.02h Mapped object 2 in RPDO1

Hex:	1600-02h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.03h Mapped object 3 in RPDO1

Hex:	1600-03h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.04h **Mapped object 4 in RPDO1**

Hex:	1600-04h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.05h **Mapped object 5 in RPDO1**

Hex:	1600-05h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.06h **Mapped object 6 in RPDO1**

Hex:	1600-06h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.07h **Mapped object 7 in RPDO1**

Hex:	1600-07h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.08h **Mapped object 8 in RPDO1**

Hex:	1600-08h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.09h **Mapped object 9 in RPDO1**

Hex:	1600-09h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.0Ah **Mapped object 10 in RPDO1**

Hex:	1600-0Ah	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.0Bh **Mapped object 11 in RPDO1**

Hex:	1600-0Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.0Ch **Mapped object 12 in RPDO1**

Hex:	1600-0Ch	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value: 0xFFFFFFFF
Default value: 0x0
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.0Dh **Mapped object 13 in RPDO1**

Hex: 1600-0Dh
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.0Eh **Mapped object 14 in RPDO1**

Hex: 1600-0Eh
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.0Fh **Mapped object 15 in RPDO1**

Hex: 1600-0Fh
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1600.01h.

1600.10h **Mapped object 16 in RPDO1**

Hex: 1600-10h
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1600.01h.

1600.11h Mapped object 17 in RPDO1

Hex:	1600-11h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1600.01h.

1600.12h Mapped object 18 in RPDO1

Hex:	1600-12h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1600.01h.

1600.13h Mapped object 19 in RPDO1

Hex:	1600-13h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1600.01h.

1600.14h Mapped object 20 in RPDO1

Hex:	1600-14h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1600.01h.

1A00.00h Number of valid mapped objects in TPDO1

Hex:	1A00-00h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt8
Default value:	0	Change mode:	Read-only

Range:
0 to 20
Parameter descriptions:
This object can be modified only when PDO is inactive. When 0 is written, the mapping objects of other sub-indexes are cleared.

1A00.01h Mapped object 1 in TPDO1

Hex:	1A00-01h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The total length of a mapping object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The indexes and sub-indexes of mapping objects must exist in the object dictionary list. The attribute of mapping objects is readable and the objects can be mapped.
Sub-indexes are written in the following format:
bit31 to bit16: index
bit15 to bit8:
Object length
bit7 to bit0:
Sub-index

1A00.02h Mapped object 2 in TPDO1

Hex:	1A00-02h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.03h Mapped object 3 in TPDO1

Hex:	1A00-03h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.04h **Mapped object 4 in TPDO1**

Hex:	1A00-04h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.05h **Mapped object 5 in TPDO1**

Hex:	1A00-05h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.06h **Mapped object 6 in TPDO1**

Hex:	1A00-06h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.07h **Mapped object 7 in TPDO1**

Hex:	1A00-07h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.08h **Mapped object 8 in TPDO1**

Hex:	1A00-08h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.09h **Mapped object 9 in TPDO1**

Hex:	1A00-09h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.0Ah **Mapped object 10 in TPDO1**

Hex:	1A00-0Ah	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.0Bh **Mapped object 11 in TPDO1**

Hex:	1A00-0Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.0Ch **Mapped object 12 in TPDO1**

Hex:	1A00-0Ch	Effective mode:	-
Min. value:	0x0	Unit:	-

Max. value: 0xFFFFFFFF
Default value: 0x0
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.0Dh **Mapped object 13 in TPDO1**

Hex: 1A00-0Dh
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.0Eh **Mapped object 14 in TPDO1**

Hex: 1A00-0Eh
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.0Fh **Mapped object 15 in TPDO1**

Hex: 1A00-0Fh
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
Same as 1A00.01h.

1A00.10h **Mapped object 16 in TPDO1**

Hex: 1A00-10h
Min. value: 0x0
Max. value: 0xFFFFFFFF
Default value: 0x0
Effective mode: -
Unit: -
Data type: UInt32
Change mode: Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1A00.01h.

1A00.11h Mapped object 17 in TPDO1

Hex:	1A00-11h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1A00.01h.

1A00.12h Mapped object 18 in TPDO1

Hex:	1A00-12h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1A00.01h.

1A00.13h Mapped object 19 in TPDO1

Hex:	1A00-13h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1A00.01h.

1A00.14h Mapped object 20 in TPDO1

Hex:	1A00-14h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Same as 1A00.01h.

1C12.00h **Number of assigned PDOs**

Hex:	1C12-00h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0x2	Data type:	UInt8
Default value:	0x2	Change mode:	Read-only

Range:
0x0 to 0x2
Parameter descriptions:
The number of allocated PDOs.

1C12.01h **PDO mapping object index of assigned RxPDO1**

Hex:	1C12-01h	Effective mode:	-
Min. value:	0x1600	Unit:	-
Max. value:	0x17FF	Data type:	UInt16
Default value:	0x1701	Change mode:	Read-only

Range:
0x1600 to 0x17FF
Parameter descriptions:
The index of the PDO mapping object of the assigned RxPDO1.

1C12.02h **PDO mapping object index of assigned RxPDO2**

Hex:	1C12-02h	Effective mode:	-
Min. value:	0x1600	Unit:	-
Max. value:	0x17FF	Data type:	UInt16
Default value:	0x170A	Change mode:	Read-only

Range:
0x1600 to 0x17FF
Parameter descriptions:
The index of the PDO mapping object of the assigned RxPDO2.

1C13.00h **Number of assigned PDOs**

Hex:	1C13-00h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0x2	Data type:	UInt8
Default value:	0x2	Change mode:	Read-only

Range:
0x0 to 0x2
Parameter descriptions:
The number of allocated PDOs.

1C13.01h **PDO mapping object index of assigned TxPDO1**

Hex:	1C13-01h	Effective mode:	-
Min. value:	0x1A00	Unit:	-

Max. value:	0x1BFF	Data type:	UInt16
Default value:	0x1B01	Change mode:	Read-only

Range:
0x1A00 to 0x1BFF
Parameter descriptions:
The index of the PDO mapping object of the assigned TxPDO1.

1C13.02h PDO mapping object index of assigned TxPDO1

Hex:	1C13-02h	Effective mode:	-
Min. value:	0x1A00	Unit:	-
Max. value:	0x1BFF	Data type:	UInt16
Default value:	0x1B0A	Change mode:	Read-only

Range:
0x1A00 to 0x1BFF
Parameter descriptions:
The index of the PDO mapping object of the assigned TxPDO2.

1C32.01h Sync mode

Hex:	1C32-01h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
The synchronization mode.

1C32.02h Cycle time

Hex:	1C32-02h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The cycle time.

1C32.04h Sync modes supported

Hex:	1C32-04h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter descriptions:

The supported synchronization mode.

1C32.05h **Minimum cycle time**

Hex:	1C32-05h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

The minimum cycle time.

1C33.01h **Sync mode**

Hex:	1C33-01h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter descriptions:

The synchronization mode.

1C33.02h **Cycle time**

Hex:	1C33-02h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

The cycle time.

1C33.04h **Sync modes supported**

Hex:	1C33-04h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter descriptions:

The supported synchronization mode.

1C33.05h **Minimum cycle time**

Hex:	1C33-05h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
The minimum cycle time.

15.33 6000h Object Dictionary

603Fh **Error code**

Hex:	603Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
When an error described in the DSP402 profile occurs on the servo drive, 603Fh is as described in DS402.
When an error specified by the user occurs on the servo drive, 603Fh is 0xFF00. The value of 603Fh is in hexadecimal.
In addition, the object dictionary 203Fh displays auxiliary bytes of fault codes in hexadecimal. 203Fh is a UInt32 value, in which the high 16 bits indicate the internal fault code of the manufacturer, and the low 16 bits indicate the external fault code of the manufacturer.

6040h **Control word**

Hex:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0xFFFF
Parameter description
See section “Basic Functions of the Servo Drive” for the description of the control word.

6041h **Status word**

Hex:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Parameter description
See section "Basic Functions of the Servo Drive" for the description of the status word.

605Ah **Quick stop mode**

Hex:	605Ah	Effective mode:	At stop
Min. value:	0	Unit:	-
Max. value:	7	Data type:	Int16
Default value:	2	Change mode:	Real time

Range:

Setpoint	Stop mode
0	Coast to stop, keeping the de-energized status
1	Ramp to stop as defined by 6084h/609Ah (HM), keeping the de-energized status
2	Ramp to stop as defined by 6085h, keeping the de-energized state
3	Stop at the emergency stop torque, keeping de-energized state
4	N/A
5	Ramp to stop as defined by 6084h/609Ah (HM), keeping the position lock status
6	Ramp to stop as defined by 6085h, keeping the position lock state
7	Stop at emergency-stop torque, keeping the position lock status

Parameter descriptions:
Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor status after stop.
0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state 6: Ramp to stop as defined by 6085h, keeping position lock state 7: Stop at emergency stop torque, keeping position lock state Note: If the setpoint of 605Ah is lower than 4 after the braking is enabled, 605Ah will be forcibly set to 2 (Ramp to stop as defined by 6085h, keeping de-energized state).

605Ch **Stop mode at S-OFF**

Hex:	605Ch	Effective mode:	At stop
Min. value:	-4	Unit:	-
Max. value:	2	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state
-3: Stop at zero speed, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Dynamic braking stop, keeping de-energized state

Parameter descriptions:

Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.
-4: Ramp to stop as defined by 6085h, keeping dynamic braking state
-3: Stop at zero speed, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah, keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah, keeping de-energized state 2: Dynamic braking stop, keeping de-energized state Note: After the brake is enabled, 605Ch will be forcibly set to -4 (Ramp to stop as defined by 6085h, keeping dynamic braking state).

605Dh **Halt mode**

Hex:	605Dh	Effective mode:	At stop
Min. value:	1	Unit:	-
Max. value:	3	Data type:	Int16
Default value:	1	Change mode:	Real time

Range:

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state
2: Ramp to stop as defined by 6085h, keeping position lock state
3: Stop at emergency stop torque, keeping the position lock state

Parameter descriptions:

Defines the deceleration mode of the motor for stopping rotating upon pause and the motor status after stop.
PP/PV/HM mode:

Setpoint	Stop mode
1	Ramp to stop as defined by 6084h/609Ah (HM), keeping the position lock status
2	Ramp to stop as defined by 6085h, keeping the position lock state
3	Stop at emergency-stop torque, keeping the position lock status

PT mode:

Setpoint	Stop mode
1/2/3	Ramp to stop as defined by 6087h, keeping the position lock status

605Eh **Stop mode at No.2 fault**

Hex:	605Eh	Effective mode:	At stop
Min. value:	-5	Unit:	-
Max. value:	4	Data type:	Int16

Default value:	2	Change mode:	Real time

Range:

-5: Stop at zero speed, keeping dynamic braking state

-4: Stop at emergency stop torque, keeping dynamic braking state

-3: Ramp to stop as defined by 6085h, keeping dynamic braking state

-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Ramp to stop as defined by 6085h, keeping de-energized state

3: Stop at emergency stop torque, keeping de-energized state

4: Dynamic braking stop, keeping de-energized state

Parameter descriptions:

Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No.1 fault occurs.

-5: Stop at zero speed, keeping dynamic braking state

-4: Stop at emergency stop torque, keeping dynamic braking state

-3: Ramp to stop as defined by 6085h, keeping dynamic braking state

-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency-stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state Note: After the brake is enabled, 605Eh will be forcibly set to -3 (Stop at emergency-stop torque as defined by 6085h, keeping de-energized state).

6060h **Servo drive mode**

Hex:	6060h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode

Parameter descriptions:

Defines the operation mode of the servo drive.

1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: CSP mode 9: CSV mode 10: CST mode If an operation mode not supported is selected through SDO, an SDO error can be returned.

If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.

6061h **Operation mode display**

Hex:	6061h	Effective mode:	-
Min. value:	0	Unit:	-

Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode

Parameter descriptions:

Indicates the actual operation mode.

1: Profile position (PP) mode

3: Profile velocity (PV) mode

4: Profile torque (PT) mode

6: Homing (HM) mode

8: CSP mode

9: CSV mode

10: CST mode

6062h Position demand value

Hex:	6062h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:

-2147483648 to 2147483647

Parameter descriptions:

Indicates the real-time position reference (reference unit).

6063h Position actual value

Hex:	6063h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:

-2147483648 to 2147483647

Parameter descriptions:

Indicates the absolute position feedback (encoder unit) of the motor in real time.

6064h Position actual value

Hex:	6064h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:

-2147483648 to 2147483647

Parameter descriptions:

Indicates the absolute position feedback (reference unit) in real time.
Position actual value in user-defined unit (6064h) x Gear ratio (6091h) = Position actual value in encoder unit (6063h)

6065h **Following error window**

Hex:	6065h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit
Max. value:	4294967295	Data type:	UInt32
Default value:	27486951	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the threshold of excessive position deviation (reference unit).
When the difference value between position demand value (6062h) and position actual value (6064h) keeps exceeding ±6065h after the time defined by 6066h elapses, B00.0 (Position deviation too large) occurs.

6066h **Time lapse to trigger excessive position deviation**

Hex:	6066h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the time lapse to trigger excessive position deviation, which must be used together with 6065h.

6067h **Position window**

Hex:	6067h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit
Max. value:	4294967295	Data type:	UInt32
Default value:	5872	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the threshold for position reach.
If the difference between 6062h and 6064h is within ±6067h, and the time reaches 6068h, the servo drive considers that the position is reached, and sets bit10 of status word 6041h to 1 in profile position mode.
This flag bit is valid only when the S-ON signal is valid in profile position control mode.

6068h **Position window time**

Hex:	6068h	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the window time for position reach, which is used together with 6067h.

606Ch **Velocity actual value**

Hex:	606Ch	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit/s
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
It indicates the velocity actual value.

606Dh **Velocity window**

Hex:	606Dh	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:
0 to 65535
Parameter descriptions:
Defines the threshold for speed reach.
If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches the value defined by 606Eh, the speed is reached. In this case, bit 10 of the status word 6041h is set to 1 in the profile velocity mode.
This flag bit is meaningful only when the servo drive is enabled in PV mode.

606Eh **Velocity window time**

Hex:	606Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

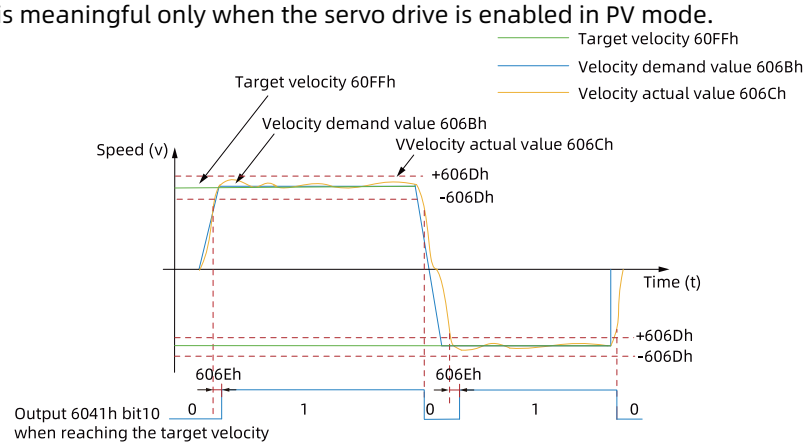
Range:
0 to 65535

Parameter descriptions:

Defines the time window for speed reach, which is used together with 606Dh.

Defines the time window for speed arrival. If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches 606Eh, the speed is reached and bit 10 of the status word 6041h is set to 1 in the profile velocity (PV) mode.

This flag bit is meaningful only when the servo drive is enabled in PV mode.



606Fh **Zero speed signal threshold**

Hex:	606Fh	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Defines the threshold for determining whether the user velocity is 0.

When 606Ch is within ±606Fh and the time reaches the value set by 6070h, the user velocity is 0.

When either condition is not met, the user velocity is not 0.

This flag bit is valid only in PV mode.

This flag bit is unrelated to the enable/disable state of the servo drive.

6070h **Velocity threshold time**

Hex:	6070h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0 to 65535

Parameter descriptions:

Defines the time window for determining whether the user velocity is 0, which is used together with 606Fh.

6071h **Target torque**

Hex:	6071h	Effective mode:	Real time

Min. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:
-4000 to 4000
Parameter descriptions:
Defines the target torque of the servo drive in the profile torque mode.
The value 1000 corresponds to the rated torque of the motor.

6072h **Max. torque reference**

Hex:	6072h	Effective mode:	Real time
Min. value:	0	Unit:	0.10%
Max. value:	4000	Data type:	UInt16
Default value:	3500	Change mode:	Real time

Range:
0 to 4000
Parameter descriptions:
Defines the maximum torque reference limit.
The value 1000 corresponds to the rated torque of the motor.

6074h **Torque reference**

Hex:	6074h	Effective mode:	-
Min. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-4000 to 4000
Parameter descriptions:
Defines the target torque value.
The value 1000 corresponds to the rated torque of the motor.

6077h **Torque actual value**

Hex:	6077h	Effective mode:	-
Min. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-4000 to 4000
Parameter descriptions:
It displays the internal actual torque of the servo drive.
The value 1000 corresponds to the rated torque of the motor.

607Ah **Target position**

Hex:	607Ah	Effective mode:	Real time

Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the target position of the servo drive in the profile position mode.
When bit 6 of 6040h is set to 0, 607Ah indicates the absolute target position of current segment.
After positioning of current segment is done, the value of 6064h will be the same as the value of 607Ah.
When bit 6 of 6040h is set to 1, 607Ah indicates the target increment displacement of current segment.
After positioning of current segment is done, user displacement increment will be the same as the value of 607Ah.

607Ch **Home offset**

Hex:	607Ch	Effective mode:	At stop
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the physical location of mechanical zero that deviates from the home of the motor in position control modes (profile position mode, interpolation mode, and homing mode).
The home offset is activated only after homing is done upon power-on and bit15 of 6041h is set to 1.
After homing is done, the position actual value (6064h) will be the same as the value of 607Ch.
If 607Ch is outside the value of 607Dh (Software position limit), E09.1 (Home setting error) will occur.

607D.01h **Min. position limit**

Hex:	607D-01h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	-2147483648	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the minimum software position limit relative to the mechanical zero point.
Minimum software position limit = (607D.01h)
The software position limit is used to judge the absolute position. When homing is not performed, the internal software position limit is invalid.
The condition for activating the software position limit is set in H0A.01 (object dictionary 0x200A.02h).

607D.02h **Max. position limit**

Hex:	607D-02h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	2147483647	Change mode:	Real time

Range:
-2147483648 to 2147483647
Parameter descriptions:
Defines the maximum software position limit relative to the mechanical zero.
Maximum software position limit = (607D.02h)

607Eh **Polarity**

Hex:	607Eh	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFF
Parameter descriptions:
Defines the polarity of position or speed references.
When bit 7 is 1, it indicates the position reference is multiplied by "-1" and the motor direction is reversed in the standard position mode or interpolation mode.
When bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the speed mode.
When bit 5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.
Other bits are meaningless.

607Fh **Max. profile velocity**

Hex:	607Fh	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the maximum speed in user-defined unit.
Set a proper gear ratio (8/1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 [mm/s]/[rpm].

6081h **Profile velocity**

Hex:	6081h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32

Default value:	111848106	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
It sets the average velocity normally attained at the end of the acceleration ramp during a profiled motion.
The setpoint takes effect after the slave receives the displacement reference.

6083h **Profile acceleration**

Hex:	6083h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s2
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the acceleration rate in the acceleration stage of the displacement reference in the profile position mode.
The following formula applies if a 23-bit motor needs to run at 400 [mm/s]/[rpm] (6081h: 400 x 8388608/60) with acceleration rate being 400 [mm/s]/[rpm]/s (6083h: 400 x 8388608/60) and deceleration rate being 200 [mm/s]/[rpm]/s (6084h: 200 x 8388608/60) under a gear ratio of 1:1: Acceleration time tup = Δ6081h/ Δ6083h = 1 (s); Deceleration time tdown = Δ6081h/Δ6084h = 2 (s).
The setpoint 0 will be forcibly changed to 1.

6084h **Profile deceleration**

Hex:	6084h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s2
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the deceleration rate in the deceleration stage of the displacement reference in the profile position mode.
The following formula applies if a 23-bit motor needs to run at 400 [mm/s]/[rpm] (6081h: 400 x 8388608/60) with acceleration rate being 400 [mm/s]/[rpm]/s (6083h: 400 x 8388608/60) and deceleration rate being 200 [mm/s]/[rpm]/s (6084h: 200 x 8388608/60) under a gear ratio of 1:1: Acceleration time tup = Δ6081h/Δ6083h = 1 (s); Deceleration time tdown = Δ6081h/Δ6084h = 2 (s).
The setpoint 0 will be forcibly changed to 1.

6085h **Quick stop deceleration**

Hex:	6085h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s2

Max. value:	4294967295	Data type:	UInt32
Default value:	2147483647	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the deceleration rate when the quick stop command (6040h = 0x0002) is active and 605Ah (Quick stop option code) is set to 2 or 5.
The setpoint 0 will be forcibly changed to 1.

6087h **Torque slope**

Hex:	6087h	Effective mode:	Real time
Min. value:	0	Unit:	0.1%/s
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the rate of change of torque in profile torque mode, in unit of torque increment per second.
In profile torque mode, if 605Ah (Quick stop option code) = 1/2/5/6 or 605Dh (Halt option code) = 1/2, the servo drive decelerates to stop as defined by 6087h.
If the value exceeds the torque reference limit, the servo drive runs at the limit.
The setting value 0 will be forcibly changed into 1.

6091.01h **Motor resolution**

Hex:	6091-01h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	1	Change mode:	At stop

Range:
1 to 4294967295
Parameter descriptions:
Defines the numerator of the gear ratio.
Defines the proportional relation between the load shaft displacement designated by the user and the motor shaft displacement.
The relation between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows.
Motor position feedback = Load shaft position feedback x Gear ratio
The relation between the motor speed ([mm/s]/[rpm) and the load shaft speed (reference unit/s) is as follows:
Motor speed ([mm/s]/[rpm]) = Load shaft speed * 6091h * 60/Encoder resolution
The motor acceleration ([mm/s]/[RPM/ms) and the load shaft acceleration (reference unit/s2) is in the following relationship:
Motor acceleration ([mm/s]/[rpm]/ms) = Load shaft acceleration x 6091h x 1000/Encoder resolution/60

6091.02h **Shaft resolution**

Hex:	6091-02h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	1	Change mode:	At stop

Range:
1 to 4294967295
Parameter descriptions:
Defines the denominator of the gear ratio.

6098h **Homing method**

Hex:	6098h	Effective mode:	Real time
Min. value:	-3	Unit:	-
Max. value:	35	Data type:	Int8
Default value:	1	Change mode:	Real time

Value range:
-3 to +35
Parameter description
Defines the homing method.

Table 15–1 Description of homing methods

Value	Description
-3	Nearby homing, Z signal as home
-2	Forward homing, positive mechanical limit as deceleration point and Z signal as home
-1	Reverse homing, negative mechanical limit as deceleration point and Z signal as home
1	Reverse homing, negative limit switch as deceleration point and Z signal as home, falling edge of the negative limit switch signal must be reached before Z signal
2	Forward homing, positive limit switch as deceleration point and Z signal as home, falling edge of positive limit switch signal must be reached before Z signal
3	Forward homing, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
4	Forward homing, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
5	Reverse homing, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
6	Reverse homing, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
7	Forward homing, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal
8	Forward homing, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
9	Forward homing, home switch as deceleration point and Z signal as home, rising edge on the other side of the home switch signal must be reached before Z signal
10	Forward homing, home switch as deceleration point and Z signal as home, falling edge on the other side of the home switch signal must be reached before Z signal
11	Reverse homing, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal

Value	Description
12	Reverse homing, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal
13	Reverse homing, home switch as deceleration point and Z signal on the other side of the home switch signal as home, rising edge on the other side of the home switch signal must be reached before Z signal
14	Reverse homing, home switch as deceleration point and Z signal on the other side of the home switch signal as home, falling edge on the other side of the home switch signal must be reached before Z signal
17 to 30	Similar to 1 to 14 except that the deceleration point coincides with the home
33	Reverse homing, Z signal as home
34	Forward homing, Z signal as home
35	Current position as home
6098h = 15/16/31/32	Undefined. The servo drive does not perform the homing operation.

6099.01h Speed during search for switch

Hex:	6099-01h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32
Default value:	111848106	Change mode:	At stop

Range:

0 to 4294967295

Parameter descriptions:

Defines the speed during search for the deceleration point signal. A large setpoint helps prevent the homing timeout fault.

6099.02h Speed during search for zero

Hex:	6099-02h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32
Default value:	11184810	Change mode:	At stop

Range:

0 to 4294967295

Parameter descriptions:

Defines the speed in searching for the home signal. Setting this speed to a low value prevents overshoot during stop at high speed, avoiding excessive deviation between the stop position and the set mechanical home.

609Ah Homing acceleration

Hex:	609Ah	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s2
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:

0 to 4294967295

Parameter descriptions:

It sets the acceleration during the homing operation.

60B0h **Position offset**

Hex:	60B0h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Used to set the position offset.

60B1h **Velocity offset**

Hex:	60B1h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit/s
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:

Used to set the speed offset.

60B2h **Torque offset**

Hex:	60B2h	Effective mode:	Real time
Min. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:

-4000 to 4000

Parameter descriptions:

Used to set the torque offset.

60B8h **Touch probe function**

Hex:	60B8h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFF

Parameter descriptions:

Bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	Bit0 to bit5: settings related to probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 positive edge 0: Latching at positive edge disabled 1: Latching at positive edge enabled	
5	Touch probe 1 negative edge 0: Latching at negative edge disabled 1: Latching at negative edge enabled	
6 to 7	N/A	-
8	Touch probe 2 function selection 0: Probe 2 disabled 1: Probe 2 enabled	Bit8 to bit13: settings related to probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 positive edge 0: Latching at positive edge disabled 1: Latching at positive edge enabled	
13	Touch probe 2 negative edge 0: Latching at negative edge disabled 1: Latching at negative edge enabled	
14 to 15	N/A	-

60B9h **Touch probe status**

Hex:	60B9h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF

Parameter descriptions:
Defines the functions of touch probe 1 and touch probe 2.

See the following table for descriptions of each bit of 60B9h.

Bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	Bit0 to bit2: Status of probe 1
1	Touch probe 1 positive edge value 0: No positive edge value latched 1: Edge value latched	
2	Touch probe 1 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
3 to 5	N/A	-
6 to 7	The total number of times that the probe is triggered when the function of probe 1 is set for continuous sampling	The total number of times (0 to 3) that the probe is triggered when the function of probe 1 is set for continuous sampling
8	Touch probe 2 function selection 0: Probe 2 disabled 1: Probe 2 enabled	Bit8 to bit10: Status of probe 2
9	Touch probe 2 positive edge value 0: No positive edge value latched 1: Edge value latched	
10	Touch probe 2 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
11 to 13	N/A	-
14 to 15	The total number of times that the probe is triggered when the function of probe 2 is set for continuous sampling	The total number of times (0 to 3) that the probe is triggered when the function of probe 2 is set for continuous sampling

60BAh **Touch probe 1 positive edge**

Hex:	60BAh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647

Parameter descriptions:
Indicates the position feedback value (reference unit) latched at positive edge of touch probe 1 signal.

60BBh **Touch probe 1 negative edge**

Hex:	60BBh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit

Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Indicates the position feedback value (reference unit) latched at negative edge of touch probe 1 signal.

60BCh **Touch probe 2 positive edge**

Hex:	60BCh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Indicates the position feedback value (reference unit) latched at positive edge of touch probe 2 signal.

60BDh **Touch probe 2 negative edge**

Hex:	60BDh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Indicates the position feedback value (reference unit) latched at negative edge of touch probe 2 signal.

60C5h **Max. acceleration**

Hex:	60C5h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s2
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.
The setpoint 0 will be forcibly changed to 1.

60C6h **Max. deceleration**

Hex:	60C6h	Effective mode:	Real time

Min. value:	0	Unit:	Reference unit/s2
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter descriptions:
Defines the maximum permissible deceleration in the profile position mode, profile velocity mode, and homing mode.
The setpoint 0 will be forcibly changed to 1.

60D5h **Touch probe 1 positive edge counter**

Hex:	60D5h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
The counting value is added by "1" each time this object is triggered.

60D6h **Touch probe 1 negative edge counter**

Hex:	60D6h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
The counting value is added by "1" each time this object is triggered.

60D7h **Touch probe 2 positive edge counter**

Hex:	60D7h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
The counting value is added by "2" each time this object is triggered.

60D8h **Touch probe 2 negative edge counter**

Hex:	60D8h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16

Default value:	0x0	Change mode:	Read-only

Range:
0x0 to 0xFFFF
Parameter descriptions:
The counting value is added by "2" each time this object is triggered.

60E0h **Positive torque limit**

Hex:	60E0h	Effective mode:	Real time
Min. value:	0	Unit:	0.10%
Max. value:	4000	Data type:	UInt16
Default value:	3500	Change mode:	Real time

Range:
0 to 4000
Parameter descriptions:
Defines the maximum positive torque limit.

60E1h **Negative torque limit**

Hex:	60E1h	Effective mode:	Real time
Min. value:	0	Unit:	0.10%
Max. value:	4000	Data type:	UInt16
Default value:	3500	Change mode:	Real time

Range:
0 to 4000
Parameter descriptions:
Defines the maximum negative torque limit.

60F4h **Position deviation**

Hex:	60F4h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647
Parameter descriptions:
Indicates the position deviation (reference unit).

60FCh **Position demand value**

Hex:	60FCh	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:
-2147483648 to 2147483647

Parameter descriptions:

Indicates the position reference (encoder unit).

If no alarm is detected when the S-ON signal is active, the relation between the position reference in reference unit and that in encoder unit is as follows:

60FCh (in encoder unit) = 6062h (in reference unit) x 6091h

60FDh **DI state**

Hex:	60FDh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFFFFFF

Parameter descriptions:

Indicates the current DI logic of the drive.

0: Inactive

1: Active

The signal indicated by each bit is described as follows:

Bit signal

Table 15–2 The DI signal indicated by each bit

Bit	Description
0	Reverse overtravel active
1	Forward overtravel active
2	Home signal active
3 to 15	N/A
16	DI1 input active
17	DI2 input active
18	DI3 input active
19	DI4 input active
20	DI5 input active
21 to 26	N/A
27	STO1 signal input
28	STO2 signal input
29	EDM output active
30	Z signal active
31	N/A

60FFh **PV, CSV mode speed reference**

Hex:	60FFh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit/s
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Range:

-2147483648 to 2147483647

Parameter descriptions:
Defines the target speed in the cyclic synchronous velocity mode/profile velocity mode.

60FE.01h **Physical output**

Hex:	60FE-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Parameter description
Indicates the DO logic.
The signal indicated by each bit is described as follows:
Description of bits

Bit	Description
0 to 15	N/A
16	Forced DO1 output (0: off, 1: on); when bit 16 of 60FE.02 is set to 1
17	Forced DO2 output (0: off, 1: on) when bit 17 of 60FE.02 is set to 1
18 to 25	N/A
26	Switched between P and PI for gain switchover when bit 26 of 60FE.02 is set to 1
27 to 31	N/A

60FE.02h **Physical output enabling**

Hex:	60FE-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFFFFFF
Parameter descriptions:
0 to 15: N/A
16: Forced DO1 output enable
17: Forced DO2 output enable
18 to 25: N/A
26: P/PI switchover enable
27 to 31: N/A

16 Troubleshooting

16.1 Fault Levels and Display

Faults and alarms 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 faults
- No.1: resettable faults
- No.2: resettable fault
- No.3: resettable warnings

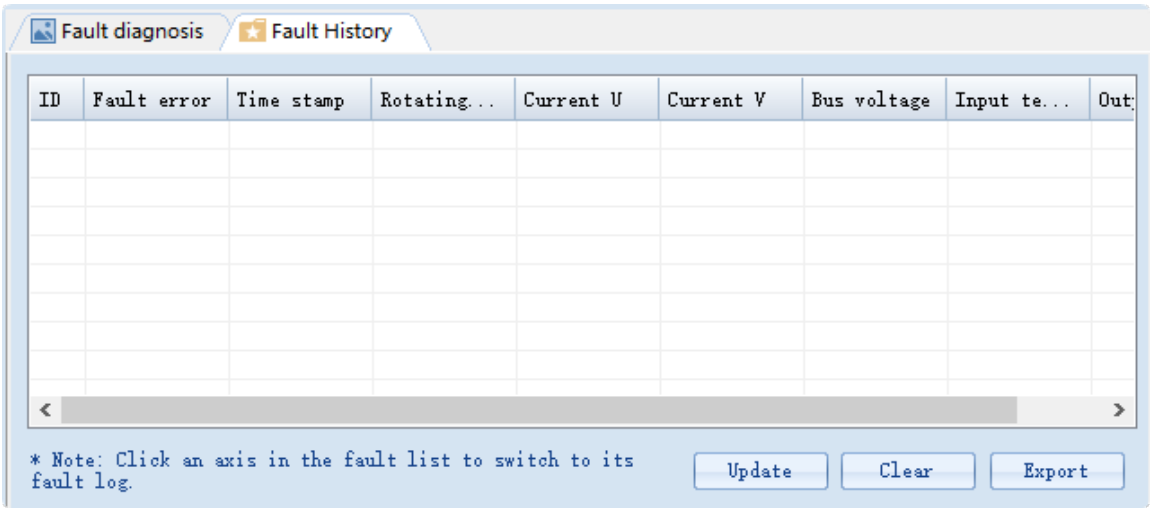
Note

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

Fault and alarm log

The servo drive can record the latest 20 faults and alarms and values of status parameters upon faults and alarms. If a fault is repeated in the latest 5 records, the fault can be logged more than once after being cleared. If an alarm is repeated in the latest 5 records, the alarm is logged only once.

A fault or an alarm will still be saved in the fault log after reset. To remove the fault or alarm from the fault log, set H02.31 (Parameter initialization) to 2, as shown in the following figure.



Read the value of H0b.34 in the InoDriverShop software tool to obtain the fault or alarm code, as described in the following table.

H0b.34 (Hexadecimal)	Description of H0b.34 (hexadecimal)
0101	0: Fault subcode 101: Fault code

16.2 Fault Reset

16.2.1 Reset After Troubleshooting

- To stop the keypad from displaying the fault/alarm, set H0d.01 (Fault reset) to 1 or activate the DI terminal assigned with DI function 2 (FunIN.2: ALM- RST, fault and alarm reset).
- To reset No.1 and No.2 faults, switch off the S-ON signal, and then set H0d.01 to 1 or activate the DI terminal that is assigned DI function 2.
- To reset No.3 alarms, set H0d.01 to 1 or activate the DI terminal that is assigned DI function 2.

Note

- Some faults and alarms can be reset only after the fault causes are rectified by modifying the settings. The fault can be reset only after the fault causes are rectified.
- For modifications that can be activated only at next power-on. Power off and on the drive again.
- For modifications that can be activated only after stop, switch off the S-ON signal. The drive can operate normally after the modification is activated.

☆ Related parameters:

Startup process	Fault symptom	Cause	Verification method
FunIN.2	ALM-RST	Fault/Alarm reset signal	The servo drive may, depending on the alarm type, continue operating after 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 allocate this function to the high-speed DI. Otherwise, this function becomes invalid. • Inactive: Not resetting the fault/alarm • Active: Resetting the fault/alarm

16.3 Troubleshooting

16.3.1 List of Fault Codes

No.1 non-resettable faults:

Table 16–1 List of No.1 non-resettable faults

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E101.0	Abnormal parameters in groups H02 and above	1	No	0x6320	0x01010101
E101.1	Abnormal parameters in group H00/H01	1	No	0x6320	0x11010101
E101.2	Address error in read/write operation after the number of parameters changes	1	No	0x6320	0x21010101
E101.9	Parameter attribute initialization check error	1	No	0x0101	0x91010101
E102.0	FPGA communication establishment error	1	No	0x7500	0x01020102

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E102.1	FPGA initialization start error	1	No	0x7500	0x11020102
E102.8	Software versions of MCU and FPGA mismatch	1	No	0x7500	0x81020102
E104.1	MCU operation timeout (MCU crashed)	1	No	0x7500	0x11040104
E104.2	FPGA operation timeout (FPGA crashed)	1	No	0x7500	0x21040104
E104.4	MCU reference update timeout	1	No	0x7500	0x41040104
E120.0	Unknown encoder type	1	No	0x7122	0x01200120
E120.1	Unknown motor model	1	No	0x7122	0x11200120
E120.2	Unknown drive model	1	No	0x7122	0x21200120
E120.5	Motor and drive current mismatch	1	No	0x7122	0x51200120
E120.6	FPGA and motor model mismatch	1	No	0x7122	0x61200120
E120.7	Model check error	1	No	0x0120	0x71200120
E120.8	Junction temperature parameter check error	1	No	0x0120	0x81200120
E136.0	Encoder ROM motor parameter verification error	1	No	0x7305	0x01360136
E136.1	Encoder ROM motor parameter read error	1	No	0x7305	0x11360136
E136.9	Range parameter initialization error	1	No	0x7305	0x11360136
E138.0	Accuracy compensation data error	1	No	0x0138	0x01380138
E138.1	Cogging fluctuation compensation data check failure	1	No	0x0138	0x11380138
E140.0	Encryption integrated circuit verification fault	1	No	0x0140	0x01400140
E140.2	Encryption chip version error	1	No	0x0140	0x21400140
E140.3	Encryption integrated circuit damaged	1	No	0x0140	0x31400140
E201.0	Phase-P overcurrent	1	No	0x2312	0x02010201
E201.1	Phase-U overcurrent	1	No	0x2312	0x12010201
E201.2	Phase-V overcurrent	1	No	0x2312	0x22010201
E201.4	Phase-N overcurrent	1	No	0x2312	0x42010201
E210.0	Output ground fault	1	No	0x2330	0x02100210
E210.2	Output ground fault detection hardware error	1	No	0x2330	0x22100210
E234.0	Runaway (protection scheme 1)	1	No	0x0234	0x02340234
E234.1	Runaway (protection scheme 2)	1	No	0x0234	0x12340234
E308.0	Pulse encoder phase A disconnected	1	No	0x0308	0x03080308
E308.1	Pulse encoder phase B disconnected	1	No	0x0308	0x13080308
E308.2	Pulse encoder phase Z disconnected (no alarm reported for encoders without phase Z)	1	No	0x0308	0x23080308
E619.0	Absolute accuracy compensation parameter setting error	1	No	0x0619	0x06190619
E619.1	Absolute accuracy compensation overflow	1	No	0x0619	0x16190619
E720.0	Encoder interface incorrect	1	No	0x0720	0x07200720

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E740.0	Absolute encoder communication timeout	1	No	0x0740	0x07400740
E740.2	Absolute encoder error	1	No	0x7305	0x27400740
E740.3	Absolute encoder single-turn calculation error	1	No	0x7305	0x37400740
E740.6	Encoder write error	1	No	0x7305	0x67400740
E740.9	Encoder data transmission delay too long	1	No	0x7305	0x97400740
E755.0	Nikon encoder communication fault	1	No	0x0FFF	0x07552755
E765.0	Third-party encoder over-temperature or overspeed	1	No	0x0765	0x07650765
EA33.0	Encoder read/write verification error	1	No	0x7305	0x0A330A33
EA34.0	The Hall state is abnormal.	1	No	0x0A34	0x0A340A34
EA34.1	Dynamic Hall auto-tuning error	1	No	0x0A34	0x1A340A34
EA34.2	Static Hall auto-tuning error	1	No	0x0A34	0x2A340A34
EE12.0	EtherCAT initialization failure	1	No	0x0E12	0x0E120E12
EE16.0	MCU and ESC communication error	1	No	0x0E16	0x0E160E16

No.1 resettable faults

Table 16–2 List of No.1 resettable faults

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E150.0	STO safety state applied	1	Yes	0x0150	0x01502150
E150.1	STO input state abnormal	1	Yes	0x0150	0x11502150
E150.2	Buffer 5 V supply error	1	Yes	0x0150	0x21502150
E150.3	STO input circuit hardware diagnosis failure	1	Yes	0x0150	0x31502150
E150.4	PWM buffer hardware diagnosis failure	1	Yes	0x0150	0x41502150
E150.5	STO input signal interference	1	Yes	0x0150	0x51500150
E202.0	Bus discharge overcurrent	1	Yes	0x2312	0x02022202
E202.1	Bus phase P overcurrent	1	Yes	0x2312	0x12022202
E202.2	Bus phase N overcurrent	1	Yes	0x2312	0x22022202
E202.3	Bus current sampling hardware error	1	Yes	0x2312	0x32022202
E203.0	Current feedback closed-loop error of the power cable	1	Yes	0x2312	0x02032203
E203.1	Phase U overcurrent of the power cable	1	Yes	0x2312	0x12032203
E203.2	Phase V overcurrent of the power cable	1	Yes	0x2312	0x22032203
E203.3	Phase W overcurrent of the power cable	1	Yes	0x2312	0x32032203
E203.4	Current detection hardware error of the power cable	1	Yes	0x2312	0x42032203
E208.2	Encoder communication timeout	1	Yes	0x0208	0x22082208
E208.4	FPGA current loop operation timeout	1	Yes	0x0208	0x42082208

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E240.0	Excessive deviation between the observed electrical angle and feedback electrical angle	1	Yes	0x0240	0x02402240
E240.1	Angle auto-tuning verification error	1	Yes	0x1240	0x12402240
E240.2	Hall operation verification fault	1	Yes	0x2240	0x22402240
E243.0	Brake release error	1	Yes	0x0243	0x02430243
E243.1	Brake apply error	1	Yes	0x0243	0x12430243
E247.1	Torque saturation fault	1	Yes	0x0247	0x12470247
E248.0	Overspeed reference	1	Yes	0x0248	0x02480248
E320.0	Braking resistor overloaded	1	Yes	0x0320	0x03202320
E320.1	Enclosure temperature of the braking resistor excessively high	1	Yes	0x0320	0x13202320
E321.0	Dynamic brake resistor overloaded	1	Yes	0x0321	0x03210321
E400.0	Main circuit overvoltage	1	Yes	0x3210	0x04002400
E410.0	Main circuit undervoltage	1	Yes	0x3220	0x04100410
E410.1	Main circuit powered off	1	Yes	0x0410	0x14102410
E500.0	Motor overspeed	1	Yes	0x8400	0x05000500
E500.1	Speed feedback overflow	1	Yes	0x8400	0x15000500
E500.2	FPGA position feedback pulse overspeed	1	Yes	0x0500	0x25000500
E602.0	Angle auto-tuning failure	1	Yes	0x0602	0x06022602
E602.1	Angle auto-tuning overtravel	1	Yes	0x0602	0x16022602
E602.2	U/V/W phase sequence reversed	1	Yes	0x0602	0x26020602
E602.3	Excessive encoder feedback fluctuation during angle auto-tuning	1	Yes	0x0602	0x36022602
E602.4	Angle auto-tuning timeout	1	Yes	0x0602	0x46022602
E602.5	Angle auto-tuning failed and Z signal not found	1	Yes	0x0602	0x56022602
E602.6	Angle auto-tuning not convergent	1	Yes	0x0602	0x66022602
E605.0	Overspeed upon S-ON	1	Yes	0x0605	0x06052605
E612.0	Stall detected in phase sequence auto-tuning	1	Yes	0x0612	0x06122612
E612.1	Overtravel in phase sequence auto-tuning	1	Yes	0x0612	0x16122612
E612.3	Excessive encoder change in angle auto-tuning	1	Yes	0x0612	0x36122612
E612.4	Phase sequence auto-tuning failed, leading to auto-tuning timeout	1	Yes	0x0612	0x46122612
E613.0	Resistance/Inductance auto-tuning timeout	1	Yes	0x0613	0x06132613
E620.0	Motor overload	1	Yes	0x3230	0x06200620
E620.1	Motor overload in overload current limit mode	1	Yes	0x3230	0x16200620
E621.0	Overload current limit torque reached	1	Yes	0x0621	0x06210621

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E630.0	Motor stall over-temperature protection	1	Yes	0x7121	0x06300630
E640.0	IGBT junction temperature excessively high	1	Yes	0x4210	0x06402640
E640.1	Flywheel diode junction temperature excessively high	1	Yes	0x0640	0x16402640
E650.0	Heatsink temperature excessively high	1	Yes	0x4210	0x06502650
E660.0	Motor temperature excessively high	1	Yes	0x4210	0x06602660
E744.0	Absolute encoder communication timeout	1	Yes	0x7305	0x07442744
E744.2	Absolute encoder error	1	Yes	0x7305	0x27442744
E770.0	Phase A input disconnected in fully closed-loop mode	1	Yes	0x7305	0x07702770
E770.1	Phase B input disconnected in fully closed-loop mode	1	Yes	0x7305	0x17702770
E770.2	Phase Z input disconnected in fully closed-loop mode	1	Yes	0x7305	0x27702770
E939.0	Motor power cable disconnected	1	Yes	0x0939	0x09390939
EB00.0	Excessive position deviation	1	Yes	0x8611	0x0B006B00

No.2 resettable faults

Table 16–3 List of No.2 resettable faults

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E122.0	Multi-turn absolute encoder setting error	2	Yes	0x6320	0x0122E122
E122.1	DI function allocation error	2	Yes	0x6320	0x11226122
E122.2	DO function assignment fault	2	Yes	0x0122	0x21220122
E122.3	Excessively high upper limit in rotation mode	2	Yes	0x6320	0x31226122
E122.4	VDI function assignment error	2	Yes	0x0122	0x41226122
E122.5	DI and VDI assigned the same function	2	Yes	0x0122	0x51226122
E122.7	Fully closed-loop parameter setting error	2	Yes	0x6320	0x71226122
E122.8	Interpolater version mismatch	2	Yes	0x6320	0x81220122
E126.0	Process segment number error	2	Yes	0x0126	0x01260126
E126.1	Internal operation mode error of the process segment	2	Yes	0x0126	0x11260126
E126.2	Position reference type error in process segment position mode	2	Yes	0x0126	0x21260126
E246.0	Encoder PPR (H0b.70) before power-off different from that after power-off	2	Yes	0x0246	0x02460246
E246.1	Single-turn absolute position (H0b.71) of the encoder before power-off different from that after power-off	2	Yes	0x0246	0x12460246

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E246.2	Position feedback changes before and after power-off	2	Yes	0x0246	0x22460246
E249.0	Excessive speed deviation	2	Yes	0x0249	0x02490249
E24A.0	Hard limit reached in the wrong direction	2	Yes	0x6320	0x024A024A
E420.0	Main circuit phase loss	2	Yes	0x3130	0x04200420
E661.0	STune failure	2	Yes	0x0661	0x06616661
E662.0	ETune failure	2	Yes	0x0662	0x06626662
E664.0	Excessive resonance	2	Yes	0x0664	0x06646664
E731.0	Encoder multi-turn position data loss	2	Yes	0x7305	0x07310731
E733.0	Encoder multi-turn counting error	2	Yes	0x7305	0x07336733
E735.0	Encoder multi-turn counting overflow	2	Yes	0x7305	0x07356735
E760.0	Encoder over-temperature	2	Yes	0x4210	0x07606760
EB00.1	Position deviation overflow	2	Yes	0x8611	0x1B006B00
EB01.1	Individual position reference increment excessively high	2	Yes	0x6320	0x1B016B01
EB01.2	Position reference increment remains excessively high	2	Yes	0x6320	0x2B016B01
EB01.3	Reference overflow	2	Yes	0x6320	0x3B016B01
EB02.0	Excessive position deviation in fully closed-loop mode	2	Yes	0x8611	0x0B026B02
EB02.1	Position deviation overflow in fully closed-loop mode	2	Yes	0x8611	0x1B026B02
EB03.0	Electronic gear ratio overlimit - H05.02	2	Yes	0x0B03	0x0B036B03
EB03.1	Electronic gear ratio overlimit - Electronic gear ratio 1	2	Yes	0x0B03	0x1B036B03
EB03.2	Electronic gear ratio overlimit - Electronic gear ratio 2	2	Yes	0x0B03	0x2B036B03
EB05.0	Excessive standstill deviation	2	Yes	0x0B05	0x1B050B05
ED02.0	Modbus communication timeout	2	Yes	0x0D02	0x0D020D02
EE08.0	Synchronization signal loss	2	Yes	0x0E08	0x0E086E08
EE08.1	Status switchover error	2	Yes	0x0E08	0x1E086E08
EE08.3	Unstable network connection	2	Yes	0x0E08	0x3E086E08
EE08.4	Data frame loss protection error	2	Yes	0x0E08	0x4E086E08
EE08.5	Data frame transfer error	2	Yes	0x0E08	0x5E086E08
EE08.6	Data update timeout	2	Yes	0x0E08	0x6E086E08
EE09.0	Software position limit setting error	2	Yes	0x6320	0x0E096E09
EE09.1	Home setting error	2	Yes	0x6320	0x1E096E09
EE09.2	Gear ratio overlimit	2	Yes	0x6320	0x2E096E09
EE09.3	Homing method setting error	2	Yes	0x6320	0x3E096E09

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
EE09.5	PDO mapping overlimit	2	Yes	0x6320	0x5E096E09
EE10.0	Protection against MailBox setting error	2	Yes	0x0E10	0x0E106E10
EE10.1	SM2 setting error	2	Yes	0x0E10	0x1E106E10
EE10.2	SM3 setting error	2	Yes	0x0E10	0x2E106E10
EE10.3	PDO watchdog setting error	2	Yes	0x0E10	0x3E106E10
EE10.4	Protection against PLL completion interrupt (no sync signal)	2	Yes	0x0E10	0x4E106E10
EE10.5	PHY setting error	2	Yes	0x0E10	0x5E100E10
EE11.0	ESI validation error	2	Yes	0x5530	0x0E116E11
EE11.1	EEPROM bus read failure	2	Yes	0x5530	0x1E116E11
EE11.2	EEPROM update failure	2	Yes	0x5530	0x2E116E11
EE11.3	Mismatch between ESI file and actual drive model	2	Yes	0x0E11	0x3E110E11
EE13.0	EtherCAT synchronization cycle setting error	2	Yes	0x6320	0x0E136E13
EE15.0	Excessive EtherCAT synchronization cycle error	2	Yes	0x0E15	0x0E156E15

16.3.2 List of Alarm Codes

Table 16–4 List of alarm codes

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E108.0	Storage parameter write error	3	Yes	0x5530	0x0108E108
E108.1	Storage parameter read error	3	Yes	0x5530	0x1108E108
E108.2	Verification error on the data written to EEPROM	3	Yes	0x5530	0x2108E108
E108.3	Verification error on data read from EEPROM	3	Yes	0x5530	0x3108E108
E108.4	A single piece of data is stored too many times	3	Yes	0x0108	0x4108E108
E110.0	Frequency-division pulse output setting error	3	Yes	0x0110	0x0110E110
E120.3	Drive and motor power not match	3	Yes	0x7122	0x3120E120
E121.0	Invalid S-ON command	3	Yes	0x0121	0x0121E121
E126.3	PR process segment parameter outside the upper/lower limit	3	Yes	0x0126	0x31260126
E244.0	Abnormal input torque reference	3	Yes	0x0244	0x02440244
E244.1	An error occurs during internal torque/speed limit calculation	3	Yes	0x0244	0x12440244
E247.0	Torque saturation alarm	3	Yes	0x0247	0x02470247
E510.0	Frequency division pulse output overspeed	3	Yes	0x0510	0x0510E510
E600.0	Inertia auto-tuning failure	3	Yes	0x0600	0x06000600

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E601.0	Homing alarm	3	Yes	0x0601	0x0601E601
E601.1	Homing switch error	3	Yes	0x0601	0x1601E601
E601.2	Homing mode setting error	3	Yes	0x6320	0x2601E601
E601.3	Position feedback alarm	3	No	0x0601	0x36010601
E602.9	Angle auto-tuning not performed on incremental encoder	3	Yes	0x0602	0x96022602
E609.0	Data storage timeout	3	Yes	0x0609	0x06090609
E609.1	Data storage overflow	3	Yes	0x0609	0x16090609
E609.2	Data storage failure	3	Yes	0x0609	0x26090609
E609.3	Data erasure failure	3	Yes	0x0609	0x36090609
E621.1	Overload current limit torque reached	3	Yes	0x0621	0x16210621
E730.0	Encoder battery alarm	3	Yes	0x7305	0x0730E730
E831.1	Excessive AI1 zero offset	3	Yes	0x0831	0x18310831
E831.2	Excessive AI2 zero offset	3	Yes	0x0831	0x28310831
E834.1	AI1 overvoltage alarm	3	Yes	0x0834	0x18340834
E834.2	AI2 overvoltage alarm	3	Yes	0x0834	0x28340834
E900.0	DI emergency braking	3	Yes	0x0900	0x0900E900
E902.0	Invalid DI/VDI setting	3	Yes	0x6320	0x09020902
E902.1	Invalid DO/VDO setting	3	Yes	0x0902	0x19020902
E902.2	Invalid torque arrival setting	3	Yes	0x0902	0x29020902
E909.0	Motor overload alarm	3	Yes	0x3230	0x0909E909
E910.0	Control circuit overvoltage	3	Yes	0x3210	0x0910E910
E920.0	Braking resistor overloaded	3	Yes	0x3210	0x0920E920
E921.0	Dynamic braking resistor overload alarm	3	Yes	0x3210	0x09210921
E922.0	Excessively low resistance of the external braking resistor	3	Yes	0x6320	0x0922E922
E924.0	Braking transistor over-temperature	3	Yes	0x3230	0x0924E924
E940.0	The controlled motor changes. It is recommended to restore default values before use.	3	Yes	0x0940	0x09400940
E941.0	Modified parameters activated at next power-on	3	No	0x6320	0x09410941
E942.0	Parameter stored too frequently	3	Yes	0x7600	0x0942E942
E950.0	Forward overtravel	3	Yes	0x5443	0x0950E950
E952.0	Reverse overtravel	3	Yes	0x5444	0x0952E952
E954.0	Position reference overflow	3	Yes	0x0954	0x09540954
E956.0	Forward position reference overtravel in process segment position mode	3	Yes	0x0956	0x09560956

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Aux. code (203Fh)
E958.0	Reverse position reference overtravel in process segment position mode	3	Yes	0x0958	0x09580958
E971.0	Undervoltage alarm from voltage drop protection	3	Yes	0x0971	0x0971E971
E980.0	Frequency-division output overflow	3	Yes	0x0980	0x09800980
EA34.9	Missing Hall configurations during Hall auto-tuning	3	Yes	0x0A34	0x9A340A34
EA41.0	Torque fluctuation compensation failure	3	Yes	0X0A41	0x0A410A41
EE08.7	Error frame alarm	3	Yes	0x0E08	0x7E08EE08
EE08.8	OUT port error frame alarm	3	Yes	0x0E08	0x8E08EE08

16.3.3 Description of Fault Codes

16.3.3.1 Troubleshooting Faults

E101.0: Abnormal parameters in groups H02 and above

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.

Troubleshooting:

Cause	Verification method	Solution
1. The control power voltage drops instantaneously.	1. Check whether the control circuit (L1C, L2C) is in the process of power-off or instantaneous power failure occurs. 2. Measure whether the voltage input of the control cable on the non-drive side during operation is within the following specifications: 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: 10% to +10% (180 V to 264 V) 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: 10% to +10% (342 V to 528 V)	1. Restore system parameters to default (H02.31 = 1) and write parameters again. 2. Enlarge the power capacity or replace with a power supply of higher capacity, restore system parameters to default values (H02.31 = 1), and then write parameters again.
2. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs during parameter storage.	Power on the system again, restore system parameters to default (H02.31 = 1), and write parameters again.

Cause	Verification method	Solution
3. The number of parameter-write operations within a certain period of time exceeds the limit.	1. Check whether instantaneous power failure occurs during parameter storage. 2. Check whether parameters are updated frequently through the host controller.	1. If the drive is faulty, replace the drive. 2. Change the way of writing and write parameters again. 3. Power on the system, restore default setting (H02.31 = 1), and write parameters again.
4. The software is upgraded.	Check whether parameter values in group H02 and above exceed the upper/lower limit due to software update.	Reset the servo drive model and servo motor model, and restore system parameters to default (H02.31 = 1).
5. The servo drive is faulty.	Restart the power supply and restore parameters to default values. If the fault persists, the drive is faulty.	Replace the servo drive.

E101.1: Parameter error in group H00/H01

Cause:

The total number of parameters changes, which generally occurs after software update. Values of parameters in groups H00 or H01 exceed the limit, which generally occurs after software update.

Troubleshooting:

Cause	Verification method	Solution
The drive detects whether parameter values in groups H00 and H01 exceed the upper/lower limit range during initialization upon power-on. If yes, the panel displays E101.1. Motor parameters in group H00 are read from the encoder. Drive parameters in group H01 are mapped based on the drive model defined by H01.10.	Check which parameter in groups H00 and H01 exceeds the limit range. Check whether this parameter range is abnormal.	Replace the motor or servo drive.

E101.2: Address error in read/write operation after the number of parameters changes

Cause:

Address error in read/write operation after the number of parameters changes.

Troubleshooting:

Cause	Verification method	Solution
The total number of parameters changes after software update, leading to an address error in read/write operation.	View the abnormal parameter group number through H0b.90 and H0b.91.	1. Rectify the wrong values value. 2. Restore the default settings.

E101.9: Parameter attribute initialization check error

Cause:

An error occurs during parameter property initialization verification.

Troubleshooting:

Cause	Verification method	Solution
Parameter attribute initialization check error	Check whether a parameter has been written to H0A.99.	If the fault persists after the servo drive is powered off and on repeatedly, replace the drive.

E102.0: FPGA communication establishment error

Cause:

The communication between MCU and FPGA cannot be established.

Troubleshooting:

Cause	Verification method	Solution
The communication between MCU and FPGA cannot be established.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E102.1: FPGA initialization startup error

Cause:

FPGA failed.

Troubleshooting:

Cause	Verification method	Solution
FPGA cannot start.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E102.8: FPGA and MCU versions mismatch

Cause:

FPGA and MCU software versions do not match.

Troubleshooting:

Cause	Verification method	Solution
The software versions of MCU and FPGA are inconsistent.	1. Check whether the MCU version of H01.00 is 9xx.x (the 4th digit on the panel is 9). 2. Check whether the FGPA version of H01.01 is 9xx.x (the 4th digit on the panel is 9).	Contact Inovance for technical support. Update the FPGA or MCU software.

E104.1: MCU operation timeout (MCU crashed)

Cause:

The access to MCU times out.

Troubleshooting:

Cause	Verification method	Solution
1. The FPGA is faulty. 2. The communication handshake between FPGA and HOST is abnormal. 3. Access timeout occurs between the HOST and the coprocessor.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E104.2: FPGA operation timeout (FPGA crashed)

Cause:

The MCU torque interrupt scheduling time is abnormal. This fault is reported only in the commissioning stage.

Troubleshooting:

Cause	Verification method	Solution
1. The FPGA is faulty. 2. The communication handshake between the FPGA and the MCU is abnormal.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E104.4: MCU reference update timeout

Cause:

Taking the moment when the interruption starts as the starting time, if the time when commands are written to MCU is larger than the time when position and speed regulators are started by FPGA, an alarm will be reported.

Troubleshooting:

Cause	Verification method	Solution
The system reports that the encoder communication time is set improperly, or the command calculation time is excessively long.	Check whether the fault persists after the drive is powered off and on repeatedly.	1. Hide unnecessary functions. 2. Replace the servo drive.

E120.0: Unknown encoder type

Cause:

The servo drive detects the encoder model during initialization upon power-on. If the encoder model does not comply with the requirement, E120.0 occurs.

Troubleshooting:

Cause	Verification method	Solution
1. The product (motor or servo drive) code does not exist.	Read the nameplates of the servo drive and motor to check whether SV670N series servo drive and corresponding servo motor are used. Meanwhile, check whether H00.00 (Motor code) is set to a proper value. View the servo drive code (H01.02) to check whether this servo drive code exists.	If the motor code is unknown, set H00.00 to 14101 when the SV670N series servo drive and 23-bit servo motor are used. If the servo drive code does not exist, 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 model (H01.02) matches the bus motor model (H00.05).	Replace the product that does not match.

E120.1: Unknown motor model

Cause:

The drive detects the motor model defined by H00.00 during initialization upon power-on. If the motor model does not exist, E120.1 occurs.

Troubleshooting:

Cause	Verification method	Solution
The motor model defined by H00.00 is abnormal.	Check whether the value of H00.00 matches the motor used.	Rectify the value of H00.00.

E120.2: Unknown drive model

Cause:

The servo drive detects the servo drive model defined by H01.10 during initialization upon power-on. If the servo drive model does not exist, E120.2 occurs.

Troubleshooting:

Cause	Verification method	Solution
H01.10 is set improperly.	Check the value of H01.10.	Disable drive model auto-tuning function and set H01.10 to a proper value manually.

E120.5: Motor and drive current mismatch

Cause:

The rated output of the servo drive is greatly higher than the rated current of the motor. You must use a servo drive of lower rated output or a motor with higher rated current.

Troubleshooting:

Cause	Verification method	Solution
The internal scale value is abnormal.	Check whether the servo drive model is correct. If the current sampling coefficient is excessively high, calculation overflow can occur.	Replace the servo drive.

E120.6: FPGA and motor model mismatch

Cause:

1. The motor model is set improperly, causing mismatch and malfunction of the servo drive.
2. The motor model is set properly, but the motor encoder is not supported by the servo drive.

Troubleshooting:

Cause	Verification method	Solution
The FPGA software version does not match the motor model specified by H00.00.	Check whether the FPGA software version (H01.01) supports the motor model set by H00.00.	Update the FPGA software to support the motor model set by H00.00 or replace the motor.

E120.7: Model parameter verification error

Cause:

The drive model parameter cannot be identified.

Troubleshooting:

Cause	Verification method	Solution
Model parameter CRC failed.	Check whether the model parameters are lost or not programmed.	Program the model parameters again.

E120.8: Junction temperature parameter verification error

Cause:

The junction temperature parameter is identified incorrectly.

Troubleshooting:

Cause	Verification method	Solution
Junction temperature parameter CRC failed.	Check whether the junction temperature parameters are lost or not programmed.	Program the junction temperature parameter again.

E122.0: Multi-turn absolute encoder setting error

Cause:

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

Troubleshooting:

Cause	Verification method	Solution
The motor does not match the absolute position mode or the motor code is set incorrectly.	1. View the motor nameplate to confirm if the motor is a multi-turn absolute encoder motor. 2. Check whether the motor model (H00.00) is correct.	Reset H00.00 (motor code) according to the motor nameplate or use a suitable motor.

E122.1: Different DIs assigned with the same function

Cause:

1. The same function is assigned to different DIs.
2. The DI function No. exceeds the maximum number allowed for DI functions.

Troubleshooting:

Cause	Verification method	Solution
1. The same function is assigned to different DIs.	Check whether parameters in groups H03 (H03.02, and H03.04 to H03.20) and H17 (H17.00, and H17.02 to H17.30) are assigned with the same non-zero DI function number.	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 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.

E122.2: Different DOs assigned with the same function

Cause:

The DO function No. exceeds the maximum number allowed for DO functions.

Troubleshooting:

Cause	Verification method	Solution
The DO function No. exceeds the maximum number allowed for DO functions.	Check whether DO function numbers defined by H04.00 and H04.02 are abnormal.	Set the correct DO function No.

E122.3: Invalid upper limit in rotation mode

Cause:

The upper limit of mechanical single-turn position exceeds 2^{31} in the absolute rotation mode.

Troubleshooting:

Cause	Verification method	Solution
The upper limit (reference range) of the mechanical single-turn position exceeds 2^{31}.	Check the setting of the mechanical gear ratio, the upper limit of the mechanical single-turn position, and the electronic gear ratio when the servo drive runs in absolute rotation mode (H02.01 = 2).	Reset the mechanical gear ratio, the upper limit of mechanical single-turn position and the electronic gear ratio to ensure the upper limit of mechanical single-turn position (reference range) does not exceed 2^{31}.

E122.4: Different VDIs assigned with the same function

Cause:

The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Troubleshooting:

Cause	Verification method	Solution
1. The same function is assigned to different VDIs.	Check whether parameters in groups H03 (H03.02, and H03.04 to H03.20) and H17 (H17.00, and H17.02 to H17.30) are assigned with the same non-zero DI function number.	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 VDI function No. exceeds the maximum number allowed for VDI functions.	Check whether the MCU program is updated.	Restore system parameters to default values (H02.31 = 1) and restart the servo drive.

E122.5: DI and VDI assigned with the same function

Cause:

The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Troubleshooting:

Cause	Verification method	Solution
Two or more DIs and VDIs are assigned with the same function No.	Check whether DI function numbers set in groups H03 and H17 are repetitive.	Make sure that each DI or VDI is assigned a unique function No.

E122.7: Fully closed-loop parameter setting error

Cause:

In fully closed-loop applications, the rotation mode is set in the inner loop.

Troubleshooting:

Cause	Verification method	Solution
When H0F.00 is not 0, set H02.01 to 2 (absolute position rotation mode).	Check the value of H02.01 if fully closed-loop is used.	Set the value of H02.01 to 2 if fully closed-loop is used.

E122.8: Interpolater version mismatch

Cause:

Interpolater version mismatch

Troubleshooting:

Cause	Verification method	Solution
T2 Interpolator mismatch with motor	Check whether the setting of H00.50 is consistent with that of H00.51 and neither of them are set to 65535.	1. Check whether the interpolator is used mixedly. If yes, rectify it. 2. The warning is caused by interpolator replacement. Check corresponding default parameters and write them to the interpolator.

E126.0: Process segment number error

Cause:

The process segment number is not 1000 or any other value from 0 to 15 in the process segment mode.

Troubleshooting:

Cause	Verification method	Solution
The process segment number is not 1000 or any other value from 0 to 15 in the process segment mode.	Check whether the value of H22.00 exceeds the specified range of process segment number (0–15 or 1000).	Write 0 to 15 to H22.00 in process segment mode.

E126.1: Process segment internal operation mode error

Cause:

The process segment operation mode is not 0, 1, 2, 3, 7, or 8.

Troubleshooting:

Cause	Verification method	Solution
The process segment operation mode is not 0, 1, 2, 3, 7, or 8.	Check whether the values of bit0 to bit3 of the parameter defined by the process segment at fault is 0, 1, 2, 3, 7, or 8.	Set the process segment operation mode to 0, 1, 2, 3, 7, or 8.

E126.2: Position reference type error in process segment position mode

Cause:

The position reference type in the process segment position mode is not 00 (Absolute reference) or 10 (Incremental mode).

Troubleshooting:

Cause	Verification method	Solution
The position reference type in the process segment position mode is not 00 (Absolute reference) or 10 (Incremental mode).	Check whether the value of bit6 or bit7 of the parameter defined by the process segment at fault is 00 or 10.	Set the position reference type in the process segment position mode to 00 (Absolute reference) or 10 (Incremental reference).

E136.0: Encoder ROM motor parameter check error

Cause:

When reading parameters from the encoder ROM, the servo drive detects that no parameters are saved or parameter values are inconsistent with the setpoints.

Troubleshooting:

Cause	Verification method	Solution
1. The servo drive model does not match the motor model.	Check whether the SV670N series servo drive and servo motor are used.	Replace the servo drive and motor.
2. A parameter check error occurs, or no parameter is saved in the serial incremental encoder ROM.	1. Check whether the encoder cable provided by Inovance is used. Cables are connected securely without scratching, breaking or poor contact on both ends. 2. Measure signals PS+, PS-, +5V and GND on both ends of the encoder cable and observe whether signals at both ends are consistent. For signal assignment, see Chapter "Wiring" in the hardware guide.	1. 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. 2. Route encoder cables and power cables (R/S/T, U/V/W) through different routes.
3. The drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

E136.1: Encoder ROM motor parameter read error

Cause:

The encoder cable is not connected properly.

A communication error occurs on the encoder due to interference.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable connections are incorrect or loosened.	Check the encoder cable connection. Check whether ambient vibration is excessive, which loosens the encoder cable and even damages the encoder.	1. Connect the cables again according to the correct wiring diagram. 2. Connect the cables again and ensure encoder terminals are connected securely.
2. The servo drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.
3. The encoder communication is being disturbed.	Check whether the fault 136.1 occurs.	Install the magnetic ring and ensure that the power cable and communication cable are routed through different routes.

E136.9: Dimension parameter initialization error

Cause:

An encoder read/write error causes 32-bit scaling compatibility initialization error.

Troubleshooting:

Cause	Verification method	Solution
An encoder read/write error causes 32-bit scaling compatibility initialization error.	Check whether compatibility is enabled in H32.50.	1. Disable the compatibility function. If encoder communication faults still occur, rectify the fault based on common solutions. 2. Disable the compatibility function, if everything is normal after power-on but an alarm is reported upon start, contact Inovance for technical support.

E138.0: Accuracy compensation data error

Cause:

Accuracy compensation data error

Troubleshooting:

Cause	Verification method	Solution
1. The accuracy compensation data is lost, leading to check failure. 2. The hardware of FLASH is faulty.	Read the drive compensation data through the software tool to observe whether the data is normal.	1. Perform compensation through the software tool again, and restart the drive. 2. If the fault persists, contact Inovance.

E138.1: Cogging fluctuation compensation data check failure

Cause:

Cogging fluctuation compensation data check failure

Troubleshooting:

Cause	Verification method	Solution
1. The cogging fluctuation compensation data is lost, leading to check failure. 2. The hardware of FLASH is faulty.	Read the data through software tool.	1. Perform compensation again, and restart the drive. 2. If the fault persists, contact Inovance.

E140.0: Encryption integrated circuit verification fault

Cause:

Encryption chip check failure

Troubleshooting:

Cause	Verification method	Solution
The encryption software is not programmed.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E140.2: Encryption chip version error

Cause:

The MCU does not establish communication with the encryption chip.

Troubleshooting:

Cause	Verification method	Solution
The encryption software is not programmed.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E140.3: Encryption chip damaged

Cause:

The MCU does not establish communication with the encryption chip.

Troubleshooting:

Cause	Verification method	Solution
The MCU does not establish communication with the encryption chip.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E150.0: STO safety state applied

Cause:

The STO input protection applies (safety state).

Troubleshooting:

Cause	Verification method	Solution
One or two 24 V inputs are disconnected simultaneously, triggering the STO function.	1. Check whether the STO function is activated. 2. Check whether the STO power supply is normal. 3. Check whether the fault persists after the preceding causes are rectified.	There is no need to take any corrective actions. After the STO terminal is back to normal, clear the fault using the fault reset function. Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected. Replace the drive.

E150.1: STO input state error

Cause:

The single-channel input of STO is inactive.

Troubleshooting:

Cause	Verification method	Solution
1. The STO input power supply is abnormal.	Check whether the STO power supply is normal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
2. The STO input resistor is abnormal.	After STO is triggered, only one STO signal is sent to MCU after the 24 V power supply is cut off due to input resistor drift.	Replace the servo drive.
3. STO is inactive.	The fault persists after preceding causes are rectified.	Replace the servo drive.

E150.2: Buffer 5 V voltage detection error

Cause:

The MCU monitors the 5 V power supply of the PWM Buffer to detect whether overvoltage or undervoltage occurs. If the voltage is abnormal, this alarm occurs.

Troubleshooting:

Cause	Verification method	Solution
The 5 V voltage supplied to the STO Buffer is abnormal due to undervoltage or overvoltage.	Check whether the fault can be removed by a restart. If not, the 5V voltage supplied to the buffer is abnormal.	Replace the servo drive.

E150.3: STO input circuit hardware diagnosis failure

Cause:

Short circuit occurs on the optocoupler of the upstream hardware circuit of STO.

Troubleshooting:

Cause	Verification method	Solution
Shoot-through occurs on the upstream optocoupler of STO1 or STO2.	Check whether the fault persists and the panel displays E150.3 after the drive is powered on again.	Replace the servo drive.

E150.4: PWM buffer hardware diagnosis failure

Cause:

An error occurs on the PWM Buffer integrated circuit during initialization upon power-on (the PWM signal cannot be blocked).

Troubleshooting:

Cause	Verification method	Solution
An error occurs on the STO buffer during detection upon power-on.	The fault persists and the panel displays E150.4 after restart.	Replace the servo drive.

E150.5: STO input signal interference

Cause:

The STO signal is being disturbed, and the noise filtering condition defined by H0A.73 is not met.

Troubleshooting:

Cause	Verification method	Solution
The STO terminal is in poor contact or the external 24 V input voltage is unstable, which may lead to malfunction of STO.	Check whether the 24 V input voltage of the STO terminal is unstable, leading to frequent restart.	Replace the 24 V power supply to ensure the STO terminal input voltage is stable.

E201.0: Phase P overcurrent

Cause:

An excessively high current flows through the positive pole of the DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	1. Motor parameters are set improperly, change motor parameters. 2. Current loop parameters are set improperly, re-adjust the current loop parameters. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. The servo drive operates improperly. Replace it.
2. The encoder cable is aged, corroded, or connected improperly or 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.17 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	1. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. 2. Disconnect the motor cable and power on the servo drive again, but the fault persists. 3. Check whether resistance of the external braking resistor is too small or the braking resistor is short-circuited (between terminals P⊕ and C).	1. Replace with a regenerative resistor with matching resistance and perform wiring again. 2. Replace the servo drive.
4. Overcurrent occurs on the braking resistor.	Check whether resistance of the external braking resistor is excessively low or the braking resistor is short-circuited (between terminals P⊕ and C).	Replace with a braking resistor of proper resistance. Perform wiring again.

E201.1: Phase U overcurrent

Cause:

A current higher than the detection threshold is collected in the phase-U current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.2: Phase-V overcurrent

Cause:

A current higher than the threshold is collected in the phase-V current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.4: Phase N overcurrent

Cause:

An excessively high current flows through the negative pole of the DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	Perform gain tuning.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aged, corroded, or connected loosely.	Re-solder, tighten, or replace the encoder cable.
3. Overcurrent occurs on the braking resistor.	Check whether resistance of the external braking resistor is excessively low or the braking resistor is short-circuited (between terminals P⊕ and C).	Replace with a braking resistor of proper resistance. Perform wiring again.
4. Overcurrent is caused by the superposition of the braking current and phase current.	Check whether the drive accelerates abruptly during braking. Check whether the voltage feedback exceeds the braking threshold through the Inovance drive software tool and whether the torque reference increases abruptly.	Increase the acceleration/ deceleration time.
5. The servo drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E202.0: Bus discharge overcurrent

Cause:

When in the discharge state, excessive current flows through phase P or N of the bus in the DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. The braking resistor is set improperly.	Check whether resistance of the external braking resistor is excessively low or the braking resistor is short-circuited (between terminals P⊕ and C).	Replace with a braking resistor of proper resistance. Perform wiring again.
2. The gain is set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	1. Motor parameters are set improperly, change motor parameters. 2. Current loop parameters are set improperly, re-adjust the current loop parameters. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. The servo drive operates improperly. Replace it.

Cause	Verification method	Solution
3. Overcurrent is caused by the superposition of the braking current and phase current.	Check whether the drive accelerates abruptly during braking. Check whether the voltage feedback exceeds the braking threshold through the Inovance drive software tool and whether the torque reference increases abruptly.	Increase the acceleration/ deceleration time.
4. The servo drive is faulty.	1. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. 2. Disconnect the motor cable and power on the servo drive again, but the fault persists. 3. Check whether resistance of the external braking resistor is too small or the braking resistor is short-circuited (between terminals P⊕ and C).	1. Replace with a regenerative resistor with matching resistance and perform wiring again. 2. Replace the servo drive.

E202.1: Bus phase N overcurrent

Cause:

Overcurrent occurs on phase P of the bus in DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	Perform gain tuning.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aged, corroded, or connected loosely.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E202.2: Bus phase N overcurrent

Cause:

Overcurrent occurs on phase N of the bus in DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	Perform gain tuning.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aged, corroded, or connected loosely.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E202.3: Bus current sampling hardware error

Cause:

Excessively high current flows through the phase P or phase N of the bus in the DC-AC circuit in the S-OFF state.

Troubleshooting:

Cause	Verification method	Solution
1. The servo drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E203.0: Current feedback closed-loop error of the power cable

Cause:

The current feedback exceeds 20% of the torque reference for a period longer than 1 ms.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	1. Motor parameters are set improperly, change motor parameters. 2. Current loop parameters are set improperly, re-adjust the current loop parameters. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. The servo drive operates improperly. Replace it.
2. The encoder cable is aged, corroded, or connected improperly or 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.17 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	After enabling the drive, keep the reference to 0 and check whether H0b.24 is within the normal range.	Replace the servo drive.

E203.1: Phase-U overcurrent of the power cable

Cause:

A current higher than the detection threshold is collected in the phase-U current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E203.2: Phase-V overcurrent of the power cable

Cause:

A current higher than the threshold is collected in the phase-V current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E203.3: Phase-W overcurrent of the power cable

Cause:

A current higher than the detection threshold is detected in the phase W current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E203.4: Current error detected by power cable

Cause:

In the S-OFF state, a high current that exceeds the detection threshold is detected in the U/V/W power cables.

Troubleshooting:

Cause	Verification method	Solution
Check whether the servo drive is faulty.	Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E208.2: Encoder communication timeout

Cause:

The FPGA detects a communication timeout with the encoder.

Troubleshooting:

Cause	Verification method	Solution
The servo drive fails to receive the data fed back by the encoder in three consecutive cycles.	Check whether bit12 of parameter H0b.30 is 1. If bit12 is 1, an error is reported. If bit12 is 0, no error is reported. The encoder cable is wired improperly. The encoder cable is loosened. The encoder cable is too long. The encoder communication suffers from interference. The encoder is faulty.	1. Check whether the motor model is correct. 2. Check the condition of the encoder cable. 3. Check whether the encoder version (H00.04) is set properly. 4. The drive is abnormal, replace the drive.

E208.4: FPGA current loop operation timeout

Cause:

The operating time of the current loop exceeds the interval threshold.

Troubleshooting:

Cause	Verification method	Solution
FPGA operation timeout	Internal fault code H0b.45 = 4208: Current loop operation timeout	Disable some unnecessary functions to reduce the operating load of the current loop.

E210.0: Output ground fault

Cause:

The drive detects an abnormal motor phase current or bus voltage during self-test upon power-on.

1. The bus voltage exceeds the discharge threshold.
2. The phase U current of drives in size C/D/E exceeds 1/4 of the value of H01.07.
3. Overcurrent occurs on phase P and phase N of drives in sizes A and B.

Troubleshooting:

Cause	Verification method	Solution
1. The drive power cables (U/V/W) are short-circuited to ground.	Disconnect the motor cables, and measure whether the servo drive power cables (U/V/W) are short-circuited to ground (PE).	Connect the cables again 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 drive is faulty.	Disconnect the servo drive power cables from the servo drive. Check whether the fault persists after the power supply is switched on multiple times.	Replace the servo drive.
4. The motor speed is excessively high during ground fault detection.	Check whether the motor is rotating upon power-on.	Reduce the motor speed to a value lower than 10 rpm.
5. The bus voltage of the control circuit is higher than the discharge threshold.	Check whether the bus voltage upon fault is greater than the bus voltage discharge threshold.	Set a proper DC bus voltage discharge threshold.

E210.2: Output ground fault

Cause:

The drive detects that the motor phase current is at full scale during self-test upon power-on.

Troubleshooting:

Cause	Verification method	Solution
1. 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.
2. The servo drive is faulty.	Disconnect the servo drive power cables from the servo drive. Check whether the fault persists after the power supply is switched on multiple times.	Replace the servo drive.

E234.0: Runaway (protection scheme 1)

Cause:

The speed feedback direction is opposite to torque reference direction, and the speed feedback reaches the runaway speed threshold (H0A.57). The torque reference reaches the runaway current threshold (H0A.55) and the minimum value of torque limit in the speed or position control mode, or is non-zero in the torque control mode. The fault duration reaches the value of H0A.59 (Runaway protection detection time).

Troubleshooting:

Cause	Verification method	Solution
1. The U/V/W cables are connected improperly.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables according to the correct sequence.
2. The motor rotor initial phase error is detected due to interference signals upon power-on.	The U/V/W phase sequence is correct, but E234.0 is reported when the servo drive is enabled.	Power cycle the drive.
3. The encoder type is set incorrectly, or the wiring is incorrect.	Check whether the set motor code (H00.00) matches the one on the motor nameplate.	Set the correct motor code (H00.00) according to the motor nameplate.
4. The encoder cable is aged or corroded, or connected incorrectly or loosely.	1. Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. 2. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.10 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten, or replace the encoder cable.
5. The gravity load is excessive in a vertical axis application.	Check whether the load of the vertical axis is excessive. Adjust brake parameters H02.09 to H02.12 to check whether the fault can be cleared.	Reduce the load on the vertical axis or increase the stiffness level. You can also mask this fault if it does not affect safety performance and normal use.
6. Improper parameter setting leads to excessive vibration.	The stiffness level is set to an excessively high value, leading to excessive vibration.	Set a proper stiffness level to avoid excessive vibration.

E234.1: Runaway (protection scheme 2)

Cause:

The speed feedback direction is opposite to the torque reference direction, and the speed feedback reaches the runaway speed threshold (H13.03) of scheme 2 in speed or position mode or runaway speed threshold (H13.04) of scheme 2 in torque mode. The torque reference reaches the runaway current threshold (H13.02) of scheme 2 and the minimum value of the torque limit in speed or position mode, or is non-zero in torque mode. The runaway distance meets the abnormal distance threshold (H13.01).

Troubleshooting:

Cause	Verification method	Solution
1. The torque limit or equipment model is inadequate, triggering a runway false alarm.	Check whether the torque is limited or the current is saturated during operation, leading to insufficient torque output and false runaway fault.	1. Increase the torque limit properly through H07.09/H07.10 or P models, or 60E0h/60E1h/6072h for N models. 2. Check whether the motor load is excessive due to mechanical factors. 3. Reduce the acceleration/ deceleration speed or operating speed. 4. Re-calculate the device power rating needed. 5. Increase the runaway threshold properly or mask this fault without affecting safety performance and operation.
2: Abnormal collision, triggering a runway false alarm.	Check whether a collision occurs on site. If yes: 1. Check whether 607Ah and 6064h are not aligned in the host controller program and whether the host controller commands jump abnormally. 2. Check whether the electronic gear ratio of the drive is excessively high. 3. Check whether the host controller instructions are planned properly and whether the trajectory overlaps with other mechanisms. 4. For models without dynamic brake, check whether the stop distance at zero speed is excessive. 5. Check whether the motor runs beyond the specifications, resulting in excessively long deceleration distance.	1. Align 607Ah and 6064h to avoid data error. This parameter applies to the CSP mode of the N model and the IP mode of the C model. 2. Set a proper electronic gear ratio. 3. Optimize the instruction planning of the host controller or increase the safety distance between mechanisms. 4. For models without dynamic brake, you can install a dynamic brake box or decrease the safety distance for stop at zero speed. 5. Reduce the acceleration/ deceleration speed and operating speed to avoid operation beyond specifications, or re-calculate the device power rating needed.
3. The gravity load in vertical axis scenarios is too large, triggering a runway false alarm.	Check whether the load of the vertical axis is excessive. Adjust brake parameters H02.09 to H02.12 to check whether the fault can be cleared.	Reduce the load in the vertical axis or increase the stiffness level, or increase the runaway threshold. You can also mask this fault without affecting safety or operation.
4. Strong vibration occurs, leading to a false runaway fault.	1. Check whether the stiffness level is excessively high, leading to excessive vibration. 2. Check whether the load is excessive, leading to vibration during stop at overtravel.	1. Set a proper stiffness level to avoid excessive vibration. 2. Modify the stop mode from "Stop at overtravel" to "Ramp to stop".

Cause	Verification method	Solution
5. The electrical angle is abnormal.	1. Check whether the U/V/W phase sequence is incorrect. 2. Check whether the encoder cable and power cable belong to the same motor. 3. Check whether the electrical angle is not auto-tuned. 4. Check whether the Hall is installed improperly. 5. Check whether deviation exists in the electrical angle and absolute position feedback in the same physical position after motor runaway occurs or after the motor operates for a period of time.	1. Connect the U/V/W cables according to the correct phase sequence. 2. Connect the encoder cable and power cable properly. 3. Perform angle auto-tuning again. 4. Install the Hall sensor properly. 5. Perform angle auto-tuning repeatedly and restart to perform auto-tuning again, or replace the encoder.
6. The encoder cable is faulty.	1. Check whether the encoder cable is aged, corroded, connected loosely, or broken. 2. Check whether the encoder cable shield fails, the power cable is being disturbed, or whether the read head is contaminated.	1. Re-solder, tighten, or replace the encoder cable. 2. Route the encoder cable and power cable of high-power devices through different routes, take measures to prevent disturbance to the signal cable, and clean the read head.
7. Power cables are damaged.	Check whether the power cable is aged, corroded, connected loosely, or broken.	Re-solder, tighten, or replace the power cable.
8. Damaged motor or drive.	Check whether the motor and drive are damaged. Perform cross-verification to check whether the fault follows.	Replace the motor or drive.

E240.0: Excessive deviation between the observed value and feedback values of the electrical angle

Cause:

The deviation between the estimated value and the feedback value of the encoder exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. Inaccurate initial angle from auto tuning. 2. The encoder feedback value is incorrect. 3. Observer alarms are enabled during angle auto-tuning. During angle auto-tuning, excessive deviation can be detected if the speed threshold condition is met. 4. The observed deviation during acceleration/deceleration is excessive. 5. Excessive motor inductance/ resistance parameter deviation affects the observed value of electrical angle. 6. Unstable loop operation and improper gain parameters affect the observed value of electrical angle.	1. Perform angle auto-tuning again and check whether the alarm persists. 2. Check whether the encoder is contaminated. Observe the position feedback signal waveform to check for pulse loss or abnormal feedback value. Mark a fixed position, record current position feedback, run the motor back and forth for a period of time, then manually rotate the motor to marked position, record position feedback again, and compare whether the two position feedback values are consistent. If not, the encoder is abnormal. 3. Check whether the alarm is reported in the angle auto-tuning state. 4. Set the function switch to "Observe only, without reporting alarm". The oscilloscope monitors the waveform of H13.71. If the value of H13.71 in the constant speed segment is high, the electrical angle may be abnormal. If the value of H13.71 is small in the constant-speed segment but large in the acceleration/deceleration segment, increase the value of H13.19/H13.20 accordingly and perform observation again. 5. Check whether the inductance/ resistance parameters of the motor deviate greatly. 6. Check whether the control loop operates improperly, the speed fluctuates, or the position deviation is abnormal, leading to deviation in the electrical angle observed.	1. Perform angle auto-tuning again to get the correct initial angle. 2. Check whether the encoder grating scale is contaminated and whether the position feedback is abnormal. Replace the motor encoder. 3. Disable the electrical angle observer alarm during angle auto-tuning. 4. If the acceleration/deceleration segment (H13.71) is high, increase H13.19/H13.20 properly and observe again. 5. Perform inductance/resistance auto-tuning again. Adjust the loop gain parameters to ensure normal operation of the motor. 6. Re-adjust the gain parameters to ensure normal operation of the control loop. For details, see the section on parameter tuning in the manual.

E240.1: Angle auto-tuning check error alarm

Cause:

Incremental encoder: After the drive is enabled, the difference between two angle auto-tuning values exceeds the threshold.
Absolute encoder: After the drive is enabled, the difference between the angle auto-tuning value and the original value of H00.28 exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The angle auto-tuning value is inaccurate. 2. The original value of H00.28 is incorrect.	1. Check whether the angle auto-tuning value is abnormal. Perform angle auto-tuning again and observe whether the value of H00.28 changes by more than 20 degrees (electrical angle). 2. Check whether the encoder is disturbed by an external interference source during angle auto-tuning.	Perform angle auto-tuning again by using a proper angle auto-tuning method.

E240.2: Hall operation check fault

Cause:

The Hall signal is abnormal in static Hall auto-tuning upon start of the motor.

Troubleshooting:

Cause	Verification method	Solution
1. The Hall is connected loosely or the installed improperly. 2. The six Hall electrical angles saved are incorrect (H32.63 to H32.68).	1. Check whether the Hall element is installed properly. 2. Move the motor and observe whether the Hall signal waveform is abnormal.	1. Install the Hall sensor properly. 2. Perform dynamic Hall auto-tuning again.

E243.0: Brake released improperly

Cause:

Brake release error

Troubleshooting:

Cause	Verification method	Solution
The brake of the brake motor is released improperly, and the load in forward/reverse run is excessive.	Check whether the brake is wired properly. During operation, check whether the current feedback exceeds the threshold defined by H13.39.	1. Connect the brake cable correctly according to the instructions in the user guide. 2. Check that the brake is wired properly. If the current feedback exceeds H13.39 due to excessive load, increase the value of H13.39 properly based on the auto-tuned values of H13.75 and H13.76. 3. Check that the brake is wired properly. If the load is not the cause for current feedback error, replace the motor.

E243.1: Brake applied improperly

Cause:

Brake apply error

Troubleshooting:

Cause	Verification method	Solution
On a motor with brake, the displacement distance after the brake is closed exceeds the set threshold.	Apply the brake when the motor is switched off, stops at overtravel, and stops at a No.2 fault, and calculate whether the travel distance is longer than H13.40. Check whether the brake is wired properly and whether the motor can rotate after the brake applies.	1. Connect the brake cable correctly according to the instructions in the user guide. 2. Verify that the brake is wired properly. If the brake backlash does not match the default range, increase the value of H13.40 properly based on the brake backlash or auto-tuned value of H13.77. 3. Verify that the brake is wired properly. After the parameters are adjusted, if the alarm persists after the S-ON and S-OFF signals are triggered several times, replace the motor.

E246.0: Encoder PPR (H0b.70) changed before and after power-off

Cause:

The deviation between the number of encoder multi-turn revolutions before and after power-off exceeds the set threshold (H0b.70).

Troubleshooting:

Cause	Verification method	Solution
The difference in encoder multi-turn data before and after power-off exceeds the set threshold.	1. Check whether H13.43 is set properly. 2. Check whether the encoder battery is faulty.	1. Adjust the threshold and set the absolute value mode. 2. Check the encoder battery. 3. Identify the fault cause and contact the manufacturer.

E246.1: Single-turn absolute position (H0b.71) of the encoder changed before and after power-off

Cause:

The difference between the encoder single-turn absolute position values (H0b.71) before and after power-off exceeds the set threshold.

Troubleshooting:

Cause	Verification method	Solution
The difference in encoder single-turn position data before and after power-off exceeds the set threshold.	1. Check whether H13.44 is set properly. 2. Check whether the encoder battery is faulty.	1. Adjust the threshold and set the absolute value mode. 2. Check the encoder battery. 3. Identify the fault cause and contact the manufacturer.

E246.2: Position feedback changes before and after power-off

Cause:

The difference between the servo feedback position data before and after power-off exceeds the set threshold.

Troubleshooting:

Cause	Verification method	Solution
The difference between the servo feedback position data before and after power-off exceeds the set threshold.	1. Check whether H13.46 is set properly. 2. Check whether the encoder battery is faulty.	1. Adjust the threshold and set the absolute value mode. 2. Check the encoder battery. 3. Identify the fault cause and contact the manufacturer.

E247.1: Torque saturation fault

Cause:

The motor torque reference remains excessively high for a long time.

Troubleshooting:

Cause	Verification method	Solution
The motor torque reference remains excessively high for a long time.	1. Check whether the acceleration/ deceleration is excessively high. 2. Check whether the torque is limited. 3. Check whether the load is excessive and the motor is running out of specification.	1. Reduce the acceleration/ deceleration rate properly. 2. Adjust the torque limit value. 3. Optimize the operation parameters or adjust the model.

E248.0: Reference speed excessively high

Cause:

The reference speed exceeds the motor speed limit.

Troubleshooting:

Cause	Verification method	Solution
The reference speed exceeds the motor speed limit.	1. Check whether the electronic gear ratio is improper. 2. Check whether the speed reference in the current operation mode exceeds H00.15 × H13.52. 3. Check whether the object dictionary unit (H0E.07) is set improperly.	Adjust the parameter value or increase the threshold as appropriate.

E249.0: Excessive speed deviation

Cause:

The deviation between the speed feedback and speed reference remains above the set threshold for the set period of time.

Troubleshooting:

Cause	Verification method	Solution
The deviation between the speed feedback and speed reference remains above the set threshold for the set period of time.	Check whether the deviation between the speed feedback and speed reference exceeds the set threshold.	1. Increase the values of H13.53 and H13.54. 2. Reduce the value of H13.55.

E24A.0: Hardware limit reached in the wrong direction

Cause:

The negative limit switch signal is triggered during positive operation or the positive limit switch signal is triggered during negative operation.

Troubleshooting:

Cause	Verification method	Solution
The hard limit signal is wired to the incorrect terminal.	Check whether the hardware limit signal is connected to the correct terminal.	Wire the limit signal to the correct terminal.

E308.0: Pulse encoder phase A disconnected

Cause:

Phase A of the pulse encoder is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. The phase A of the encoder is wired improperly. 2. The motor model is set improperly.	1. Check the wiring of the encoder. 2. Check whether the motor code (H00.00) is set properly or matches the actual encoder type.	1. Re-connect the encoder and perform a restart. 2. Check whether the motor code (H00.00) is set properly or matches the actual encoder type.

E308.1: Pulse encoder phase B disconnected

Cause:

Phase B of the pulse encoder is disconnected.

Troubleshooting:

Cause	Verification method	Solution
The encoder phase B is connected improperly.	Check the encoder wiring.	Re-connect the encoder and perform a restart.

E308.2: Phase Z of the pulse encoder disconnected (no alarm reported for the encoder without Z)

Cause:

Phase Z of the pulse encoder is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder phase Z is wired improperly. 2. The encoder type is set improperly. Only phases A and B of the encoder are used.	1. Check whether Z signal is wired properly. 2. Check whether there is Z signal output.	1. Perform wiring again. 2. Re-install the motor and select phase A/B encoder in the encoder configuration interface.

E320.0: braking resistor overload

Cause:

The braking resistor is overloaded.

Troubleshooting:

Cause	Verification method	Solution
The cumulative heat of the braking resistor exceeds its maximum thermal capacity.	Check whether the value of H0b.67 exceeds 100%.	1. Check whether the bus voltage is excessively high, leading to excessively high bleeder current. 2. Check whether the motor is being driven by external force, leading to excessively high bleeder current. 3. Replace the servo drive.

E320.1: Enclosure temperature of the braking resistor excessively high

Cause:

The cumulative heat of the built-in braking resistor is excessive.

Troubleshooting:

Cause	Verification method	Solution
The cumulative heat of the built-in braking resistor is excessive.	Power off and check whether the built-in braking resistor is overheated.	1. Check whether the bus voltage is excessively high, leading to excessively high bleeder current. 2. Check whether the motor is being driven by external force in the reverse direction, leading to excessively high bleeder current. 3. Replace the servo drive.

E321.0: Dynamic brake resistor overload

Cause:

The dynamic braking resistor is overloaded.

Troubleshooting:

Cause	Verification method	Solution
The accumulative heat of the dynamic braking resistor exceeds the maximum thermal capacity of the resistor.	Check whether the value of H0b.98 exceeds 100%.	To avoid excessively high discharge current, prevent the motor from being driven reversely.

E400.0: Main circuit overvoltage

Cause:

The DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold.
200 V servo drive: Normal value: 280 V; Overvoltage threshold: 420 V
400 V servo drive: Normal value: 560 V; Overvoltage threshold: 820 V

Troubleshooting:

Cause	Verification method	Solution
1. The main circuit input voltage is excessively high.	Check the input power supply specifications of the drive and measure whether the input voltage of the main circuit cable (RST) on the drive side meets the following specifications: 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V)	Replace or adjust the power supply according to the specified range.
2. The power supply is unstable or affected by the lightning strike.	Check whether the power supply is unstable, affected by lightning, or complies with the preceding range.	Connect a surge protection device (SPD) and switch on the power supplies of the control circuit and the main circuit. If the fault persists, replace the servo drive.
3. The braking resistor fails.	If a built-in braking 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 braking resistor is used (H02.25 = 1 or 2), measure the resistance of the external braking resistor connected between terminals P⊕ and C. For details, See table "Specifications of the braking resistor" in the user guide.	1. If the resistance is "∞" (infinite), the braking resistor is disconnected internally. 2. If a built-in braking resistor is used, change to use an external braking resistor (H02.25 = 1 or 2) and remove the jumper between terminals P ⊕ and D. Select an external braking resistor of the same resistance and equal or higher power than the built-in one. 3. If an external braking resistor is used, replace with a new one and connect it between terminals P⊕ and C. 4. Set H02.26 (Power of external braking resistor) and H02.27 (Resistance of external braking resistor) to values consistent with the specifications of the external braking resistor used.
4. The resistance of the braking resistor is excessively high, and energy absorption during braking is insufficient.	Measure the resistance of the external braking resistor connected between terminals P⊕ and C. Compare the measured value with the recommended value.	1. Replace with an external braking resistor of recommended resistance, and connect it between terminals P⊕ and C. 2. Set H02.26 (Power of external braking resistor) and H02.27 (Resistance of external braking resistor) to values consistent with the specifications of the external braking resistor used.
5. The motor is in abrupt acceleration/deceleration status. The maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/ deceleration time during operation and measure whether the DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold during deceleration.	After verifying that the input voltage of the main circuit is within the specified range, increase the acceleration/deceleration time if allowed.

Cause	Verification 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: 200 V servo drive: H0b.26 > 420 V 400 V servo drive: H0b.26 > 820 V Measure whether the DC bus voltage between P⊕ and N⊖ is within the normal range and lower than H0b.26.	Contact Inovance for technical support.
7. The servo drive is faulty.	Check whether the fault persists after repeated power cycling of the main circuit.	Replace the servo drive.

E410.0: Main circuit undervoltage

Cause:

The DC bus voltage between terminals P⊕ and N⊕ is lower than the threshold:
200 V servo drive: Normal value: 280 V; Undervoltage threshold: 200 V (180 V for S5R5 models)
400 V servo drive: Normal value: 560 V; Undervoltage threshold: 380V

Troubleshooting:

Cause	Verification method	Solution
1. The power supply of the main circuit is unstable or a power failure occurs. 2. An instantaneous power failure occurs.	Check the input power supply specifications of the drive. Measure whether the input voltage of the main circuit cable on the non-drive side and drive side (RST) meets the following specifications. 200 V drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) All three phases need to be measured.	Increase the power capacity.
3. The power voltage drops during operation.	Check the power input voltage and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and a voltage dip.	Increase the power capacity.
4. A three-phase servo drive is connected to a single-phase power supply, leading to phase loss.	Check the wiring of the main circuit.	Replace the cables and connect the main circuit cables in the correct phase sequence (three-phase: R/S/T).
5. The servo drive is faulty.	Check whether the value of H0b.26 (Bus voltage) is within the following range: 200 V drive: H0b.26 < 200 V 400 V drive: H0b.26 < 380V The fault persists after the main circuit is restarted several times.	Replace the servo drive.

E410.1: Main circuit de-energized

Cause:

Phase loss occurs on the three-phase servo drive.

Troubleshooting:

Cause	Verification method	Solution
The power supply is disconnected during operation.	1. Check the input power specifications of the servo drive. Measure whether the input voltage on the power supply side and the drive side (RST) of the main circuit cable meets the following specifications. 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% All three phases need to be measured. 2. 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. 3. Check whether the value of H0b.26 (Bus voltage) is in the following range: 200 V drive: H0b.26 < 200 V 400 V drive: H0b.26 < 380V. The fault persists after the main circuit is powered off and on repeatedly. 4. Check the wiring of the main circuit.	1. Increase the capacity of the power supply. 2. Replace the servo drive. 3. Replace the cables and connect the main circuit cables (three-phase: RST/L1L2L3) properly.

E420.0: Main circuit phase loss

Cause:

Three-phase input phase loss fault of the drive

Troubleshooting:

Cause	Verification method	Solution
1. The three-phase power cables are not connected well.	Check whether the R/S/T cables on the drive side and cables on the non-drive side are in good condition and connected properly.	Replace the cables and connect the main circuit cables properly.
2. A single-phase power supply is used for a three-phase drive. 3. The three-phase power supply is unbalanced or the voltages of the three phases are excessively low.	Check the input power supply specifications of the drive and check the actual input voltage specifications. Measure whether the input voltage of the main circuit meets the following specifications: 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V) All the three phases need to be measured.	Servo drives of 0.75 kW (H01.10 = 5) can be supplied by single-phase power supplies. If the input voltage is within the specified range, set H0A.00 to 2 (Inhibit power input phase loss fault and alarm). If it exceeds the specified range, replace or adjust the power supply according to the specified range.

E500.0: Motor overspeed

Cause:

The motor speed fed back by the motor exceeds the overspeed threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The U/V/W phase sequence of the motor is incorrect.	Check whether the drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables according to the correct sequence.
2. H0A.08 is set to an improper value.	Check whether the overspeed threshold is lower than the maximum speed needed in actual applications: Overspeed threshold = 1.2 times the maximum motor speed (H0A-08 = 0); Overspeed threshold = H0A-08 (H0A-08 ≠ 0, and H0A-08 < 1.2 times the maximum motor speed).	Reset the overspeed threshold according to the actual mechanical requirement.

Cause	Verification method	Solution
3. The input reference is higher than the overspeed threshold.	Check whether the motor speed corresponding to the input reference exceeds the overspeed fault threshold. Position control mode: In CSP mode, view the gear ratio 6091.01h/6091.02h to check the position reference increment for a single synchronous cycle and convert it to the speed information. In PP mode, view the gear ratio 6091.01h/6091.02h and define the value of 6081h (Profile velocity). In HM mode, view the gear ratio 6091.01h/6091.02h, and define the value of 6099.01h and 6099.02h. Speed control mode: View the gear ratio (6091h), and the values of 60FFh (Target velocity), H06.06 to H06.09 (speed limit), and 607Fh (Maximum profile speed). In torque control mode, view the speed limit defined by H07.17 and check the corresponding speed limit.	Position control mode: In CSP mode, decrease the position reference increment for a single synchronous cycle. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the value of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions. Speed control mode: Decrease the target velocity, speed limit value, gear ratio. In PV mode, increase the speed ramp 6083h and 6084h. In CSV mode, the host controller should add speed ramp processing. Torque control mode: Set the speed limit threshold to a value lower than the overspeed threshold.
4. The motor speed overshoots.	Check whether the speed feedback exceeds the overspeed threshold through the software tool.	Adjust the gain or mechanical operating conditions.
5. The servo drive is faulty.	The fault persists after the drive is powered off and on again.	Replace the servo drive.
6. Encoder data errors occur.	Check whether there is interference, whether the encoder type is incorrect, and whether the encoder parameter settings are incorrect.	1. Take measures to prevent interference, such as installing magnetic ring and connecting shielded cables. 2. Check whether the encoder type is correct. If not, replace it with the correct encoder type. 3. Configure the encoder parameters correctly according to the encoder user guide.
7. The motor type selected is incorrect.	Check whether the motor type is set incorrectly, for example, the linear motor is set to rotary motor or the rotary motor is set to a linear motor.	Replace with the correct motor type or change the value of H00.00 based on the motor used.

E500.1: Speed feedback overflow

Cause:

The FPGA speed measurement overflows.

Troubleshooting:

Cause	Verification method	Solution
1. FPGA internal speed overflows.	Check whether the drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables according to the correct sequence.
2. The motor speed overshoots.	Check whether the speed feedback exceeds the overspeed threshold through the software tool.	Adjust the gain or mechanical operating conditions.
3. The encoder data is incorrect.	Check whether there is interference, whether the encoder type is incorrect, and whether the encoder parameter settings are incorrect.	1. Take measures to prevent interference, such as installing magnetic ring and connecting shielded cables. 2. Check whether the encoder type is correct. If not, replace it with the correct encoder type. 3. Configure the encoder parameters correctly according to the encoder user guide.
4. The motor type is incorrect.	Check whether the motor type is set incorrectly, for example, the linear motor is set to rotary motor or the rotary motor is set to a linear motor.	Replace with the correct motor type or change the value of H00.00 based on the motor used.

E500.2: FPGA position feedback pulse overspeed

Cause:

The MCU has detected that the position feedback increment from the FPGA is excessive.

Troubleshooting:

Cause	Verification method	Solution
1. The MCU has detected that the position feedback increment from the FPGA is excessively large.	Check whether the value of H0b.17 changes abruptly.	Modify the value of H0A.70 (Overspeed threshold), which is 0 by default. Use the maximum speed of the motor as the threshold for excessive feedback increment.
2. The encoder data is incorrect.	Check whether there is interference, whether the encoder type is incorrect, and whether the encoder parameter settings are incorrect.	1. Take measures to prevent interference, such as installing magnetic ring and connecting shielded cables. 2. Check whether the encoder type is correct. If not, replace it with the correct encoder type. 3. Configure the encoder parameters correctly according to the encoder user guide.
3. The motor type selected is incorrect.	Check whether the motor type is set incorrectly, for example, the linear motor is set to rotary motor or the rotary motor is set to a linear motor.	Replace with the correct motor type or change the value of H00.00 based on the motor used.

E602.0: Angle auto-tuning failure

Cause:

Unusual jitter occurs on the encoder feedback during angle auto-tuning.

Troubleshooting:

Cause	Verification method	Solution
1. The mechanical device is stalled. 2. An encoder feedback data error occurs. 3. The U/V/W power cables are connected improperly or disconnected. 4. The drive hardware or the motor is faulty.	1. Try to Rotate a stopped motor to check whether the mechanical device is stalled. 2. After rotating the motor, check whether the encoder feedback is normal by observing whether the encoder generates feedback, whether the feedback data is consecutive, and whether the observed displacement is consistent with actual displacement through the oscilloscope. 3. Check the wiring of U/V/W power cables and test whether they are disconnected with a multimeter. 4. If the preceding fault causes are ruled out, contact the manufacturer to locate the drive or motor fault.	1. After confirming the mechanical device has been stalled, rectify the stall causes and perform angle auto-tuning (phase sequence auto-tuning) again. 2. After confirming the encoder feedback data is wrong, replace the encoder and perform angle auto-tuning (phase sequence auto-tuning) again. 3. After confirming the U/V/W cables are connected improperly or disconnected, perform wiring and angle auto-tuning (phase sequence auto-tuning) again. 4. After preceding causes are ruled out, contact the manufacturer to locate the drive or motor fault.

E602.1: Angle auto-tuning overtravel

Cause:

Angle auto-tuning overtravel

Troubleshooting:

Cause	Verification method	Solution
Excessive displacement occurs during angle auto-tuning, leading to overtravel. 1. The auto-tuning parameters does not match the load characteristics, leading to overtravel due to excessive impact during auto-tuning. 2. An encoder feedback data error occurs, leading to false overtravel alarm.	1. Observe whether the displacement is excessive to check whether the overtravel alarm is caused by improper setting of auto-tuning parameters. 2. Observe whether the encoder feedback action is consecutive, whether the displacement is consistent with actual displacement, and whether the encoder feedback data is normal through the oscilloscope.	1. If excessive displacement occurs during auto-tuning, prevent the overtravel alarm by adjusting auto-tuning parameters properly. Reduce the current rising slope [H32.21 for closed-loop pre-positioning] [H32.31 for position lock] or the maximum auto-tuning current [H32.20 for closed-loop pre-positioning] [H32.30 for position lock]. 2. If an encoder feedback data error occurs, perform angle auto-tuning/phase sequence auto-tuning again after replacing the encoder.

E602.2: U/V/W phase sequence reversed

Cause:

An incorrect U/V/W phase sequence is detected during angle auto-tuning.

Troubleshooting:

Cause	Verification method	Solution
The drive indicates the U/V/W cables are wired improperly, preventing the motor from getting out of control.	Check whether U/V/W phases of the motor are wired correctly through phase sequence auto-tuning.	1. After adjusting the phase sequence through phase sequence auto-tuning, perform angle auto-tuning again. 2. Exchange any two of U/V/W phases manually and perform angle auto-tuning again.

E602.3: Excessive encoder runout during angle auto-tuning

Cause:

Excessive encoder feedback fluctuation during angle auto-tuning

Troubleshooting:

Cause	Verification method	Solution
The encoder feedback data fluctuates excessively.	Check whether the data changes normally when the encoder is in the static state.	1. Check the wiring of the encoder. 2. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. 3. Manually increase the values of H32.14/H32.16 for angle auto-tuning through inching or the values of H32.34/H32.36 for angle auto-tuning through position lock.

E602.4: Angle auto-tuning timeout

Cause:

Angle auto-tuning timeout

Troubleshooting:

Cause	Verification method	Solution
The angle auto-tuning process lasts for an excessively long time, leading to a timeout alarm (angle auto-tuning not done within 30s). The causes may be: 1. External interference exists (such as vibration generated by other devices), leading to angle auto-tuning failure. 2. The encoder feedback data characteristics are inadequate, disturbed, or abnormal, leading to angle auto-tuning failure.	1. Check whether the machine is affected by other devices that generate vibration. 2. Check whether the encoder generates feedback, whether the feedback data is consecutive, whether the displacement is consistent with the actual displacement, and whether the data changes during standby through the oscilloscope in the software tool.	1. Check the wiring of the encoder to ensure the shielded cable is connected properly. If the encoder data is abnormal, replace the encoder and perform angle auto-tuning or phase sequence auto-tuning again. 2. Adjust angle auto-tuning parameters properly to reduce the threshold for angle auto-tuning completion.

E602.5: Angle auto-tuning failed and Z signal not found

Cause:

Angle auto-tuning failed and Z signal not found

Troubleshooting:

Cause	Verification method	Solution
1. The encoder is configured improperly. The actual motor encoder has no Z signal. 2. The polarity of the Z signal is configured improperly. 3. The encoder feedback data is abnormal. There is no Z signal.	1. Check whether the motor has Z signal. 2. Check the configuration of Z signal polarity through bit13 of H00.26. 3. Check whether the encoder generates feedback, whether the feedback data is consecutive, and whether the displacement is consistent with the actual displacement through the oscilloscope in the software tool.	1. Check the wiring of the encoder to ensure the shielded cable is connected properly. Check whether the Z signal polarity is configured properly. 2. If the encoder data is abnormal, replace the encoder and perform angle auto-tuning again.

E602.6: Angle auto-tuning not convergent

Cause:

Angle auto-tuning not convergent

Troubleshooting:

Cause	Verification method	Solution
1. The angle auto-tuning is not convergent due to external disturbance, such as vibration of other components. 2. Angle auto-tuning is not convergent due to improper auto-tuning parameter setting.	1. Check whether the machine is affected by other vibration sources. 2. Check whether the angle gain is so high that the angle auto-tuning is not convergent.	1. Check whether external electromagnetic interference exists. Install a magnetic ring and connect the shielded cable. 2. For the position lock mode, decrease the angle gain (H32.37) manually. 3. For the inching mode, decrease the action judgment threshold (H32.13/H32.15) manually or increase the standstill threshold (H32.14/H32.16).

E605.0: Motor overspeed upon S-ON

Cause:

The motor speed exceeds the rated speed when the servo drive in size A/B is enabled.

Troubleshooting:

Cause	Verification method	Solution
The motor speed exceeds the rated speed when the servo drive is switched on.	Check whether the drive is enabled when the motor is being driven.	Enable the drive when the motor is at standstill.

E612.0: Motor stalled during phase sequence auto-tuning

Cause:

Stall detected in phase sequence auto-tuning

Troubleshooting:

Cause	Verification method	Solution
1. The mechanical device is stalled. 2. An encoder feedback data error occurs. 3. The U/V/W power cables are connected improperly or disconnected. 4. The drive hardware or the motor is faulty.	1. Try to Rotate a stopped motor to check whether the mechanical device is stalled. 2. After rotating the motor, check whether the encoder feedback is normal by observing whether the encoder generates feedback, whether the feedback data is consecutive, and whether the observed displacement is consistent with actual displacement through the oscilloscope. 3. Check the wiring of U/V/W power cables and test whether they are disconnected with a multimeter. 4. If the preceding fault causes are ruled out, contact the manufacturer to locate the drive or motor fault.	1. After confirming the mechanical device has been stalled, rectify the stall causes and perform angle auto-tuning (phase sequence auto-tuning) again. 2. After confirming the encoder feedback data is wrong, replace the encoder and perform angle auto-tuning (phase sequence auto-tuning) again. 3. After confirming the U/V/W cables are connected improperly or disconnected, perform wiring and angle auto-tuning (phase sequence auto-tuning) again. 4. After preceding causes are ruled out, contact the manufacturer to locate the drive or motor fault.

E612.1: Overtravel during phase sequence auto-tuning

Cause:

Overtravel in phase sequence auto-tuning

Troubleshooting:

Cause	Verification method	Solution
Excessive displacement occurs during angle auto-tuning, leading to overtravel. 1. The auto-tuning parameters does not match the load characteristics, leading to overtravel due to excessive impact during auto-tuning. 2. An encoder feedback data error occurs, leading to false overtravel alarm.	1. Observe whether the displacement is excessive to check whether the overtravel alarm is caused by improper setting of auto-tuning parameters. 2. Observe whether the encoder feedback action is consecutive, whether the displacement is consistent with actual displacement, and whether the encoder feedback data is normal through the oscilloscope.	1. If excessive displacement occurs during auto-tuning, prevent the overtravel alarm by adjusting auto-tuning parameters properly. Reduce the current rising slope manually [H32.21]. 2. If an encoder feedback data error occurs, perform angle auto-tuning/phase sequence auto-tuning again after replacing the encoder.

E612.3: Excessive encoder runout in phase sequence auto-tuning

Cause:

Excessive encoder change in angle auto-tuning

Troubleshooting:

Cause	Verification method	Solution
The encoder feedback data fluctuates excessively.	Check whether the data changes normally when the encoder is in the static state.	1. Check the wiring of the encoder. 2. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. 3. Increase the values of H32.24 and H32.25 manually.

E612.4: Phase sequence auto-tuning timeout

Cause:

Phase sequence auto-tuning failed, leading to auto-tuning timeout

Troubleshooting:

Cause	Verification method	Solution
The angle auto-tuning process lasts for an excessively long time, leading to a timeout alarm (angle auto-tuning not done within 30s). This may be caused by: 1. External interference exists (such as vibration generated by other devices), leading to angle auto-tuning failure. 2. The encoder feedback data characteristics are inadequate, disturbed, or abnormal, leading to angle auto-tuning failure.	1. Check whether the machine is affected by other devices that generate vibration. 2. Check whether the encoder generates feedback, whether the feedback data is consecutive, whether the displacement is consistent with the actual displacement, and whether the data changes during standby through the oscilloscope in the software tool.	1. Check the wiring of the encoder to ensure the shielded cable is connected properly. If the encoder data is abnormal, replace the encoder and perform phase sequence auto-tuning again. 2. Adjust phase sequence auto-tuning parameters properly to reduce the threshold for phase sequence auto-tuning completion.

E613.0: Resistor inductance auto-tuning timeout

Cause:

Resistance/Inductance auto-tuning timeout

Troubleshooting:

Cause	Verification method	Solution
The resistor inductance auto-tuning is not done within 30 s, leading to a timeout alarm. 1. The current feedback cannot reach the reference value because the motor power cables are disconnected or in poor contact.	Check whether the motor power cables are disconnected or in poor contact.	1. Check the motor power cables and ensure that they are connected properly.

E619.0: Absolute accuracy compensation parameter setting error

Cause:

The accuracy compensation parameter setting is improper.

Troubleshooting:

Cause	Verification method	Solution
1. Set the accuracy compensation interval (H33.64) to 0. 2. Inovance communication encoder DDL: 1. The distance from the mechanical home to the calibrated home exceeds the upper limit of Inovance communication-type encoder (encoder unit 2^{34}). 2. The length of the calibration exceeds the upper limit of the Inovance communication-type encoder (encoder unit 2^{34}). 3. The homing mode record is incorrect. The value of H33.70 is not within the values of {-2, -1, 1, 2, 4, 6, 17, 18, 24, 28, 33, 34}.	1. Check whether H33.64 is set to 0. 2. Check whether the distance between the mechanical home and the calibrated home (start position) exceeds the limit (encoder unit 2^{34}). 3. Check whether the value of H33.70 is within the values of {-2, -1, 1, 2, 4, 6, 17, 18, 24, 28, 33, 34}.	1. Set a correct compensation point interval. 2. Set a correct distance from the mechanical home to the calibrated home. 3. Set H33.70 to a proper value.

E619.1: Absolute accuracy compensation overflow

Cause:

1. The input quadrature pulse frequency (quadrupled) is higher than 1 ÷ (H33.74 × 25 ns).
2. The pulse count per-cycle compensation is higher than 1.

Troubleshooting:

Cause	Verification method	Solution
1. The input quadrature pulse frequency (quadrupled) is higher than 1 ÷ (H33.74 × 25 ns). 2. The pulse count per-cycle compensation is higher than 1.	1. Check the motor speed upon occurrence of the alarm. 2. View the compensation list to check whether a length longer than one index range exists.	1. Reduce the operating speed of motor. 2. Load the correct error compensation list.

E620.0: Motor overload

Cause:

Heat accumulation of the motor reaches the fault threshold.

Troubleshooting:

Cause	Verification method	Solution
1. Wiring of the motor and encoder is incorrect or in poor contact.	Check the wiring between the servo drive, servo motor and the encoder according to the correct "wiring diagram".	Connect cables according to the correct wiring diagram. Preferably use the cables provided by Inovance. When customized cables are used, prepare and connect the cables according to the hardware wiring instructions.
2. The load is excessive. The motor keeps outputting effective torque that higher than the rated torque for a long time.	Check the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the drive keeps exceeding 100.0%.	Use a drive of higher capacity and a matching motor. Alternatively, reduce the load and increase the acceleration/deceleration time.

Cause	Verification method	Solution
3. Acceleration/deceleration is frequent, or the load inertia is large.	Calculate the mechanical inertia ratio or perform inertia auto-tuning and view H08.15 (Inertia ratio). Confirm the single-shot operation cycle when the motor runs cyclically.	Increase the acceleration/ deceleration time for single-shot operation.
4. The gain is improper, or the stiffness is excessively high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust the gains.
5. The set servo drive model or motor model are incorrect.	View the motor model in H00.00 and drive model in H01.10.	Check the servo drive nameplate and set the servo drive model (H01.10) and motor model properly according to section "Servo Drive Model and Nameplate" in SV670N-INT Series Servo Drive Hardware Guide.
6. The motor is stalled due to mechanical problems, resulting in excessive load during operation.	Check the reference and motor speed (H0b.00) through the software tool or panel: Reference in position control mode: H0b.13 (Input position reference counter); Reference in speed control mode: H0b.01 (Speed reference); Reference in torque control mode: H0b.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Rectify mechanical problems.
7. The servo drive is faulty.	The fault persists after the drive is power-cycled.	Replace the servo drive.

E620.1: Motor overload in overload current limit mode

Cause:

Motor overload in overload current limit mode

Troubleshooting:

Cause	Verification method	Solution
1. The load is too heavy and the effective torque output by the motor remains above the rated torque. 2. Acceleration/deceleration is too frequent or the load inertia is too large. 3. The motor and encoder are wired improperly. 4. The gain is improper or the stiffness level is too high. 5. The motor is stalled due to mechanical factors, resulting in overload during operation. 6. The drive is faulty.	Confirm the overload characteristics of the servo drive or servo motor. Check whether the average load ratio (H0b.12) remains above 100.0%.	1. Replace with a drive of larger capacity and a matching motor, or reduce the load and increase the acceleration/deceleration time.

E621.0: Overload current limit torque reached

Cause:

Overload current limit torque reached

Troubleshooting:

Cause	Verification method	Solution
1. The load is too heavy and the effective torque output by the motor remains above the rated torque. 2. Acceleration/deceleration is too frequent or the load inertia is too large. 3. The motor and encoder are wired improperly. 4. The gain is improper or the stiffness level is too high. 5. The motor is stalled due to mechanical factors, resulting in overload during operation. 6. The drive is faulty.	1. Confirm the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive remains above 100.0%. 2. Check whether H32.78 is set to an excessively high value.	1. Replace with a drive of larger capacity and a matching motor, or reduce the load and increase the acceleration/deceleration time.

E630.0: 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.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss, open circuit, or incorrect phase sequence occurs on the servo drive.	Perform a motor trial run without load and check cable connections and the phase sequence with a multimeter.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The motor parameter settings (especially the number of pole pairs) are improper, motor angle auto-tuning is not performed, or the motor power is higher than the drive power.	Read parameters in group H00 to check whether the number of pole pairs are set properly. Perform angle auto-tuning on the motor several times and check whether the value of H00.28 is consistent during angle auto-tuning. Check whether the motor power matches the drive power.	Modify the motor parameter values and replace with a drive of the same power.

Cause	Verification method	Solution
3. The references set through communication are disturbed.	Check whether jitter occurs on the references sent from the host controller and whether communication is disturbed.	Check whether communication between the host controller and the drive is disturbed.
4. The motor is stalled due to mechanical problems.	Check the reference and motor speed (H0B.00) through the software tool or panel: Reference in position control mode: H0B.13 (Input position reference counter); Reference in speed control mode: H0B.01 (Speed reference); Reference in torque control mode: H0B.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode. Check the current feedback (torque reference) waveform.	Check whether any mechanical part is stuck or eccentric.

E640.0: IGBT junction temperature excessively high

Cause:

The IGBT temperature reaches the fault threshold defined by H0A.18.

Troubleshooting:

Cause	Verification method	Solution
1. The ambient temperature is excessively high. 2. The drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault log (set H0b.33 and view H0b.34) to check whether an overload fault/alarm is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	Improve the cooling conditions of the drive to lower down the ambient temperature. Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. 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 installation direction and clearance between servo drives are improper.	Check whether the drive is installed properly.	Install the drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists upon restart five minutes after power-off.	Replace the servo drive.

E640.1: Flywheel diode junction temperature excessively high

Cause:

The temperature of the flywheel diode reaches the fault threshold defined by H0A.18.

Troubleshooting:

Cause	Verification method	Solution
1. The ambient temperature is excessively high. 2. The drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault log (set H0b.33 and view H0b.34) to check whether an overload fault/alarm is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	Improve the cooling conditions of the drive to lower down the ambient temperature. Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. 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 installation direction and clearance between servo drives are improper.	Check whether the drive is installed properly.	Install the drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists upon restart five minutes after power-off.	Replace the servo drive.

E650.0: Heatsink over-temperature

Cause:

The temperature of the servo drive power module is higher than the over-temperature threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The ambient temperature is excessively high. 2. The drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault log (set H0b.33 and view H0b.34) to check whether an overload fault/alarm is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	Improve the cooling conditions of the drive to lower down the ambient temperature. Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. 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 installation direction and clearance between servo drives are improper.	Check whether the drive is installed properly.	Install the drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists upon restart five minutes after power-off.	Replace the servo drive.

E660.0: Motor over-temperature

Cause:

The temperature of the air-cooled motor is too high.

Troubleshooting:

Cause	Verification method	Solution
The temperature of the air-cooled motor is excessively high.	Measure whether the temperature of the air-cooled motor is excessively high.	Cool the motor down.

E661.0: STune failure

Cause:

During STune tuning, gain reduction has reached the lower limit:
Position loop gain < 5;
Speed loop gain < 5;
Model loop gain < 10.

Troubleshooting:

Cause	Verification method	Solution
During STune tuning, gain reduction has reached the lower limit: Position loop gain < 5; Speed loop gain < 5; Model loop gain < 10.	Check whether vibration resonance is properly suppressed in the system. The torque resonance amplitude exceeds the setpoint of H09.11.	1. Set the notch manually when vibration cannot be suppressed automatically. 2. Modify the electronic gear ratio to improve the command resolution, the command filter time constant in the "Parameter configuration" interface. 3. Check the machine for cyclic fluctuation. 4. Set H09.58 to 1 to clear resonance suppression parameter and perform STune again.

E662.0: ETune failure

Cause:

Resonance during ETune operation cannot be suppressed.

Troubleshooting:

Cause	Verification method	Solution
Resonance during ETune operation cannot be suppressed.	Check whether unusual noise or torque fluctuation occurs during operation.	1. When vibration cannot be suppressed automatically, set the notch manually. 2. Modify the electronic gear ratio to improve the reference resolution, or increase the reference filter time properly in the parameter configuration interface. 3. Increase the value of H09.11 properly. 4. Check whether the machine fluctuates periodically. 5. Check whether positioning threshold is excessively low. Increase the reference acceleration/deceleration time.

E664.0: Excessive resonance

Cause:

Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H09.54.

Troubleshooting:

Cause	Verification method	Solution
Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H09.54.	Check whether unusual noise or torque fluctuation occurs during operation.	1. Check whether the inertia ratio or loop gain parameters are set properly. 2. Check whether resonance suppression parameters are set properly. 3. Increase the value of H09.54 or set this parameter to 0 to hide this function.

E720.0: Encoder interface selected improperly

Cause:

The drive does not support the present encoder interface.

Troubleshooting:

Cause	Verification method	Solution
The drive does not support the present encoder interface.	Check whether H32.01 and H0F.06 are set to correct values. If the gantry function is enabled, check whether the gantry function is in conflict with the master encoder or fully closed-loop encoder setting.	1. Check whether the signal cable required by current encoder interface solution exceeds the upper limit of an individual interface. 2. Change the values of H32.01 and H0F.01.

E731.0: Encoder multi-turn position data loss

Cause:

Encoder multi-turn position data loss

Troubleshooting:

Cause	Verification method	Solution
1. The primary encoder battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set H0d.20 to 1 to clear the fault.
2. The primary encoder battery voltage is lower than 2.9 V.	Measure the battery voltage.	Replace the battery with a new one that provides matching voltage.
3. The primary encoder is disturbed by a strong magnetic field.	Check whether the encoder is in an environment with a strong magnetic field.	Remove the strong magnetic field source and set H0d.20 to 1.

E733.0: Encoder multi-turn counting error

Cause:

An encoder multi-turn counting error occurs.

Troubleshooting:

Cause	Verification method	Solution
The encoder is faulty.	Set H0d.20 to 2 to clear the fault, but E733.0 persists after a power cycle.	Replace the motor.

E735.0: Encoder multi-turn count overflow

Cause:

A multi-turn counting overflow occurs on the absolute encoder.

Troubleshooting:

Cause	Verification method	Solution
The number of forward revolutions exceeds 32767 or the number of reverse revolutions exceeds 32768.	Check whether the value of H0b.70 (Number of absolute encoder revolutions) is 32767 or 32768 when the servo drive works in the absolute linear mode (H02.01 = 1).	Set H0d.20 to 2 to power on again. Perform homing if necessary.

E740.0: Absolute encoder communication timeout

Cause:

The real-time communication timeout fault state of the encoder has been set for 100 consecutive current loop cycles.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable is abnormal, disconnected, or in poor contact. 2. The motor type is set incorrectly. 3. The encoder is damaged.	1. Check the wiring of the encoder and power on the drive again. Check whether H30.16 exceeds 100. 2. Check whether the motor type is set properly. 3. Replace the encoder.	1. After checking that the encoder is connected properly, restart the drive. 2. Check whether the encoder type is consistent with the setting. After checking that the motor type is set correctly, restart the drive. 3. Replace the encoder for cross-verification.

E740.2: Absolute encoder error

Cause:

This fault is caused by encoder communication timeout, stop bit error, CRC error, data field error, or position counter error during non-real-time communication (initialization upon power-on or during reading ROM).
Or, this fault is caused by N (defined by H0A.50) errors that occurred consecutively during real-time communication.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable is abnormal or communication with the encoder is disturbed. 2. The data bit of the third-party encoder is set improperly.	1. Check whether the value of H0b.28 is not 0. Check whether the signal transmission process is disturbed. 2. Check the motor encoder user guide and confirm that the data bits (H00.43/H00.44) are set correctly.	1. Ensure that the drive and motor are grounded properly. You can wind the encoder cable on a magnetic ring to reduce interference. Use a twisted pair to connect the encoder. 2. Check the encoder user guide and set a correct encoder data length.

E740.3: Absolute encoder single-turn calculation error

Cause:

An internal fault occurs on the encoder.

Troubleshooting:

Cause	Verification method	Solution
An internal fault occurs on the encoder.	Check whether bit7 of H0b.28 is set to 1.	1. Check whether encoder version (H00.04) is set properly. 2. Check whether the encoder cable is proper. 3. Replace the motor.

E740.6: Encoder write fault

Cause:

The attempt to write the encoder data fails.

Troubleshooting:

Cause	Verification method	Solution
1. The attempt to write position offset after angle auto-tuning/ phase sequence auto-tuning failed. 2. The attempt to write auto-tuned parameters after resistance/ inductance auto-tuning failed. 3. The attempt to write the current loop gain after current loop auto-tuning failed.	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 certain position, power on the system several times, and observe the change of H0b.17 (Electrical angle). The electrical angle deviation should be within ±30° when the motor position does not change.	Use 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.

E740.9: Encoder data transmission delay too long

Cause:

The set encoder data transmission delay exceeds the time of one current loop cycle.

Troubleshooting:

Cause	Verification method	Solution
1. H01.59 is set to an excessively high value. 2. The number of encoder data bits is excessive.	Power off and restart the drive.	1. Reduce the value of H01.59. 2. Replace with an encoder with lower number of bits.

E744.0: Absolute encoder communication timeout

Cause:

Communication timeout occurs on the absolute encoder.

Troubleshooting:

Cause	Verification method	Solution
The communication between the servo drive and the encoder times out.	Check the wiring of the encoder. After clearing the fault source, reset the fault.	1. Check whether the values of H30.16 and H30.18 are excessively high. 2. Check the wiring of the encoder.

E744.2: Absolute encoder error

Cause:

A communication error occurs on the RX side of the encoder.

Troubleshooting:

Cause	Verification method	Solution
An error occurs on the communication between the servo drive and the encoder due to disturbance.	Check whether the shielded cable of the encoder is connected properly. After the fault source is cleared, reset the fault.	1. Check whether the value of H30.17 is excessively high. 2. Check whether the encoder cable is connected properly. 3. Check whether the servo drive and motor are grounded properly. You can wind the encoder cable onto the magnetic ring to reduce interference.

E755.0: Nikon encoder communication fault

Cause:

Nikon encoder communication failure

Troubleshooting:

Cause	Verification method	Solution
An error occurs on the communication between the drive and encoder.	Check whether the shielded cable of the encoder is connected properly. After the fault source is cleared, reset the fault.	1. Check whether the value of H30.17 is excessively high. 2. Check whether the encoder cable is connected properly. 3. Check whether the servo drive and motor are grounded properly. You can wind the encoder cable onto the magnetic ring to reduce interference.

E760.0: Encoder over-temperature

Cause:

The temperature of the absolute encoder is too high.

Troubleshooting:

Cause	Verification method	Solution
The temperature of the absolute encoder is too high.	Measure the encoder or motor temperature.	Switch off the S-ON signal to wait for the encoder to cool down.

E765.0: Third-party encoder over-temperature or overspeed

Cause:

Encoder over-temperature or overspeed

Troubleshooting:

Cause	Verification method	Solution
Motor temperature excessively high	Check whether the ambient temperature or the average load rate is excessively high.	Switch off the S-ON signal to wait for the encoder to cool down.

E770.0: Fully-closed input phase A disconnected

Cause:

The phase A differential voltage input is disconnected in closed-loop control.

Troubleshooting:

Cause	Verification method	Solution
The phase A differential voltage input is disconnected in closed-loop control.	Measure whether the differential voltage of phase A is lower than 2.5 V.	Adjust the fully-closed loop phase A input voltage.

E770.1: Fully-closed loop input phase B disconnected

Cause:

The phase B differential voltage input is disconnected in closed-loop control.

Troubleshooting:

Cause	Verification method	Solution
The phase B differential voltage input is disconnected in closed-loop control.	Measure the phase B differential voltage to check whether it is below 2.5 V.	Adjust the fully-closed loop phase B input voltage.

E770.2: Fully-closed loop input phase Z disconnected

Cause:

The phase Z differential voltage input is disconnected in closed-loop control.

Troubleshooting:

Cause	Verification method	Solution
The phase Z differential voltage input is disconnected in closed-loop control.	Measure the phase Z differential voltage to check whether it is below 2.5 V.	Adjust the fully-closed loop phase Z input voltage.

E939.0: Motor power cable disconnected

Cause:

At least one phase of the motor power cables is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. One or two phases of the motor power cables (U/V/W) are disconnected. 2. The current loop gain is set improperly.	1. Check the wiring of U/V/W power cables. 2. The power cable is not disconnected, and current feedback and torque reference following errors occur. The fault can be cleared after inductance resistance auto-tuning and current loop auto-tuning are performed.	1. Check whether the power cables are disconnected or in poor contact. Re-connect the power cables. 2. Replace the motor. 3. Perform inductance resistance auto-tuning and current loop auto-tuning again.

EA33.0: Encoder read/write check error

Cause:

Internal parameters of the encoder are abnormal.

Troubleshooting:

Cause	Verification method	Solution
1. The serial incremental encoder cable is disconnected or connected loosely.	Check the wiring.	Check whether the encoder cables are connected incorrectly, disconnected, or in poor contact. If the motor cables and encoder cables are bundled together, separate them.
2. The attempt to read/write bus incremental encoder parameters failed.	If the fault persists after the drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

EA34.0: Hall state error

Cause:

Hall signal outputs all high or low

Troubleshooting:

Cause	Verification method	Solution
Hall signal outputs all high or low	Check whether the Hall is wired properly. Sample the Hall state with the oscilloscope in the software tool. Rotate the motor rotor to observe whether the Hall state ranges from 0 or 7.	1. Check the U/V/W wiring of the Hall. If the fault persists after repeated restart, the Hall unit is faulty. In this case, replace the Hall unit. 2. Check whether the shield of the encoder is connected. 3. If a certain phase of the Hall is connected improperly, modify H32_55 to adjust the active state of the single-phase level of the Hall.

EA34.1: Dynamic Hall auto-tuning error

Cause:

Dynamic Hall auto-tuning error

Troubleshooting:

Cause	Verification method	Solution
An electrical angle error is detected during dynamic Hall auto-tuning.	1. Check whether the motor rotates properly. 2. Check whether the Hall signal output corresponds to the electrical angle change. 3. Check whether the Hall function is enabled for the motor without Hall signal. 4. Check whether the Hall element is wired properly.	1. Ensure the motor can move by single side, without being affected by limit. 2. After checking parameters are set properly, test whether the Hall signal changes every time the electrical angle changes by nearly 60 degrees. If not, the Hall signal output is abnormal. In this case, replace the Hall components. 3. Check whether the motor is equipped with the Hall function. 4. Check whether Hall is wired properly.

EA34.2: Static Hall auto-tuning error

Cause:

Static Hall auto-tuning error

Troubleshooting:

Cause	Verification method	Solution
Static Hall auto-tuning cannot be enabled.	1. Check whether the motor is equipped with an incremental encoder . 2. Check whether H32-62 is set to 1 when H0A13 is set to 6.	1. Static Hall auto-tuning is supported only by the motor equipped with an incremental encoder. 2. Perform dynamic Hall auto-tuning again when H32-62 is not set to 1 but H0A.13 is set to 6.

EB00.0: Excessive position deviation

Cause:

The position deviation is larger than the value of 6065h in position control mode.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W output cables or encoder cables are disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.

Cause	Verification method	Solution
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or panel: Reference in position control mode: H0b.13 (Input position reference counter) Reference in speed control mode: H0b.01 (Speed reference) Reference in torque control mode: H0b.02 (Internal torque reference) Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is excessive.	Position control mode: In CSP mode, check the gear ratio (6091.01h/6091.02h) to determine the position reference increment for an individual synchronization period and convert it to speed. In PP mode, check the gear ratio (6091.01h/6091.02h) and determine the value of 6081h (Profile velocity). In HM mode, check the gear ratio (6091.01h/6091.02h) and determine 6099.01h and 6099.02h.	In CSP mode, decrease the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the values of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of 6065h is excessively low relative to the operating conditions.	Check whether 6065h is set to an excessively low value.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB00.1: Position deviation overflow

Cause:

Deviation of the position calculated by the drive is excessive.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W output cables or encoder cables are disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or panel: References in the position control mode: H0b.13 (Input position reference counter) References in speed control mode: H0b.01 (Speed reference) References in torque control mode: H0b.02 (Internal torque reference) Check whether the operation reference is not 0, but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is excessive.	Position control mode: In CSP mode, check the gear ratio (6091.01h/6091.02h) to determine the position reference increment for an individual synchronization period and convert it to speed. In PP mode, check the gear ratio (6091.01h/6091.02h) and determine the value of 6081h (Profile velocity). In HM mode, check the gear ratio (6091.01h/6091.02h) and determine 6099.01h and 6099.02h.	In CSP mode, decrease the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the values of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of 6065h is excessively low relative to the operating conditions.	Check whether 6065h is set to an excessively low value.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB01.1: Individual position reference increment too large

Cause:

The incremental distance to the target position is excessively large.

Troubleshooting:

Cause	Verification method	Solution
The target position increment is too large.	Check the variation between two adjacent target positions by using the software tool.	1. Check whether the maximum motor speed fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profiled reference speed. If not, replace the servo motor. 2. Before switching the modes or switching on the servo drive, check whether the target position is aligned with current position feedback. 3. The communication time sequence of the host controller is abnormal, leading to errors in the data received by slave. Check the communication time sequence of the host controller.

EB01.2: Excessive position reference increment persisted

Cause:

The target position increment is excessively large for a long time.

Troubleshooting:

Cause	Verification method	Solution
The target position increment is excessively large for a long time.	Check the variation between two adjacent target positions by using the software tool.	1. Check whether the maximum motor speed fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profiled reference speed. If not, replace the servo motor. 2. Before switching the modes or switching on the servo drive, check whether the target position is aligned with current position feedback. 3. The communication time sequence of the host controller is abnormal, leading to errors in the data received by slave. Check the communication time sequence of the host controller.

EB01.3: Reference overflow

Cause:

The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.

Troubleshooting:

Cause	Verification method	Solution
The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.	Check whether the host controller keeps sending commands after the overtravel alarm is reported by the servo drive.	1. Detect the servo limit signal (bit0 and bit1 of 60FDh recommended) through the host controller. 2. The host controller stops transmitting the limit direction reference after detecting the active servo limit signal.

EB02.0: Excessive position deviation in fully closed-loop mode

Cause:

The absolute value of position deviation in fully closed-loop mode exceeds the value of H0F.08 (Excessive position deviation threshold in fully closed-loop mode).

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W cables or internal/external encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or panel: Reference in position control mode: H0b.13 (Input position reference counter); Reference in speed control mode: H0b.01 (Speed reference); Reference in torque control mode: H0b.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The input pulse frequency is high.	When the pulse reference is used as the position reference source, check whether the pulse frequency is excessively high or whether the acceleration/deceleration time is set to 0 or an excessively low value.	Reduce the position reference frequency or the electronic gear ratio. If position pulses are outputted through the host controller, you can set the acceleration/deceleration time through the host controller directly. If not, increase the values of H05.04 and H05.06.

Cause	Verification method	Solution
6. The value of H0F.08 (Threshold of excessive position deviation) is excessively low under current operating conditions.	Check whether the value of H0F.08 is excessively low.	Increase the setpoint of H0F.08.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB02.1: Fully closed-loop position deviation overflow

Cause:

The absolute value of the fully closed-loop position deviation is greater than 2^{31}.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W cables or encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or panel: Reference in position control mode: H0b.13 (Input position reference counter); Reference in speed control mode: H0b.01 (Speed reference); Reference in torque control mode: H0b.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.

Cause	Verification method	Solution
5. The position reference increment is excessive.	Position control mode: In IP/CSP mode, view the gear ratio 6091.01h/6091.02h to check the position reference increment for a single synchronous cycle and convert it to the speed information. In PP mode, view the gear ratio 6091.01h/6091.02h and define the value of 6081h (Profile velocity). In HM mode, view the gear ratio 6091.01h/6091.02h, and define the value of 6099.01h and 6099.02h.	In IP/CSP mode, decrease the position reference increment for a single synchronous cycle. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the value of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of H0F.08 (Threshold of excessive position deviation) is excessively low under current operating conditions.	Check whether 6065h is set to an excessively low value.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB03.0: Electronic gear ratio beyond the limit - H05.02

Cause:

The electronic gear ratio (H05.02) exceeds the limit: (0.001, 4000 × Encoder resolution ÷ 10000).

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio converted by H05.02 exceeds the maximum gear ratio or is lower than the minimum gear ratio.	Check whether the electronic gear ratio converted by H05.02 is within the range of 0.001–4000 × Encoder resolution ÷ 10000.	Change the value of H05.02.

EB03.1: Electronic gear ratio 1 beyond the limit

Cause:

The electronic gear ratio 1 exceeds the limit: (0.001 to 4000 × Encoder resolution/10000).

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio 1 exceeds the maximum gear ratio or is lower than the minimum gear ratio.	Check if the electronic gear ratio 1 is within the range of 0.001–4000 × Encoder resolution ÷ 10000.	Change the values of H05.07 and H05.09.

EB03.2: Electronic gear ratio 2 beyond the limit

Cause:

The electronic gear ratio 2 exceeds the limit: (0.001–4000 × Encoder resolution÷10000).

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio 2 exceeds the maximum gear ratio or is lower than the minimum gear ratio.	Check whether electronic gear ratio 2 is within the range of 0.001–4000 × Encoder resolution ÷ 10000.	Change the values of H05.11 and H05.13.

EB05.0: Excessive static error

Cause:

When the motor is at standstill, the motor moves beyond the set threshold for a period of time.

Troubleshooting:

Cause	Verification method	Solution
When the motor is at standstill, the motor moves beyond the set threshold for a period of time.	Check whether the motor moves beyond the set threshold when it is at standstill.	Check whether H13.12 and H13.13 are set to proper values.

ED02.0: Modbus communication timeout

Cause:

Modbus communication timeout

Troubleshooting:

Cause	Verification method	Solution
Modbus communication timeout	Increase the value of H0E.83.	Determine the Modbus access cycle by frame capture.

EE08.0: Synchronization (SYNC) signal loss

Cause:

The SYNC signal is turned off when the EtherCAT network is in the OP state.

Troubleshooting:

Cause	Verification method	Solution
1. The sync signal is not generated due to hardware errors.	Check whether the sync signal cycle is 0 using the oscilloscope in the software tool.	Replace the servo drive. Contact Inovance for maintenance.
2. The data received by the slave is abnormal during synchronous communication.	Check whether the communication cable is shielded twisted pairs. Check whether the drive is grounded properly. Check whether the network port of the drive is damaged.	Use shielded twisted pair cables. Connect cables according to wiring instructions. Check the network connection status through the first LED.

Cause	Verification method	Solution
3. The data sent by the master is abnormal during synchronous communication.	The synchronization clock of the host controller is not activated. The synchronization clock error of the host controller is excessively high.	Measure the synchronization cycle through the oscilloscope in the software tool or the actual oscilloscope. If the synchronization cycle is 0, the synchronization clock of the host controller is not active. Check whether the network cables connected to each slave come in from the IN port and out from the OUT port. If yes, restart the network. If the network cables are connected in the correct sequence, without the need for prior check, restart the network directly. If the synchronization cycle is not 0 and within the permissible fluctuation range (2 us) of the drive, increase the synchronization loss threshold of the slave (H0E.32h).
4. The network switches from OP to non-OP when the drive is enabled.	Check whether the network status switches from the OP state to non-OP state.	Check the network status switchover program of the host controller.

EE08.1: Network status switchover error

Cause:

When the servo drive is enabled, the EtherCAT network status switches from OP state to other status.

Troubleshooting:

Cause	Verification method	Solution
This fault is caused by mal-operation of the master or the operator.	Check whether the master switches the network status when the servo drive is enabled.	Check the network status switchover program of the host controller.
2. The data received by the slave is abnormal during synchronous communication.	Check whether the communication cable is shielded twisted pairs. Check whether the drive is grounded properly. Check whether the network port of the drive is damaged.	Use shielded twisted pair cables. Connect cables according to wiring instructions. Check the network connection status through the first LED.

Cause	Verification method	Solution
3. The data sent by the master is abnormal during synchronous communication.	The synchronization clock of the host controller is not activated. The synchronization clock error of the host controller is excessively high.	Measure the synchronization cycle through the oscilloscope in the software tool or the actual oscilloscope. If the synchronization cycle is 0, the synchronization clock of the host controller is not active. Check whether the network cables connected to each slave come in from the IN port and out from the OUT port. If yes, restart the network. If the network cables are connected in the correct sequence, without the need for prior check, restart the network directly. If the synchronization cycle is not 0 and within the permissible fluctuation range (2 us) of the drive, increase the synchronization loss threshold of the slave (H0E.32h).
4. The network switches from OP to non-OP when the drive is enabled.	Check whether the network status switches from the OP state to non-OP state.	Check the network status switchover program of the host controller.

EE08.3: Network cable connected improperly

Cause:

The network cable of the servo drive is connected improperly. (The low 16 bits of H0E.29 represents the number of IN port loss events. The high 16 bits of H0E.29 represents the number of OUT port loss events.)

Troubleshooting:

Cause	Verification method	Solution
The physical connection of the data link is unstable, or the process data is lost due to plug-in/plug-out of the network cable.	Check whether the network cable of the servo drive is connected securely, whether strong vibration occurs on site, whether the network cable is plugged in or out, and whether a network cable provided by Inovance is used.	Check the connection of the network port through the change of the H0E.29 value. Use a new network cable that can connect reliably.

EE08.4 Data frame loss protection error

Cause:

PDO data is corrupted due to EMC interference or an inferior network cable.

Troubleshooting:

Cause	Verification method	Solution
The data is lost due to EMC interference, poor quality of the network cable, or improper connection.	Check whether the high 16 bits of H0E-25 have values that are increased.	Check whether proper grounding is performed and rectify EMC measures. Check whether the network cable used is provided by Inovance. Check whether the network cable is reliable.

EE08.5: Data frame transfer error

Cause:

Error data frames are generated from the upstream slave, and invalid data frames are transferred to the downstream slave.

Troubleshooting:

Cause	Verification method	Solution
The upstream station detects that the data frame has been corrupted and marked. Then the data frame is transferred to the local slave, triggering an alarm.	Check whether a processing unit error occurs due to transfer errors (H0E.27) or invalid frames (H0E.28) upon the fault, and check whether counting is not performed in RX-ERR of port 0.	Check the upstream station to locate the fault cause.

EE08.6: Data update timeout

Cause:

The slave is in the OP status and does not receive the data frame after a long period of time.

Troubleshooting:

Cause	Verification method	Solution
The data frame is lost or discarded in the upstream slave or the master performance is not up to standard.	Check through the software tool whether the phase difference between SYNC and IRQ exceeds the product of H0E.22 × communication period.	Check whether the CPU load of the master during operation is excessive. Reduce the communication time and set H0E-22 to a high value. Check whether link loss occurs to upstream stations.

EE09.0: Software limit setting error

Cause:

The lower limit of the software limit is equal to or larger than the upper limit.

Troubleshooting:

Cause	Verification method	Solution
The software lower limit is equal to or higher than the software upper limit.	Check the values of 607D.01h and 607D.02h.	Reset the values and ensure that the value of 607D.01h is smaller than that of 607D.02h.

EE09.1: Home setting error

Cause:

The home offset exceeds the upper/lower limit.

Troubleshooting:

Cause	Verification method	Solution
1. The home offset is outside the software limit range.	Check whether the home offset is outside the software position limit range when the encoder works in the incremental mode, absolute linear mode, and single-turn absolute mode.	Set the home offset to a value within the software position limit range.
2. The home offset is beyond the upper/lower limit in rotation mode.	The home offset is outside the mechanical single-turn upper/ lower limit when the encoder works in rotation mode.	Set the home offset to a value within the mechanical single-turn upper/lower limit.

EE09.2: Gear ratio beyond limit

Cause:

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

Troubleshooting:

Cause	Verification method	Solution
The set electronic gear ratio exceeds the preceding range.	The gear ratio 6091.01h/6091.02h exceeds the preceding range.	Keep the gear ratio within the preceding range.

EE09.3: Homing mode setting error

Cause:

The MCU does not receive the synchronization signal when the servo communication is switched to OP status.

Troubleshooting:

Cause	Verification method	Solution
1. The communication sync clock is configured improperly.	Replace with another master (such as Beckhoff or Omron PLC) and perform tests to compare between different masters.	Rectify the communication configuration of the master.
2. The communication IN and OUT ports are connected inversely.	Check the connection of the IN and OUT ports.	Connect the IN and OUT ports in the correct sequence.
3. The slave controller integrated circuit is damaged.	If the fault persists after the master is replaced, detect the synchronization signal generated by the slave controller integrated circuit with an oscilloscope. If there is no signal, the slave controller integrated circuit is damaged.	Contact Inovance for replacing the slave controller integrated circuit.
4. The MCU pins are damaged.	Detect the synchronization signal generated by the slave controller integrated circuit with an oscilloscope. If there is a signal, the pins of the MCU integrated circuit are damaged.	Contact Inovance for replacing the MCU chip.

EE09.5: PDO mapping beyond the limit

Cause:

The number of mapping objects in TPDO or RPDO exceeds 20 or the number of bytes exceeds 40.

Troubleshooting:

Cause	Verification method	Solution
The number of mapping objects in TPDO or RPDO exceeds 20 or the number of bytes exceeds 40.	Check the number of self-indexes and bytes configured in 1600h or 1A00h.	The number of mapping objects in TPDO or RPDO cannot exceed 20. The number of bytes cannot exceed 40.

EE10.0: Protection against MailBox setting error

Cause:

1. Check whether the SM channel is enabled.
2. Check whether the read/write direction is configured correctly.
3. Check whether the mailbox mode applies (single buffer mode).
4. Check whether the length of the data received is within the setting range.
5. Check whether the address of the data received is within the setting range.
6. Check whether the memory of the read/write mailbox overlaps.

Troubleshooting:

Cause	Verification method	Solution
1. The master is configured improperly. 2. The XML file of the slave is wrong.	The panel displays the fault code.	Check the configuration of SM0 and SM1 channels for errors.

EE10.1: SM2 setting error

Cause:

1. PDO mapping object dictionary index exceeds the set maximum value (0x1600-0x170A).
2. The length of SM and RxPDO is not 0 when SM2 is not enabled.
3. The RxPDO length does not match.
4. Not writing
5. In the preop state, the address of RxPDO is not in the set address field (maximum and minimum addresses), or in a non-preop state, the address of SM2 is equal to the starting address of RxPDO.
6. The memory of SM2 overlaps with adjacent SM1 or SM3.

Troubleshooting:

Cause	Verification method	Solution
1. The master is configured improperly. 2. The XML file of the slave is wrong.	Check the configuration of SM2 for errors. Check whether the index of the RxPDO mapping object dictionary exceeds the limit (the maximum index is 0x0A).	Ensure that the SM2 channel is configured correctly. The index of the RxPDO mapping object dictionary is correct.

EE10.2: SM3 configuration error

Cause:

1. PDO mapping object dictionary index exceeds the set maximum value (0x1A00-0x1B0A).

2. The length of SM and TxPDO is not 0 when SM3 is not enabled.
3. The TxPDO length does not match.
4. Not reading.
5. In the preop state, the address of TxPDO is not in the set address field (maximum and minimum addresses), or in a non-preop state, the address of SM3 is equal to the starting address of TxPDO.
6. Buffer overruns. The memory of SM2 overlaps SM3 and SM0 or SM1.

Troubleshooting:

Cause	Verification method	Solution
1. The master is configured improperly. 2. The XML file of the slave is wrong.	Check the configuration of SM3 for errors. Check whether the index of the TxPDO mapping object dictionary is out of bounds (the maximum index is 0x1A).	Ensure that the SM3 channel is configured correctly. The index of the TxPDO mapping object dictionary is correct.

EE10.3: PDO watchdog setting error

Cause:

1. The watchdog is enabled but the counting value is zero.
2. The watchdog is not enabled but the counting value is not zero.

Troubleshooting:

Cause	Verification method	Solution
1. The watchdog is enabled but the counting value is zero. 2. The watchdog is not enabled but the counting value is not zero.	The master is configured improperly.	Make sure that the watchdog time is correct.

EE10.4: Protection against PLL completion interrupt (no sync signal)

Cause:

During the process from SAFEOP to OP, DC is enabled but not running.

Troubleshooting:

Cause	Verification method	Solution
During SAFEOP-to-OP, DC is enabled but not running.	The master is configured improperly.	Make sure that a sync0 signal is generated.

EE10.5: PHY configuration error

Cause:

The PHY chip is configured improperly during initialization upon power-on, leading to mal-operation of PHY.

Troubleshooting:

Cause	Verification method	Solution
The PHY integrated circuit is damaged or the pins are soldered improperly.	The alarm persists in spite of repeated restart.	Return it to the manufacturer for service.

EE11.0: ESI check error

Cause:

The attempt to load the XML file fails during EtherCAT communication.

Troubleshooting:

Cause	Verification method	Solution
1. The XML configuration file is not programmed.	Check whether the XML version displayed in H0E.96 is normal.	Program the XML file.
2. The drive is faulty. The XML file is modified unexpectedly.	The XML version number is not empty.	Set H0E.37 to 1 and perform a restart.

EE11.1: Failed to read from EEPROM by bus

Cause:

The EEPROM communication of external EtherCAT devices fails.

Troubleshooting:

Cause	Verification method	Solution
The attempt to read EtherCAT data from the EEPROM failed.	This fault persists after repeated power cycling.	Replace the servo drive.

EE11.2: EEPROM update failure by bus

Cause:

The communication is normal but the message in the EEPROM is incorrect or lost.

Troubleshooting:

Cause	Verification method	Solution
The EtherCAT data in the EEPROM cannot be updated.	This fault persists after repeated power cycling.	Replace the servo drive.

EE11.3: ESI and drive model mismatch

Cause:

The XML file does not match the drive model.

Troubleshooting:

Cause	Verification method	Solution
1. The XML file programmed does not match the drive model. 2. The drive is faulty and the XML file has been modified illegally.	Check whether the XML version displayed in H0E.96 is normal.	Program the XML file.

EE12.0: EtherCAT initialization failure

Cause:

EtherCAT peripheral initialization failed after power-on.

Troubleshooting:

Cause	Verification method	Solution
1. The device configuration file is not programmed.	The slave ID is empty when the host controller scans the slave.	Program the device configuration file.
2. The servo drive is faulty.	The servo drive is faulty.	Replace the servo drive.

EE13.0: EtherCAT sync period setting error

Cause:

After the system switches to the operation mode, the synchronization cycle is not an integer multiple of 125 us or 250 us.

Troubleshooting:

Cause	Verification method	Solution
The synchronization cycle is not an integer multiple of 125 μs or 250 μs.	Check the setting of the sync cycle in the controller.	Modify the synchronization cycle to an integer multiple of 125 μs or 250 μs.

EE15.0: Excessive EtherCAT sync cycle error

Cause:

The synchronization cycle deviation exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
The synchronization cycle deviation of the controller is excessive.	Measure the sync cycle of the controller by using a digital oscilloscope or the oscilloscope function in the software tool.	Increase the value of H0E.32.

EE16.0: MCU and ESC communication error

Cause:

Communication between MCU and ESC times out.

Troubleshooting:

Cause	Verification method	Solution
The attempt to establish communication between MCU and ESC times out.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

16.3.3.2 Internal Faults

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

- E602.0: Angle auto-tuning failure
- E220.0: Phase sequence incorrect
- EA40.0: Parameter auto-tuning failure
- E111.0: Internal parameter error

16.3.4 Description of Alarm Codes

E108.0: Storage parameter write fault

Cause:

Parameter values cannot be written to EEPROM.

Troubleshooting:

Cause	Verification method	Solution
A fault occurs when writing parameters.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.1: Storage parameter read fault

Cause:

Parameter values cannot be read from EEPROM.

Troubleshooting:

Cause	Verification method	Solution
The parameter-read operation is abnormal, and the system indicates an EEPROM read failure.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.2: EEPROM data write verification error

Cause:

The verification on the data written to EEPROM failed.

Troubleshooting:

Cause	Verification method	Solution
A fault occurs when writing parameters.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.3: EEPROM data read verification error

Cause:

The verification on the data read from EEPROM failed.

Troubleshooting:

Cause	Verification method	Solution
An error occurs when reading parameters.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.4: Single data saved frequently

Cause:

Single data is saved frequently to EEPROM.

Troubleshooting:

Cause	Verification method	Solution
Saving single data frequently to the EEPROM may damage the EEPROM.	1. Check H0b.90 and H0b.91. H0b.90 displays parameters or object dictionaries that are saved frequently (displayed in hexadecimal). If H0b.91 is set to 15, H0b.90 displays the internal variable of the software. 2. Check "Func test 1" through the oscilloscope. This channel displays the address that is being saved by EEPROM. 3. Check the number of saving events through "Func test 2" of the oscilloscope.	1. If the alarm is caused by manual modification of a certain parameter or object dictionary, there will be no frequent storage of a certain data entry during operation, and you can reset the fault. 2. Check the abnormal parameter through H0b. 90 or the oscilloscope channel, and identify the cause. For example, if the host controller program frequently writes parameters through SDO, you can modify the program to stop it, or you can set H0E.01 to 0.

E110.0: Frequency-division pulse output setting error

Cause:

The frequency-division output setpoint (H05.17) exceeds the encoder resolution.

Troubleshooting:

Cause	Verification method	Solution
The number of frequency-division pulses (after quadrature multiplication) exceeds the motor resolution.	Check the setpoint of H05.17.	Adjust the value of H05.17 based on the motor resolution.

E120.3: Different power between motor and drive

Cause:

The rated power of the motor does not match that of the drive.

Troubleshooting:

Cause	Verification method	Solution
The rated power of the motor does not match that of the drive.	Check rated motor voltage and current (H00.09, H00.11) and rated drive power (H01.10, H01.16).	1. Replace the motor or drive to make their power match each other. 2. If the motor and drive can work properly in spite of the mismatch, set bit4 of H0A.71 to 1 to block the alarm.

E121.0: S-ON command inactive

Cause:

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

Troubleshooting:

Cause	Verification method	Solution
The external S-ON signal is active when servo drive is enabled internally.	Check whether auxiliary functions (H0d.02, H0d.03, and H0d.12) are used and whether DI function 1 (FunIN.1: S-ON signal) is active.	Deactivate the DI assigned with FunIN.1 (both hardware DI and virtual DI).

E126.3: PR process segment parameter beyond the upper/lower limit

Cause:

In segment mode, the parameter written exceeds the upper limit of this parameter.

Troubleshooting:

Cause	Verification method	Solution
In segment mode, the parameter written exceeds the upper limit of this parameter.	Check the upper/lower limit value of the written parameter.	In segment mode, the parameter written exceeds the upper limit of this parameter.

E244.0: Abnormal input torque reference

Cause:

Abnormal input torque reference

Troubleshooting:

Cause	Verification method	Solution
The input torque reference is abnormal. The input torque reference of the motor with brake is 0 or the input torque reference is smaller than H13.41 while the input torque reference monitoring function is enabled.	Check whether the torque limit input is abnormal.	1. Adjust the torque limit input. 2. Adjust the alarm threshold (H13.41) according to the scenario.

E244.1: Positive/negative internal torque limit calculation error

Cause:

An error occurs during internal torque/speed limit calculation

Troubleshooting:

Cause	Verification method	Solution
An error occurs during internal torque/speed limit calculation	Adjust the input of torque/speed limit and electronic gear ratio to check whether the alarm is reported again.	1. Adjust the input of torque/speed limit and electronic gear ratio. 2. Identify the cause of error and contact the manufacturer.

E247.0: Torque saturation alarm

Cause:

The motor torque reference remains excessively high for a long time.

Troubleshooting:

Cause	Verification method	Solution
The motor torque reference remains excessively high for a long time.	1. Check whether the acceleration/ deceleration is excessively high. 2. Check whether the torque is limited. 3. Check whether the load is excessive and the motor is running out of specification.	1. Reduce the acceleration/ deceleration rate properly. 2. Adjust the torque limit value. 3. Optimize the operation parameters or adjust the model.

E510.0: Frequency division pulse output overspeed

Cause:

The single-channel output pulse frequency exceeds the frequency upper limit allowed by the hardware (4 MHz) when pulse output is used (H05.38 = 0/1/2).

Troubleshooting:

Cause	Verification method	Solution
The MCU detects excessive pulse increment fed back by FPGA.	1. When H05.38 is set to 0 (encoder frequency-division output) or 2 (secondary encoder frequency-division output), check whether the output pulse frequency corresponding to the motor speed upon fault exceeds the limit. Output pulse frequency (Hz) = Motor speed (rpm) ÷ 60 × H05.17 2. The input pulse frequency exceeds 2 MHz or interference exists in the pulse input pins when H05.38 is set to 1 (Reference pulse synchronous output). Low-speed pulse input pins: 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: 8 Mpps	1. 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. 2. Decrease the input pulse frequency to a value within the frequency upper limit allowed by hardware. In this case, if you do not modify the electronic gear ratio, the motor speed will decrease. 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 parameter H0A.24 or H0A.30). This is to prevent false alarms caused by interference pulses superimposed to actual pulse references.

E600.0: Angle auto-tuning failure

Cause:

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 the mechanism is eccentric. Rectify mechanical faults.
An alarm occurs during auto-tuning and causes interruption. Clear the alarm and perform auto-tuning again.
The vibration cannot be suppressed if the load carries large inertia. In this case, increase the acceleration/deceleration time to ensure the motor current is not saturated.
The position following performance is inadequate. This is usually caused by the maximum motor speed being lower than the speed set for inertia auto-tuning, resulting in failure to follow the position. Ensure the speed setpoint is lower than the maximum motor speed.

Troubleshooting:

Cause	Verification method	Solution
1. Continuous vibration exists during auto-tuning. 2. The auto-tuned values fluctuate dramatically. 3. Mechanical connections of the load are loosened or eccentric. 4. An alarm occurs during auto-tuning and causes interruption. 5. The vibration cannot be suppressed if the load carries large inertia. In this case, increase the acceleration/deceleration time to ensure the motor current is unsaturated. 6. The position following performance is inadequate, which is usually caused by the situation that the maximum motor speed is lower than the speed set by inertia auto-tuning, leading to position following error.	The torque jitters upon stop at internal detection (not FFT). Three times more than the last auto-tuned value for variation less than 5 times. 0.5 times more than last auto-tuned value for variation above 5 times.	1. Clear the fault and perform inertia auto-tuning again. 2. Enable vibration suppression when the vibration cannot be suppressed automatically. 3. Check and ensure mechanical connections are secure. 4. During ETune operations, increase the maximum running speed, reduce the acceleration/deceleration time, and shorten the screw stroke. 5. Ensure that the speed setpoint is lower than the maximum speed of the motor.

E601.0: Homing alarm

Cause:

The homing time exceeds the setpoint.

Troubleshooting:

Cause	Verification method	Solution
1. The home switch is faulty.	During homing, the system continuously searches for the home at high speed. After high-speed searching, low-speed searching at reverse speed applies.	If a hardware DI is used, check whether the corresponding DI function is allocated to a certain DI in group H03 and check the wiring of this DI. Change the DI logic manually and observe the value of H0b.03 (monitored DI status) to monitor whether the servo drive receives corresponding DI level changes. If the home signal is Z signal, but it cannot be found, check the condition of the Z signal.
2. The home-searching time is too short.	Check whether the value of H05.35 is excessively low.	Increase the value of H05.35.
3. The speed for searching for the home switch signal at high speed is excessively low.	Check the distance between the start position of homing and the home switch. Then, check whether the setpoint of 6099.01h is too low, resulting in a long homing process.	Increase the value of 6099.01h.

E601.1: Homing switch error

Cause:

The home switch is set improperly.

Troubleshooting:

Cause	Verification method	Solution
The home switch is set improperly.	Check whether the limit signals at two sides are both active. Check whether the limit signal and the deceleration point signal/home signal are both active. Check whether the positive and negative position limits are activated successively.	Set the position of the hardware switch properly.

E601.2: Homing mode setting error

Cause:

The homing mode value exceeds the existing homing mode value.

Troubleshooting:

Cause	Verification method	Solution
The homing mode value exceeds the existing homing mode value.	Check whether the homing mode value exceeds the existing homing mode value (object dictionary 6098h).	Change the value of 6098h.

E601.3: Position feedback alarm

Cause:

After the encoder is disconnected and reconnected, the position feedback system reports an alarm.

Troubleshooting:

Cause	Verification method	Solution
1. After homing is completed in incremental mode, if bit4 of H0C.73 is set to 0 after the encoder is disconnected and reconnected, E601.3 (User position feedback error) is reported by the drive. 2. After homing is completed in absolute mode, if bit4 of H0C.73 is set to 0 after the encoder is disconnected and reconnected, E601.3 (User position feedback error) is reported by the drive.	1. Check whether the encoder was disconnected in incremental mode. 2. Check whether the encoder is connected improperly after disconnection in absolute mode.	1. The fault can be cleared upon power-on. 2. Set bit4 of H0C.73 to 1 to block the alarm. 3. Perform homing again.

E602.9: Angle auto-tuning not performed on incremental encoder

Cause:

Angle auto-tuning not performed on incremental encoder

Troubleshooting:

Cause	Verification method	Solution
Angle auto-tuning is not performed on the incremental encoder and the corresponding alarm is enabled.	Confirm whether bit1 of H32.04 is set.	1. The alarm is reset automatically after angle auto-tuning is completed. 2. If this alarm is not needed, reset bit1 of H32.04.

E609.0: Data storage timeout

Cause:

Data download by the software tool interrupted

Troubleshooting:

Cause	Verification method	Solution
Data download by the software tool interrupted	Check the connection between the drive and software tool.	Download the data again.

E609.1: Data storage overflow

Cause:

Data download by the software tool interrupted

Troubleshooting:

Cause	Verification method	Solution
Data download by the software tool interrupted	Check the connection between the drive and software tool.	Download the data again.

E609.2: Data storage failure

Cause:

Data storage failure

Troubleshooting:

Cause	Verification method	Solution
The FLASH memory chip is faulty or the interface between MCU and FLASH is faulty.	Download the data again at next power-on.	If the fault persists after repeated restart, replace the drive.

E609.3: Data erasure failure

Cause:

Data erasure failure

Troubleshooting:

Cause	Verification method	Solution
The FLASH memory chip is faulty or the interface between MCU and FLASH is faulty.	Download the data again at next power-on.	If the fault persists after repeated restart, replace the drive.

E621.1: Overload current limit torque reached

Cause:

Overload current limit torque reached

Troubleshooting:

Cause	Verification method	Solution
1. The load is too heavy and the effective torque output by the motor remains above the rated torque. 2. Acceleration/deceleration is too frequent or the load inertia is too large. 3. The motor and encoder are wired improperly. 4. The gain is improper or the stiffness level is too high. 5. The motor is stalled due to mechanical factors, resulting in overload during operation. 6. The drive is faulty.	1. Confirm the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive remains above 100.0%. 2. Check whether H32.77 is set to an excessively high value.	1. Replace with a drive of larger capacity and a matching motor, or reduce the load and increase the acceleration/deceleration time.

E730.0: Encoder battery alarm

Cause:

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

Troubleshooting:

Cause	Verification method	Solution
The battery voltage of the absolute encoder is lower than 3.0 V.	Measure the battery voltage.	Replace the battery with a new one that provides matching voltage.

E831.1: Excessive AI1 zero offset

Cause:

The AI1 zero offset exceeds 500 mV.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use shielded twisted pairs and shorten the circuit length. Increase AI1 input filter time.
2. The servo drive is faulty.	Disconnect AI1 and measure whether the actual terminal voltage exceeds 0.5 V.	If not, replace the drive.

E831.2: AI2 zero offset too large

Cause:

The AI2 zero offset exceeds 500 mV.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use shielded twisted pairs and shorten the circuit length. Increase AI21 input filter time.
2. The servo drive is faulty.	Disconnect AI2 and measure whether the actual terminal voltage exceeds 0.5 V.	If not, replace the drive.

E834.1: AI1 overvoltage alarm

Cause:

AI1 input voltage exceeds 11.5 V.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use shielded twisted pairs and shorten the circuit length. Increase AI1 input filter time.
2. The input voltage is too high.	Measure whether the actual terminal voltage exceeds 11.5 V.	Adjust the input voltage to a value lower than 11.5 V.

E834.2: AI2 overvoltage

Cause:

AI2 input voltage exceeds 11.5 V.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use shielded twisted pairs and shorten the circuit length. Increase AI2 input filter time.
2. The input voltage is too high.	Measure whether the actual terminal voltage exceeds 11.5 V.	Adjust the input voltage to a value lower than 11.5 V.

E900.0: DI emergency braking

Cause:

The logic of the DI (including the hardware DI and virtual DI) assigned with DI function 34 (FunIN.34: Emergency stop) is active.

Troubleshooting:

Cause	Verification method	Solution
The DI function 34 (FunIN.34: Emergency stop) is triggered.	Check whether the logic of DI assigned with FunIN.34: Emergency stop is activated.	Check the operation mode and deactivate the DI braking signal without affecting the safety performance.

E902.0: Invalid DI/VDI settings

Cause:

DI/VDI function parameters are set to invalid values.

Troubleshooting:

Cause	Verification method	Solution
DI or VDI function parameters are set to invalid values.	Check whether DI function configuration parameters in groups H03 and H17 are set to invalid values.	Set DI/VID function parameters to valid values.

E902.1: Invalid DO/VDO settings

Cause:

DO/VDO function parameters are set to invalid values.

Troubleshooting:

Cause	Verification method	Solution
DO or VDO function parameters are set to invalid values.	Check whether DI function configuration parameters in groups H04 and H17 are set to invalid values.	Set DO/VDO function parameters to valid values.

E902.2: Torque arrival setting inactive

Cause:

The DO parameters set for torque arrival in the torque control mode are inactive.

Troubleshooting:

Cause	Verification method	Solution
The DO parameters set for torque reach in torque control mode are inactive.	Check whether the value of H07.22 is lower than or equal to the value of H07.23 (unit: 0.1%).	Set H07.22 to a value higher than that of H07.23.

E909.0: Motor overload alarm

Cause:

The accumulative heat of the motor reaches 90% of the fault threshold.

Troubleshooting:

Cause	Verification method	Solution
1. Wiring of the motor and encoder is incorrect or in poor contact.	Check the wiring among the servo drive, servo motor and the encoder according to the correct wiring diagram.	Connect cables according to the correct wiring diagram. Preferably use the cables provided by Inovance. When customized cables are used, prepare and connect the cables according to the hardware wiring instructions.
2. The load is excessive. The motor keeps outputting effective torque that higher than the rated torque for a long time.	Check the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive remains above 100.0%.	Use a drive of higher capacity and a matching motor. Alternatively, reduce the load and increase the acceleration/ deceleration time.

Cause	Verification method	Solution
3. Acceleration/deceleration is frequent, or the load inertia is high.	Check the mechanical inertia ratio or perform inertia auto-tuning. View the value of H08.15 (Load moment of inertia ratio). Check the single-shot operation cycle when the motor runs cyclically.	Increase the acceleration/ deceleration time.
4. The gain is improper, or the stiffness is excessively high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust the gains.
5. The set servo drive model or motor model are incorrect.	View the model of the motor equipped with a fieldbus encoder in H00.05 and the servo drive model in H01.10.	Read the servo drive nameplate and set the servo drive model (H01.10) and motor model properly according to section "Servo Drive Model and Nameplate" in SV670N-INT Series Servo Drive Selection Guide.
6. The motor is stalled due to mechanical factors, resulting in excessive load during operation.	Check the reference and motor speed (H0b.00) through the software tool or keypad: Reference in the position control mode: H0b.13 (Input position reference counter) Reference in the speed control mode: H0b.01 (Speed reference) Reference in the torque control mode: H0b.02 (Internal torque reference) Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Rectify mechanical problems.
7. The servo drive is faulty.	Power cycle the servo drive.	If the fault persists after a power cycle, replace the drive.

E910.0: Control circuit overvoltage

Cause:

The control circuit voltage exceeds the overvoltage threshold.

Troubleshooting:

Cause	Verification method	Solution
Overvoltage occurred on the control circuit of the drive.	1. Check the input power specifications of the servo drive and measure whether the input voltage of the control cable complies with the following specifications: 200 V servo drive: Valid value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Valid value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V) 2. Check whether control circuit cables are connected properly and whether the voltage of control circuit cables (L1C and L2C) on the drive side is within the specified range.	Re-connect or replace the cables.

E920.0: braking resistor overload

Cause:

The accumulative heat of the braking resistor exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The cable of the external braking resistor is in poor connection, connected loosely, or disconnected.	Remove the external braking resistor and measure whether its resistance is "∞" (infinite). Measure whether the resistance between terminals P⊕ and C is "∞" (infinite).	Use a new external braking resistor. If the resistance measured is the same as the nominal value, connect the resistor between P and C. Connect the external braking resistor between P and C with a new cable.
2. The jumper between terminals P⊕ and D is shorted or disconnected when the built-in braking resistor is used.	Measure whether the resistance between terminals P⊕ and D is "∞" (infinite).	Connect terminals P⊕ and D directly with a proper cable.
3. H02.25 is set to an incorrect value when an external braking resistor is used. 4. The resistance of the external braking resistor used is excessively high. 5. The value of H02.27 is higher than the resistance of the external braking resistor used.	Check the value of H02.25. Measure whether the resistance of the external resistor connected between P⊕ and C is too high. Check whether the value of H02.27 is larger than the resistance of the external braking resistor connected between P⊕ and C.	1. Refer to "Wiring and Setting of the Regenerative Resistor" in SV670N-INT Series Servo Drive Hardware Guide to set H02.25: H02.25=1 (External braking resistor, naturally ventilated) H02.25=2 (External braking resistor, forced-air cooling) 2. Select a proper resistor according to "Specifications of the Braking Resistor" in SV670N-INT Series Servo Drive Selection Guide. 3. Set H02.27 according to the resistance of the external braking resistor used.

Cause	Verification method	Solution
6. The input voltage of the main circuit exceeds the specifications.	Measure whether the main circuit input voltage on the drive side complies with the following specifications: 200 V servo drive: Valid value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Valid value: 380V to 480V Allowable deviation: -10% to +10% (342 V to 528 V)	Replace or adjust the power supply according to the specified range.
7. The load moment of inertia ratio is excessively high. 8. The motor speed is excessively high and deceleration is not done within the set time. The motor is in the continuous deceleration status during cyclic operation. 9. The capacity of the drive or braking resistor is not sufficient.	1. Perform inertia auto-tuning according to section "Inertia Auto-Tuning" or calculate total mechanical inertia according to the mechanical parameters. Check whether the actual load inertia ratio exceeds 30. 2. View the motor speed curve during cyclic operation and check whether the motor is in the deceleration status for a long time. 3. View the motor speed curve in a single cycle and calculate whether the maximum braking energy can be absorbed completely.	Select an external braking resistor of large capacity and set H02.26 according to the actual value. Select a servo drive of large capacity. Reduce the load if allowed. Increase the acceleration/ deceleration time if allowed. Increase the motor running cycle if allowed.
10. The servo drive is faulty.	-	Replace the servo drive.

E921.0: Dynamic brake resistor overload alarm

Cause:

The dynamic braking resistor is close to overload.

Troubleshooting:

Cause	Verification method	Solution
The accumulative heat of the dynamic braking resistor is close to the maximum thermal capacity of the resistor.	Check whether the value of H0b.98 is higher than or equal to 70%.	To avoid excessively high discharge current, prevent the motor from being driven reversely.

E922.0: Resistance of the external braking resistor too small

Cause:

The value of H02.27 (resistance of external braking resistor) is lower than the value of H02.21 (allowed minimum resistance of external braking resistor).

Troubleshooting:

Cause	Verification method	Solution
When an external braking 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 whether the resistance of the external braking resistor between terminals P⊕ and C is lower than the value of H02.21.	If yes, replace with an external braking 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.

E924.0: Braking transistor overtemperature

Cause:

The estimated temperature of the braking transistor is higher than H0A.49 (IGBT overtemperature threshold).

Troubleshooting:

Cause	Verification method	Solution
1. The junction temperature of the braking transistor is too high. 2. The braking transistor will be turned off automatically after overload occurs.	The braking transistor temperature exceeds the threshold defined by H0A.49.	Increase the deceleration time and control the usage of the braking transistor.

E940.0: The controlled motor changes. It is recommended to restore default settings before operating the motor.

Cause:

The controlled motor changes.

Troubleshooting:

Cause	Verification method	Solution
The controlled motor type changes. To ensure proper operation of the drive, it is recommended to restore default values before use. The alarm will be reported only once.	Check whether the motor model (H00.00) changes.	It is recommended to restore default values before use when the controlled motor changes. Alternatively, you can also keep the original parameter values.

E941.0: Parameter modifications activated at next power-on

Cause:

This alarm is reported if the parameters modified are those whose "Effective time" is "Next power-on".

Troubleshooting:

Cause	Verification method	Solution
The parameters modified are those whose "Effective time" is "Next power-on".	Check whether parameters modified are designed to be activated at next power-on.	Power cycle the motor.

E942.0: Frequent parameter storage

Cause:

The number of parameters modified at a time exceeds 700.

Troubleshooting:

Cause	Verification method	Solution
Too many parameters are modified and saved to EEPROM at a brief interval.	Check whether parameters are modified through the host controller at a brief interval.	Check the operation mode. For parameters that need not be saved to EEPROM, set H0E.01 properly.

E950.0: Forward overtravel alarm

Cause:

The logic of the DI allocated with FunIN.14: P-OT (Positive limit switch) is valid.

Troubleshooting:

Cause	Verification method	Solution
1. The logic of the DI assigned with FunIN.14 (P-OT function 14, positive limit switch) is effective.	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 operation mode. Send a reverse run command or rotate the motor to deactivate the DI function 14 without affecting the safety performance.
2. The position feedback of the drive reaches the positive software position limit.	Check whether the position feedback (H0b.17) is higher than the value of H0A.41. Check whether the software position limit is set in H0A.01.	Use proper servo drive references to ensure the load travel range is within the software position limit.

E952.0: Reverse overtravel alarm

Cause:

The logic of the DI allocated with FunIN.15: N-OT (negative limit switch) is valid.

Troubleshooting:

Cause	Verification method	Solution
1. The logic of the DI assigned with FunIN.15 is active.	Check whether a certain DI in group H03 is assigned with FunIN.15. Check whether the logic of DI corresponding to the bit of H0b.03 (Monitored DI status) is active.	Check the operation mode. On the prerequisite of safety, send a forward run command or rotate the motor to deactivate the logic of DI assigned with FunIN.15.
2. The position feedback of the drive reaches the negative software position limit.	Check whether the position feedback (H0b.17) is lower than the value of H0A.43. Check whether the software position limit is set in H0A.01.	Use proper servo drive references to ensure the load travel range is within the software position limit.

E954.0: Position command overflow

Cause:

Position reference overflow

Troubleshooting:

Cause	Verification method	Solution
In process segment mode, the position reference exceeds the limit.	Check the position reference. Check the limit value.	Change the value of the position reference and the limit.

E956.0: Forward position reference overtravel in process segment position mode

Cause:

Forward position reference overtravel occurs in the process segment position mode.

Troubleshooting:

Cause	Verification method	Solution
The position reference exceeds the limit upon forward run in the process segment, leading to an alarm.	In position control mode of the process segment, E956.0 occurs when the motor runs in the forward direction and the position reference exceeds the value of H22.04.	Reduce the position reference to a value lower than the setpoint of H22.04.

E958.0: Reverse position reference overtravel in process segment position mode

Cause:

Reverse direction position reference overtravel occurs in process segment position mode.

Troubleshooting:

Cause	Verification method	Solution
The position reference exceeds the limit upon reverse run in the process segment, leading to an alarm.	In position control mode of the process segment, E958.0 occurs when the motor runs in the reverse direction and the position reference exceeds the value of H22.06.	Increase the position reference to a value greater than the setpoint of H22.06.

E971.0: Undervoltage alarm for voltage drop protection

Cause:

The bus voltage is lower than the undervoltage threshold when voltage drop protection is enabled.

Troubleshooting:

Cause	Verification method	Solution
The bus voltage is lower than the undervoltage threshold.	Check the bus voltage.	Check the grid power supply.

E980.0: Frequency-division output overflow alarm

Cause:

Frequency-division output frequency calculation overflow

Troubleshooting:

Cause	Verification method	Solution
The frequency-division output frequency is excessive, leading to calculation overflow.	Check whether E510.0 alarm occurred and set H05.17 to a value until E510.0 is not reported.	Set H0517 to a proper value or decrease the maximum running speed.

EA34.9: Hall not configured during Hall auto-tuning

Cause:

Missing Hall configurations during Hall auto-tuning

Troubleshooting:

Cause	Verification method	Solution
H00.26 is not configured when dynamic Hall auto-tuning is enabled.	1. When H0A.13 is set to 6, check whether bit3 of H0026 is not set to 1. 2. Check whether H0A.13 is set to 6 by mistake for encoders without Hall (bit3 of H0026 is 0).	1. For motors with a Hall device, Hall auto-tuning is required (H0A.13 = 6). Set bit3 of H0026 to 1. 2. For motors without a Hall device, Hall auto-tuning cannot be used (H0A.13 cannot be set to 6).

EA41.0: Torque fluctuation compensation failure

Cause:

Torque fluctuation compensation failure

Troubleshooting:

Cause	Verification method	Solution
Auto-tuning torque fluctuation compensation failure	1. Check whether homing is not performed during cogging force fluctuation auto-tuning of the incremental encoder. 2. Check whether cogging force fluctuation auto-tuning is interrupted due to emergency stop or external fault. 3. Perform auto-tuning on the torque fluctuation compensation value again.	1. Check whether homing is performed during cogging force fluctuation auto-tuning of the incremental encoder. 2. Check whether cogging force fluctuation auto-tuning is interrupted due to emergency stop or external fault. 3. Perform auto-tuning on the torque fluctuation compensation value again.

EE08.7: Error frame early warning

Cause:

The 0x300 register value increment is checked on a regular basis (set in H16.44), and the threshold set by H16.43 (Error frame alarm switch/threshold) is reached.

Troubleshooting:

Cause	Verification method	Solution
Check whether the IN port network cable is improper or interference exists.	Check the IN port network cable or check interference on site.	Replace the IN port network cable or rectify interference on site.

EE08.8: OUT port error frame alarm

Cause:

The 0x302 register value increment, which is checked regularly (defined by H16.44), reaches the threshold defined by H16.43 (Error frame pre-alarm function switch/threshold).

Troubleshooting:

Cause	Verification method	Solution
Check whether the OUT port network cable is improper or interference exists.	Check the OUT port network cable or check interference on site.	Replace the OUT port network cable or rectify interference on site.

16.3.5 SDO Transmission Abort Code

Abort code	Description
0503 0000	Trigger bits not alternated
0504 0000	SDO protocol timeout
0504 0001	Invalid or unknown client/server command word
0504 0005	Memory overflow
0601 0000	Inaccessible object
0601 0001	Attempt to read a write-only object
0601 0002	Attempt to write a read-only object
0602 0000	Object unavailable in the OD
0604 0041	Object cannot be mapped to the PDO
0604 0042	Number and length of objects to be mapped exceed those of PDOs
0604 0043	General parameter incompatibility
0604 0047	General internal incompatibility
0606 0000	Failure to access objects because of hardware errors
0607 0010	Incorrect data type: incorrect service parameter length
0607 0012	Incorrect data type: service parameter too long
0607 0013	Incorrect data type: service parameter too short
0609 0011	Sub-index does not exist
0609 0030	Invalid parameter value
0609 0031	Written parameter value too large
0609 0032	Written parameter value too small
0609 0036	Maximum value smaller than minimum value
0800 0000	General error
0800 0020	Data unable to be transmitted or saved to the application
0800 0021	Data unable to be transmitted or saved to the application because of local control
0800 0022	Data unable to be transmitted or saved to the application because of the device state
0800 0023	OD error or OD unavailable
0800 0024	Value not exist

17 Maintenance

17.1 Maintenance Period

The electrical and electronic parts inside the servo drive and motor may be mechanically worn out and degraded. To keep the servo drive and servo motor in good condition, perform parts replacement based on the following table. Before replacement, contact the agent or Inovance first to check whether the components need to be replaced.

Object	Item	Standard replacement cycle	Description
Drive	Power bus capacitor	About 8 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment[1])	The standard replacement interval is for reference only. If any device or component works improperly before the replacement cycle expires, replace it immediately.
	Number of cooling fans	About 5 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment[1])	
	Control circuit aluminum electrolytic capacitor	About 10 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment[1])	
	Pre-charge relay	About 100,000 operations (depending on the operating conditions)	
	Pre-charge resistor	About 20,000 operations (depending on the operating conditions)	
	Dynamic brake relay	About 1,000 operations (rated motor speed; interval: 5 min; inertia: 20)	
	Dynamic brake resistor		
Motor	Bearing	22,000 to 40,000 hours	The standard replacement interval is for reference only. If any device or component works improperly before the replacement cycle expires, replace it immediately.
	Fan	30,000 to 40,000 hours	
	Encoder	22,000 to 40,000 hours	
	Encoder battery	22,000 to 40,000 hours	
	Insulation resistance	Check the insulation resistance at least once per year.	Use an insulation resistance gauge (set to 500 VDC) to measure the insulation resistance. Measurement method: Measure the resistance between the PE (grounding) and any phase among U/V/W. The resistance measured should be higher than 10 MΩ.
Device	Overall inspection	Perform overall inspection at least once every five years or every 20,000 hours, whichever comes first.	Perform maintenance based on the related maintenance guide of the equipment.

Note

[1]: For details on the standard environment, see *"5.2.2 Installation Environment" on page 57*.

17.2 Daily Maintenance and Inspection

17.2.1 Routine Maintenance Items

The standard environmental conditions are as follows: average ambient temperature: 30°C; average load rate: < 80%; uptime: < 20 hours per day

Routine checklist

Table 17–1 Routine checklist

No.	Routine checklist	Tick
1	The ambient temperature and humidity are normal. There is no dust or unwanted objects in the servo drive.	☐
2	There is no abnormal vibration or noise.	☐
3	The voltage of the power supply is normal.	☐
4	There is no strange smell.	☐
5	There are no fibers adhered to the air inlet.	☐
6	There is no intrusion of unwanted objects on the load end.	☐
7	The brake circuit is functioning properly. The control circuit is not loose or showing any other abnormalities, such as blackening or melting. Perform a separate brake functional test to verify that the brake operates normally.	☐

Routine cleaning list

Table 17–2 Routine cleaning list

No.	Routine cleaning list	Tick
1	Clean the dust on the equipment surface, especially the metallic dust.	☐
2	Keep the front end of the servo drive and the connectors clean.	☐

Note

- Before cleaning, switch off the power supply and clean with an air gun or a piece of dry cloth.
- Do not use gasoline, dilutes, alcohol, or acid or alkaline detergent to prevent enclosure discolor or damage.

17.2.2 Periodic Inspection Items

Table 17–3 Periodic checklist

No.	Item	Yes
1	The screws used to fix the couplings between devices are in place.	☐
2	There is no sign of overheating.	☐
3	Terminal blocks are in good condition without any sign of damage.	☐
4	The clamping units of terminal blocks are in place.	☐

17.3 Replacing Components

17.3.1 Replacing the Drive

Caution

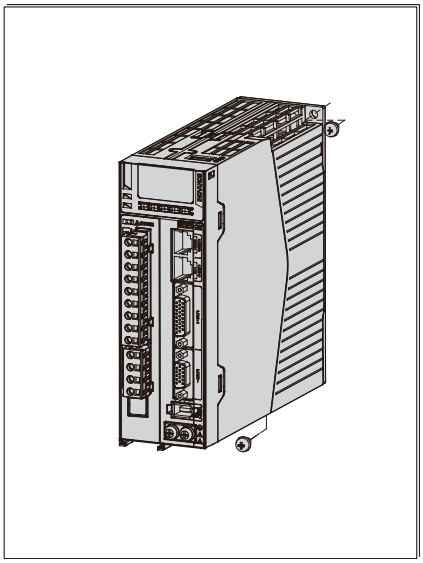
- Note that the drive is energized with high voltage. All the wiring work can be performed with power off only.
- Before maintenance, power off and wait for at least 15 minutes until the voltage of drive is lower than 36 VDC. Failure to comply may result in personal injury caused by the residual voltage in the capacitor.
- Only trained professionals are allowed to perform inspection and maintenance on the drive. Failure to comply may result in severe personal injury, death, or major property loss.
- Even if the motor is not running, the power supply and terminals may still be live due to presence of an external power supply. Be careful when you operate with the equipment.
- Take cautious when handling heavy equipment or equipment with high center of gravity. Improper lifting or handling may result in death, serious personal injury, or major property loss.

Procedure

1. Disconnect the driver from power supply.
2. 15 minutes after power-off, check whether the drive voltage is lower than 36 VDC.
3. Remove all cables from the drive.
4. Unscrew the 2 M4 screws from the drive and remove the drive.

Note:

- Servo drives in sizes A and C are secured by two screws, with one screw on the top and the other one at the bottom.
- Servo drives in Size D are secured by three screws, with two screws on the top and another one at the bottom.
- Servo drives in Size E are secured by four screws, with two screws on the top and the other two at the bottom.



5. Install the drive and secure it with two M4 screws. The recommended torque is 1.2 N·m. After the drive is installed, check the items according to the checklist. For details about mechanical installation and the post-installation checklist, see *" Mechanical Installation" on page 67*.
6. Re-connect the cables and check the items according to the post-inspection checklist. For details about electrical installation and the post-wiring checklist, see *"6.2 Electrical Wiring Diagram" on page 74*.
7. Power-on the drive.
8. Complete commissioning with the commissioning tool. For details about the commissioning tool and commissioning procedure, see *" Commissioning Tools" on page 125* and *" Commissioning and Operation" on page 156*.

17.3.2 Replacing the Motor Flat Key

Caution

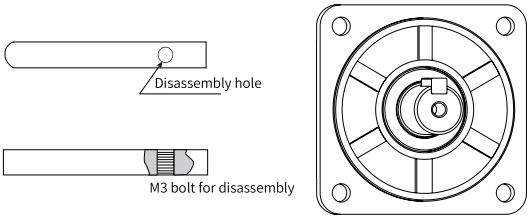
- Observe all the requirements presented in this chapter. Failure to comply may result in equipment fault or damage.
- Violent disassembly is not allowed. Take enough care during disassembly to prevent personal injury.

Standard MS1 series motors in flange sizes 60, 80, and 130 adopt the C-type flat key that carries a disassembly hole. To disassemble the flat key, select a proper disassembly bolt (inner hexagon bolt recommended) based on the following table.

Specification of the key disassembly bolt		
Motor size	Flat key size (unit: mm)	Specifications of the disassembly bolt (Inner hexagon bolt)
Size 40	Type-A/B flat key–3×3×14	-
Frame size 60	Type-C flat key–C5 × 5 × 16.5	M3 × 10 and above
Size 80	Type-C flat key–C6 × 6 × 25	M3 × 15 and above
Size 100	Type-C flat key–C8 × 7 × 35	M3 × 20 and above
Size 130	Type-C flat key–C8 × 7 × 35	M3 × 20 and above
Size 180	Type-C flat key–C10 × 8 × 64	M3 × 20 and above

- Tool needed: an Allen wrench
- Removal procedure:

1. Select a proper disassembly bolt (inner hexagon bolt recommended) based on the motor model.
2. Use an Allen wrench to screw down the screw until the A-A end of the flat key is detached from the keyway, as shown below.



18 Servo Technical Specifications

18.1 Electrical Specifications

- Single-phase 200 V drive

Item		Size A		Size C		Size D
Servo drive model		S1R6	S2R8	S5R5	S7R6	S012
Drive power (kW)		0.2	0.4	0.75	1.0	1.5
Max. applicable motor capacity (kW)		0.2	0.4	0.75	1.0	1.5
Power supply equipment capacity (kVA)		1.4	2.8	4.6	6.0	8.0
Continuous output current (Arms)		1.6	2.8	5.5	7.6	12.0
Max. output current (Arms)		5.8	10.1	16.9	23.0	32.0
Main circuit	Continuous input current (Arms)	2.3	4.0	7.9	9.6	12.8
	Main circuit power supply	Single-phase 200 VAC–240 VAC, -10% to +10%, 50 Hz/60 Hz				
	Heat generation (W)[1]	12	23.8	38.2	47.32	69.84
Control circuit	Control circuit power supply	Single-phase 200 VAC–240 VAC, -10% to +10%, 50 Hz/60 Hz				
	Heat generation (W)[2]	16				
Braking Resistor	Resistance (Ω)	Optional	Optional	50	25	25
	Resistor power (W)	Optional	Optional	50	80	80
	Min. resistance of external resistor (Ω)	40	40	40	20	15
	Max. braking energy absorbed by capacitor (J)	9.3	18.59	32.42	32.42	47.68
	Braking resistor	All models in the series support built-in and external braking resistors, but Size A does not come with a built-in braking resistor as standard.				
Cooling method		Natural ventilation		Air cooling		
Overvoltage category		III				
Max. input surge current at power-on (A)		18.65	18.65	9.325	9.325	12.433
3 τ (ms)[3] (3 x RC time constant)		23.4	46.8	163.2	163.2	180

Note

- The main circuit of S2R8, S5R5, S7R6, and S012 servo drives support single-phase 200 V power supplies without derating.
- The maximum braking energy that can be absorbed by capacitors is calculated based on the rated input of 220 VAC.

- Three-phase 200 V drives

Item		Size A		Size C		Size D	Size E		
Servo drive model		S1R6	S2R8	S5R5	S7R6	S012	S018	S022	S027
Drive power (kW)		0.2	0.4	0.75	1.0	1.5	2.0	3.0	5.0
Max. applicable motor capacity (kW)		0.2	0.4	0.75	1.0	1.5	2.0	3.0	5.0
Power supply equipment capacity (kVA)		1.21	2.42	3.84	5.05	6.68	8.33	10.42	20.08
Continuous output current (Arms)		1.6	2.8	5.5	7.6	12.0	18.0	22.0	27.0
Max. output current (Arms)		5.8	10.1	16.9	23.0	32.0	45	55	67.5
Main circuit	Continuous input current (Arms)	1.1	2.3	4.4	5.1	8.0	8.7	11.0	23.8
	Main circuit power supply	Three-phase 200 VAC–240 VAC, -10% to +10%, 50Hz/60Hz							
	Heat generation (W)[1]	12	23.8	38.2	47.32	69.84	120	125	200
Control circuit	Control circuit power supply	Single-phase 200 VAC–240 VAC, -10% to +10%, 50 Hz/60 Hz							
	Heat generation (W)[2]	16							
Braking Resistor	Resistance (Ω)	Optional	Optional	50	25	25	20	20	20
	Resistor power (W)	Optional	Optional	50	80	80	100	100	100
	Mini. resistance of external resistor (Ω)	40	40	40	20	15	20	20	20
	Max. braking energy absorbed by capacitor (J)	9.3	18.59	32.42	32.42	47.68	78.19	114.43	114.43
	Braking resistor	All models in the series support built-in and external braking resistors, but Size A does not come with a built-in braking resistor as standard.					Built-in and external resistors are supported.		
Cooling method		Natural ventilation		Air cooling					
Overvoltage category		III							
Max. input surge current (A)		18.65	18.65	9.325	9.325	12.433	12.433	12.433	12.433
3 τ (ms)[3] (3 x RC time constant)		23.4	46.8	163.2	163.2	180	295.2	432	432

Note

The maximum braking energy that can be absorbed by capacitors is calculated based on the rated input of 220 VAC.

- Three-phase 400 V drives

Item	Size C		Size D		Size E		
Servo drive model	T3R5	T5R4	T8R4	T012	T017	T021	T026
Drive power (kW)	1.0	1.5	2.0	3.0	5.0	6.0	7.5
Max. applicable motor capacity (kW)	1.0	1.5	2.0	3.0	5.0	6.0	7.5
Power supply equipment capacity (kVA)	6.05	9.08	10.23	15.15	22.25	25.0	31.25

Item		Size C		Size D		Size E		
Continuous output current (Arms)		3.5	5.4	8.4	12.0	17.0	21.0	26.0
Max. output current (Arms)		11.0	14.0	20.0	30.0	42.5	52.5	65.0
Main circuit	Continuous input current (Arms)	2.4	3.6	5.6	8.0	12.0	16.0	21.0
	Main circuit power supply	Three-phase 400 VAC–480 VAC, -10% to +10%, 50 Hz/60 Hz						
	Heat generation (W)[1]	39.5	63.25	94.82	135.47	187.62	228.28	258.63
Control circuit	Control circuit power supply	Single-phase 400 VAC–480 VAC, -10% to +10%, 50 Hz/60 Hz						
	Heat generation (W)[2]	16						
Braking Resistor	Resistance (Ω)	100	100	50	50	35	35	35
	Resistor power (W)	80	80	80	80	100	100	100
	Min. resistance of external resistor (Ω)	80	60	45	40	35	25	25
	Max. braking energy absorbed by capacitor (J)	36.06	43.79	64.40	64.40	105.62	154.56	154.56
	Braking resistor	Built-in braking resistor						
Cooling method		Air cooling						
Overvoltage category		III						
Max. input surge current (A)		18.65	18.65	24.86667	24.867	24.867	24.867	24.867
3 τ (ms)[3] (3 x RC time constant)		33.6	40.8	45	45	73.8	108	108

Note

The maximum braking energy that can be absorbed by capacitors is calculated based on the rated input of 400 VAC.

Note

- [1]: Main circuit heat generation refers to the amount of heat generated under rated output current of the servo drive.
- [2] Control circuit heat generation refers to the heat generated under rated input current of the servo drive.
- [3] RC time constant = Buffer resistor R x Bus capacitor C, which is used to indicate the power-on time (when the bus voltage reaches the stable state after a time of 3τ.
- Select the external braking resistor according to the actual operating conditions. For details about how to select a braking resistor, see *"20.5 Braking Resistor" on page 1138*.

18.2 Technical Specifications

Item			Description
Basic specifications	Control mode		IGBT SVPWM control, sine wave current drive mode
			200 V, 400 V: Single-phase/Three-phase full bridge rectification
	Encoder feedback		23-bit multi-turn absolute encoder, which can be used as an incremental encoder in absence of the battery **DDL motors:** Inovance communication encoders, and ABZ incremental encoders with TTL signals **DDR motors:** Inovance communication encoders, and ABZ incremental encoders with TTL signals **Servo motors:** Inovance communication encoders, ABZ incremental encoders with TTL signals, Nikon encoders, and TAMAGAWA encoders **Note:**For details, see"Commissioning Object Description" in SV670N-INT Series Servo Quick Start Guide.
	Conditions for use	Ambient/Storage temperature [1]	0℃ to 55℃ (load ratio not exceeding 80% in ambient temperatures between 45℃ to 55℃, and non-freezing)/-40℃ to 70℃
		Operating/Storage humidity	Below 90% RH (no condensation)
		Vibration resistance	Operation: • Displacement amplitude: 3.5 mm between 5 Hz and 8.4 Hz • Acceleration amplitude: 1 g between 8.4 Hz and 200 Hz Product package: • 5 Hz to 100 Hz: 0.01 g^2/Hz • 200 Hz: 0.001g^2/Hz • Grms = 1.14 g
		Impact resistance	19.6 m/s^2
		IP rating	IP20 Note: Terminals are excluded, which have an IP rating of IP00.
		Pollution degree	PD2
		Protection class	Class I
		Altitude	The maximum altitude is 2,000 m. • 1,000 m and below: Derating is not required. • For altitudes above 1,000 m, derate 1% for every additional 100 m. • If the altitude exceeds 2,000 m, contact Inovance

Item				Description
Speed torque control mode	Performance	Speed control range		1 rpm to 10,000 rpm (The lower limit of the speed control range is subject to the prerequisites that the load keeps rotating under rated motor torque control)
		Torque control accuracy [2]		±2%
	Input signal	Speed reference input	EtherCAT communication mode	CSV/PV mode
			Analog setting; digital setting (H06.03)	
		Torque reference input	EtherCAT communication mode	CST/PT mode
			Analog setting; digital setting (H07.03)	
Position control mode	Input signal	EtherCAT communication mode		CSP mode/PP mode/HM mode
	Output mode			Phase A, phase B: differential output
				Phase Z: differential output or open collector output
	Position output	Frequency division ratio		Any frequency division
Input/ Output signal	DI signal	DI signal function assignment		5 DIs DI1–DI3: normal DI (rising edge (24 V input low to high) input delay: 100 us, falling edge (24 V input high to low) input delay: 50 us, voltage range: 20 V–30 V) DI4 and DI5: fast DI (rising edge (24 V input from low to high) input delay: 30 us, falling edge (24 V input from high to low) input delay: 5 us, voltage range: 20 V–30 V)
	DO signal	Output signal function selection		2 DOs With-load capacity: 50 mA Voltage range: 5 V to 30 V
	AI signal			AI1 voltage input: 16-bit, -10 V to +10 V; maximum allowable voltage: ±12 V Sampling frequency: 4 kHz
				AI2 voltage input: 12-bit, -10 V to +10 V; max. allowable voltage: ±12 V Sampling frequency: 4 kHz
	AO signal			AO1 voltage output range: -10 V to +10 V Output frequency: 10 kHz

Item			Description
Built-in functions	Overtravel (OT) prevention		The servo drive stops immediately when the P-OT or N-OT signal is active.
	Electronic gear ratio		0.001 ≤ B/A ≤ 26843545.6
	Protective functions		Protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overheat, power phase loss, overspeed, encoder error, CPU error, and parameter error
	STO safety function [3]	Safety function categories	Input block signal of STO functional safety module
		Applicable standards	IEC 61800-5-2:2016
	LED display		Main circuit CHARGE indicator, 5-digit LED display
	Vibration suppression		5 notches (including two adaptive notches) available, 50 Hz to 8000 Hz
	Usability functions		One-key parameter tuning, adaptive parameter tuning, intelligent parameter tuning, speed observer, and model tracking
	Communication function	Software tool commissioning	Type_C
		Multi-station communication	EtherCAT
		Number of multi-station communication axes	Maximum number of slaves: 65535
		Axis address setting	No physical knob, set to 0 to 65535 through the software
		Description	Status display, user parameter setting, monitored value display, fault tracing display, jog and auto-tuning, and communication and motion control command setting
	Others		Gain tuning, alarm record, and jog

Note

- [1] Install the servo drive within the allowable ambient temperature range. When it is installed inside a control cabinet, the temperature inside the cabinet must also be within this range.
- The voltage change and temperature change may result in amplifier deviations, which change the calculated resistance value. Such changes are reflected by the speed change. Speed changes caused by the voltage change and the temperature change will be indicated respectively by a percentage to the rated speed.
- [3]: The STO safety function is applicable only to non-standard models (-FS).

18.3 Communication Specifications

EtherCAT communication specifications

Item		Specification
Basic performance of slave	Communication protocol	EtherCAT protocol
	Support services	CoE (PDO, SDO)
	Synchronization mode	DC - Distributed clock FreeRun
	Physical layer	100BASE-TX
	Baud rate	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Topology	Ring, linear, star, and tree
	Transmission medium	Shielded cables of Cat 5e or higher
	Transmission distance	Less than 100 m between two nodes (with a proper environment and cables)
	Number of slaves	Up to 65535 by protocol
	EtherCAT frame length	44 bytes to 1498 bytes
	Process data	A maximum of 1486 bytes per Ethernet frame
	Synchronous jitter of two slaves	< 1
	Minimum sync period	250 μs
	Bit error rate	10^{-10} Ethernet standard
Configuration unit	Number of FMMU units	8
	Number of storage synchronization management units	8
	Process data RAM	8 KB
	Distributed Clock	64-bit
	EEPROM capacity	32 kbit

18.4 Dynamic Brake Characteristic Curve

Calculating the approximate dynamic braking distance

According to the motor model, initial speed, and load inertia, the dynamic braking distance can be estimated. The approximate value of the dynamic braking distance can be calculated by the following formula.

Maximum braking distance s (turn):

$$s = \frac{V_0}{60}\left(t_e + (\tau_1 + \tau_2 V_0^2)\left(1 + \frac{J_L}{J_M}\right)\right)$$

The coefficient is as follows:

$$\tau_1 = \frac{2R_sJ}{3p_n^2\Psi_f^2} = \frac{10000\pi^2R_sJ}{9K_e^2}$$

$$\tau_2 = \frac{\pi^2L_d^2J}{4050R_s\Psi_f^2} = \frac{100L_d^2\pi^4P_n^2J}{243R_sK_e^2}$$

$$\Psi_f = \frac{\sqrt{6}K_e}{100\pi P_n}$$

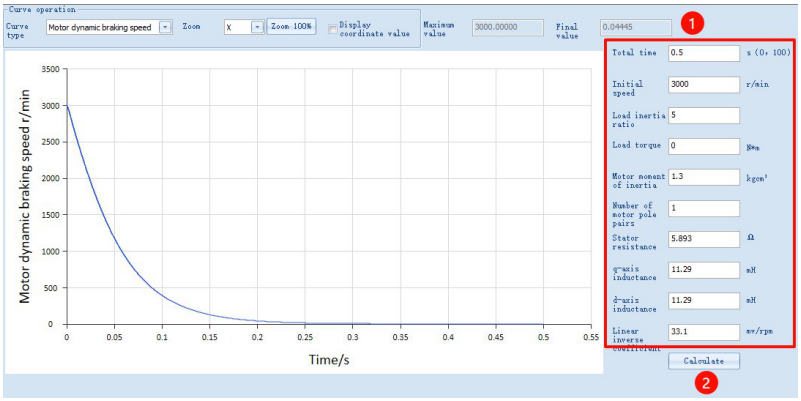
- V_0 : Maximum feedback speed
- t_e : Dynamic brake program and relay delay
- $J_{L:}$ Load moment of inertia
- J_M : Motor moment of inertia
- P_n : Number of motor pole pairs
- R_s : Stator resistance (Ω)
- Ke : Kelvin, unit of thermodynamic temperature
- L_q , L_d : q-axis inductance (mH), d-axis inductance (mH)

Calculating accurate dynamic braking distance

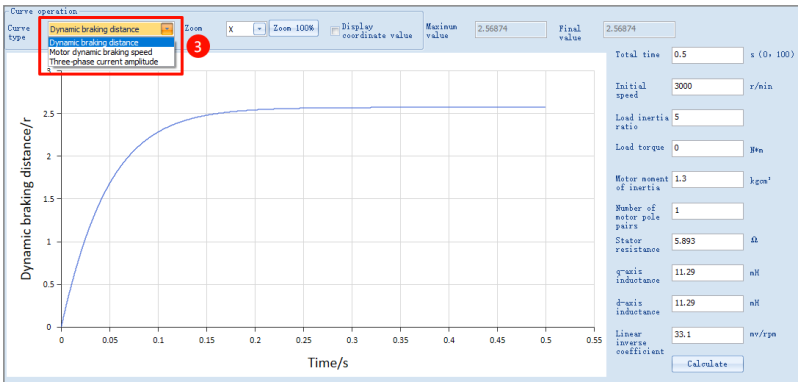
Use InoDriverShop to calculate the accurate dynamic braking distance.

Procedure:

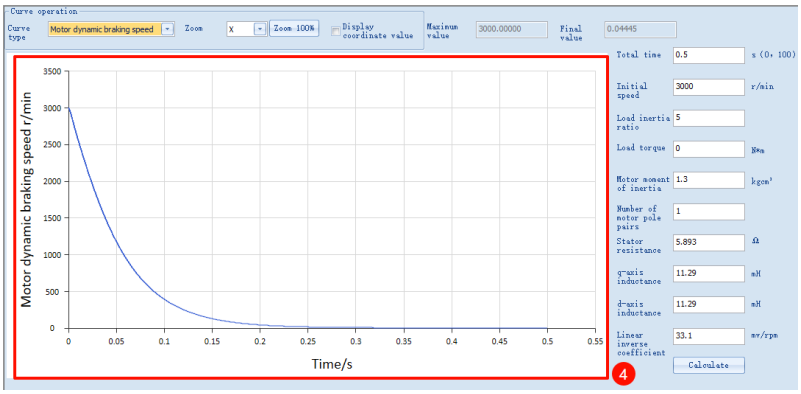
1. Set the corresponding parameters at ① according to actual motor, load, and operation parameters. The time range of the x-coordinate of the calculation chart can be adjusted by setting the total time.
2. After parameter setting is done, click "Calculate" at ② to generate dynamic braking measurement curve.



3. This function provides three dynamic braking calculation curves: dynamic braking distance-time curve (relationship between braking distance and time during dynamic braking), dynamic braking speed-time curve (relationship between motor speed and time during dynamic braking), and three-phase current amplitude-time curve (relationship between three-phase current amplitude and time during dynamic braking). You can select the curve type at ③ based on the curve needed.



4. After the curve type is selected, the curve is automatically generated at ④.



Applicable scenario:

To trigger dynamic braking at a motor speed of 3000 rpm and estimate how long can the motor stop (speed reduced to 0 rpm), perform as follows. Set parameters at ① based on actual motor parameters. After calculation at ②, select "Dynamic motor braking speed" at ③ and a "Dynamic braking speed-time curve" will be generated automatically at ④.

18.5 Load Moment of Inertia

The load moment of inertia represents the inertia of the load. The larger the load moment of inertia is, the weaker the responsiveness is. An excessively high inertia may result in unstable motion. The allowable load moment of inertia () of the motor is restricted. This value is provided strictly as a guideline and results depend on the motor driving conditions.

An overvoltage warning may occur during deceleration if the load moment of inertia exceeds the allowable value. For servo drives with a built-in regenerative resistor, an overload alarm my be present. In case of such warnings, take one of the following measures:

- Reduce the torque limit values.
- Reduce the deceleration rate.
- Reduce the maximum speed.
- Install an external braking resistor if the alarm cannot be cleared by using the above measures.

Caution

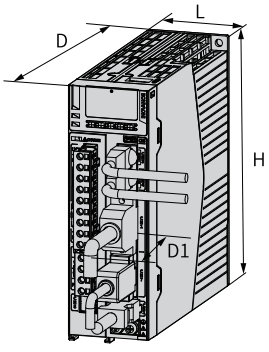
- Drives below 400 W does not provide a built-in braking resistor.
- Even if you use a built-in resistor, the energy generated in some conditions will exceed the allowable capacity loss (W) of the resistor. Therefore, an external braking resistor is required.

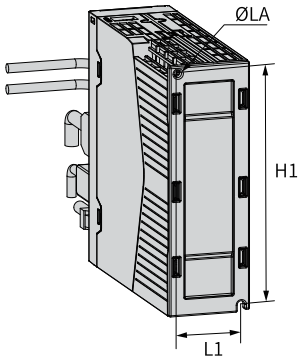
Table 18–1 Allowable load moment of inertia

Motor speed	Size A		Size B		Size C				Size D			Size E					
	S1R6	S2R8	T1R4	T2R3	S5R5	S7R6	T3R5	T5R4	S012	T8R4	T012	S018	S022	S027	T017	T021	T026
1,500 rpm	x 20																
3,000 rpm	x 20											x 10					
4,500 rpm	x 20											x 5					Not supported
6,000 rpm	x 20											x 5					Not supported
7,000 rpm	x 20		Not supported		x 20			Not supported									

Note: *Motor speed* indicates the maximum speed supported by the motor of the drive. For example, MS1H1/H4 supports 7,000 rpm, MS1H2 supports 6,000 rpm, and MS1H3 supports 4,500 rpm. When the speed exceeds 10 times of the inertia, an sufficient acceleration/deceleration time will cause drive alarms.

18.6 Product Dimensions





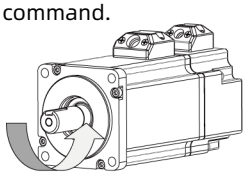
Size	L	H	D	L1	H1	D1	ØLA	Recommended tightening torque	Weight
	Unit: mm (in.)							Unit: (N·m)	Unit: (kg)
A	45.5 (1.79)	170 (6.69)	150 (5.91)	33 (1.30)	161 (6.34)	75 (2.95)	2xM4	1.2	0.96
C	55±1 (2.17±0.04)	170 (6.69)	173±1 (6.81±0.04)	44 (1.73)	160 (6.30)	75 (2.95)	2xM4	1.2	1.3
D	80±1 (3.15±0.04)	170 (6.69)	183 (7.20)	71 (2.80)	160 (6.30)	75 (2.95)	3 × M4	1.2	1.8
E	90 (3.54)	250 (9.84)	230 (9.06)	78 (3.07)	240.5 (9.47)	75 (2.95)	4 × M4	1.2	3.6

19 Motor Technical Specifications

19.1 MS1-R-INT Series Servo Motor

19.1.1 General Specifications

19.1.1.1 Mechanical Characteristics

Item	Description
Duty type	S1 (Continuous duty)
Vibration class[1]	V15
Insulation resistance	500 VDC, above 10 MΩ
Excitation mode	Permanent magnet
Installation method	Flange
Thermal class	F (155℃)
Insulation voltage	1500 VAC, 1 minute (200 V class) 1800 VAC, 1 minute (400 V class)
IP rating	IP67 (excluding shaft opening and flying leads type motor connectors)
Direction of rotation	Rotates counterclockwise (CCW) when viewed from the shaft extension side with a forward run command.  CCW

Item		Description
Ambient condition	Ambient temperature	0°C to 40°C (non-freezing)
	Ambient humidity	20% RH to 80% RH (without condensation)
	Rated operating altitude	1000 m
	Altitude-based derating	• 1000 m and below: Derating is not needed. • For use above 1000 m, derate according to *"19.1.1.3 Derating Characteristics" on page 1013*. For altitudes above 2000 m, install an isolation transformer at the power input end.
	Installation location	• Free from corrosive or explosive gases • Well ventilated with minimum amount of dust, waste, and moisture • Convenient for inspection and cleaning • Away from sources that may generate strong magnetic field • Away from heating sources such as heating stoves. • Use a motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings. • Oil seal protection capability: The oil seal is only dust-proof. It cannot withstand the intrusion of oil for a long term. For direct-connected reducer applications requiring long-term oil resistance on the motor oil seal, contact Inovance technical support. • Not applicable to vacuum environments. • Not applicable to inching (not full-turn) [2] and may be stuck. • The motor with brake may generate a pattering sound. • In upstream applications of the motor, ensure the force applied on the shaft end is lower than the allowable axial force and radial force of the motor. • The system should avoid continuous operation at a natural frequency. Exceeding the allowable vibration value may damage the system.
	Storage environment	Observe the following requirements for storing a de-energized motor. • Temperature: -20°C to +60°C (non-freezing) • Storage humidity: 20% to 80% RH (without condensation)
Shock resistance [3][5]	Shock acceleration (taking flange side as standard)	490m/s^2
	Number of shocks	2
Vibration resistance [4][5]	Vibration acceleration (taking flange side as standard)	• Radial 49 m/s^2 • Axial 24.5 m/s^2

Note

- [1] Vibration class V15 indicates that the amplitude of vibration is lower than 15 μm when an individual motor rotates at rated values.
- [2] For applications that require the motor shaft to swing back and forth at a certain angle, contact Inovance.
- [3] The resistance for shock in the vertical direction when the motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [4] The vertical, side-to-side, and front-to-back resistance for vibration in three directions when the servo motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [5] The vibration intensity applied on the motor is affected by the transmission structure, alignment accuracy, mounting conditions, and external vibration. These factors may enhance the vibration applied on the motor. When the maximum allowable vibration limit is exceeded, the motor may fail. Therefore, take necessary measures to limit resonance.
- The vibration intensity applied on the motor varies with applications.

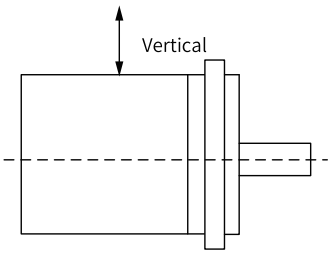


Figure 19-1 Shock applied to the servo motor

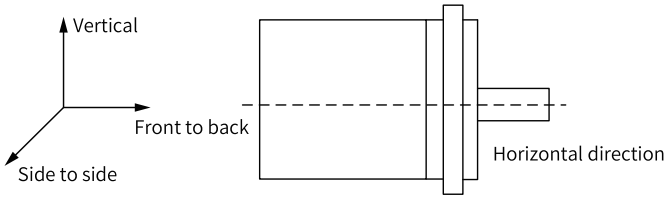


Figure 19-2 Vibration applied to the servo motor

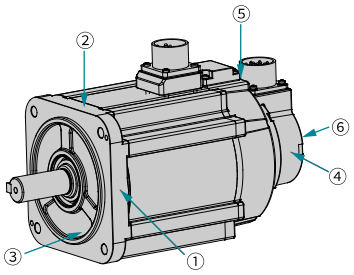


Figure 19-3 Max. allowable vibration limit of the motor

Direction	Measuring point	Limit value (10 Hz to 2000 Hz)
Radial	①②④⑤	49m/s²
Axial	③⑥	24.5m/s²

Note

The preceding vibration/shock standards cannot be applied for a long term. For long-term application, contact Inovance.

19.1.1.2 Overload Characteristics

The drive is compliant with NEC and CEC requirements and equipped with protective functions against overload and overtemperature.

The following overload protection curve applies to hot start at an ambient temperature of 40℃, which cannot guarantee continuous duty in cases of 100% output or above. During use, keep the effective torque of the load within the continuous duty zone.

To protect different load motors, set the motor overload protection gain based on the overload capacity of the motor. Use the default gain in general conditions. However, when one of the following conditions occurs, change the gain based on actual motor temperature:

- The motor operates in environments with high temperature.
- The motor is in cyclic motion featuring a short motion cycle and frequent acceleration/ deceleration.
- Overload thermal protection only occurs during continuous energized operation. You need to check the motor temperature when the drive is powered off.

The motor overload protection curve is shown in the following figure.

- **MS1H1/H4 (frame size 40/60/80)**

Load ratio (%)	Operating time (s)
120	230
130	80
140	40
150	30
160	20
170	17
180	15
190	12
200	10
210	8.5
220	7
230	6
240	5.5
250	5
300	3
350	2

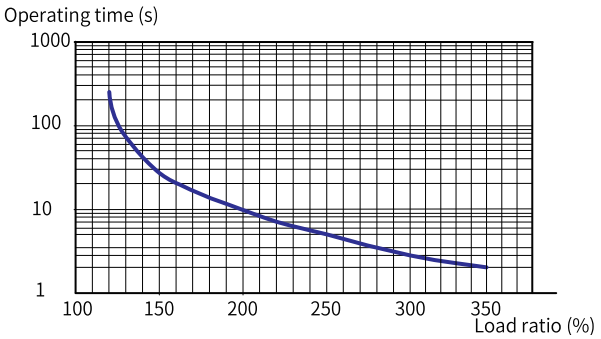


Figure 19-4 MS1H1/H4 (frame size 40/60/80) series motor overload curve

Note

The maximum torque of H1 and H4 models is the rated torque x 3.5.

- **MS1H2/MS1H3**

Load ratio (%)	Operating time (s)
115	6000
120	2533
125	1226
130	915
135	769
140	527
145	352
150	221
155	128
160	99
165	83
170	67
175	55
180	49
185	45
190	41
195	38
200	34
205	31
210	28
215	24
220	22
225	21
230	19
235	18
240	16
245	14
250	13
255	12
260	11
265	10
270	9
275	9
280	8
285	7
290	6
295	5
300	5

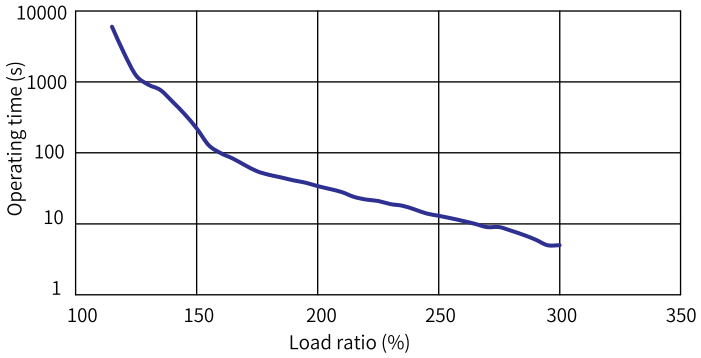


Figure 19-5 Overload curve of MS1H2 and MS1H3 series motors

Note

- The maximum torque of H2 models is the rated torque x 3.
- The maximum torque of H3 models is the rated torque x 2.5.

- **MS1H1-03B30CB-U210R-S**

Load ratio (%)	Operating time (s)
120	75.00
130	43.39
140	27.97
150	19.84
160	15.10
170	15.02
180	9.82
190	8.12
200	6.70
210	5.62
220	4.79
230	4.14
240	3.63
250	3.22
260	2.89
270	2.61
280	2.38
290	2.18
300	2.01
310	1.86
320	1.73
330	1.60
340	1.50
350	1.40

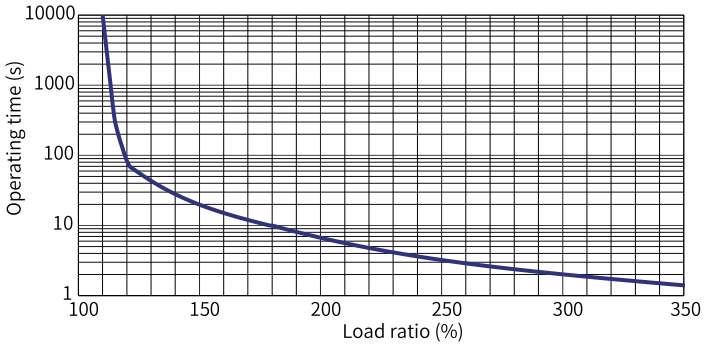


Figure 19-6 Overload curve of MS1H1-03B30CB-U210R-S series motors

19.1.1.3 Derating Characteristics

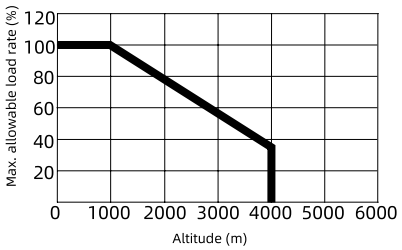
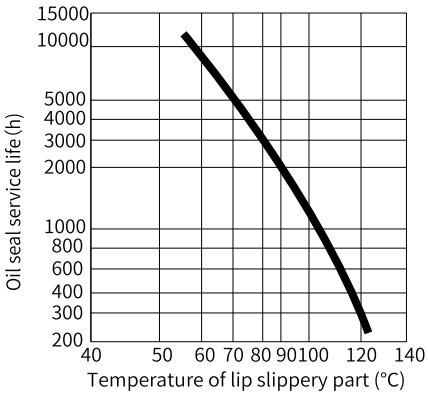


Figure 19-7 Altitude-based derating curve

19.1.1.4 Temperature Curve of the Oil Seal



19.1.1.5 Load Moment of Inertia

The load moment of inertia represents the ratio of the load inertia to the rotor inertia. The higher the load inertia ratio, the weaker the responsiveness will be. An excessively high inertia ratio can result in unstable operation. The allowable load inertia ratio of the servo motor is limited. The value is a general standard and varies according to the driving conditions of the servo motor.

An overvoltage alarm may occur during deceleration if the load moment of inertia exceeds the allowable value. For servo drives with a built-in braking resistor, an overload alarm may be reported. In cases of such alarms, take one of the following measures:

- Reduce the torque limit value.
- Reduce the deceleration rate.

- Reduce the maximum speed.
- Install an external braking resistor if the warning cannot be cleared using the above measures.

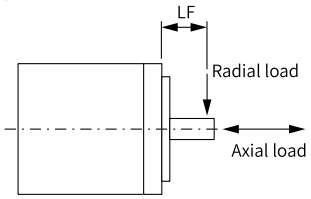
Caution

- For the built-in braking resistor of the drive, see section "Components".
- Even if you use a built-in resistor, the energy generated in some regenerative conditions may exceed the allowable capacity loss (W) of the resistor. Therefore, an external braking resistor is required.

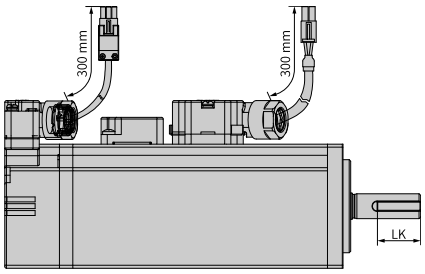
19.1.2 Motor Model Selection

19.1.2.1 Selection Precautions

- Description of torque-speed characteristics curves:
  - All parameters and torque-speed characteristic values are subject to the conditions that the motor works with an Inovance servo drive and the armature coil temperature is 20°C.
  - Continuous working area: refers to a series of states in which the motor can operate safely and continuously, and the actual torque must be located in this area.
  - Intermittent duty zone: refers to a series of states in which the motor can run within a short period of time when the actual torque is greater than the rated torque.
- The characteristic values are obtained in cases where the motor is installed with the following heatsink (unit: mm):
  - MS1H1 to MS1H4: 250 × 250 × 6 (aluminum)
  - MS1H2-10C to 25C: 400 × 400 × 20 (steel)
  - MS1H2-30C to 50C: 400 × 400 × 20 (steel)
  - MS1H3-85B to 18C: 400 × 400 × 20 (steel)
  - MS1H3-29C to 55C: 550 × 550 × 30 (aluminum)
  - MS1H3-75C: 700 × 700 × 30 (aluminum)
- Radial and axial loads of the motor:



- Dimensions of flying leads type motors
  Flying leads type motors with frame size 80 and below (model ended with "-S") provide a drain wire of about 300 mm in length, as shown in the following figure.



- As shown in the preceding figure, the product is marked with an LK value in the dimension diagram in the section of each model. LK indicates the length of the shaft key.
- MS1H3 (130-flange and 180-flange) comes with a key slot. When the operating speed is above 3000 rpm, the motor must run with the keyway. If you need to run the motor without the keyway at speeds higher than 3000 rpm, contact Inovance.

Note

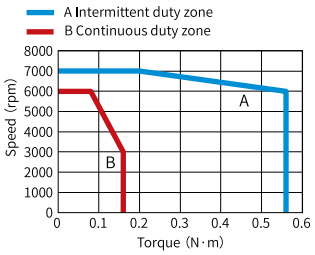
- Values inside the parentheses in the sections corresponding to the models are parameters of the servo motor carrying a brake.
- The motor with oil seal must be derated by 10% during use.
- Use your own DC power supply as 24 V power supply of the brake. For the cable connecting the DC power supply to the motor brake, it is recommended to use cables with a diameter of 0.2 mm^2 or above for motors with low power of 750 W or below. It is recommended to use cables with a diameter of 0.8 mm^2 or above for motors with a power of 750 W or above. The brake cannot share the power supply with other appliances to prevent the voltage or current from falling due to the simultaneous operation of other electrical appliances, which may result in brake malfunction.
- Do not share a power supply with multiple brakes. Otherwise, the coil is short-circuited after one brake is dry-worn, causing failures to start the brakes that are connected to the power supply in parallel.
- The brake apply time and release time vary with the discharge circuit. Check the actual action delay of the product during use. The holding brake cannot be used for braking purpose.

19.1.2.2 Low Inertia and Small Capacity (MS1H1)

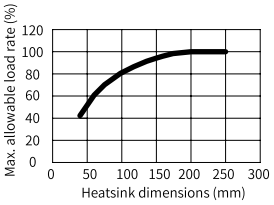
19.1.2.2.1 MS1H1-05B30CB-A33*R-INT

Motor specifications		
Frame size (mm)	40	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.05	
Rated voltage (V)	220	
Rated torque (N·m)	0.16	
Maximum torque (N·m)	0.56	
Rated frequency (Hz)	250	
Rated current (A)	1.2	
Maximum current (A)	4.8	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/A)	0.15	
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.018 ± 10%
	Motor with brake	0.0208 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



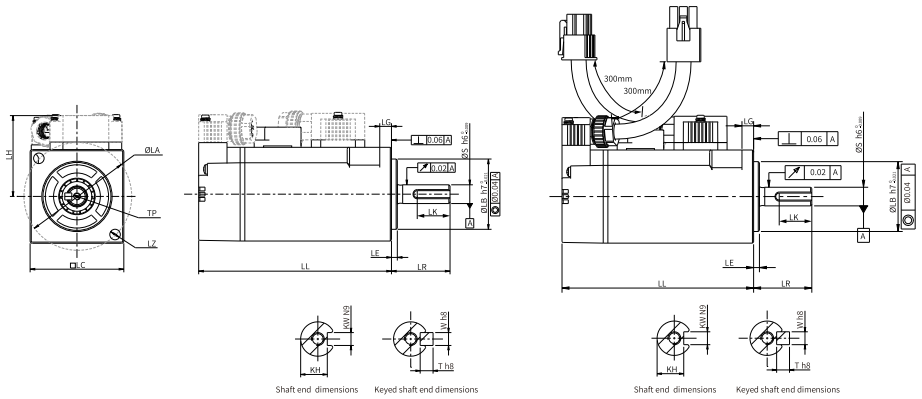
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

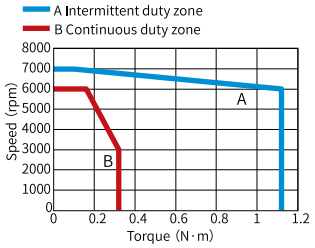
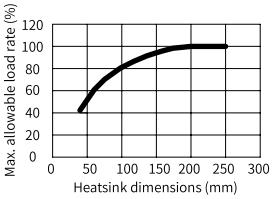
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)



LL	LC	LR	LA	LZ	LH	LG	LE	
54.5 (81.8)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	140 - 0.36	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.43)

19.1.2.2.2 MS1H1-10B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	250		
Rated current (A)	1.2		Heatsink-based derating curve
Maximum current (A)	4.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.30		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.0316 ± 10%	
	Motor with brake	0.0345 ± 10%	

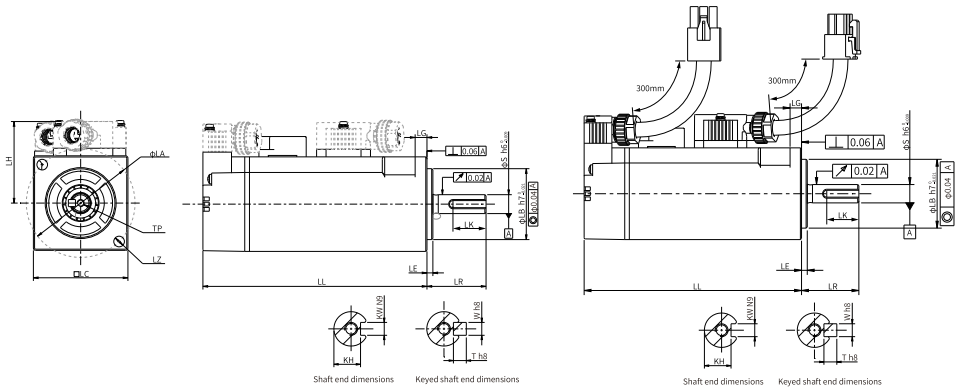
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

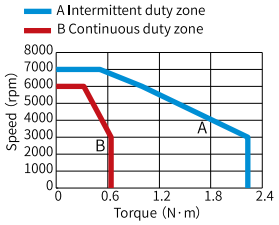
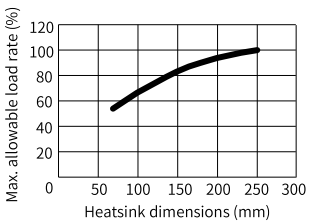
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)



LL	LC	LR	LA	LZ	LH	LG	LE	
67 (94.3)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	140 - 0.36	$6.2^{0}_{-0.1}$	3	3	3	0.35 (0.52)

19.1.2.2.3 MS1H1-20B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.2		
Voltage (V)	220		
Rated torque (N·m)	0.64		
Maximum torque (N·m)	2.24		
Rated frequency (Hz)	250		
Rated current (A)	1.5		Heatsink-based derating curve
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.094 ± 10%	
	Motor with brake	0.106 ± 10%	

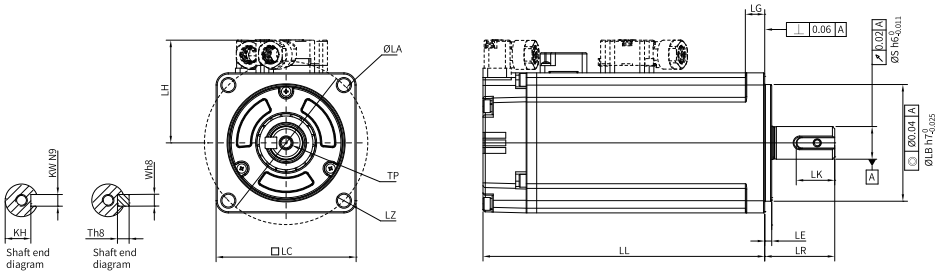
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

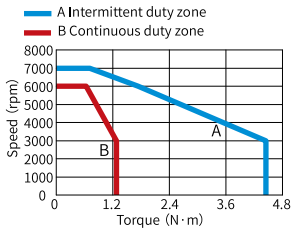
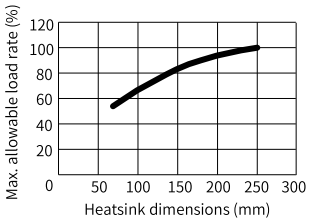
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	75.5 (103)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	160 -0.53	110 -0.1	5	5	5	0.80 (1.17)

19.1.2.2.4 MS1H1-40B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.5		Heatsink-based derating curve
Maximum current (A)	9.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.57		
Rotor moment of inertia (kg·cm²)	Motor without brake	0.145 ± 10%	
	Motor with brake	0.157 ± 10%	

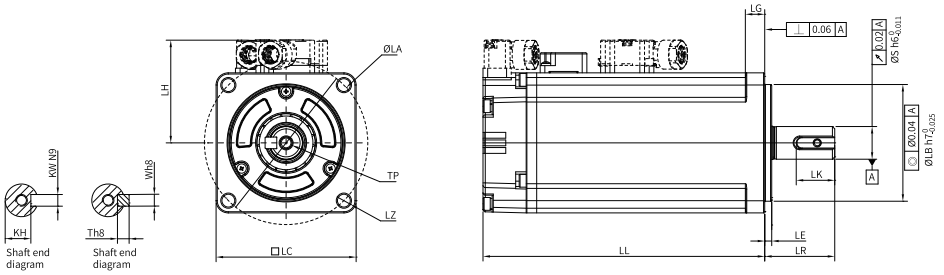
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

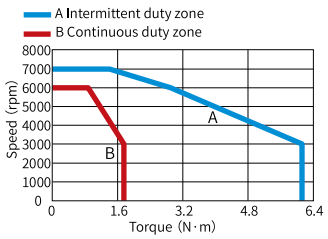
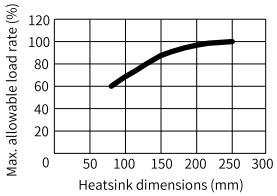
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	93 (121)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	160 -0.53	110 -0.1	5	5	5	1.11 (1.48)

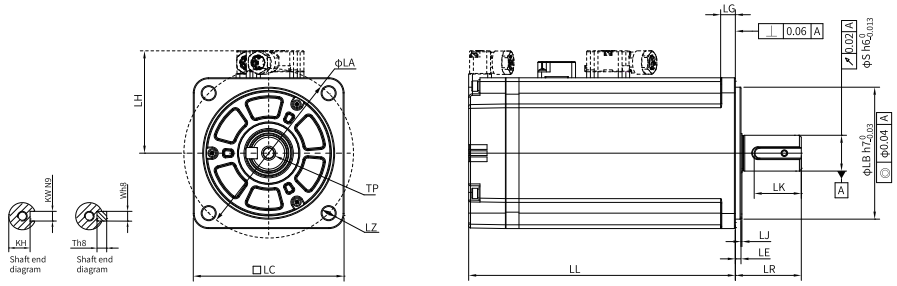
19.1.2.2.5 MS1H1-55B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.9		Heatsink-based derating curve
Maximum current (A)	15		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia (kg·cm^2)	Motor without brake	0.55 ± 10%	
	Motor with brake	-	

Allowable load

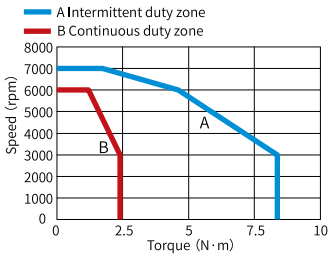
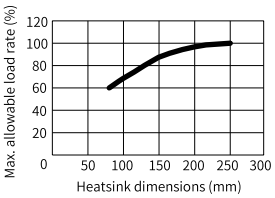
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 - 0.62	15.50 - 0.1	6	6	6	1.88

19.1.2.2.6 MS1H1-75B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.75		
Voltage (V)	220		
Rated torque (N·m)	2.39		
Maximum torque (N·m)	8.36		
Rated frequency (Hz)	250		
Rated current (A)	4.4		Heatsink-based derating curve
Maximum current (A)	16.9		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.62		
Rotor moment of inertia (kg·cm²)	Motor without brake	0.68 ± 10%	
	Motor with brake	0.71 ± 10%	

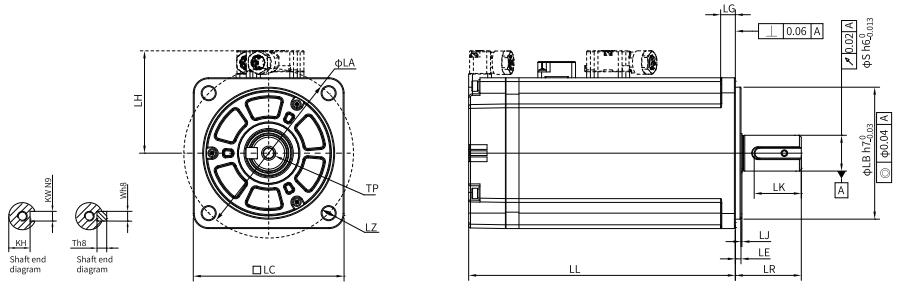
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

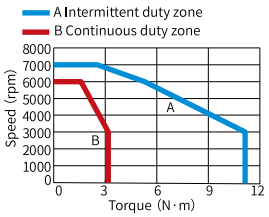
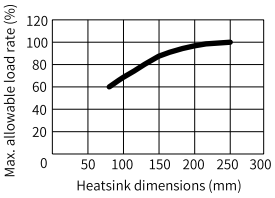
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (141.5)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 $^{-0.62}$	15.50 $^{-0.1}$	6	6	6	2.22 (2.88)

19.1.2.2.7 MS1H1-10C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.13		
Rated frequency (Hz)	250		
Rated current (A)	6.2		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.59		
Rotor moment of inertia (kg·cm^2)	Motor without brake	0.82 ± 10%	
	Motor with brake	0.87 ± 10%	

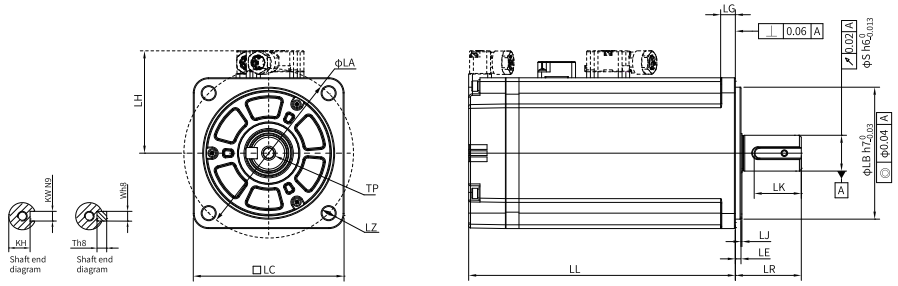
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

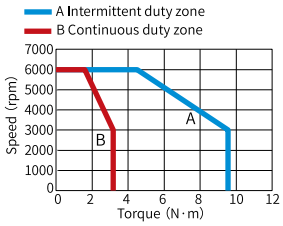
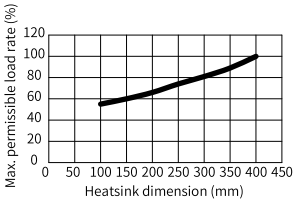
Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	119.2 (153.4)	35 ± 0.5	90	4 × φ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 -0.62	15.50 -0.1	6	6	6	2.61 (3.27)

19.1.2.3 Low Inertia and Medium Capacity (MS1H2)

19.1.2.3.1 MS1H2-10C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia and capacity	low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	6.4		Heatsink-based derating curve
Maximum current (A)	23		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	6000		
Torque coefficient (N·m/A)	0.54		
Rotor moment of inertia (kg·cm²)	Motor without brake	1.78±10%	
	Motor with brake	2.6±10%	

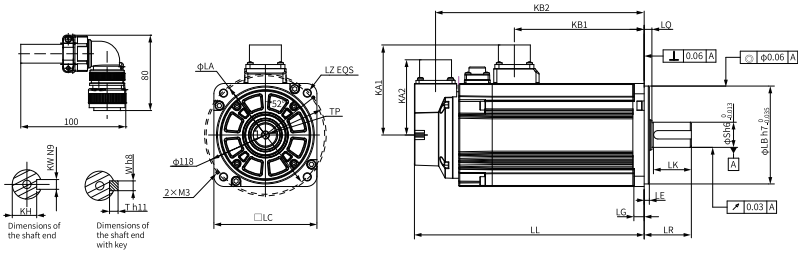
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable loads

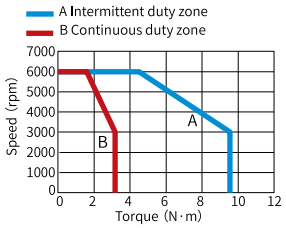
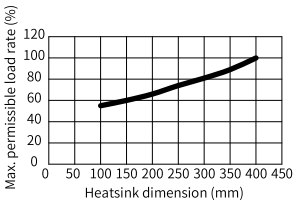
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Product dimensions (in mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45±1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5±0.3
LQ	LB		S	TP	LK	KH	KW	W	T	Weight (kg)
7.5±0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

19.1.2.3.2 MS1H2-10C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	380		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	11		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.07		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.78 ± 10%	
	Motor with brake	2.6 ± 10%	

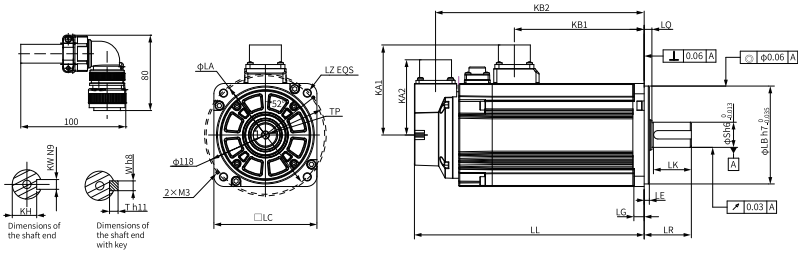
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

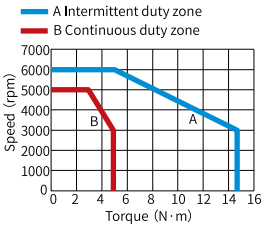
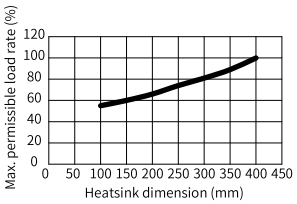
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45 ± 1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	3.85 (4.9)

19.1.2.3.3 MS1H2-15C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	220		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	8.6		Heatsink-based derating curve
Maximum current (A)	32		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.62		
Rotor moment of inertia (kg·cm²)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

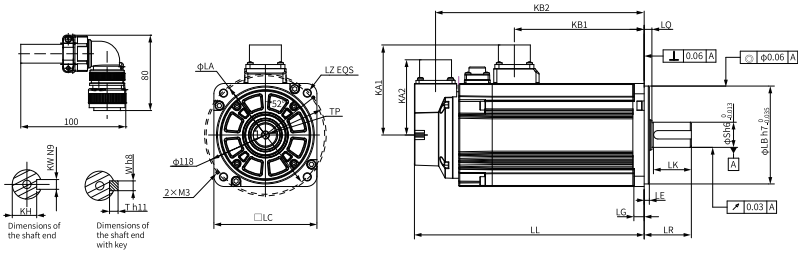
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

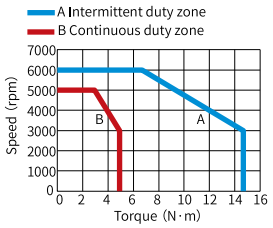
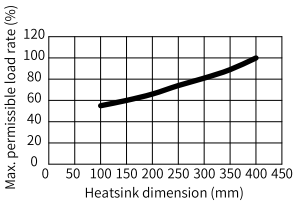
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	4.65 (5.75)

19.1.2.3.4 MS1H2-15C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	380		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	4.2		Heatsink-based derating curve
Maximum current (A)	14		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.28		
Rotor moment of inertia (kg·cm²)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

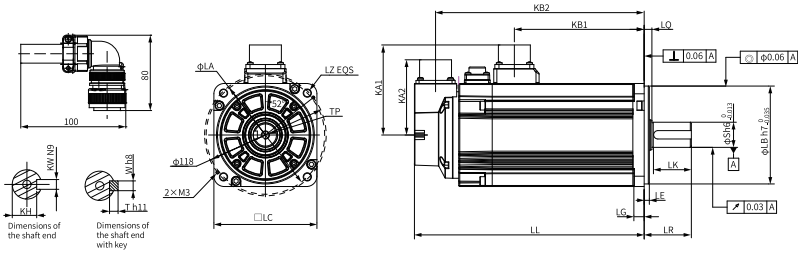
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

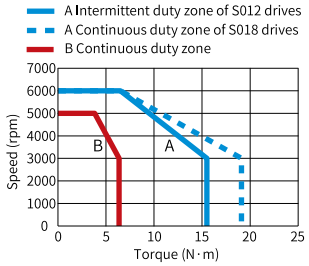
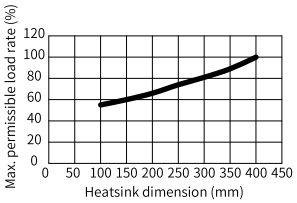
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 - 0.62	200 - 0.2	8	8	7	4.65 (5.75)

19.1.2.3.5 MS1H2-20C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	220		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	11.3		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.60		
Rotor moment of inertia (kg·cm²)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

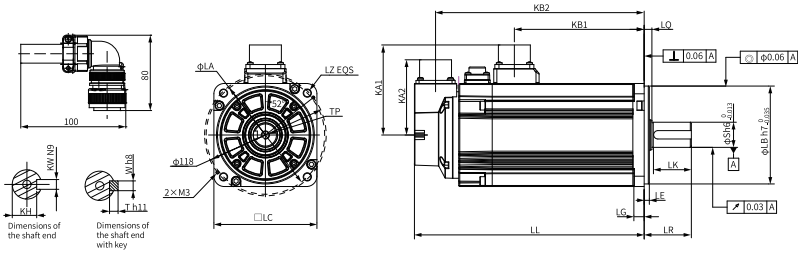
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

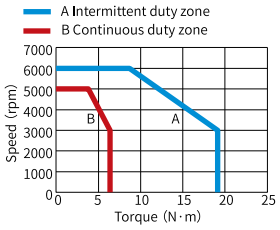
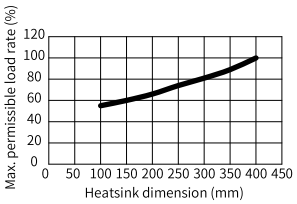
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	350 - 0.62	200 - 0.2	8	8	7	5.5 (6.55)

19.1.2.3.6 MS1H2-20C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	380		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	5.6		Heatsink-based derating curve
Maximum current (A)	20		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.19		
Rotor moment of inertia (kg·cm²)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

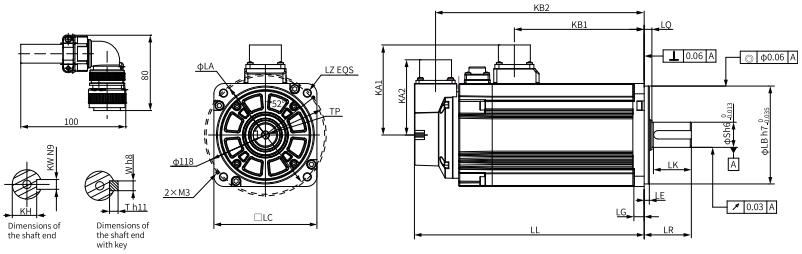
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

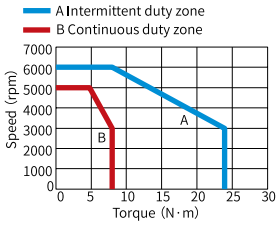
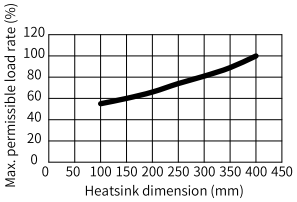
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	350 -0.62	200 -0.2	8	8	7	5.5 (6.55)

19.1.2.3.7 MS1H2-25C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	220		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	14.7		Heatsink-based derating curve
Maximum current (A)	53		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.60		
Rotor moment of inertia (kg·cm²)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

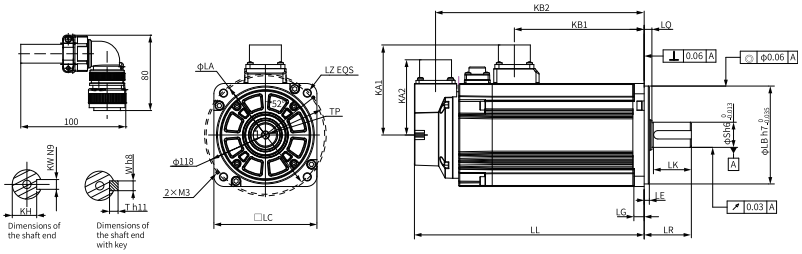
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

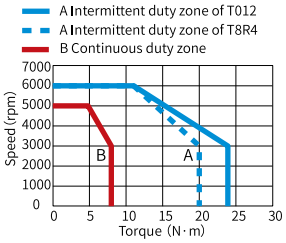
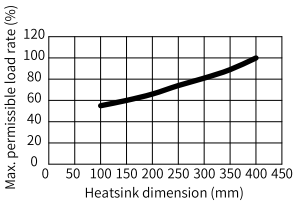
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	350 -0.62	200 -0.2	8	8	7	6.3 (7.35)

19.1.2.3.8 MS1H2-25C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	380		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	7.2		Heatsink-based derating curve
Maximum current (A)	26		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.18		
Rotor moment of inertia (kg·cm²)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

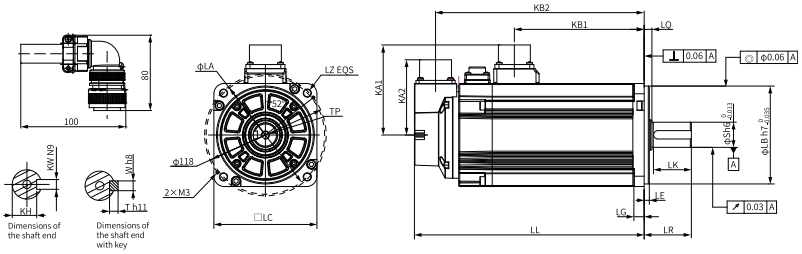
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

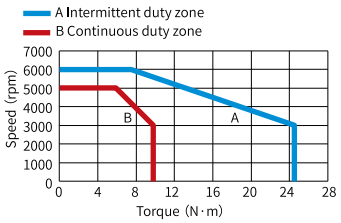
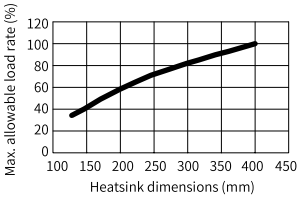
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 - 0.62	200 - 0.2	8	8	7	6.3 (7.35)

19.1.2.3.9 MS1H2-30C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	220		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	24.5		
Rated frequency (Hz)	150		
Rated current (A)	16.6		Heatsink-based derating curve
Maximum current (A)	55		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.67		
Rotor moment of inertia (kg·cm²)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

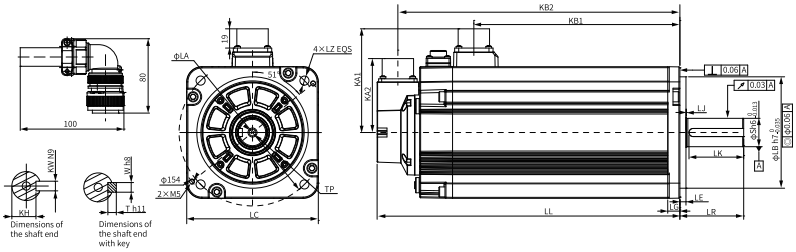
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

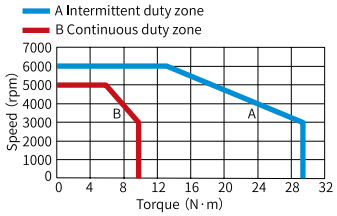
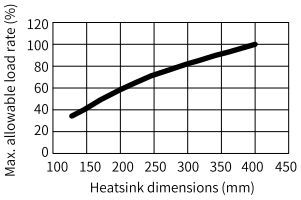
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 $^{-0.62}$	240 $^{-0.2}$	8	8	7	10.0 (11.9)

19.1.2.3.10 MS1H2-30C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	380		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	29.4		
Rated frequency (Hz)	150		
Rated current (A)	8.9		Heatsink-based derating curve
Maximum current (A)	29		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia (kg·cm^2)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

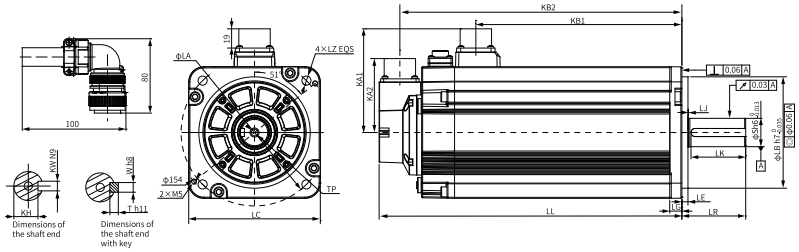
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

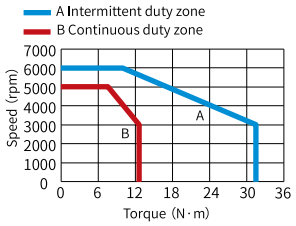
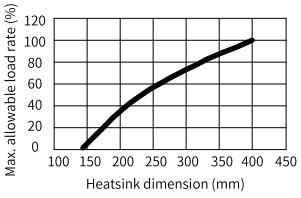
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 $^{0}_{-0.62}$	240 $^{0}_{-0.2}$	8	8	7	10.0 (11.9)

19.1.2.3.11 MS1H2-40C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	220		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	31.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.65		
Rotor moment of inertia (kg·cm^2)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

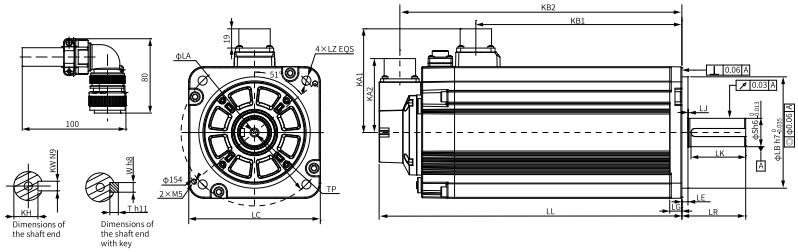
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

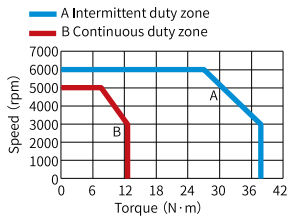
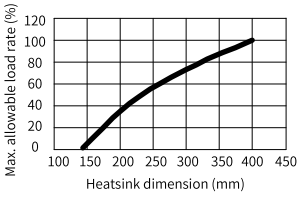
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	530 $^{0}_{-0.62}$	240 $^{0}_{-0.2}$	8	8	7	13.2 (15.1)

19.1.2.3.12 MS1H2-40C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	380		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	37.8		
Rated frequency (Hz)	150		
Rated current (A)	13.5		Heatsink-based derating curve
Maximum current (A)	42.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.06		
Rotor moment of inertia (kg·cm^2)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

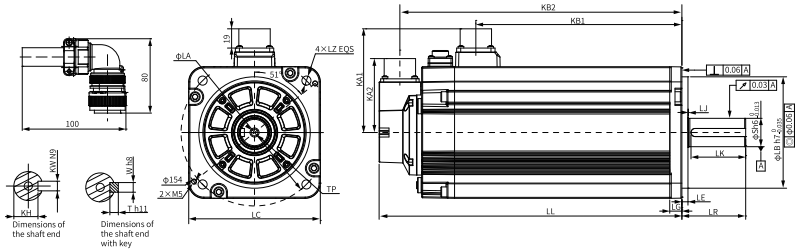
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

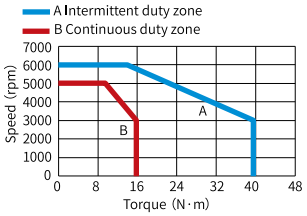
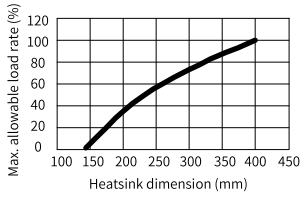
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	530 $^{-0.62}$	240 $^{-0.2}$	8	8	7	13.2 (15.1)

19.1.2.3.13 MS1H2-50C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	220		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	39.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.81		
Rotor moment of inertia (kg·cm^2)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

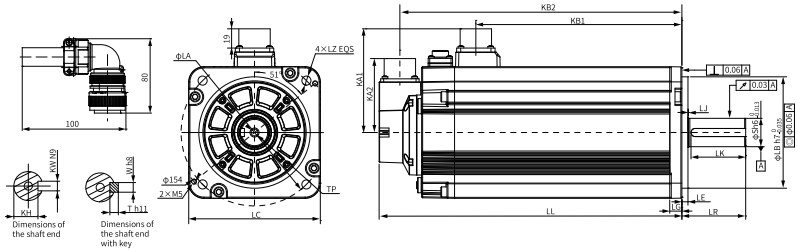
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

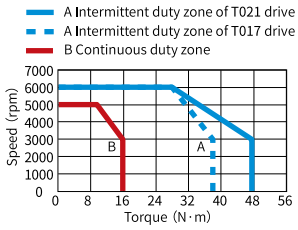
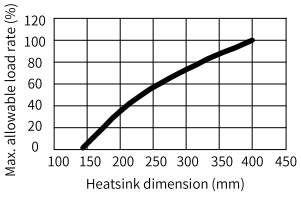
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	530 $^{0}_{-0.62}$	240 $^{0}_{-0.2}$	8	8	7	16.35 (18.25)

19.1.2.3.14 MS1H2-50C30CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	380		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	47.4		
Rated frequency (Hz)	150		
Rated current (A)	17		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.04		
Rotor moment of inertia (kg·cm^2)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

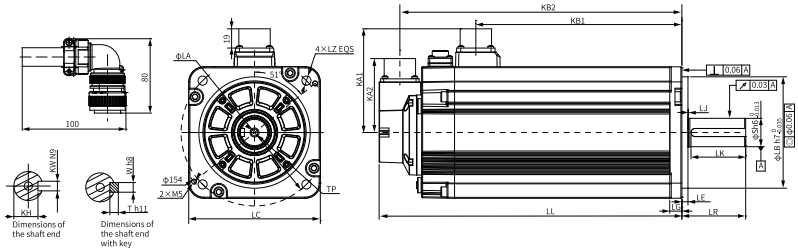
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

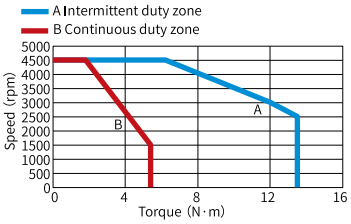
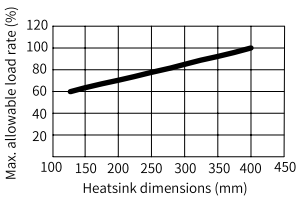
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	530 $^{0}_{-0.62}$	240 $^{0}_{-0.2}$	8	8	7	16.35 (18.25)

19.1.2.4 Medium Inertia and Medium Capacity (MS1H3)

19.1.2.4.1 MS1H3-85B15CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	0.85		
Voltage (V)	220		
Rated torque (N·m)	5.39		
Maximum torque (N·m)	13.5		
Rated frequency (Hz)	125 m		
Rated current (A)	6.6		Heatsink-based derating curve
Maximum current (A)	17.2		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	0.93		
Rotor moment of inertia (kg·cm^2)	Motor without brake	13.56 ± 10%	
	Motor with brake	15.8 ± 10%	

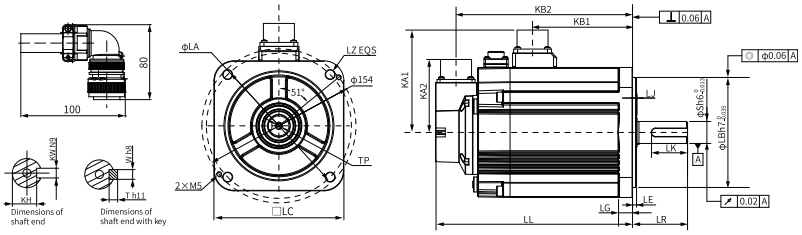
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

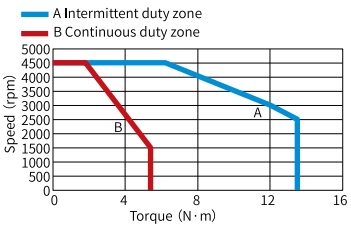
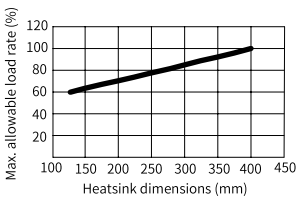
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	350 $^{0.62}_{-}$	180 $^{0.2}_{-}$	8	8	7	5.8 (7.7)

19.1.2.4.2 MS1H3-85B15CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	0.85		
Voltage (V)	380		
Rated torque (N·m)	5.39		
Maximum torque (N·m)	13.5		
Rated frequency (Hz)	125 m		
Rated current (A)	3.5		Heatsink-based derating curve
Maximum current (A)	8.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.84		
Rotor moment of inertia (kg·cm^2)	Motor without brake	13.56 ± 10%	
	Motor with brake	15.8 ± 10%	

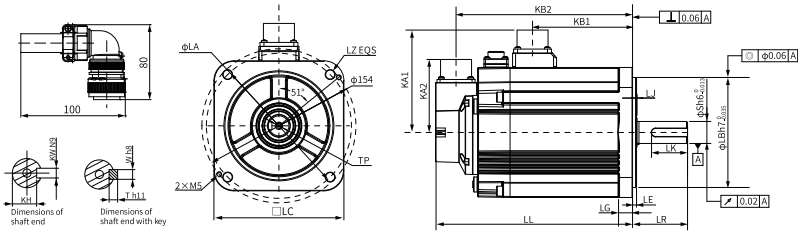
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

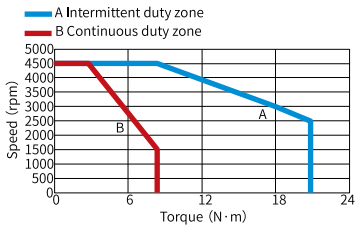
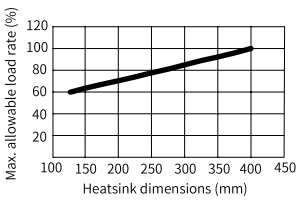
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 - 0.62	180 - 0.2	8	8	7	5.8 (7.7)

19.1.2.4.3 MS1H3-13C15CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.3		
Voltage (V)	220		
Rated torque (N·m)	8.34		
Maximum torque (N·m)	20.85		
Rated frequency (Hz)	125 m		
Rated current (A)	10.5		Heatsink-based derating curve
Maximum current (A)	27.3		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	0.89		
Rotor moment of inertia (kg·cm²)	Motor without brake	19.25 ± 10%	
	Motor with brake	21.5 ± 10%	

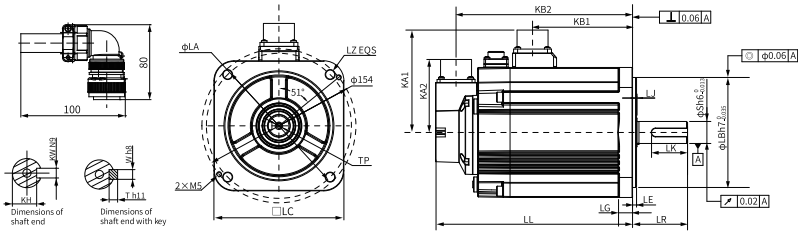
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

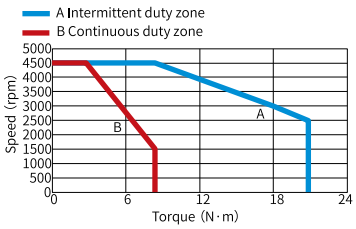
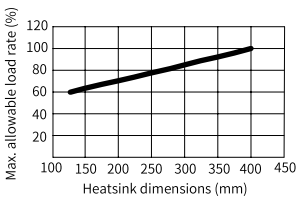
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	350 - 0.62	180 - 0.2	8	8	7	7.1 (8.9)

19.1.2.4.4 MS1H3-13C15CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.3		
Voltage (V)	380		
Rated torque (N·m)	8.34		
Maximum torque (N·m)	20.85		
Rated frequency (Hz)	125 m		
Rated current (A)	5.1		Heatsink-based derating curve
Maximum current (A)	12.6		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.85		
Rotor moment of inertia (kg·cm²)	Motor without brake	19.25 ± 10%	
	Motor with brake	21.5 ± 10%	

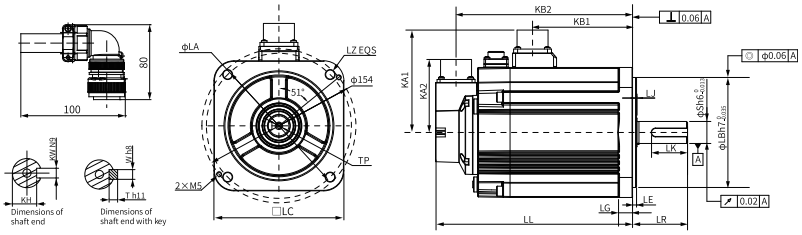
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

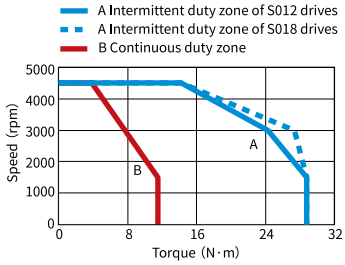
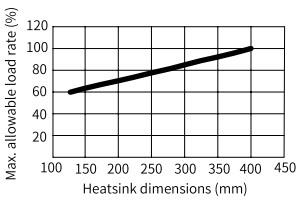
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 -0.62	180 -0.2	8	8	7	7.1 (8.9)

19.1.2.4.5 MS1H3-18C15CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	220		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125 m		
Rated current (A)	11.9		Heatsink-based derating curve
Maximum current (A)	32.2		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.09		
Rotor moment of inertia (kg·cm²)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

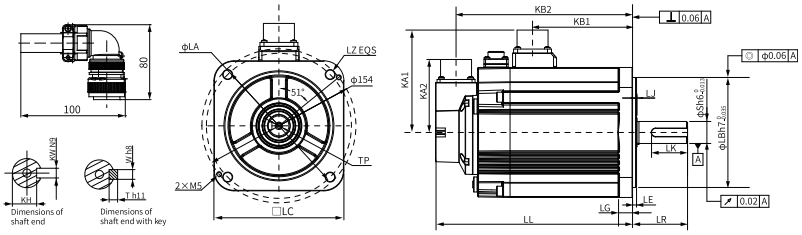
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

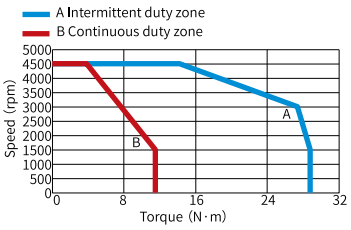
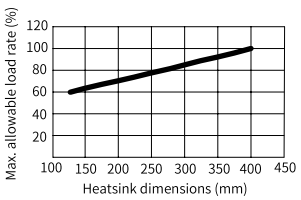
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	350 -0.62	180 -0.2	8	8	7	8.5 (10.3)

19.1.2.4.6 MS1H3-18C15CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	380		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125 m		
Rated current (A)	6.75		Heatsink-based derating curve
Maximum current (A)	17.7		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.87		
Rotor moment of inertia (kg·cm²)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

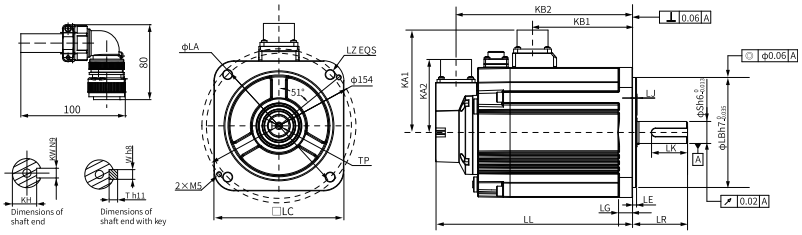
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

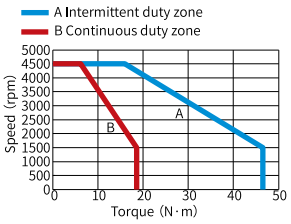
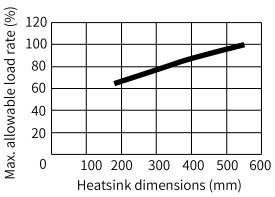
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	350 -0.62	180 -0.2	8	8	7	8.5 (10.3)

19.1.2.4.7 MS1H3-29C15CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	2.9		
Voltage (V)	220		
Rated torque (N·m)	18.6		
Maximum torque (N·m)	46.5		
Rated frequency (Hz)	125 m		
Rated current (A)	18		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.16		
Rotor moment of inertia (kg·cm²)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

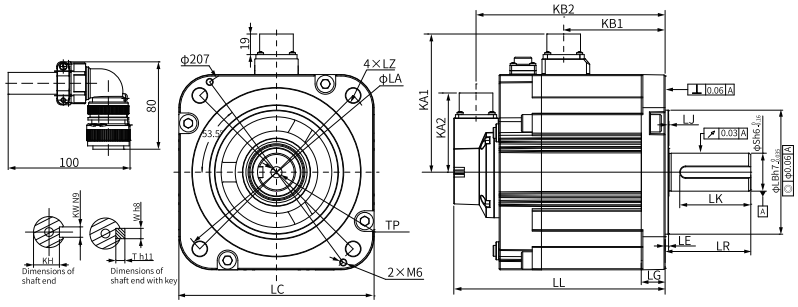
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

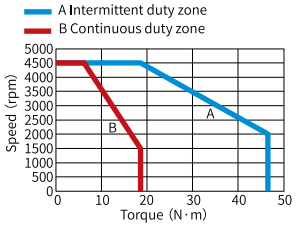
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

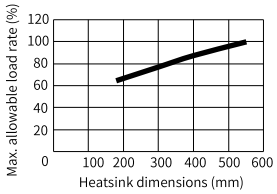
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	13.8 (17.9)

19.1.2.4.8 MS1H3-29C15CD-A33*R-INT

Motor specifications		Torque-speed characteristics
Frame size (mm)	180	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	2.9	
Voltage (V)	380	
Rated torque (N·m)	18.6	
Maximum torque (N·m)	46.5	
Rated frequency (Hz)	125 m	
Rated current (A)	10.5	Heatsink-based derating curve

Motor specifications			Torque-speed characteristics
Maximum current (A)	29.75		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.94		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

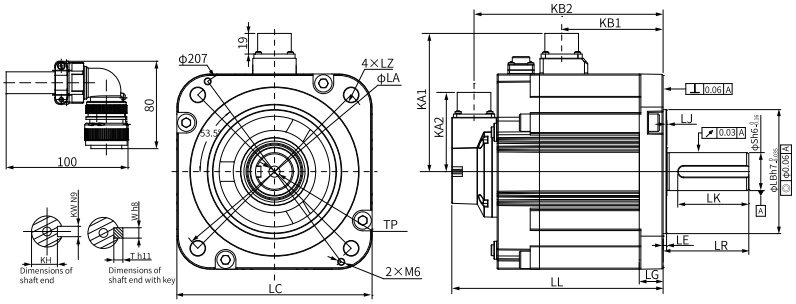
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

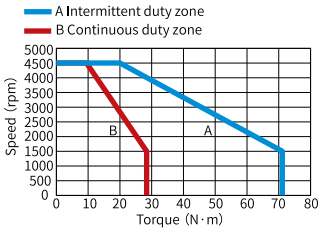
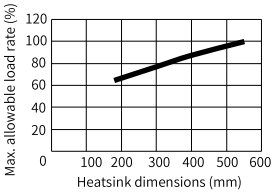
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		35	M12 × 25	640 - 0.74	300 - 0.2	10	10	8	13.8 (17.9)

19.1.2.4.9 MS1H3-44C15CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	220		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125 m		
Rated current (A)	25.5		Heatsink-based derating curve
Maximum current (A)	67		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

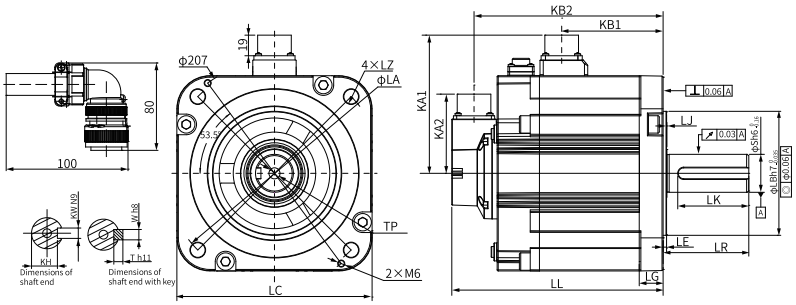
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

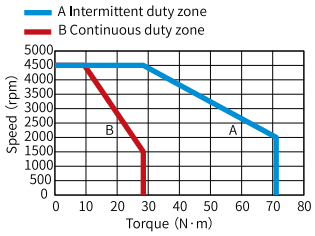
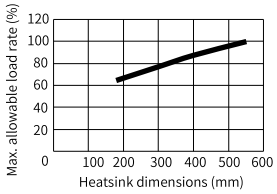
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	17.4 (21.9)

19.1.2.4.10 MS1H3-44C15CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	380		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125 m		
Rated current (A)	16		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.96		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

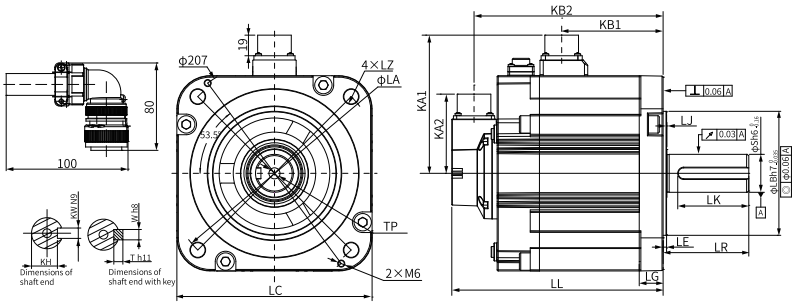
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

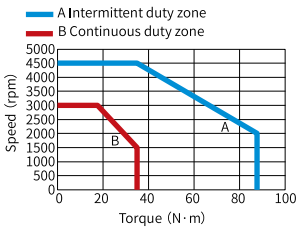
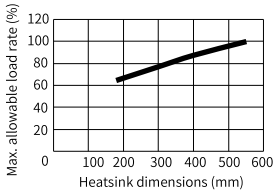
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	17.4 (21.6)

19.1.2.4.11 MS1H3-55C15CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	5.5		
Voltage (V)	380		
Rated torque (N·m)	35		
Maximum torque (N·m)	87.6		
Rated frequency (Hz)	125 m		
Rated current (A)	20.7		Heatsink-based derating curve
Maximum current (A)	52		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.92		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	86.9 ± 10%	
	Motor with brake	94.55 ± 10%	

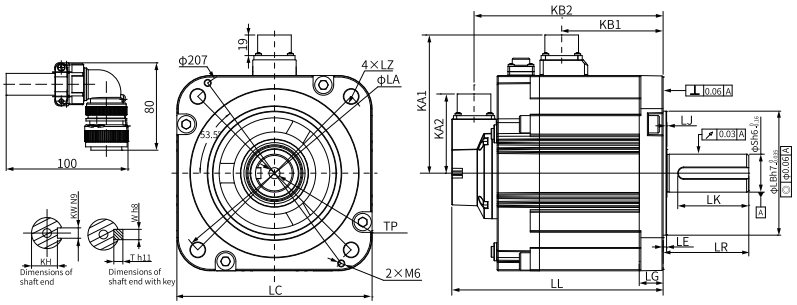
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

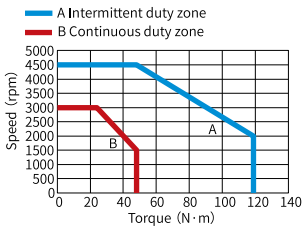
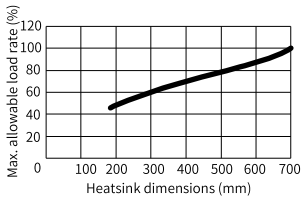
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	208 (241.8)	113 ± 1	200	4 × ϕ13.5	127.4	140.5	73	187.5 (221.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		42	M16 × 32	950 $^{-0.87}$	370 $^{-0.2}$	12	12	8	21.7 (25.9)

19.1.2.4.12 MS1H3-75C15CD-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	7.5		
Voltage (V)	380		
Rated torque (N·m)	48		
Maximum torque (N·m)	119		
Rated frequency (Hz)	125 m		
Rated current (A)	25		Heatsink-based derating curve
Maximum current (A)	65		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	2.13		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	127.5 ± 10%	
	Motor with brake	135.15 ± 10%	

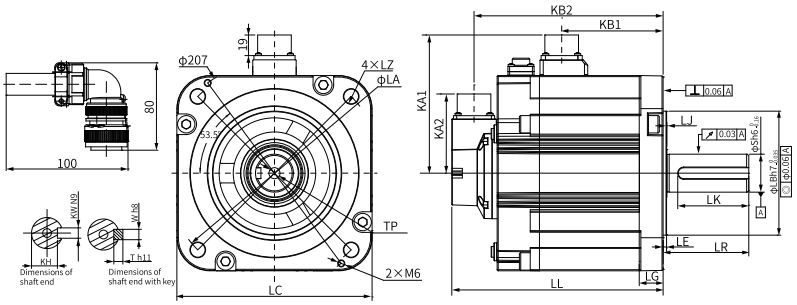
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

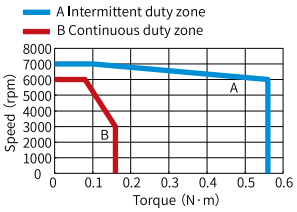
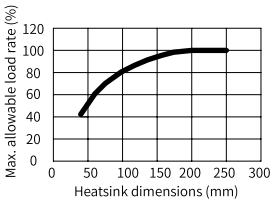
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	255 (288.8)	113 ± 1	200	4 × ϕ13.5	127.4	187.5	73	234.5 (268.5)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		42	M16 × 32	950 -0.87	370 -0.2	12	12	8	29 (33.2)

19.1.2.5 Medium Inertia and Small Capacity (MS1H4)

19.1.2.5.1 MS1H4-05B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Medium inertia, low capacity		
Rated output (kW)	0.05		
Voltage (V)	220		
Rated torque (N·m)	0.16		
Maximum torque (N·m)	0.56		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.15		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.038 ± 10%	
	Motor with brake	0.04 ± 10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)

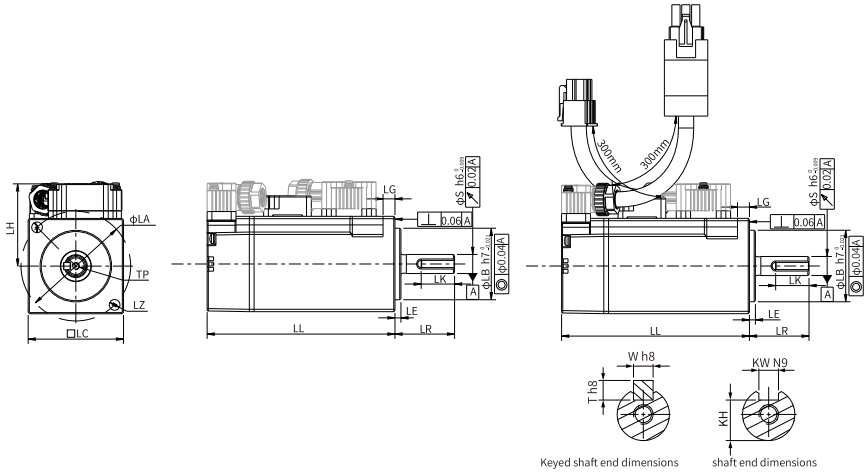


Figure 19-8 MS1H4-05B30CB-A330R and MS1H4-05B30CB-A332R

LL	LC	LR	LA	LZ	LH	LG	LE	
51 (78.3)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	140 - 0.36	$6.2^{0}_{-0.1}$	3	3	3	0.24 (0.40)

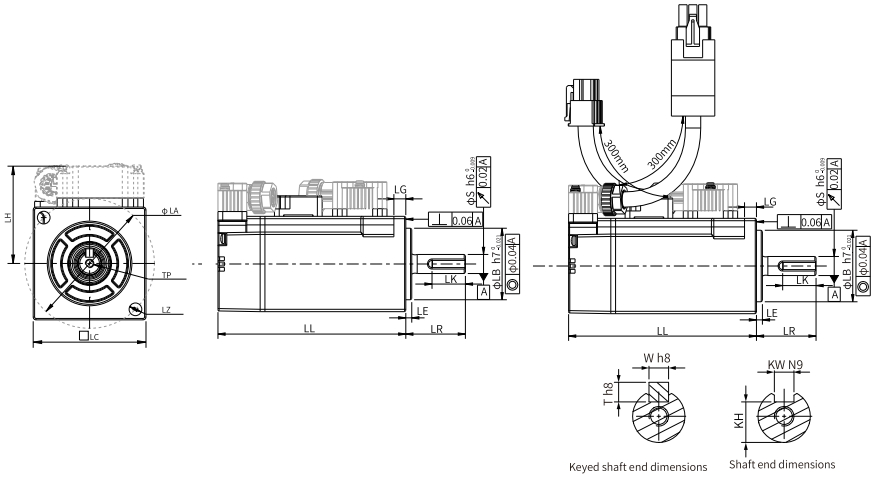
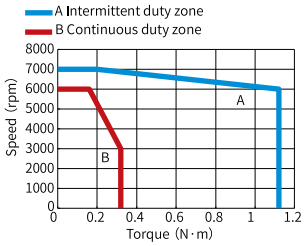
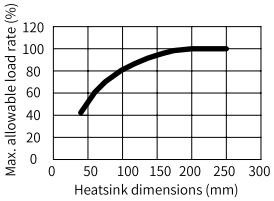


Figure 19-9 MS1H4-05B30CB-A331R and MS1H4-05B30CB-A334R

LL	LC	LR	LA	LZ	LH	LG	LE	
53.7 (81)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	140 - 0.36	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.42)

19.1.2.5.2 MS1H4-10B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Medium inertia, low capacity		
Rated output (kW)	0.1		
Voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.29		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.072 ± 10%	
	Motor with brake	0.074 ± 10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)

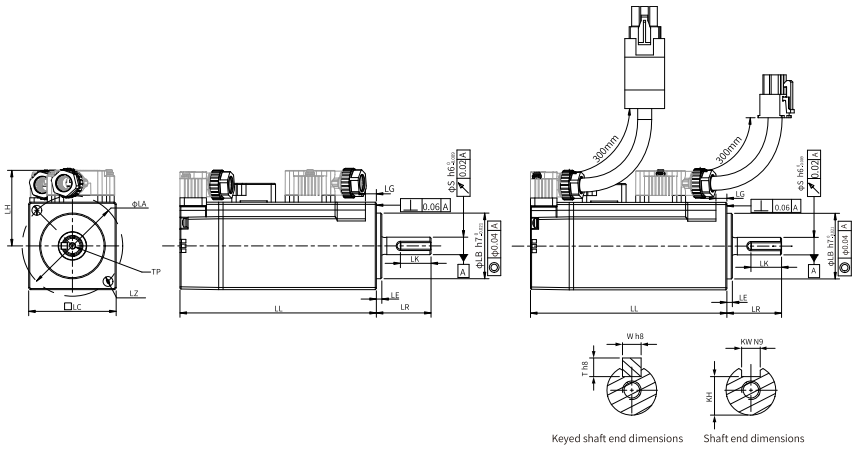


Figure 19-10 MS1H4-10B30CB-A330R and MS1H4-10B30CB-A332R

LL	LC	LR	LA	LZ	LH	LG	LE	
62 (89.3)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	140 -0.36	$6.2^{0}_{-0.1}$	3	3	3	0.32 (0.48)

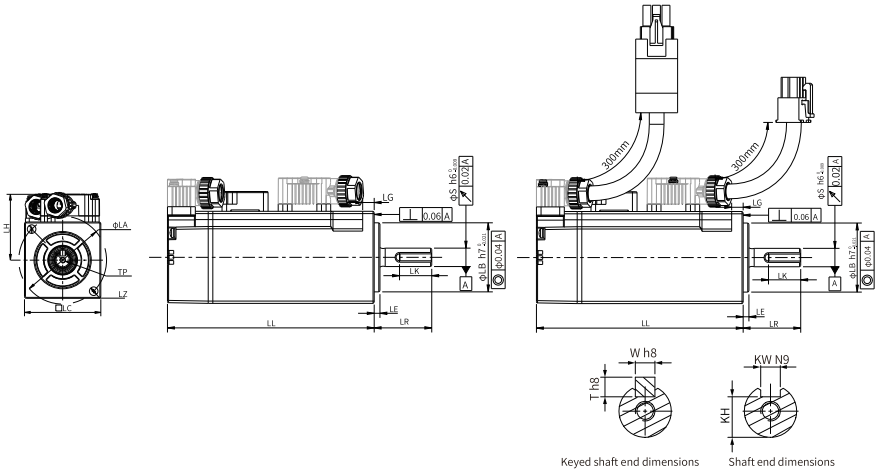
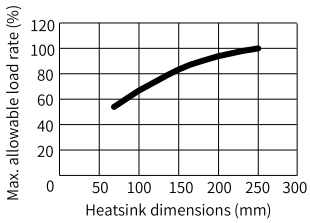


Figure 19-11 MS1H4-10B30CB-A331R and MS1H4-10B30CB-A334R

LL	LC	LR	LA	LZ	LH	LG	LE	
64.7 (92)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	140 -0.36	$6.2^{0}_{-0.1}$	3	3	3	0.34 (0.50)

19.1.2.5.3 MS1H4-20B30CB-A33*R-INT

Motor specifications		Torque-speed characteristics
Frame size (mm)	60	A Intermittent duty zone B Continuous duty zone Speed (rpm) 8000 7000 6000 5000 4000 3000 2000 1000 0 0 0.6 1.2 1.8 2.4 Torque (N·m) B A
Inertia, capacity	Medium inertia, low capacity	
Rated power (kW)	0.2	
Voltage (V)	220	
Rated torque (N·m)	0.64	
Maximum torque (N·m)	2.24	
Rated frequency (Hz)	250	
Rated current (A)	1.3	Heatsink-based derating curve

Motor specifications			Torque-speed characteristics
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.55		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.22 ± 10%	
	Motor with brake	0.23 ± 10%	

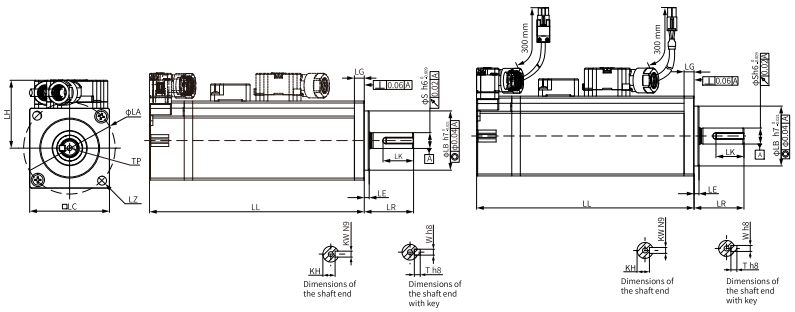
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable load

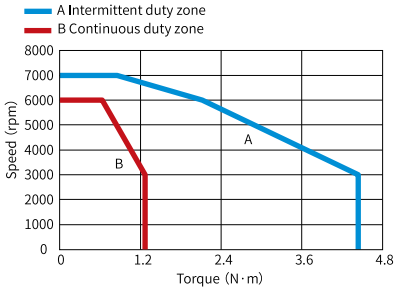
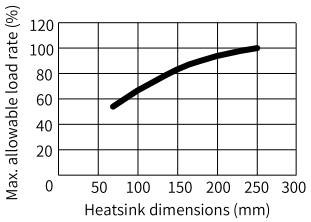
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	73.5 (101.1)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 8	16.50 $^{-0.53}$	110 - $^{0.1}$	5	5	5	0.78 (1.16)

19.1.2.5.4 MS1H4-40B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia and capacity	Medium inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.4		Heatsink-based derating curve
Maximum current (A)	9.2		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.43±10%	
	Motor with brake	0.44±10%	

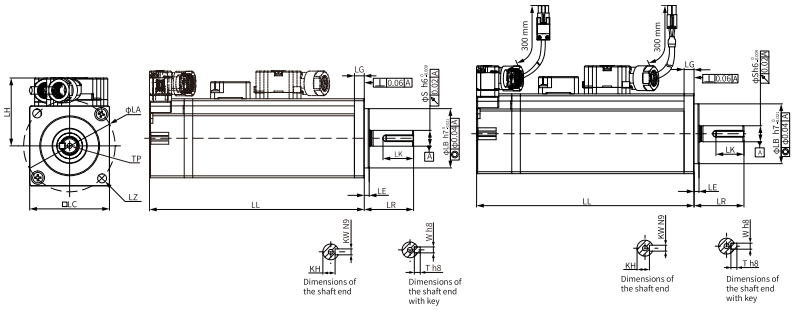
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable loads

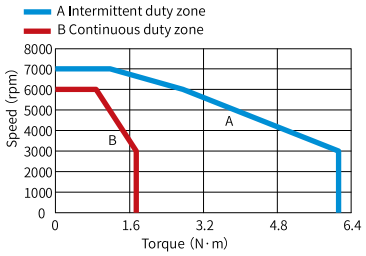
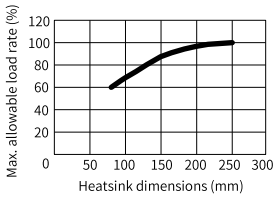
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Product dimensions (in mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	92 (119.8)	30±0.5	70	4 × ϕ5.5	44	8.0	3±0.5	
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

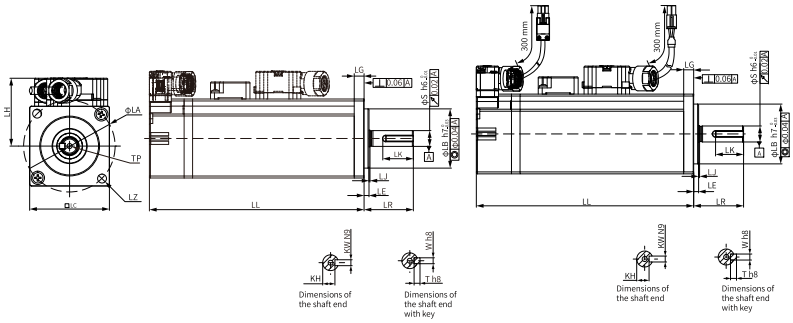
19.1.2.5.5 MS1H4-55B30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	13.2		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.12 ± 10%	
	Motor with brake	-	

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)

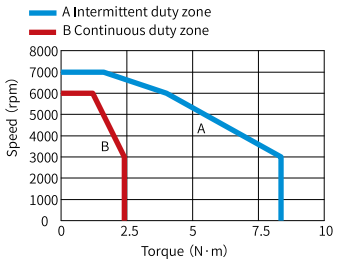


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$250_{-0.62}$	$15.50_{-0.1}$	6	6	6	1.85

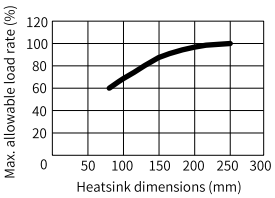
19.1.2.5.6 MS1H4-75B30CB-A33*R-INT

Motor specifications		
Frame size (mm)	80	
Inertia, capacity	Medium inertia, small capacity	
Rated power (kW)	0.75	
Voltage (V)	220	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.37	
Rated frequency (Hz)	250	
Rated current (A)	4.4	
Maximum current (A)	16.9	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/A)	0.63	
Rotor moment of inertia ($kg \cdot cm^2$)	Brake-less motor	1.46±10%
	Brake motor	1.51±10%

Torque-speed characteristics



Heatsink-based derating curve



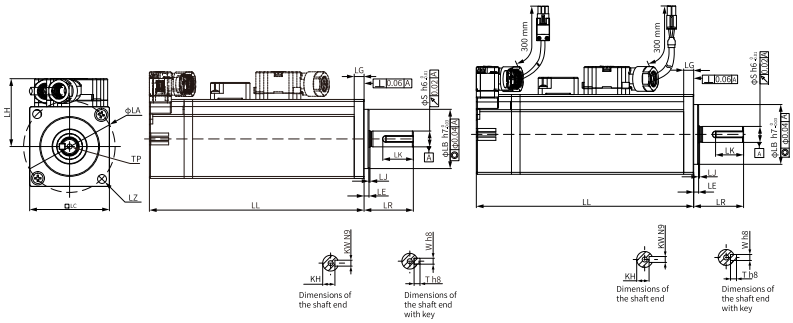
Electrical specifications of the brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

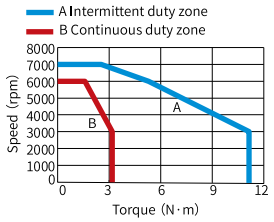
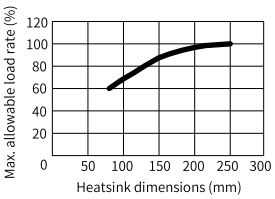
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Product dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (140.5)	35± 0.5	90	4 x ϕ7	54	7.5	3±0.5	0.5±0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6x20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.18 (2.82)

19.1.2.5.7 MS1H4-10C30CB-A33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.13		
Rated frequency (Hz)	250		
Rated current (A)	6.5		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.53		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.87 ± 10%	
	Motor with brake	1.97 ± 10%	

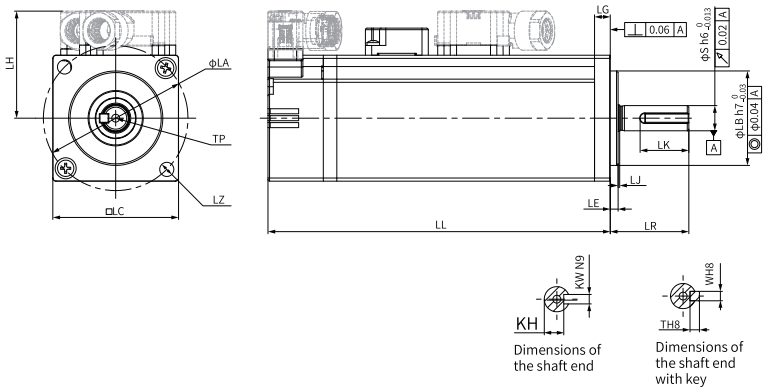
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)

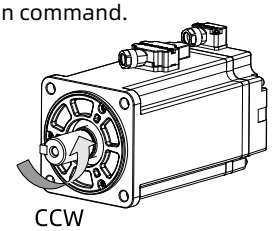


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	118.7 (153.2)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 $^{-0.62}$	15.50 $^{-0.1}$	6	6	6	2.55 (2.9)

19.2 MS1-R Series Servo Motor with Battery-free Encoder

19.2.1 General Specifications

19.2.1.1 Mechanical Characteristics

Item	Description
Duty type	S1 (Continuous duty)
Vibration grade[1]	V15
Insulation resistance	500 VDC, above 10 MΩ
Excitation mode	Permanent magnet
Installation method	Flange
Thermal class	F
Insulation voltage	1500 VAC, 1 min (200 V class) 1800 VAC, 1 min (400 V class)
IP rating	IP67 (except the shaft opening)
Direction of rotation	Rotates counterclockwise (CCW) when viewed from the shaft extension side with a forward run command.  CCW

Item		Description
Ambient condition	Ambient temperature	0°C to 40°C (non-freezing)
	Ambient humidity	20% RH to 80% RH (without condensation)
	Rated operating altitude	1000 m
	Altitude-based derating	• 1000 m and below: Derating is not needed. • For use above 1000 m, derate according to *"19.2.1.3 Derating Characteristics" on page 1063*. For altitudes above 2000 m, install an isolation transformer at the power input end.
	Installation location	• Free from corrosive or explosive gases • Well ventilated with minimum amount of dust, waste, and moisture • Convenient for inspection and cleaning • Away from sources that may generate strong magnetic field • Away from heating sources such as heating stoves. • Use a motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings. • Oil seal protection capability: The oil seal is only dust-proof. It cannot withstand the intrusion of oil for a long term. For direct-connected reducer applications requiring long-term oil resistance on the motor oil seal, contact Inovance technical support. • Not applicable to vacuum environments. • Not applicable to inching conditions (not full-turn) [2], which may stuck the motor • The motor with brake may generate a pattering sound. • In upstream applications of the motor, ensure the force applied on the shaft end is lower than the allowable axial force and radial force of the motor. • The system should avoid continuous operation at a natural frequency. Exceeding the allowable vibration value may damage the system.
	Storage environment	Observe the following requirements for storing a de-energized motor. • Temperature: -20°C to +60°C (non-freezing) • Storage humidity: 20% to 80% RH (without condensation)
Shock resistance [3][5]	Shock acceleration (flange side as standard)	490 m/s^2
	Number of shocks	2
Vibration resistance [4][5]	Vibration acceleration (flange side as standard)	Radial 49 m/s^2 Axial 24.5 m/s^2

Note

- [1] Vibration class V15 indicates that the amplitude of vibration is lower than 15 μm when an individual motor rotates at rated values.
- [2] For applications that require the motor shaft to swing back and forth at a certain angle, contact Inovance.
- [3] The resistance for shock in the vertical direction when the motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [4] The vertical, side-to-side, and front-to-back resistance for vibration in three directions when the servo motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [5] The vibration intensity applied on the motor is affected by the transmission structure, alignment accuracy, mounting conditions, and external vibration. These factors may enhance the vibration applied on the motor. When the maximum allowable vibration limit is exceeded, the motor may fail. Therefore, take necessary measures to limit resonance.
- The vibration intensity applied on the motor varies with applications.

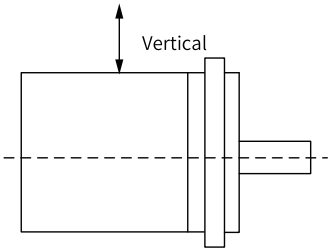


Figure 19-12 Shock applied to the servo motor

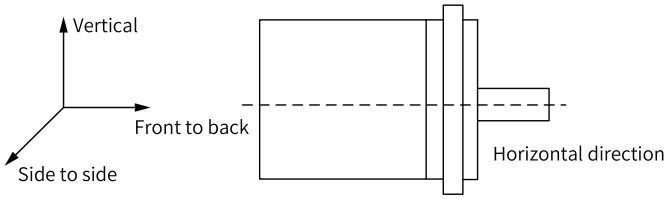


Figure 19-13 Vibration applied to the servo motor

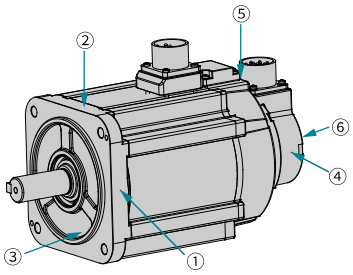


Figure 19-14 Max. allowable vibration limit of the motor

Direction	Measuring point	Limit value (10 Hz to 2000 Hz)
Radial	①②	49 m/s^2
	④⑤	49 m/s^2
Axial	③	24.5 m/s^2
	⑥	24.5 m/s^2

Note

The preceding vibration/shock standards cannot be applied for a long term. For long-term application, contact Inovance.

19.2.1.2 Overload Characteristics

The drive is compliant with NEC and CEC requirements and equipped with protective functions against overload and overtemperature.

The following overload protection curve applies to hot start at an ambient temperature of 40℃, which cannot guarantee continuous duty in cases of 100% output or above. During use, keep the effective torque of the load within the continuous duty zone.

To protect different load motors, set the motor overload protection gain based on the overload capacity of the motor. Use the default gain in general conditions. However, when one of the following conditions occurs, change the gain based on actual motor temperature:

- The motor operates in environments with high temperature.
- The motor is in cyclic motion featuring a short motion cycle and frequent acceleration/deceleration.
- Overload thermal protection only occurs during continuous energized operation. You need to check the motor temperature when the drive is powered off.

The motor overload protection curve is as follows:

- **MS1H1/H4 (frame size 40/60/80)**

Load ratio (%)	Operating time (s)
120	230
130	80
140	40
150	30
160	20
170	17
180	15
190	12
200	10
210	8.5
220	7
230	6
240	5.5
250	5
300	3
350	2

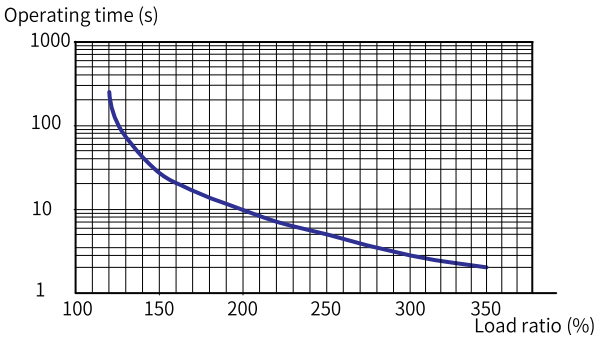


Figure 19-15 MS1H1/H4 (frame size 40/60/80) series motor overload curve

Note

The maximum torque of H1 and H4 models is the rated torque x 3.5.

- **MS1H2/MS1H3**

Load ratio (%)	Operating time (s)
115	6000
120	2533
125	1226
130	915
135	769
140	527
145	352
150	221
155	128
160	99
165	83
170	67
175	55
180	49
185	45
190	41
195	38
200	34
205	31
210	28
215	24
220	22
225	21
230	19
235	18
240	16
245	14
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260	11
265	10
270	9
275	9
280	8
285	7
290	6
295	5
300	5

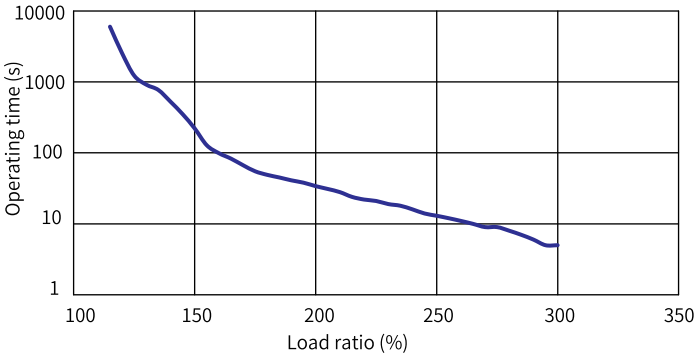


Figure 19-16 Overload curve of MS1H2 and MS1H3 series motors

Note

- The maximum torque of H2 models is the rated torque x 3.
- The maximum torque of H3 models is the rated torque x 2.5.

19.2.1.3 Derating Characteristics

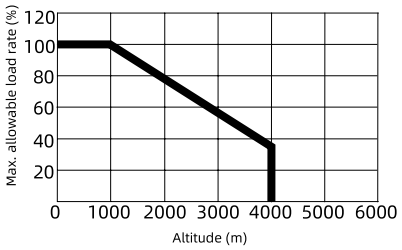
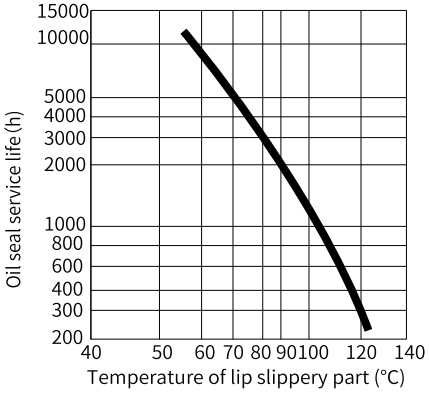


Figure 19-17 Altitude-based derating curve

19.2.1.4 Temperature Curve of the Oil Seal



19.2.1.5 Load Moment of Inertia

The load moment of inertia represents the ratio of the load inertia to the rotor inertia. The higher the load inertia ratio, the weaker the responsiveness will be. An excessively high inertia ratio can result in unstable operation. The allowable load inertia ratio of the servo motor is limited. The value is a general standard and varies according to the driving conditions of the servo motor.

An overvoltage alarm may occur during deceleration if the load moment of inertia exceeds the allowable value. For servo drives with a built-in braking resistor, an overload alarm my be reported. In cases of such alarms, take one of the following measures:

- Reduce the torque limit values.
- Reduce the deceleration rate.
- Reduce the maximum speed.
- Install an external braking resistor if the alarm cannot be cleared by using the above measures.

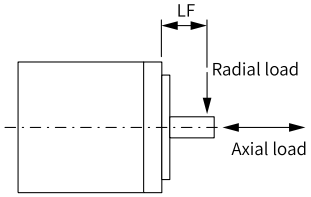
Caution

- For the built-in braking resistor of the drive, see Components.
- Even you use a built-in resistor, the energy generated in some regenerative conditions may exceed the allowable capacity loss (W) of the resistor. In this case, an external braking resistor is required.

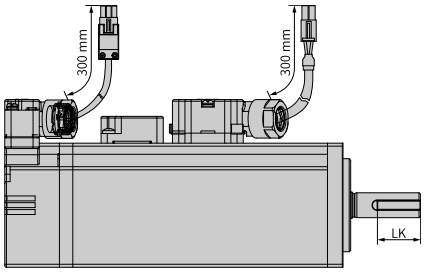
19.2.2 Model Specifications

19.2.2.1 Selection Instructions

- Description of torque-speed characteristics curves:
  - All parameters and torque-speed characteristic values are subject to the conditions that the motor works with an Inovance servo drive and the armature coil temperature is 20°C.
  - Continuous duty zone: refers to a series of states in which the motor can operate safely and continuously, and the actual torque must be located in this area.
  - Intermittent duty zone: refers to a series of states in which the motor can run within a short period of time when the actual torque is greater than the rated torque.
- The characteristic values are obtained in cases where the motor is installed with the following heatsink (unit: mm):
  - MS1H1/MS1H4: 250 x 250 x 6 (aluminum)
  - MS1H2-10C to 25C: 400 x 400 x 20 (steel)
  - MS1H2-30C to 50C: 400 x 400 x 20 (steel)
  - MS1H3-85B to 18C: 400 x 400 x 20 (steel)
  - MS1H3-29C to 55C: 550 x 550 x 30 (aluminum)
  - MS1H3-75C: 700 x 700 x 30 (aluminum)
- Radial and axial loads of the motor:



- Dimensions of flying leads type motors
  Flying leads type motors with frame sizes 60/80 (model ended with "-S") provide a drain wire of about 300 mm in length, as shown in the following figure.



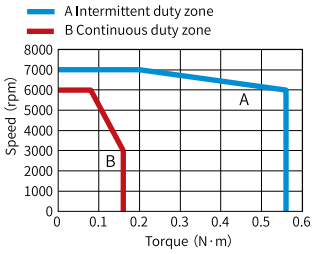
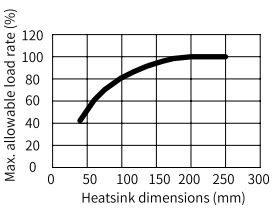
- As shown in the preceding figure, the product is marked with an LK value in the dimension diagram. LK indicates the length of the shaft key.
- MS1H3 (130-flange and 180-flange) comes with a key slot. When the operating speed is above 3000 rpm, the motor must run with the keyway. If you need to run the motor without the keyway at speeds higher than 3000 rpm, contact Inovance.

Note

- Values inside the parentheses in the following sections are parameters of the servo motor with a brake.
- The motor with oil seal must be derated by 10% during use.
- Use your own DC power supply as 24 V power supply of the brake. For the cable connecting the DC power supply to the motor brake, it is recommended to use cables with a cross-sectional area of 0.2 mm^2 or above for motors with rated 750 W or below. It is recommended to use cables with a cross-sectional area of 0.8 mm^2 or above for motors rated 750 W or above. The brake cannot share the same power supply with other appliances to prevent the voltage or current from falling due to the simultaneous operation of other electrical appliances, which may result in brake malfunction.
- Do not share a power supply among multiple brakes. Otherwise, a short-circuited coil caused by dry friction will lock other brakes that are connected to the power supply in parallel, resulting in dry friction on these brakes.
- The brake apply time and release time vary with the discharge circuit. Check the actual action delay of the product during use. The holding brake cannot be used for braking purpose.

19.2.2.2 Low Inertia and Small Capacity (MS1H1)

19.2.2.2.1 MS1H1-05B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Low inertia, small capacity		
Rated power (kW)	0.05		
Rated voltage (V)	220		
Rated torque (N·m)	0.16		
Maximum torque (N·m)	0.56		
Rated frequency (Hz)	250		
Rated current (A)	1.2		Heatsink-based derating curve
Maximum current (A)	4.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.15		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.018±10%	
	Motor with brake	0.0208±10%	

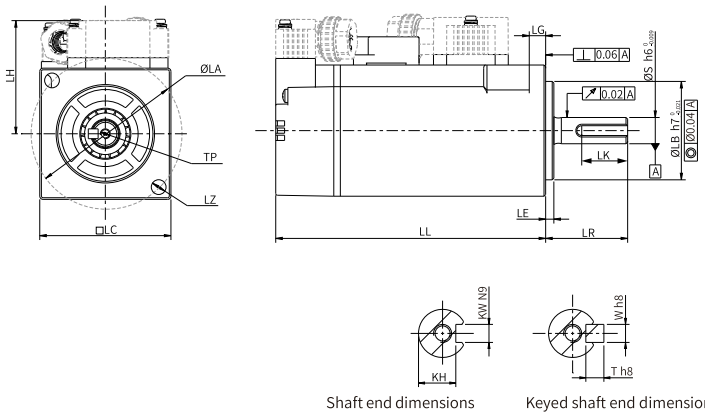
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

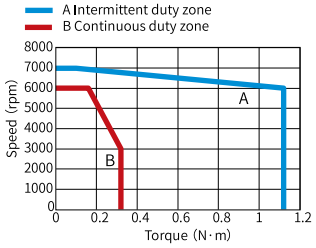
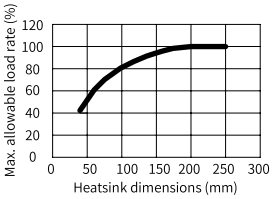
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Product dimensions (in mm)



LL	LC	LR	LA	LZ	LH	LG	LE	
57 (84.3)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	KW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.43)

19.2.2.2.2 MS1H1-10B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Low inertia, small capacity		
Rated power (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	250		
Rated current (A)	1.2		Heatsink-based derating curve
Maximum current (A)	4.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.30		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.0316±10%	
	Motor with brake	0.0345±10%	

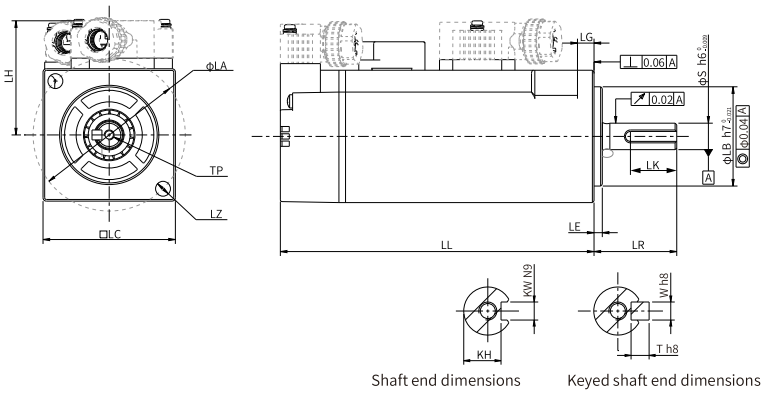
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

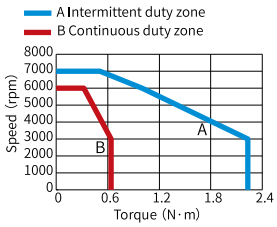
Product dimensions (in mm)

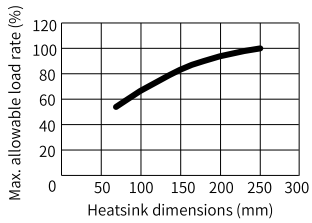


Shaft end dimensions Keyed shaft end dimensions

LL	LC	LR	LA	LZ	LH	LG	LE	
69.5 (96.8)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	KW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.35 (0.52)

19.2.2.2.3 MS1H1-20B30CB-V33*R-INT

Motor specifications		Torque-speed characteristics
Frame size (mm)	60	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.2	
Voltage (V)	220	
Rated torque (N·m)	0.64	
Maximum torque (N·m)	2.24	
Rated frequency (Hz)	250	
Rated current (A)	1.5	Heatsink-based derating curve

Motor specifications			Torque-speed characteristics
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.094 ± 10%	
	Motor with brake	0.106 ± 10%	

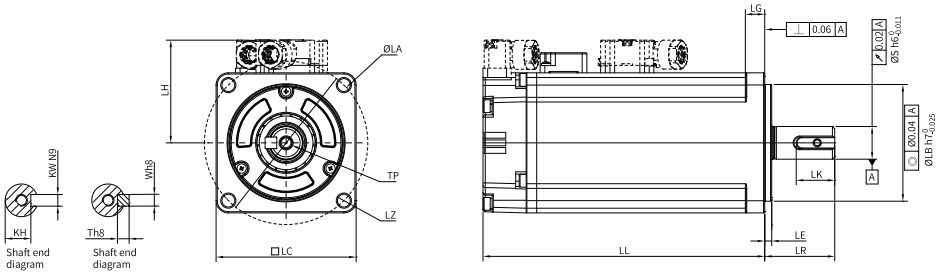
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

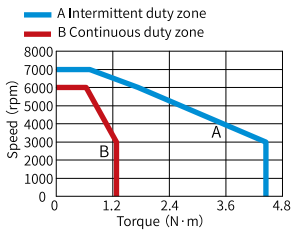
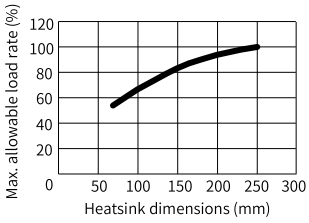
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	75.5 (103)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	160 -0.53	110 -0.1	5	5	5	0.80 (1.17)

19.2.2.2.4 MS1H1-40B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.5		Heatsink-based derating curve
Maximum current (A)	9.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.57		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.145 ± 10%	
	Motor with brake	0.157 ± 10%	

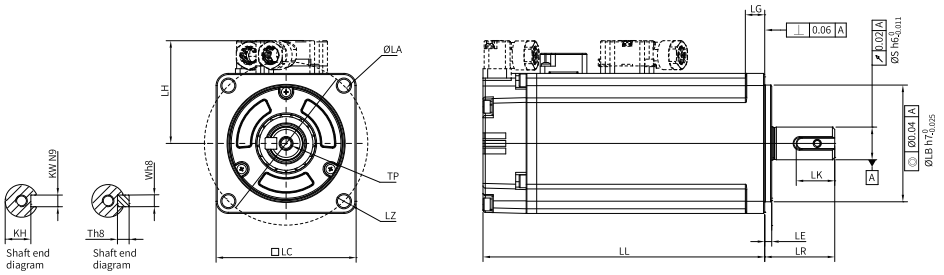
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

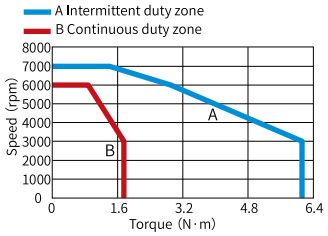
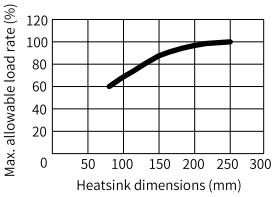
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	93 (121)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	$160_{-0.53}$	$110_{-0.1}$	5	5	5	1.11 (1.48)

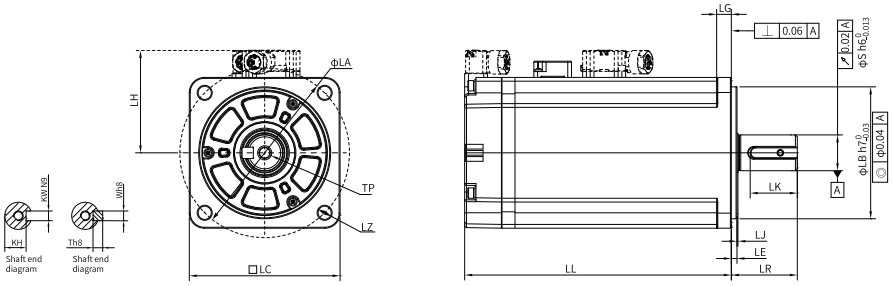
19.2.2.2.5 MS1H1-55B30CB-V331R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.9		Heatsink-based derating curve
Maximum current (A)	15		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.55 ± 10%	
	Motor with brake	-	

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)

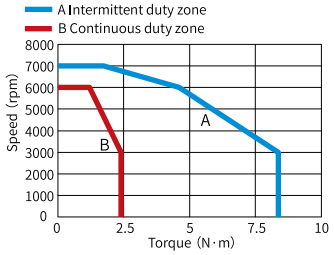


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 -0.62	15.50 -0.1	6	6	6	1.88

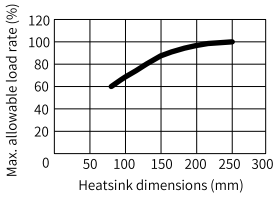
19.2.2.2.6 MS1H1-75B30CB-V33*R-INT

Motor specifications		
Frame size (mm)	80	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.75	
Voltage (V)	220	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.36	
Rated frequency (Hz)	250	
Rated current (A)	4.4	
Maximum current (A)	16.9	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/A)	0.62	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.68 ± 10%
	Motor with brake	0.71 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



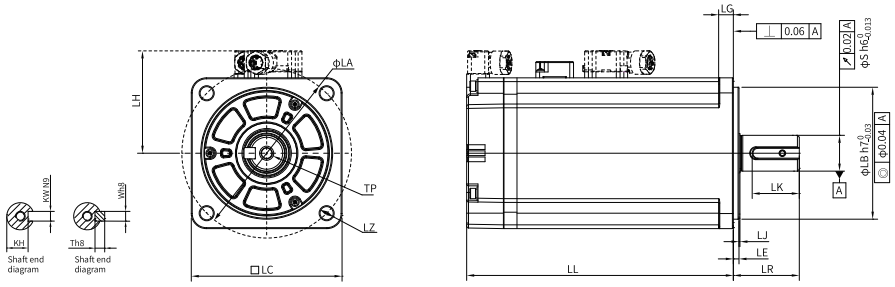
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

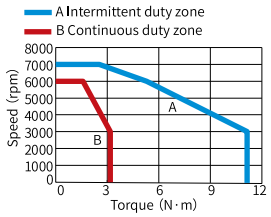
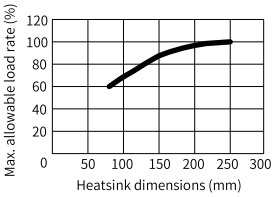
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (141.5)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 - 0.62	15.50 -0.1	6	6	6	2.22 (2.88)

19.2.2.2.7 MS1H1-10C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.13		
Rated frequency (Hz)	250		
Rated current (A)	6.2		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.59		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.82 ± 10%	
	Motor with brake	0.87 ± 10%	

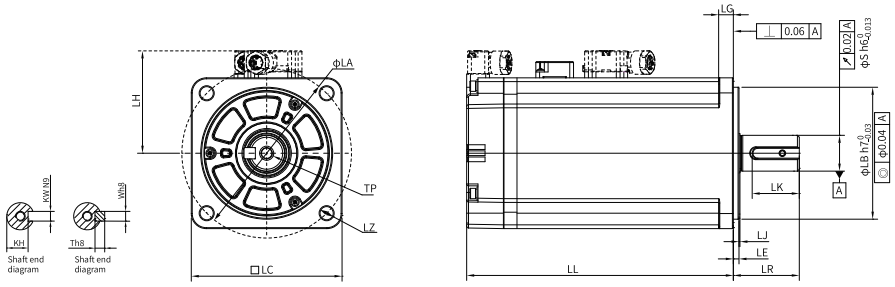
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

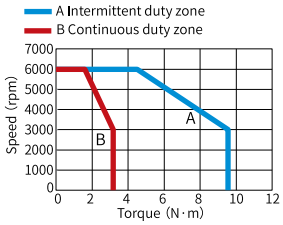
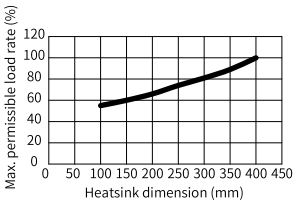
Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	119.2 (153.4)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 -0.62	15.50 -0.1	6	6	6	2.61 (3.27)

19.2.2.3 Low Inertia and Medium Capacity (MS1H2)

19.2.2.3.1 MS1H2-10C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia and capacity	low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	6.4		Heatsink-based derating curve
Maximum current (A)	23		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	6000		
Torque coefficient (N·m/A)	0.54		
Rotor moment of inertia (kg·cm^2)	Motor without brake	1.78±10%	
	Motor with brake	2.6±10%	

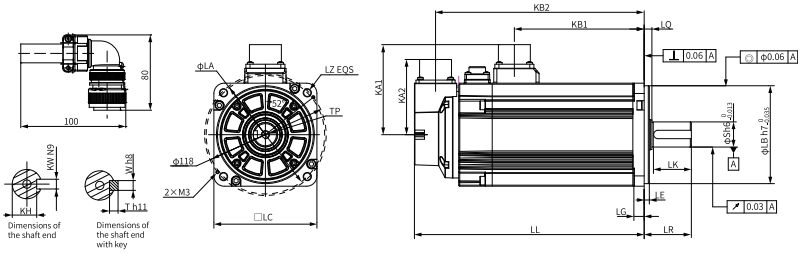
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable loads

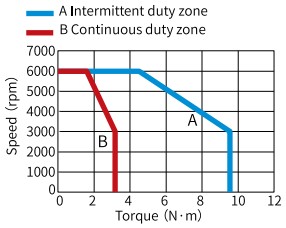
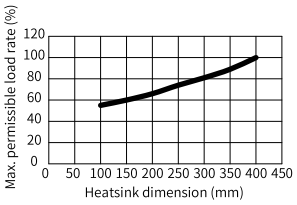
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Product dimensions (in mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45±1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5±0.3
LQ	LB		S	TP	LK	KH	KW	W	T	Weight (kg)
7.5±0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

19.2.2.3.2 MS1H2-10C30CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	380		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	11		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.07		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.78 ± 10%	
	Motor with brake	2.6 ± 10%	

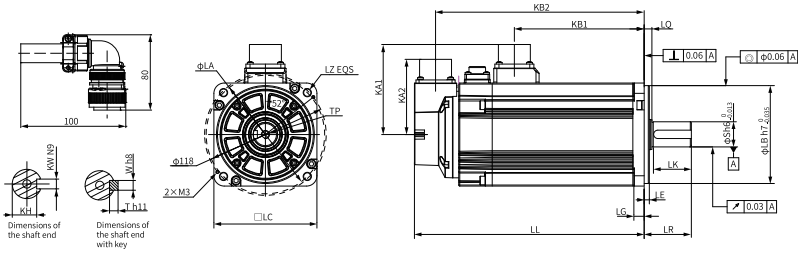
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

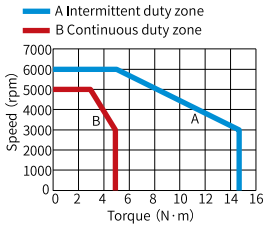
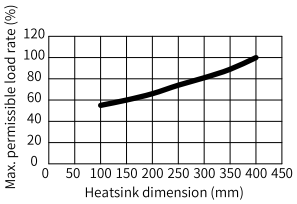
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45 ± 1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 $^{-0.62}$	200 $^{-0.2}$	8	8	7	3.85 (4.9)

19.2.2.3.3 MS1H2-15C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	220		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	8.6		Heatsink-based derating curve
Maximum current (A)	32		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.62		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

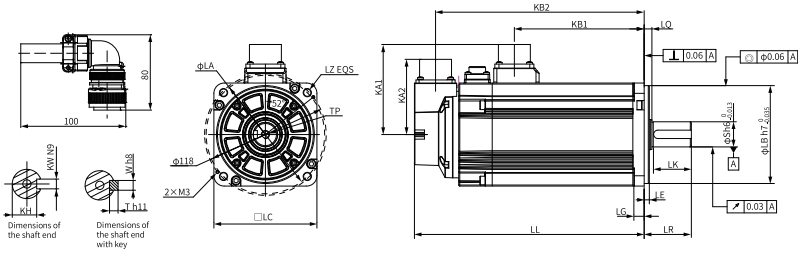
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

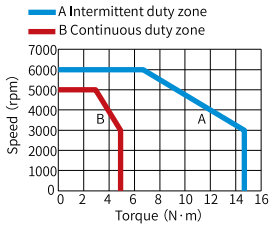
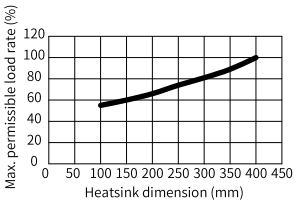
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	350 -0.62	200 -0.2	8	8	7	4.65 (5.75)

19.2.2.3.4 MS1H2-15C30CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	380		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	4.2		Heatsink-based derating curve
Maximum current (A)	14		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.28		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

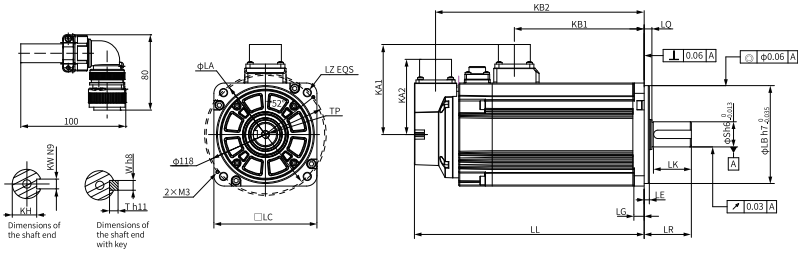
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)

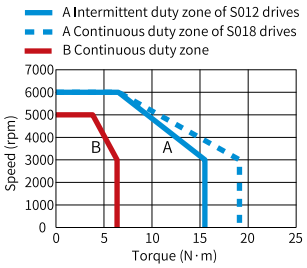


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	4.65 (5.75)

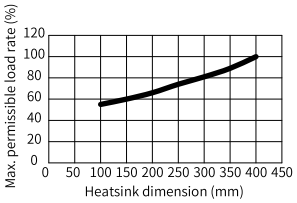
19.2.2.3.5 MS1H2-20C30CB-V33*R-INT

Motor specifications		
Frame size (mm)	100	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	2.0	
Voltage (V)	220	
Rated torque (N·m)	6.36	
Maximum torque (N·m)	19.1	
Rated frequency (Hz)	250	
Rated current (A)	11.3	
Maximum current (A)	42	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/A)	0.60	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.92 ± 10%
	Motor with brake	3.74 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



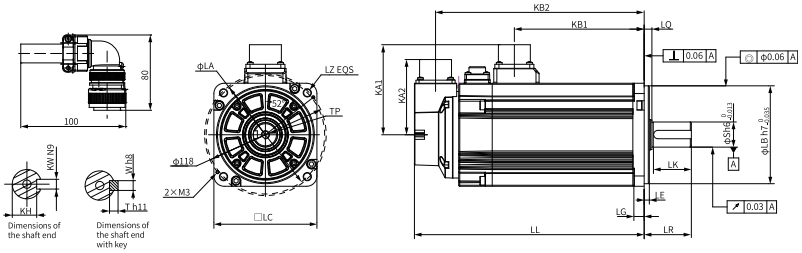
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

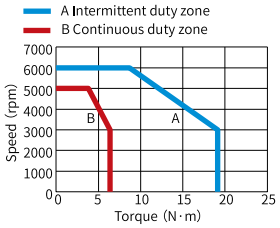
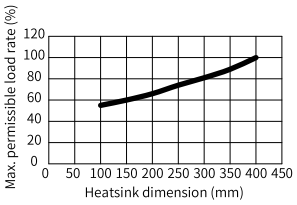
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	5.5 (6.55)

19.2.2.3.6 MS1H2-20C30CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	380		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	5.6		Heatsink-based derating curve
Maximum current (A)	20		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.19		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

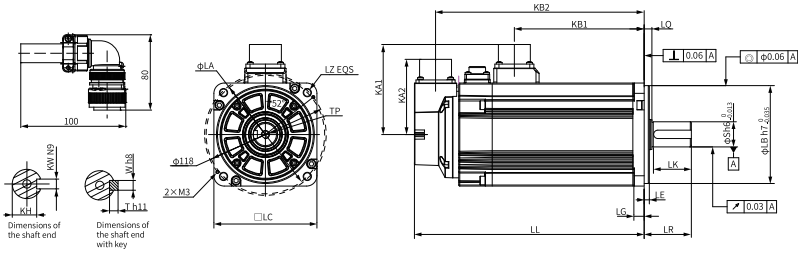
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

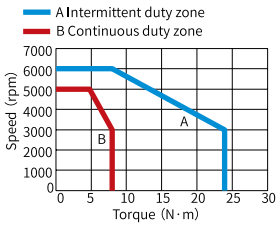
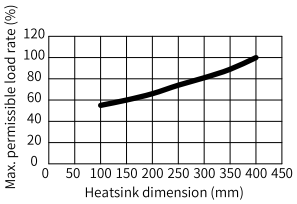
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	5.5 (6.55)

19.2.2.3.7 MS1H2-25C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	220		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	14.7		Heatsink-based derating curve
Maximum current (A)	53		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.60		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

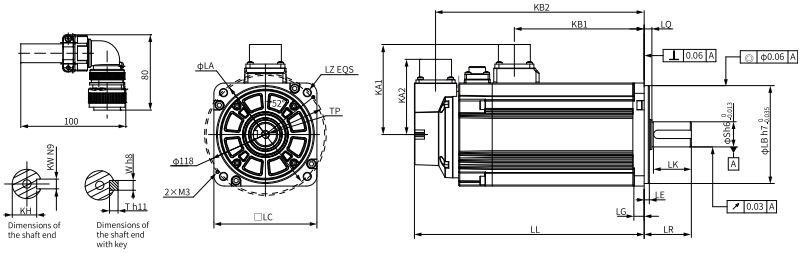
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

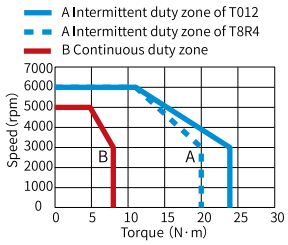
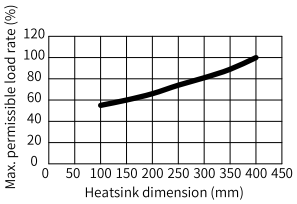
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	6.3 (7.35)

19.2.2.3.8 MS1H2-25C30CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	380		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	7.2		Heatsink-based derating curve
Maximum current (A)	26		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.18		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

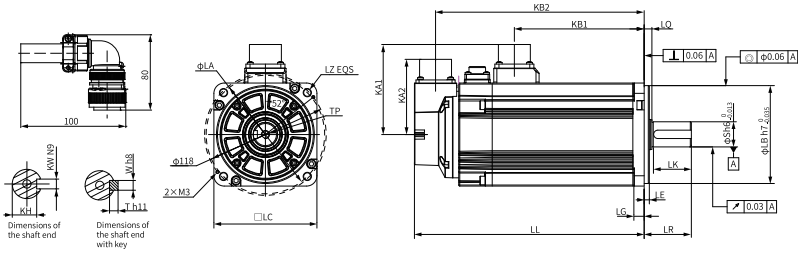
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

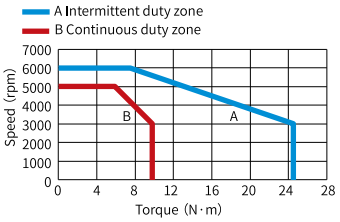
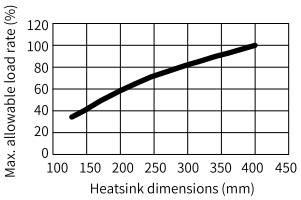
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	350 -0.62	200 -0.2	8	8	7	6.3 (7.35)

19.2.2.3.9 MS1H2-30C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	220		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	24.5		
Rated frequency (Hz)	150		
Rated current (A)	16.6		Heatsink-based derating curve
Maximum current (A)	55		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.67		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

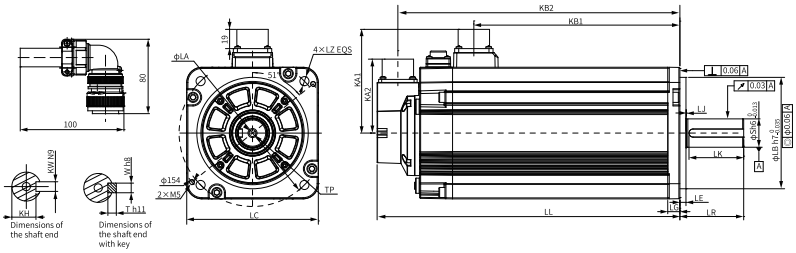
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



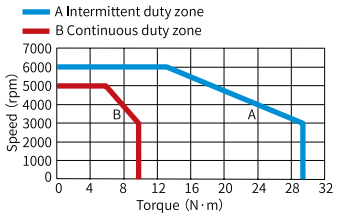
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 $^{-0.62}$	240 $^{-0.2}$	8	8	7	10.0 (11.9)

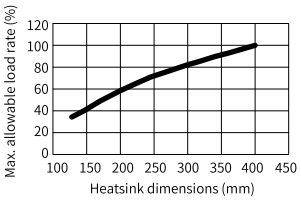
19.2.2.3.10 MS1H2-30C30CD-V33*R-INT

Motor specifications		
Frame size (mm)	130	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	3.0	
Voltage (V)	380	
Rated torque (N·m)	9.8	
Maximum torque (N·m)	29.4	
Rated frequency (Hz)	150	
Rated current (A)	8.9	
Maximum current (A)	29	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/A)	1.25	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	6.4 ± 10%
	Motor with brake	9.38 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



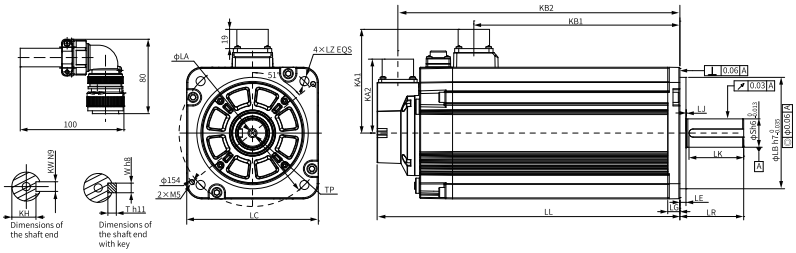
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

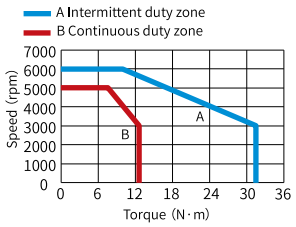
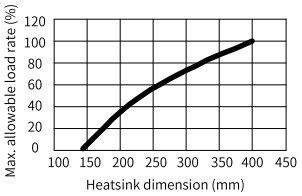
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 -0.62	240 -0.2	8	8	7	10.0 (11.9)

19.2.2.3.11 MS1H2-40C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	220		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	31.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.65		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

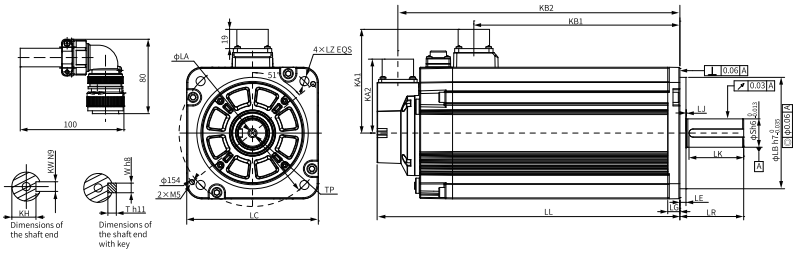
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

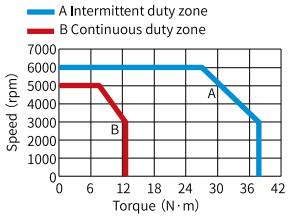
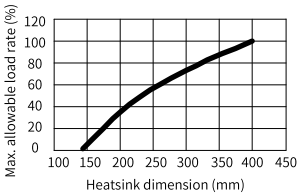
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 -0.62	240 -0.2	8	8	7	13.2 (15.1)

19.2.2.3.12 MS1H2-40C30CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	380		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	37.8		
Rated frequency (Hz)	150		
Rated current (A)	13.5		Heatsink-based derating curve
Maximum current (A)	42.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.06		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

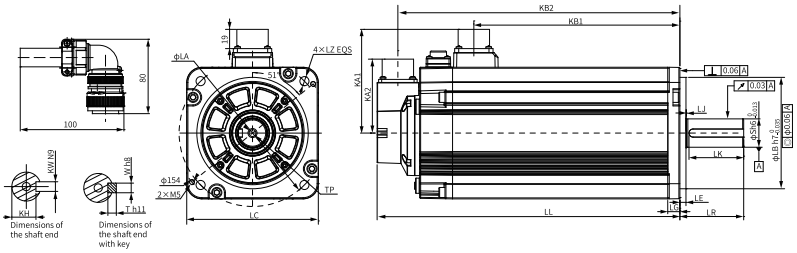
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



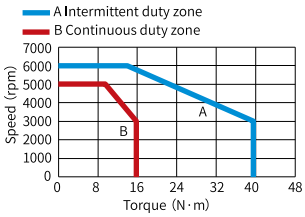
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 $^{-0.62}$	240 $^{-0.2}$	8	8	7	13.2 (15.1)

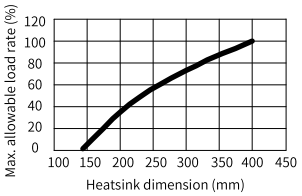
19.2.2.3.13 MS1H2-50C30CB-V33*R-INT

Motor specifications		
Frame size (mm)	130	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	5.0	
Voltage (V)	220	
Rated torque (N·m)	15.8	
Maximum torque (N·m)	39.5	
Rated frequency (Hz)	150	
Rated current (A)	22	
Maximum current (A)	67.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/A)	0.81	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	11.6 ± 10%
	Motor with brake	14.58 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



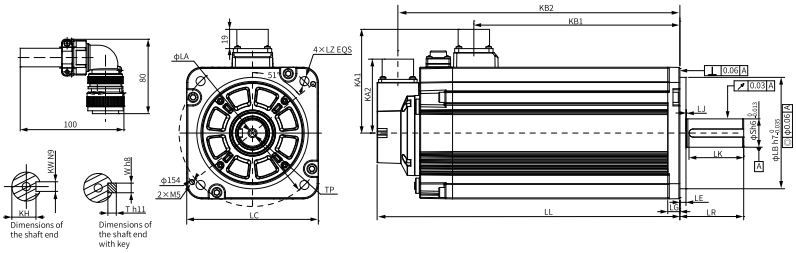
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

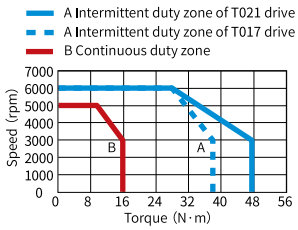
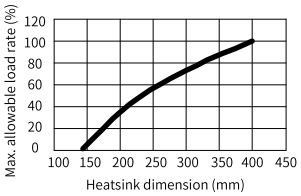
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 $^{-0.62}$	240 $^{-0.2}$	8	8	7	16.35 (18.25)

19.2.2.3.14 MS1H2-50C30CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	380		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	47.4		
Rated frequency (Hz)	150		
Rated current (A)	17		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.04		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

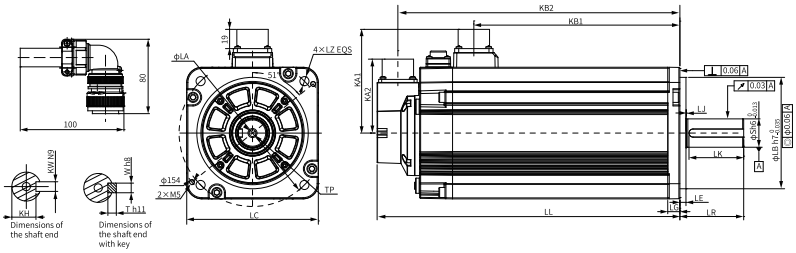
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3

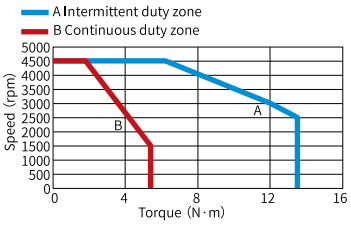
LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	530 $^{-0.62}$	240 $^{-0.2}$	8	8	7	16.35 (18.25)

19.2.2.4 Medium Inertia and Medium Capacity (MS1H3)

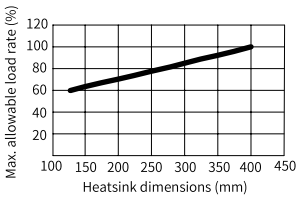
19.2.2.4.1 MS1H3-85B15CB-V33*R-INT

Motor specifications		
Frame size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	0.85	
Voltage (V)	220	
Rated torque (N·m)	5.39	
Maximum torque (N·m)	13.5	
Rated frequency (Hz)	125 m	
Rated current (A)	6.6	
Maximum current (A)	17.2	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/A)	0.93	
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	13.56 ± 10%
	Motor with brake	15.8 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



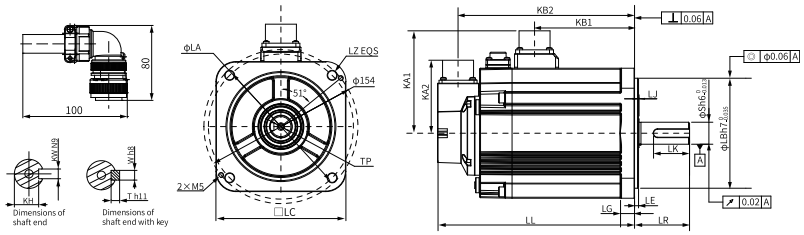
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

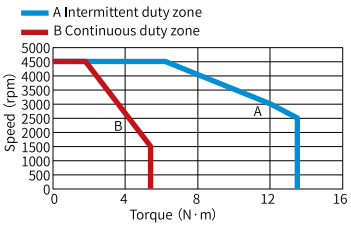
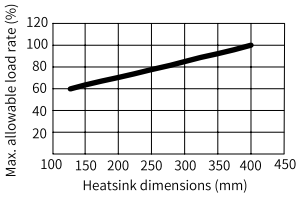
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 -0.62	180 -0.2	8	8	7	5.8 (7.7)

19.2.2.4.2 MS1H3-85B15CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	0.85		
Voltage (V)	380		
Rated torque (N·m)	5.39		
Maximum torque (N·m)	13.5		
Rated frequency (Hz)	125 m		
Rated current (A)	3.5		Heatsink-based derating curve
Maximum current (A)	8.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.84		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	13.56 ± 10%	
	Motor with brake	15.8 ± 10%	

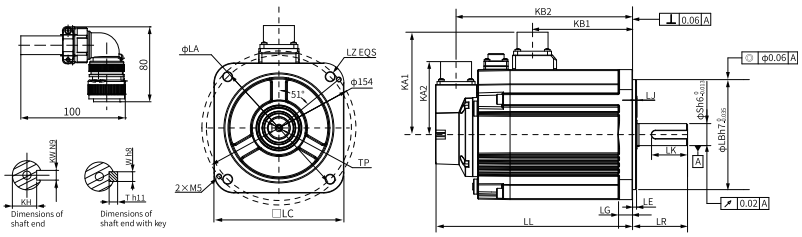
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



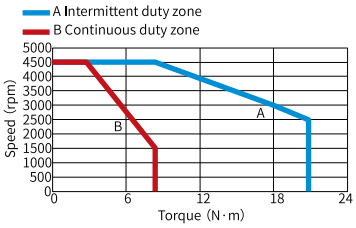
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 -0.62	180 -0.2	8	8	7	5.8 (7.7)

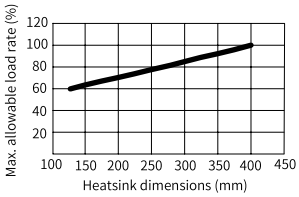
19.2.2.4.3 MS1H3-13C15CB-V33*R-INT

Motor specifications		
Frame size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	1.3	
Voltage (V)	220	
Rated torque (N·m)	8.34	
Maximum torque (N·m)	20.85	
Rated frequency (Hz)	125 m	
Rated current (A)	10.5	
Maximum current (A)	27.3	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/A)	0.89	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	19.25 ± 10%
	Motor with brake	21.5 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



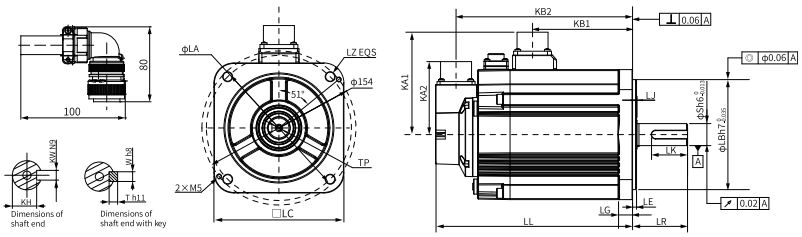
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



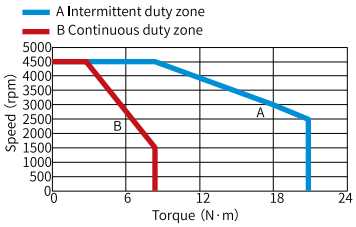
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 $^{-0.62}$	180 $^{-0.2}$	8	8	7	7.1 (8.9)

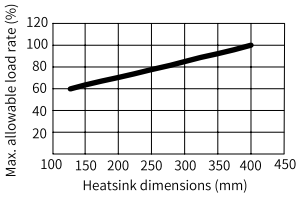
19.2.2.4.4 MS1H3-13C15CD-V33*R-INT

Motor specifications		
Frame size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	1.3	
Voltage (V)	380	
Rated torque (N·m)	8.34	
Maximum torque (N·m)	20.85	
Rated frequency (Hz)	125 m	
Rated current (A)	5.1	
Maximum current (A)	12.6	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/A)	1.85	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	19.25 ± 10%
	Motor with brake	21.5 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



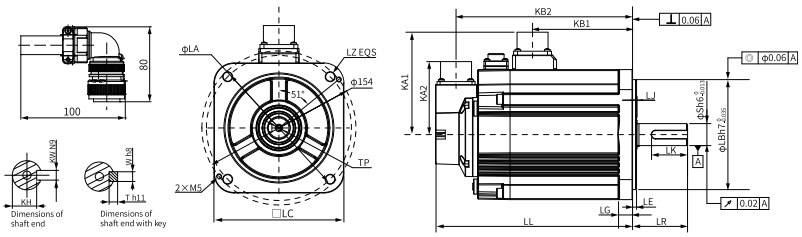
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

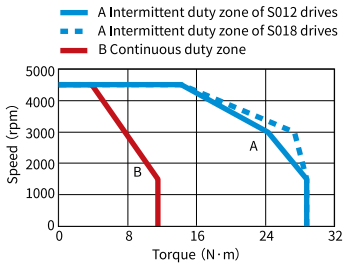
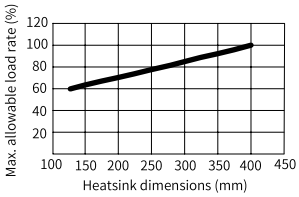
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × φ9	103	85	73	136.5 (161.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 -0.62	180 -0.2	8	8	7	7.1 (8.9)

19.2.2.4.5 MS1H3-18C15CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	220		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125 m		
Rated current (A)	11.9		Heatsink-based derating curve
Maximum current (A)	32.2		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.09		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

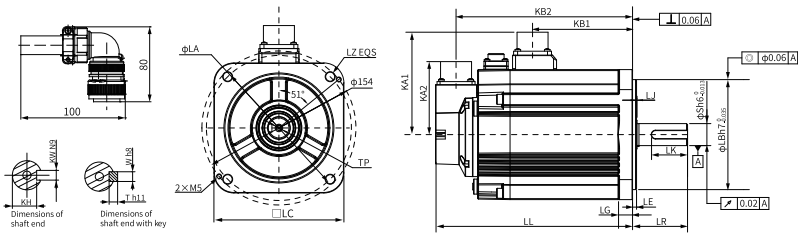
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

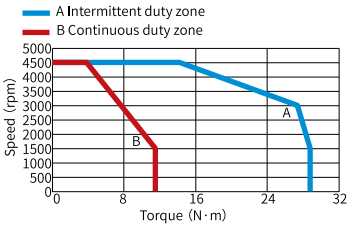
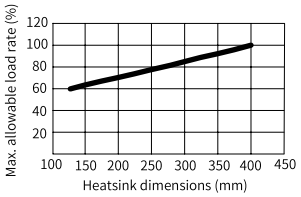
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × φ9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	350 -0.62	180 -0.2	8	8	7	8.5 (10.3)

19.2.2.4.6 MS1H3-18C15CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	380		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125 m		
Rated current (A)	6.75		Heatsink-based derating curve
Maximum current (A)	17.7		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.87		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

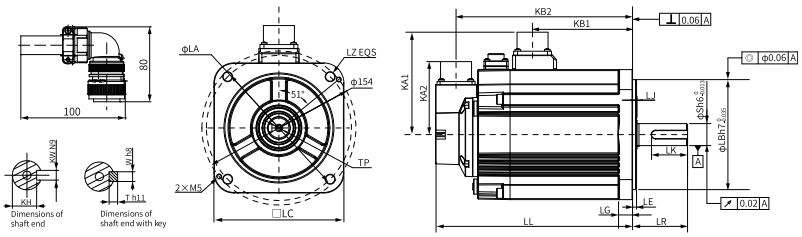
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

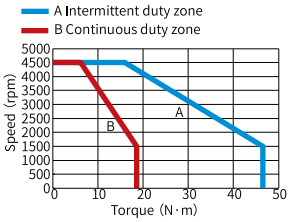
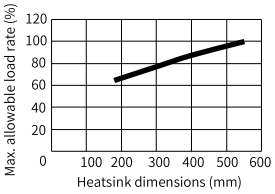
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	350 -0.62	180 -0.2	8	8	7	8.5 (10.3)

19.2.2.4.7 MS1H3-29C15CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	2.9		
Voltage (V)	220		
Rated torque (N·m)	18.6		
Maximum torque (N·m)	46.5		
Rated frequency (Hz)	125 m		
Rated current (A)	18		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.16		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

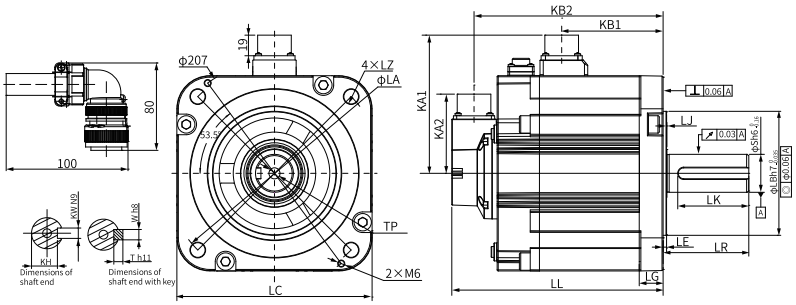
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

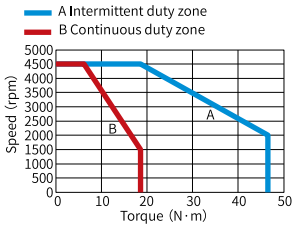
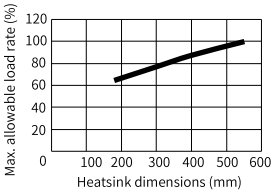
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	13.8 (17.9)

19.2.2.4.8 MS1H3-29C15CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	2.9		
Voltage (V)	380		
Rated torque (N·m)	18.6		
Maximum torque (N·m)	46.5		
Rated frequency (Hz)	125 m		
Rated current (A)	10.5		Heatsink-based derating curve
Maximum current (A)	29.75		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.94		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

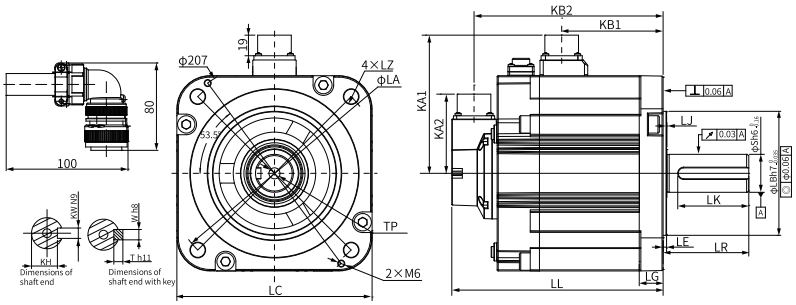
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

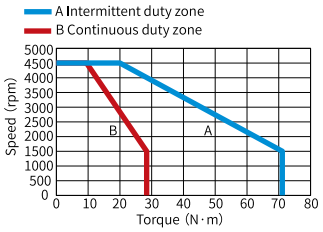
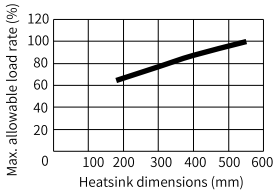
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	13.8 (17.9)

19.2.2.4.9 MS1H3-44C15CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	220		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125 m		
Rated current (A)	25.5		Heatsink-based derating curve
Maximum current (A)	67		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

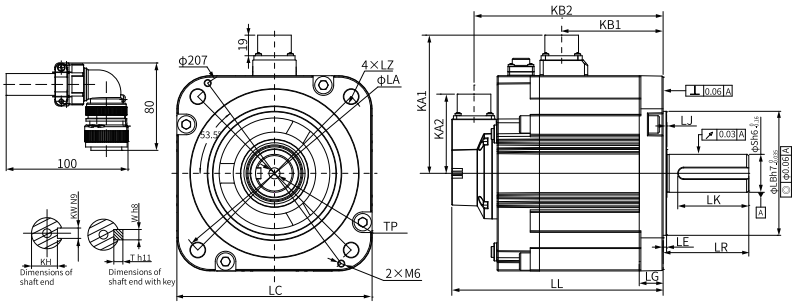
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

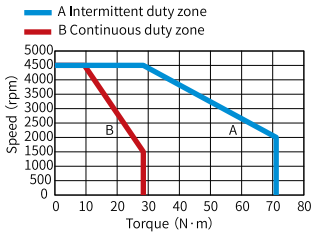
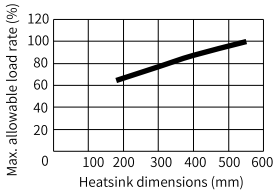
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	17.4 (21.9)

19.2.2.4.10 MS1H3-44C15CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	380		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125 m		
Rated current (A)	16		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.96		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

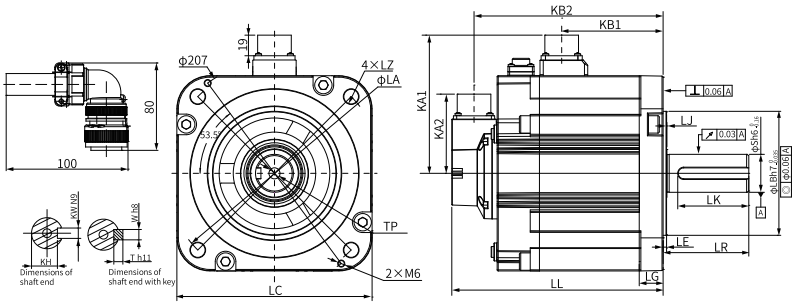
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

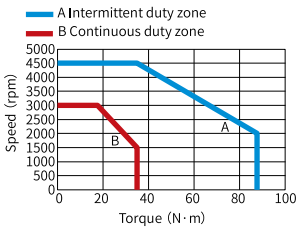
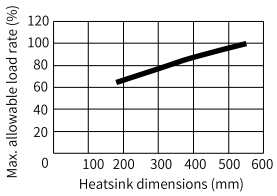
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	640 $^{-0.74}$	300 $^{-0.2}$	10	10	8	17.4 (21.6)

19.2.2.4.11 MS1H3-55C15CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	5.5		
Voltage (V)	380		
Rated torque (N·m)	35		
Maximum torque (N·m)	87.6		
Rated frequency (Hz)	125 m		
Rated current (A)	20.7		Heatsink-based derating curve
Maximum current (A)	52		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.92		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	86.9 ± 10%	
	Motor with brake	94.55 ± 10%	

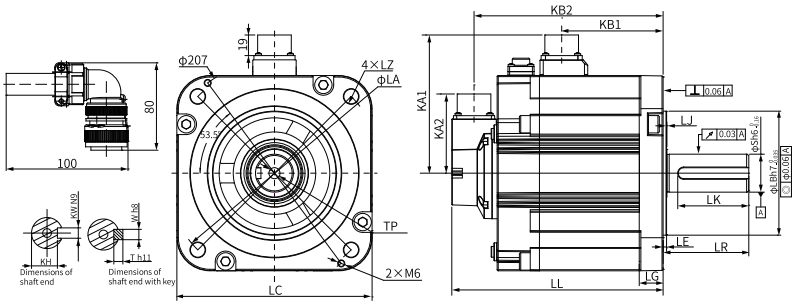
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

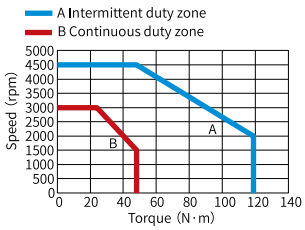
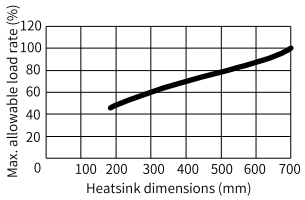
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	208 (241.8)	113 ± 1	200	4 × ϕ13.5	127.4	140.5	73	187.5 (221.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		42	M16 × 32	950 $^{-0.87}$	370 $^{-0.2}$	12	12	8	21.7 (25.9)

19.2.2.4.12 MS1H3-75C15CD-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	7.5		
Voltage (V)	380		
Rated torque (N·m)	48		
Maximum torque (N·m)	119		
Rated frequency (Hz)	125 m		
Rated current (A)	25		Heatsink-based derating curve
Maximum current (A)	65		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	2.13		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	127.5 ± 10%	
	Motor with brake	135.15 ± 10%	

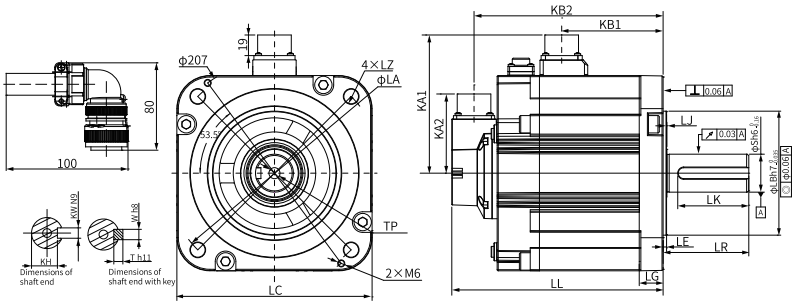
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

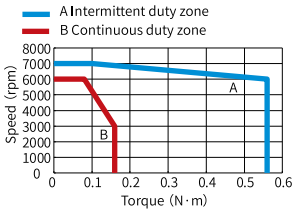
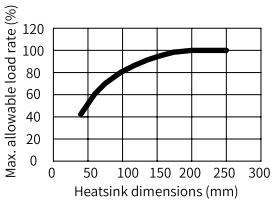
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	255 (288.8)	113 ± 1	200	4 × ϕ13.5	127.4	187.5	73	234.5 (268.5)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		42	M16 × 32	950 $^{-0.87}$	370 $^{-0.2}$	12	12	8	29 (33.2)

19.2.2.5 Medium Inertia and Small Capacity (MS1H4)

19.2.2.5.1 MS1H4-05B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Medium inertia, small capacity		
Rated output (kW)	0.05		
Rated voltage (V)	220		
Rated torque (N·m)	0.16		
Maximum torque (N·m)	0.56		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.15		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.038±10%	
	Motor with brake	0.04±10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Product dimensions (in mm)

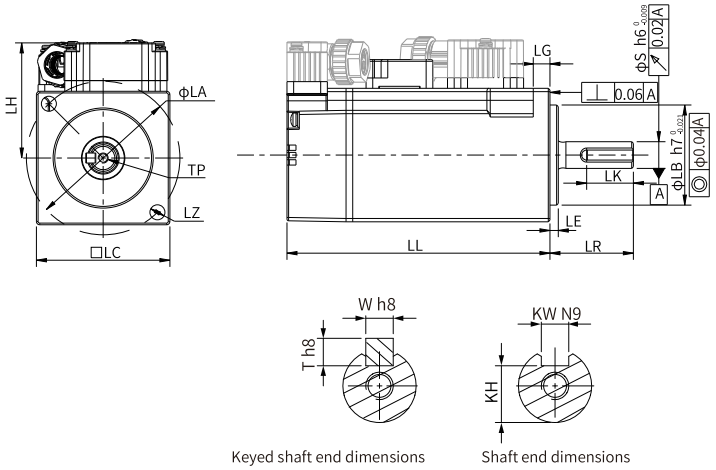


Figure 19-18 MS1H4-05B30CB-V330R-INT and MS1H4-05B30CB-V332R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
53.5 (80.8)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.24 (0.40)

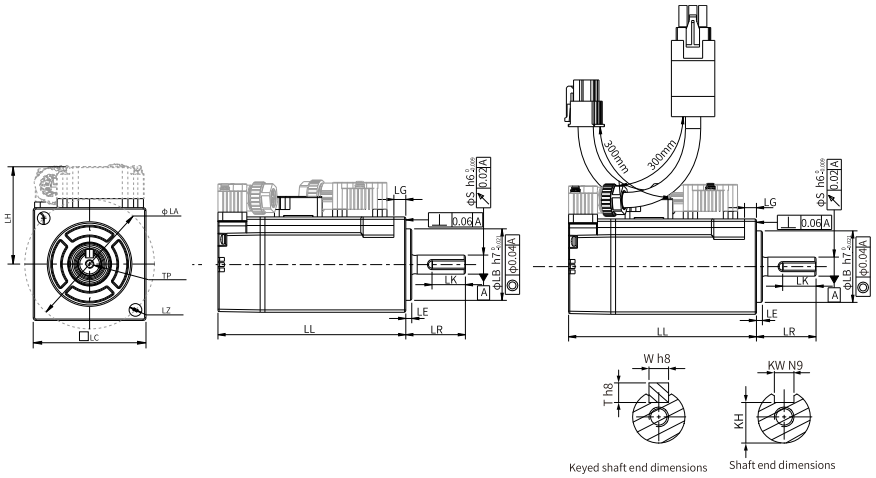
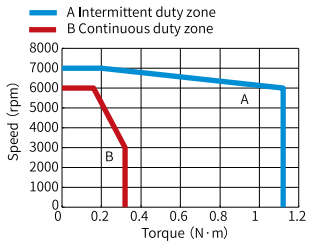
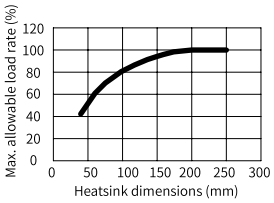


Figure 19-19 MS1H4-05B30CB-V331R-INT and MS1H4-05B30CB-V334R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
56.15 (83.45)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$140_{-0.36}$	$6.20_{-0.1}$	3	3	3	0.26 (0.42)

19.2.2.5.2 MS1H4-10B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Medium inertia, small capacity		
Rated output (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.29		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.072±10%	
	Motor with brake	0.074±10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Product dimensions (in mm)

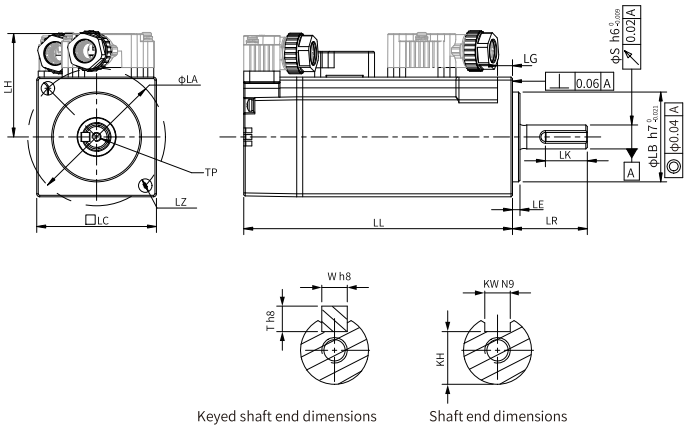


Figure 19-20 MS1H4-10B30CB-V330R-INT and MS1H4-10B30CB-V332R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
64.5 (91.8)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.32 (0.48)

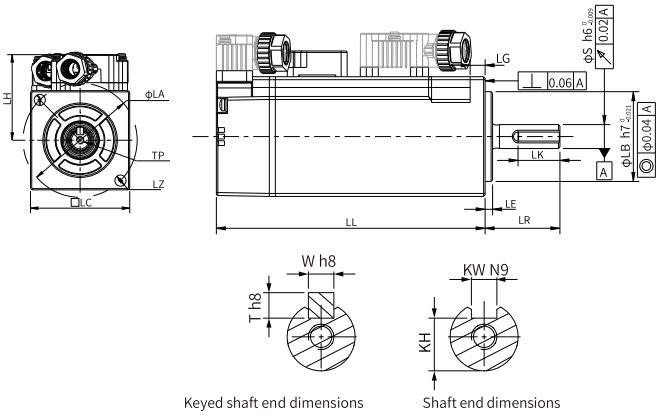
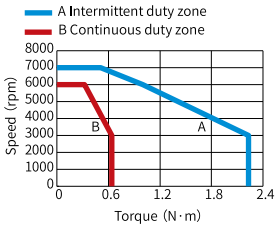
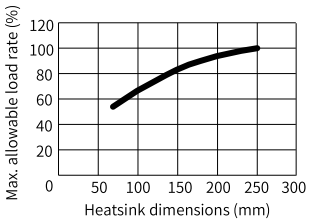


Figure 19-21 MS1H4-10B30CB-V331R-INT and MS1H4-10B30CB-V334R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
67.15 (94.45)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$140_{-0.36}$	$6.20_{-0.1}$	3	3	3	0.34 (0.50)

19.2.2.5.3 MS1H4-20B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.2		
Voltage (V)	220		
Rated torque (N·m)	0.64		
Maximum torque (N·m)	2.24		
Rated frequency (Hz)	250		
Rated current (A)	1.3		Heatsink-based derating curve
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.55		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.22 ± 10%	
	Motor with brake	0.23 ± 10%	

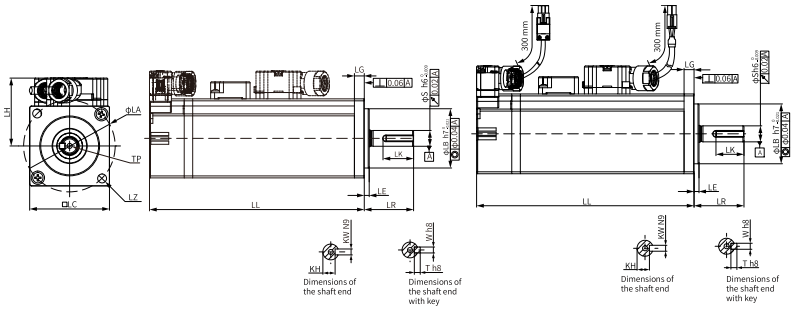
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable load

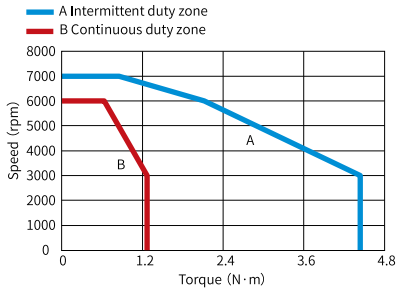
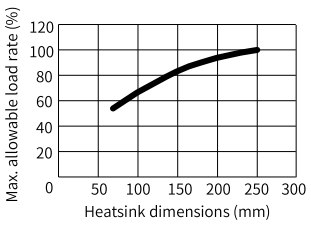
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	73.5 (101.1)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 8	$16.50_{-0.53}$	$110_{-0.1}$	5	5	5	0.78 (1.16)

19.2.2.5.4 MS1H4-40B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia and capacity	Medium inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.4		Heatsink-based derating curve
Maximum current (A)	9.2		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.43±10%	
	Motor with brake	0.44±10%	

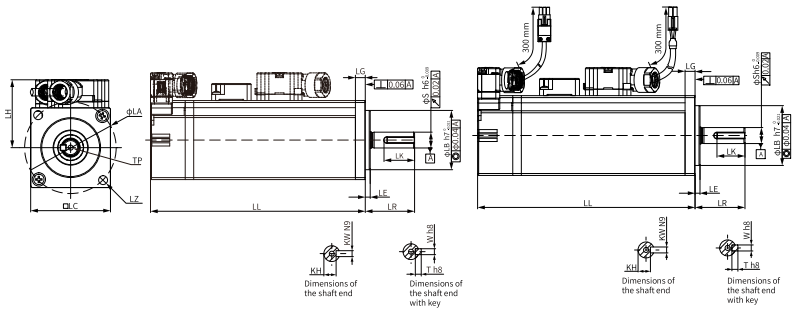
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable loads

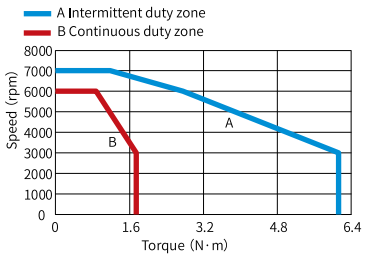
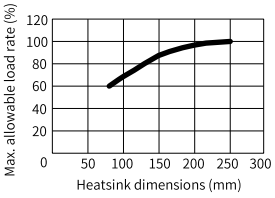
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Product dimensions (in mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	92 (119.8)	30±0.5	70	4 × ϕ5.5	44	8.0	3±0.5	
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

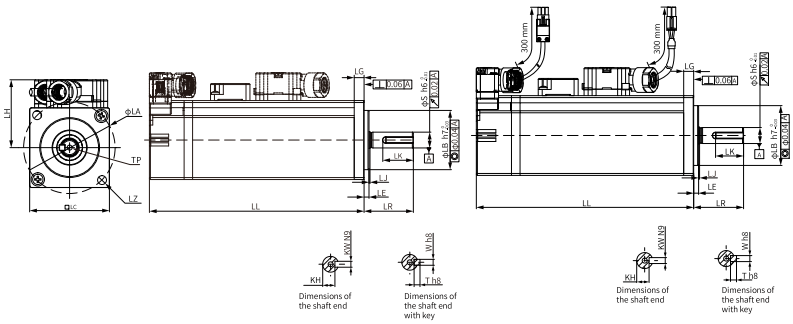
19.2.2.5.5 MS1H4-55B30CB-V331R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	13.2		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.12 ± 10%	
	Motor with brake	-	

Allowable load

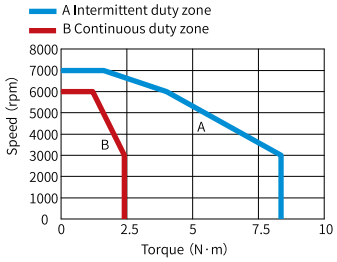
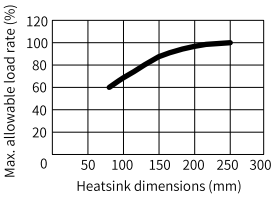
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 $^{0.62}_{-}$	15.50 $_{-0.1}$	6	6	6	1.85

19.2.2.5.6 MS1H4-75B30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, small capacity		
Rated power (kW)	0.75		
Voltage (V)	220		
Rated torque (N·m)	2.39		
Maximum torque (N·m)	8.37		
Rated frequency (Hz)	250		
Rated current (A)	4.4		Heatsink-based derating curve
Maximum current (A)	16.9		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.63		
Rotor moment of inertia ($kg \cdot cm^2$)	Brake-less motor	1.46±10%	
	Brake motor	1.51±10%	

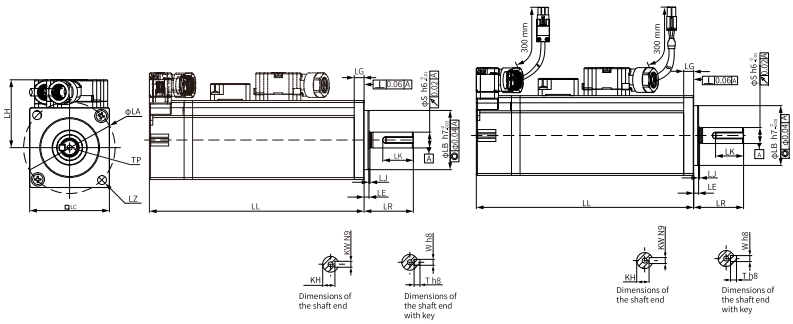
Electrical specifications of the brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

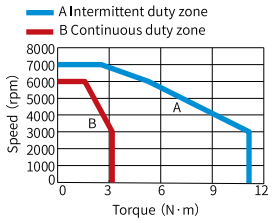
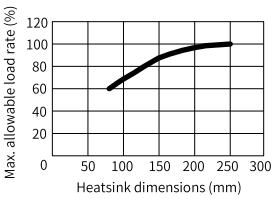
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Product dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (140.5)	35± 0.5	90	4 x ϕ7	54	7.5	3±0.5	0.5±0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6x20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.18 (2.82)

19.2.2.5.7 MS1H4-10C30CB-V33*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.13		
Rated frequency (Hz)	250		
Rated current (A)	6.5		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.53		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.87 ± 10%	
	Motor with brake	1.97 ± 10%	

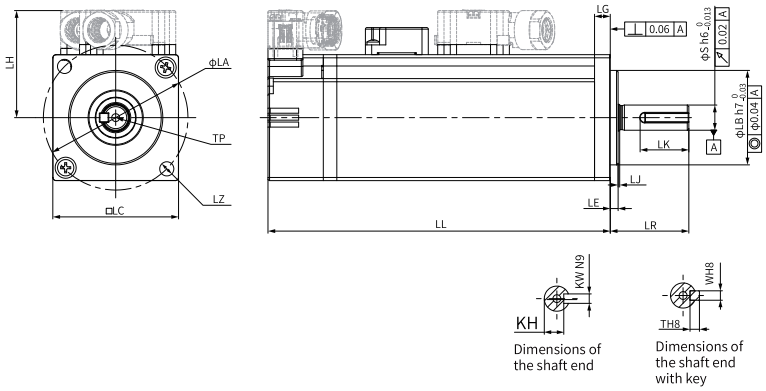
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	118.7 (153.2)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 - 0.62	15.50 -0.1	6	6	6	2.55 (2.9)

20 Options

20.1 Cables

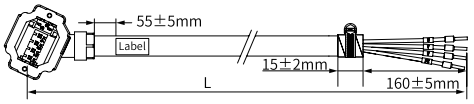
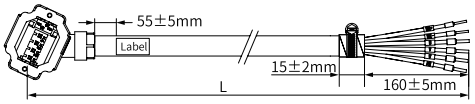
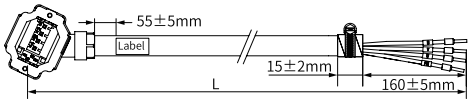
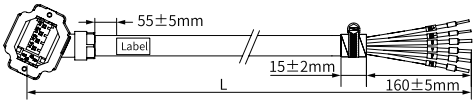
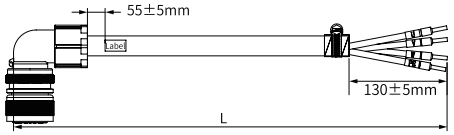
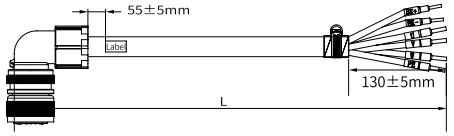
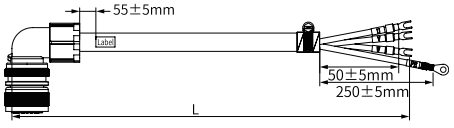
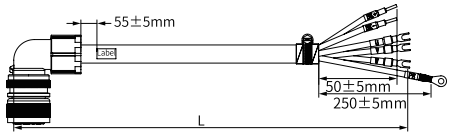
20.1.1 Power Cables

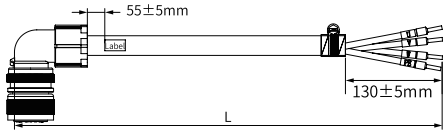
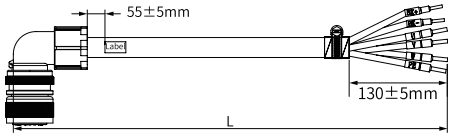
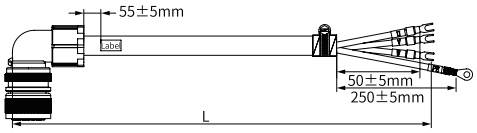
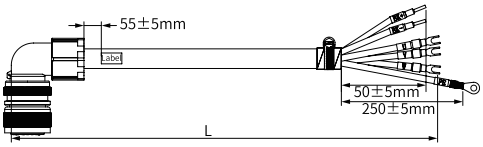
Power cable models

S6-L-M ① 0 ② 0 ③ 1 ④ - 3.0 ⑤ - T ⑥ - X ⑦ - INT ⑧

① **Cable type** S6-L-M: Power cable for motion control M: without a brake	③ **Cross sectional area** 0: Flange sizes 25/40/60/80 mm 1: Frame sizes 100/130/180 mm with drive rated current lower than 13 A 2: Frame sizes 180 mm with drive rated power higher than 13 A 4: 4 × 2.5 mm^2 5: 4 × 1.5 mm^2 6: 4 × 0.75 mm^2 B: 4 x 12 AWG	⑤ **Cable length (m)** 3.0: 3 5.0: 5 8.0: 8 10.0: 10 12.0: 12 15.0: 15 20.0: 20
② **Connector type at drive side** 0: U-type terminal 1: Pin-type terminal	④ **Connector type at motor side** 0: 6-conductor plastic connector 1: 9-conductor aviation connector 2: 6-conductor aviation connector 7: MS1 custom connector (front outlet) 8: MS1 custom connector (rear outlet) D: AVIC JY27P14-4TK2 aviation plug	⑥ **Special requirements** Blank: Fixed cables T: Cable in the drag chain ≥ 10 million times TTS: Drag chain shielding ≥ 20 million times ⑦ **Manufacturer** Blank: Default 2: Brand xx ⑧ **Version** INT: Global version

List of Power Cables (Compatible with MS1-R-INT Series Motor)

Motor model	Name		Cable model	Cable length (mm)	Drawing
MS1H1/ MS1H4 motor	Front outlet	Without brake	S6-L-M107-3.0 (-T) -INT	3000	
			S6-L-M107-5.0 (-T) -INT	5000	
			S6-L-M107-10.0 (-T) -INT	10000	
		With bake	S6-L-B107-3.0 (-T) -INT	3000	
			S6-L-B107-5.0 (-T) -INT	5000	
			S6-L-B107-10.0 (-T) -INT	10000	
	Rear outlet	Without brake	S6-L-M108-3.0 (-T) -INT	3000	
			S6-L-M108-5.0 (-T) -INT	5000	
			S6-L-M108-10.0 (-T) -INT	10000	
		With bake	S6-L-B108-3.0 (-T) -INT	3000	
			S6-L-B108-5.0 (-T) -INT	5000	
			S6-L-B108-10.0 (-T) -INT	10000	
MS1H2 motors rated 3 kW or below/ MS1H3 motors rated 1.8 kW or below	Without brake		S6-L-M111-3.0 (-T) -INT	3000	
			S6-L-M111-5.0 (-T) -INT	5000	
			S6-L-M111-10.0 (-T) -INT	10000	
	With bake		S6-L-B111-3.0 (-T) -INT	3000	
			S6-L-B111-5.0 (-T) -INT	5000	
			S6-L-B111-10.0 (-T) -INT	10000	
MS1H2 motors rated 4 kW/5 kW	Without brake		S6-L-M011-3.0 (-T) -INT	3000	
			S6-L-M011-5.0 (-T) -INT	5000	
			S6-L-M011-10.0 (-T) -INT	10000	
	With bake		S6-L-B011-3.0 (-T) -INT	3000	
			S6-L-B011-5.0 (-T) -INT	5000	
			S6-L-B011-10.0 (-T) -INT	10000	

Motor model	Name	Cable model	Cable length (mm)	Drawing
MS1H3 motors (2.9 kW)	Without brake	S6-L-M112-3.0 (-T) -INT	3000	
		S6-L-M112-5.0 (-T) -INT	5000	
		S6-L-M112-10.0 (-T) -INT	10000	
	With bake	S6-L-B112-3.0 (-T) -INT	3000	
		S6-L-B112-5.0 (-T) -INT	5000	
		S6-L-B112-10.0 (-T) -INT	10000	
MS1H3 (4.4 kW and above)	Without brake	S6-L-M022-3.0 (-T) -INT	3000	
		S6-L-M022-5.0 (-T) -INT	5000	
		S6-L-M022-10.0 (-T) -INT	10000	
	With bake	S6-L-B022-3.0 (-T) -INT	3000	
		S6-L-B022-5.0 (-T) -INT	5000	
		S6-L-B022-10.0 (-T) -INT	10000	

List of Motor Model Selection (Compatible with LMC Linear Module)

For details about power cable models, see *"2.3 List of Motor Model Selection (Compatible with LMC Linear Module)" on page 34*.

List of Power Cables (Compatible with ISM Series Torque Motor)

For details about power cable models, see *"2.5 List of Motor Model Selection (Compatible with ISM Series Torque Motor)" on page 35*.

List of Power Cables (Compatible with MP Series Torque Motor)

For details about power cable models, see *"2.4 List of Motor Model Selection (Compatible with MP Series Torque Motor)" on page 35*.

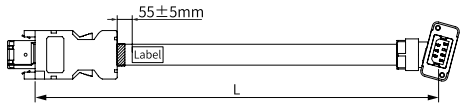
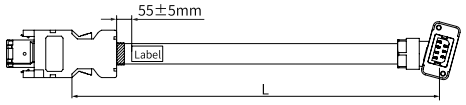
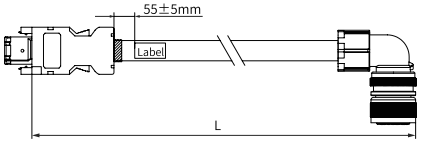
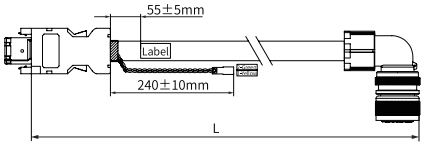
20.1.2 Encoder Cables

Encoder cable model

S6-L-P ① 1 ② 2 ③ 1 ④ - 3.0 ⑤ - T ⑥ - X ⑦ - X ⑧ - X ⑨ - INT ⑩

① **Cable type** S6-L-P: Encoder cable	④ **Connector type at motor side** 1: 17-core military-spec connector 4: MS1 custom connector (front outlet) 5: MS1 custom connector (rear outlet) A: RSF (MS15 series) and Inovance (EL0I) pulse-type grating C: DB15 with 2 rows of LAMOTION (RU2 series) grating D: Inovance communication-type incremental grating/magnetic grating G: DB9 plug H: USB plug N: TSUN absolute magnetic grating (2 rows of DB9 females) P: LAMOTION absolute magnetic grating (2 rows of DB9 females)	⑥ **Special requirements** Blank: Fixed cables T: Cable in the drag chain ≥ 10 million times TTS: Drag chain shielding ≥ 20 million times
② **Connector type at drive side** 1: USB 2: DB15		⑦ **Manufacturer** Blank: Default 2: Brand xx
		⑧ **Hall sensor** Empty: Without Hall H: With Hall
③ **Encoder** 1: Communication-type incremental encoder 2: Communication-type multi-turn absolute encoder 3: Grating 4: Magnetic grating 5: 23-bit single-turn absolute encoder	⑤ **Cable length (m)** 0.5: 0.5 3.0: 3 5.0: 5 8.0: 8 10.0: 10 12.0: 12 15.0: 15 20.0: 20	⑨ **Limit** Empty: No limit L: With limit
		⑩ **Version** INT: Global version

List of Encoder Cables (Compatible with MS1-R-INT Series Motor)

Motor model	Name		Cable model	Cable length (mm)	Drawing
MS1H1/ MS1H4 terminal-type motors	Front outlet	Single-turn absolute encoder cable	S6-L-P114-3.0 (-T) -INT	3000	
			S6-L-P114-5.0 (-T) -INT	5000	
			S6-L-P114-10.0 (-T) -INT	10000	
		Multi-turn absolute encoder cable	S6-L-P124-3.0 (-T) -INT	3000	
			S6-L-P124-5.0 (-T) -INT	5000	
			S6-L-P124-10.0 (-T) -INT	10000	
	Rear outlet	Single-turn absolute encoder cable	S6-L-P115-3.0 (-T) -INT	3000	
			S6-L-P115-5.0 (-T) -INT	5000	
			S6-L-P115-10.0 (-T) -INT	10000	
		Multi-turn absolute encoder cable	S6-L-P125-3.0 (-T) -INT	3000	
			S6-L-P125-5.0 (-T) -INT	5000	
			S6-L-P125-10.0 (-T) -INT	10000	
MS1H2/MS1H3 motor		Single-turn absolute encoder cable	S6-L-P111-3.0 (-T) -INT	3000	
			S6-L-P111-5.0 (-T) -INT	5000	
			S6-L-P111-10.0 (-T) -INT	10000	
		Multi-turn absolute encoder cable	S6-L-P121-3.0 (-T) -INT	3000	
			S6-L-P121-5.0 (-T) -INT	5000	
			S6-L-P121-10.0 (-T) -INT	10000	

Note

- The encoder cable is equipped with a shield as standard.
- [1]: The 6-conductor cable can be used in normal cases. The cable is reserved for compatibility with the original battery model. It is not required to be connected to the battery box during actual use.

List of Encoder Cables (Compatible with LMC Linear Module)

Readhead type	Cable length (m)				
	3	5	8	10	12
RSF-MS15 series, RU2 series, Inovance pulse-type grating (DB15, two rows), Renishaw grating, and LAMOTION RU2 grating without limits (No Hall or limit)	S6-L-P23A-3.0-TTS-2-INT	S6-L-P23A-5.0-TTS-2-INT	S6-L-P23A-8.0-TTS-2-INT	S6-L-P23A-10.0-TTS-2-INT	S6-L-P23A-12.0-TTS-2-INT
RSF-MS15 series, RU2 series, Inovance pulse-type grating (DB15, two rows), Renishaw grating, and LAMOTION RU2 grating without limits (No Hall or limit)	S6-L-P23A-3.0-TTS-2-H-INT	S6-L-P23A-5.0-TTS-2-H-INT	S6-L-P23A-8.0-TTS-2-H-INT	S6-L-P23A-10.0-TTS-2-H-INT	S6-L-P23A-12.0-TTS-2-H-INT
Inovance communication-type ELMI magnetic grating/ELOI grating (No Hall or limit)	S6-L-P24D-3.0-TTS-2-INT	S6-L-P24D-5.0-TTS-2-INT	S6-L-P24D-8.0-TTS-2-INT	S6-L-P24D-10.0-TTS-2-INT	S6-L-P24D-12.0-TTS-2-INT
Inovance communication-type ELMI magnetic grating/ELOI grating (No Hall or limit)	S6-L-P24D-3.0-TTS-2-H-INT	S6-L-P24D-5.0-TTS-2-H-INT	S6-L-P24D-8.0-TTS-2-H-INT	S6-L-P24D-10.0-TTS-2-H-INT	S6-L-P24D-12.0-TTS-2-H-INT
LAMOTION grating (RU2 series) with limit (No Hall or limit)	S6-L-P23C-3.0-TTS-2-L-INT	S6-L-P23C-5.0-TTS-2-L-INT	S6-L-P23C-8.0-TTS-2-L-INT	S6-L-P23C-10.0-TTS-2-L-INT	S6-L-P23C-12.0-TTS-2-L-INT
LAMOTION grating (RU2 series) with limit (With Hall and limit)	S6-L-P23C-3.0-TTS-2-H-L-INT	S6-L-P23C-5.0-TTS-2-H-L-INT	S6-L-P23C-8.0-TTS-2-H-L-INT	S6-L-P23C-10.0-TTS-2-H-L-INT	S6-L-P23C-12.0-TTS-2-H-L-INT

List of Encoder Cables (Compatible with ISM Series Torque Motor)

Motor model	Servo drive SV670-INT	Encoder extension cable length (3 m)	Encoder extension cable length (5 m)	Encoder extension cable length (10 m)
ISMT1-160F12AB-A113X-INT ISMT1-160F12AB-A133X-INT	S2R8	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
ISMT1-160F45AB-A133X-INT				

List of Encoder Cables (Compatible with MP Series Torque Motor)

Motor model	Servo drive SV670-INT	Extension cable length (3 m)	Extension cable length (5 m)	Extension cable length (10 m)
MP1-112F10AB-U313X-INT	S2R8	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
MP1-140S10BB-U323X-INT	S012	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
MP1-175S11BB-U333X-INT	S012	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
MP1-220S15BB-U323X-INT	S012	S6-L-P25G-3.0-INT	S6-L-P25G-5.0-INT	S6-L-P25G-10.0-INT
MP1-220S30BD-U323X-INT	T021	S6-L-P25G-3.0-INT	S6-L-P25G-5.0-INT	S6-L-P25G-10.0-INT
MP1-220S30BD-U323L-C-INT	T026	S6-L-P25G-3.0-INT	S6-L-P25G-5.0-INT	S6-L-P25G-10.0-INT

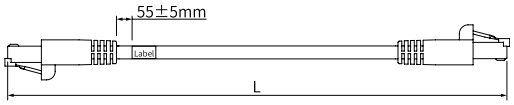
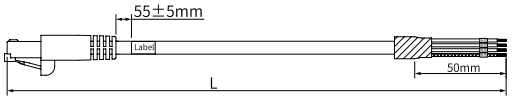
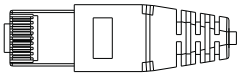
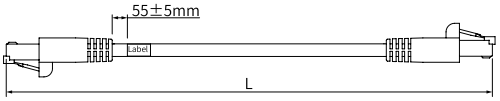
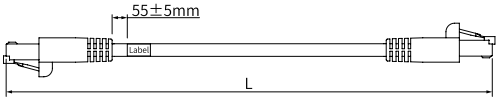
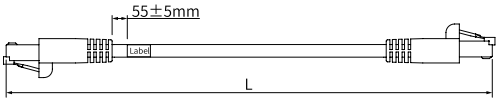
20.1.3 Communication Cable

Model number of communication cables

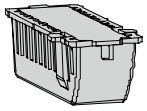
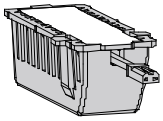
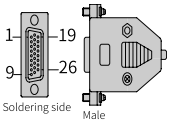
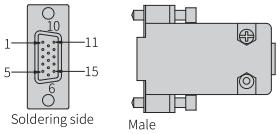
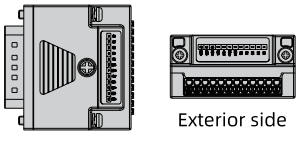
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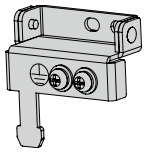
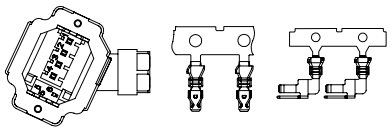
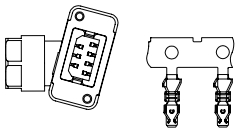
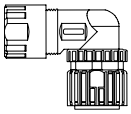
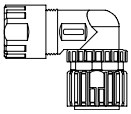
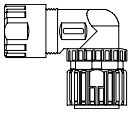
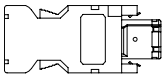
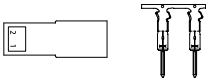
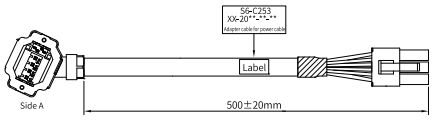
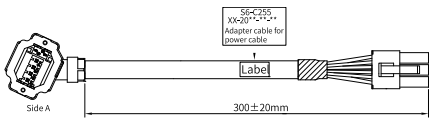
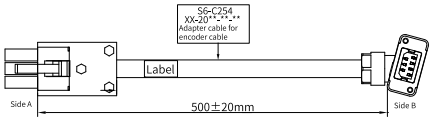
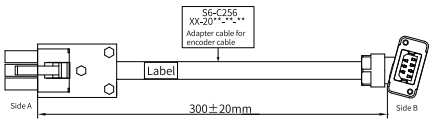
① **Cable Type**	② **Cable type**	③ **Cable Length (m)**
S6-L-T: Motion control communication cable	01: Servo drive multi-drive communication cable (CAN&RS485) 02: Drive-PLC communication cable 03: Servo drive communication termination resistor cable (CAN&RS485) 04: Servo drive network communication cable (CAT.5E&PROFINET) 07: Servo drive network communication cable (CAT6A&PROFINET) 08: Servo drive network communication cable (CAT7&PROFINET)	0.3: 0.3 2.0: 2 ...

List of communication cables

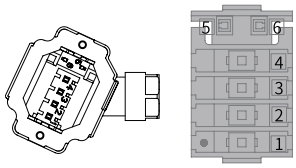
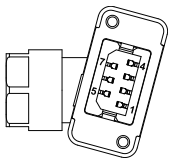
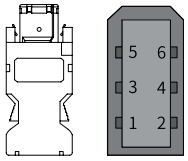
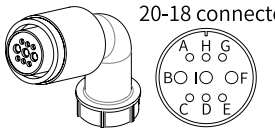
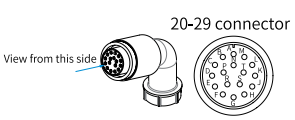
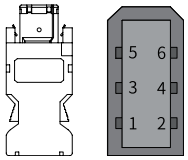
Cable Name	Cable Model	Cable Length (mm)	Illustration
Multi-drive communication cable	S6-L-T01-0.3	300	
Drive-PLC communication cable	S6-L-T02-2.0	2000	
Servo drive termination resistor connector	S6-L-T03-0.0	-	
Servo drive network communication cable (CAT.5E&PROFINET)	S6-L-T04-0.3	300	
Servo drive network communication cable (CAT.T6A&PROFINET)	S6-L-T07-0.3	300	
Servo drive network communication cable (CAT7&PROFINET)	S6-L-T08-0.3	300	

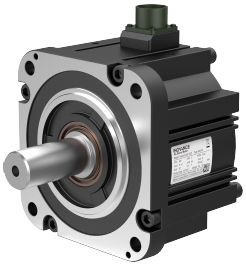
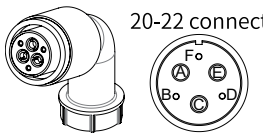
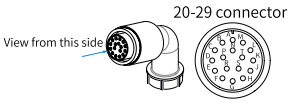
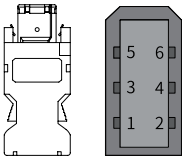
20.1.4 Connector Kit

Name	Cable model	Drawing
Battery box kit (without battery)	S6-C4A-NB	
Battery kit	S6-C4A	
CN1 terminal (DB26)	S6-C74	
CN7 terminal (DB15)	S6-C6	
Adapter (14-pin pluggable terminal block)	S6-C220	

Name	Cable model	Drawing
Shield bracket	S6-C25 (Optional for size A to size C)	
	S6-C27 (Optional for size D to size E)	
Power connector at motor side with power below 750 W	S6-C246	
Encoder connector at motor side with power below 750 W	S6-C247	
Power connector for frame sizes 100 to 130 at motor side with power above 1000 W	S6-C248	
Power connector for frame size 180 at motor side with power above 1000 W	S6-C249	
Encoder connector at motor side with power above 1000 W	S6-C250	
CN2 (1394)	S6-C251	
Battery box connector	S6-C252	
Power flying leads at motor side with power below 750 W - 500 mm	S6-C253	
Power flying leads at motor side with power below 750 W - 300 mm	S6-C255	
Encoder flying leads at motor side with power below 750 W - 500 mm	S6-C254	
Encoder flying leads at motor side with power below 750 W - 300 mm	S6-C256	

20.1.5 Cable Terminal Description

<table>
<tr><th>Name</th><th>Diagram</th><th colspan="3">6-pin connector of power cables</th><th colspan="3">7-pin connector of the encoder on the motor side</th><th colspan="3">6-pin male on the drive side</th></tr>
<tr><td rowspan="9">Assignment of terminals on the terminal-type motor side (flange size 40/60/80)</td><td rowspan="9"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Pin No.</td><td>Signal name</td><td>Color</td><td>Pin No.</td><td>Signal name</td><td>Color</td><td>Pin No.</td><td>Signal name</td><td>Color</td></tr>
<tr><td>1</td><td>PE</td><td>Yellow/ Green</td><td>1</td><td>PS+</td><td>Gray</td><td>1</td><td>+5V</td><td>White</td></tr>
<tr><td>2</td><td>W</td><td>Black 3</td><td>2</td><td>PS-</td><td>Pink</td><td>2</td><td>GND</td><td>Brown</td></tr>
<tr><td>3</td><td>V</td><td>Black 2</td><td>3</td><td>DC+</td><td>Yellow</td><td>5</td><td>PS+</td><td>Gray</td></tr>
<tr><td>4</td><td>U</td><td>Black 1</td><td>4</td><td>DC-</td><td>Green</td><td>6</td><td>PS-</td><td>Pink</td></tr>
<tr><td>5</td><td rowspan="2">-</td><td>White</td><td>5</td><td>+5V</td><td>White</td><td rowspan="3">Enclosure</td><td rowspan="3">PE</td><td rowspan="3">-</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Brown</td><td>6</td><td>GND</td><td>Brown</td></tr>
<tr><td>7</td><td>PE</td><td>-</td></tr>
<tr><td rowspan="9">Assignment of terminals on the flange motor side (flange size 100/130)</td><td rowspan="9"></td><td colspan="3">Power cable connector</td><td colspan="3">Encoder cable connector</td><td colspan="3">6-pin male on the drive side</td></tr>
<tr><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Pin No.</td><td>Pin No.</td><td>Color</td><td>Pin No.</td><td>Signal name</td><td>Color</td><td>Pin No.</td><td>Signal name</td><td>Color</td></tr>
<tr><td>B</td><td>U</td><td>Black 1</td><td>A</td><td>PS+</td><td>Gray</td><td>1</td><td>+5V</td><td>White</td></tr>
<tr><td>I</td><td>V</td><td>Black 2</td><td>B</td><td>PS-</td><td>Pink</td><td>2</td><td>GND</td><td>Brown</td></tr>
<tr><td>F</td><td>W</td><td>Black 3</td><td>E</td><td>DC+</td><td>Yellow</td><td>5</td><td>PS+</td><td>Gray</td></tr>
<tr><td>G</td><td>PE</td><td>Yellow/ Green</td><td>F</td><td>DC-</td><td>Green</td><td>6</td><td>PS-</td><td>Pink</td></tr>
<tr><td>C</td><td rowspan="3">-</td><td>Black 4</td><td>G</td><td>+5V</td><td>White</td><td rowspan="3">Enclosure</td><td rowspan="3">PE</td><td rowspan="3">-</td></tr>
<tr><td rowspan="2">E</td><td rowspan="2">Black 5</td><td>H</td><td>GND</td><td>Brown</td></tr>
<tr><td>J</td><td>Shield</td><td>-</td></tr>
</table>

<table>
<tr><td rowspan="10">Assignment of terminals on the flange motor side (flange size 180)</td><td rowspan="10"></td><td colspan="3">Power cable connector</td><td colspan="3">Encoder cable connector</td><td colspan="3">6-pin male on the drive side</td></tr>
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</td><td colspan="3">
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</td></tr>
<tr><td>Pin No.</td><td>Pin No.</td><td>Color</td><td>Pin No.</td><td>Signal name</td><td>Color</td><td>Pin No.</td><td>Signal name</td><td>Color</td></tr>
<tr><td>A</td><td>U</td><td>Black 1</td><td>A</td><td>PS+</td><td>Gray</td><td>1</td><td>+5V</td><td>White</td></tr>
<tr><td>C</td><td>V</td><td>Black 2</td><td>B</td><td>PS-</td><td>Pink</td><td>2</td><td>GND</td><td>Brown</td></tr>
<tr><td>E</td><td>W</td><td>Black 3</td><td>E</td><td>DC+</td><td>Yellow</td><td>5</td><td>PS+</td><td>Gray</td></tr>
<tr><td>F</td><td>PE</td><td>Yellow/ Green</td><td>F</td><td>DC-</td><td>Green</td><td>6</td><td>PS-</td><td>Pink</td></tr>
<tr><td>B</td><td rowspan="2">-</td><td>Black 4</td><td>G</td><td>+5V</td><td>White</td><td rowspan="2">Enclosure</td><td rowspan="2">PE</td><td rowspan="2">-</td></tr>
<tr><td>D</td><td rowspan="2">Black 5</td><td>H</td><td>GND</td><td>Brown</td></tr>
<tr><td></td><td></td><td></td><td>J</td><td>Shield</td><td>-</td></tr>
</table>

20.2 Peripheral Electrical Components

20.2.1 List of Peripheral Electrical Components

Name	Installation position	Applicable drive model	Function
Fuse and circuit breaker	Input side of the servo drive	All	To comply with EN 61800-5-1 and UL61800-5-1 standards, install a fuse/circuit breaker on the input side of the servo drive to prevent accidents caused by short circuit in the internal circuit.
Electromagnetic contactor	Input side of the servo drive		Used to connect or disconnect the circuit.
AC input reactor	Input side of the servo drive		Used to eliminate the higher harmonics of the input side effectively and improve the power factor of the input side.
EMC filter	Input side of the servo drive		Used to reduce external conduction and radiation interference of the drive.
Magnetic ring and ferrite clamp	Output side of the drive		Reduces interferences to the outside and the bearing current.
	Signal cable		Improves the anti-interference performance of signals.

20.2.2 Fuse (CE)

To prevent accidents caused by short circuit, install a fuse on the input side of the drive.

Table 20–1 Recommended fuse

Drive model SV670-INT series			Recommended fuse Rated current (A)
Size	Model	Rated input current (A)	
Single-phase 200 V			
A	S1R6	2.3	5
	S2R8	4.0	12
C	S5R5	7.9	12
	S7R6	9.6	15
D	S012	12.8	20
Three-phase 200 V			
A	S1R6	1.1	5
	S2R8	2.3	5
C	S5R5	4.4	12
	S7R6	5.1	12
D	S012	8.0	15
E	S018	8.7	20
	S022	11.0	20
	S027	23.8	32
Three-phase 400 V			
C	T3R5	2.4	5
	T5R4	3.6	10
D	T8R4	5.6	15
	T012	8.0	15
E	T017	12.0	20
	T021	16.0	25
	T026	21.0	30

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm^2.

When you select a fuse, take into account the maximum input surge current parameter in the "Electrical Specifications" section of the User Guide to ensure that the fuse pre-arcing (I^2t) can withstand surge current conditions multiple times over its expected service life.

20.2.3 Fuse (UL)

Table 20–2 Recommended protective device for the drive

Drive model SV670-INT series			Recommended non-semiconductor fuse
Size	Model	Continuous input current of main circuit (A)	Rated current (A)
Single-phase 200 V			
A	S1R6	2.3	6
	S2R8	4	10

Drive model SV670-INT series			Recommended non-semiconductor fuse
Size	Model	Continuous input current of main circuit (A)	Rated current (A)
C	S5R5	7.9	15
	S7R6	9.6	20
D	S012	12.8	20
Three-phase 200 V			
A	S1R6	1.1	6
	S2R8	2.3	6
C	S5R5	4.4	10
	S7R6	5.1	10
D	S012	8.0	15 to 20
E	S018	8.7	15 to 40
	S022	11.0	20 to 40
	S027	23.8	40
Three-phase 400 V			
C	T3R5	2.4	6 to 10
	T5R4	3.6	6 to 10
D	T8R4	5.6	10 to 20
	T012	8.0	15 to 20
E	T017	12.0	20 to 40
	T021	16.0	30 to 40
	T026	21.0	35 to 40

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm^2.

When you select a fuse, take into account the maximum input surge current parameter in the "Electrical Specifications" section of the User Guide to ensure that the fuse pre-arcing (I^2t) can withstand surge current conditions multiple times over its expected service life.

Fuse selection requirements:

If the short-circuit current rating is 5 kA/65 kA and the drive size is A/C/D/E, it is recommended to use a class J or class CC fuse that complies with the UL 248 standard. If you use a class CC fuse, the maximum allowable rating of the circuit breaker is 30 A.

20.2.4 Electromagnetic Contactor

Table 20–3 Recommended electromagnetic contactor models

Servo drive SV670N-INT series			Recommended contactor		
Size	Model	Rated input current (A)	Manufacturer	Current (A)	Model
Single-phase 200 V					
A	S1R6	2.3	Schneider	9	LC1 D09
	S2R8	4.0		9	LC1 D09
C	S5R5	7.9		9	LC1 D09
	S7R6	9.6		12	LC1 D12
D	S012	12.8		18	LC1 D18
Three-phase 200 V					
A	S1R6	1.1	Schneider	9	LC1 D09
	S2R8	2.3			
C	S5R5	4.4			
	S7R6	5.1			
D	S012	8.0		9	LC1 D09
E	S018	8.7		12	LC1 D12
	S022	11.0			
	S027	23.8		25	LC1 D25
Three-phase 400 V					
C	T3R5	2.4	Schneider	9	LC1 D09
	T5R4	3.6		9	LC1 D09
D	T8R4	5.6		9	LC1 D09
	T012	8.0		9	LC1 D09
E	T017	12.0		18	LC1 D18
	T021	16.0		18	LC1 D18
	T026	21.0		25	LC1 D25

20.2.5 Circuit Breaker (CE)

Table 20–4 Recommended circuit breaker models

Drive model SV670-INT series			Recommended circuit breaker Rated current (A)
Size	Model	Rated input current (A)	
Single-phase 200 V			
A	S1R6	2.3	4
	S2R8	4.0	6
C	S5R5	7.9	16
	S7R6	9.6	16
D	S012	12.8	20
Three-phase 200 V			
A	S1R6	1.1	4
	S2R8	2.3	4
C	S5R5	4.4	6
	S7R6	5.1	10
D	S012	8.0	16

Drive model SV670-INT series			Recommended circuit breaker Rated current (A)
Size	Model	Rated input current (A)	
E	S018	8.7	16
	S022	11.0	16
	S027	23.8	32
Three-phase 400 V			
C	T3R5	2.4	4
	T5R4	3.6	6
D	T8R4	5.6	10
	T012	8.0	16
E	T017	12.0	16
	T021	16.0	25
	T026	21.0	32

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm^2.

When you select a circuit breaker, take into account parameter "Surge current (A)" in section "Electrical Specifications" in the User Guide. Make sure that the trip characteristics curve of the circuit breaker can support the surge current working conditions.

If a residual current device (RCD) is needed, select the RCD according to the following requirements:

- Use a B-type residual current device (RCD) because the drive may generate DC leakage current in the protective conductor.
- For each drive, use an RCD with tripping current not lower than 100 mA to prevent RCD malfunction due to high-frequency leakage current generated by the drive.
- When multiple drives are connected in parallel and one RCD is used, select an RCD whose tripping current is not lower than 300 mA.
- It is recommended to use Chint or Schneider RCDs.

20.2.6 Circuit Breaker (UL)

Table 20–5 Recommended protective device for the drive

Drive model SV670-INT series			Recommended inverse time circuit breaker (Breaking capacity 5 kA, compliant with UL 489)	Recommended inverse time circuit breaker (Breaking capacity 65 kA, compliant with UL 489)	Recommended inverse time circuit breaker[1] (Breaking capacity 5 kA or 65 kA, compliant with UL 489)
Size	Model	Continuous input current of main circuit (A)	Rated current (A)	Rated current (A)	Rated current (A)
Single-phase 200 V					
A	S1R6	2.3	5 to 15	-	≤ 40
	S2R8	4.0	8 to 15	-	≤ 40
C	S5R5	7.9	15	15	≤ 40
	S7R6	9.6	15	15	≤ 100
D	S012	12.8	20	20	≤ 100
Three-phase 200 V					
A	S1R6	1.1	5 to 15	-	≤ 40
	S2R8	2.3	5 to 15	-	≤ 40
C	S5R5	4.4	8 to 15	-	≤ 40
	S7R6	5.1	10 to 15	-	≤ 100
D	S012	8.0	15 to 20	15	≤ 100
E	S018	8.7	16 to 40	20	≤ 100
	S022	11.0	20 to 40	20	≤ 100
	S027	23.8	40	40	≤ 100
Three-phase 400 V					
C	T3R5	2.4	5 to 15	-	≤ 100
	T5R4	3.6	7 to 15	-	≤ 100
D	T8R4	5.6	12 to 20	-[2]	≤ 100
	T012	8.0	15 to 20	15	≤ 100
E	T017	12.0	25 to 40	25	≤ 100
	T021	16.0	30 to 40	30	≤ 100
	T026	21.0	40	40	≤ 100

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm^2.

Circuit breaker selection requirements:

- When you select a circuit breaker, take into account parameter "Max. input surge current (A)" in section "Electrical Specifications" in the User Guide. Make sure that the trip characteristics curve of the circuit breaker can support the surge current working conditions.
- If the short-circuit current rating is 5 kA/65 kA and the drive size is A/C/D/E, it is recommended to use an inverse-time circuit breaker that complies with the UL 489 standard.
- [1]: It is recommended to refer to this column when you select circuit breakers for multi-drive parallel systems.
- [2]: For this drive model, when used with a circuit breaker having a breaking capacity of 65 kA, no recommended current value is provided. However, the rated current of this circuit breaker must not exceed the maximum rated current of the selected circuit breaker with a breaking capacity of 5 kA.

20.2.7 AC Input Reactor

Model selection

An AC input reactor is optional and mainly used to reduce harmonic waves in the input current. In scenarios where harmonic waves need to be suppressed, install an external reactor. The following table lists the recommended manufacturers and models of input reactors.

Table 20–6 AC input reactor model selection

Servo drive SV670N-INT series			Applicable reactor	Inductance (mH)
Size	Model	Rated input current (A)		
Three-phase 200 V				
A	S1R6	1.1	MD-ACL-10-5-4T	5
	S2R8	2.3	MD-ACL-10-5-4T	5
C	S5R5	4.4	MD-ACL-10-5-4T	5
	S7R6	5.1	MD-ACL-10-5-4T	5
D	S012	8.0	MD-ACL-10-5-4T	5
E	S018	8.7	MD-ACL-15-3-4T	3
	S022	11.0	MD-ACL-15-3-4T	3
	S027	23.8	MD-ACL-40-1.45-4T	1.45
Three-phase 400 V				
C	T3R5	2.4	MD-ACL-10-5-4T	5
	T5R4	3.6	MD-ACL-10-5-4T	5
D	T8R4	5.6	MD-ACL-10-5-4T	5
	T012	8.0	MD-ACL-10-5-4T	5
E	T017	12.0	MD-ACL-15-3-4T	3
	T021	16.0	MD-ACL-40-1.45-4T	1.45
	T026	21.0	MD-ACL-40-1.45-4T	1.45

Dimensions

- Inovance input reactors

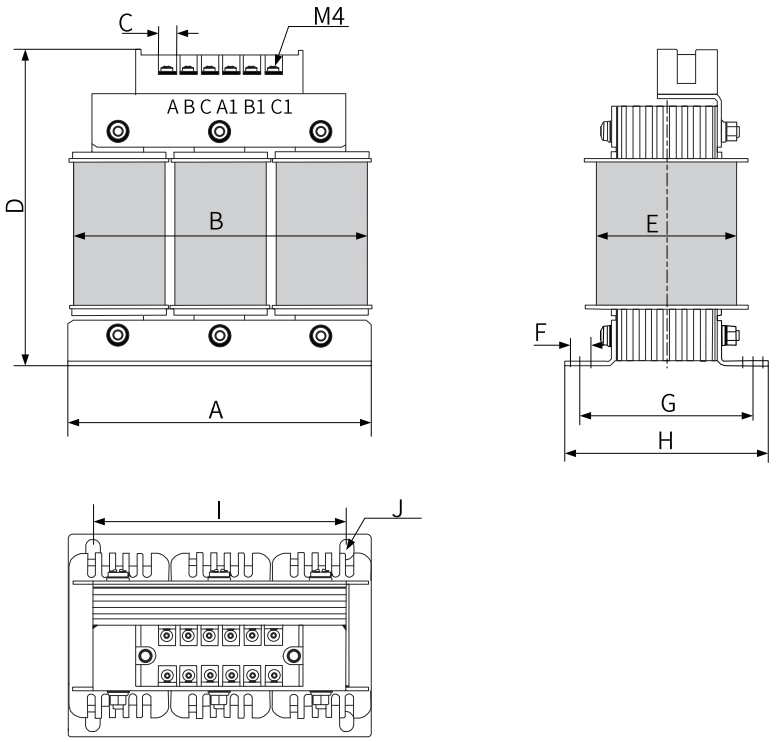


Figure 20-1 Dimension drawing of 10 A to 15 A AC input reactors

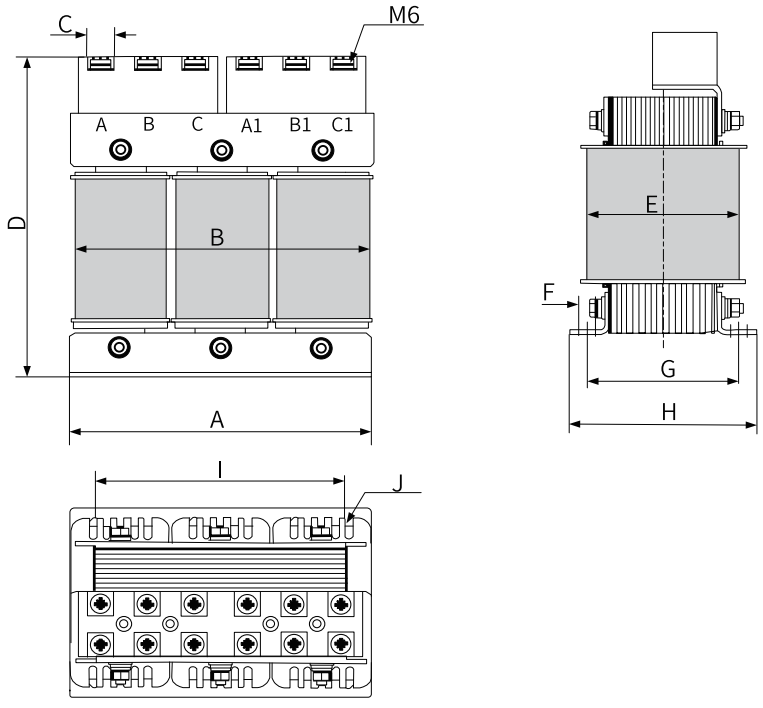


Figure 20-2 Dimensions of 40 A (1.45 mH) AC input reactors

Table 20–7 Dimensions of Inovance AC input reactors (unit: mm)

Model	A	B	C	D	E	F	G	H	I	J
MD-ACL-10-5-4T	150±2	155	8	160	80	10	85±2	100±2	125±1	Ø7 x 10
MD-ACL-15-3-4T	150±2	155	8	160	80	10	85±2	100±2	125±1	Ø7 x 10
MD-ACL-40-1.45-4T	180±2	185	16	200	105	10	95±2	117±2	150±1	Ø7 x 10

20.2.8 EMC Filter

20.2.8.1 Connecting One Drive to One EMC Filter

- **Model selection**

  To comply with the radiated and conducted emission requirements of EN IEC 61800-3, install an external EMC filter. The recommended EMC filters for this drive are Schaffner FN2090 and FN3287 filters. Filters of equivalent specifications and performance from other brands are also acceptable. The specifications of Schaffner FN2090 and FN3287 filters are as follows.

Table 20–8 Standard EMC filter model and appearance

Filter model (recommended)		Appearance
Schaffner	FN2090	
	FN3287	

Table 20–9 Selection of filters

Servo drive SV670-INT series			Applicable filter (recommended)
Size	Model	Rated input current (A)	
Single-phase 200 V			
A	S1R6	2.3	FN2090-3-06
	S2R8	4.0	FN2090-4-06
C	S5R5	7.9	FN2090-8-06
	S7R6	9.6	FN2090-10-06
D	S012	12.8	FN2090-16-06
Three-phase 200 V			
A	S1R6	1.1	FN3287-10-44-C28-R65
	S2R8	2.3	FN3287-10-44-C28-R65
C	S5R5	4.4	FN3287-10-44-C28-R65
	S7R6	5.1	FN3287-10-44-C28-R65
D	S012	8.0	FN3287-10-44-C28-R65

Servo drive SV670-INT series			Applicable filter (recommended)
Size	Model	Rated input current (A)	
E	S018	8.7	FN3287-10-44-C28-R65
	S022	11.0	FN3287-16-44-C33-R65
	S027	23.8	FN3287-25-33-C33-R65
Three-phase 400 V			
C	T3R5	2.4	FN3287-10-44-C28-R65
	T5R4	3.6	FN3287-10-44-C28-R65
D	T8R4	5.6	FN3287-10-44-C28-R65
	T012	8.0	FN3287-10-44-C28-R65
E	T017	12.0	FN3287-16-44-C33-R65
	T021	16.0	FN3287-16-44-C33-R65
	T026	21.0	FN3287-25-33-C33-R65

- **Dimensions**
  - Dimensions of Schaffner FN2090 filters:

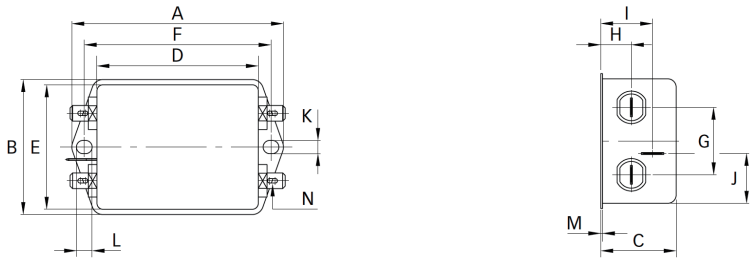


Figure 20-3 Dimensions of FN2090 filters (unit: mm)

Table 20–10 Dimensions of FN2090 filters (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	85	54	30.3	64.8	49.8	75	27	12.3	20.8	19.9	5.3	6.3	0.7	6.3 × 0.8
4														
6														
8	113.5±1	57.5±1	45.4±1	94±1	56	103	25	12.4	32.4	15.5	4.4	6	1	6.3 × 0.8

  - Dimensions of Schaffner FN3287 filters:

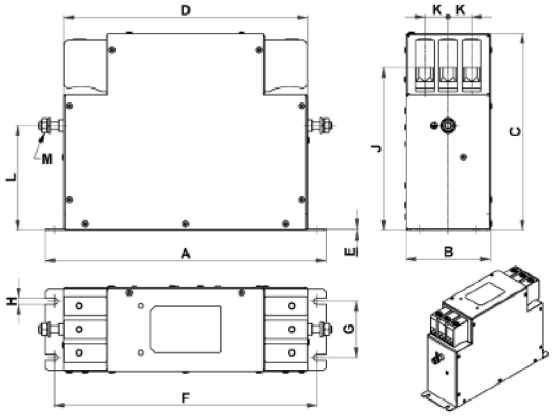


Figure 20-4 Dimensions of FN3287 filters (unit: mm)

Table 20–11 Dimensions of FN3287 filters (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	J±2	K	L±1	M
10	180	40	112	153	0.8	170	20	4.5	94	11	68	M5
16	200	45	112	170	0.8	185	25	5.4	102	11	76	M5
25	205	45	132	173	0.8	190	25	5.4	113	13	83	M5

20.2.8.2 Connecting Multiple Drives to One EMC Filter

Note

An EMC filter can be connected to multiple servo drives, and is suitable for the three-phase 200 V voltage class (three-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz) and three-phase 400 V voltage class (three-phase 380VAC to 480 VAC, -10%~+10%, 50 Hz/60 Hz).

- **Model selection**
  - Selection criteria

    To connect an EMC filter to multiple drives, make sure that the following requirements are met:

    - If only one EMC filter is used, the sum of the power cable length of all drives must not exceed 100 m.
    - The number of drives to which the EMC filter is connected must not exceed 10.
    - The rated current of the EMC filter must be equal to or higher than the sum of the rated current of all drives. It is recommended to select an EMC with a rated current between 30 A and 55 A for the drives.

Note

Even if multiple servo drives are not operating simultaneously on the same EMC filter, the above-mentioned requirements must still be met, because the accumulated common-mode currents when the servo drives are enabled at zero speed can cause adverse effects such as saturation and overheating of the EMC filter.

- Keep the distance between the EMC filter and the drives as short as possible. It is recommended to keep the power cable length between the EMC filter and the drives no longer than 2 m.

- Servo drive specifications

Table 20–12 Servo drive specifications at three-phase 200 V

Specification	Size A		Size C		Size D	Size E		
Drive model	S1R6	S2R8	S5R5	S7R6	S012	S018	S022	S027
Drive power (kW)	0.2	0.4	0.75	1.0	1.5	2.0	3.0	5.0
Continuous input current of main circuit (A)	1.1	2.3	4.4	5.1	8.0	8.7	11.0	23.8
Main circuit power supply	Three-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz							

Table 20–13 Servo drive specifications at three-phase 400 V

Specification	Size C		Size D		Size E		
Drive model	T3R5	T5R4	T8R4	T012	T017	T021	T026
Drive power (kW)	1.0	1.5	2.0	3.0	5.0	6.0	7.5
Continuous input current of main circuit (A)	2.4	3.6	5.6	8.0	12.0	16.0	21.0
Main circuit power supply	Three-phase 380VAC to 480 VAC, -10% to +10%, 50 Hz/60 Hz						

- To prevent the EMC filter from operating in saturation and failing due to overheating, the SV670-INT servo drive, which is compatible with three-phase 200 V voltage class (three-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz) and three-phase 400 V voltage class (three-phase 380VAC to 480 VAC, -10%~ to 10%, 50 Hz/60 Hz), must be equipped with an EMC filter with a rated current between 30 A and 55 A. The recommended EMC filter for this drive is Schaffner FN3258. Other brands of EMC filters with equivalent specifications and performance can also be used, provided they meet the required specifications in *"Table 20-16" on page 1131*. The specifications of Schaffner FN3258 filters are as follows.

Table 20–14 Standard EMC filter model and appearance

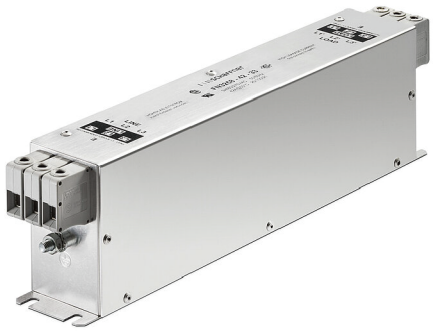
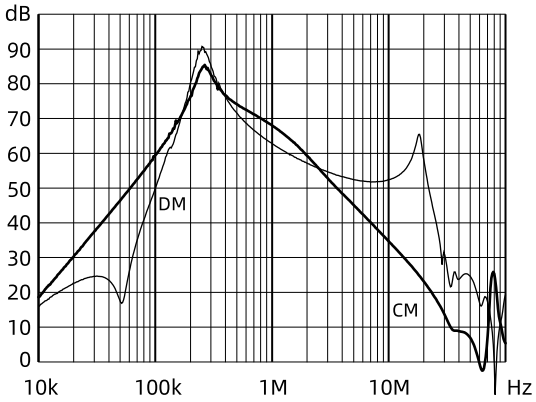
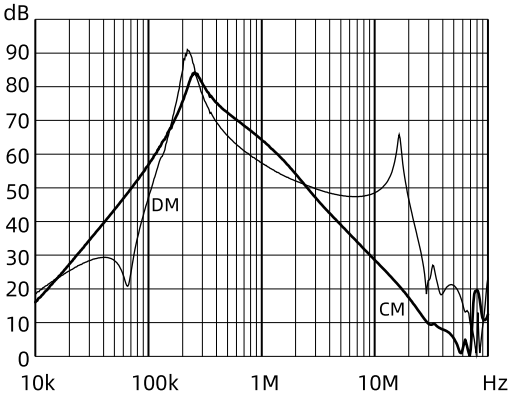
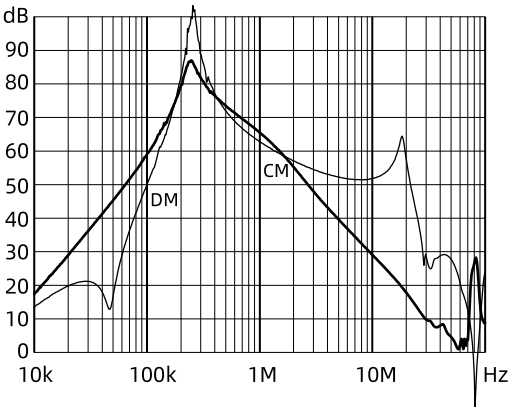
Filter model (recommended)		Appearance
Schaffner	FN3258	

Table 20–15 EMC filter specifications

Model	Rated current 50°C (40°C) (A)	Rated drive power (kW)	Leakage current 400 VAC/50 Hz (mA)	Power loss 25 °C/50 Hz (W)	Input/output connector terminal types and wiring requirements	Weight (kg)
FN3258-30-33	30 (32.9)	15	33.0	11.8	-33	1.2
FN3258-42-33	42 (46.0)	22	33.0	15.7	-33	1.4
FN3258-55-34	55 (60.2)	30	33.0	25.9	-34	2.0

Table 20–16 EMC filter performance

Item	Specification
Overall performance	Meets the EN55011 Class A limits, with saturation resistance for cable length exceeding 50 meters.
Input voltage class	• Maximum continuous operating voltage: FN3258 supports three-phase 380V/ 277 V AC input. • Nominal operating voltage: 400 VAC
Rated operating current	• In applications where one EMC filter is connected to multiple drives, the operating current of the three EMC filters recommended by Inovance is 30 A, 42 A, and 55 A, respectively. If you use EMC filters of other brands, the rated current must comply with the current range of the EMC filters recommended by Inovance. • The rated current must meet the requirements at 50°C.
Operating temperature range	Within the specified range of FN3258: -25°C~ to 100°C.
Leakage current requirements	≤ 4.3 mA at 480 V/520 VAC at 50Hz

Item	Specification
Attenuation performance (30 A) FN3258-30-33	The differential and common-mode attenuation performance of the 30 A EMC filter is no less than that of the Schaffner FN3258-30-33 filter. 
Attenuation performance (42 A) FN3258-42-33	The differential and common-mode attenuation performance of the 42 A EMC filter is no less than that of the Schaffner FN3258-42-33 filter. 
Attenuation performance (55 A) FN3258-55-34	The differential and common-mode attenuation performance of the 55 A EMC filter is no less than that of the Schaffner FN3258-55-34 filter. 

- Configuration example: one EMC filter connected to multiple drives
  In this example, nine drives are installed in one control cabinet. The drive model and the length of the motor power cables on-site are shown in the table below.

Model	Continuous input current of main circuit (A)	Motor power cable length (m)
T3R5	2.4	10
T3R5	2.4	15
T3R5	2.4	15

Model	Continuous input current of main circuit (A)	Motor power cable length (m)
T3R5	2.4	10
T3R5	2.4	15
T8R4	5.6	10
T8R4	5.6	20
T5R4	3.6	10
T8R4	5.6	20
Total	32.4	125

Configuration instructions:

- Based on the requirement that the length of the motor power cable for a single EMC filter should be no longer than 100 m, the total length of the motor power cables in the above table is 125 m. Therefore, they need to be divided into two groups, with the total length of the power cables in each group required to be no longer than 100 m.
- Because the minimum EMC filter supported is 30 A, the total continuous input current of the main circuit in the above table is 32.4 A. Therefore, two sets of 30 A EMC filters are configured.

Conclusion:

Table 20–17 Selection of filters

Group No.	Servo drive SV670-INT series			Applicable filter (recommended)	Motor power cable length (m)
	Size	Model	Rated input current (A)		
Three-phase 400 V voltage class (Three-phase 380VAC to 480 VAC, -10% to +10%, 50 Hz/60 Hz)					
1	C	T3R5	2.4 A	FN3258-30-33 (Rated current: 30 A)	10
	C	T3R5	2.4 A		15
	C	T3R5	2.4 A		15
	C	T3R5	2.4 A		10
	C	T3R5	2.4 A		15
	D	T8R4	5.6 A		10
	D	T8R4	5.6 A		20
2	C	T5R4	3.6 A	FN3258-30-33 (Rated current: 30 A)	10
	D	T8R4	5.6 A		20

Note

Under the premise of meeting the selection criteria, you can adjust the configuration as needed. For example, two of the seven servo drives in Group 1 can be moved to Group 2, adjusting Group 1 to five drives and Group 2 to four drives.

- **Dimensions**

  Dimensions of Schaffner FN3258 filters:

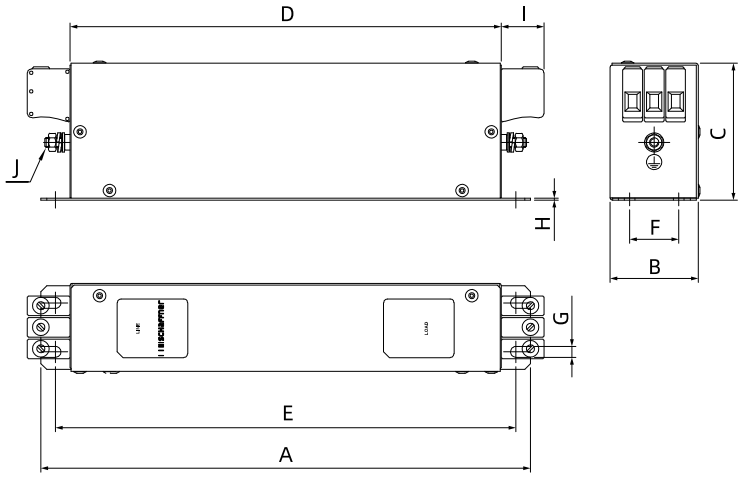


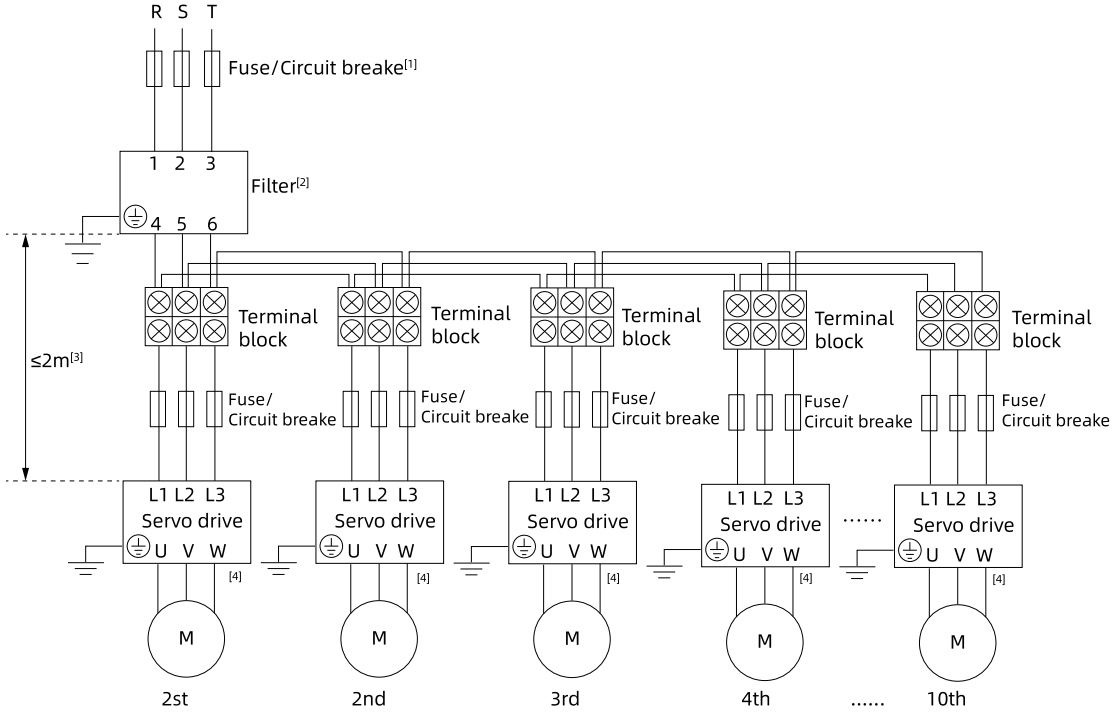
Figure 20-5 Dimensions of FN3258 filters (unit: mm)

Table 20–18 Dimensions of FN3258 filters (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J
30	270.0	50.0	85.0	240.0	255.0	30.0	5.4	1.0	25.0	M5

- **Routing requirements**

  Connect the EMC filter output cable first to the circuit breaker, and then connect the circuit breaker to the servo drive.



[1]: The rated current of the fuse/circuit breaker must be ≥ the rated current of the EMC filter ≥ the sum of the rated input currents of all connected servo drives.

[2]: The EMC filter must be selected with a rated input current between 30 A and 55 A. A single EMC filter can support up to 10 servo drives.

[3]: The distance between the EMC filter and the servo drives should be kept as short as possible.
It is recommended that the power cable length between the EMC filter and the servo drive does not exceed 2 m.

[4]: Under a single EMC filter, the total length of all servo motor power cables must not exceed 100 m.

Caution

- Ensure that the sum of the rated input currents of the servo drives is less than or equal to the rated current of the EMC filter. Otherwise, equipment damage or malfunction may occur.
- When connecting multiple servo drives to the same EMC filter, use a relay terminal block to connect the EMC filter to the servo drives. Do not bundle the terminals on the EMC filter terminal block together. Otherwise, equipment damage or malfunction may occur.
- Select a relay terminal block that allows terminals to be securely bundled, with a maximum of two terminals bundled together. Otherwise, the equipment may overheat or fail.

Warning

When multiple servo drives are connected to the same EMC filter, ensure that the cable used on the input side of the EMC filter and the cable between the EMC filter and the relay terminal block have a sufficient capacity to carry the rated current of the EMC filter. Failure to comply could result in fire accidents or electric shock.

20.2.9 Magnetic Ring and Magnetic Buckle

The magnetic ring can be installed on the input or output side of the drive. Install the magnetic ring as close to the drive as possible. Installing the magnetic ring on the input side can suppress the noise in the input power supply system of the drive. A magnetic ring on the output side is mainly used to reduce the external interference of the drive and reduce the bearing current.

In applications with leakage current and signal cable interference, install a magnetic ring or a ferrite clamp.

Model selection

- Amorphous magnetic ring: supports high permeability when the frequency is within 1 MHz and excellent anti-interference performance, but is not as low-cost as the ferrite clamp. See *“ Dimensions” on page 1136* for details.
- Ferrite clamp: supports good interference suppression performance within a frequency band above 1 MHz, and is applicable to low-power servo drives and signal cables. It is low-cost and easy to install

Magnetic ring and magnetic buckle (recommended)			Appearance
Type	Model	Manufacturer	
Magnetic ring	DY644020H	DAYOU-TECH	
	DY805020H	DAYOU-TECH	
Magnetic buckle	DYR-130-B	Dongyang Ferrite Material Co., Ltd	

Dimensions

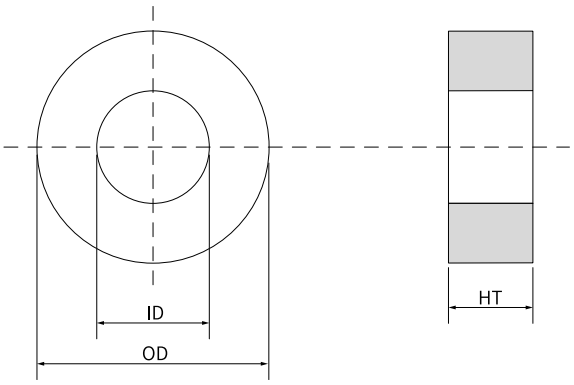


Figure 20-6 Dimensions of the magnetic ring

Table 20–19 Dimensions of the magnetic ring

Model	Dimension (OD × ID × HT) (mm)
DY644020H	64 × 40 × 20
DY805020H	80 × 50 × 20

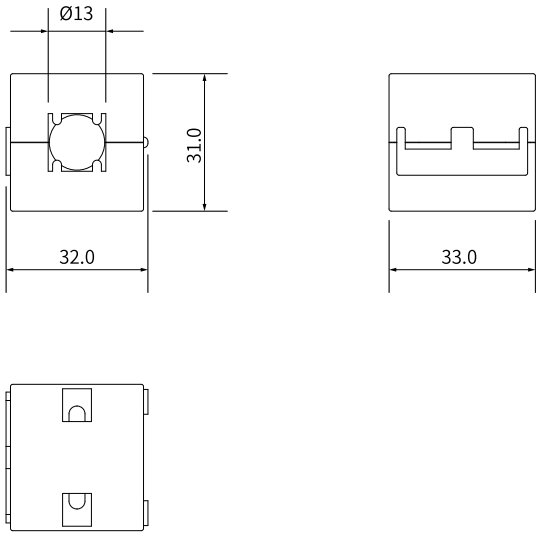


Figure 20-7 Dimensions of the magnetic buckle

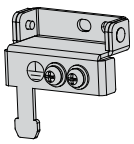
Table 20–20 Dimensions of the magnetic buckle

Model	Dimension (width × outer diameter × inner diameter) (mm)
DYR-130-B	32.0 × 31 × 13

20.3 Shield Bracket

To reduce electromagnetic interference, shield brackets and clamps are used with the drive cables.

Table 20–21 Shield bracket

Model	Outline drawing
S6-C25 (optional for size A to size C)	
S6-C27 (optional for size D to size E)	

20.4 Absolute Encoder Batteries

Selection

Select an appropriate battery according to the following table.

Table 20–22 Description of the absolute encoder battery

Specification	Item	Rating			Condition
		Min.	Typical Value	Max.	
Output: 3.6 V, 2700 mAh	External battery voltage (V)	3.2	3.6	3.8	In standby state[1]
	Circuit fault voltage (V)	-	2.6	-	In standby state
	Battery alarm voltage (V)	2.85	3	3.15	-
	Current consumed by the circuit (uA)	-	2	-	In normal operation[2]
		-	10	-	In standby state, shaft at standstill
		-	300	-	In standby state, shaft rotating
	Ambient temperature (℃)	0	-	40	Same as the motor.
	Storage temperature (℃)	0	-	30	

The preceding values are obtained under an ambient temperature of 20℃.

Note

- [1]: The "standby state" means the encoder counts the multi-turn data by using the power from the external battery when the servo drive power supply is not switched on. In this case, data transceiving stops.
- [2]: During normal operation, the absolute encoder supports one-turn or multi-turn data counting and transceiving. Power on the servo drive after connecting the absolute encoder properly. The encoder starts data transceiving after a short delay of about 5s upon power-on. The motor speed must be lower than or equal to 10 rpm during transition from the standby state to the normal operation state (upon power-on). Otherwise, Er.740 (Encoder fault) may occur. In this case, you need to power off and on the servo drive again.

20.5 Braking Resistor

When the motor torque direction is opposite to the speed direction, the energy is transmitted from the motor back to the servo drive, causing rise of the bus voltage. When the bus voltage rises to the braking threshold, the energy is consumed by the braking resistor according to the braking requirements. Otherwise, the drive will be damaged. You can use either a built-in or external braking resistor. Do not use a built-in braking resistor and an external braking resistor at the same time. Specifications of the braking resistor are as follows.

Table 20–23 Braking resistor specifications

Drive model	Specifications of built-in braking resistors			Min. allowable resistance of external braking resistor (Ω) (H02.21)
	Resistance (Ω)	Power (Pr) (W)	Processing power Pa (W)	
SV670NS1R6I-INT	-	-	-	40
SV670NS2R8I-INT	-	-	-	
SV670NS5R5I-INT	50	50	40	
SV670NS7R6I-INT	25	80	64	20
SV670NS012I-INT				15

Drive model	Specifications of built-in braking resistors			Min. allowable resistance of external braking resistor (Ω) (H02.21)
	Resistance (Ω)	Power (Pr) (W)	Processing power Pa (W)	
SV670NS018I-INT	20	100	80	20
SV670NS022I-INT				
SV670NS027I-INT				
SV670NT3R5I-INT	100	80	64	80
SV670NT5R4I-INT	100			60
SV670NT8R4I-INT	50			45
SV670NT012I-INT				40
SV670NT017I-INT	35	100	80	35
SV670NT021I-INT				25
SV670NT026I-INT				

Note

- The built-in braking resistor is not available in standard S1R6 and S2R8 models. You can install an external braking resistor as needed or contact Inovance to order customized S1R6 and S2R8 models that carry the built-in braking resistor.
- The processing power (P_a) of the built-in braking resistor is affected by the ambient temperature and actual load rate of the drive.

The kinetic energy generated upon braking of a reciprocating motor is converted into electric energy that is fed back to the bus capacitor. When the bus voltage rises above the braking voltage threshold, the braking resistor starts consuming the excessive energy fed back by the motor. Figure *"Figure 20-8" on page 1139* shows the motor speed curve.

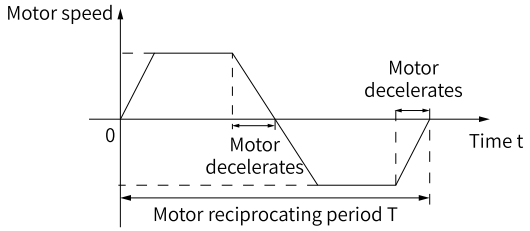


Figure 20-8 Motor speed curve

Energy calculation

The built-in braking resistor is not available in SV670* S1R6I-INT and SV670*S2R8I-INT models. An external braking resistor is needed when the rotational energy of the motor and the load exceeds the values listed in the following table.

Drive model	Regenerative Energy That Can Be Absorbed (W)	Remarks
SV670NS1R6I-INT	13.15	The input voltage of the main circuit power supply is 200 VAC.
SV670NS2R8I-INT	26.29	

- The following table shows the energy generated by a 200 V motor in decelerating from the rated speed to a standstill during no-load operation.

Values inside the parentheses "()" are for the motor with a brake.

Table 20–24 200 V motor energy data

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia J(10^{-4} kg·m^2)	Braking energy generated from rated speed to standstill: E_O (J)	Max. braking energy absorbed by the capacitor E_C (J)
0.05	MS1H1-05B30CB-A330Z-INT MS1H1-05B30CB-A332Z-INT	0.026 (0.028)	0.13 (0.14)	9.3
0.1	MS1H1-10B30CB-A330Z-INT MS1H1-10B30CB-A332Z-INT	0.041 (0.043)	0.20 (0.21)	
0.2	MS1H1-20B30CB-A330R-INT MS1H1-20B30CB-A332R-INT	0.0938 (0.106)	0.46 (0.52)	
0.4	MS1H1-40B30CB-A330R-INT MS1H1-40B30CB-A332R-INT	0.145 (0.157)	0.72 (0.78)	18.59
0.55	MS1H1-55B30CB-A330R-INT	0.55	2.72	32.42
0.75	MS1H1-75B30CB-A330R-INT MS1H1-75B30CB-A332R-INT	0.68 (0.71)	3.36 (3.51)	32.42
1	MS1H1-10C30CB-A330R-INT MS1H1-10C30CB-A332R-INT	0.82 (0.87)	4.05 (4.30)	32.42
1	MS1H2-10C30CB-A331R-INT MS1H2-10C30CB-A334R-INT	1.78 (2.6)	8.80 (12.86)	32.42
1.5	MS1H2-15C30CB-A331R-INT MS1H2-15C30CB-A334R-INT	2.35 (3.17)	11.6 (15.68)	47.68
2.0	MS1H2-20C30CB-A331R-INT MS1H2-20C30CB-A334R-INT	2.92 (3.74)	14.44 (18.49)	78.19
2.5	MS1H2-25C30CB-A331R-INT MS1H2-25C30CB-A334R-INT	3.49 (4.3)	17.26 (21.26)	114.43
3.0	MS1H2-30C30CB-A331R-INT MS1H2-30C30CB-A334R-INT	6.4 (9.38)	31.65 (46.38)	114.43
4.0	MS1H2-40C30CB-A331R-INT MS1H2-40C30CB-A334R-INT	9 (11.98)	44.51 (59.24)	114.43
5.0	MS1H2-50C30CB-A331R-INT MS1H2-50C30CB-A334R-INT	11.6 (14.58)	57.36 (72.10)	114.43
0.85	MS1H3-85B15CB-A331R-INT MS1H3-85B15CB-A334R-INT	13.56 (15.8)	16.45 (17.3)	32.42
1.3	MS1H3-13C15CB-A331R-INT MS1H3-13C15CB-A334R-INT	19.25 (21.5)	22 (22.86)	47.68
1.8	MS1H3-18C15CB-A331R-INT MS1H3-18C15CB-A334R-INT	24.9 (27.2)	30.78 (33.63)	78.19

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia J(10^{-4} kg·m^2)	Braking energy generated from rated speed to standstill: E_O (J)	Max. braking energy absorbed by the capacitor E_C (J)
2.9	MS1H3-29C15CB-A331R-INT MS1H3-29C15CB-A334R-INT	44.7 (52.35)	55.26 (64.72)	114.43
4.4	MS1H3-44C15CB-A331R-INT MS1H3-44C15CB-A334R-INT	64.9 (72.55)	80.23 (89.69)	114.43
0.1	MS1H4-10B30CB-A330Z-INT MS1H4-10B30CB-A332Z-INT	0.102 (0.104)	0.50 (0.51)	9.3
0.2	MS1H4-20B30CB-A331R-INT MS1H4-20B30CB-A334R-INT	0.22 (0.23)	1.09 (1.14)	9.3
0.4	MS1H4-40B30CB-A331R-INT MS1H4-40B30CB-A334R-INT	0.43 (0.44)	2.13 (2.18)	18.59
0.55	MS1H4-55B30CB-A331R-INT	1.12	5.54	32.42
0.75	MS1H4-75B30CB-A331R-INT MS1H4-75B30CB-A334R-INT	1.46 (1.51)	7.22 (7.47)	32.42
1.0	MS1H4-10C30CB**31R-INT MS1H4-10C30CB**34R-INT	1.87 (1.97)	9.25 (9.74)	32.42

- The following table shows the energy generated by a 400 V motor in decelerating from the rated speed to a standstill during no-load operation.
  Values inside the parentheses "()" are for the motor with a brake.

Table 20–25 400 V motor energy data

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia J(10^{-4} kg·m^2)	Braking energy E_O (J) generated during process from no-load rated speed to a standstill (J)	Max. braking energy absorbed by the capacitor E_C (J)
1.0	MS1H2-10C30CD-A331R-INT MS1H2-10C30CD-A334R-INT	1.78 (2.6)	8.8 12.86	36.06
1.5	MS1H2-15C30CD-A331R-INT MS1H2-15C30CD-A334R-INT	2.35 (3.17)	11.62 (15.68)	43.77
2.0	MS1H2-20C30CD-A331R-INT MS1H2-20C30CD-A334R-INT	2.92 (3.74)	14.44 (18.49)	64.40
2.5	MS1H2-25C30CD-A331R-INT MS1H2-25C30CD-A334R-INT	3.49 (4.3)	17.26 (21.26)	64.40
3.0	MS1H2-30C30CD-A331R-INT MS1H2-30C30CD-A334R-INT	6.4 (9.38)	31.65 (46.38)	64.40
4.0	MS1H2-40C30CD-A331R-INT MS1H2-40C30CD-A334R-INT	9 (11.98)	44.51 (59.24)	105.62
5.0	MS1H2-50C30CD-A331R-INT MS1H2-50C30CD-A334R-INT	11.6 (14.58)	57.36 (72.10)	105.62

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia J(10^{-4} kg·m^2)	Braking energy E_O (J) generated during process from no-load rated speed to a standstill (J)	Max. braking energy absorbed by the capacitor E_C (J)
0.85	MS1H3-85B15CD-A331R-INT MS1H3-85B15CD-A334R-INT	13.56 (15.8)	16.76 (19.53)	36.06
1.3	MS1H3-13C15CD-A331R-INT MS1H3-13C15CD-A334R-INT	19.25 (21.5)	23.8 (26.58)	43.79
1.8	MS1H3-18C15CD-A331R-INT MS1H3-18C15CD-A334R-INT	24.9 (27.2)	30.78 (33.63)	64.40
2.9	MS1H3-29C15CD-A331R-INT MS1H3-29C15CD-A334R-INT	44.7 (52.35)	55.26 (64.72)	64.40
4.4	MS1H3-44C15CD-A331R-INT MS1H3-44C15CD-A334R-INT	64.9 (72.55)	80.23 (89.69)	105.62
5.5	MS1H3-55C15CD-A331R-INT MS1H3-55C15CD-A334R-INT	86.9 (94.55)	107.43 (116.89)	154.56
7.5	MS1H3-75C15CD-A331R-INT MS1H3-75C15CD-A334R-INT	127.5 (135.15)	157.62 (167.08)	154.56

If the total braking time T is known, you can determine whether an external braking resistor is required and the power required using the following flowchart and formula.

Braking resistor selection for rotary motor

- **Without external load torque**

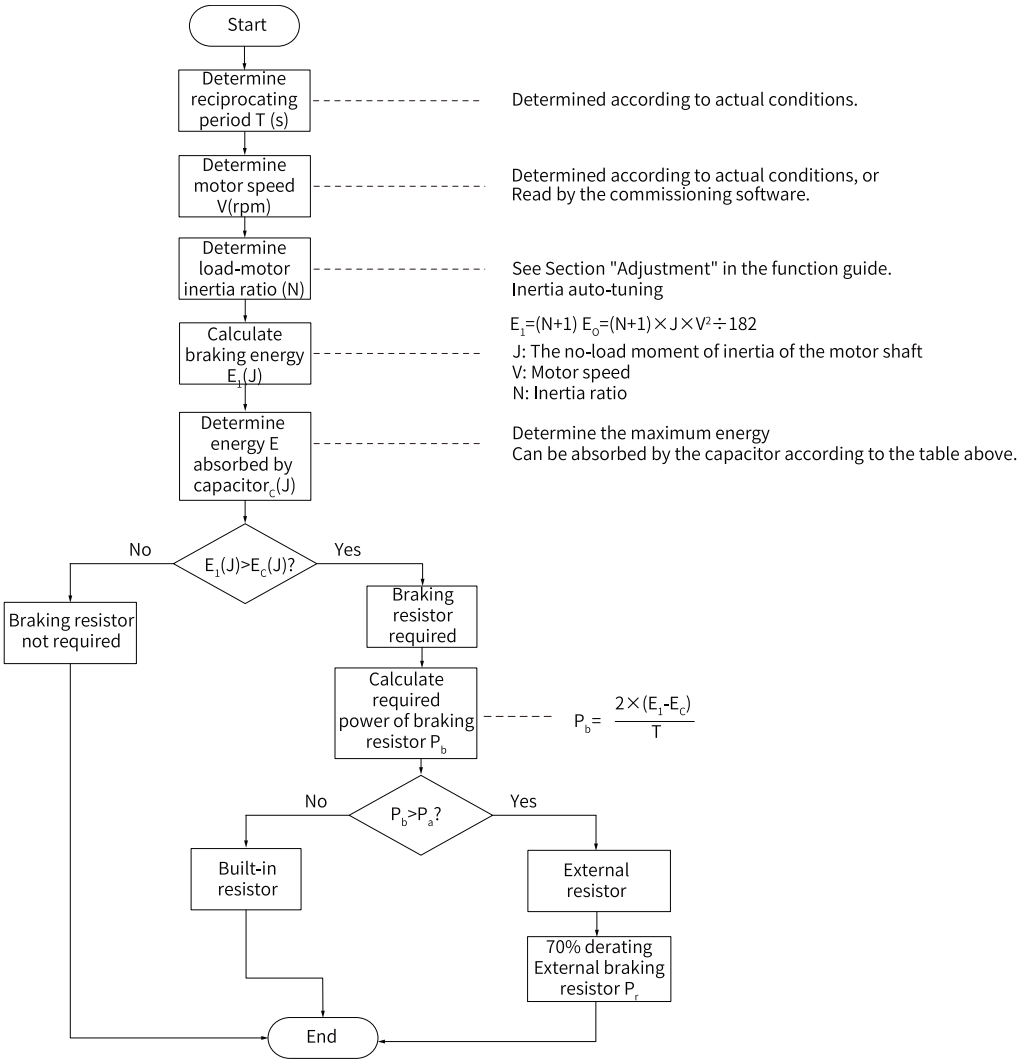


Figure 20-9 Flowchart for selecting the braking resistor

Table 20–26 Description of braking resistor selection factors

Factor	Unit	Definition
Reciprocating motion cycle T	s	Set it based on actual conditions.
Motor speed (V)	rpm	Determined based on actual operating conditions or read from the Inovance software tool.
Inertia ratio (N)	-	For details, see section "Tuning".
Rotor inertia (J)	kg·m²	For the specific rotor inertia of MS1 series motors, see *"Table 20-24 200 V motor energy data" on page 1140*
Braking energy E_1	J	$E_1 = (N + 1) \times J \times V^2 \div 182$
Energy absorbed by capacitor E_c	J	For the maximum braking energy absorbed by capacitor, see *"Table 20-24 200 V motor energy data" on page 1140*
Power of braking resistor (P_b)	W	$P_b = 2 \times (E_1 - E_C) \div T$
Power of built-in braking resistor (P_a)	W	The built-in braking resistor is not available in models S1R6 or S2R8 ($P_a = 0$). For details, see *"Table 20-23 Braking resistor specifications" on page 1138*

Note

- Take the process in which the motor decelerates from 3,000 rpm to 0 RPM as an example. Assume that the load inertia is (N x Motor inertia). In this case, the braking energy is (N + 1) x E_O when the motor decelerates from 3,000 rpm to 0 rpm. The energy consumed by the braking resistor is (N + 1) x E_O - E_C (E_C represents the energy absorbed by the capacitor). Assume that the reciprocating cycle is T. In this case, the power required by the braking resistor is 2 x [(N + 1) x E_O - E_C]/T. For values of E_O and E_C, see *"Table 20-24 200 V motor energy data" on page 1140* and *"Table 20-25 400 V motor energy data" on page 1141*.
- Determine whether to use the braking resistor according to the preceding figure and select a built-in or an external braking resistor as needed. Then, set H02.25 accordingly.
- It is recommended to use a resistor enclosed by an aluminum case.

Take the H1 series 750 W model as an example. Assume that the reciprocating movement period T = 2s, maximum speed = 3000 RPM, inertia ratio = 4, the required regenerative resistor power is:

$$P_b = \frac{2\times[(N+1)\times E_O - E_C]}{T} = \frac{2\times[(4+1)\times 6.824 - 32.422]}{2} = 1.698W$$

The calculated result is smaller than the processing capacity (P_a = 40 W) of the built-in braking resistor, so a built-in braking resistor is enough.

If the inertia ratio is 10 and other conditions are the same, the required braking resistor power is:

$$P_b = \frac{2\times[(N+1)\times E_O - E_C]}{T} = \frac{2\times[(10+1)\times 6.824 - 32.422]}{2} = 42.642W$$

The calculation result is larger than the processing capacity (P_a = 40 W) of the built-in braking resistor, Therefore, an external braking resistor is required. The recommended power of the external braking resistor is P_b ÷ (1 - 70%) = 142.14 W.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode
H02.21	2002-16h	Min. allowable resistance of braking resistor	1 to 1000	40	Ω	Read-only
H02.24	2002-19h	Resistor heat dissipation coefficient	10 to 100	30	%	Real time
H02.25	2002-1Ah	Braking resistor type	0: Built-in 1: External, natural cooling 2: External, forced air cooling 3: No resistor needed	3	-	Real time
H02.26	2002-1Bh	Power of external braking resistor	1 to 65535	40	W	Real time
H02.27	2002-1Ch	Resistance of external braking resistor	15 to 1000	50	Ω	Real time

- Braking resistor not needed

  When E_1 is smaller than E_C, no braking resistor is required because the braking energy can be absorbed by the bus capacitor. In this case, set H02.25 to 3.

- Using the built-in braking resistor
  When P_b is smaller than P_a and E_1 is greater than E_C, use the built-in braking resistor. In this case, set H02.25 to 0.

  When using the built-in regenerative resistor, connect terminals $P_\oplus$ and D with a jumper bar.

- Using an external braking resistor
  When P_b is greater than P_a, use an external braking resistor. Set H02.25 to 1 or 2 based on the cooling mode of the braking resistor.

  Use the external braking resistor with 70% derated, that is, $P_r = P_b \div (1 - 70\%)$, and ensure the resistance of the braking resistor is higher than the minimum allowable resistance allowed by the servo drive. Remove the jumper bar between terminals $P_\oplus$ and D, and connect the external braking resistor between terminals $P_\oplus$ and C.

  Set H02.25 to 1 or 2 based on the cooling mode of the braking resistor.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode
H02.21	2002-16h	Min. allowable resistance of braking resistor	1 to 1000	40	Ω	Read-only
H02.25	2002-1Ah	Braking resistor type	0: Built-in 1: External, natural cooling 2: External, forced air cooling 3: No resistor needed	3	-	Real time
H02.26	2002-1Bh	Power of external braking resistor	1 to 65535	40	W	Real time
H02.27	2002-1Ch	Resistance of external braking resistor	15 to 1000	50	Ω	Real time

Caution

- Set the power and resistance of the external braking resistor in H02.26 and H02.27. Otherwise, this function may be unavailable.
- Make sure that the resistance of the external braking resistor is higher than or equal to the minimum allowable resistance.
- When the braking resistor is used at its rated power rather than the processing power (average value) in environments within the specified temperature range, the temperature of the resistor will rise to above 120°C under continuous braking. To ensure safety, cool the resistor down through forced air cooling or use a resistor equipped with a thermal switch. For the load characteristics of the braking resistor, consult with the manufacturer.

Set the heat dissipation coefficient based on the heat dissipation condition of the external braking resistor.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value	Default value	Unit	Change mode
H02.24	2002-19h	Resistor heat dissipation coefficient	10 to 100	30	%	Real time

Note

Higher resistor heat dissipation coefficient indicates higher braking efficiency.

- **External load torque applied, motor in generating state**
  When rotation directions of the motor and shaft are the same, the motor is in the motoring state. In some special applications where the motor torque direction is opposite to the rotating direction, the motor is in generating state, and pumps the electric energy back to the servo drive.

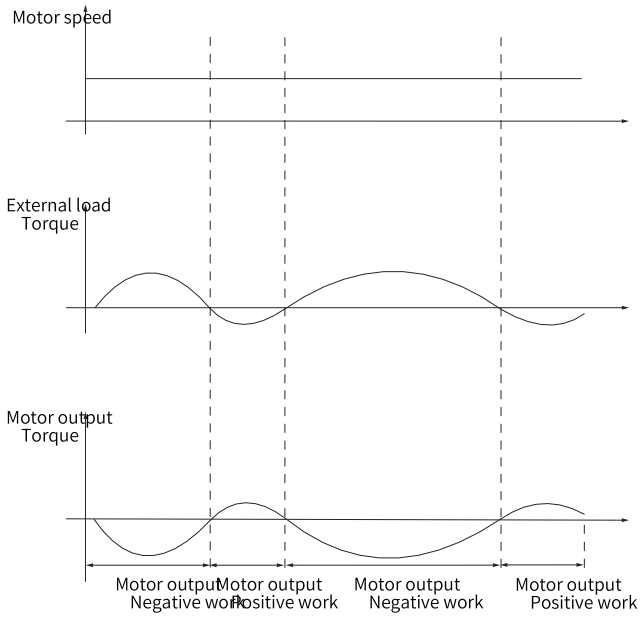


Figure 20-10 Example of the curve with external load torque

Take H1 series 750 W models (rated torque: 2.39 N·m) as an example. When the external load torque is 60% of the rated torque and the motor speed reaches 1500 RPM, the power fed back to the drive is (60% × 2.39) × (1500 × 2π/60) = 225 W. Because the braking resistor needs to be derated by 70%, the power of the external braking resistor is 225 ÷ (1 - 70%) = 750 W, with resistance being 50 Ω.

Braking resistor selection for direct drive

- **Without external load torque**

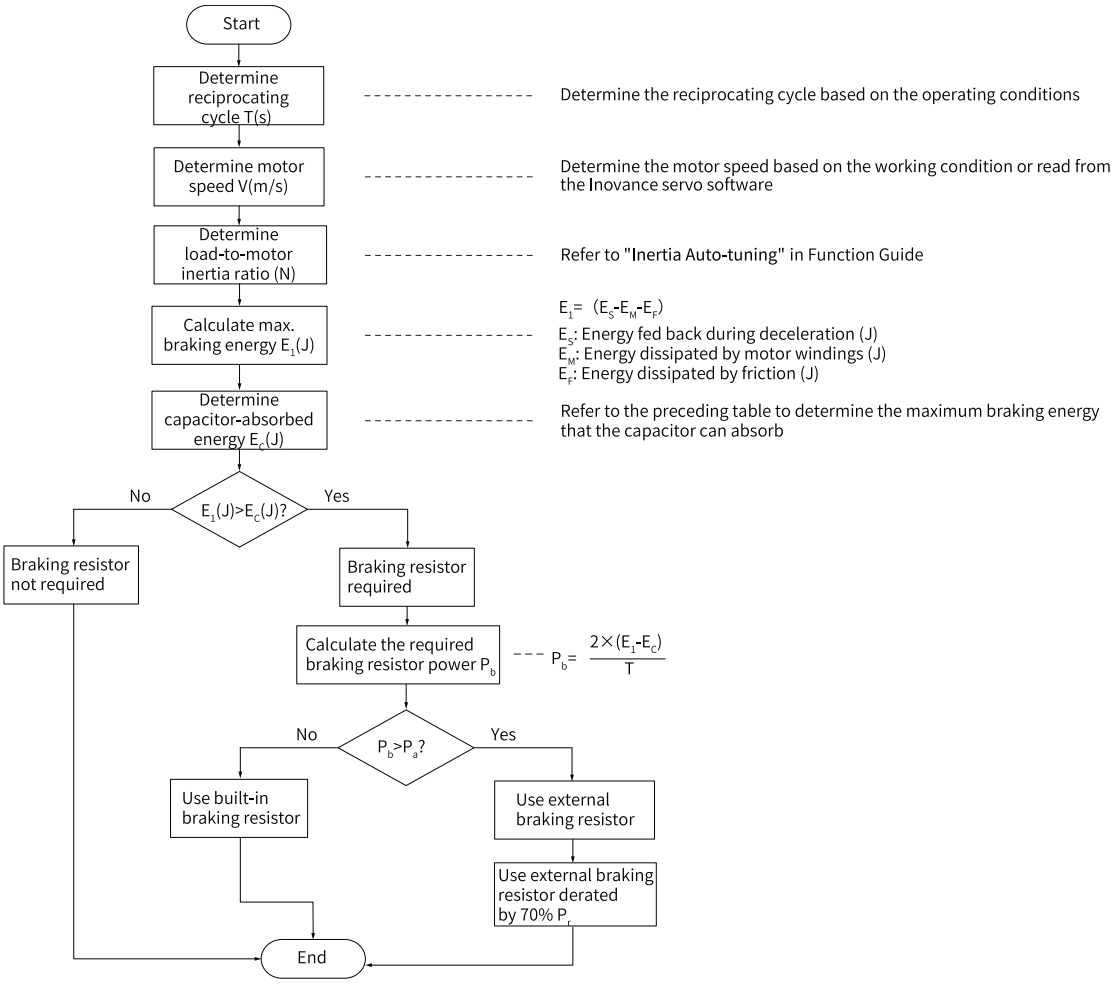


Figure 20-11 Flowchart for selecting the braking resistor

Note

- Determine whether to use a braking resistor, select a built-in or external braking resistor as needed, and then set H02.25.
- It is recommended to use a resistor enclosed by an aluminum case.

- **Calculate the energy returned at each deceleration**

$$E_S = \frac{1}{2} \times (M_M + M_L) \times (V_1^2 - V_2^2)$$

E_S : Feedback energy upon deceleration (J)

M_M : Rotor weight (kg)

M_L : Load Weight (kg)

V_1 : Speed before deceleration (m/s)

V2 : Speed after deceleration (m/s)

- **Determine the energy consumed by the motor**

$$E_M = 3 \times I_M^2 \times (R_M/2) \times t_d$$

E_M : Energy consumed by motor winding (J)

I_M : Current at deceleration (A)

R_M : Motor phase resistance (Ω)

t_d : Deceleration time (s)

- **Determine the energy consumed by friction (direct drive motor friction loss is low, which can be ignored based on actual operating conditions)**

$$E_F = \frac{1}{2} \times T_f \times (V_1 - V_2) \times t_d$$

E_F : Energy consumed by friction (J)

T_f : Friction resistance (N)

V_1 : Speed before deceleration (m/s)

V2 : Speed after deceleration (m/s)

t_d : Deceleration time (s)

- **Determine the energy consumed by the drive**

$$E_1 = E_F - E_M - E_F$$

E_1 : Energy consumed by the drive (J)

- **Determine the energy consumed by the braking resistor**
  - $E_1 > E_C$: An external braking resistor is required
  - $E_1 < E_C$: no braking resistor is required

- **Calculate the power of the braking resistor**

$$P_b = 2 \times (E_1 - E_C) / T$$
$$P_r = P_b / 0.3$$

P_b : Power needs to be processed by the braking resistor (W)

P_r : Recommended power for the braking resistor (W)

T: Repeated motor running cycle (s)

0.3: Resistor heat dissipation coefficient (set in H02.24)

- Take the S5R5 model as an example:
  Assume the following operating conditions: reciprocating cycle T = 2s, maximum running speed is 8 m/s, and a deceleration time of 0.05 s for acceleration to zero speed. The load weight is three times the motor rotor weight and the friction torque is 2.5 N·m. In the motor parameter settings, the motor rotor weight is 0.6 kg, the motor phase resistance is 1.53 Ω, and the force constant is 23.5 N/A. In this case:

  The deceleration current can be obtained through H0b.24 (Active value of phase current) when the drive monitors deceleration:

  $I_M = 15$ (A)

  Energy calculation:

$$E_S = \frac{1}{2} \times (1+3) \times 0.6 \times 8^2 = 76.8\ (J)$$
$$E_M = 3/15^2/\frac{1.53}{2} \times 0.05 = 25.82\ (J)$$
$$E_F = \frac{1}{2} \times 2.5 \times 8 \times 0.05 = 0.5\ (J)$$
$$E_1 = E_S - E_M - E_F = 50.48\ (J)$$

  Because $E_1 > E_C$, a braking resistor is required. The power of the braking resistor is as follows:

$$P_b = 2 \times (50.48 - 32.42) / 2 = 18.06\ (W)$$

Because $P_b < P_a$ (Processing capacity of the built-in braking resistor), the built-in braking resistor is applicable.

- **External load torque applied, motor in generating state**
  When rotation directions of the motor and shaft are the same, the motor is in the motoring state. In some special applications where the motor torque direction is opposite to the rotating direction, the motor is in generating state, and pumps the electric energy back to the servo drive.

  When the load is in the continuous generating state continuously, it is recommended to use the common DC bus mode.

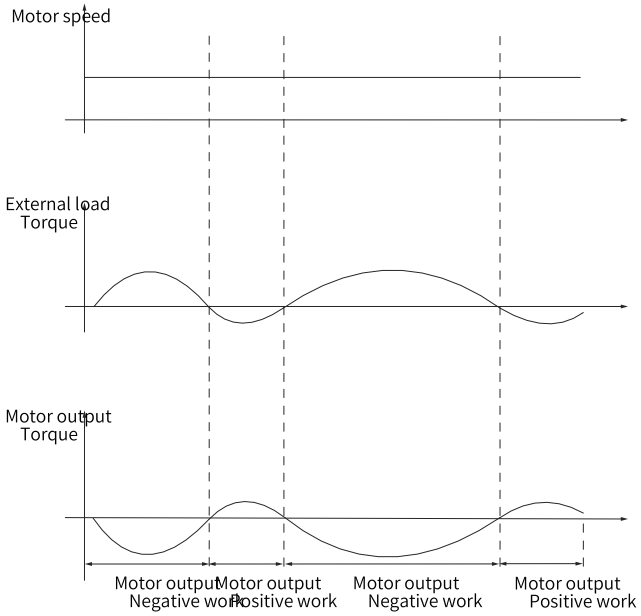


Figure 20-12 Example of the curve with external load torque

21 Certification and Standard Requirements

21.1 CE Certification



Figure 21-1 CE Marking

- The CE mark indicates compliance with the Low Voltage Directive LVD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives.
- The CE mark is required for engaging in commercial business (production, importation, and distribution) in Europe.
- The drive complies with LVD, EMC, and RoHS directives and carries the CE mark.
- Machines and devices integrated with this drive must also comply with CE requirements for distribution in Europe.
- The integrator who integrates this drive into other products and attaches CE mark to the final assembly has the responsibility of ensuring compliance with CE certification.

21.1.1 Requirements for Compliance with EMC

The drive is applicable to the first environment and second environment and complies with EMC directive 2014/30/EU and standard EN 61800-3.

As required by EMC Directive 2014/30/EU and standard EN IEC 61800-3, install an EMC filter on the input side of the drive and use shielded cables on the output side. Ensure the filter is grounded properly and the shield of the output cable is grounded 360 degrees.



When applied in the first environment, the drive may generate radio interference. In addition to the CE compliance requirements described in this chapter, take additional measures to prevent radio interference if necessary.

Introduction to EMC standards

Electromagnetic compatibility (EMC) describes the ability of electrical and electronic devices or systems to work properly in the electromagnetic environment without introducing electromagnetic interferences that disturb the operation of other local devices or systems. In other words, EMC includes two aspects: 1) The electromagnetic interference generated by a device during normal operation cannot exceed a certain limit. 2) The device must have sufficient immunity to the electromagnetic interference in the environment.

EN 61800-3 defines the following two types of environments.

- First environment: Environment that includes domestic premises, and establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes
- Second environment: Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes

Devices are divided into the following four categories based on the intended application environment.

- Category C1: a Power drive system (PDS) with the rated voltage less than 1000 V, intended for use in the first environment.
- Category C2 equipment: PDS with rated voltage less than 1000 V, which is neither a plug-in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by professionals.
- Category C3 equipment: PDS with rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.
- Category C4 equipment: PDS with rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

21.1.2 Requirements for Compliance with LVD

The drive has been tested in accordance with EN61800-5-1 to determine compliance with LVD. Observe the following requirements to enable machines and devices integrated with this drive to comply with the LVD.

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by EN61800-5-1.

Installation environment

For requirements of the installation environment, see *"5.2.2 Installation Environment" on page 57*.

Installation protection requirements

The drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations and relevant IEC standards.

IP20-rated drives intended to be installed inside the cabinet must be installed in a structure that prevents intrusion of unwanted objects from the top and the front.

Requirements for main circuit wiring

For wiring requirements of main circuit terminals, see *"6.3.2 Wiring Precautions and Requirements" on page 76*.

Requirements for protective devices

To comply with EN 61800-5-1, install a fuse or a circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit.

For details about how to select a fuse/circuit breaker, see *"20.2.2 Fuse (CE)" on page 1119* and *"20.2.5 Circuit Breaker (CE)" on page 1122*.

21.2 UL/cUL Certification



Figure 21-2 UL/cUL mark

The UL/cUL mark commonly applies to products sold in the United States and Canada. Products with UL/cUL mark have been inspected and assessed by the UL organization. To pass UL/cUL certification, main built-in components of electrical products must also be UL certified.

The drive has been tested in accordance with UL 61800-5-1 and CSA C22.2 No.274 to determine compliance with UL/cUL standards. Observe the following requirements to enable machines and devices integrated with this drive to comply with UL/cUL standards.

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by UL61800-5-1.

Ambient temperature

According to the protection level, the ambient temperature must be maintained within the following range:

0°C to 50°C for open-type products

Installation requirements

Installation requirements for open-type products:

SV670-INT series servo drives are open-type drives that must be installed in a fireproof cabinet with the housing that provides effective electrical and mechanical protection. The installation must conform to local laws and regulations and related NEC requirements.

Wiring requirements for the main circuit

Warning

On-site installation of output terminals (such as $P_{\oplus}$, C, and $N_{\ominus}$) is not allowed.

- Terminals ($P\oplus$, C, and $N\ominus$) are used to connect optional parts. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- The control circuit is an internal safety extra-low voltage (SELV) circuit that must be strictly insulated and isolated from other circuits. Make sure that the control circuit is connected to an external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder twisted conductors (if used).
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws with an angle not higher than 5°. Failure to comply may damage the terminal screws.

Wiring requirements for the control circuit

Observe the requirements in UL508 during wiring.

Cable requirements

Cable dimensions must be compliant with requirements in NEC (National Electric Code) and CEC (Canadian Electrical Code) Part I and local regulations.

- Use cables with copper conductors.
- The recommended cables for the main circuit are 600 V class 2 heat-resistant indoor PVC cables that can work under temperature of 75°C continuously. The following conditions are premises for use of the cables.
  - Ambient temperature: < 40°C
  - Normal operating ratings

If the recommended cable specifications for peripheral devices or options do not comply with the applicable cable specifications, contact Inovance.

Terminal cable selection

To comply with UL61800-5-1 and CSA C22.2 No.274, power cables used for SV670 series servo drives must meet the following requirements:

- Compliant with NEC, Table 310-16 of NFPA70, and NFPA79
- Comprised of copper conductors with a rated temperature not lower than 75°C (167°F)
- Compliant with 14AWG or higher
- With a rated voltage not lower than the rated voltage of the drive
- It is recommended to use cables compliant with UL758 Style 2517 and Style 2586 as motor main circuit cables.

Requirements for protective devices

To comply with UL61800-5-1, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit.

Install sufficient protective devices against short circuit in branch circuits according to applicable regulations and this guide. The drive is applicable to circuits with a rated breaking capacity lower than 5 kA and 65 kA and a maximum voltage of 480 VAC (class 400 V).

Note

All breaker protective devices must be UL-certified.

For details about the fuses and circuit breakers that work with the SV670-INT series servo drive in North America, see *"20.2.3 Fuse (UL)" on page 1120* and *"20.2.6 Circuit Breaker (UL)" on page 1124*.

21.3 KC Certification

Figure 21-3 KC mark

Drives with the KC mark on their nameplates comply with the electromagnetic compatibility (EMC) directives of ROK.

이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device.

This device is intended to be used in areas other than at home.

21.4 UKCA Certification

Products exported to The UK must have the UKCA mark on their nameplates. Currently, the CE mark is still acceptable by the UK.

21.5 Conformance Certification



EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

22 Appendix

22.1 DIDO Function Assignment

Code	Name	Function	Description	Remarks
Description of DI signals				
FunIN.1	S-ON	Servo ON	Disabled: Servo motor disabled Enabled: Servo motor enabled	The corresponding terminal logic must be level-triggered. Changes to the corresponding DI/VDI or terminal logic are applied at the next power-on.
FunIN.2	ALM-RST	Alarm reset signal	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 alarm type, continue operating after reset.
FunIN.5	DIR-SEL	Multi-reference direction	Inactive: Reference direction by default Active: Reverse to reference direction.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.6	CMD1	Multi-reference switchover CMD1	Used to select a reference from 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.7	CMD2	Multi-reference switchover CMD2	Used to select a reference from 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.8	CMD3	Multi-reference switchover CMD3	Used to select a reference from 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.9	CMD4	Multi-reference switchover CMD4	Used to select a reference from 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.14	P-OT	Positive limit switch	Enabled: Forward drive inhibited Disabled: Forward drive permitted	Overtravel prevention applies when the machine moves beyond the limit. It is recommended that the corresponding terminal logic is level-triggered.
FunIN.15	N-OT	Negative limit switch	Overtravel prevention applies when the load moves beyond the limit. Active: Reverse drive inhibited Inactive: Reverse drive allowed	The corresponding terminal logic is recommended to be level-triggered.
FunIN.18	JOGCMD+	Forward jog	Active: Input based on command Inactive: Command input stopped	The corresponding terminal logic is recommended to be level-triggered.
FunIN.19	JOGCMD-	Jog in the reverse direction	Active: Input in reverse to the command Inactive: Command input stopped	The corresponding terminal logic is recommended to be level-triggered.

Code	Name	Function	Description	Remarks
FunIN.24	GEAR_SEL	Electronic gear ratio switchover	Inactive: Electronic gear ratio 1 Active: Electronic gear ratio 2	The corresponding terminal logic is recommended to be level-triggered.
FunIN.28	PosInSen	Multi-position reference enable	Disabled: The reference is ineffective. Enabled: The reference is enabled.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.31	HomeSwitch	Home switch	Inactive: The switch is not triggered Enabled: The switch is triggered.	The corresponding terminal logic must be level-triggered. It is recommended to assign this function to a high-speed DI terminal. If the logic is set to 2 (rising edge active), the servo drive forcibly changes it to 1 (active high). If the logic is set to 3 (falling edge active), the servo drive forcibly changes it to 0 (active low). If the logic is set to 4 (both rising edge and falling edge active), the servo drive forcibly changes it to 0 (low level active).
FunIN.34	Emergency Stop	Emergency stop	Enabled: Position lock is applied after stop at zero speed. Disabled: Current operating state remains unaffected.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.38	TouchProbe1	Touch probe 1	Disabled - Touch probe is not triggered. Enabled: Touch probe is triggerable.	The touch probe logic is related only to the touch probe function (60B8h).
FunIN.39	TouchProbe2	Touch probe 2	Disabled - Touch probe is not triggered. Enabled: Touch probe is triggerable.	The touch probe logic is related only to the touch probe function (60B8h).
FunIN.40	Multi-speed	Multi-speed enable	Disabled: The internal multi-speed reference is ineffective. Enabled: The internal multi-speed reference is enabled.	The corresponding terminal logic is recommended to be level-triggered.
Description of DO signals				
FunOUT.1	S-RDY	Ready to switch on	The servo drive is ready to receive the S-ON signal. Disabled: The servo drive not ready. Enabled: The servo drive is ready.	-
FunOUT.2	TGON	Motor rotation signal	Inactive. Absolute value of filtered motor speed is lower than the setpoint of H06.16. Active. Absolute value of filtered motor speed reaches the setpoint of H06.16.	-

Code	Name	Function	Description	Remarks
FunOUT.9	BK	Brake	Enabled - Brake signal output by the drive Disabled - Brake signal not output	-
FunOUT.10	WARN	Alarm	Disabled: No alarm is reported by the drive or the alarm has been reset. Enabled: The servo drive issued an alarm.	-
FunOUT.11	ALM	Fault	The servo drive is faulty. Inactive: No fault occurred on the servo drive or the fault has been reset.	-
FunOUT.25	CMP	Position comparison DO	Disabled: The servo drive does not pass the target position comparison point. Enabled: The servo drive passes the target position comparison point.	-
FunOUT.26	LoopState	Closed loop state	0: Half closed loop. Position feedback signals come from the built-in encoder of the servo motor. 1: Fully closed loop. Position feedback signals come from the full closed-loop external encoder.	-
FunOUT.31	Communication-forced DO		See *"Table 22-1 Communication-forced DO" on page 1158*.	-
FunOUT.32	EDM	EDM output	Enabled: STO is triggered Disabled: STO is not triggered	The EDM outputs active signals only when both the 24 V input voltages for STO1 and STO2 are disconnected at the same time.

Table 22–1 Communication-forced DO

Type	Data	Description
bit0	0	DO1 status unchanged
	1	No output from DO1
bit1	0	DO2 status unchanged
	1	No output from DO2

22.2 Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit https://www.inovance.com/global to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.

- Channel #3: Download My Inovance app (https://zshc-eu.inovance.com/download-pc/) where you can access products info and documentation, and query product parameters.

We are committed to providing you with quick and professional technical support, and we look forward to your satisfaction and trust.

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