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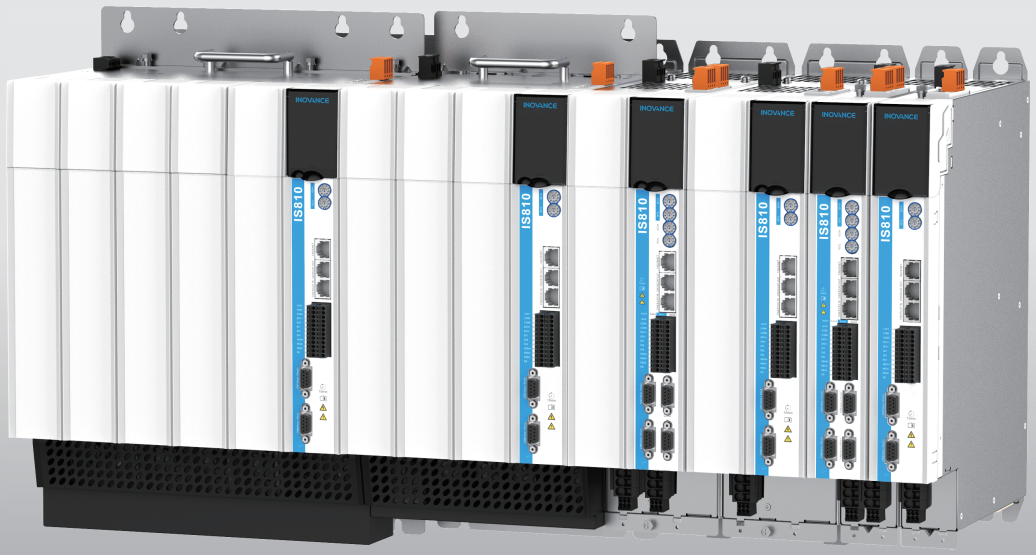

IS810N-INT Series Standard Multi-drive Servo System

User Guide

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

Data code 19010647C07

Preface

Introduction

Thank you for purchasing the IS810N-INT series multi-drive servo system.

The IS810N-INT AC servo drive is a high performance multi-drive product. The servo drive covers a power range from 0.85 kW to 120 kW and carries EtherCAT communication interfaces to work with the host controller for a networked operation of multiple servo drives. The drive supports stiffness level setting, inertia auto-tuning and vibration suppression to simplify the operation process. It works together with Inovance MS1 series high response servo motors (with a 23-bit multi-turn absolute value encoder) and ISMG series high response servo motors, making the running stable and quiet and the positioning control more accurate. This servo drive is able to implement rapid and accurate position, speed and torque control, and is applicable for such automation equipment as cutters, gravure presses, flexo presses, corrugated paper printing equipment, semiconductor manufacturing equipment, chip mounters, PCB punching machines, transport machinery, food processing machinery, machine tools and conveying machinery.

This User Guide describes the correct use of the drive, including safety information, mechanical and electrical installation, commissioning and maintenance. Read and understand this user guide before first-time use. If you have any doubts about some functions and performance, please do not hesitate to consult the technical support staff of Inovance.

The drive can work with an Inovance 810 series power supply unit or Inovance 880 series active power supply unit. For details, see "810 Series Power Supply Unit User Guide" and "880 Series Power Supply Unit User Guide".

Due to the continuous improvement of our products, the information provided here is subject to change without prior notice.

Note

- The drawings in the manual are shown for description only and may not match the product you purchased.
- The instructions are subject to change due to product upgrade, specification modification as well as efforts to increase the accuracy and convenience of the manual.

Revision History

Date	Version	Description
May 2025	C07	**Added new contents:** • Two new models, 045 and 060, have been added, involving chapters: selection list, model description, electrical specifications, installation dimension requirements, recommended models and specifications of main circuit cables. • New "Communication Cable Purchase Requirements" and "Network Port Cable Installation Instructions" have been added. **Updated contents:** • Updated the system wiring diagram. • Updated "STO Safety Features" section. • Updated brake wiring diagram of models T017 to T037. **Removed contents:** • Deleted "theoretical battery life". • Removed the maximum applicable motor capacity from the electrical specification sheet.

Date	Version	Description
2024–12	C06	**Added new contents:** • Added FreeRun to the synchronization method of "EtherCAT Communication Technical Specifications". • In the "Offline Inertia Identification" section, "SET" is changed to "ENTER". • "MS1 series motor power cable (with shielded bracket)" is added to the section of "Cable List". • Added parameters H09.41, H09.42 and H09.03. • A new chapter on "Buffer Unit Selection Guidance" was added. **Updated contents:** • Updated "Data Coding" in the "Preface" section. • Updated "Selection List" section. • Added "Screw Specifications" to the "Product Dimensions" section. • Added instructions to the section "Electrical Wiring Diagram". • Updated "ISMG Series Motors" section. • Updated the "Matching Cable List" section. • Updated the schematic diagram of the brake terminal in "Introduction to Inverter Unit Terminals". • In "Related EMC Requirements", "RF Interference" is updated to "High Frequency Interference". • In the "Panel Display" section, the display occasion of "CN4 Connection Indication" is updated to "CN4 (i.e. EtherCAT output) successfully connected". • In the section "User Password", update "Schematic diagram of user password setting steps". • In the "Debugging Software" section, "Windows10x64 Operating System" is updated to "Windows10/11x64 Operating System". • Updated the "Stop Timing Diagram in case of Warning or Failure" section in the "Servo Operation" section. • Updated schematic diagram in "Connection to MS1 series motors" and schematic diagram in "Connection to ISMG series motors". • Minor corrections. **Removed contents:** Deleted section "Connection to third-party motor communication type encoder".
2024–04	C05	• Added E201.3. • Updated "Functional Block Diagram" in "Origin Regression Mode (hm)" section. • Updated the sequence of "H0b Parameter Group List" and "H0C Parameter Group List" sections. • Updated the description of DB braking in the "Servo Stop" section.
2024–03	C04	• Updated "Communication Cycles Supported by Modes" in the "Servo Modes" section. • Updated the "Use Procedures" example in the "Probe Features" section. • Updated "Communication Address Hardware Dial Code" in the "Part Description" section. • Updated "MS1 series motors" chapter; • Updated the company address in the back cover.

Date	Version	Description
2024–01	C03	• Added H0d.20 function code description; Added H0C.71 function code and corresponding description. • Modified the maximum elevation of Size3 and Size4 to 2000m. • Safety precautions, 15 minutes in the safety identification section was changed to 10 minutes. • A new protection category, Class I, has been added to the technical specifications. • TN/TT grid conditions have been added to wiring precautions. • Continuous input current is supplemented in electrical specifications. • The nr.x description and the STO description are added to the panel display. • Deleted information on E120.3. • Added description of motor temperature detection function. • Modified the bit description of H0A.71; Modified H0E.40 to 72's hexadecimal address; Modified H0A.75 defaults; Modified the H0C.34 setpoint.
2024–01	C02	Schematic diagram of optimized brake wiring.
2023–10	C01	• S _ PS + and S _ PS-Introduction are deleted throughout the guide. • Removed BiSS-C encoder connection and remove E770.3, E770.4, E770.5 faults. • In section "Full Closed Loop Parameter Setting", only AB quadrature pulses are retained; • In Section "List of Matching Cables", improved the matching power cables and encoder cables. • The "Selection List" chapter is supplemented to match the 220V MS1-R motor.
2023–7	C00	• Structure adjustment. • Improved the introduction of CN6/CN8 and CN5/CN7 terminals. • Added introduction to servo operation modes.
2023–3	B06	Minor corrections.
2022–8	B05	• Increased the width of Size 1. • Modified the power line (non-brake) model of MS1H3 motor supporting cable selection table. • Added biaxial terminal distribution diagram. • Modified the brake wiring diagram and its description. • Added net weight of drive and dimensional weight with outer packaging. • Updated battery box model.
2021–10	B04	• Added fan replacement instructions. • Added parameters H07-24 to H07-31.
2021–7	B03	• Updated PTC wiring schematic diagram. • Updated MS1 series motor side power wire pin definition. • Added drive model IS810N50M4TS240INT. • Updated section 3.4.1.
2021–1	B02	• Changed TS075 to Size 3 throughout the guide. • Optimized motor nameplate information, electrical specifications, and system supporting specifications.
2020–11	B01	Minor corrections.

Date	Version	Description
2020–9	B00	• Updated motor-related models and other related content throughout the guide. • Updated drive models throughout the guide. • Updated section 3.4.2. • Section 5.2 Content updated; Added Section 5.3.5 "Cases". • Chapter 6 Troubleshooting chapter Updated fault codes. • Updated the related content of the object group list.
2020–8	A03	Removed the customer service phone.
2018–11	A02	Logo updated.
2017–11	A01	• Updated the preface certification information content. • Chapter 2 amends the following: • Modified the ISMG motor information and add the model description of the brake model. • Modified the electrical specifications of the MS1 series brake motor. • Modified the overall dimension drawing of ISMG1 motor, and add the parameters of brake model. • Chapter 4 amends the following: • In Section 4.3.2, modified the schematic diagram of protective grounding connection. • In Section 4.4.3, added new schematic diagram of disassembly of biaxial battery box. • In Section 4.4.3, added battery information description of dual-axis absolute value encoder. • In Section 4.4.3 added theoretical life of dual-axis absolute value encoder battery. • Added 4.4 servo drive main loop cable connection. • Modified the contents of 4.6 brake wiring. • Added 4.15 EMC filter selection guidance. • Four new Size-3 models are added: T184, T224, T262 and T296. • Chapter 5 added a new DIP switch description. • Chapter 6 amended the following: • Modified the comparison of the two stop modes in Table 6-5. • Modified 605C and 605E parameter description. • Appendix 1 is amended as follows: • Added parameters: H05-62, H08-06, H0A-38, H0D-23, H0E-35, H0E-96. • Modified parameters: H01-10, H0E-33, H0E-34, 605C-00, 605E-00, 6083, 6084, 6085, 6091, 609A.
2017–7	A00	First release.

Access to the Guide

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

- Do keyword search at *http://www.inovance.com*.
- Scan the QR code on the equipment to acquire more.
- Scan the QR code below to install the app, where you can search for and download manuals.

Warranty

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. You will be charged for any repair work after the warranty period expires.

Within the warranty period,maintenance fee will be charged for the following damage:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

The maintenance fee is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see the Product Warranty Card.

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Safety Instructions

Disclaimer

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

Safety Levels and Definitions

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

Safety Instructions

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

Unpacking
 • Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.
 • Check whether the package is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the package by following the unpacking sequence. Do not strike the package violently. • Check whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking. • Check whether the package contents are consistent with the packing list before unpacking.

Storage and Transportation
 • Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage. • Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage. • Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment. • When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.
 • Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage. • When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries. • Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage. • Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration. • Avoid storing this product for more than three months. Long-term storage requires stricter protection and necessary inspections. • Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation. • Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.
Installation
 • The equipment must be operated only by professionals with electrical knowledge. Non-professionals are not allowed.

WARNING

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

CAUTION

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

Wiring

DANGER

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

- Do not connect the input power supply to the output end of the equipment. Failure to comply can result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in an electric shock or equipment damage.

- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.

Power-on

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.

- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

Operation

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

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

Maintenance
DANGER • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. • Do not maintain the equipment with power ON. Failure to comply will result in an electric shock. • Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label. • In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply will result in an electric shock.
WARNING • Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.
Repair
DANGER • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. • Do not repair the equipment with power ON. Failure to comply will result in an electric shock. • Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
WARNING • Submit the repair request according to the warranty agreement. • When the fuse blows, the circuit breaker trips or the residual current operated protector (ELCB) trips, please wait for at least the time specified in the warning label on the product before turning on the power supply or operating the machine, otherwise it may cause casualties and equipment damage! • When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly. • Replace quick-wear parts of the equipment according to the replacement instructions. • Do not use damaged equipment. Failure to comply may result in death, personal injuries, or severe equipment damage. • After the equipment is replaced, check the wiring and set parameters again.
Disposal
WARNING • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death. • Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Additional Precautions

Cautions for the dynamic brake

- Dynamic braking can only be used for emergency stop in case of failure and sudden power failure. Do not trigger failure or power failure frequently.

- Ensure that the dynamic braking function has an operation interval of more than 5 minutes at high speed, otherwise the internal dynamic braking circuit may be damaged.
- 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 regenerative state and short-circuit current passes through the dynamic brake. If this situation continues, the drive, and even the motor, may be burned.

Effect of the electromagnetic field on implants

- The motor may harm a nearby person who wears a medical implant.
- The electromagnetic field may cause malfunction of the medical Implant (such as the heartbeat starter) being used.

Safety label

For safe equipment operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. The following table describes the meaning of the safety labels.

Safety label	Description
	• Never fail to connect the protective earth (PE) terminal. Read through the guide and follow the safety instructions before use. • Never fail to connect Protective Earth (PE) terminal. Read the manual and follow the safety instructions before use. • Do not touch the terminals within 10 minutes after the power supply is cut off. Risk of electric shock. • Do not touch terminals within 10 minutes after Disconnect the power. Risk of electric shock. • Do not touch the heatsink when the power is on. Risk of burn. • Do not touch heatsink when power is ON. Risk of burn.

1 Selection

Table 1–1 MS1 servo motor selection list

Servo Motor				Servo Drive (IS810N50M4T*******)		
Motor without Brake	Motor with Brake	Frame	Rated Power (kW)	Size	Recommended Drive Model	No.
MS1H1 (n_N= 3000 rpm, n_{max}=7000 rpm) series ratings						
MS1H4-05B30CB-A330R	MS1H4-05B30CB-A332R	40	0.05	1	S(D)3R5INT	10001
MS1H4-10B30CB-A330R	MS1H4-10B30CB-A332R	40	0.1			
MS1H1-20B30CB-A331R	MS1H1-20B30CB-A334R	60	0.2			
MS1H1-40B30CB-A331R	MS1H1-40B30CB-A334R	60	0.4			
MS1H1-55B30CB-A331R	-	80	0.55		S(D)5R4INT	10002
MS1H1-75B30CB-A331R	MS1H1-75B30CB-A334R	80	0.75			
MS1H2 (n_N= 3000 rpm, n_{max}= 6000 rpm) series ratings						
MS1H2-10C30CD-A331R	MS1H2-10C30CD-A334R	100	1.0	1	S(D)3R5INT	10001
MS1H2-15C30CD-A331R	MS1H2-15C30CD-A334R	100	1.5		S(D)5R4INT	10002
MS1H2-20C30CD-A331R	MS1H2-20C30CD-A334R	100	2.0		S(D)8R4INT	10003
MS1H2-25C30CD-A331R	MS1H2-25C30CD-A334R	100	2.5		S(D)012INT	10004
MS1H2-30C30CD-A331R	MS1H2-30C30CD-A334R	130	3.0			
MS1H2-40C30CD-A331R	MS1H2-40C30CD-A334R	130	4.0	2	S(D)017INT	10005
Ratings of MS1H3 (n_N=1500 rpm, n_{max} =3000 rpm) motors						
MS1H3-85B15CD-A331R	MS1H3-85B15CD-A334R	130	0.85	1	S(D)3R5INT	10001
MS1H3-13C15CD-A331R	MS1H3-13C15CD-A334R	130	1.3		S(D)5R4INT	10002
MS1H3-18C15CD-A331R	MS1H3-18C15CD-A334R	130	1.8		S(D)8R4INT	10003
MS1H3-29C15CD-A331R	MS1H3-29C15CD-A334R	180	2.9		S(D)012INT	10004
MS1H3-44C15CD-A331R	MS1H3-44C15CD-A334R	180	4.4	2	S(D)017INT	10005
MS1H3-55C15CD-A331R	MS1H3-55C15CD-A334R	180	5.5		S(D)021INT	10006
MS1H3-75C15CD-A331R	MS1H3-75C15CD-A334R	180	7.5		S(D)026INT	10007
MS1H4 (n_N= 3000 rpm, n_{max}=7000 rpm) series ratings						
MS1H4-40B30CB-A331R	MS1H4-40B30CB-A334R	60	0.4	1	S(D)3R5INT	10001
MS1H4-75B30CB-A331R	MS1H4-75B30CB-A334R	80	0.75		S(D)5R4INT	10002

Note

S(D): Single-axis (S) or D (dual-axis)

Table 1–2 Selection of ISMG series servo motors

Servo Motor Model					Servo drive					
Max. Speed (flux weakening on) (RPM)	Rated power (kW)	Rated Current (*) (A)	Motor Model	Frame (mm)	In S1 duty			In S4 duty		
					Model IS810N50 M4T*******	Size	Code	Model IS810N50 M4 T*******	Size	Code
2500	7.9 (9.5)	15.4 (18.5)	ISMG1-95C15CD-A331FA (without brake) ISMG1-95C15CD-A334FA (with brake)	200	S(D)017INT	2	10005	S(D)021INT	2	10006
3000	10.5 (12.6)	20.8 (26.0)	ISMG1-12D20CD-A331FA (without brake) ISMG1-12D20CD-A334FA (with brake)	200	S(D)021INT	2	10006	S(D)026INT	2	10007
2500	11.8 (14.1)	24.4 (29.2)	ISMG1-14D15CD-A331FA (without brake) ISMG1-14D15CD-A334FA (with brake)	200	S(D)026INT	2	10007	S(D)032INT	2	10008
2500	14.5 (17.3)	29.9 (35.7)	ISMG1-17D15CD-A331FA (without brake) ISMG1-17D15CD-A334FA (with brake)	200	S(D)032INT	2	10008	S(D)037INT	2	10009
3000	15.7 (18.8)	28.6 (36.4)	ISMG1-18D20CD-A331FA (without brake) ISMG1-18D20CD-A334FA (with brake)	200	S(D)032INT	2	10008	S(D)037INT	2	10009
2500	18.1 (22.0)	35.5 (41.7)	ISMG1-22D15CD-A331FA (without brake) ISMG1-22D15CD-A334FA (with brake)	200	S(D)037INT	2	10009	S(D)037INT	2	10009
3000	19.3 (23.0)	37.0 (47.6)	ISMG1-23D20CD-A331FA (without brake) ISMG1-23D20CD-A334FA (with brake)	200	S(D)037INT	2	10009	S075INT	3	10012
3000	24.1 (28.3)	49.8 (58.4)	ISMG1-28D20CD-A331FA (without brake) ISMG1-28D20CD-A334FA (with brake)	200	S075INT	3	10012	S075INT	3	10012
2500	23.6 (30.6)	48.7 (63.3)	ISMG1-30D15CD-A331FA (without brake) ISMG1-30D15CD-A334FA (with brake)	200	S075INT	3	10012	S075INT	3	10012
3000	31.4 (41.0)	57.3 (78.9)	ISMG1-41D20CD-A331FA (without brake) ISMG1-41D20CD-A334FA (with brake)	200	S075INT	3	10012	S075INT	3	10012
2500	27.0 (31.4)	49.4 (61.7)	ISMG2-31D15CD-A331FA (without brake)	266	S075INT	3	10012	S075INT	3	10012
2500	36.1 (42.4)	74.0 (87.7)	ISMG2-42D15CD-A331FA (without brake)	266	S075INT	3	10012	S090INT	3	10013

Servo Motor Model					Servo drive					
Max. Speed (flux weakening on) (RPM)	Rated power (kW)	Rated Current (*) (A)	Motor Model	Frame (mm)	In S1 duty			In S4 duty		
					Model IS810N50 M4T*******	Size	Code	Model IS810N50 M4 T*******	Size	Code
3000	35.6 (41.9)	69.1 (86.6)	ISMG2-42D20CD-A331FA (without brake)	266	S075INT	3	10012	S090INT	3	10013
2500	44.8 (52.6)	87.2 (104.4)	ISMG2-52D15CD-A331FA (without brake)	266	S090INT	3	10013	S112INT	3	10014
3000	48.2 (56.5)	93.1 (109.3)	ISMG2-57D20CD-A331FA (without brake)	266	S090INT	3	10013	S112INT	3	10014
2500	53.4 (60.5)	98.8 (118.8)	ISMG2-60D15CD-A331FA (without brake)	266	S112INT	3	10014	S112INT	3	10014
3800	11.8 (13.8)	24.3 (30.86)	ISMG1-12D30CD-A331FA-GL (without brake)	200	S(D)026INT	2	10007	S(D)032INT	2	10008
4700	17.2 (20.2)	30.0 (38.1)	ISMG1-17D33CD-A311FA-GL (without brake)	200	S(D)032INT	2	10008	S(D)037INT	2	10009
4800	23.6 (27.6)	57.3 (72.77)	ISMG1-29D30CD-A3A1FA-GL (without brake)	200	S075INT	3	10012	S075INT	3	10012
4300	18.8 (22.1)	36.2 (45.97)	ISMG2-18D30CD-A3A1FA-GL (without brake)	266	S(D)037INT	2	10009	S075INT	3	10012
4330	22.0 (25.7)	40.7 (51.69)	ISMG1-22D30CD-A3A1L-GL (without brake)	200	S075INT	3	10012	S075INT	3	10012
4550	45.0 (52.7)	87.4 (111.0)	ISMG1-45D30CD-A3A1L-GL (without brake)	200	S090INT	3	10013	S090INT	3	10013
4330	55.0 (64.3)	101.7 (129.16)	ISMG1-55D30CD-A3A1L-GL (without brake)	200	S112INT	3	10014	S112INT	3	10014
5300	92.7 (108.5)	122.0 (154.94)	ISMG2-92D38CD-A3B1L-GL (without brake)	320[1]	S240INT	4	10016	S152INT	3	10014

Note

- In the "Rated Power" and "Rated Current" columns, the first row contains data in the S1 duty type and the brackets of the second row contains data in the S4 duty type.
- S4 (IEC 60034-1): intermittent periodic duty with starting The duty type S4 is defined as a sequence of identical duty cycles, each cycle including a significant starting time, a time of operation at constant load and a time de-energized and at rest.
- S (D) may be "S uniaxial" or "D biaxial".
- [1]: This model is a customized model for the industry, which is different from the standard flange.

2 IS810N series inverter unit

2.1 Product Information

2.1.1 Model Number and Nameplate

Model Number and Nameplate

IS810 N 50M 4T D 3R5 INT
① ② ③ ④ ⑤ ⑥ ⑦

① **Series** IS810: IS810 series servo drive	⑤ **Number of Axes** S: single axis D: dual axis	⑦ **Model** INT: global version
② **Product Type** N: EtherCAT network type	⑥ **Rated Current (A)**[1] Dual axis (rated current per axis)	
③ **Unit Type** 50M: drive unit	3R5: 3.5 A 5R4: 5.4 A 8R4: 8.4 A 012: 11.9 A 017: 16.5 A 021: 20.8 A 026: 25.7 A 032: 32 A	037: 37 A 045: 45 A 060: 60 A 075: 75 A 090: 90 A 112: 112 A 152: 152 A 240: 240 A
④ **Voltage class** 4T: 380 V–480 V		

Note

[1]: uniaxial: 3R5-240; Biaxial: 3R5 ~ 037.

For more product specification information, please refer to "Product Specifications" in this chapter.

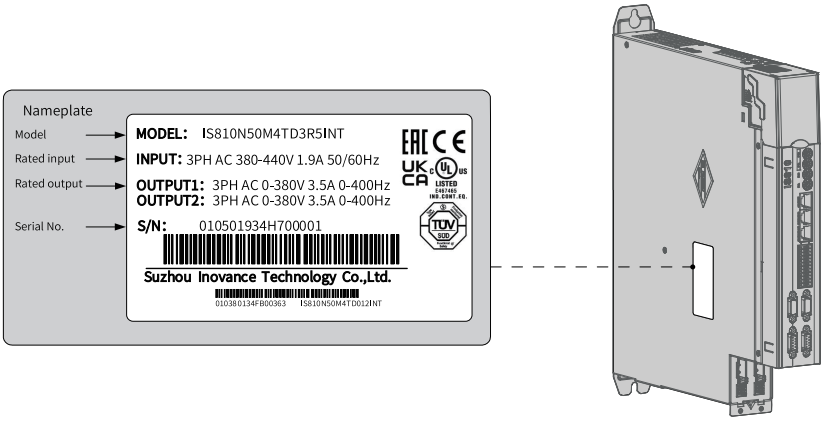


Figure 2-1 Nameplate

Encryption of the production serial number

01050193 4 S 7 00001
① ② ③ ④ ⑤

① **Internal code** Equipment material code	③ **Year** 9: 2009 A: 2010 ... N: 2021 S: 2024 ... Note: I/L/O/Q is not used.	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: The S/N 010019324S700001 indicates the drive is manufactured in July, 2024.

2.1.2 Components

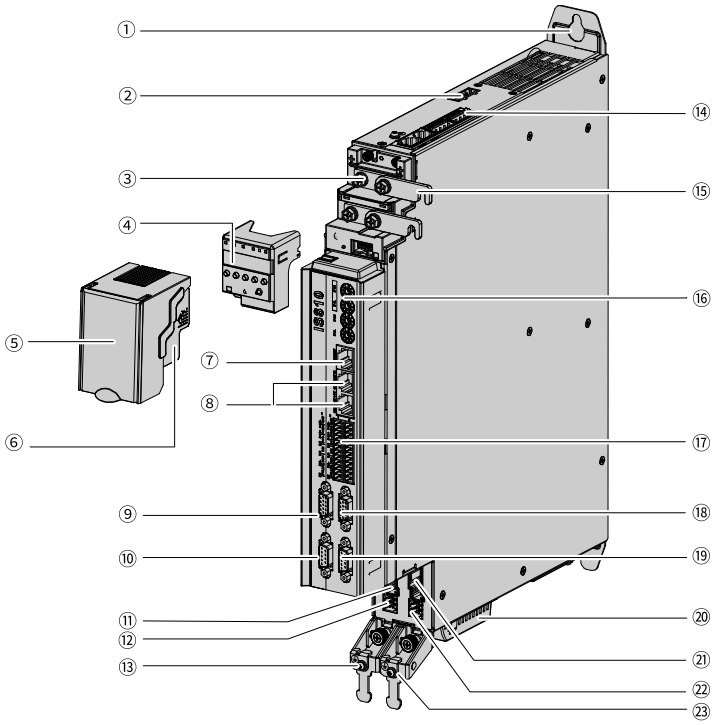


Figure 2-2 Dual axis components

Table 2–1 Components

No.	Components	No.	Components
1	Mounting hole	13	Shielding bracket (axis 1)
2	24 V power input	14	STO terminal
3	Built-in busbar	15	Busbar connection
4	Keypad	16[1]	Communication address hardware DIP switch
5	Face cover plate	17	DIDO connection terminal
6	Busbar guard	18	Full closed loop input and frequency division output terminal (axis 2)
7	EtherNet terminal	19	Encoder cable terminal (axis 2)
8	EtherCAT terminal	20	Absolute encoder battery (optional)
9	Full closed loop input and frequency division output terminal (axis 1)	21	Power cable terminal (axis 2)
10	Encoder cable terminal (axis 1)	22	Brake output terminal (axis 2)
11	Power cable terminal (axis 1)	23	Shielding bracket (axis 2)
12	Brake output terminal (axis 1)	-	-

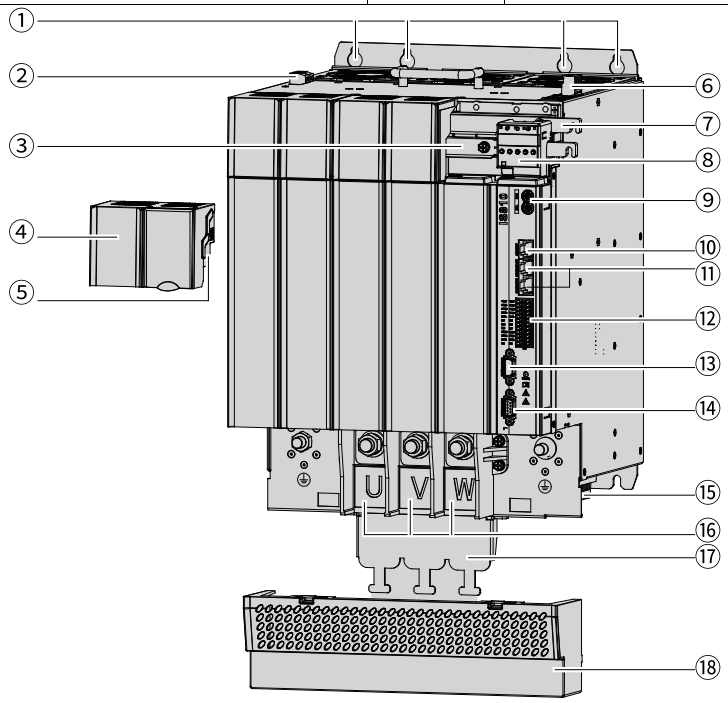


Figure 2-3 Single axis components

Table 2–2 Components

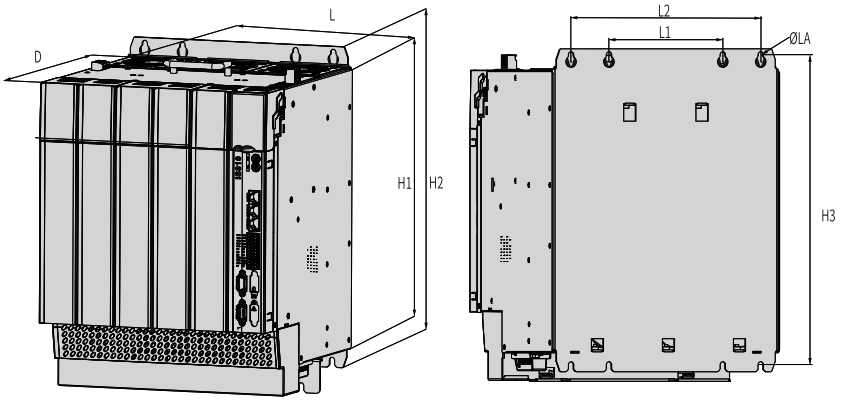
No.	Components	No.	Components
1	Mounting hole	10	EtherNet terminal
2	24 V power input	11	EtherCAT terminal
3	Built-in busbar	12	DIDO connection terminal
4	Face cover plate	13	Full closed loop input and frequency division output terminal
5	Busbar guard	14	Encoder cable terminal
6	STO terminal	15	Absolute encoder battery (optional)
7	Busbar Connection	16	Power cable terminal

No.	Components	No.	Components
8	Keypad	17	Shield Bracket
9[1]	Communication address hardware DIP switch	18	Terminal cover

Note

For details of Hardware DIP switches, see *" DIP switch" on page 117*.

2.1.3 Product Dimensions



Size	L	H1	H2	D	L1	L2	H3	ϕLA	Tightening Torque		Mass
	Unit: mm								Recommended screw models	Unit: (N·m)	Unit: kg
1 (biaxial)	50	350	400	305	-	-	384	2×ϕ7	M6	4.8	5.25
2 (biaxial)	100	350	400	305	50	-	384	4×ϕ7	M6	4.8	9.56
1 (single axis)	50	350	400	305	-	-	384	2×ϕ7	M6	4.8	5.25
2 (single axis)	100	350	400	305	50	-	384	4×ϕ7	M6	4.8	9.56
3 (single axis)	200	350	400	305	150	-	384	4×ϕ7	M6	4.8	18.6
4 (single axis)	300	350	400	302	150	250	384	8×ϕ7	M6	4.8	25

2.2 Specifications

2.2.1 Electrical Specifications

Size 1 electrical specification

Item	Size 1							
Servo drive model: IS810N	S3R5	D3R5	S5R4	D5R4	S8R4	D8R4	S012	D012
Power of the Drive (kW)	0.85		1.3		1.8		2.9	

Item	Size 1							
Continuous output current (Arms)	3.5		5.4		8.4		11.9	
Max. output current (Arms)	8.5		14		20		28	
Continuous input current (Arms)	4	8	7	14	12	24	17	34
Main circuit power supply	537 VDC to 679 VDC							
Thermal Loss (W)	57	94	80	140	96	171	139	258
Control circuit power supply	21.6 VDC to 26.4 VDC							
24V power supply heating power consumption (W)	12							

Size 2 electrical specification

Item	Size 2									
Servo drive model: IS810N	S017	D017	S021	D021	S026	D026	S032	D032	S037	D037
Power of the Drive (kW)	4.4		5.5		7.5		15		18.5	
Continuous output current (Arms)	16.5		20.8		25.7		32		37	
Max. output current (Arms)	42		55		65		57.6		66.6	
Continuous input current (Arms)	22	44	26	52	32	64	40	80	46	92
Main circuit power supply	537 VDC to 679 VDC									
Thermal Loss (W)	146	258	172	311	209	384	253	473	291	549
Control circuit power supply	21.6 VDC to 26.4 VDC									
24V power supply heating power consumption (W)	12									

Size 2/Size 3/Size 4 electrical specification

Item	Size 2			Size 3			Size 4
Servo drive model: IS810N	S045	S060	S075	S090	S112	S152	S240
Power of the Drive (kW)	22	30	37	45	55	75	120

Item	Size 2			Size 3			Size 4
Continuous output current (Arms)	45	60	75	90	112	152	240
Max. output current (Arms)	90	120	150	225	280	380	384
Continuous input current (Arms)	52	71	86	103	126	171	274
Main circuit power supply	537 VDC to 679 VDC						
Thermal Loss (W)	353	469	578	765	936	1253	2030
Control circuit power supply	21.6 VDC to 26.4 VDC						
24V power supply heating power consumption (W)	12						

2.2.2 Technical Specifications

Item			Description
General Specifications	Control mode		IGBT PWM control, sine wave current drive mode 380 V: three-phase full wave rectification
	Encoder feedback		Inovance 23-bit serial absolute encoder
	Conditions for use	Operating temperature[1]	0 °C to 40 °C (if the ambient temperature is above 40 °C, please derate it. For every 1 °C increase in ambient temperature, the derate will be 1.5%, and the maximum operating ambient temperature is 50 °C).
		Storage temperature	-25°C–+70°C
		Operating/Storage humidity	5% to less than 90% RH (no condensation)
		Vibration/Shock resistance	Not more than 0.6 g
		IP rating	IP20 (Except the power terminal)
		Pollution degree	Degree 2
		Protection class	Class I
		Altitude	Below 1000m, please derate when exceeding 1000m (1% derate for every 100m ascent, of which the maximum use altitude of Size 1 to Size 2 is 3000m, and the maximum use altitude of Size 3 to Size 4 is 2000m). Note: An isolation transformer should be added when the altitude exceeds the specified altitude, which cannot exceed 5000m.
		Operating environment	Cannot be used in vacuum environment
Input/ Output signal	DI signal	Signal allocation changes can be made (shared by two axes)	8 DIs (HDI4 and HDI8 being high-speed DI)
	Digital output signal	Signal allocation changes can be made (shared by two axes)	2 DOs
Built-in functions	Overtravel (OT) prevention		The servo drive stops immediately when P-OT or N-OT is active
	Electronic gear ratio		0.1048576 ⩽ B/A ⩽ 419430.4
	Protective functions		Protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overheat, overspeed, encoder error, CPU error, parameter error, and other.
	LED display		Main circuit CHARGE indicator, 5-digit LED display
	Others		Gain tuning, alarm log, JOG

Note

[1]: Install the drive unit within the ambient temperature range. When stored in an electric cabinet, the temperature inside the electric cabinet should not exceed this temperature value.

2.2.3 Technical Data of EtherCAT Communication

Item			Description
EtherCAT slave	Basic performance of EtherCAT 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	Shielded cables of Cat 6 or higher
		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
		Min. sync period	1ms
		Bit error rate	10^{-10} EtherNet standard
	EtherCAT 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

3 MS1 Series Motor

For detailed information about MS1-R series motors, see "MS1-R Series Servo Motor Selection Guide" and "MS1-R Series Servo Motor Installation Guide".

Visit *http://www.inovance.com*, go to Support > Download, search by keyword, and then download the PDF file. You can also get the PDF file in the app My Inovance.

4 ISMG Series Motor

For details about ISMG series motors, see "ISMG Series Servo Motor Selection Guide”.

Visit *http://www.inovance.com*, go to Support > Download, search by keyword, and then download the PDF file. You can also get the PDF file in the app My Inovance.

5 Options

5.1 Cables

5.1.1 Description of the Model

> ***Note***
> Cables with "-INT" are oil-resistant cables by default.

Power cable

S6-L-M ① 0 ② 0 ③ 0 ④ - 3.0 ⑤ – T ⑥ - INT ⑦ - PE ⑧

① **Cable Type** S6-L-B/M: motion control power cable B: with brake M: without brake	④ **Connector type at motor side** 1: 9-core military-spec connector 2: 6-core military-spec connector 7: SDC-06T series connector (front outgoing) 8: SDC-06T series connector (rear outgoing)	⑥ **Special requirements** _: Fixed cable T: Drag chain ⩾ 10 million times
② **Connector type at drive side** 1: Needle-shaped cable lug		⑦ **Version** INT: global version
③ **Frame** 0: Sizes 25/40/60/80 1: Sizes 100/130/180 2: Size 180	⑤ **Cable Length (m)** 3.0: 3 m 5.0: 5 m 10.0: 10 m	⑧ **Special requirements** PE: pin terminal grounding

For related power cables, see *" MS1 series motor power cable (without shield bracket)" on page 37*, *" MS1 series motor power cable (with shield bracket)" on page 39* and *" Power cables for ISMG series motors" on page 41*.

Model number of encoder cables

S6-L-P ① - 1 ② 2 ③ 1 ④ - 3.0 ⑤ - T ⑥ - INT ⑦

① **Cable Type** S6-L-P: encoder cable	③ **Encoder** 1: Communication incremental encoder 2: Multi-turn absolute	⑤ **Cable Length (m)** 3.0: 3 5.0: 5 10.0: 10
② **Connector type at drive side** 0: DB9 1: USB	④ **Connector type at motor side** 1: 9-core military-spec connector 4: SDC-06T series connector (front outgoing) 5: SDC-06T series connector (rear outgoing)	⑥ **Special requirements** _: Fixed cable T: Drag chain ⩾ 10 million times
		⑦ **Version** INT: global version

For related encoder cables, see *" MS1 series motor encoder cable" on page 41* and *" ISMG series motor encoder cable" on page 43*.

Model number of communication cables

S6-L-T ① 00 ② - 3.0 ③

① Cable Type	② Cable type	③ Cable Length (m)
S6-L-T: Motion control communication cable	00: Servo drive PC communication cable 02: Drive-PLC communication cable 04: Servo drive network communication cable (CAT.5EPROFINET) 07: Servo drive network communication cable (CAT6A&PROFINET) 08: Servo drive network communication cable (CAT7&PROFINET)	0.3: 0.3

For related communication cables, see *" Communication cables" on page 43*.

5.1.2 Cable Type

Fixed cables

Do not bend or move fixed cables during use. Bending or moving fixed cables may damage the cables and lead to a series of cable-related faults such as poor contact. Secure fixed cables through fixed binding. Certain bending radius must be available for the cables to prevent stress.

Recommended bend radius ⩾ 5D (D: cable diameter)

Flexible cables

The drag chain cable is a highly flexible special cable that can move back and forth with the drag chain and is not easy to wear.

Recommended bend radius ⩾ 10D (D: cable diameter)

Note

- Do not wind or twist the cables in the drag chain.
- Ensure the cable can move within the bending radius. Do not move the cables by force. Ensure a relative movement between cables or between the cable and the guiding device is available.
- do not fix or bundle the cables inside the cable protection chain. You can bundle them at both ends of the cable protection chain;

Oil-resistant cables

Inovance oil-resistant cables are suitable for machine tools, cutting fluids, cutting oils and other scenarios.

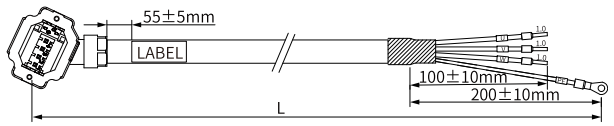
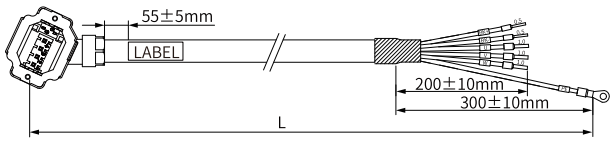
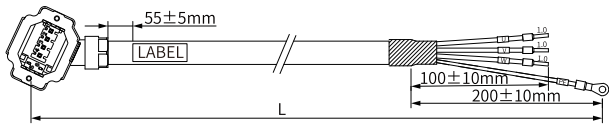
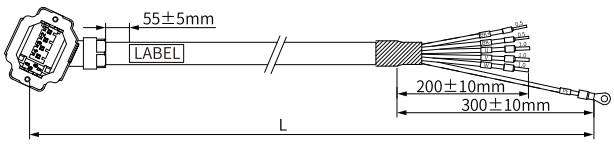
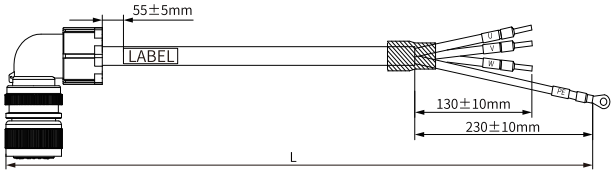
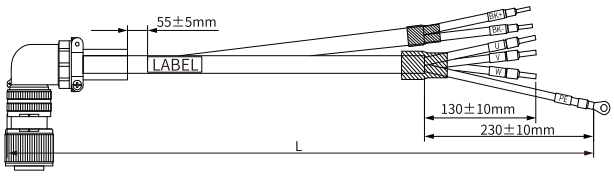
More

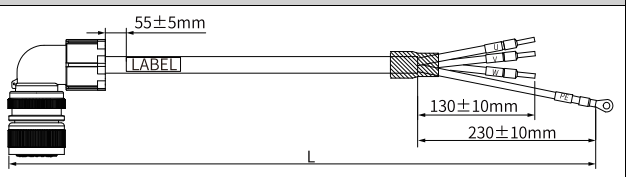
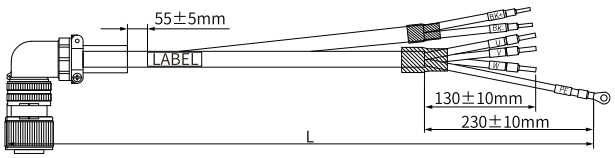
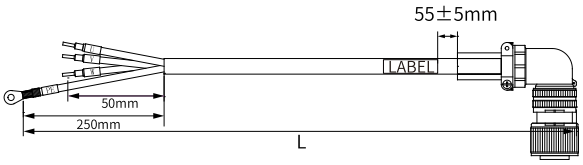
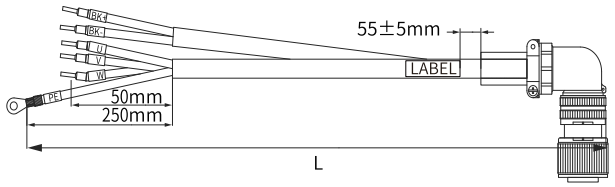
Terminal-type motor power cables and encoder cables must be connected with special equipment and tools. Therefore, purchase the cables through channels certified by Inovance.

For more cable information, see contents on cable specifications and models of the related servo drive.

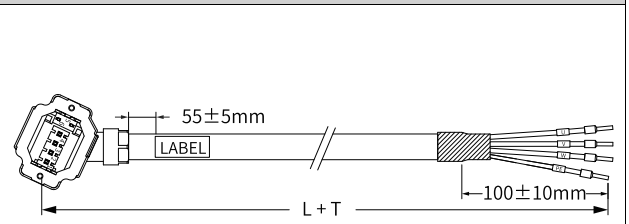
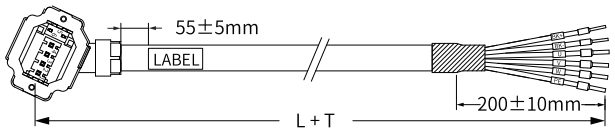
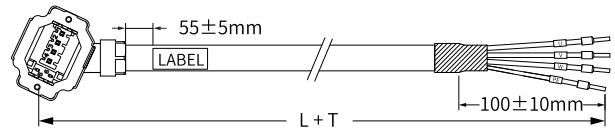
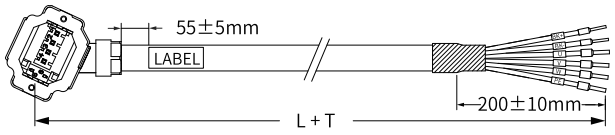
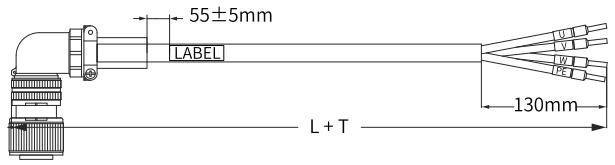
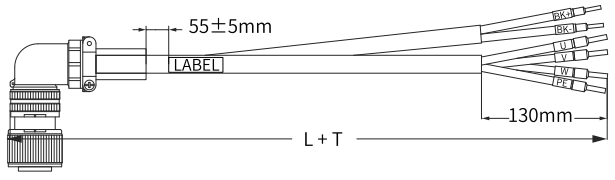
5.1.3 Cable Selection

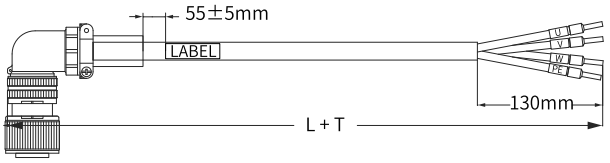
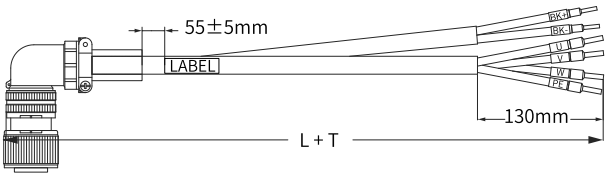
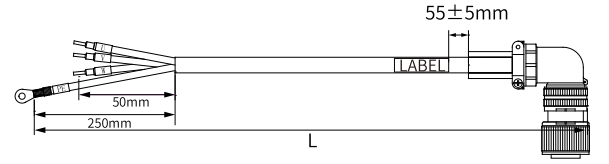
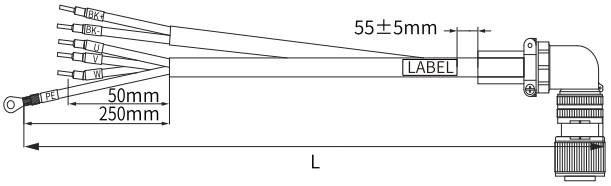
MS1 series motor power cable (without shield bracket)

Motor Model	Cable Name		Cable Model	L Cable Length (mm)	Illustration
MS1H1/MS1H4 motor	Front outlet	Power cable for motor without brake	S6-L-M107-3.0(-T)-INT	3100	
			S6-L-M107-5.0(-T)-INT	5100	
			S6-L-M107-10.0(-T)-INT	10100	
		Brake	S6-L-B107-3.0(-T)-INT	3100	
			S6-L-B107-5.0(-T)-INT	5100	
			S6-L-B107-10.0(-T)-INT	10100	
	Rear outlet	Power cable for motor without brake	S6-L-M108-3.0(-T)-INT	3100	
			S6-L-M108-5.0(-T)-INT	5100	
			S6-L-M108-10.0(-T)-INT	10100	
		Brake	S6-L-B108-3.0(-T)-INT	3100	
			S6-L-B108-5.0(-T)-INT	5100	
			S6-L-B108-10.0(-T)-INT	10100	
MS1H2 of 3kW and below, MS1H2 of 4kW/5kW and MS1H3 of 1.8 kW and below	Power cable for motor without brake		S6-L-M111-3.0(-T)-INT	3100	
			S6-L-M111-5.0(-T)-INT	5100	
			S6-L-M111-10.0(-T)-INT	10100	
	Brake		S6-L-B111-3.0(-T)-INT	3100	
			S6-L-B111-5.0(-T)-INT	5100	
			S6-L-B111-10.0(-T)-INT	10100	

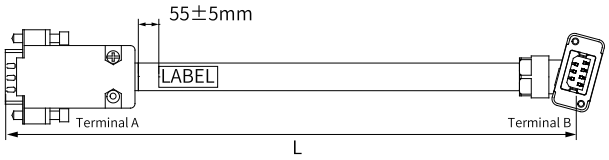
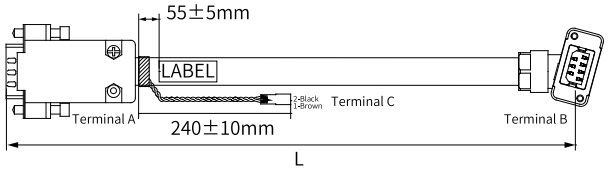
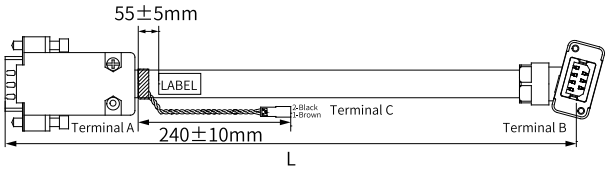
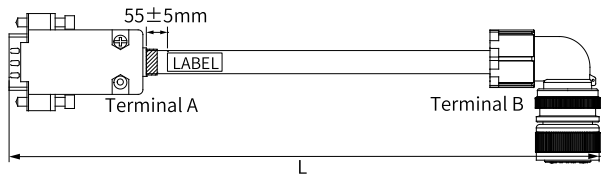
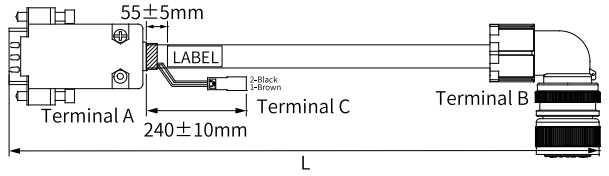
Motor Model	Cable Name	Cable Model	L Cable Length (mm)	Illustration
MS1H3 motors (2.9 kW)	Power cable for motor without brake	S6-L-M112-3.0(-T)-INT	3100	
		S6-L-M112-5.0(-T)-INT	5100	
		S6-L-M112-10.0(-T)-INT	10100	
	Brake	S6-L-B112-3.0(-T)-INT	3100	
		S6-L-B112-5.0(-T)-INT	5100	
		S6-L-B112-10.0(-T)-INT	10100	
MS1H3 (4.4 kW and above)	Power cable for motor without brake	S6-L-M122-3.0(-T)-INT	3000	
		S6-L-M122-5.0(-T)-INT	5000	
		S6-L-M122-10.0(-T)-INT	10000	
	Brake	S6-L-B122-3.0(-T)-INT	3000	
		S6-L-B122-5.0(-T)-INT	5000	
		S6-L-B122-10.0(-T)-INT	10000	

MS1 series motor power cable (with shield bracket)

Motor Model	Cable Name		Cable Model	L Cable Length (mm)	Illustration
MS1H1/MS1H4 motor	Front outlet	Power cable for motor without brake	S6-L-M107-3.0(-T)-INT-PE	3000	
			S6-L-M107-5.0(-T)-INT-PE	5000	
			S6-L-M107-10.0(-T)-INT-PE	10000	
		Brake	S6-L-B107-3.0(-T)-INT-PE	3000	
			S6-L-B107-5.0(-T)-INT-PE	5000	
			S6-L-B107-10.0(-T)-INT-PE	10000	
	Rear outlet	Power cable for motor without brake	S6-L-M108-3.0(-T)-INT-PE	3000	
			S6-L-M108-5.0(-T)-INT-PE	5000	
			S6-L-M108-10.0(-T)-INT-PE	10000	
		Brake	S6-L-B108-3.0(-T)-INT-PE	3000	
			S6-L-B108-5.0(-T)-INT-PE	5000	
			S6-L-B108-10.0(-T)-INT-PE	10000	
MS1H2 of 3kW and below, MS1H2 of 4kW/5kW and MS1H3 of 1.8 kW and below	Power cable for motor without brake		S6-L-M111-3.0(-T)-INT-PE	3000	
			S6-L-M111-5.0(-T)-INT-PE	5000	
			S6-L-M111-10.0(-T)-INT-PE	10000	
	Brake		S6-L-B111-3.0(-T)-INT-PE	3000	
			S6-L-B111-5.0(-T)-INT-PE	5000	
			S6-L-B111-10.0(-T)-INT-PE	10000	

Motor Model	Cable Name	Cable Model	L Cable Length (mm)	Illustration
MS1H3 motors (2.9 kW)	Power cable for motor without brake	S6-L-M112-3.0(-T)-INT-PE	3000	
		S6-L-M112-5.0(-T)-INT-PE	5000	
		S6-L-M112-10.0(-T)-INT-PE	10000	
	Brake	S6-L-B112-3.0(-T)-INT-PE	3000	
		S6-L-B112-5.0(-T)-INT-PE	5000	
		S6-L-B112-10.0(-T)-INT-PE	10000	
MS1H3 (4.4 kW and above)	Power cable for motor without brake	S6-L-M122-3.0(-T)-INT	3000	
		S6-L-M122-5.0(-T)-INT	5000	
		S6-L-M122-10.0(-T)-INT	10000	
	Brake	S6-L-B122-3.0(-T)-INT	3000	
		S6-L-B122-5.0(-T)-INT	5000	
		S6-L-B122-10.0(-T)-INT	10000	

MS1 series motor encoder cable

Motor Model		Cable Name	Cable Model	L Cable Length (mm)	Illustration
MS1H1/ MS1H4 motor	Front outlet	Single-turn absolute encoder cable	S6-L-P014-3.0(-T)-INT	3000	
			S6-L-P014-5.0(-T)-INT	5000	
			S6-L-P014-10.0(-T)-INT	10000	
		Multi-turn absolute encoder cable	S6-L-P024-3.0(-T)-INT	3000	
			S6-L-P024-5.0(-T)-INT	5000	
			S6-L-P024-10.0(-T)-INT	10000	
	Rear outlet	Single-turn absolute encoder cable	S6-L-P015-3.0(-T)-INT	3000	
			S6-L-P015-5.0(-T)-INT	5000	
			S6-L-P015-10.0(-T)-INT	10000	
		Multi-turn absolute encoder cable	S6-L-P025-3.0(-T)-INT	3000	
			S6-L-P025-5.0(-T)-INT	5000	
			S6-L-P025-10.0(-T)-INT	10000	
MS1H2/MS1H3 motor		Single-turn absolute encoder cable	S6-L-P011-3.0(-T)-INT	3000	
			S6-L-P011-5.0(-T)-INT	5000	
			S6-L-P011-10.0(-T)-INT	10000	
		Multi-turn absolute encoder cable	S6-L-P021-3.0(-T)-INT	3000	
			S6-L-P021-5.0(-T)-INT	5000	
			S6-L-P021-10.0(-T)-INT	10000	

Power cables for ISMG series motors

Inovance does not provide power cables of the ISMG motor, but their specifications, according to which you can make cables yourself.

Table 5–1 Specifications of ISMG motor power cables

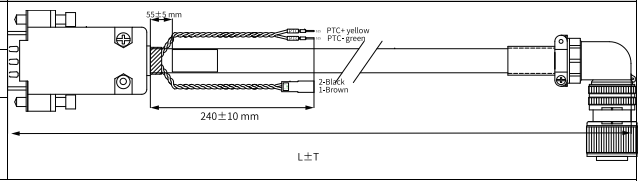
Motor without Brake	Motor with Brake	Rated Current (*) (A)	Rated Torque (*) (N·m)	Recommended Cable Diameter (mm^2)	Recommended Cable Size (AWG)
ISMG1-95C15CD-A331FA	ISMG1-95C15CD-A334FA	15.4 (18.5)	50.0 (60.0)	0.82	18
ISMG1-12D20CD-A331FA	ISMG1-12D20CD-A334FA	20.8 (26.0)	50.0 (60.0)	1.31	16

Motor without Brake	Motor with Brake	Rated Current (*) (A)	Rated Torque (*) (N·m)	Recommended Cable Diameter (mm^2)	Recommended Cable Size (AWG)
ISMG1-14D15CD-A331FA	ISMG1-14D15CD-A334FA	24.4 (29.2)	75.0 (90.0)	2.08	14
ISMG1-17D15CD-A331FA	ISMG1-17D15CD-A334FA	29.9 (35.7)	92.0 (110.0)	3.33	12
ISMG1-18D20CD-A331FA	ISMG1-18D20CD-A334FA	28.6 (36.4)	75.0 (90.0)	3.33	12
ISMG1-22D15CD-A331FA	ISMG1-22D15CD-A334FA	35.5 (41.7)	115.0 (135.0)	3.33	12
ISMG1-23D20CD-A331FA	ISMG1-23D20CD-A334FA	37.0 (47.6)	92.0 (110.0)	5.26	10
ISMG1-28D20CD-A331FA	ISMG1-28D20CD-A334FA	49.8 (58.4)	115.0 (135.0)	5.26	10
ISMG1-30D15CD-A331FA	ISMG1-30D15CD-A334FA	48.7 (63.3)	150.0 (195.0)	5.26	10
ISMG1-41D20CD-A331FA	ISMG1-41D20CD-A334FA	57.3 (78.9)	150.0 (195.0)	8.37	8
ISMG2-31D15CD-A331FA	-	49.4 (61.7)	180.0 (200.0)	8.37	8
ISMG2-42D15CD-A331FA	-	74.0 (87.7)	230.0 (270.0)	8.37	8
ISMG2-42D20CD-A331FA	-	69.1 (86.6)	170.0 (200.0)	8.37	8
ISMG2-52D15CD-A331FA	-	87.2 (104.4)	285.0 (335.0)	13.3	6
ISMG2-57D20CD-A331FA	-	93.1 (109.3)	230.0 (270.0)	13.3	6
ISMG2-60D15CD-A331FA	-	98.8 (118.8)	340.0 (385.0)	13.3	6
ISMG1-12D30CD-A331FA-GL	-	24.3 (30.86)	37.5 (43.9)	1.31	16
ISMG1-17D33CD-A311FA-GL	-	30.0 (38.1)	50.0 (58.5)	3.33	12
ISMG1-29D30CD-A3A1FA-GL	-	57.3 (72.77)	75.0 (87.8)	8.37	8
ISMG2-18D30CD-A3A1FA-GL	-	36.2 (45.97)	60.0 (70.2)	5.26	10
ISMG1-22D30CD-A3A1L-GL	-	40.7 (51.69)	70.0 (81.9)	5.26	10
ISMG1-45D30CD-A3A1L-GL	-	87.4 (111.0)	143.4 (167.8)	13.3	6
ISMG1-55D30CD-A3A1L-GL	-	101.7 (129.16)	175.0 (204.8)	21.15	4
ISMG2-92D38CD-A3B1L-GL	-	122.0 (154.94)	233.0 (272.6)	33.62	2

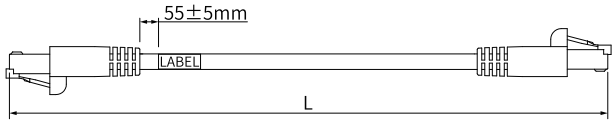
Note

- The default is the rated current and rated torque under the S1 system. The content in the () is the rated current and rated torque under the S4 system.
- The cable specifications under the S1 working system are also applicable to the motor under the S4 working system.

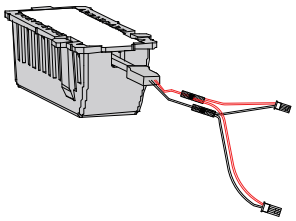
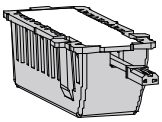
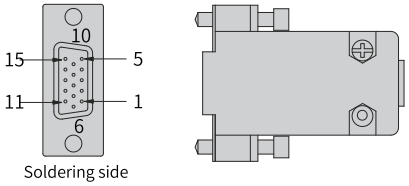
ISMG series motor encoder cable

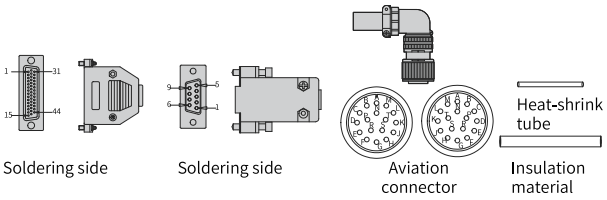
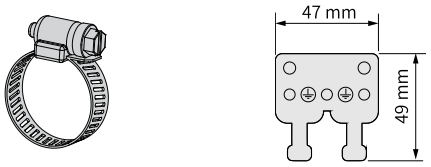
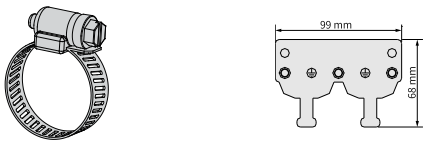
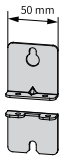
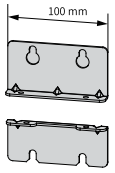
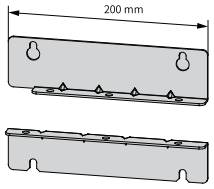
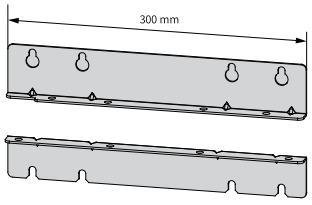
Motor Model	Cable Model	L Cable Length (mm)	Tolerance (T) (mm)	Illustration
ISMG1 (G2) -*******-A3***	S6-L-P021-3.0-PTC	3000	(-30.30)	
		5000	(-30.30)	
		10000	(-30.30)	

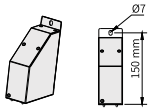
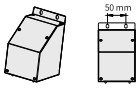
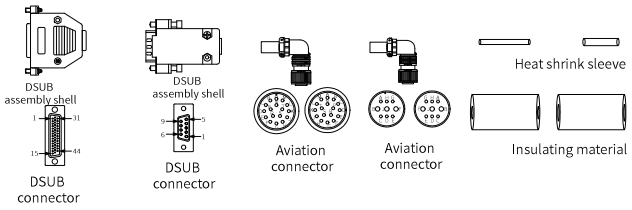
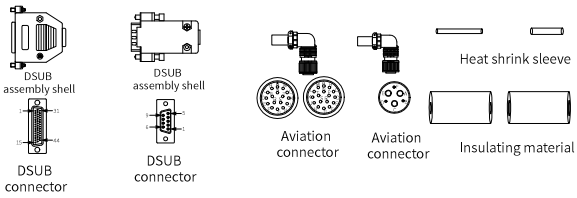
Communication cables

Cable Name	Cable Model	Cable Length (mm)	Illustration
Servo drive to PC communication cable	S6-L-T04-0.3	300	
Servo drive network communication cable (CAT.5E&PROFINET)	S6-L-T04-0.3	300	
Servo drive network communication cable (CAT6A&PROFINET)	S6-L-T07-0.3	300	
Servo drive network communication cable (CAT7&PROFINET)	S6-L-T08-0.3	300	

Connector Kit

Name	Model	Outline Drawing
Dual-axis battery kit	S6-C9A	
Single axis battery kit	S6-C4A	
CN5/CN7 terminal (DB15)	S6-C6	

Name	Model	Outline Drawing
ISMG-DB9 terminal 20-29 aviation connector	S6-C5	
Shield bracket (including hose clamps)[1]	MD810-PBJ50M-W1 (size 1 shield bracket)	
	MD810-PBJ50M-W2 (size 2 shield bracket)	
	MD810-PBJ50M-W3 (size 3 shield bracket)	
	MD810-PBJ50M-W4 (size 4 shield bracket)	
Through-hole Mounting Bracket	MD810-AZJ50M-W1 (size 1 mounting bracket)	
	MD810-AZJ50M-W2 (size 2 mounting bracket)	
	MD810-AZJ50M-W3 (size 3 mounting bracket)	
	S6-C39 (size 4 mounting bracket)	

Name	Model	Outline Drawing
Air guide plate	MD810-DLB-W1 (size 1 air guide plate)	
	MD810-DLB-W2 (size 2 air guide plate)	
MS1H2/MS1H3 (1.8 kW and below) motor connector	S6-C29	
MS1H3 (2.9 kW and above) motor connector	S6-C39	

Note

[1] Shielding brackets (including hose clamps) for Size 1 and Size 2 models are standard accessories.

5.2 Absolute Encoder Batteries

Battery box selection

Select an appropriate battery according to the following table.

Table 5–2 Description of the absolute encoder battery

Specification	Item	Single Axis Rating			Dual Axis Rating			Condition
		Min.	Typical Value	Max.	Min.	Typical Value	Max.	
Output specification: 3.6 V 2500 mAh	External battery voltage (V)	3.2	3.6	5	3.2	3.6	5	In the standby mode[1]
	Circuit fault voltage (V)	-	2.6	-	-	2.6	-	In standby mode
	Battery alarm voltage (V)	2.85	3	3.15	2.85	3	3.15	-
	Circuit draw current (μA)	-	2	-	-	4	-	In the normal operation mode[2]
		-	10	-	-	20	-	In the standby mode, the axis is static.
		-	80	-	-	160	-	In standby mode, axis rotating
	Ambient temperature (°C)	0	-	40	0	-	40	Same as the motor
	Storage temperature (°C)	-20	-	60	-20	-	60	

The preceding values are obtained under an ambient temperature of 20°C.

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.

5.3 Buffer Unit Selection Guidance

Width: 50 mm Width: 100 mm Width: 200 mm

Figure 5-1 Appearance of INOV-SU series DC soft charge units

Table 5–3 Buffer unit selection table

Servo Drive Model	DC Soft Charge Unit Model
IS810N50M4TS3R5INT	INOV-SU-30
IS810N50M4TD3R5INT	
IS810N50M4TS5R4INT	
IS810N50M4TD5R4INT	
IS810N50M4TS8R4INT	
IS810N50M4TD8R4INT	
IS810N50M4TS012INT	
IS810N50M4TD012INT	
IS810N50M4TS017INT	INOV-SU-60
IS810N50M4TD017INT	
IS810N50M4TS021INT	
IS810N50M4TD021INT	
IS810N50M4TS026INT	
IS810N50M4TD026INT	
IS810N50M4TS032INT	INOV-SU-100
IS810N50M4TD032INT	
IS810N50M4TS037INT	
IS810N50M4TD037INT	
IS810N50M4TS075INT	INOV-SU-170
IS810N50M4TS090INT	
IS810N50M4TS112INT	
IS810N50M4TS152INT	
IS810N50M4TS240INT	-

6 Installation

- Do not install the equipment in environment with water or corrosive gas.
- Do not subject the product to combustibles. Failure to comply may result in electric shock or a fire.
- Do not sit on the product or lay heavy objects on it. Failure to comply may result in personal injury.
- Install the product inside a cabinet with fire-proof and electric protection. Failure to comply may result in a fire.
- Make sure that the air inlet and outlet are unblocked and prevent entry of foreign objects. Otherwise, internal components may be aged, causing faults and fires.
- Install the product in the required direction. Failure to comply may result in faults. Ensure that there is specified distance between the servo drive, cabinet internal surface, and other devices. Failure to comply will result in a fire or fault.
- Do not exert large impact on the product. Failure to comply may result in faults.

Check the following items upon unpacking.

Item	Description
Check whether the delivered product is consistent with your order.	Check whether the servo drive model and specifications comply with your order. For the size of the packing box, see *"Table 6–1" on page 48*. The deliverables include the product, cushion, carton box, and screw bag, as shown in *"Figure 6–1" on page 48* .
Check whether the product is intact.	Check whether the product delivered is in good condition. If there is any missing or damage, contact Inovance or your supplier immediately.

Table 6–1 Dimensions of the outer packing box

Size	Outer Length (mm)	Outer Height (mm)	Weight (kg)	Net weight (kg)
1	510	395	6.16	5.52
2	530	415	10.83	9.56
3	540	430	20.2	18.6
4	525	380	33	25

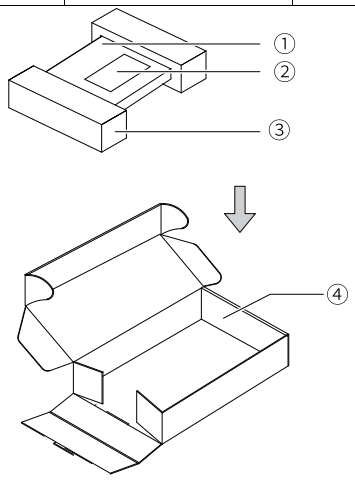


Figure 6-1 Contents inside the packing box

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

6.1 Installation Environment Requirements

Installation location

- Ambient temperature: Ambient temperature has a great effect on the service life of the drive. Do not operate the drive outside the allowable temperature range (0°C to 50°C).
- Altitude: When the installation altitude exceeds 1000 m, the IS810 drive device must be derated according to any recommended capacitance value.
- Installation surface requirements: The installation surface of the IS810 drive device must be flame retardant. Its structural strength must meet the strength requirements for device transportation, storage and running under normal conditions to avoid damage to the AC drive device due to vibration or excessive deformation of the installation surface. The installation surface must remain vertical to the horizontal ground and be secured to the cabinet properly. The installation surface must be able to withstand no less than four times the total weight of the installed device.
- Cooling requirements: A large amount of heat may be generated during the operation of the AC drive. There must be plenty of cooling space in the installation area. It must be ensured that the cooling holes of the AC drive cabinet are not blocked.
- Vibration: Install it in a place that is not easy to vibrate. The vibration acceleration must be less than or equal to 0.6 g. Keep the drive away from punch presses.
- Other requirements: Install the servo drive in an environment free from a) direct sunlight, moisture and water drops; b) corrosive, inflammable or explosive gases; and c) grease dirt and dust.
- The AC 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 to relevant IEC requirements.

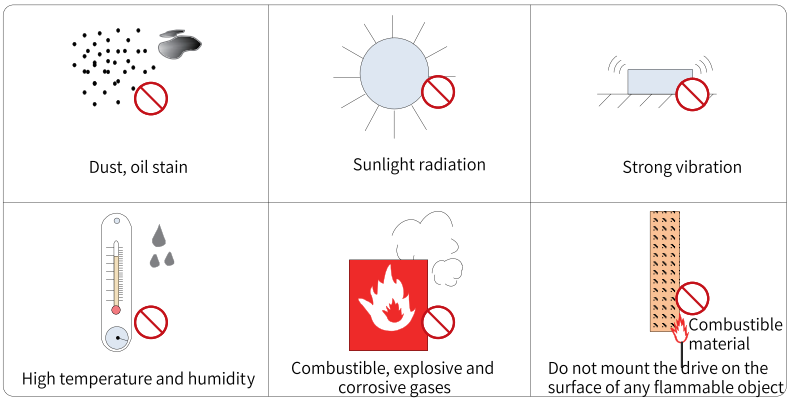


Figure 6-2 Environment requirements

Environment requirements

Table 6–2 Installation Environment

Item	Description
Ambient temperature	Operating temperature: 0°C to 40°C; temperature change rate: < 0.5°C/min; temperature above 40°C: The rated current is derated by 1.5% for every additional 1°C. The maximum temperature is 50°C. Storage temperature: –25°C to +70°C Transportation temperature: –25°C to +70°C
Relative operating humidity	Range of operating humidity change: 5% to 90%. A standard servo drive does not apply to an environment and place with corrosive gases. Please purchase a special servo drive with corrosion resistant casing with protective coating. Relative humidity for storage: 5% to 90%. Relative humidity for transportation: lower than 90% at 40 °C
IP rating	IP20
Altitude	1000 meters, derating for use above 1000 meters, 1% derating for every 100 meters rising, of which Size 1 to Size 2 has a maximum use altitude of 3000m, and Size 3 to Size 4 has a maximum use altitude of 2000m.

Cooling

Make sure the servo drive is installed vertically to the wall. Cool the servo drive by natural air or a cooling fan.

As shown in the above figure, keep sufficient clearances around the servo drive to ensure cooling by cooling fans or natural convection. Install the cooling fan onto the top of the servo drive to avoid excessive temperature rise and maintain an even temperature inside the electric cabinet.

6.2 Installation of the Power Supply Unit

For installation of the power supply unit, see "MD810 Series Multi-drive System Installation Guide". You can download it under "Service and Support - Downloads" at *www.inovance.com*.

6.2.1 Installation Dimensions

The power supply unit can be classified into the booksize unit with equal width and height and the vertical tower unit. The booksize drive unit has the width of 50 mm, 100 mm, 200 mm, and 300 mm, and the vertical tower drive unit has the width of 180 mm. Except for the 355 kW power supply units, which are vertical tower units, the power supply units of other power ratings are all booksize units.

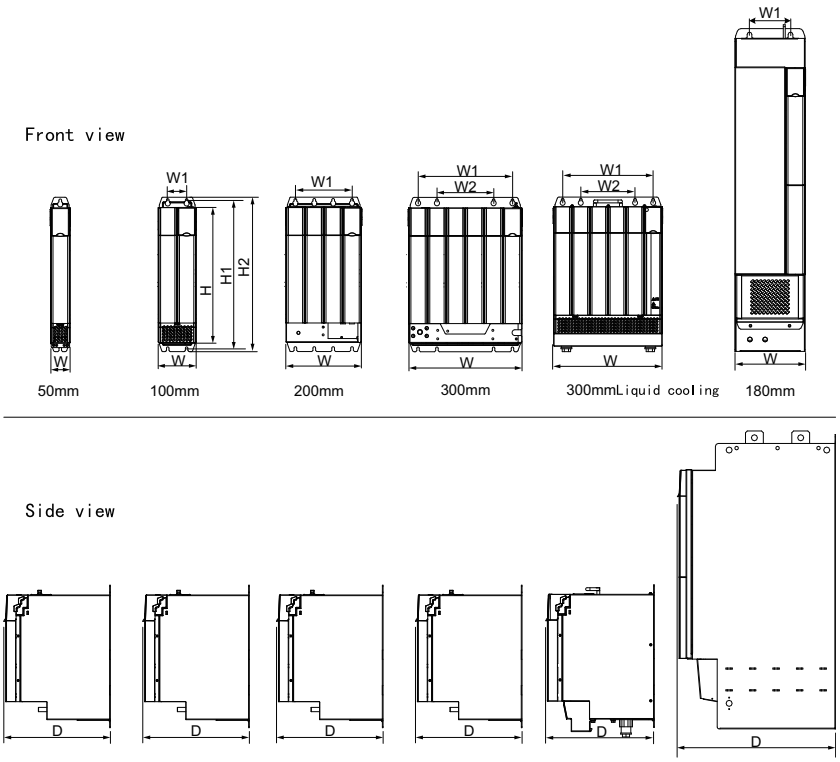


Figure 6-3 Layout and dimension of the power supply unit

Power Supply Unit Model	Physical dimensions (mm)				Mounting Hole (mm)			Recommended screw models	Hole Diameter (mm)	Mass (kg)
	H2	H	W	D	W1	W2	H1			
MD810-20M4T22GXXX	400	350	50	305	-	-	384	M6	Φ7	3.8
MD810-20M4T45GXXX	400	350	100	305	50	-	384	M6	Φ7	8
MD810-20M4T110GXXX	400	350	200	305	150	-	384	M6	Φ7	23
MD810-20M4T160GXXX	400	350	300	305	250	150	384	M6	Φ7	38
MD810-20M4T160GXXXW	426.5	350	300	305	250	150	384	M6	Φ7	38
MD810-20M4T355GXXX	832	800	180	445	105	-	795	M6	Φ12	65

6.2.2 Installation Clearance

The power supply unit is divided into the book type unit (100 mm, 200 mm and 300 mm wide) and the vertical unit (180 mm wide). The recommended installation methods are single-layer installation and two-layer installation. The following figure table and figures show the minimum clearance between two layers during two-layer installation. An insulation deflector must be installed in the lower layer of unit.

Table 6–3 Table 3-1 Minimum clearance during the installation of the power supply unit

Item	Unit with Width of 100 mm	Unit with Width of 200 mm	Unit with Width of 300 mm	Unit with Width of 180 mm
	Booksize Unit			Vertical Tower Unit
S1	⩾ 300 mm	⩾ 300 mm	⩾ 300 mm	⩾ 300 mm
S2	⩾ 300 mm	⩾ 300 mm	⩾ 300 mm	⩾ 500 mm
S3	⩾ 300 mm	⩾ 300 mm	⩾ 300 mm	-

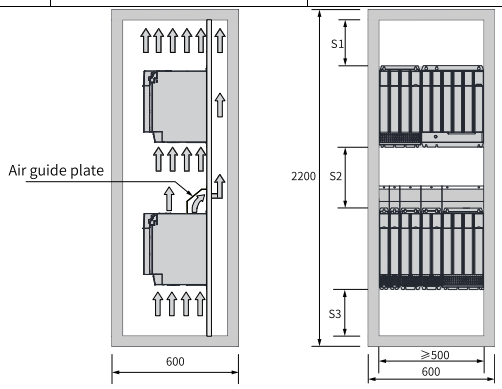


Figure 6-4 Clearances for installing the booksize power supply unit in dual-rack mode

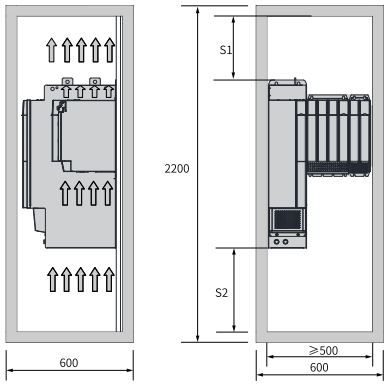


Figure 6-5 Installation space of vertical power supply unit

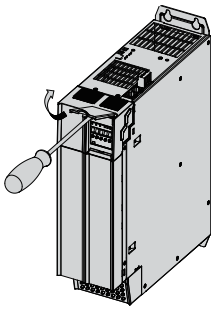
Note

Installation direction: The servo drive must be installed vertically.

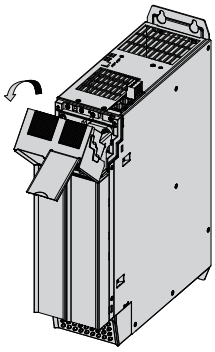
6.2.3 Removal and Installation of Power Supply unit Cover Plate

Cover removal

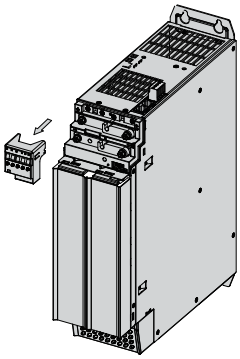
1. Pull the translucent operating panel cover upward and use a screwdriver to loosen the screws on the upper cover.



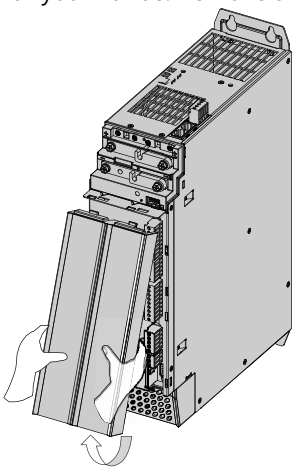
2. Remove the upper cover by turning it forward.



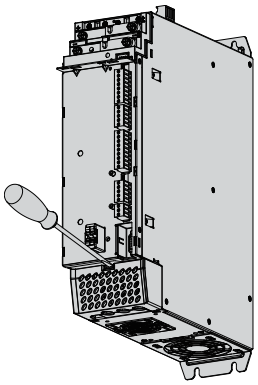
3. Pull the whole keypad box frontward.



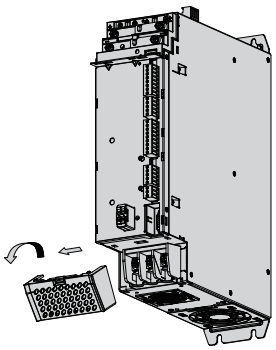
4. Hold the bottom of the lower cover with your hands. Remove the lower cover by turning it forward.



5. Insert the tool (screwdriver) into the clasp of the power terminal cover. Pry the clasp.

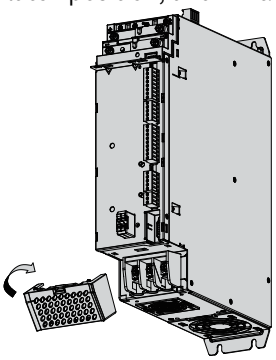


6. Remove the power terminal cover.

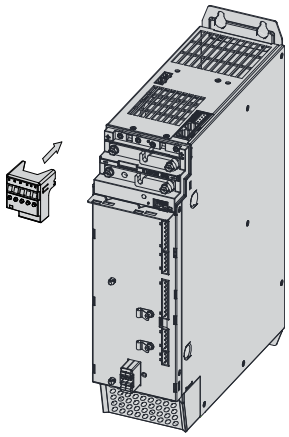


Cover installation

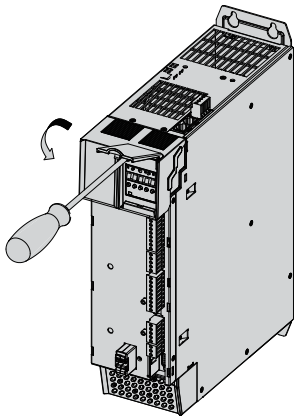
1. Locate the power terminal cover at its latch position, and fix it.



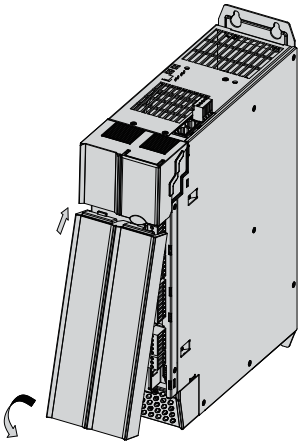
2. Insert the keypad.



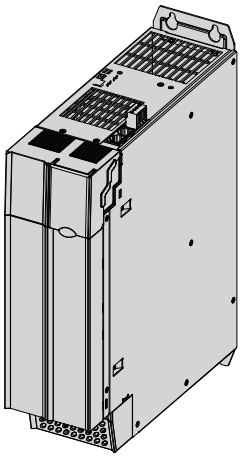
3. Align the upper cover with its latch position, press the upper cover to fix it, and then tighten the screw with a screwdriver.



4. Insert the top end of the lower cover below the upper cover. Turn the bottom end of the lower cover to clasp it.



5. The installation is completed.



6.3 Installation of inverter unit

6.3.1 Installation Dimensions

Size 1

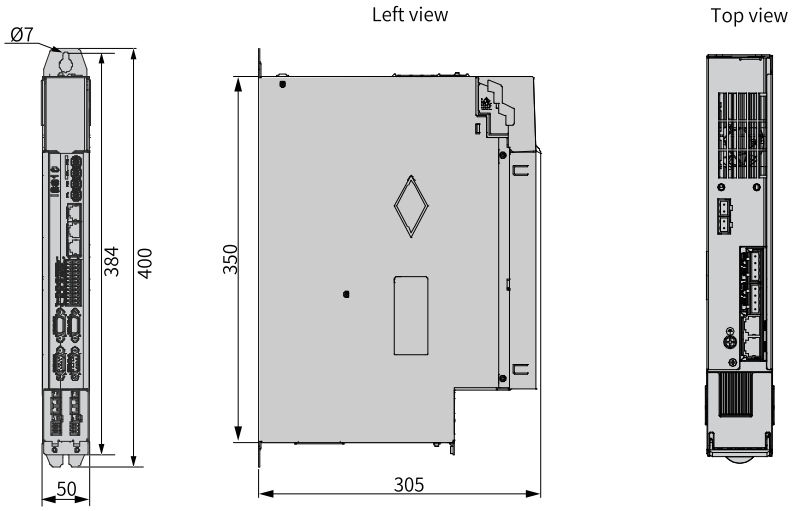


Figure 6-6 Overall dimensions of Size 1 (in mm)

Size 2 (4.4 kW to 18.5 kW)

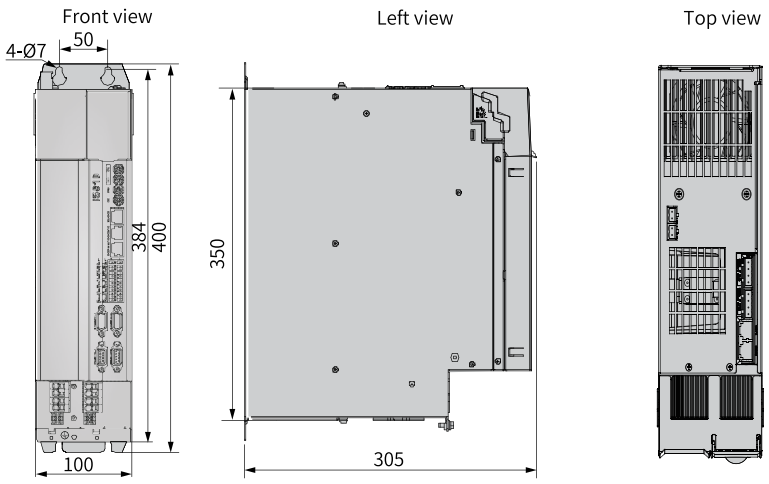


Figure 6-7 Overall dimensions of Size 2 (4.4 kW to 18.5 kW) (in mm)

Size 2 (22 kW to 37 KW)

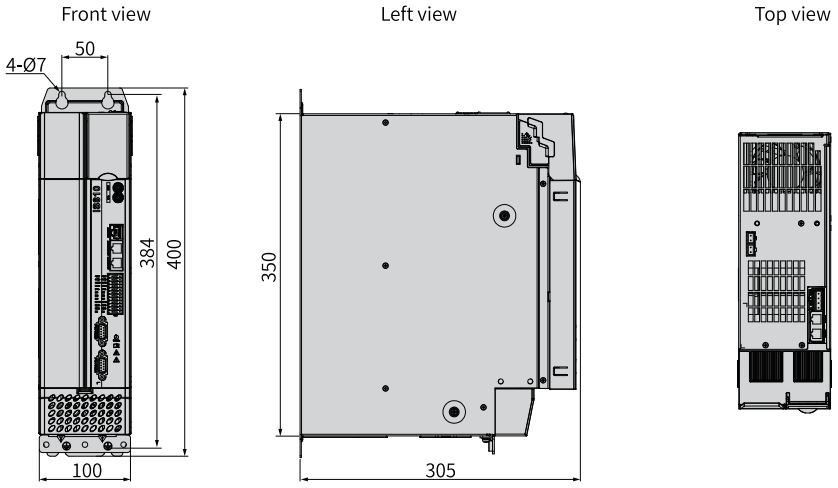


Figure 6-8 Overall dimensions of Size 2 (22 kW to 37 KW) (in mm)

Size 3

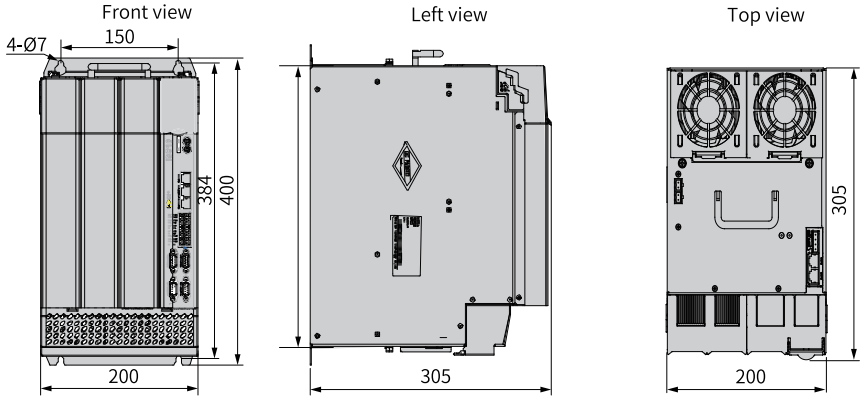


Figure 6-9 Overall dimensions of Size 3 (in mm)

Size 4

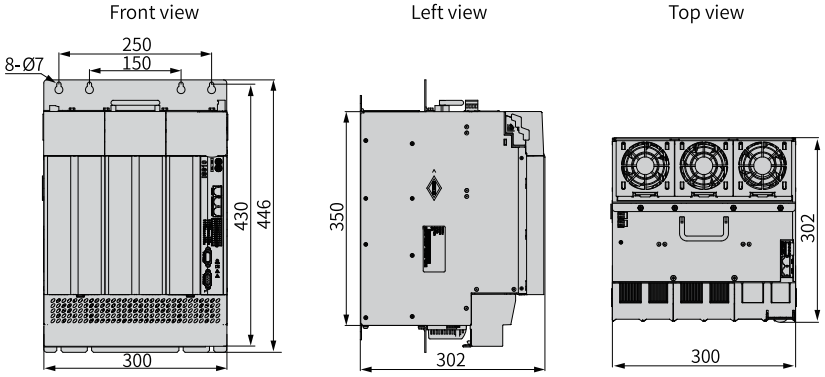
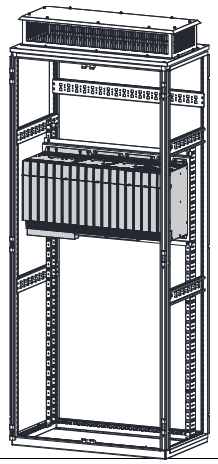
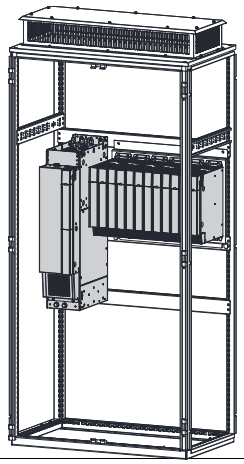


Figure 6-10 Overall dimensions of Size 4 (in mm)

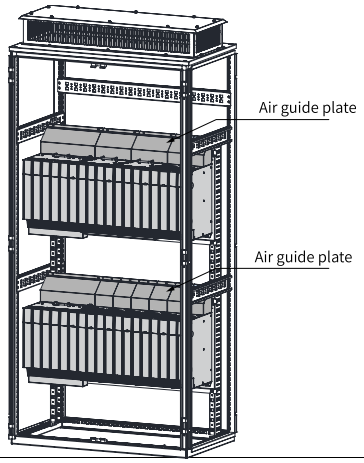
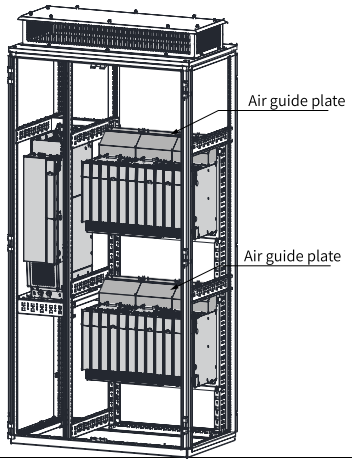
6.3.2 Installation Clearance

The cabinet combined installation method of this product supports single-row installation and two-row installation. The book type unit must be installed in close arrangement to avoid damage to the product in transit. Do not install two or less servo drives and even separately install them. An insulation deflector may be selectively installed in the upper layer of unit during two-row installation. The through-hole mounting method supports only single-row installation.

Single-rack installation

Booksize Unit	Vertical Tower Unit
	

Dual-rack installation

Booksize Unit	Vertical Tower Unit
	

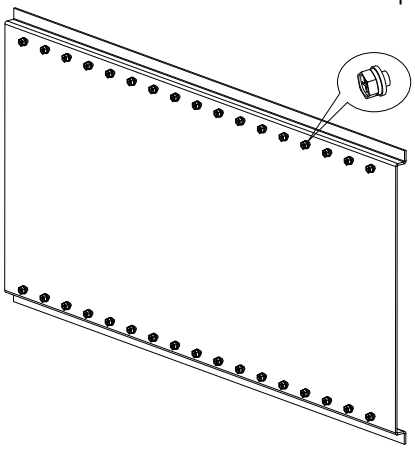
Note

- An air guide plate may be installed in the upper layer during two-row installation. For the air guide plate model, see *" Connector Kit" on page 43*.
- Do not install one or two units independently.
- The through-hole mounting method supports single-row installation only.

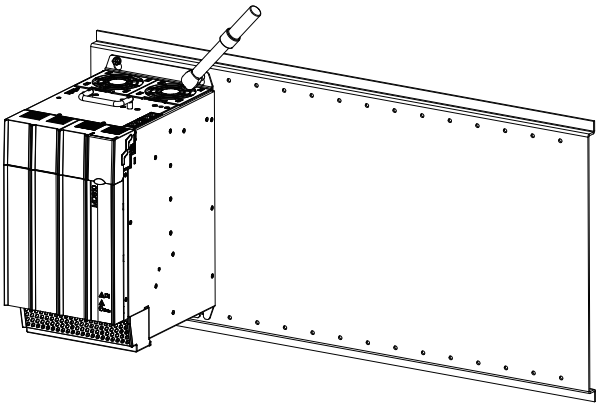
6.4 The installation procedure is as follows:

Backplate Mounting

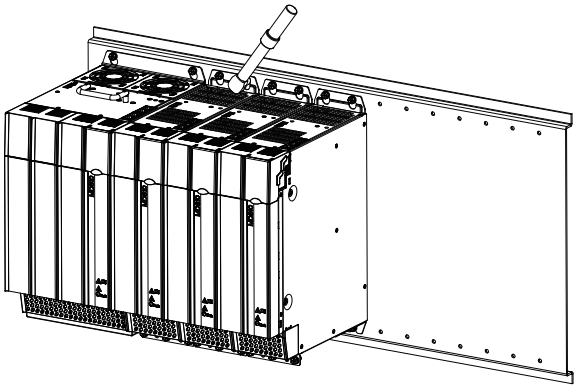
1. Pre-lock the M6x20 cross-recessed hexagon head combination screws on the installation backplane with the clearance of about 5 mm between the screws and the backplane.



2. Mount the power supply unit to the installation backplane, and then tighten the screw by using a torque wrench.

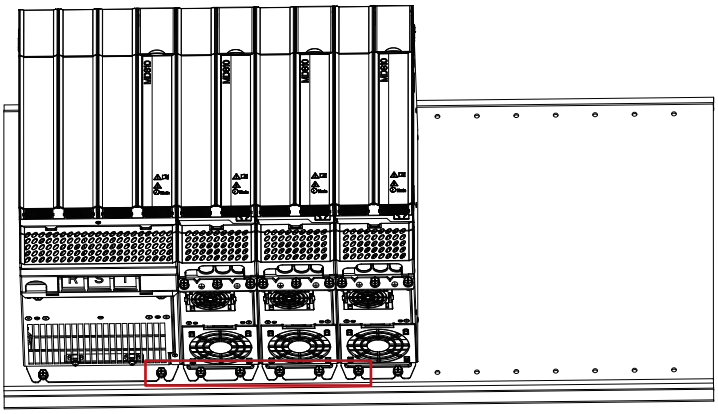


3. Mount the drive unit to the installation backplane, and then tighten the screw by using a torque wrench.

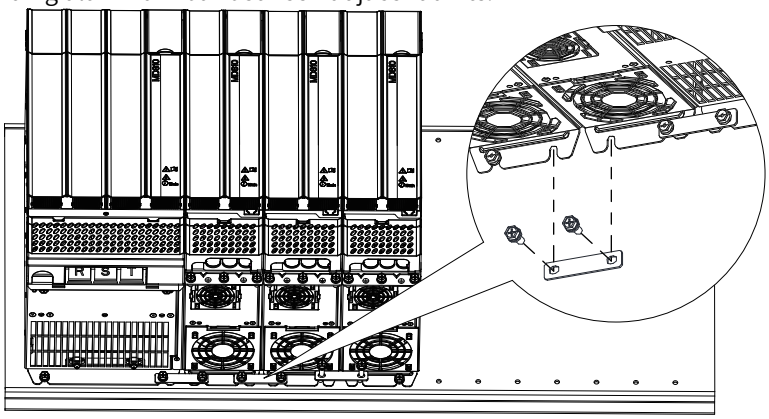


Note

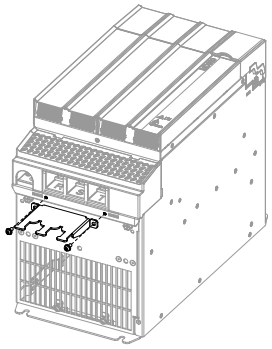
The liquid-cooled models do not support the through hole mounting method or use of the air guide plate. The shield bracket is ordered based on the user's on-site requirements.



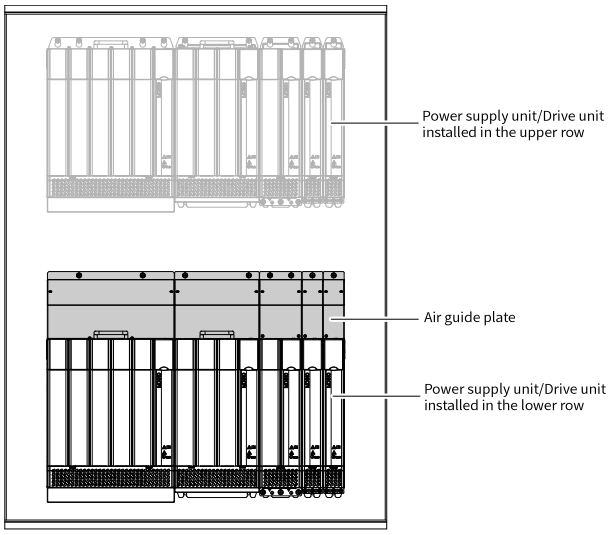
4. Install the grounding aluminum bar between adjacent units.



5. (Optional) Install the option shield bracket.



6. If units are installed in two rows, install the option air guide plate for the units installed in the lower row.



Note

For model selection details of preceding options, see *" Connector Kit" on page 43*.

The following figure describes the installation of the air guide plate for the power supply unit and drive unit.

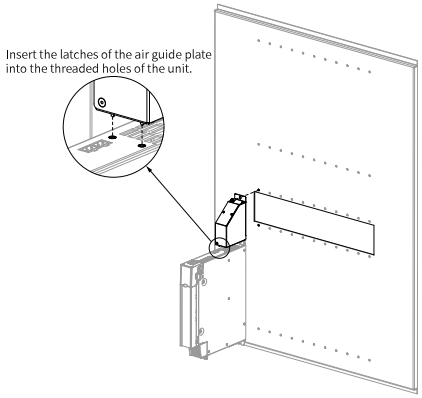


Figure 6-11 Installation of the air guide plate for the unit with the width of 50 mm

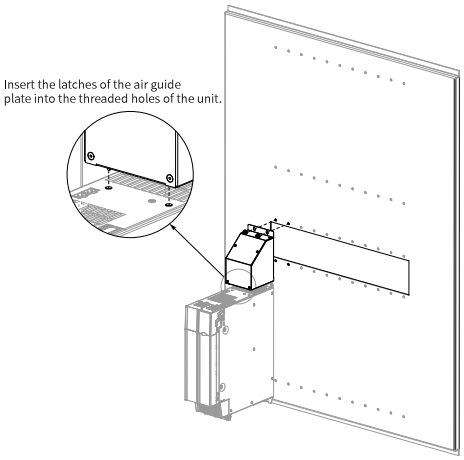


Figure 6-12 Installation of the air guide plate for the unit with the width of 100 mm

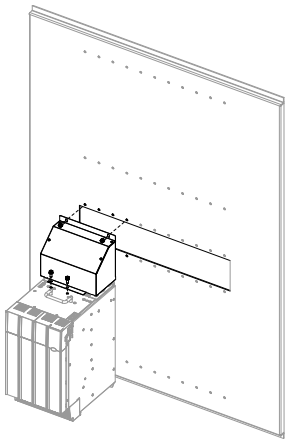


Figure 6-13 Installation of the air guide plate for the power supply unit with the width of 200 mm

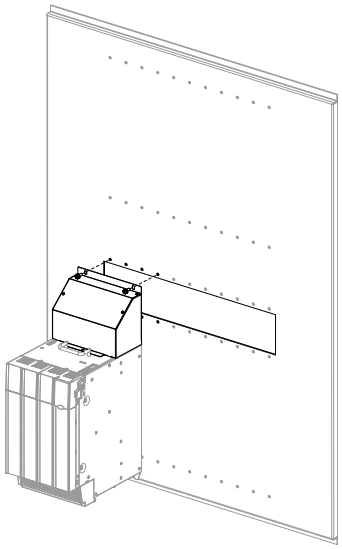


Figure 6-14 Installation of the air guide plate for the drive unit with the width of 200 mm

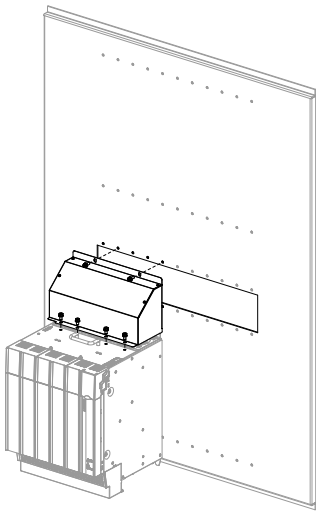
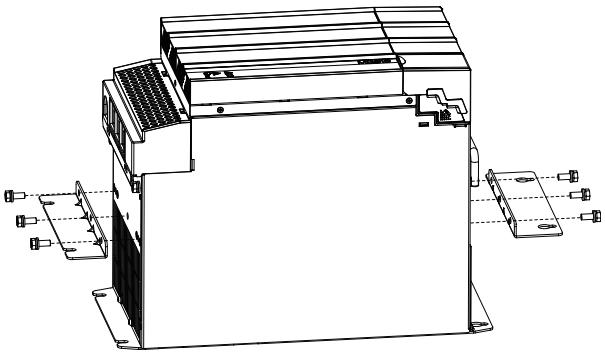


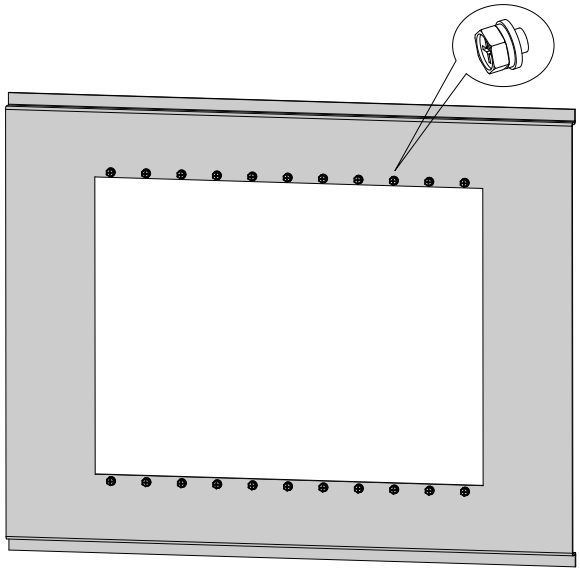
Figure 6-15 Installation of the air guide plate for the unit with the width of 300 mm

Through-Hole Mounting

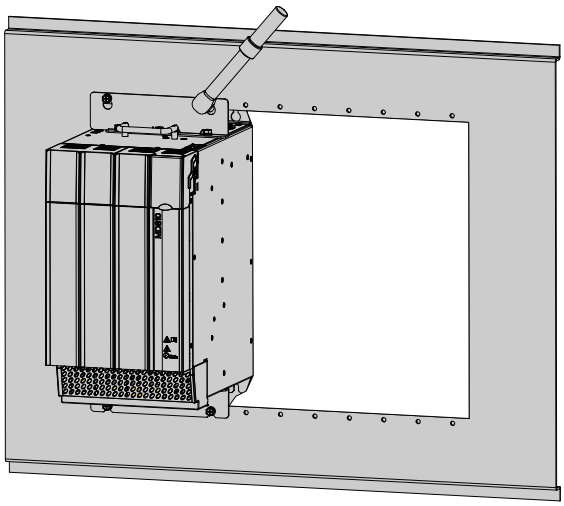
1. Install the option through-hole mounting bracket.



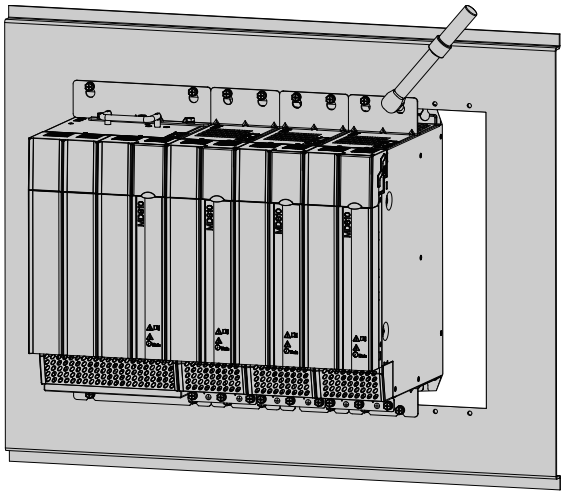
2. Pre-lock the M6x20 cross-recessed, external hexagon combination screws on the installation backplane with the clearance of about 5 mm between the screws and the backplane.



3. Mount the power supply unit to the installation backplane, and then tighten the screw by using a torque wrench.

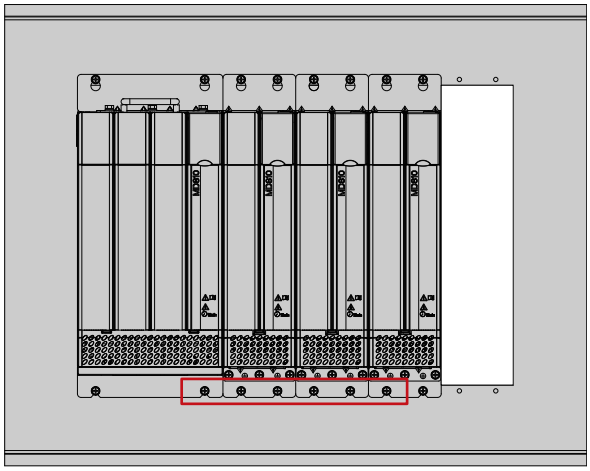


4. Mount the drive unit to the installation backplane, and then tighten the screw by using a torque wrench.

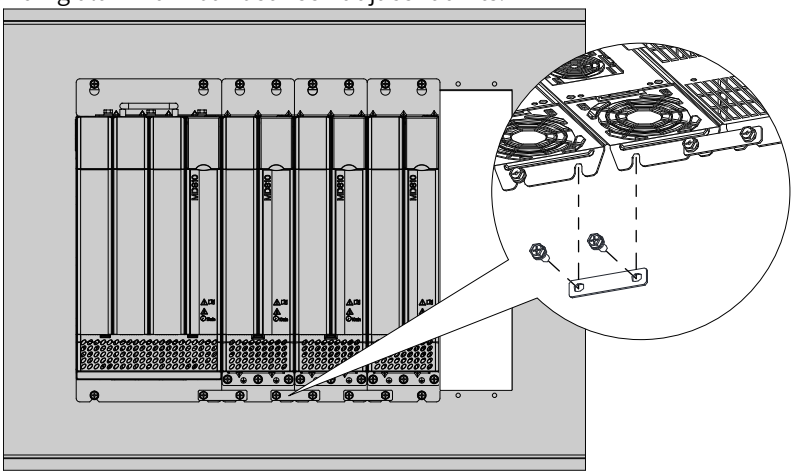


Note

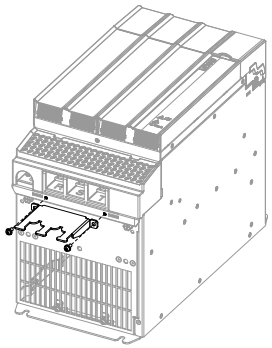
The screws on the lower side of the adjacent units are not locked (as shown in the figure below) for installing the grounding aluminum bar.



5. Install the grounding aluminum bar between adjacent units.



6. (Optional) Install the option shield bracket.



Note

For model selection details of preceding options, see *" Connector Kit" on page 43*.

6.5 Installation Instructions

Recommended torque during installation (N·m):

Item	M3	M4	M5	M6	M8	M10	M12
Electrical connection	0.55	1.2	2.8	4.8	13	20	35

Ensure that there is enough installation space on the left of the power supply unit to install the product.

A multi-axis system requires units to be lined up along the top.

Mark the position of the threaded holes for installation and drill a screw hole on the base plate for each screw.

The servo drive must be installed on the base plate vertically.

The installation procedure is as follows:

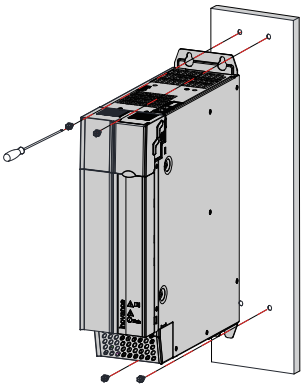


Figure 6-16 Backplate mounting of the power supply unit

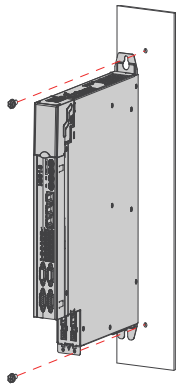


Figure 6-17 Backplate mounting of the drive unit

Grounding

Ground the grounding terminal properly. Failure to comply may result in electric shock or malfunction due to interference.

Wiring requirements

When wiring the servo drive, route the cables downward (see the following figure) to prevent liquids from flowing into the servo drive along cables.

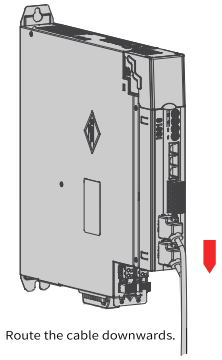


Figure 6-18 Routing direction

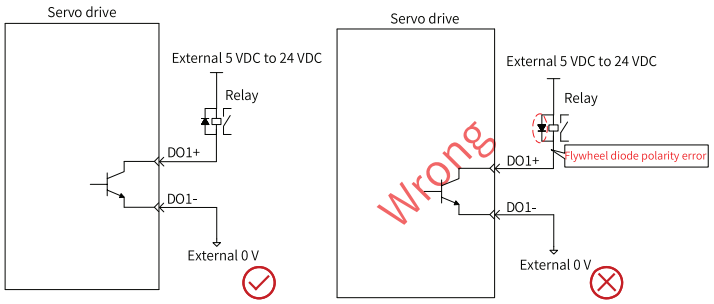
7 Wiring

7.1 Wiring Precautions

- Wiring must be performed by authorized and qualified personnel.
- After the power is off for over 10 minutes and the power indicator becomes off, measure the voltage between + and - of the busbar by using a multimeter. After the voltage is within the safety range, perform operations on the drive.
- Perform wiring after the servo drive and motor are installed properly. Failure to comply will result in electric shock.
- Do not damage the cables, lay them under large tension or pressure, or hang them. Failure to comply may result in electric shock.
- Insulate the connecting part of the power terminals to prevent electric shock.
- The specifications and installation method of external cables must comply with the applicable local regulations.
- Ensure the entire system is grounded.
- Use a TN/TT system for the power supply unit. Failure to comply may result in an electric shock.

Note

- Carry out wiring correctly. Failure to comply will result in servo motor malfunction or physical injuries.
- Connect the terminals correctly. Failure to comply may result in damage to the terminals.
- Never connect the three-phase power supply to the output terminals U, V, W of the drive. Failure to comply will result in personal injury or a fire.
- Connect U, V, W cables of the servo drive to U, V, W terminals of the motor directly. Do not connect an electromagnetic contactor. Failure to comply may result in abnormalities and faults.
- Make sure to connect the electromagnetic contactor between the power supply and main circuit of the drive (R, S, T for three-phase). If no electromagnetic contactor is connected, a fire may occur when a fault occurs and continuous large current flows through the product.
- Use the ALM (fault) signal to cut off the main circuit power supply. When the braking transistor is faulty, the braking resistor may be overheated and cause a fire.
- Please confirm the voltage specification of this product before powering on, and confirm whether the input power supply is correct (380V AC to 480V AC, 50Hz/60Hz).
- Ensure that the direction of the freewheel diode is correct, otherwise it will damage this product and cause damage to the DO.
- When connecting DO terminals to relays, pay attention to the polarity of the bypass diode. Otherwise, the drive will be damaged and signal output becomes abnormal.



- Connect the power terminals and motor terminals securely. Failure to comply may result in a fire.
- Use a noise filter to reduce electromagnetic interference on electronic devices around the product.
- Do not route the power cable and the signal cable through the same duct or bundle them together. Keep the power cable at least 30 cm away from the signal cable.
- When connecting the power supply and the main circuit, make sure S-ON can be turned off upon cutoff of the main circuit power after an alarm signal is detected.
- Use the shielded twisted pair cables as the signal cable and encoder cable with both ends of the shield grounded.
- The maximum length of the command input cables is 3 m, and that of the encoder cable is 20 m.
- Do not touch the power terminal within 10 minutes after power-off because high residual voltage may still exist in the servo drive after the power supply is switched off.
- Perform check only after the CHARGE indicator is off.
- Do not turn on or off the equipment frequently. If frequent ON/OFF operation is needed, the time interval between ON and OFF must be at least 10 minutes.
- As the servo drive contains a capacitor in the power supply part, the capacitor will be charged with a high current for about 10 seconds upon power-on or power-off. Therefore, frequent power-on or power-off will deteriorate performance of the main circuit components in the servo drive.
- Observe the following precautions when wiring the main circuit connector:
  - Remove the connector from the drive before wiring.
  - Insert one cable into one cable terminal of the connector. Do not insert multiple cables into one cable terminal. Avoid short circuit between the conductor and the adjacent cable when inserting the cable.
  - Connect the cables correctly and securely. Failure to comply may result in motor out of control, personal injuries, or faults.
  - Use the specified power supply. Otherwise, the equipment may be burnt.
  - When the power supply is poor, ensure that voltage is within the allowed fluctuation range. Failure to comply will result in damage to the equipment.
  - Install safety devices such as a circuit breaker to prevent short circuit in the external circuit. Failure to comply may result in a fire.
- Take proper shielding measures in the following scenarios to prevent equipment damage:
  - Interference due to static electricity

- Locations with strong electric field or magnetic field
- Locations with radioactive rays
- Power cables are installed nearby.

7.2 System Wiring Schematic Diagram

System wiring diagram (with shielded bracket)

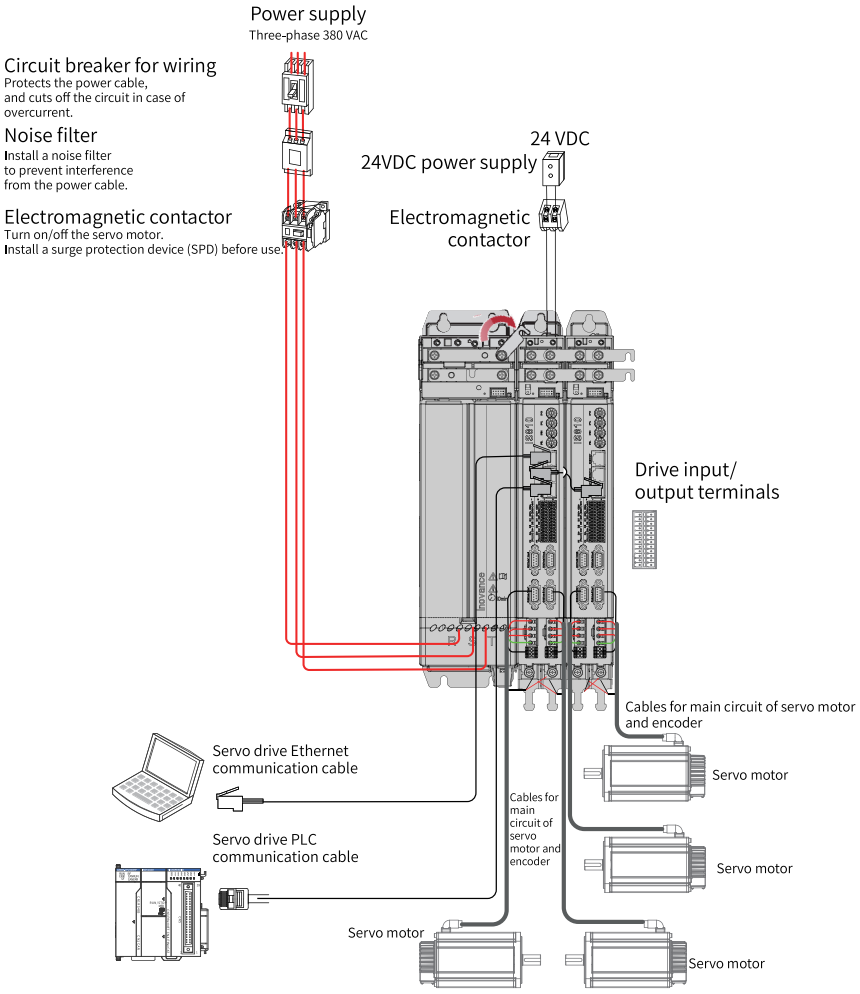


Figure 7-1 Example of wiring diagram of three-phase 380V system (with shielding bracket)

System wiring diagram (without shield bracket)

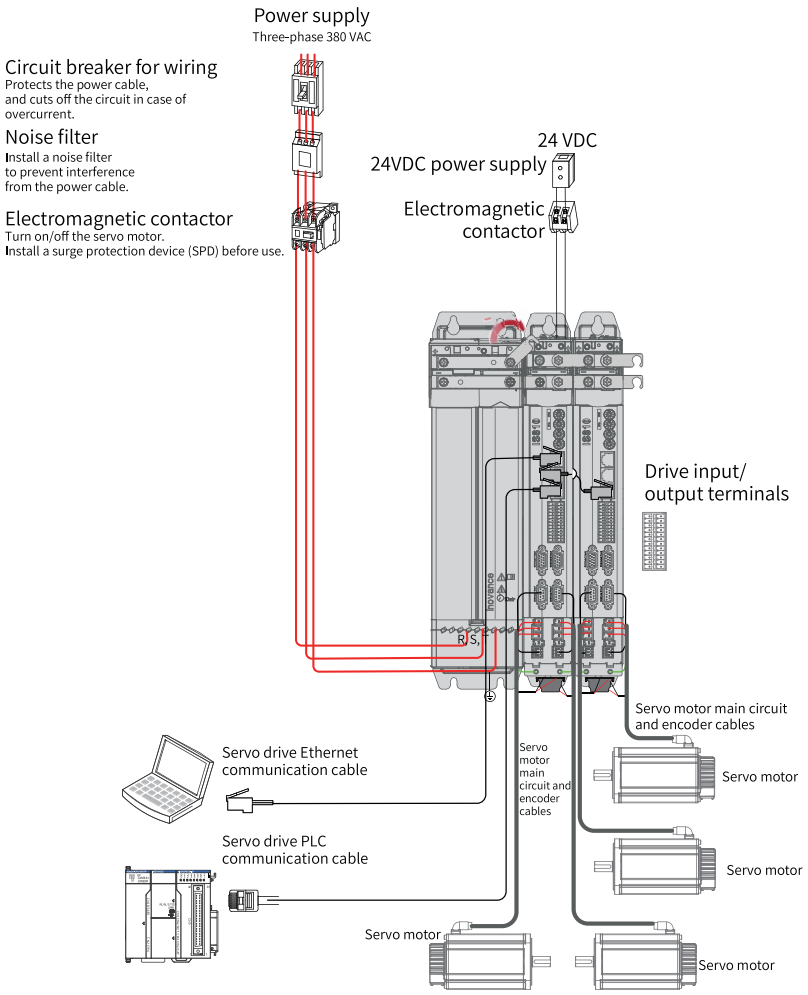


Figure 7-2 Example of wiring diagram of three-phase 380V system (without shielding bracket)

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. Because the servo drive does not have a built-in grounding protection circuit, in order to form a safer system, please use a residual current action protector for both overload and short circuit protection or a special residual current action protector for matching ground wire protection.

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.

Note

CN3 is a communication output port. CN4 is a communication input port.

7.3 Electrical Wiring Diagram

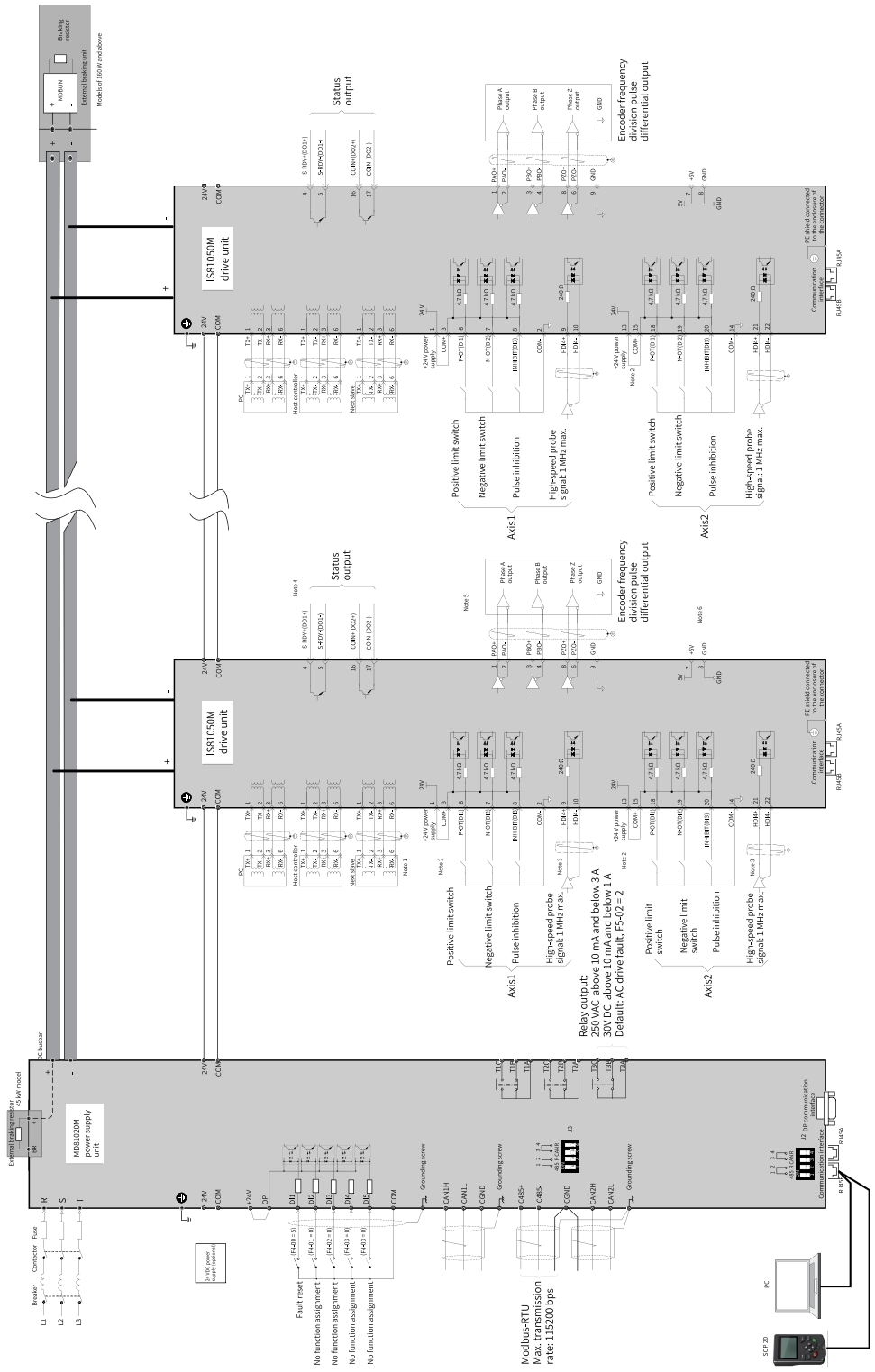


Figure 7-3 General electrical wiring diagram

Note

- Note 1: Use double-shielded Cat 5e cables for network interfaces. Direct-attach and crossover Ethernet cables are allowable.
- Note 2: The range of the internal +24 V power supply is 20 V to 28 V, with maximum operating current being 200 mA.
- Note 3: HDI4 and HDI8 are high-speed DIs. Use them according to their functions allocated. If they are used in low speed circumstances, the internal filtering parameters may be increased according to the function code.
- Note 4: The DO power supply needs to be prepared by users. The voltage range is 5 V to 24 V. The DO terminals support 30 VDC voltage and 50 mA current to the maximum.
- Note 5: Use the shielded twisted pair cable as the encoder frequency-division cable, with both ends of the shield connected to PE. Connect GND and signal GND of the host controller properly.
- Note 6: The internal +5 V power supply supports a maximum of 200 mA current.
- Note 7: The drive cannot be installed laterally.

7.4 Power Supply Unit Terminals

Before using this product, you need to purchase Inovance 810 series rectifier unit or Inovance 880 series active power supply unit. For relevant information, see *810 Series Power Supply Unit User Guide*"And *880 Series Power Supply Unit User Guide*", log in to the official website of Inovance Technology (*www.inovance.com*), "Service and Support-Data Download", search for keywords and download.

7.5 Terminals of the Drive Unit

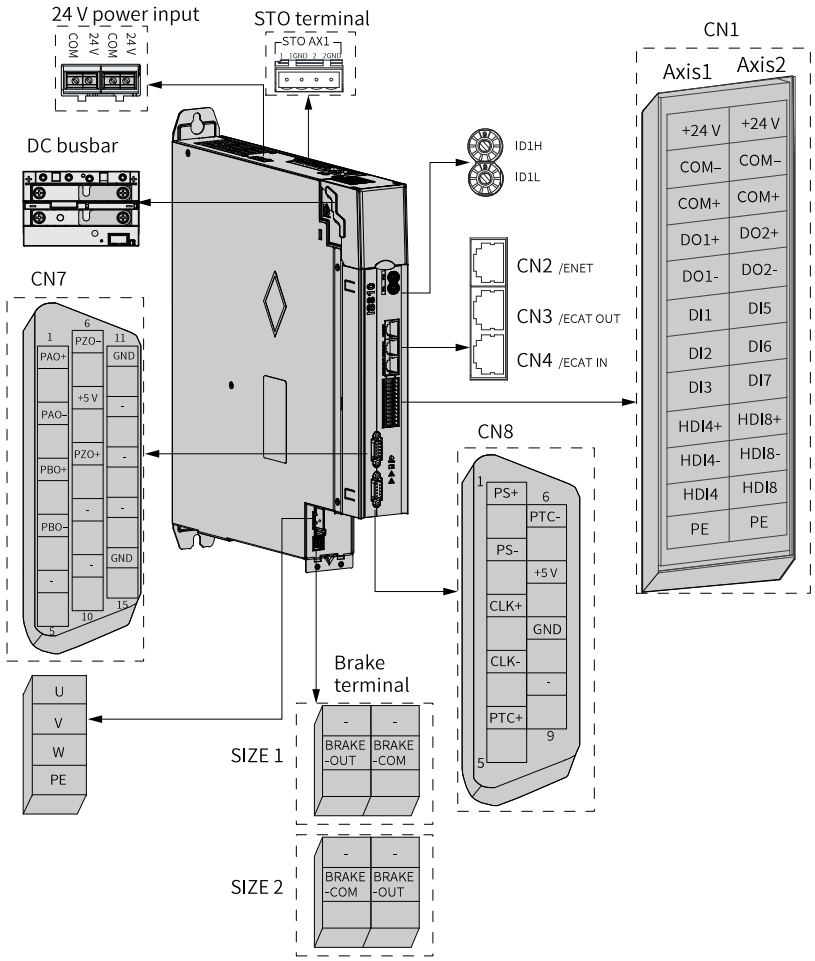


Figure 7-4 Terminal pin arrangement of single-axis drive unit

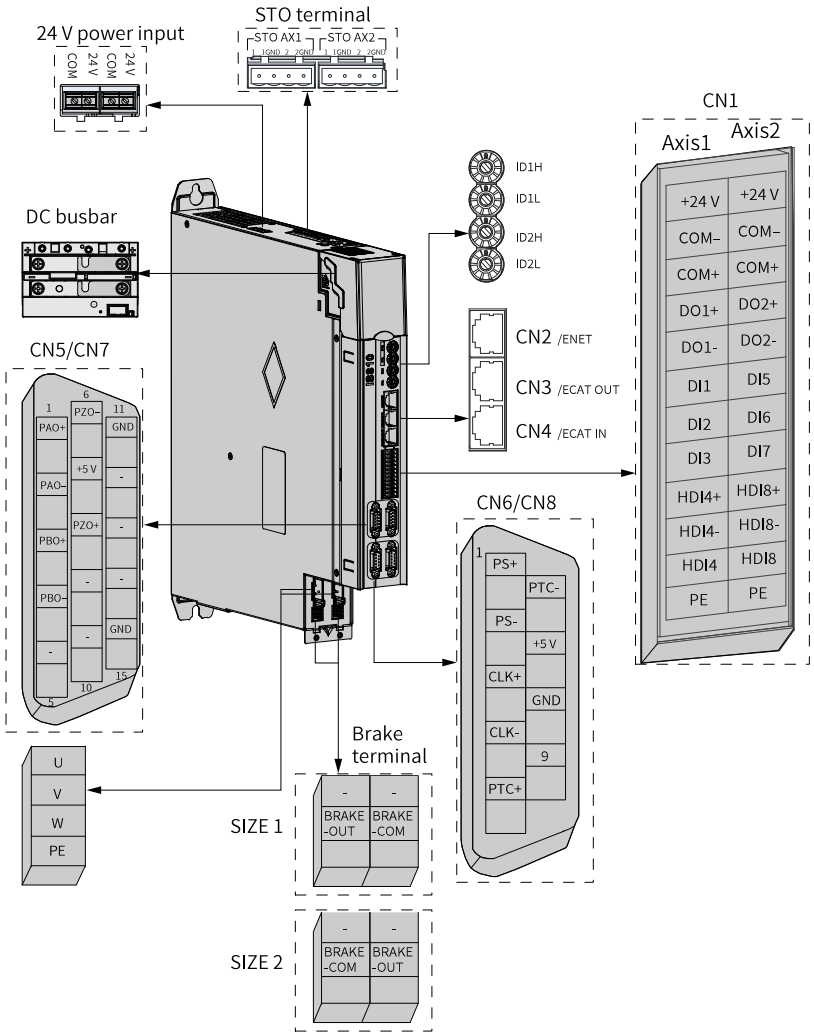


Figure 7-5 Terminal pin arrangement of dual-axis drive unit

Note

- For the main circuit terminal, see *"7.6.1 Recommended Models and Specifications Of Main Circuit Cables" on page 75*.
- Fpr CN1 control terminal, see *"7.7.1 Terminal Arrangement" on page 84*.
- For CN2 EtherNet communication terminal, see *"7.8 EtherNet Communication Terminal (CN2)" on page 90*.
- For CN3/CN4 EtherCAT communication terminal, see *"7.9.1 Terminal Arrangement" on page 91*.
- For CN5/CN7 full closed loop encoder terminals, see *" Terminal Arrangement" on page 96*.
- For CN6/CN8 motor encoder terminal, see *"7.11.1 Terminal Arrangement" on page 99*.
- The positive and negative directions of the brake terminals of Size 1 and Size 2 are different. For details, see *"7.12.1 Terminal Pin Arrangement" on page 106*.
- For STO connection terminals, see *"7.13.1 Terminal Arrangement" on page 109*.
- For 24V power terminal, see *"7.14 24V Power Input Terminal" on page 111*.

7.6 Main Circuit Terminals

7.6.1 Recommended Models and Specifications Of Main Circuit Cables

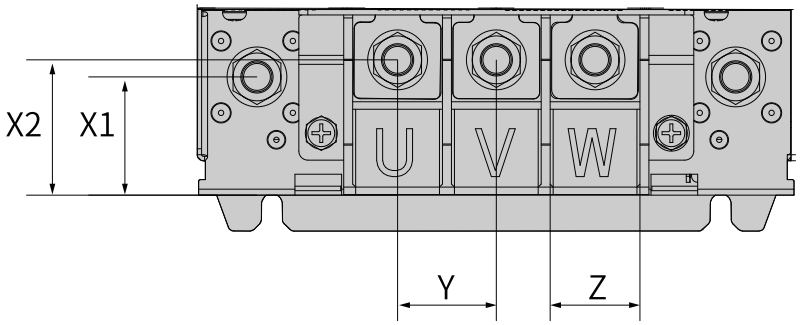


Figure 7-6 Schematic diagram of terminal block

Table 7–1 Terminal block structural specifications

Structure	Main Circuit Terminal						PE (grounding) terminal	
	X1 (mm)	X2 (mm)	Y (mm)	Z (mm)	Screw	Tightening torque (N·m)	Screw Size	Tightening torque (N·m)
22 kW–37 kW	28.85	28.5	21	18	M6 combination screw	4.8	M6 combination screw	4.8
45 kW–75 kW	39.5	45	33	30	M10 combination screw	25	M10 combination screw	25
120 kW	62	65	43	38	M12 combination screw	25	M12 combination screw	25

Table 7–2 Recommended cables and models for the main circuit of the drive

No.	Series	Servo Drive Model	U, V, W		PE	
			mm^2	AWG	mm^2	AWG
1	Size 1	3R5	3×0.75	18	0.75	18
2		5R4	3×1.5	16	1.5	16
3		8R4	3×1.5	16	1.5	16
4		012	3×1.5	16	1.5	16
5	Size 2	017	3×3.0	12	3	12
6		021	3×3.0	12	3	12
7		026	3×3.0	12	3	12
8		032	3×5.5	10	5.5	10
9		037	3×6.5	9	6.5	9
10		045	3×6.5	9	6.5	9
11		060	3×6.5	8	6.5	8
12		075	3×8.4	7	8.4	7
13	Size 3	090	3×16.5	5	16.5	5
14		112	3×21.0	4	21	4
15		152	3×26.5	3	26.5	3
16	Size 4	240	3×42	1	42	1

Note

- Size 3 screw locking torque 30 N · m; Size 4 screw locking torque 50 N·m.
- If it is not locked, it may cause fire at the wiring and cause damage to the equipment. Please be sure to lock the output terminal as required.
- For specifications of the power cable, see *"Table 5–1 Specifications of ISMG motor power cables" on page 41*.

Guidance on selection of cable lugs

Recommended cable lugs are shown below.

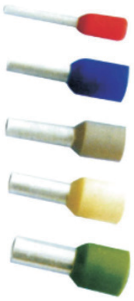


Figure 7-7 Outline drawing of the cable lug

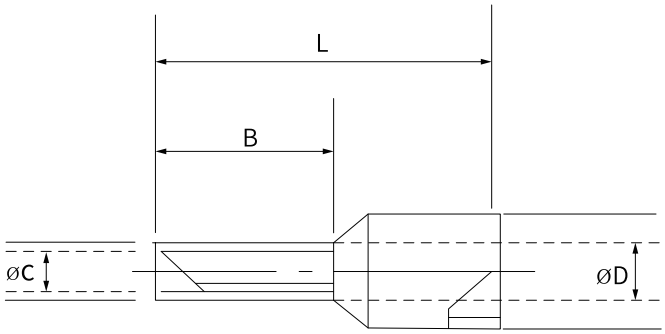


Figure 7-8 Dimensions of the cable lug

Table 7–3 Cable lug dimensions (in mm)

Cable cross sectional area (mm^2)	Dimensions				Color	Max. current (A)
	L	B	ϕC	ϕD		
0.2	10	6	0.7	1.9	Pale blue	3
	12	8				
0.3	10	6	0.8	1.9	Pink	5
	12	8				
0.5	12	6	1	2.6	Orange	8
	14	8				
	16	10				
0.7	12	6	1.2	2.8	White	10
	14	8				
	16	10				
	18	12				

Cable cross sectional area (mm^2)	Dimensions				Color	Max. current (A)
	L	B	ϕC	ϕD		
1	12	6	1.4	3	Yellow	12
	14	8				
	16	10				
	18	12				
1.5	12	6	1.7	3.5	Red	19
	14	8				
	16	10				
	18	12				
	24	18				
2.5	14	8	2.2	4.2	Blue	27
	16	10				
	18	12				
	24	18				
4	17	10	2.8	4.8	Gray	37
	20	12				
	26	18				
6	20	12	3.5	6.3	Green	48
	26	18				

Cable selection

- To prevent the internal conductor from breaking due to long-time bending, the bending radius of a cable must be greater than 5D (fixed able) or 10D (drag chain cable).
- 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. The permissible current density (A/mm^2) can be adjusted based on the following formula in case of high ambient temperature or bundled cables.
  Allowable current density = 8 x Reduction coefficient of current-carrying density of the conductor x Current correction coefficient

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

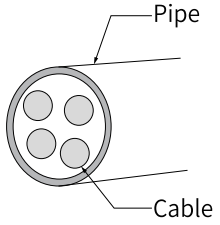


Table 7–4 Reduction coefficient of conductor current-carrying density

Number of Cables in a Duct	Current Reduction Coefficient
< 3	0.7
4	0.63
5–6	0.56
7–15	0.49

- It is recommended to route power cables and signal cables separately. To avoid EMC interference, the distance between them must be at least 30 cm.

To comply with the EMC standards, use shielded cables. See *"Figure 7–9" on page 78* .

Or use a four-core shielded cable, with one core being the PE wire. The shield of the shielded cable is comprised 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%.

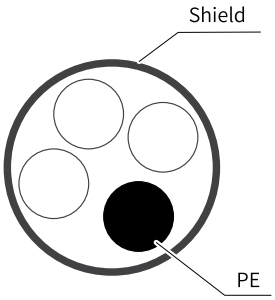


Figure 7-9 Recommended power cable

See *" Shield grounding and hose clamp" on page 79* for the correct connection of the shielded power cable.

Note

If the recommended cable specifications for peripheral devices or optional parts exceed the applicable cable specification range, contact Inovance.

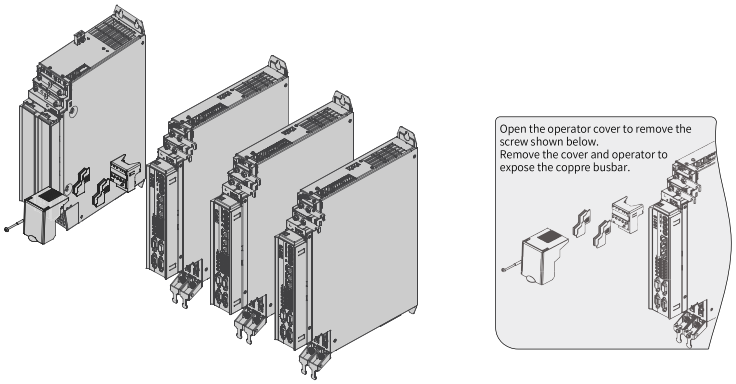
7.6.2 Wiring with the Power Supply Unit

DC bus power connection

Remove the display cover on the drive unit. Connect the power supply unit to the drive unit with the DC busbar. The preinstalled connector (busbar) is used for electrical connection of the device. Connection with a wire cannot guarantee stability and safety of device running.

Busbar Connection

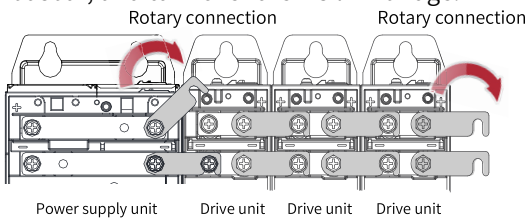
1. Loosen the screw of the manipulator, and remove the cover and the manipulator, as shown in the following figure.



Note

Before removing the cover, ensure that the machine has been powered off for over 10 minutes.

2. Loosen the screw of the DC busbar, and turn over the DC link bridge.



Note

For models with a width of 50 mm, the rotary busbar is not pre-installed on the drive, but put in the packaging box. Remove the busbar terminal screws before connecting the busbar.

3. Tighten the screws. Calibrate the torques of all screws. Recommended torque: 2.6-3 N·m.

Protective earth connection

Properly ground every device in the system! Connect the power supply unit, drive unit, and components such as the filter and reactor to the PE copper bar in the cabinet by star connection, as shown in the following figure:

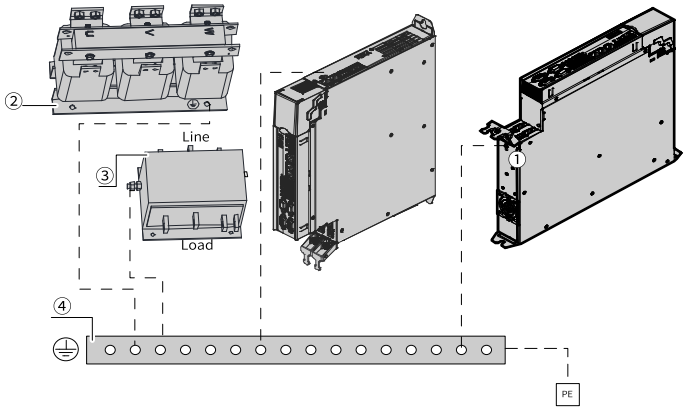


Figure 7-10 Protective grounding connection

No.	Description
1	Drive unit bottom grounding
2	Reactor grounding
3	Filter grounding
4	System grounding copper busbar

Shield grounding and hose clamp

To ensure device stability, fix the exposed shield of the cables to the shield support with a hose clamp to ensure grounding of the shield, as shown in the following figure.

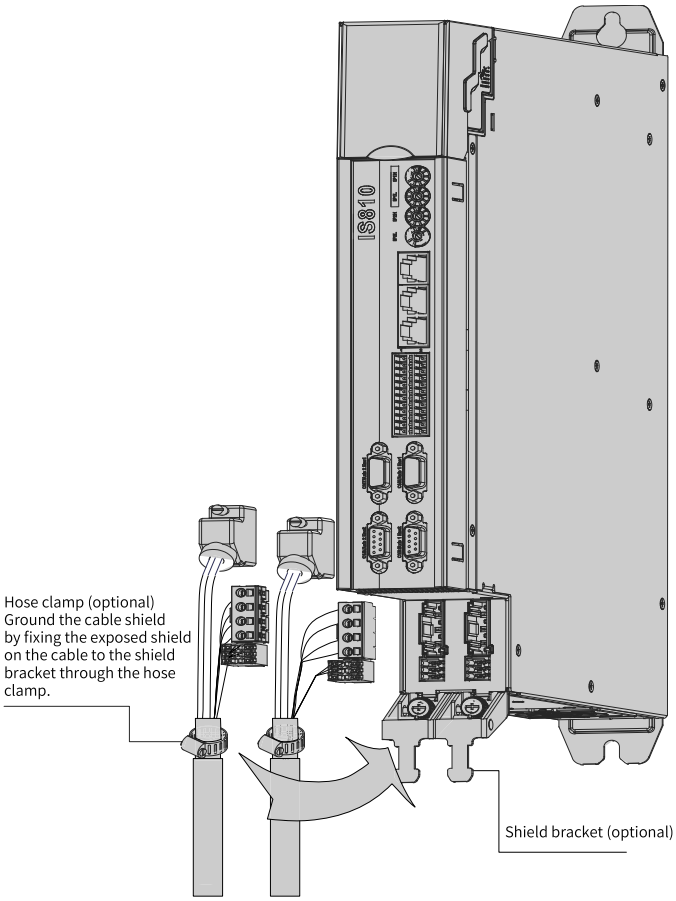


Figure 7-11 Schematic diagram of shield grounding and use of hose clamps

7.6.3 Wiring with the Motor

Grounding requirements: Please reliably ground the servo drive with the PE of the servo motor.

Connection to MS1 series motors

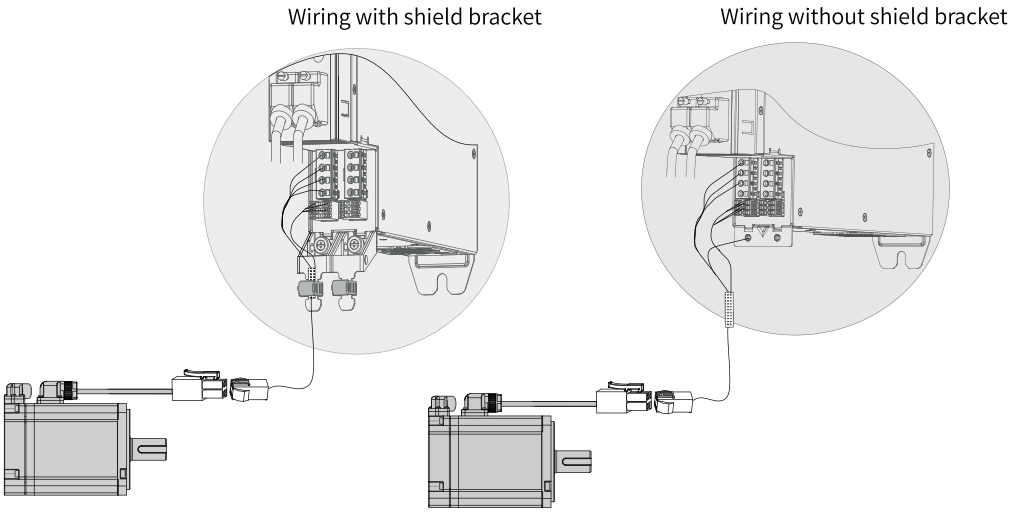
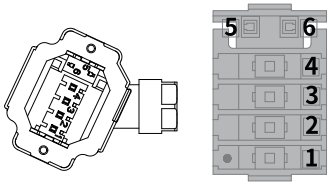


Figure 7-12 Description of the power cable connector (motor side) for terminal-type motors

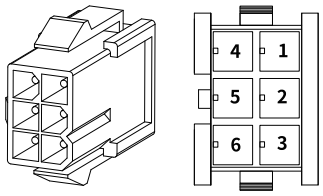
Table 7–5 Description of the power cable connector (motor side) for terminal-type motors

Flange Size [1]	Illustration	Terminal Pin Arrangement		
		Pin No.	Signal Name	Color
Terminal-type: 40 60 80	 Black 6-pin connector	1	PE	Yellow/Green
		2	W	Red
		3	V	Black
		4	U	White
		5	Brake (polarity insensitive)	Brown
		6		Blue

Note

- [1] The flange size refers to the width of the mounting flange.
- Power cable colors are subject to the actual product. All cable colors mentioned in this guide refer to Inovance cable colors.
- For motor grounding mode, see system wiring diagram.

Table 7–6 Description of the flying leads power cable connector (motor side)

Flange Size [1]	Illustration	Terminal Pin Arrangement		
		Pin No.	Signal Name	Color
Flying leads type: 40 60 80	 Black 6-pin connector	1	U	White
		2	V	Black
		4	W	Red
		5	PE	Yellow/Green
		3	Brake (polarity insensitive)	Brown
		6		Blue

Note

- [1] The flange size refers to the width of the mounting flange.
- Power cable colors are subject to the actual product. All cable colors mentioned in this guide refer to Inovance cable colors.
- For motor grounding mode, see system wiring diagram.

Table 7–7 Power cable connector (servo motor side)

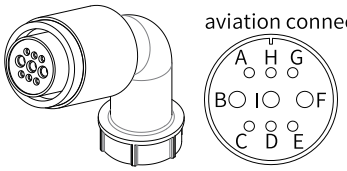
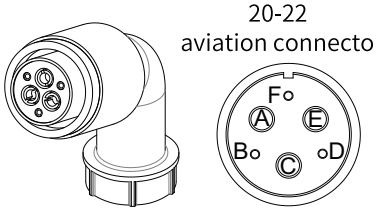
Flange Size [1]	Illustration	Terminal Pin Arrangement		
		Pin No.	Signal Name	Color
100 130	 MIL-DTL-5015 series 3108E20-18S military-spec connector	B	U	Blue
		I	V	Black
		F	W	Red
		G	PE	Yellow/Green
		C	Brake (polarity insensitive)	Red
		E		Black

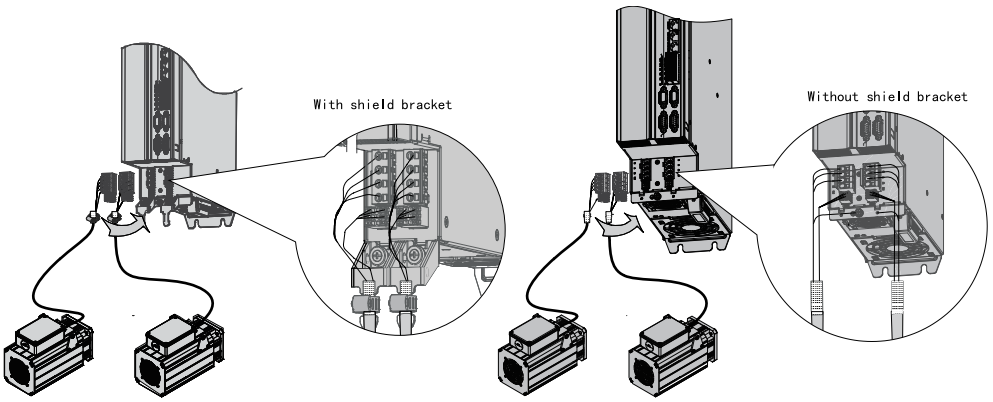
Table 7–8 Power cable connector (servo motor side)

Flange Size [1]	Illustration	Terminal Pin Arrangement		
		Pin No.	Signal Name	Color
180	 MIL-DTL-5015 series 3108E20-22S military-spec connector	A	U	Blue
		C	V	Black
		E	W	Red
		F	PE	Yellow/Green
		B	Brake (polarity insensitive)	Red
		D		Black

Note

- [1] The flange size refers to the width of the mounting flange.
- Power cable colors are subject to the actual product. All cable colors mentioned in this guide refer to Inovance cable colors.
- For motor grounding mode, see system wiring diagram.

Connection to ISMG series motors



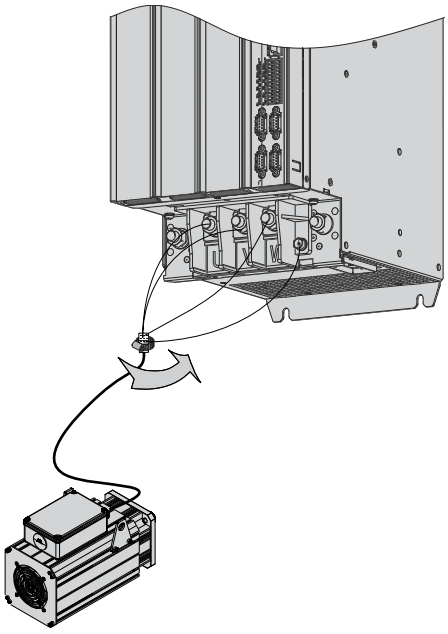


Figure 7-13 Example of connection between drive unit output and ISMG series motor

- The specifications and connections of external main circuit cables must comply with local regulations and related IEC requirements.
- To avoid risk of equipment damage or operating faults, do not connect a capacitor or surge absorber to the output side of the servo drive.
- Long motor cables can contribute to electrical resonance caused by distributed capacitance and inductance. In some cases, this might cause equipment damage in the drive, in motor or in cables. To avoid these problems, install an AC output reactor close to the drive if the cable is longer than about 100 m.
- It is recommended to use the shielded cable as the motor output cable. Perform a 360° connection on the shield structure by using the shield grounding bracket, and crimp the drain wire of the shield to the PE terminal.
- Ensure that the lead-out wire of the motor cable shield is as short as possible, and the width b ⩾ 1/5 .a.
- **Grounding terminal (PE)**
  - Ground the terminal reliably. The resistance of the grounding wire must be less than 10Ω. Failure to comply may result in operation abnormality and even damage to the product.
  - Do not connect the grounding terminal to the N terminal of the neutral wire of the power supply.
  - Use a proper grounding cable with yellow/green insulation for the protective grounding conductor.
  - Ground the shield correctly.
- It is recommended that the drive be installed on a metal mounting surface.
- Install filter and drive on the same mounting surface and ensure filtering effect.

7.7 Description of Control Terminal (CN1)

7.7.1 Terminal Arrangement

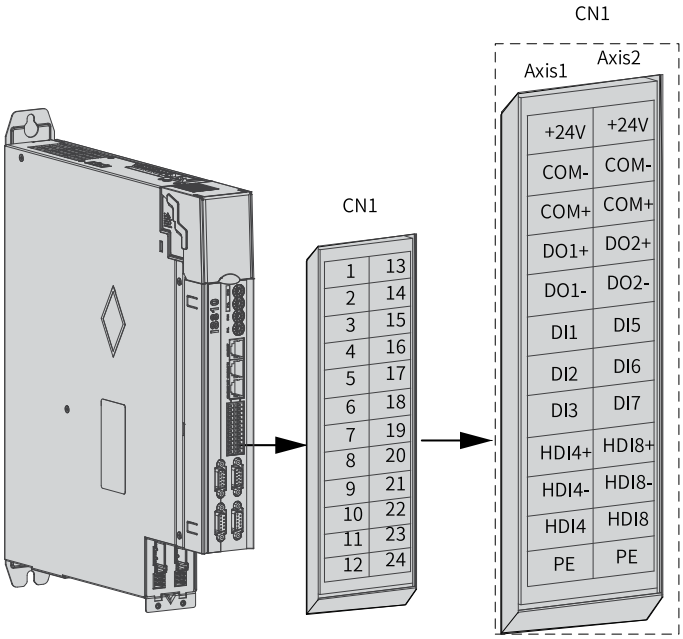


Figure 7-14 Pin layout of control circuit terminal connector of the servo drive

Table 7–9 Function Description of CN1 Terminals

Terminal Symbol	Name	Terminal Function	
Axis 1[1]	Axis 2[1]	-	-
+24 V	+24 V	Internal 24 V power supply; voltage range: 20 V to 28 V; maximum output current: 200 mA.	
COM–	COM–		
COM+	COM+	Common terminal of DI terminals	
DO1+	DO2+	-	-
DO1-	DO2-	-	-
DI1	DI5	-	-
DI2	DI6	-	-
DI3	DI7	-	-
HDI4+	HDI8+	-	-
HDI4-	HDI8-	-	-
HDI4	HDI8	-	-
PE	PE	Shield	Signal shielding ground

Note

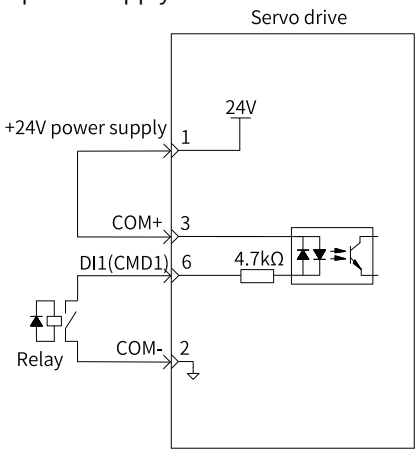
[1] The DI/DO terminals of axis 1 and axis 2 can be used in common. See parameter settings in *"16.4 Parameter Group H03" on page 386* and *"16.5 H04 Parameters" on page 389*.

7.7.2 DI/DO Signals

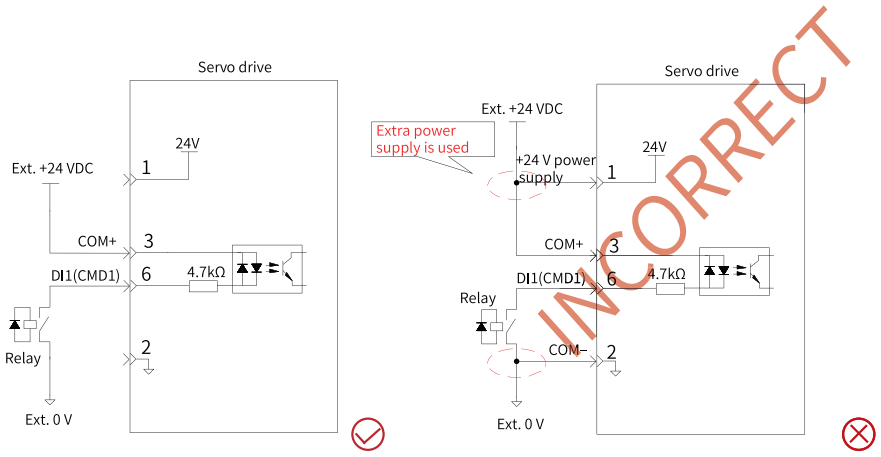
DI circuit

The circuits for DI1, DI3, DI5, and DI7 are the same. The following description takes DI1 circuit as an example.

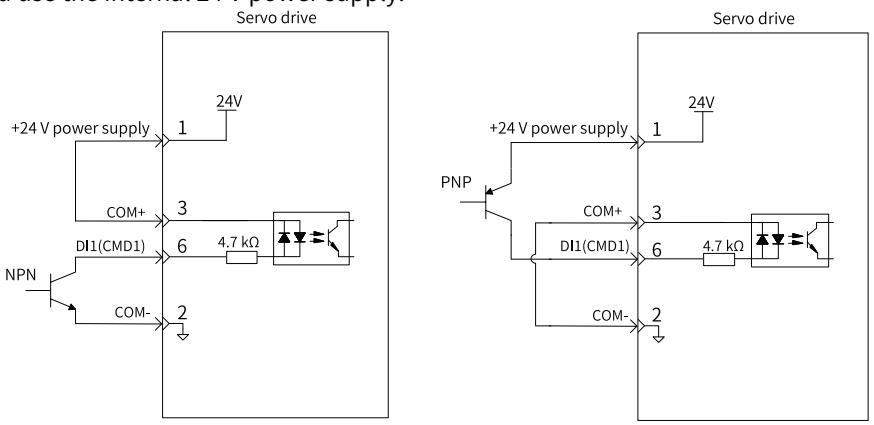
- The host controller provides relay output:
  - When you use the internal 24 V power supply:



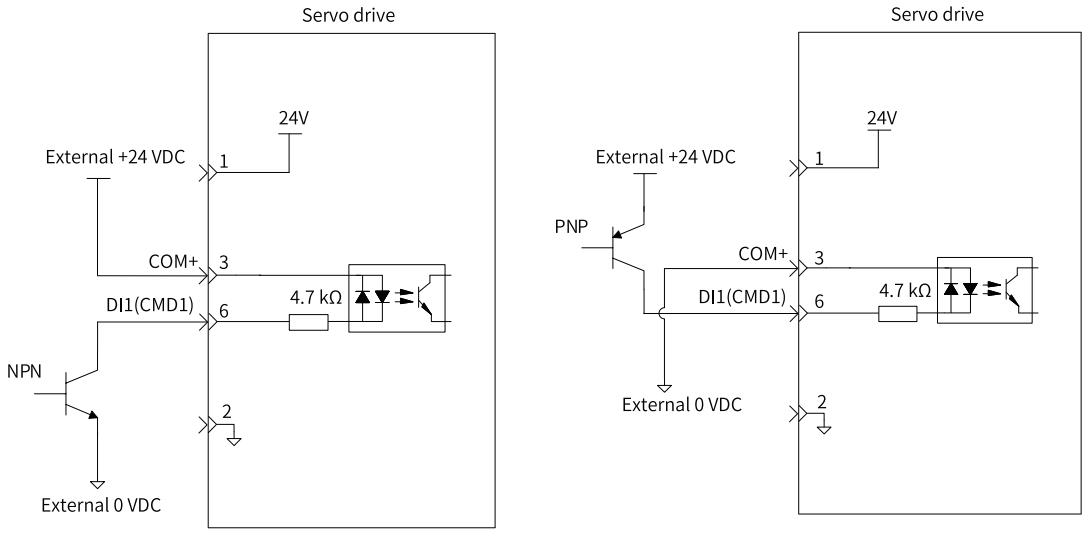
  - When you use an external power supply:



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



  - When you use an external power supply:



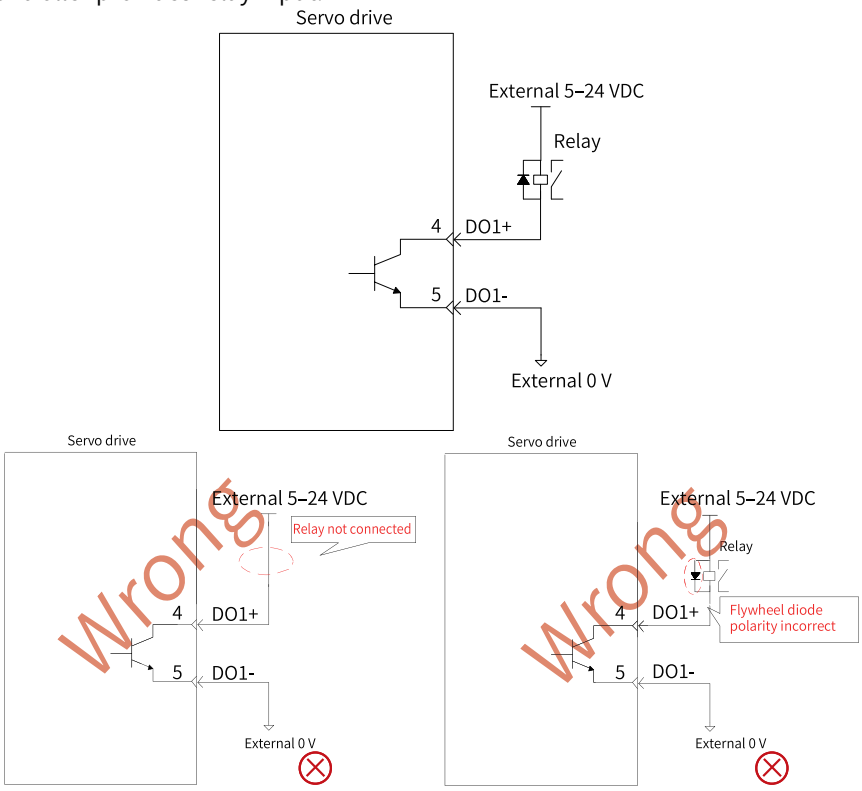
Note

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

DO circuit

The circuits for DO1 to DO2 are the same. The following description takes DO1 circuit as an example.

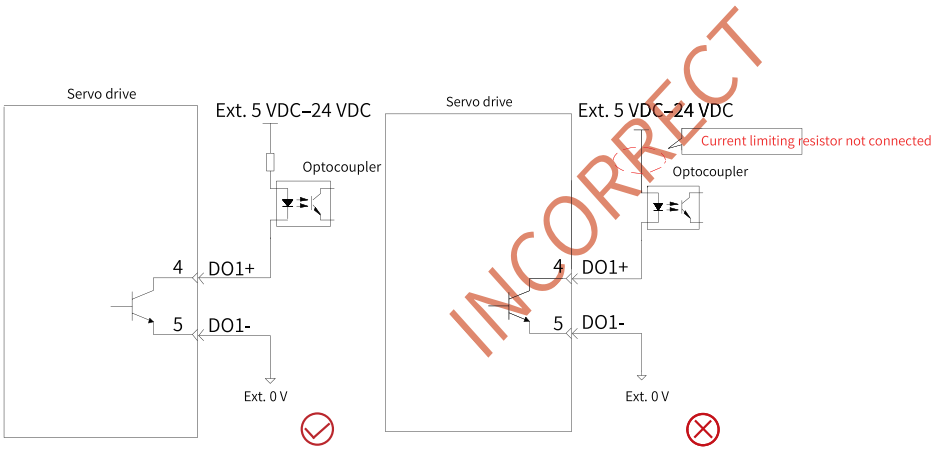
- The host controller provides relay input.



Note

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

- The host controller provides optocoupler input:



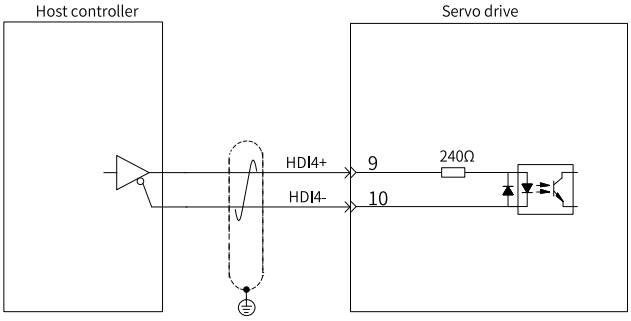
Note

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

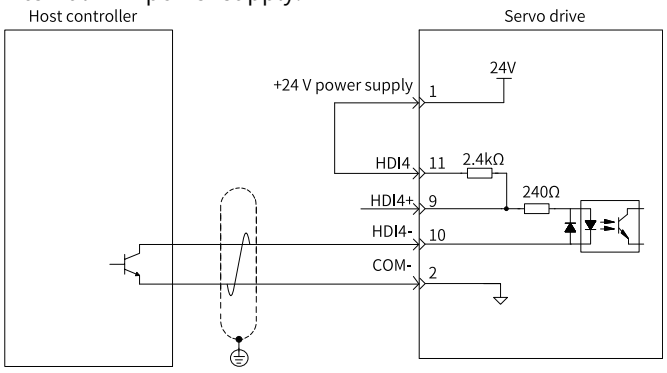
- Max. voltage: 30 VDC
- Max. current: DC 50 mA

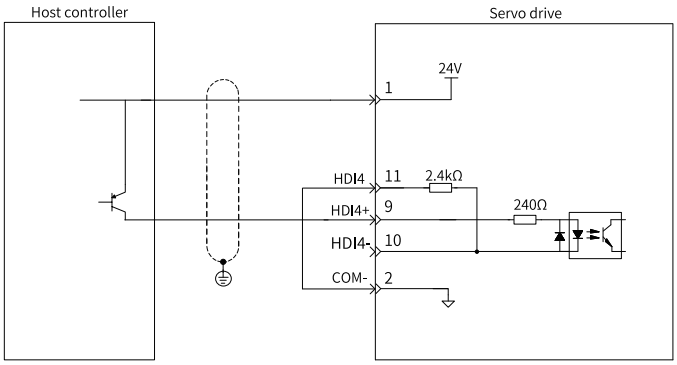
High Speed HDI4

- Differential mode

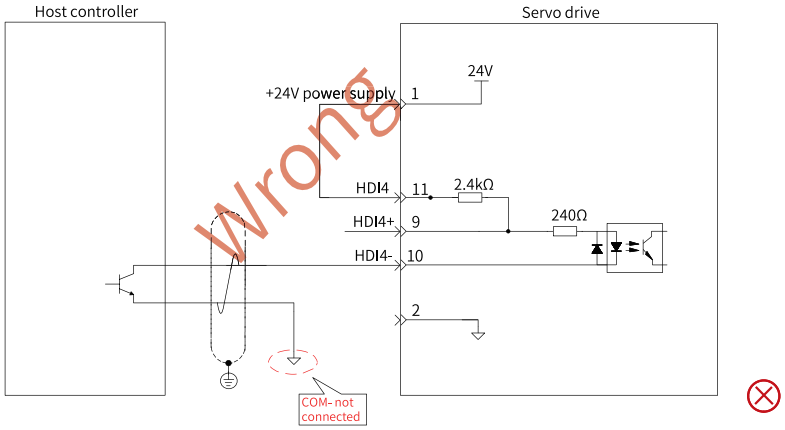


- Open-collector mode
  - When you use the internal 24 V power supply:

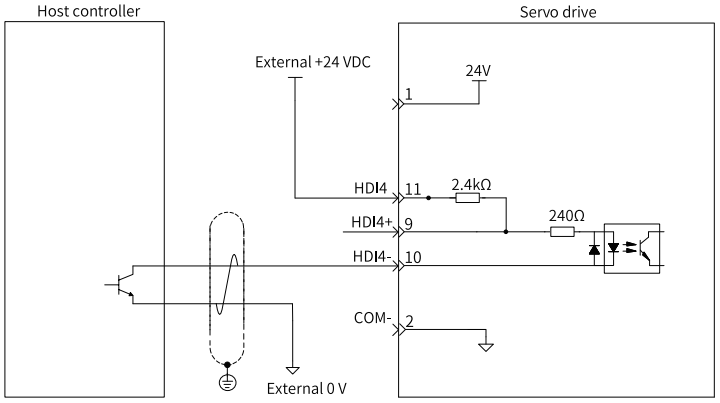


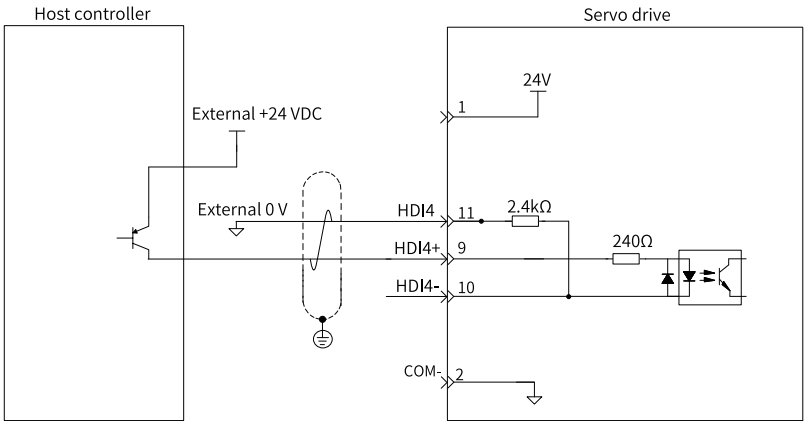


Wrong connection: Pin COM- is not connected, which cannot form a closed-loop circuit.

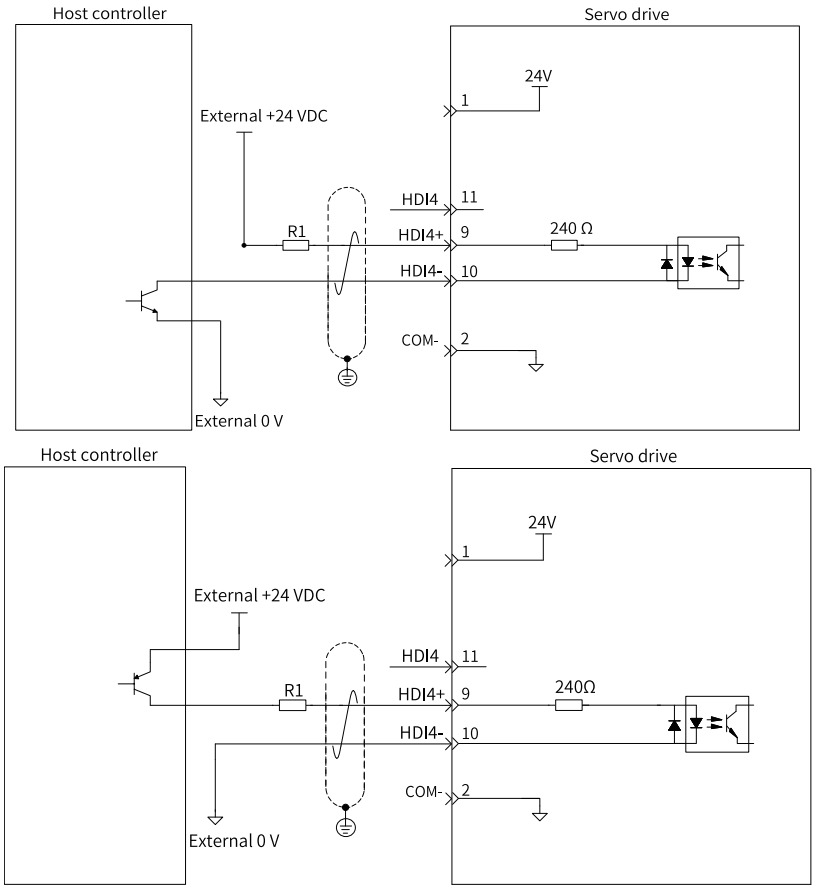


- When you use an external power supply:
  - Scheme 1: Using the built-in resistor (recommended)





  - Scheme 2: Using the external resistor



Select resistor R1 based on the following formula.

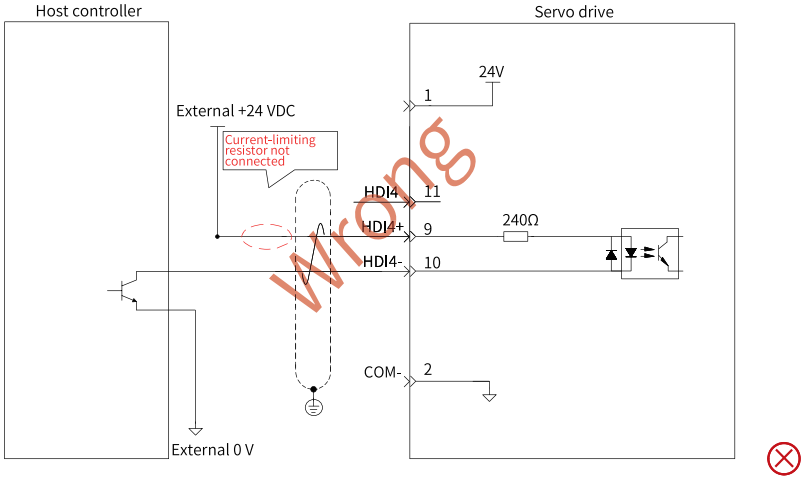
$$\frac{V_{CC}-1.5}{R1+240} = 10mA$$

Table 7–10 Recommended resistance of R1

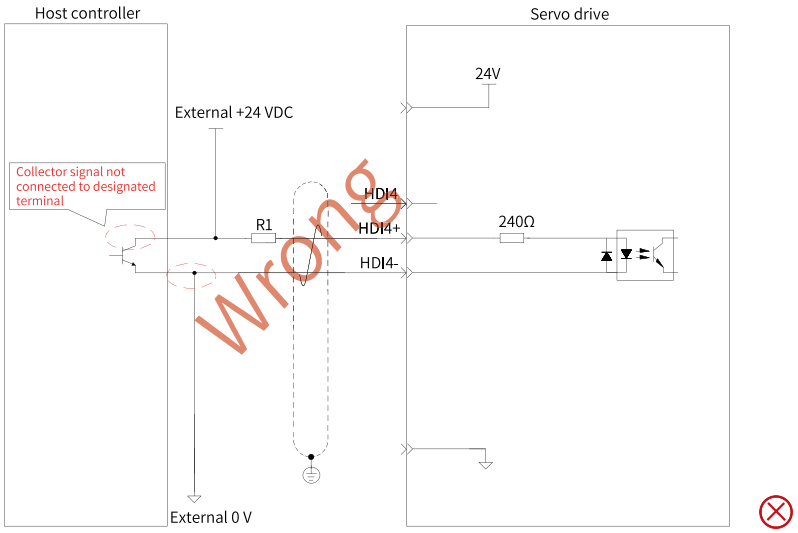
V_{CC} Voltage	Resistance of R1	Power of R1
24 V	2.4kΩ	0.5 W
12 V	1.5kΩ	0.5 W

– The following figures show examples of improper wiring.

◊ 1: The current limiting resistor is not connected, resulting in terminal burnout.



◊ 2: Terminals are not correctly connected, resulting in burnout of terminals.



High Speed HDI8

The connection method of HDI8 is the same as that of high-speed HDI4. See the text above for details.

7.8 EtherNet Communication Terminal (CN2)

Signal terminal for background communication and online upgrade.

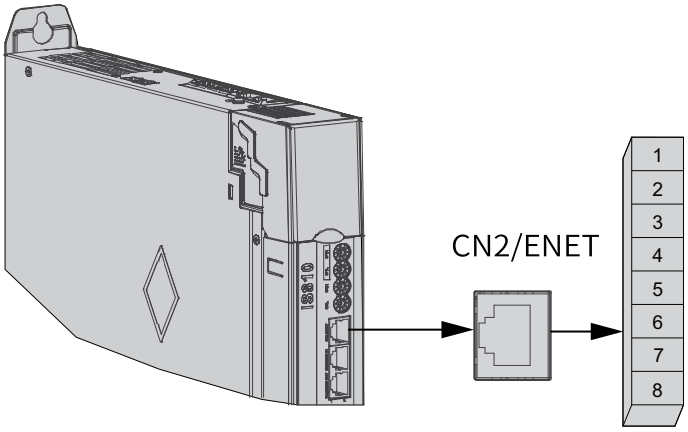


Figure 7-15 EtherNet terminal

Table 7–11 Pin assignment

No.	Description	Function and Specification
1	TX+	Data transmit positive
2	TX-	Data transmit negative
3	RX+	Data reception+
4	-	-
5	-	-
6	RX-	Data reception–
7	-	-
8	-	-

Note

Communication cables are the same as cables for multi-device communication (S6-L-T04).

7.9 Introduction to EtherCAT Communication Terminals (CN3 & CN4)

7.9.1 Terminal Arrangement

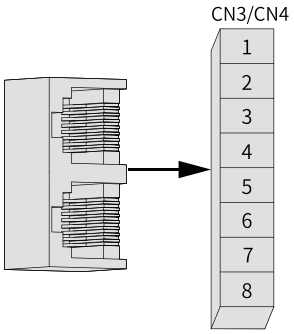


Figure 7-16 Layout of terminals

Table 7–12 Description of Communication Signal Connector Pins

Pin No.	Description	Description
1	TX+	Data transmit positive
2	TX-	Data transmit negative
3	RX+	Data reception+
4	-	-
5	-	-
6	RX-	Data reception–
7	-	-
8	-	-
Enclosure	PE	Shield

7.9.2 Description

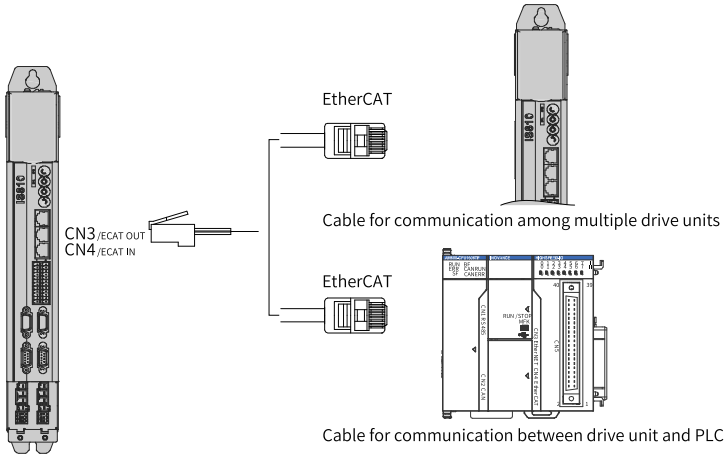


Figure 7-17 Wiring of communication cables

CN3 and CN4 are EtherCAT connectors. Connect CN4 (IN) to the communication port of the master and CN3 (OUT) to the next slave. For assignment of CN3/CN4 terminal pins, see *"7.9.1 Terminal Arrangement" on page 91*.

7.9.3 Terminal Wiring

Connection of the network cable

- Connecting the cable:

  1. The network port is equipped with a dustproof plug, and the dustproof cover needs to be taken out first to plug in the network cable;
  2. When inserting the network cable, please insert the connector into the bottom of the network port, and the latch will snap into the network port card slot to ensure the reliable connection of the network cable.

- Pull out the cable: Press the network port buckle and pull out the network cable at the same time.
  - It is forbidden to violently pull out the network cable; If the network cable is difficult to pull out, it is necessary to check whether the latch is completely loose.
  - It is recommended to use Inovance cable, specific model see *"7.9.4 Cable Requirements" on page 94*.

Topology

Topology

The communication topology of EtherCAT is flexible without any limit, as shown in *"Figure 7–18 Communication network topology" on page 93*. The drive carries IN and OUT ports.

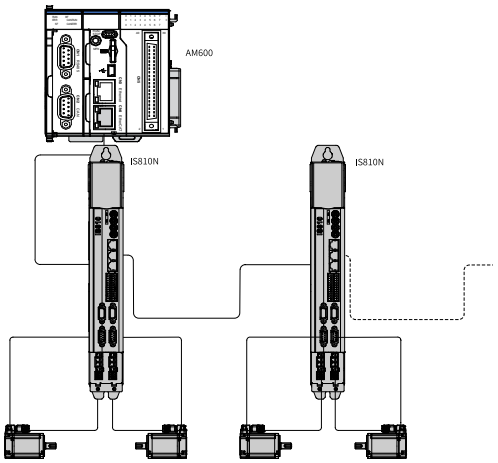
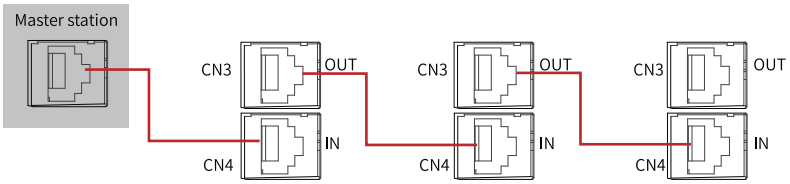
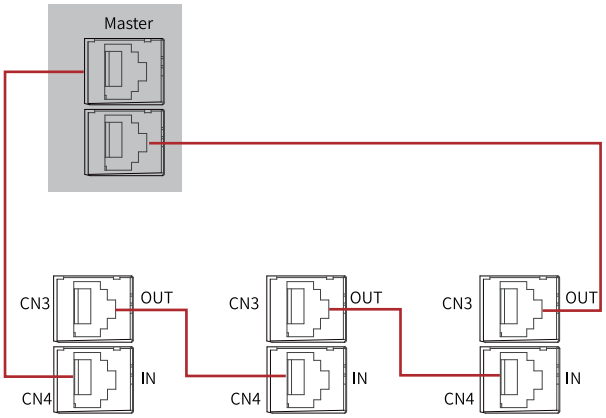


Figure 7-18 Communication network topology

Linear



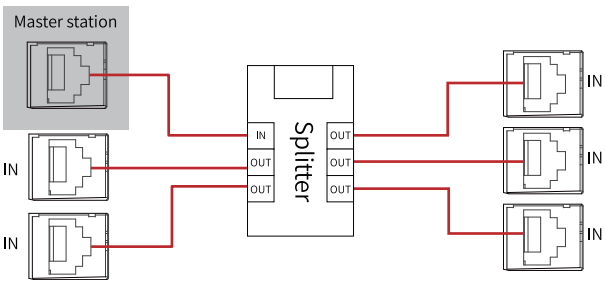
Ring



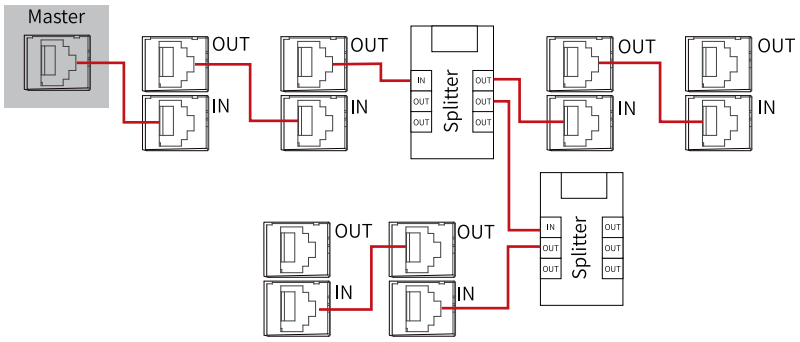
Note

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



Tree



7.9.4 Cable Requirements

Rules

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

Communication cable types

Table 7–13 Cable data

Material Code	Cable Model	Cable Length (m)	Cable Length
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	
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 7–14 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°C to +60°C.

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 want to choose the EtherCAT communication cable yourself, 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 moving, use flexible cables to avoid damage. If connectors are installed in a chemically corrosive environment, use cables with special coatings 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 described in *"Table 7–15 References for fixed cables of a permanent link" on page 95* and *"Table 7–16 References for flexible cables of a permanent link" on page 95*.

Table 7–15 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 lead wires	4 (2 pairs)
Shield	S/FTQ
Transmission impedance	< 50 mΩ/m at 10 MHz
Installation type	Stationary, no movement after installation
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 7–16 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 lead wires	4 (2 pairs)
Shield	S/FTQ
Transmission impedance	< 50 mΩ/m at 10 MHz
Installation type	Flexible, occasional movement or vibration

Characteristics	Type **B** cable (flexible)
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 7–17 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 7–15 References for fixed cables of a permanent link" on page 95* and *"Table 7–16 References for flexible cables of a permanent link" on page 95*. 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.

7.10 Introduction to Full Closed Loop Encoder Terminals (CN5 & CN7)

Terminal Arrangement

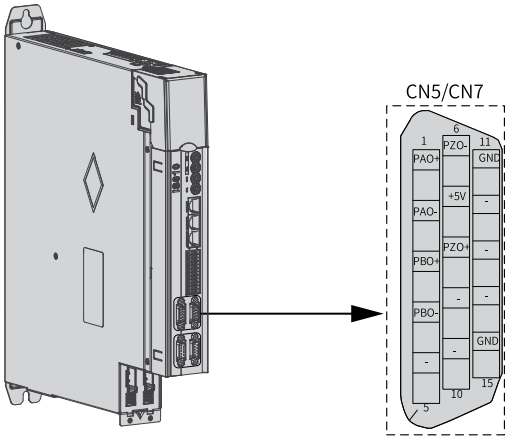


Figure 7-19 CN5/CN7 terminal

Description

Table 7–18 Description of CN5/CN7 (DB15) terminal

Signal Name	Default Function	Pin No.	Function
General	PAO+	1	Phase A frequency-division output signal
	PAO–	2	Phase A full closed-loop input
	PBO+	3	Phase B frequency-division output signal
	PBO–	4	Phase B full closed-loop input
	PZO+	8	Phase Z frequency division output signal
	PZO–	6	Phase Z full closed-loop input
	+5 V	7	Internal 5 V power supply, maximum output current: 200 mA
-	GND	11/15	5V power ground

7.10.1 Encoder Fully Closed Loop Input

Use shielded twisted pairs to match the high input frequency.

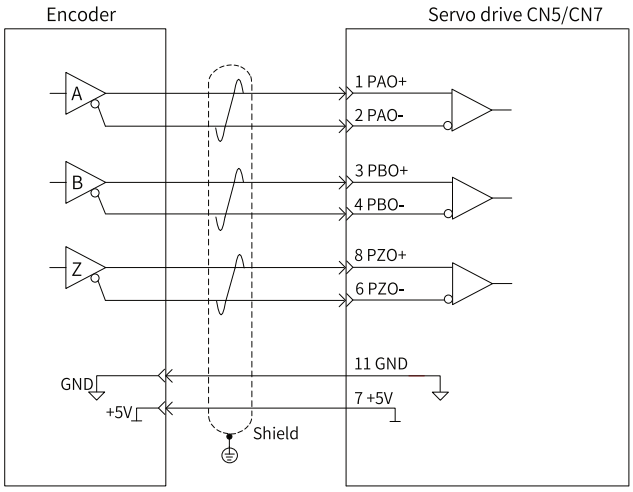


Figure 7-20 Terminal wiring

- 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 CN5/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 Mbps.
- The pulse input terminal of a phase A/B encoder supports open circuit detection.

7.10.2 Encoder frequency-division output

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.

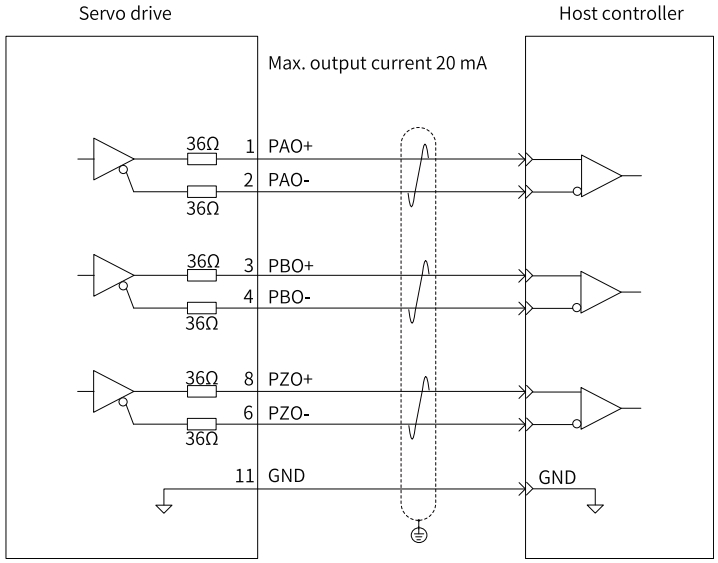


Figure 7-21 Differential receiving circuit

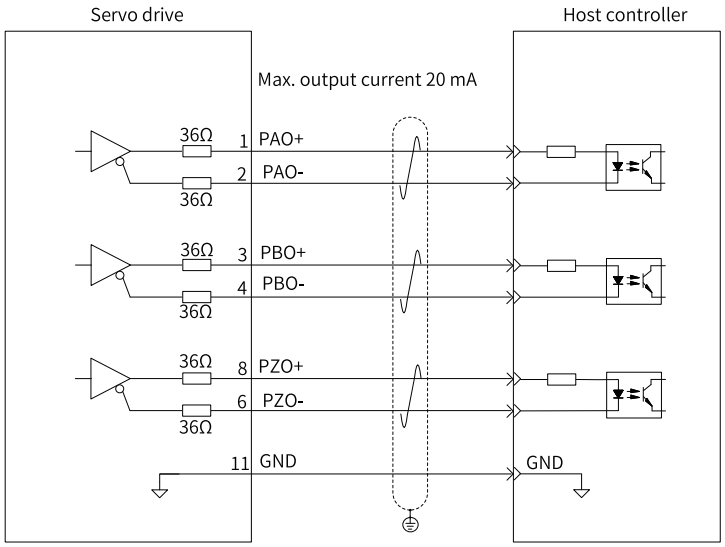


Figure 7-22 Optocoupler receiving circuit

7.11 Introduction to motor encoder terminals (CN6 & CN8)

7.11.1 Terminal Arrangement

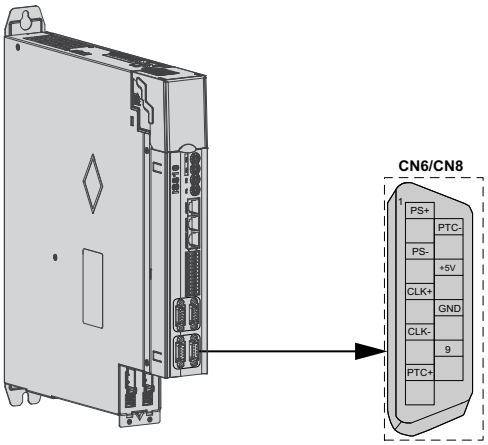


Figure 7-23 CN6/CN8 terminal

Table 7–19 CN6/CN8 terminal

Signal Name	Pin No.	Function
PS+/DATA+	1	Serial communication signal+/data+
PS-/DATA-	2	Serial communication signal-/data-
CLK+	3	Clock+
CLK-	4	Clock-
PTC+	5	Thermistor+ (PTC/KTY84/PT1000)
PTC-	6	Thermistor- (PTC/KTY84/PT1000)
+5 V	7	Encoder +5 V power supply
GND	8	Encoder +5 V power ground
PE	Shell	Shield

7.11.2 Motor encoder wiring

7.11.2.1 Connection with Absolute Encoder of MS1 Series Motor

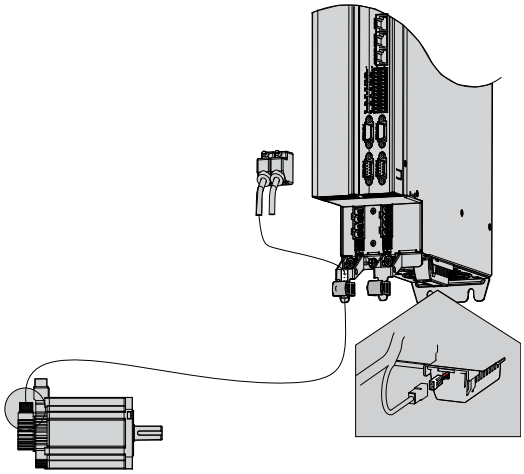


Figure 7-24 Connection with absolute encoder of MS1 series motor

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

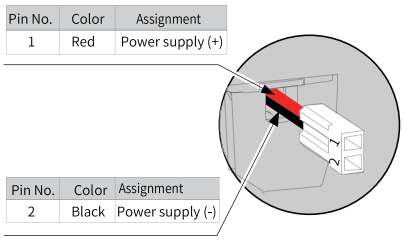
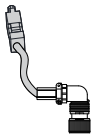
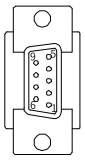
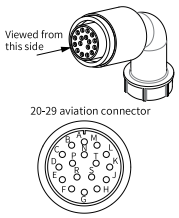


Figure 7-25 Lead wire color of the battery box

Keep the battery in environments within the required ambient temperature range and ensure the battery is in reliable contact and has sufficient power capacity. Otherwise, encoder data loss may occur.

Table 7–20 Lead type motor encoder cable connector (9-pin connector)

Motor Frame Size[1]	Illustration			Terminal Pin Arrangement			
				Pin No.	Signal Name	Color	Type
100 130 180		Servo drive side	 DB9 male	1	PS+	Blue	Twisted pair
				2	PS-	Purple	
				7	+5 V	Red	Twisted pair
				8	0 V	Orange	
				Enclosure	PE	-	-
		Motor side	 9-pin connector	A	PS+	Blue	Twisted pair
				B	PS–	Purple	
				E	Battery (+)	Brown	Twisted pair
				F	Battery (-)	Black	
				G	+5 V	Red	Twisted pair
				H	GND	Orange	
				J	Shield	-	-

Note

[1] The flange size refers to the width of the mounting flange.

7.11.2.2 Connection with Absolute Encoder of ISMG Series Motor

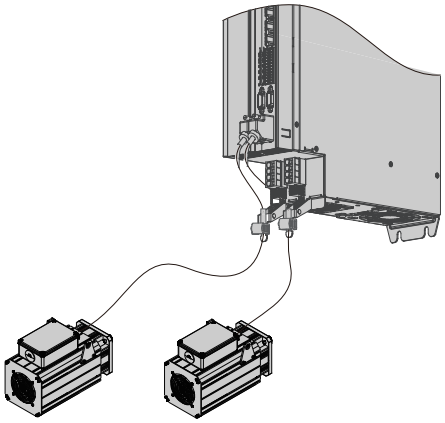


Figure 7-26 Connection with absolute encoder of ISMG series motor

Note

If connected to the brake motor, the cable needs to be extended enough to connect to the junction box.

Table 7–21 Encoder cable connector on servo drive side

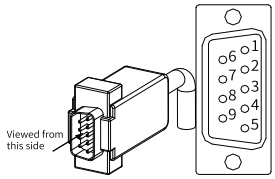
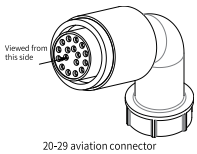
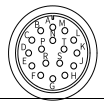
Illustration	Terminal Pin Arrangement	
	Pin No.	Signal Name
 Recommendation: DB9P connector	1	PS+
	2	PS-
	5	PTC+
	6	PTC-
	7	+5 V
	8	GND
	Shell	PE

Table 7–22 Motor side connector of the encoder cable

Illustration	Illustration		
	Pin No.	Signal Name	Type
MIL-DTL-5015 series 3108E20-29S military-spec connector  20-29 aviation connector 	A	PS+	Twisted pair
	B	PS-	
	G	+5 V	Twisted pair
	H	GND	
	J	Shield	-
	K	PTC+	Twisted pair
	L	PTC-	
		KTY+	
	M	KTY-	

7.11.3 Installing Absolute Encoder Battery Box

The optional S6-C9 battery box contains the following items:

- One sheet metal bracket
- One plastic body
- One battery (3.6 V, 2,600 mAh)
- Two M3x10 flat-head screws
- One M3x10 pan-head screw
- Double-axis conversion wire between terminal block and crimping terminal (S6-C9)

Installing the battery box

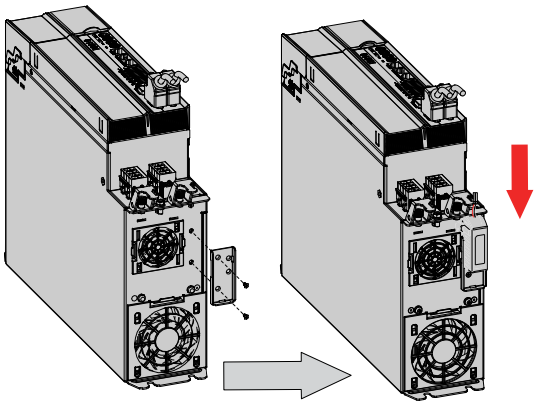


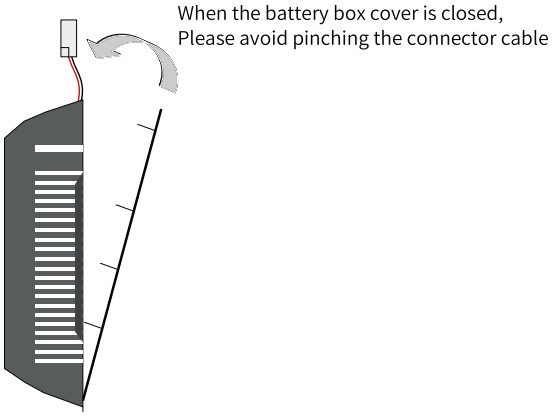
Figure 7-27 Installation of the absolute encoder battery box (Size1 model, bottom view)

Please use two grub-head screws for fixing. The grub-head screws correspond to the grub-head slot of the sheet metal part.

Removing the battery box

The battery may generate leakage liquid after long-term use. Replace it every two years. Remove the battery box in steps shown in the preceding figure, but in the reverse order.

When closing the battery box cover, prevent the connector cable from being pinched.



Improper use of the battery may result in liquid leakage which corrodes the components or leads to battery explosion. Observe the following precautions during use:

Caution

- Insert the battery with polarity (+/-) placed correctly.
- Leaving an idled or retired battery inside the device may lead to electrolyte leakage. The electrolyte inside the battery is highly corrosive, not only corroding surrounding components but also incurring the risk of short circuit. Replace the battery periodically (recommended interval: Every 2 years).
- Do not disassemble the battery because the internal electrolyte may spread out and result in personal injury.
- Do not throw the battery into the fire or heat up the battery. Failure to comply may result in an explosion.
- Do not short-circuit the battery or strip off the battery tube. Prevent terminals (+) and (-) of the battery from coming into contact with the metal. Contact with the metal will result in a large current, not only weakening the battery power, but also incurring the risk of explosion due to severe heating.
- This battery is not rechargeable.
- Dispose of the retired battery according to local regulations.
- Remove the connector from the drive before wiring.

7.11.4 Wiring for Motor Temperature Detection

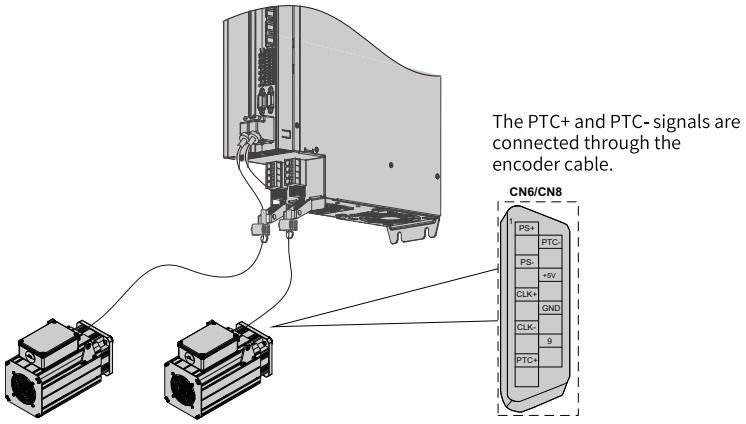


Figure 7-28 Terminal Arrangement

Note

If connected to the brake motor, the cable needs to be extended enough to connect to the junction box.

Name	Description
PTC+	Motor temperature feedback input
PTC-	

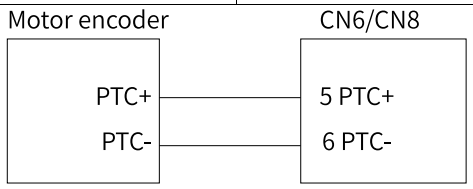


Figure 7-29 Wiring for temperature detection

Note

- Motor temperature feedback supports PTC and KTY selection. Please refer to H0C.32 for relevant function code parameters *"16.13 H0C Parameters" on page 438*.
- For an introduction to related functions, see *"13.7 Motor Temperature Detection" on page 297*。

7.11.5 Wiring

Ground the servo drive and shielded layer of the servo motor reliably. Otherwise, the servo drive will report a false alarm. It is recommended to use twisted-pair cable of size 26AWG to 16AWG. The differential signals shall be connected to two corresponding twisted-pair core wires in the twisted-pair cable. The wiring length shall be as short as possible.

To determine the length of the encoder cable, consider voltage drop caused by the cable resistance and signal attenuation caused by the distributed capacitance. It is recommended to use twisted-pair cable of size 26AWG or above (as per UL2464 standard) and with a length within 10 m. If the cable length is very large, use the cable of a larger size, as described in the following table.

Note

It is recommended to use 22AWG to 26AWG cables for 10B, 20B, 40B, and 75B series motors. If a longer cable is required, increase the cable diameter properly. See the following table for details.

Table 7–23 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 above length can be increased by 2 m to 3 m.
- If the cables of above 16AWG are required, contact the sales personnel of Inovance.
- In the preceding table, P refers to two twisted pairs of cables. 1P: +5V/0V twisted pair; 2P: DC+/- twisted pair; PS +/- twisted pair; 3P: +5V/0V twisted pair; DC+/- twisted pair. PS+/- twisted pair.

7.11.6 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.

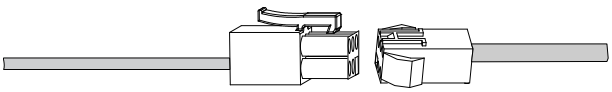


Figure 7-30 Power cable adapter

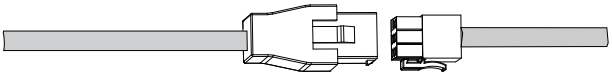


Figure 7-31 Encoder cable adapter

7.12 Introduction to brake terminal

7.12.1 Terminal Pin Arrangement

Terminal Pin Arrangement

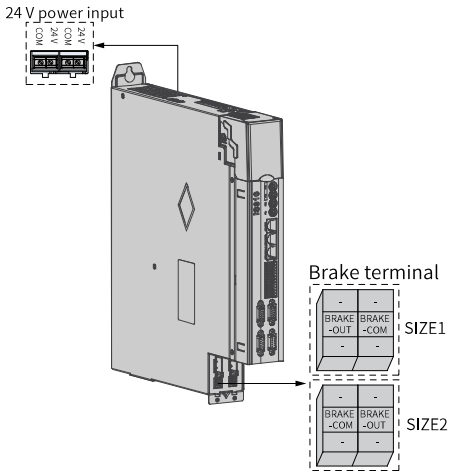


Figure 7-32 Arrangement of brake terminal pins

Table 7–24 Pin assignment

Name	Terminal Function	Remarks
24 V	External 24 V power supply	-
COM	External 24V COM	-
BRAKE-OUT	Brake+	The positive and negative pins of brake terminals of Size 1 and Size 2 are opposite.
BRAKE-COM	Brake–	

Wiring of the Brake

The brake is used to prevent the motor shaft from moving and lock the position of the motor and the motion part when the drive is in the non-operational status.

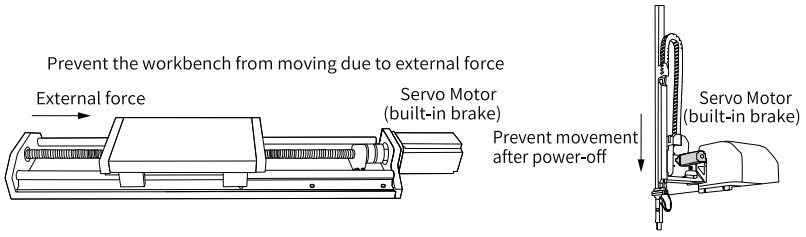


Figure 7-33 Application of the brake

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.
- Switch off the S-ON signal after the motor stops.
- When the motor with brake runs, the brake may generate a click sound, which does not affect its function.
- When brake coils are energized (the brake is released), flux leakage may occur on the shaft end.
- Keep away from the area around the motor when using a magnetic sensor.

The connection of the motor brake input signal has no polarity. You need to prepare a separate 24 V power supply to ensure that the control power supply is separate from the brake power supply. The following figure shows the standard wiring of the brake signals (BK) and the brake power supply.

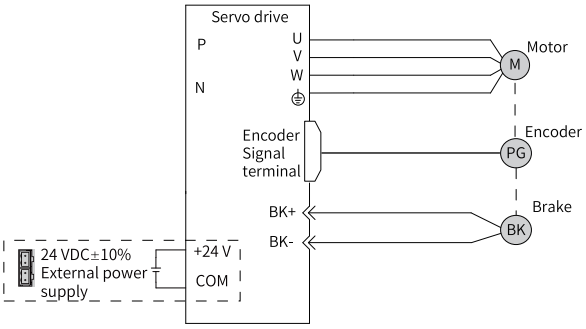


Figure 7-34 Brake wiring diagram of models below T017

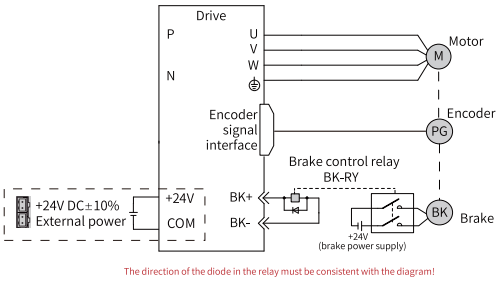


Figure 7-35 Brake wiring diagram of models T017 to T037

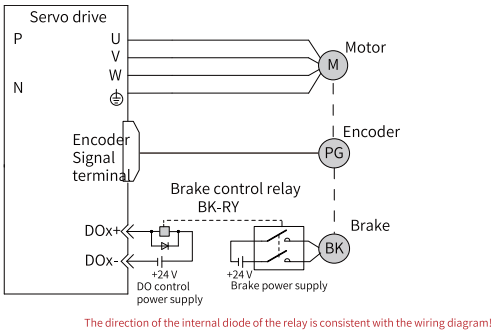


Figure 7-36 Brake wiring diagram of models above T037

Note

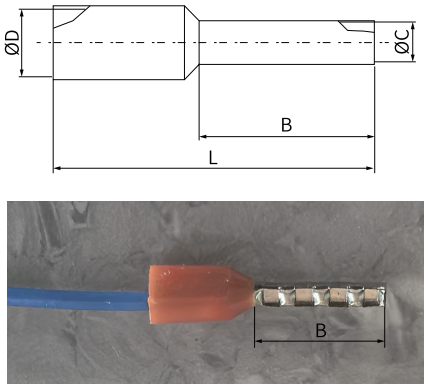
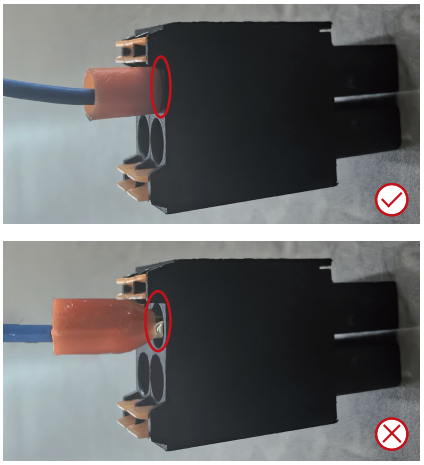
- When determining the length of the brake cable, take full account the voltage drop caused by cable resistance. The input voltage must be at least 21.6 V to enable the brake to work properly.
- When H02.16 is set to 1, the drive starts the brake.
- For models below T017, the driver uses the brake terminal to directly control the motor brake.
- For T017 to T037 models, the drive controls the motor brake through an external relay controlled by the brake terminal.
- For models above T037, the drive controls the motor brake through an external relay controlled by the DO brake. You need to prepare a separate 24 V power supply. Ensure that the DO control power supply and the brake power supply are different.

Brake-related parameters

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.09	2002-0Ah	Delay from brake output ON to command received	0 ms–500 ms	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.	250	ms	UInt16	Real-time	At stop
H02.10	2002-0Bh	Delay from brake output OFF to motor de-energized	50 ms–1000 ms	Defines the delay from the moment brake output is OFF to the moment when the motor at standstill enters the de-energized status.	150	ms	UInt16	Real-time	Real-time
H02.11	2002-0Ch	Motor speed threshold at brake output OFF in rotation state	20 rpm to 3000 rpm	Defines the motor speed threshold when brake (BK) output is OFF in the rotating state.	30	rpm	UInt16	Real-time	Real-time
H02.12	2002-0Dh	Delay from S-ON OFF to brake output OFF in rotation state	1 ms–65535 ms	Sets the delay time from BK OFF to S-ON OFF when the motor is in rotating state.	500	ms	UInt16	Real-time	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.15	2002-10h	LED Alarm Display	0: Output alarm information immediately 1: Not output alarm information	Defines whether to switch the keypad to the fault display mode when a No. 3 fault occurs.	0	-	UInt16	Real-time	Real-time
H02.16	2002-11h	Brake enable switch	0: OFF 1: ON	Turn on or off the brake function.	0	-	UInt16	Real-time	At stop

7.12.2 Wiring Precautions and Requirements

Pre-Inspection	Installation
	
Tubular terminal contact area (B) ⩽ 8 mm	Connect the terminal in place so that the contact area is not exposed.

7.13 Introduction to STO safety terminals

7.13.1 Terminal Arrangement

When a fault is detected in the safety circuit, the STO function acts immediately to cut off the output current of the controller and stop the output torque of the motor.

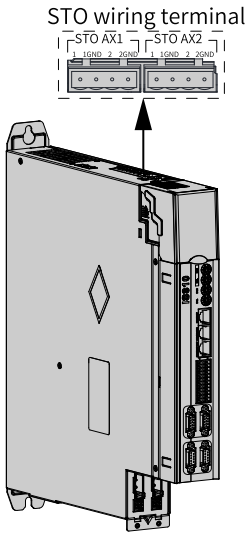


Figure 7-37 STO terminal

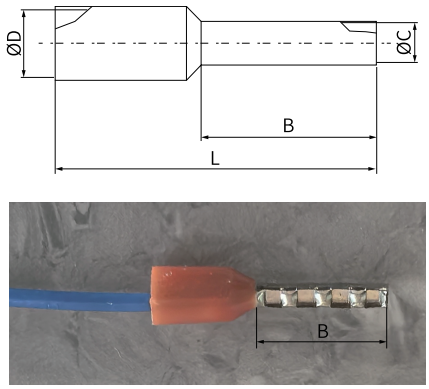
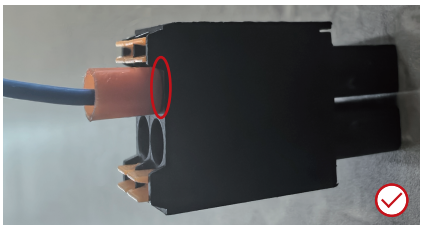
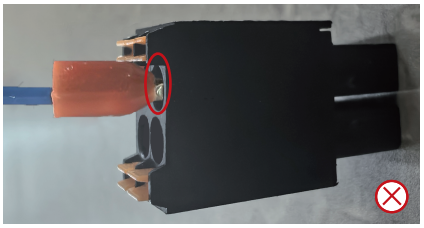
Terminal Type	Interface Name	Description
AX1 STO	1	Axis 1 STO channel 1 power+
	1GND	Axis 1 STO channel 1 power-
	2	Axis 1 STO channel 2 power+
	2GND	Axis 1 STO channel 2 power-
AX2 STO	1	Axis 2 STO channel 1 power+
	1GND	Axis 2 STO channel 1 power-
	2	Axis 2 STO channel 2 power+
	2GND	Axis 2 STO channel 1 power-

Note

If an external power supply is used, it shall be a SELV circuit power supply with the following indexes: 24 VDC ±10%, 70 mA.

For related terminal wiring and functions, see *"14.2.2 Function Use and Monitoring" on page 305*.

7.13.2 Wiring Precautions and Requirements

Pre-Inspection	Installation
 	 
Tubular terminal contact area (B) ⩽ 8 mm	Connect the terminal in place so that the contact area is not exposed.

7.14 24V Power Input Terminal

The power supply of the drive unit is divided into the control part and the power part. The control part is preferentially powered by the DC busbar that is connected to the power supply unit. It is recommended to synchronously connect the 24 V switch-mode power supply of the drive unit to an external power supply. This ensures that power supply to the control part of the drive unit is not affected after stop due to any fault of the power supply unit.

Note that the 24 V terminal in the drive unit must be correctly connected, as shown in the following figure:

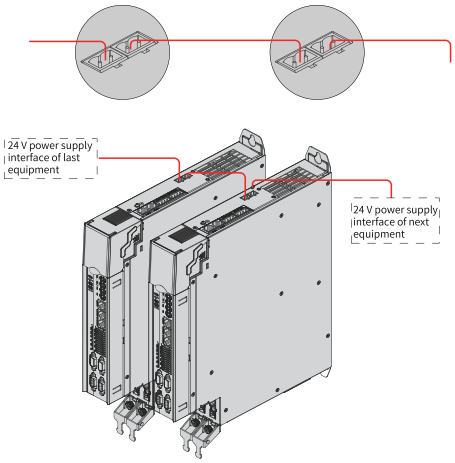


Figure 7-38 Schematic diagram of multiple 24V control power supplies cascaded

Note

- External 24V control power supply and gate power supply input port, the current specification is the current required for the brake +0.7 A.
- External 24V power supply range ± 10%, and 21.6 V–26.4 V.
- The number of cascades for brake-free applications is limited to 10.
- In the application scenario with brake holding, the number of cascades is determined according to the current: the number of cascades N = (5A-I brake) ÷ 0.5.

7.15 Related EMC Requirements

Take the following measures to suppress interference:

- Ensure the length of the reference input cable is below 3 m, and the length of the encoder cable is below 20 m.
- Use thick wires (above 2.5 mm^2) as much as possible for grounding.
  - D class (or higher class) grounding is recommended (grounding resistance below 100 Ω).
  - Use single-point grounding.
- Use a noise filter to prevent high frequency interference. For use in the residential environment or environment subject to strong noise interference, install a noise filter on the input side of the power cable.
- To prevent malfunction due to electromagnetic interference, take the following measures:
  - Install the host controller and noise filter near the servo drive.
  - Install a surge protection device on the relay, solenoid and electromagnetic contactor coils.
  - The distance between a strong-current cable and a weak-current cable must be at least 30 cm. Do not put in the same pipe or bundle together.
  - Do not share power supply with electric welding machines, electrical discharge machining equipment, etc. When the servo drive is put ear a high-frequency generator, install a noise filter on the input side of the power cable.

7.15.1 Anti-interference Wiring Example and Grounding

The servo drive uses high-speed switch element in the main circuit. The switch noise may affect the normal operation of the system due to improper wiring or grounding. Therefore, the servo drive must be properly wired and grounded. A noise filter can be added if necessary.

Anti-interference Wiring Example

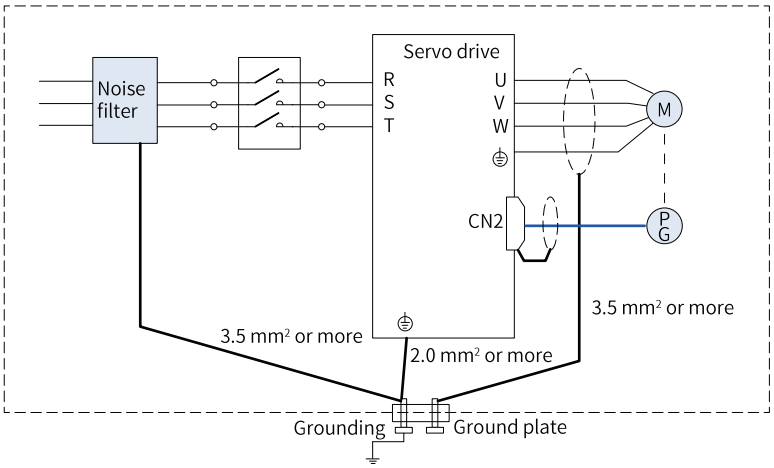


Figure 7-39 Anti-interference Wiring Example

Note

- For the grounding cable connected to the cabinet housing, use a cable of at least 3.5 mm2 thick. Plain stitch copper wires are recommended.
- If a noise filter is used, abide by the requirements in 3.5.2.

Grounding

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

- Ground the housing of the servo motor
  Ground the motor housing
- Ground the shield of the power cable
  Ground both ends of the shield or the metal conduit of the motor main circuit. Crimping is recommended to ensure good contact.
- Ground the servo drive
  Ground the PE terminal of the servo drive properly. The screw of this terminal must be fixed solidly to ensure good contact.

7.15.2 How to Use the Power Filter

To prevent interference from power cables and reduce impact of the servo drive to other sensitive devices, install a noise filter on the input side of the power supply according to the amount of the input current. In addition, install a noise filter on the power cable of peripheral devices if necessary. To ensure the performance of the noise filter, abide by the following requirements when installing and wiring the noise filter.

- Do not put the input and output cables of the noise filer in the same duct or bundle them together.

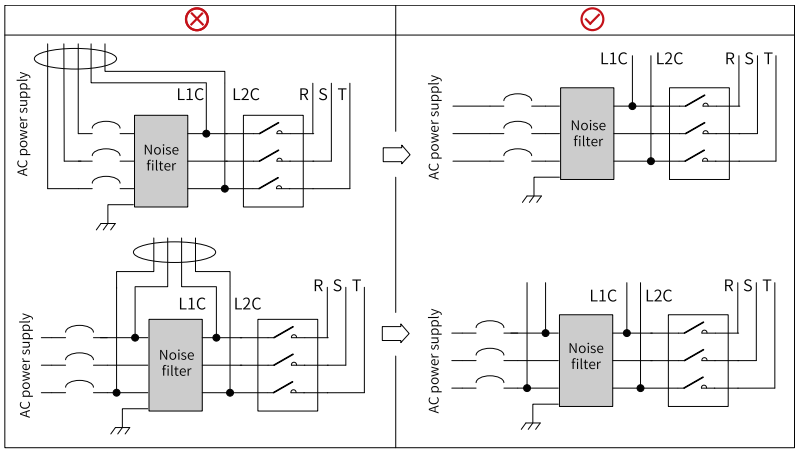


Figure 7-40 Separate routing of I/O cables of the noise filter

- Route the grounding cable and output power cable of the noise filter separately.

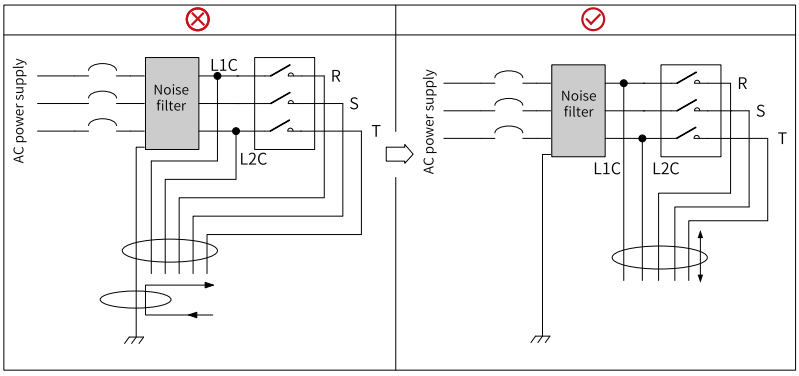


Figure 7-41 Separate routing of the grounding cable and output cable

- Use a separate, thick grounding cable as short as possible for the noise filter. Do not share the same grounding cable with other grounding devices.

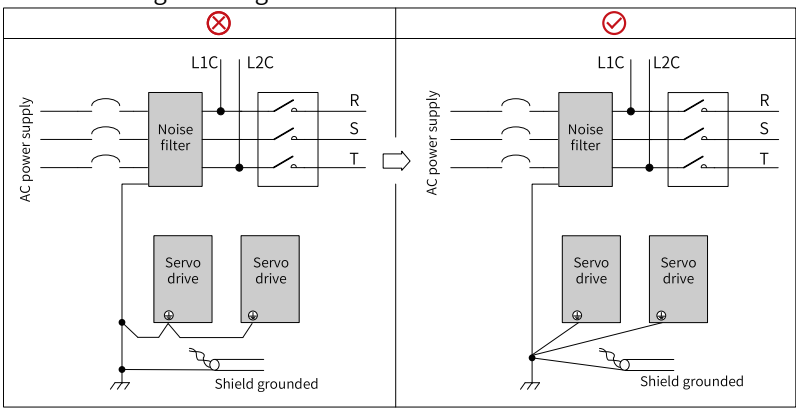


Figure 7-42 Single-point grounding

- Ground the noise filter inside the control cabinet.
  If the noise filter and the servo drive are installed in the same control cabinet, fix the noise 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.

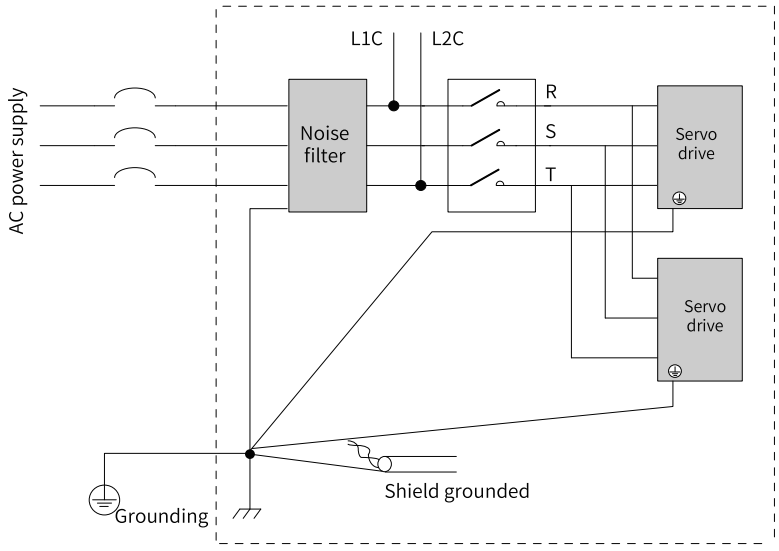


Figure 7-43 Grounding of the noise filter

7.15.3 Precautions for Use of Cables

- Do not bend or apply stress to cables. The conductor of a signal cable is only 0.2 mm or 0.3 mm in diameter. Handle the cables carefully to prevent fracture.
- 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 carrier.
  - 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.

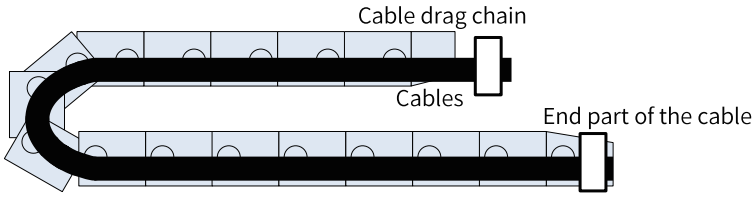


Figure 7-44 Cable drag chain

8 Commissioning Tool

8.1 Keypad

8.1.1 Components

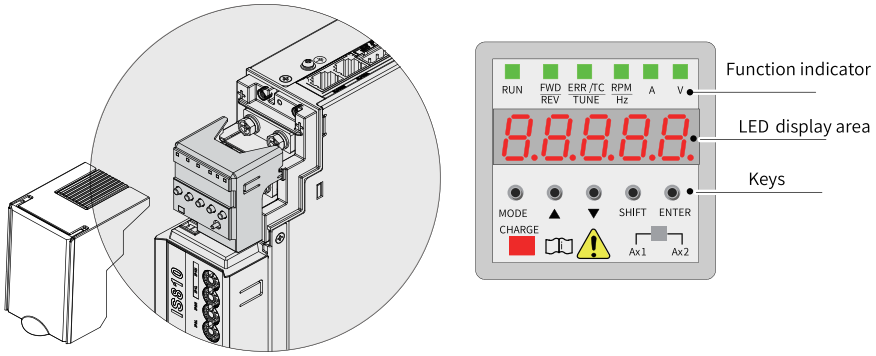


Figure 8-1 Magnified view of the keypad

The keypad consists of the 5-digit 8-segment LEDs and keys. The keypad is used for display, parameter setting, user password setting and general functions operations.

Keys

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

Table 8–1 Descriptions of keys

Button	Key Name	Function
MODE	MODE	Used to switch among different modes. Return to the previous menu.
▲	UP	Used to increase the value of the blinking digit.
▼	DOWN	Decrease the value of the blinking digit.
SHIFT	SHIFT	Used to shift the blinking digit and view the high digits of a number consisting of more than 5 digits. View the high digits of the number consisting of more than 5 digits.
ENTER	Confirmation key	Used to switch to the next menu and execute commands such as saving parameter setpoints. Execute commands such as storing parameter setting value.

LED display area

There are 5-digit LEDs on the LED keypad to display the status, parameter, fault, and monitoring information.

Table 8–2 Equivalent of the displayed content

Display	Equivalent	Display	Equivalent	Display	Equivalent	Display	Equivalent
	0		7		E		P
	1		8		F		R
	2		9		H		T
	3		A		J		U
	4		B		L		V
	5, S		C		N		Y
	6		D		O		Axis 2

DIP switch

- **Communication address hardware DIP switch**
  IS810N-INT has four DIP switches, which are divided into two groups for setting the shaft address and node address.
  - The first group of DIP codes are: ID1H and ID1L.
  - The second group of DIP codes are: ID2H and ID2L.

  1. Axis address

     The axis address (H0E.02) is determined by the IS810-INT DIP switch.

     The first and group of DIP codes are loaded on shaft 1, and the second group of DIP codes are loaded on shaft 2.

     The shaft address is only displayed on the serial port and EtherNet background.

Axis No.	High Bit (IPH) x 10 + Low Bit (IPL)	Axis address (H0E.02)
Axis 1	00	The shaft address is assigned by the drive.
	01–99	The shaft address of shaft 1 is determined by the first group of DIP codes.
Axis 2	00	The shaft address is assigned by the drive.
	01–99	The shaft address of shaft 2 is determined by the second group of DIP codes.

  2. Node address

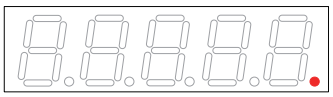
     The node address determines the number of the slave station that uses Modbus or CAN. One drive only requires one node address.

     - When H0E.08 is set to 1, the node address is determined by the first group of DIP codes. H0E.00 is used for display.
     - When H0E.08 is set to 0, the node address must be set using the function code H0E.00.

- **Axis selection DIP switch**
  The IS810N-INT has 2 DIP switches, divided into Ax1 and Ax2 (only present on dual axis servos).

  AX1 is to debug axis 1 parameters, and AX2 is to debug axis 2 parameters.

Function indicator

Indicator status		Status Description
RUN Running indicators		Off: stop or fault
		ON: running
FWD/REV Forward/Reverse run indicator		Off: forward running
		On: reverse running
ERR/TC/TUNE indicator		On (green): normal running
		Quick blinking (red): fault state (4 times/s)
		Frequency unit: Hz
		Current unit: A
		V: unit of voltage
		This point indicates the current operation axis: Steady off: Ax1 axis parameter is being handled Steady on: Ax2 axis parameter is being handled

8.1.2 Panel Display

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

- Status display: Displays 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 occurred on the servo drive.
- Monitored value display: Displays values of monitoring parameters.

Transition relation between the panel display and the operation object of the host controller

The mapping relation between the parameter displayed on the keypad (in decimal) and the object dictionary operated by the host controller (in hexadecimal, "Index" and "Sub-index") is 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 only describes 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

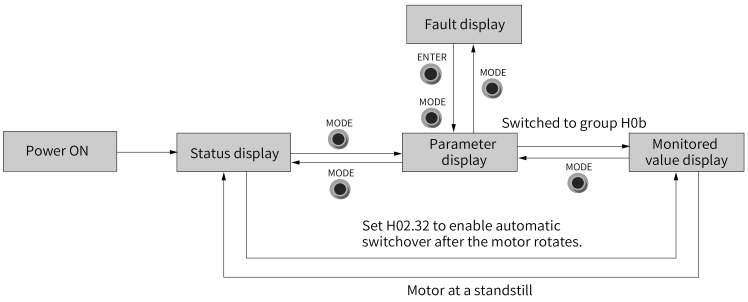


Figure 8-2 Switchover among different display modes

- The keypad enters status display immediately upon power-on.
- Press MODE to switch among different display modes based on the conditions shown in *"Figure 8-2" on page 119* .
- In status display, set H02.32 to select the parameter to be monitored. When the motor rotates, the keypad automatically switches to monitored value display. After the motor stops, the keypad automatically returns to status display.
- In the parameter display mode, after you select the parameter to be monitored in group H0b, the keypad switches to monitored value display.
- Once a fault occurs, the keypad switches to fault display immediately, with all the five LEDs blinking. Press ENTER to stop the LEDs from blinking, and then press MODE to switch to parameter display.

Status display

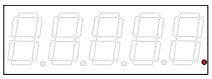
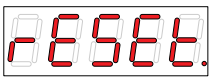
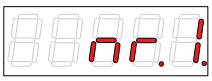
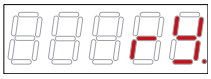
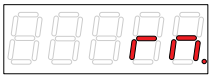
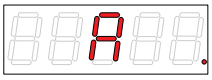
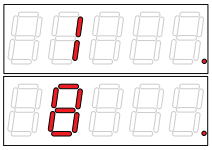
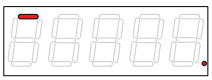
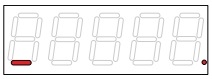
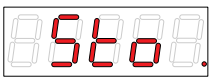
Display	Name	Applicable Occasion	Meaning
	The axis being operated (example)	Parameter display interface after selecting an axis using the axis 1/axis 2 DIP switch	Parameters displayed on the operation panel currently are parameters of axis 2
	Reset Servo drive initializing	Upon power-on	The servo drive is in the initialization or reset status. After initialization or reset is done, the servo drive automatically switches to other status.
	nr.x Servo not ready (Not ready)	Initialization done, but servo drive not ready.	The meaning of nr.x: for specific reasons and troubleshooting methods, see *"Table 8-3 Cause of displaying nr.x value and troubleshooting" on page 121*
	Ry Ready (Ready)	Servo drive ready	The servo drive is ready to run and waits for the enabling signal from the host controller.
	Rn Running (run)	Servo ON (S-ON) signal activated	The servo drive is running.
	1 to A Control mode	-	Displays present operation mode of the servo drive in hexadecimal digits. • 1: Profile position control • 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 to 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	CN3 is connected successfully when EtherCAT is output	Steady off: No communication connection detected at the physical layer Steady on: Communication connection is detected in the physical layer
	CN4 connection indication	CN4 is connected successfully when EtherCAT is input	
	STO	-	Check whether the 24V input for the STO terminal is disconnected.

Table 8–3 Cause of displaying nr.x value and troubleshooting

nr.x	Cause	Troubleshooting
nr.1	The control power is undervoltage, and the control power H0b.57 is less than the undervoltage threshold value H01.78.	1 Measure whether the control power input meets the input specifications. 2 If the control power satisfies the input, read HOb. 57; If H0b.57 approaches 0, the hardware circuit may be damaged.
nr.2	The main circuit input is abnormal.	1 Use a multimeter to check whether there is a voltage input in the main circuit. 2 Use an oscilloscope to test whether the main circuit input is phase missing.
nr.3	Bus undervoltage occurred, and the bus voltage H0b.26 is less than the undervoltage threshold H01.42.	1 Test whether the main circuit input meets the input specifications. 2 If yes, and H0b.26 is close to 0, the hardware circuit may be damaged.
nr.4	Servo soft start resistor not bypassed.	Read the bus voltage H0b.26 to see if the voltage is within the normal range.
nr.5	Encoder initialization not done.	Contact the manufacturer technical personnel.
nr.6	Short-circuit to ground detection not done.	Check the value of H0b-57.
nr.7	There are other uncompleted initialization items.	Check whether there are other items that have not been initialized, such as the safety board initialization.
nr.9	Fully closed-loop encoder initialization not done.	Contact Inovance.

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. See section List of Parameters.

- Display of parameter groups

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

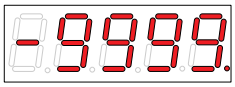
For example, "H02.00" is displayed as follows.

Display	Name	Description
	H02.00	02: Parameter group No. 00: Offset within the parameter group

- Display of negative numbers and numbers with different lengths
  - Signed number with 4 digits and below or unsigned number with 5 digits and below

Such numbers are displayed in a single page (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 or unsigned number with more than 5 digits
  Such numbers are displayed from low to high bits in several pages (5 digits per page): current page + values on current 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:

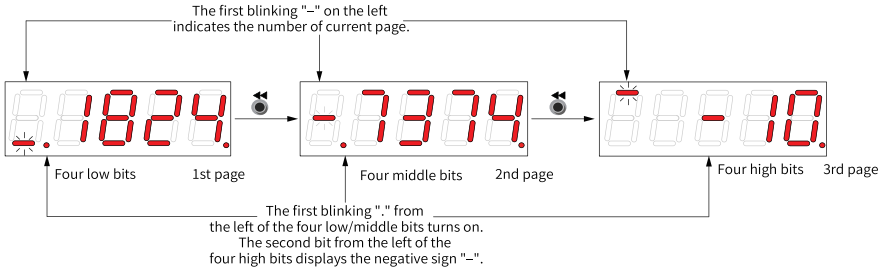


Figure 8-3 Display of "-1073741824"

Example: "1073741824" is displayed as follows:

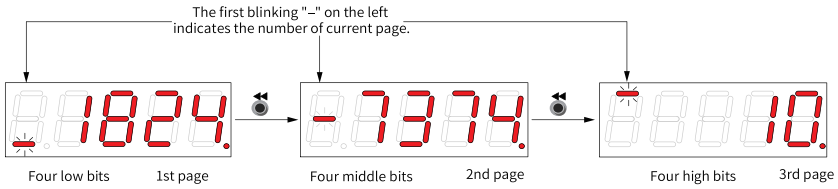
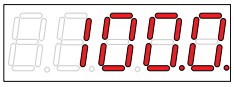
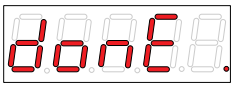
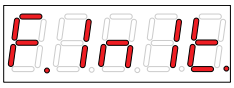
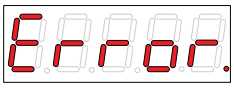
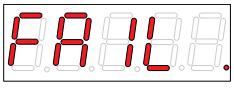


Figure 8-4 Display of "1073741824"

- Display of the decimal point
  The segment "." of the ones indicates the decimal point, which does not blink.

Display	Name	Description
	Decimal point	100.0

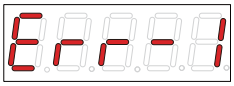
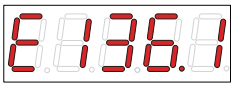
- Display of parameter setting status

Display	Name	Applicable Occasion	Meaning
	Done Parameter setting completed	The parameter is set successfully.	The parameter is set and saved to the servo drive (Done). The servo drive can execute other operations.
	F.InIt (Restored to default settings)	Parameter initialization is in progress (H02.31 = 1).	The servo drive is in the process of parameter initialization. After parameter initialization is done, switch on the control power supply again.
	Error (wrong password)	The user password (H02.30) is activated and the password entered is wrong.	A wrong password is entered. You need to enter the password again.
	FAIL	Auto-tuning with one-key enabled	The function of auto-tuning with one-key fails.

Fault Display

- The keypad can be used to display present or previous fault and alarm codes. For analysis and solutions to the faults and alarms, see Chapter "Troubleshooting".
- When a fault or alarm occurs, the operating panel displays the corresponding fault or alarm code immediately. When multiple faults or errors occur, the keypad displays the fault or error code of the highest fault level.
- You can select the previous fault/alarm to be viewed through H0b.33 and view the code of the selected fault/alarm in H0b.34.
- You can clear the latest 10 faults or alarms saved in the servo drive by setting H02.31 to 2.

Example: Axis 1 alarm E136.1 panel displays as follows:

Display	Name	Description
 	Err-1 E136.1 Display the current fault code	Err-1: There is a fault or alarm on servo drive axis 1. E136.1: Current fault code.

Note

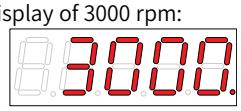
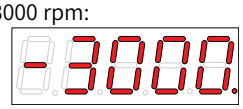
- If Axis 1 alarms E136.1, the panel alternately blinks Err-1 E136.1.
- If Axis 2 alarms E210.4, the panel alternately blinks Err-2 E210.4.
- If Axis 1 alarms E136.1 and Axis 2 alarms E210.4, the panel alternately blinks Err-1 E136.1 Err-2 E210.4.

Monitored value display

- H0b parameters monitor the operating state of the servo drive. You can enable keypad monitoring display by H02.32. The parameter group number displayed is H0b and the group offset is the setpoint of H02.32.

- When the valid offset is set in H02.32, the keypad enters the "state display" mode if the motor was in the static state, or the "parameter display" mode if the motor was in the rotating state. Mode switchover is not related to whether the servo drive is enabled.
- For example, if you set H02.32 to 00 and the motor changes from the static state to the running state, the keypad switches from the "state display" mode to "parameter display" mode and displays the value of H0b.00.

The following table describes the monitoring parameters in H0b.00.

Parameter	Name	Unit	Meaning	Example
H0b.00	Motor speed actual value	rpm	Displays the actual value of the motor speed after round-off, which can be accurate to 1 rpm.	Display of 3000 rpm:  -3000 rpm: 

Note

For details of parameter group H0B, see *"19.1 Display of Monitoring Parameters" on page 564*

8.1.3 Setting parameters

Example of parameter settings

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

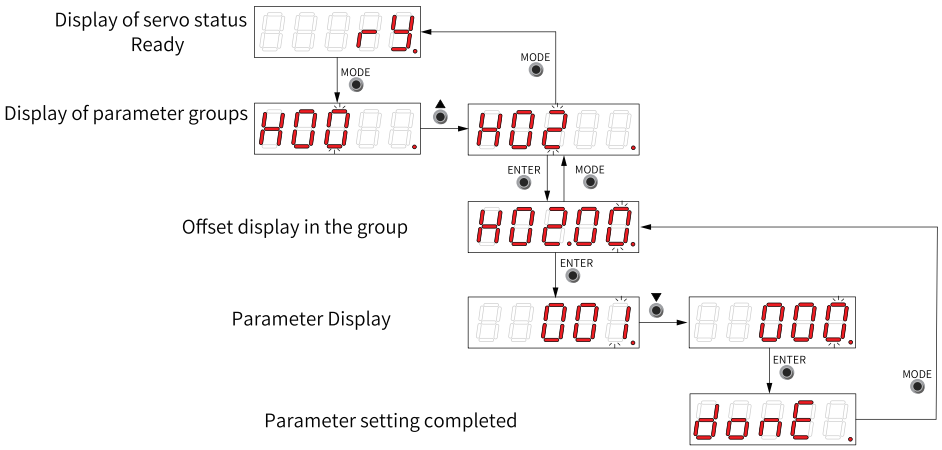


Figure 8-5 Example of parameter setting

- MODE: Used to switch the keypad display mode and return to the previous interface.
- UP/DOWN: Used to increase or decrease the value of the blinking digit.
- SHIFT: Used to shift the blinking digit.
- ENTER: Used to save the present setpoint or switch to the next interface.

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").

User password

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

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

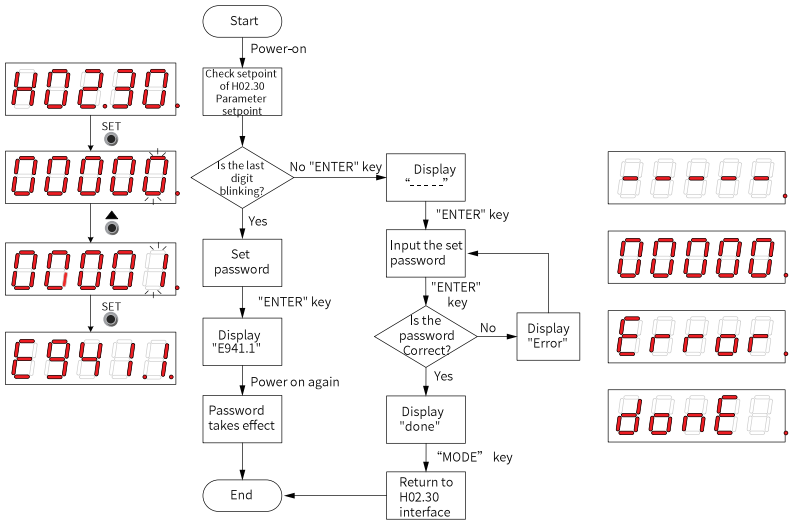


Figure 8-6 Procedure for setting the user password

- Modifying the user password
  To change the user password, input current password first to authorize the access to parameter setting. Next, enter H02.30 again to set a new password based on the procedure shown 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.

- Canceling the user password
  Enter the set user password, and set H02.30 to "00000" to cancel the user password.

DI function setting (taking H03.02 as an example)

Function setting of H03 group consists of three digits. The first digit is for setting axis No. and last two digits are for specific terminal functions. Diagram is shown in red dotted box below:

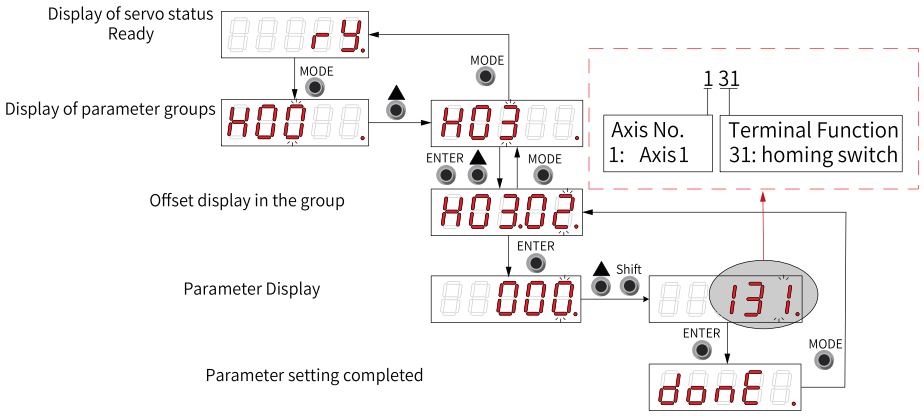


Figure 8-7 Procedures for DI function setting

For example, if DI1 and DI2 are set as the origin signals of the two modules respectively, the corresponding parameters can be set to the following values through the background software or panel: H03.02 = 131, H03.04 = 231.

Note

Set the DI terminal logic based on the hardware switch used.

DO function setting (taking H04.00 as an example)

The function No. setting of group H04 consists of three decimal digits. The first digit is for the setting the axis No. and last two digits are for allocating terminal functions. See the dotted line frame in red for details.

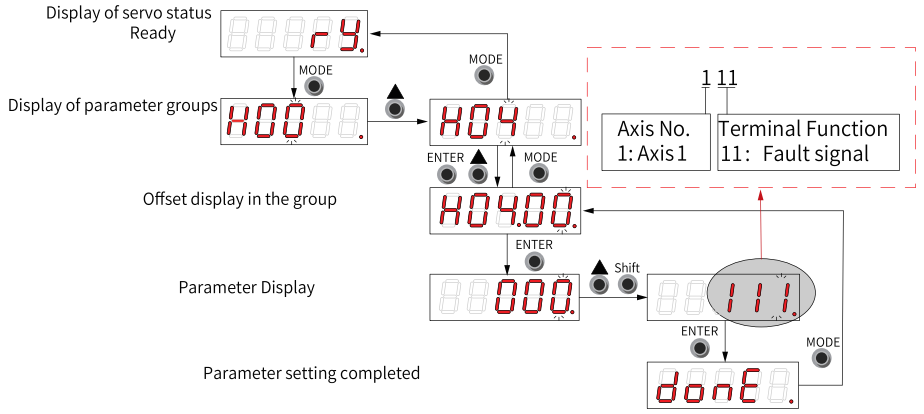


Figure 8-8 Procedures for DO function setting

For example, if DO1 and DO2 are set to the fault signals of two modules respectively, the corresponding parameters can be set to the following values through the background software or panel: H04.00 = 111, H04.02 = 211.

Note

Set the DO terminal logic based on the hardware switch used.

8.2 Commissioning Software

8.2.1 Overview

You can download the free software tool InoDriverShop at *http://www.inovance.com*.

Please use S6-L-T04 or CAT5E and above network cable for IS810 series communication with PC.

InoDriverShop supports 32-bit/64-bit Windows 7 and 64-bit Windows 10/11 operating systems. For details on how to use InoDriverShop, see the help document of InoDriverShop.

8.2.2 Installation

1. Software

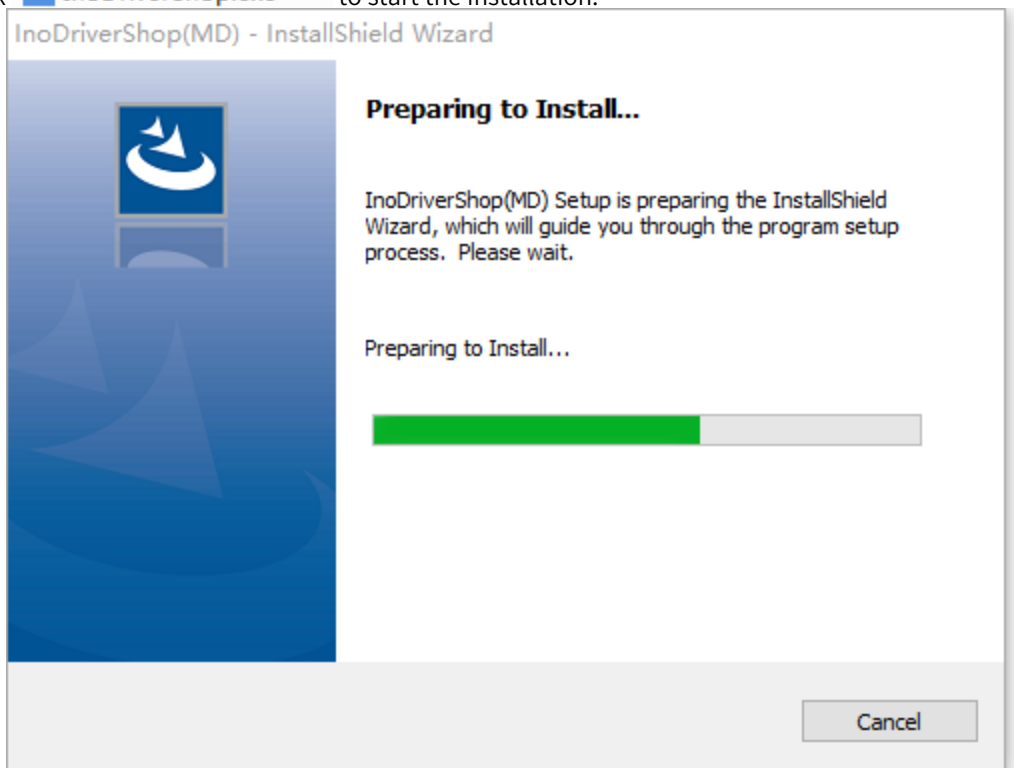
   a. Visit the official website of Inovance as shown below.
   http://www.inovance.com

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

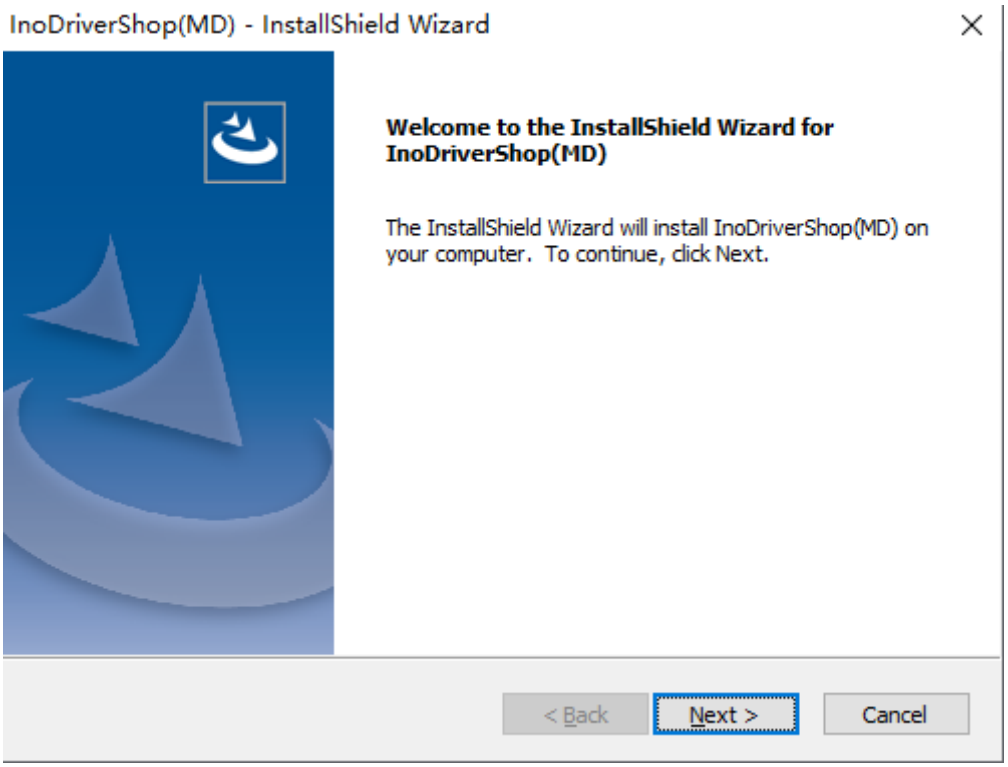
   c. Click **Download**.

2. Unzip the package downloaded.

3. Click InoDriverShop.exe to start the installation.

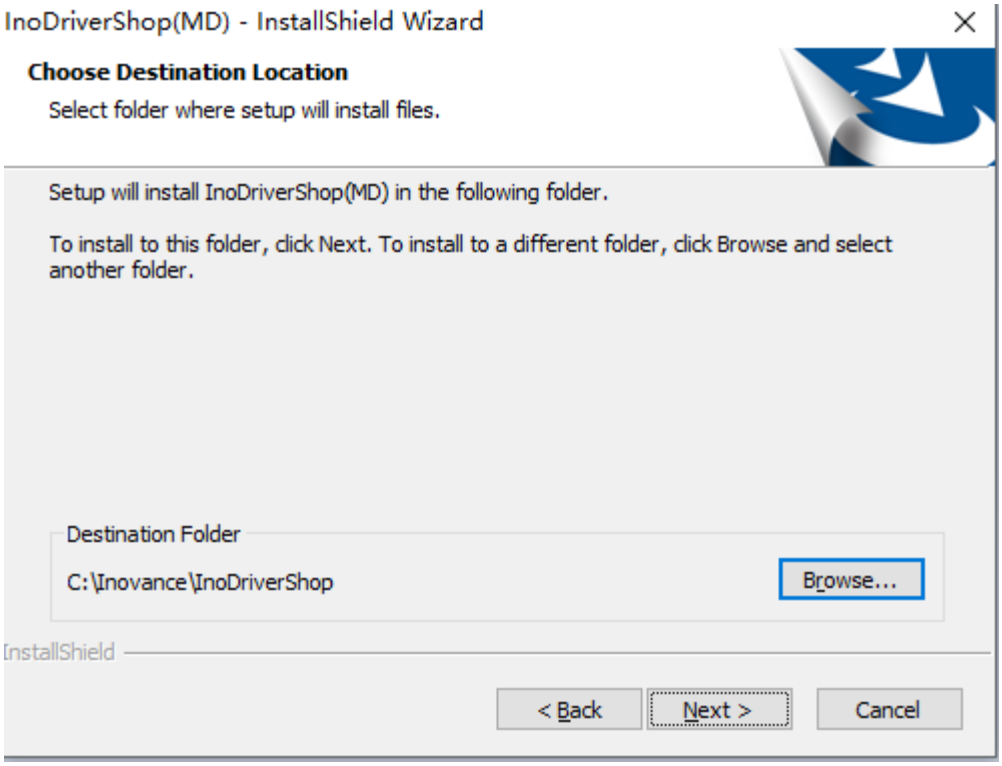


4. Click **Next**.

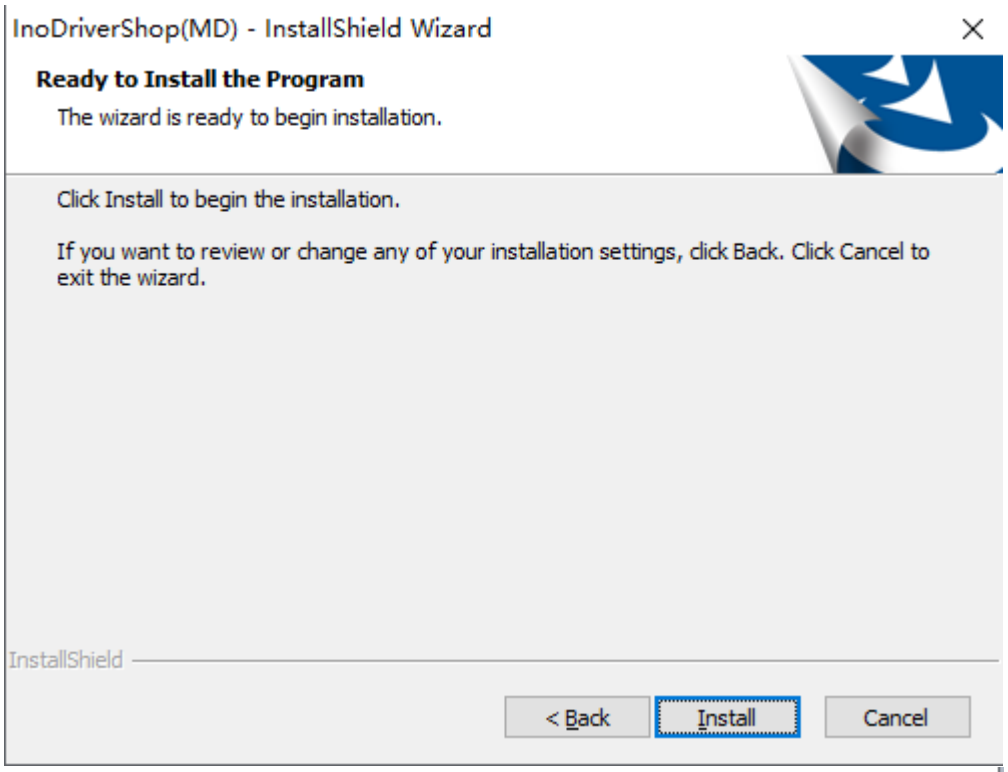


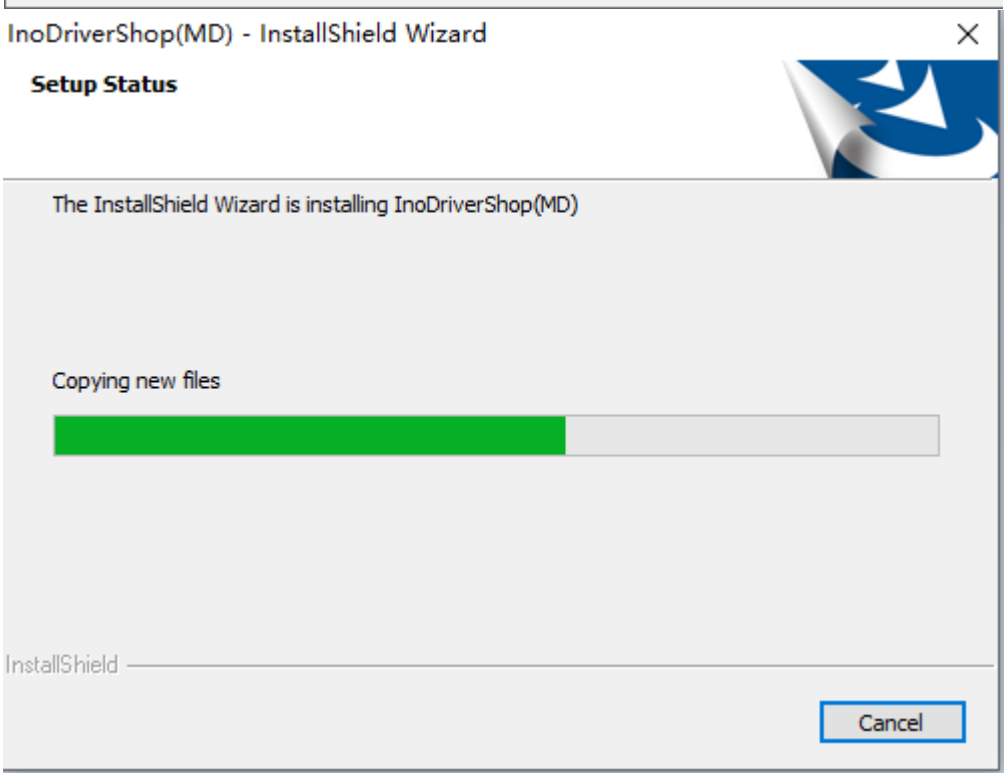
5. You can select the directory for installation as needed through the **Browse** button. The default directory for installation is "C:\Program Files\Inovance\InoDriverShop".
   In online upgrade, InoDriverShop will be upgraded directly in the original directory.

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

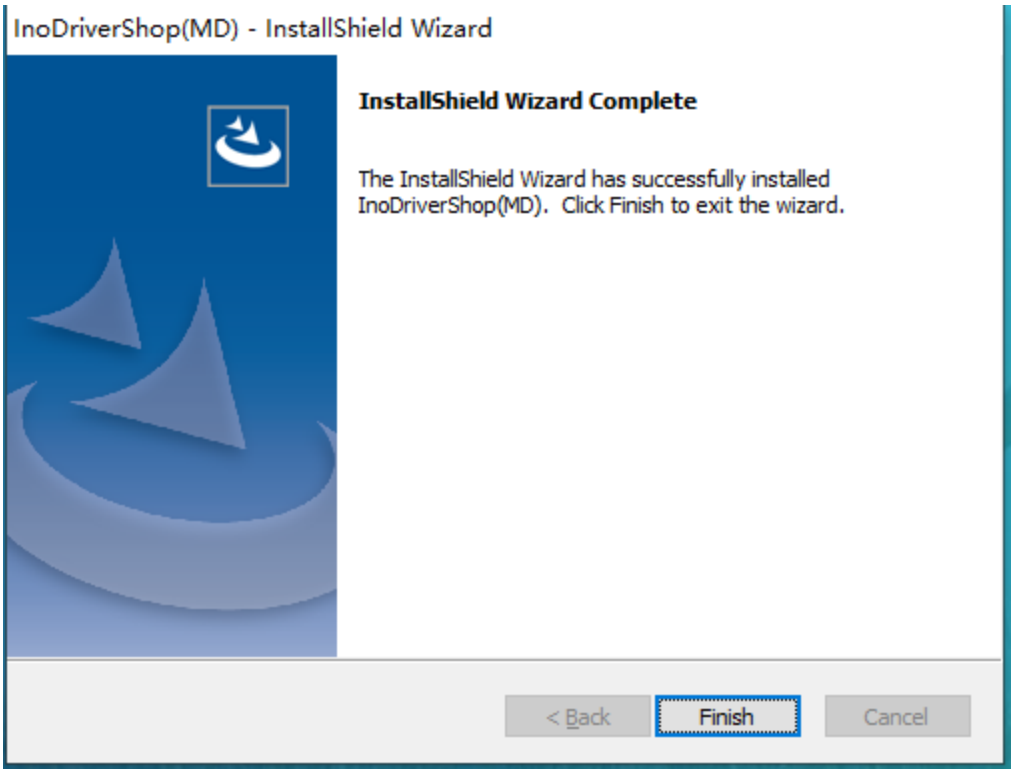


6. Click **Install** to start installation.





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



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

8.2.3 Connection

1. Start InoDriverShop.

- Double-click to start the InoDriverShop.

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

2. Create a project.

a. Click the "①" button in the figure below to create a new project.

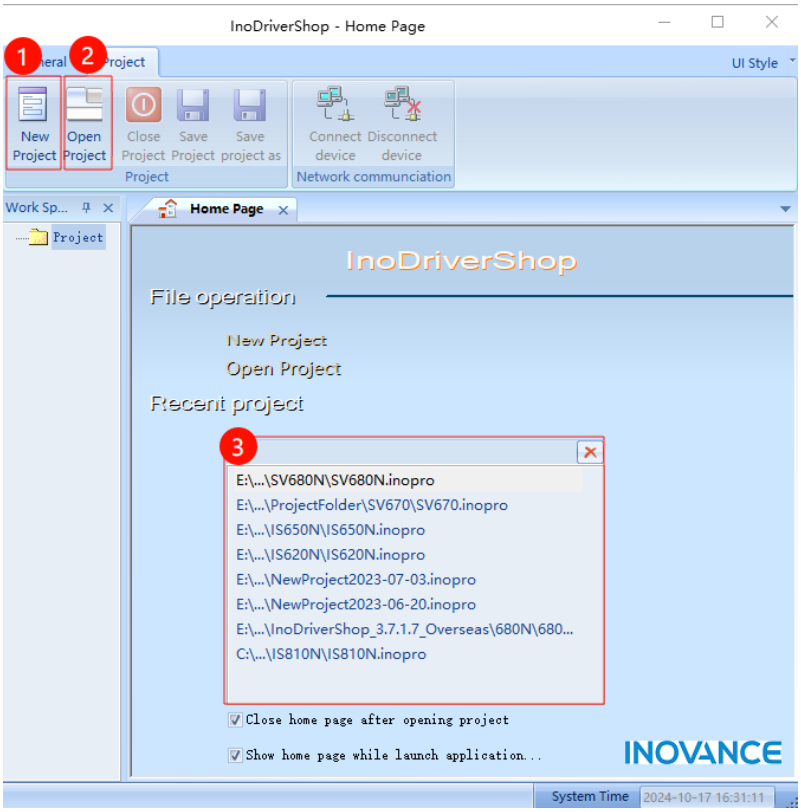


Figure 8-9 Software startup interface

Note

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

b. Open the Project Guide interface.

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

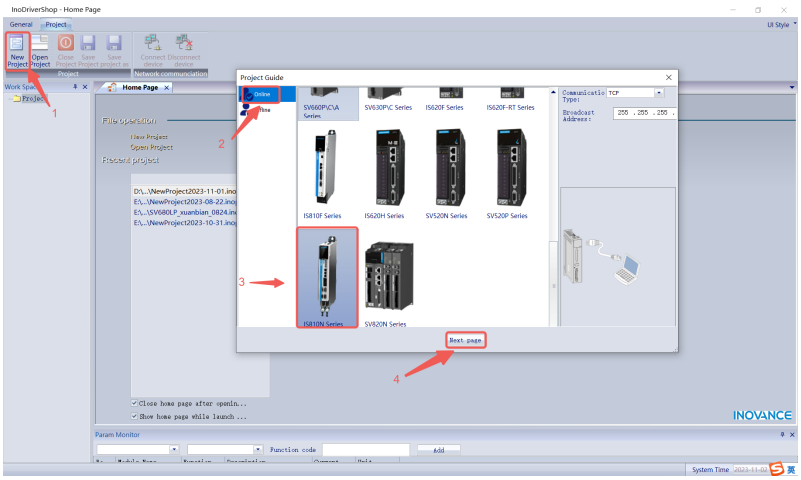


Figure 8-10 Project Guide interface

c. Click Next to create a new project.

- Creating a project for online device brings you to the following interface. The device is scanned automatically. Select the device to be commissioned and click Finish.

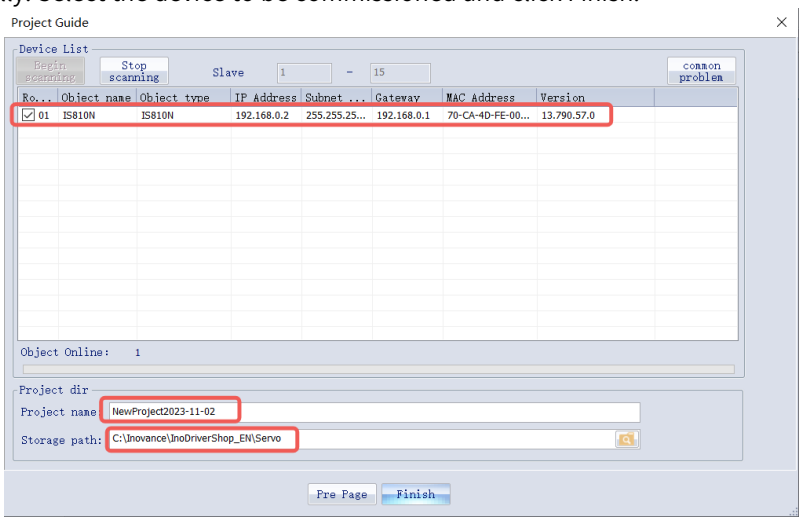


Figure 8-11 Scan interface

- Creating a project for offline device brings you to the following interface.
  You can select the Slave ID, Object Type, and Software Version as needed (1) and add different standards or customized devices (2). You can also designate the directory for storage or create multiple offline devices (4). Click (5) to complete.

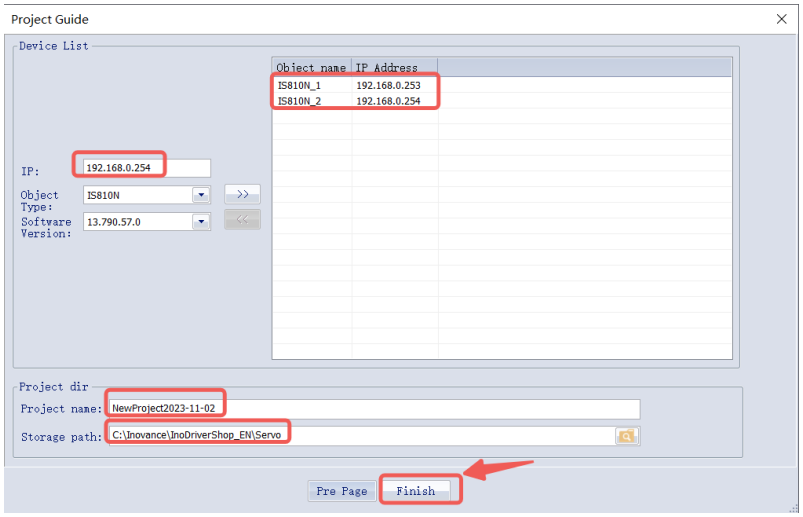


Figure 8-12 Project Guide interface for offline device

Note

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

d. The project has been created.

3. The main interface is shown as follows.

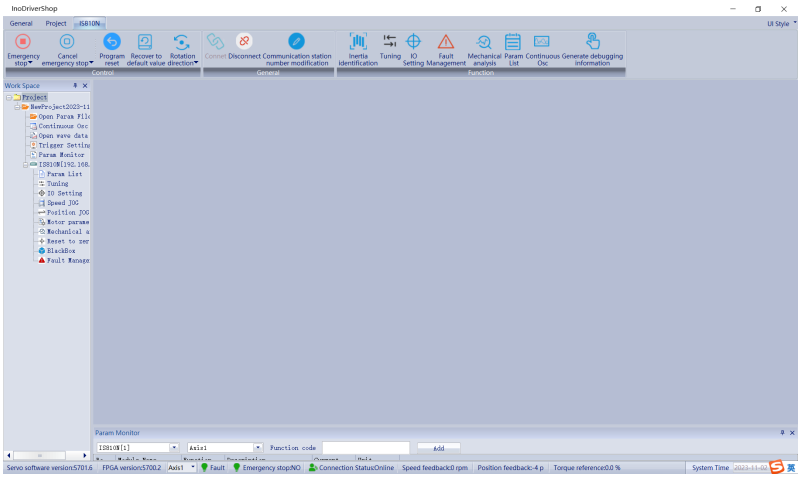
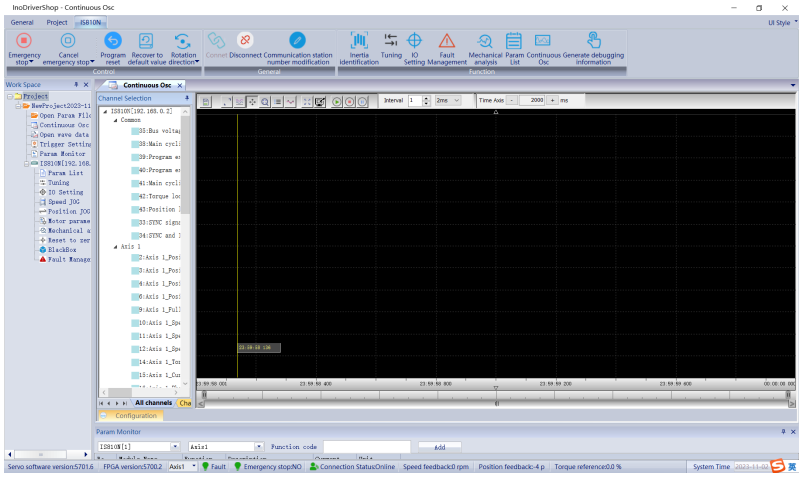


Figure 8-13 Main interface

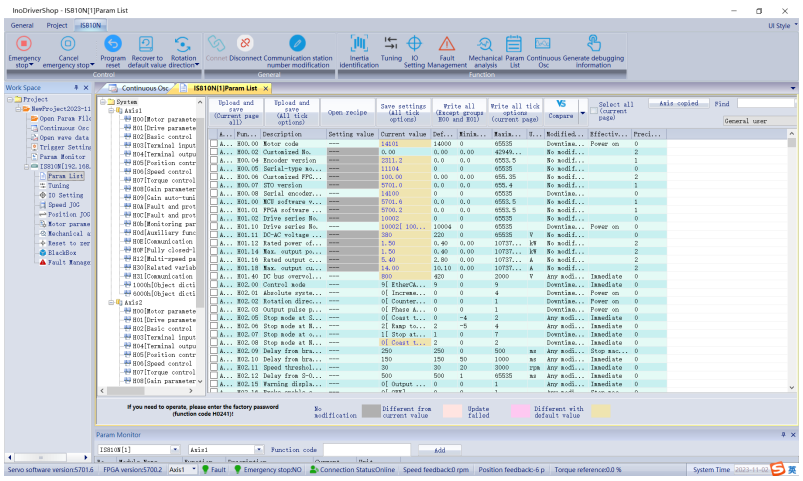
8.2.4 Common Functions

InoDriverShop features the following functions:

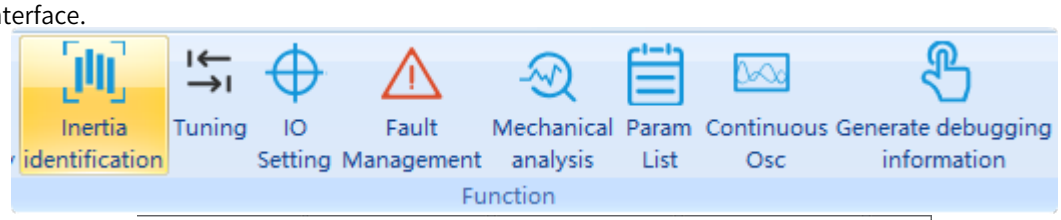
- Oscilloscope: Detects and saves the instantaneous data during operation. Double-click **Continuous Osc** in the workspace to open the continuous oscillator view.

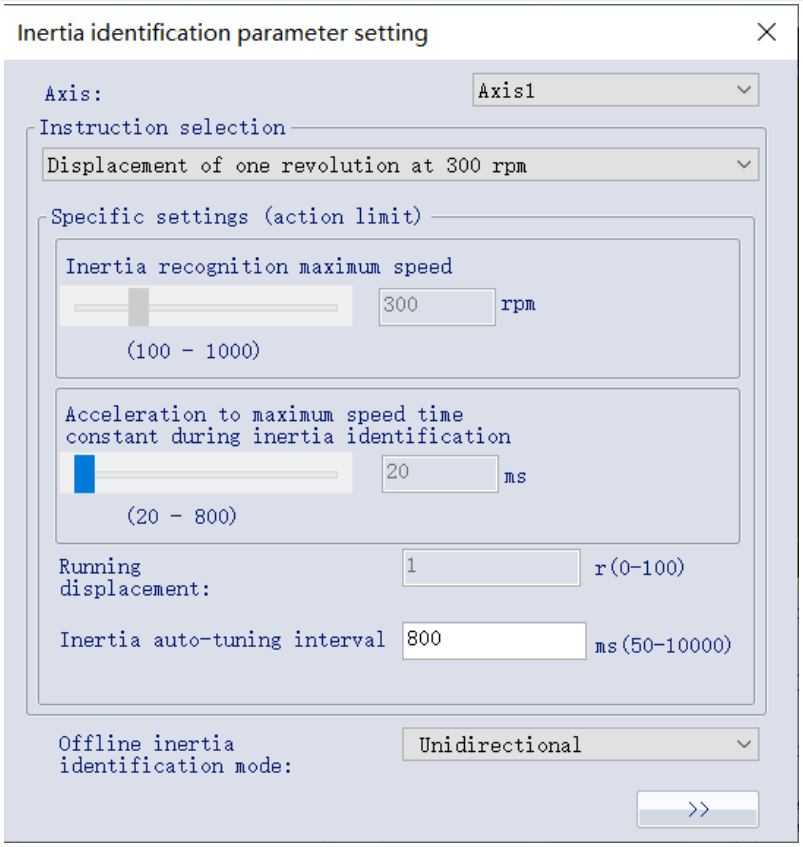


- Parameter management: Reads and downloads parameters in batches. Double-click **Parameter List** in the workspace to open the parameter list view. The current values of drive parameters are displayed in the parameter list. You can edit the parameter values and write them to the drive as needed.

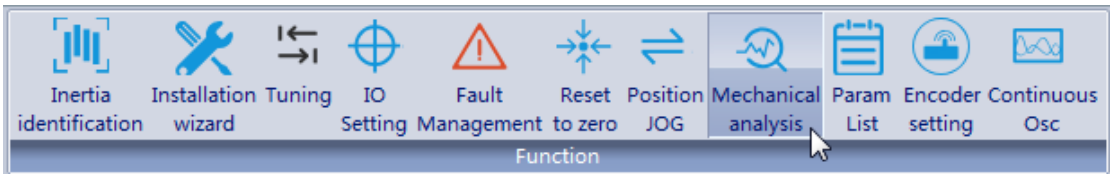


- Inertia auto-tuning: Generates the load inertia ratio automatically. Select the target axis to be operated through the drop-down list and configure the inertia auto-tuning parameters. After setting the inertia auto-tuning parameters, click the bottom button to enter the inertia auto-tuning interface.

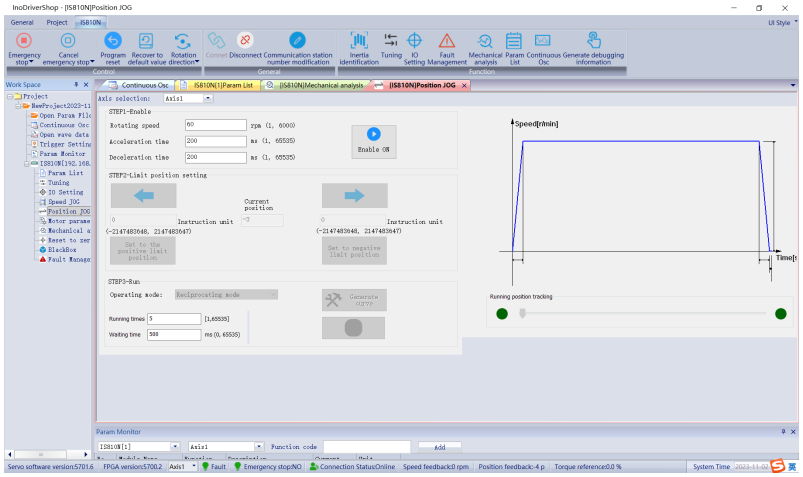




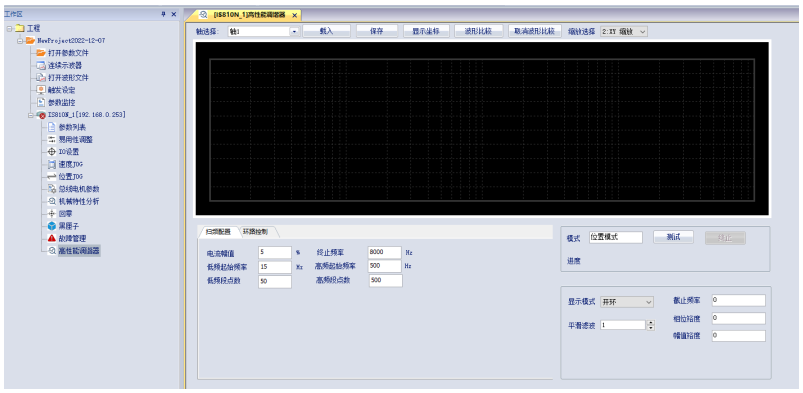
- Mechanical characteristic analysis: Analyzes the resonance frequency of the mechanical system.



- Motion JOG: Generates position references to make the motor run. Select the target axis in the drop-down list, and configure and enable parameters.



- Gain tuning: Adjusts the stiffness level and monitors the motion data.
- High-performance tuner: High-performance tuner mainly includes three functions: frequency domain characteristic identification, visual virtual debugging, and auto-tuning of control parameters.
  - Frequency domain characteristic identification can accurately identify the mechanical characteristics, open-loop characteristics and closed-loop characteristics of the control system.
  - Visual virtual commissioning can realize accurate virtual commissioning of the control system.
  - Self-tuning of control parameters realizes self-tuning of control parameters based on frequency domain.



9 Commissioning and Operation

9.1 Commissioning Flowchart

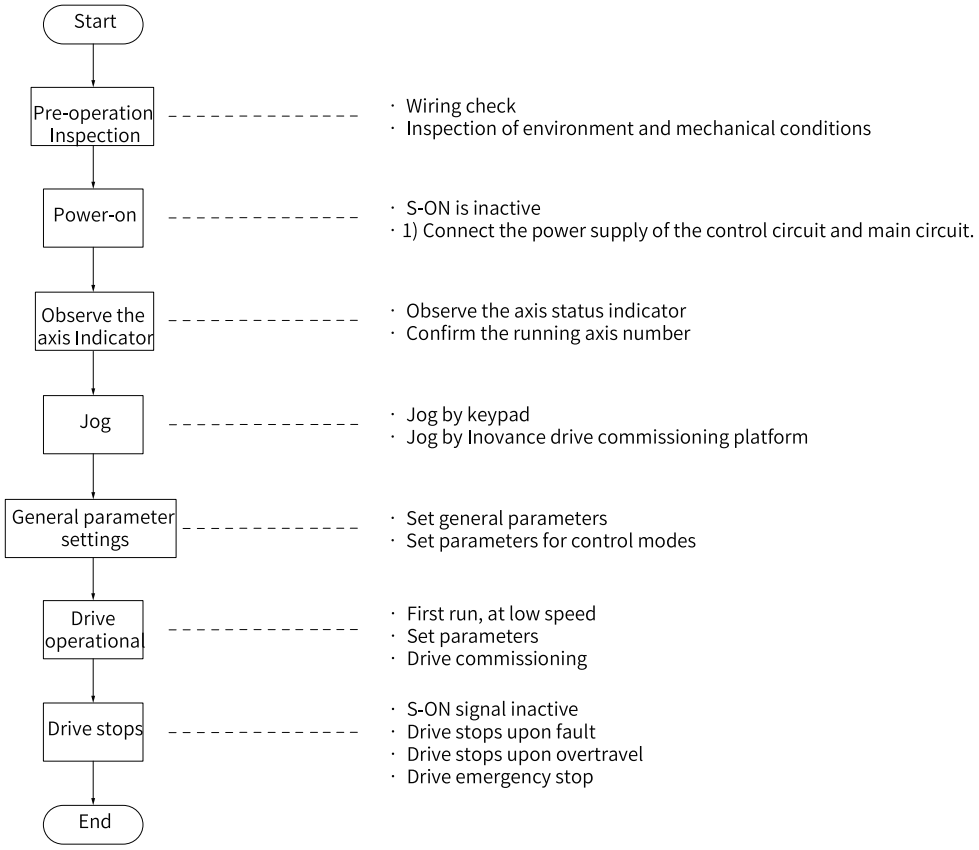


Figure 9-1 Commissioning flowchart of the drive

9.2 Inspection Before Commissioning

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

Table 9–1 Checklist before operation

Log	No.	Description
Wiring		
□	1	The main circuit power input terminals R, S, T of the power supply unit are connected correctly. The input power is 380 VAC to 480 VAC, 50/60 Hz.
□	2	The motor shaft main circuit output terminals U, V, W of the drive unit are properly connected to the power cables U, V, W of the servo motor in the correct phase sequence.
□	3	The control signal cables, such as the brake signal cable and overtravel protection signal cable, are connected properly.
□	4	The servo drive and servo motor are grounded properly.
□	5	The cable tension is within the permissible range.
□	6	All the wiring terminals are insulated properly.
Environment and Mechanical Conditions		

Log	No.	Description
☐	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 servo motor is installed properly. The motor shaft is connected to the machine securely.
☐	4	The servo motor and the connected machine are in good condition and ready to run.

9.3 Power-on

Connect the power supply of the main circuit.

After connecting the power supply of the main circuit, if the bus voltage indicator is in normal display and the keypad displays “Reset”, “Nr”, and “Ry” in sequence, it indicates that the servo drive is ready for running and waiting for the S-ON signal from the host controller.

9.4 Observing the Axis Indicator

Observe the status of the axis indicator on the panel, and obtain the running axis number and axis status.

Name	Description
Axis status indicator	Blinking: Axis is faulty On: The current axis parameter is being operated Off: The current axis parameter is not being operated

Long pressing the MODE button: executes the axis switching action once. Observe the LED to confirm whether axis 1 or 2 is operating.

9.5 Jog

Perform jogging to check whether the servo motor can rotate properly without abnormal vibration or noise. This operation can be performed via the keypad in speed mode, Inovance servo commissioning software in speed mode and keypad in position mode.

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)

- Procedure:

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

The keypad displays the default jog speed at this moment.

2. After pressing the "ENTER" key, adjust the JOG running speed through the "UP"/"DOWN" keys, and then press the "ENTER" key panel to display the "JOG" JOG status.
3. Hold the UP/DOWN key down to make the motor jog forwardly or reversely.
4. Press the MODE key to exit the jog mode and return to the upper-level menu.

Jogging through the software tool

Steps:

1. Open the Speed JOG interface in the software tool.
2. Switch the drive to a non-bus control mode (H02.00 is not 9).
3. Select the corresponding axis in "Axis Selection".
4. Set the jog speed.
5. After switching the servo status to ON, press the forward/reverse arrow displayed on the interface to switch between forward and reverse jog.

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. After pressing the "ENTER" key, modify the jog running speed through the "UP"/"DOWN" key, and then press the "ENTER" key panel to display the "JOG-P" jog status, and the motor is powered on.
3. Hold the UP/DOWN key down to make the motor jog forwardly or reversely.
   Press the MODE key to exit the jog mode and return to the upper-level menu.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H06.12	2006-0Dh	Acceleration ramp time of jog speed	0 ms–65535 ms	Sets the acceleration ramp time of jog speed.	10	ms	UInt16	Real-time	Real-time
Defines the time constant for the servo motor to accelerate from 0 RPM to 1000 RPM.									

9.6 Setting Parameters

Rotation direction selection

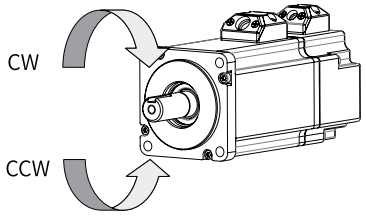
Set H02.02 to change the direction of rotation directly.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.02	2002-03h	Rotation direction selection	0: Counterclockwise (CCW) as forward direction 1: Clockwise (CW) as forward direction	Defines the forward direction of the motor when viewed from the motor shaft side.	0	-	UInt16	At stop	Upon the next power-on

Defines the forward direction of the motor when viewed from the motor shaft side.

Value	Rotating direction	Remarks
0	Counterclockwise (CCW) as forward direction	Defines the CCW direction as the forward direction when a forward run command is received, indicating the motor rotates in the CCW direction when viewed from the motor shaft side.
1	Counterclockwise (CW) as forward direction	When a forward command is input, the motor rotates in CW direction viewed from the motor shaft side, that is, the motor rotates clockwise.



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.

Selection of output pulse phase

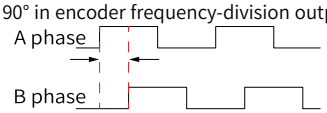
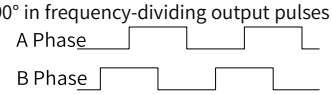
The output pulse of the servo drive is phase A + phase B quadrature pulse.

The relationship between phase A and phase B pulses can be changed directly through H02.03.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.03	2002-04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	Defines the relationship between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.	0	-	UInt16	At stop	Upon the next power-on

It sets the relation between phase A and phase B on the condition that motor rotating direction remains unchanged when pulse output is enabled.

Value	Output pulse phase	Remarks
0	Phase A leads phase B.	Phase A leads phase B by 90° in encoder frequency-division output pulses. 
1	Phase A lags phase B.	Phase A lags phase B by 90° in frequency-dividing output pulses of encoder. 

9.7 Drive Operational

When the S-ON signal is switched on, the keypad displays "88rn", but if there is no command input at this moment, the servo motor does not rotate and stays locked. After a reference is input, the motor starts rotating.

Table 9–2 Operation of the servo drive

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

Power-on sequence diagram

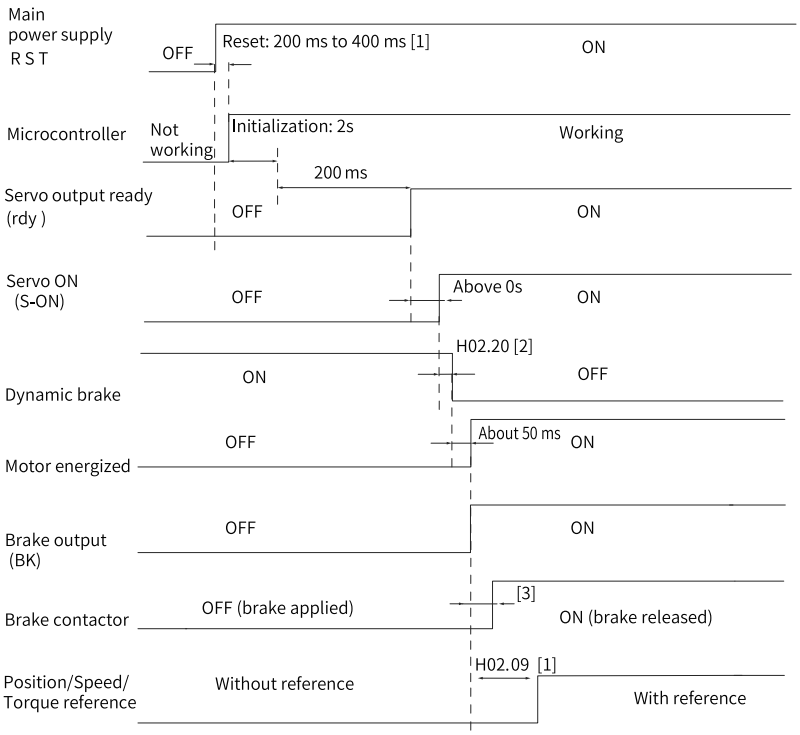


Figure 9-2 Power-on sequence diagram

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] The delay of brake contactor operation.
- [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

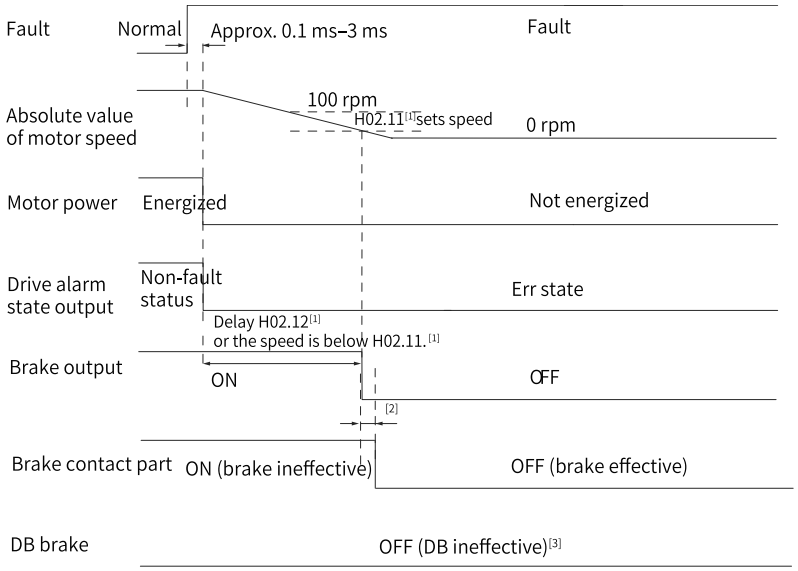


Figure 9-3 Sequence of "Coast to stop, keeping de-energized state" at No. 1 fault

Note

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

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

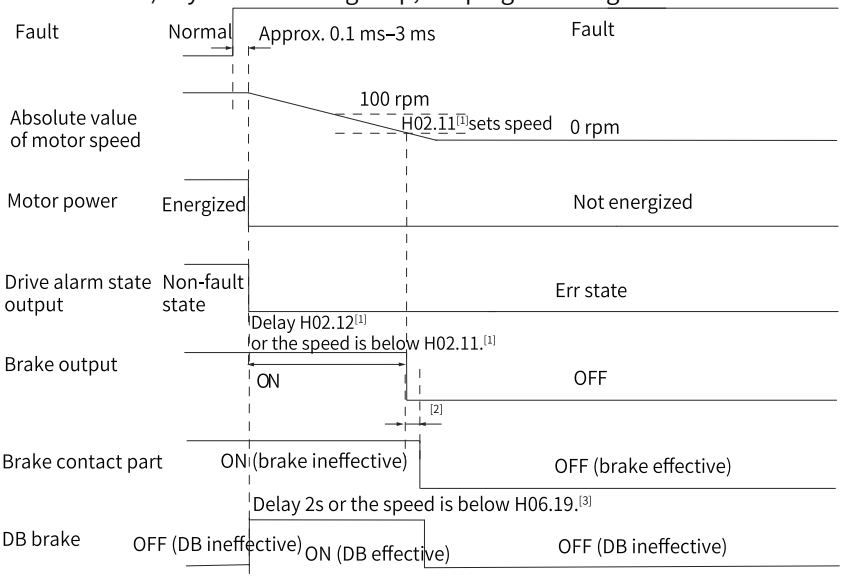


Figure 9-4 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 1 fault

Note

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

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

Figure 9-5 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] The delay of brake contactor operation.
- [3] The dynamic brake is included in the standard configuration.

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

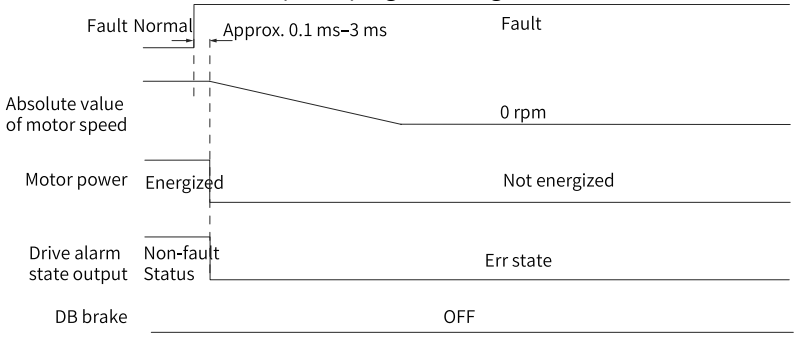


Figure 9-6 Sequence of "Coast to stop, keeping de-energized state" at No. 2 fault

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

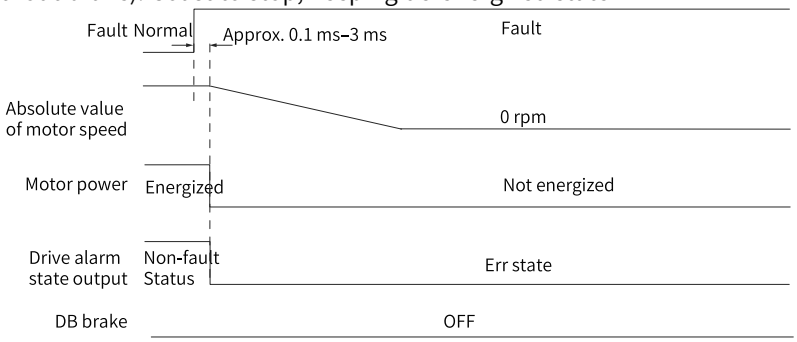


Figure 9-7 Sequence of "Coast to stop, keeping de-energized state" at No. 2 fault

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

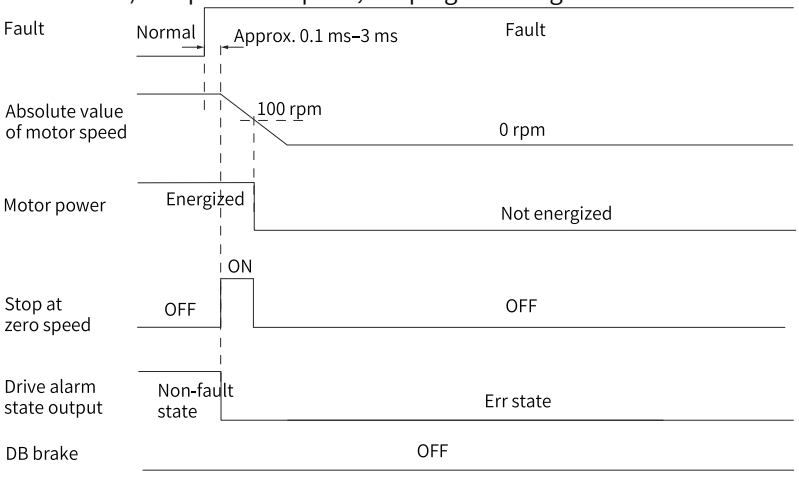


Figure 9-8 Sequence of "Stop at zero speed, keeping de-energized state" at No. 2 fault (without brake)

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

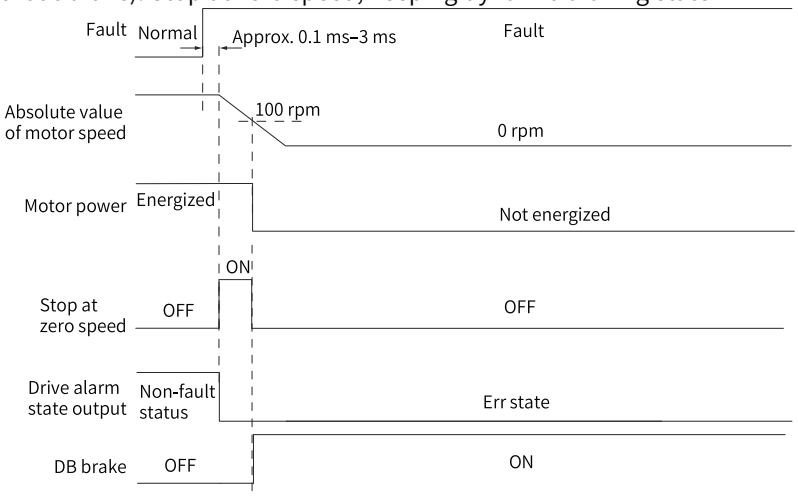


Figure 9-9 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (without brake)

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

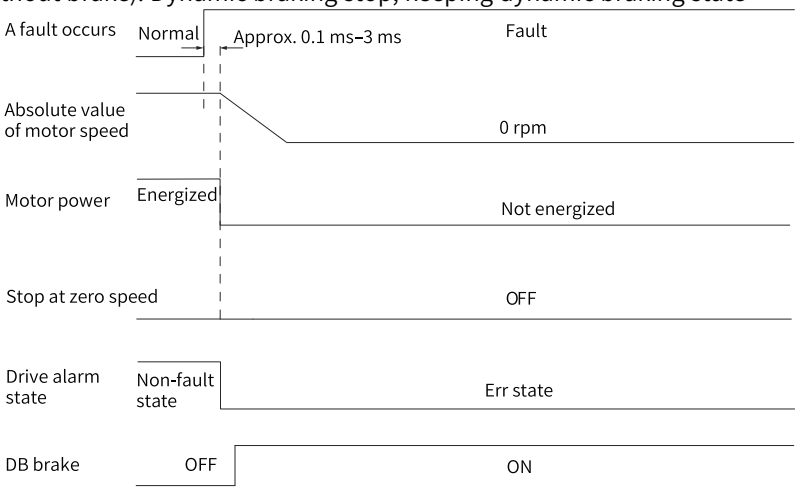


Figure 9-10 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 2 fault (without brake)

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

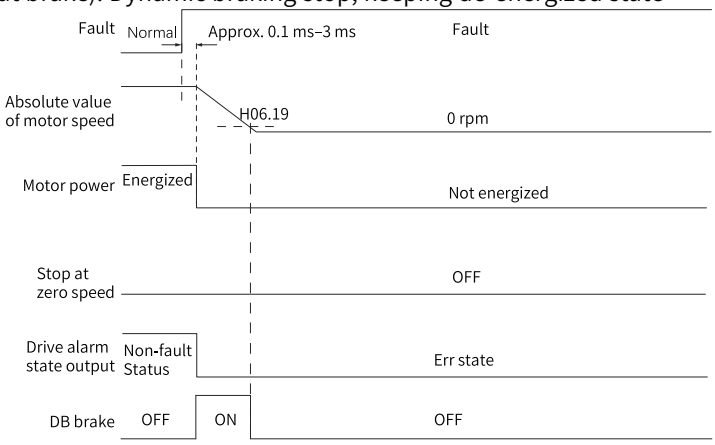


Figure 9-11 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 2 fault (without brake)

- No. 2 fault (with brake): forced to 6085 ramp to stop, keeping dynamic braking status

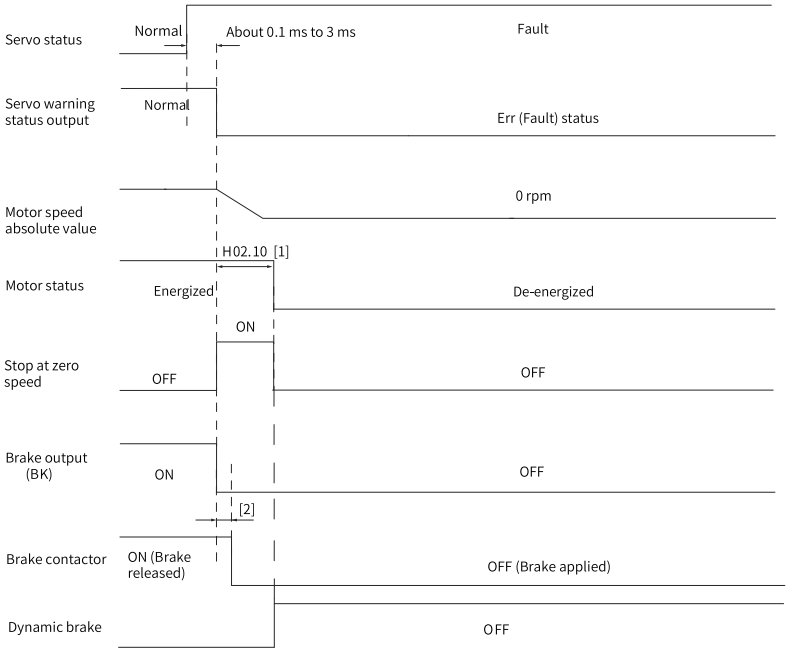


Figure 9-12 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (with brake)

Note

- [1] If the brake is not used, H02.10 is invalid.
- [2] The delay of brake contactor operation.

- 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 9–13 Sequence for alarms that cause stop" on page 146*.
- Alarms that cause stop: Stop at zero speed, keeping position lock status

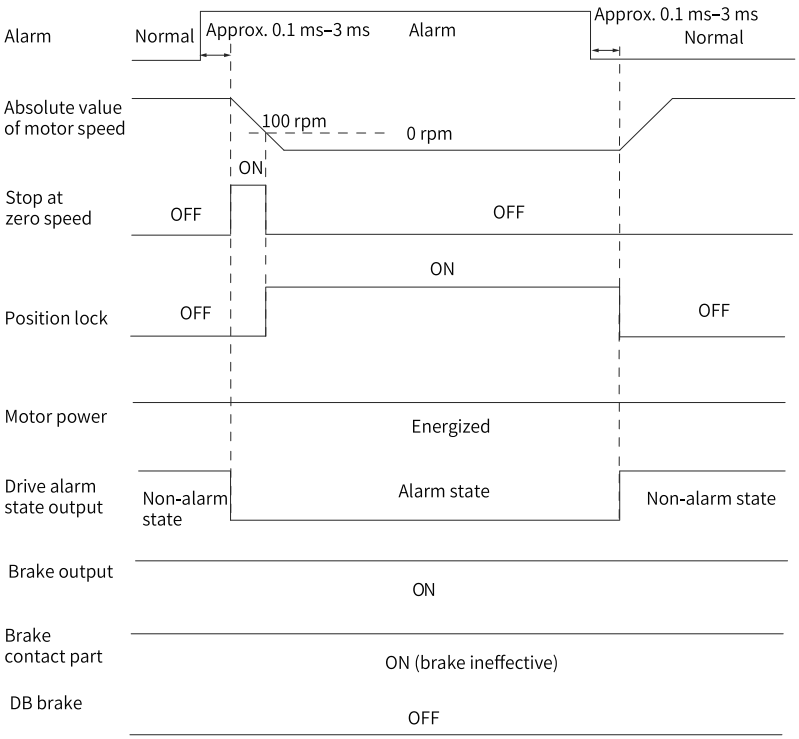


Figure 9-13 Sequence for alarms that cause stop

Other alarms do not affect the operation state of the drive. The sequence diagram for these alarms is shown in *"Figure 9–14 Sequence for alarms that do not cause stop" on page 146*.

- Alarms that do not cause stop

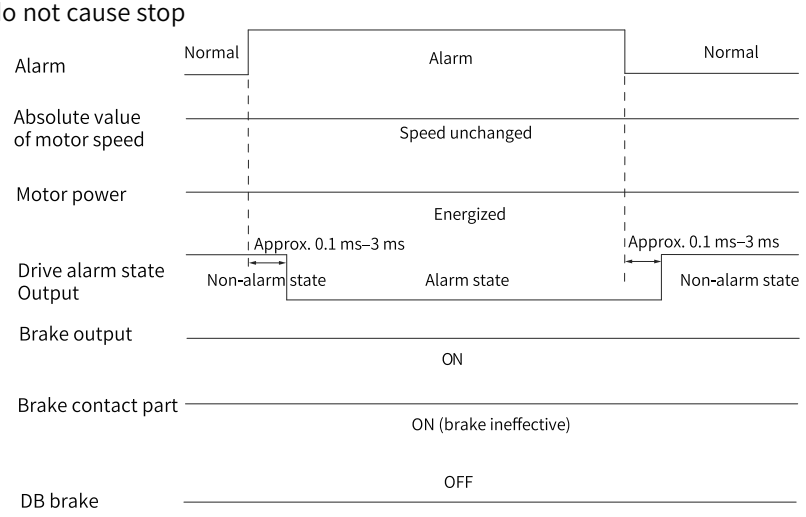


Figure 9-14 Sequence for alarms that do not cause stop

- Fault reset

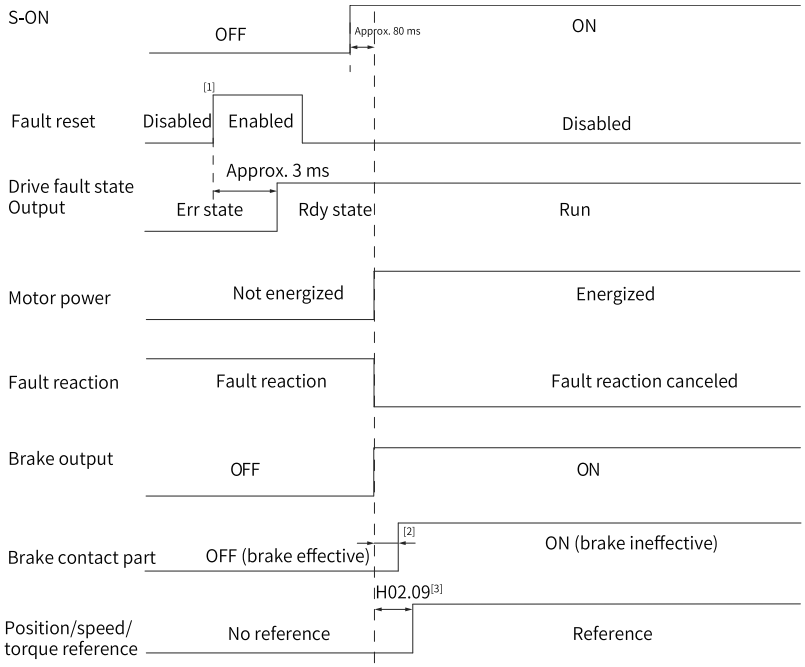


Figure 9-15 Sequence for fault reset

Note

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

9.8 Drive stops

Five type 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 kinds of stop status: de-energized, position lock, and dynamic braking. See the following table for details.

Table 9–3 Comparison of the stop modes

Stop Mode	Description	Feature
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 shock.
Stop at zero speed	The motor decelerates to 0 rpm immediately and stops.	Features quick deceleration with obvious mechanical shock.
Ramp to stop	The servo drive decelerates smoothly to 0 RPM and stops.	Features smooth and controllable deceleration with small mechanical shock.

Stop Mode	Description	Feature
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 servo motor is in the dynamic braking status. ***Note***There is no servo drive with built-in dynamic brake. It is recommended to connect an external dynamic brake to achieve fast DB braking. For details, see *Servo Dynamic Brake User Manual*.	Features quick deceleration with obvious mechanical shock.

Table 9–4 Comparison of the stop status

Stop Status	Description
De-energized	The motor is de-energized and the motor shaft can be rotated freely after the motor stops rotating.
Position Lock	The motor shaft is locked and cannot be rotated freely after the motor stops rotating.
DB state	The motor keeps DB status after stop.

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. See the following descriptions for details.

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	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
605Ch	Stop mode at S-OFF	–4: Ramp to stop as defined by 6085h, keeping dynamic braking state –3: 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	–4: Ramp to stop as defined by 6085h, keeping dynamic braking state –3: 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	-	Int16	At stop	Real-time
Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop. Set a proper stop mode according to the mechanical status and operation requirements. After the brake output is enabled, the servo enable and OFF shutdown mode is forced to "zero speed shutdown and maintain DB state".								

Fault reaction

The stop mode varies according to the fault type. For fault classification, see section "Fault Handling".

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the deceleration mode of the motor for stopping rotating when a No. 1 fault occurs and the motor status after stop.	0	-	UInt16	At stop	Real-time
Defines the deceleration mode of the motor for stopping rotating upon occurrence of a No. 1 fault and the motor status after stop. After enabling the brake output, stop mode at No.1 fault is forced to "DB stop, keeping the de-energized state."									

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
605Eh	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	–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	-	Int16	At stop	Real-time
Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 2 fault occurs. After the brake can be held and output, the shutdown mode of fault NO.2 is forced to be "zero speed stop and keep DB state".								

Stop at overtravel

★ Definition of terms:

- "Overtravel": The mechanical motion exceeds 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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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: Stop based on ramp, keeping de-energized state 4: Stop based on ramp, 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	Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when overtravel occurs.	1	-	UInt16	At stop	Real-time

Defines the deceleration mode of the motor for stopping rotating upon overtravel and the motor status after stop.

Value	Stop Mode
0	Coast to stop, keeping de-energized status
1	Stop at zero speed, keeping position lock status
2	Stop at zero speed, keeping de-energized status
3	Ramp to stop as defined by 6085h, keeping the de-energized state
4	Ramp to stop as defined by 6085h, keeping position lock status
5	Dynamic braking stop, keeping de-energized status
6	Dynamic braking stop, keeping dynamic braking status
7	Not responding to overtravel

When the servo motor drives vertical axis, set H02.07 to 1 or 4 to make the motor axis in position locking state after the limit switch signal is active to ensure safety.

After the brake output function is enabled, and motor stop mode is “forced braking”, the stop mode at overtravel is forcibly set to "Ramp to stop as defined by 6085h, keeping position lock status".

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. When the workpiece moves linearly, install the limit switch to prevent mechanical damage. When overtravel occurs, input a reverse running command to make the motor (workpiece) run in the opposite direction.

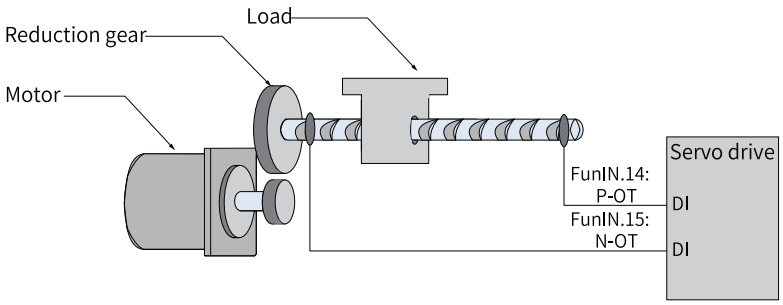


Figure 9-16 Installation of limit switches

To use the limit switches, assign FunIN.14 (P-OT, positive limit switch) and FunIN.15 (N-OT, negative limit switch) to two DIs of the servo drive and set the active logic of these DIs. This is to enable the servo drive to receive the level signals input from the limit switches. The servo drive determines whether to enable the limit switch function based on the state of the DI terminal level.

☆ Related parameters:

Code	Name	Function Name	Function
FunIN.14	P-OT	Positive limit switch	When the machine moves beyond the specified range, overtravel prevention applies. Inactive: Forward drive permitted Active: Forward drive inhibited
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

Auxiliary function: emergency stop

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0d.05	200d-06h	Emergency stop	0: No operation 1: Emergency stop	-	0	-	UInt16	Real-time	Real-time

Defines whether to enable emergency stop.

Value	Function
0	No operation
1	Enable

When this function is enabled, the servo drive immediately stops according to the Stop mode at S-ON OFF 605Ch regardless of its state.

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	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	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	-	Int16	At stop	Real-time

Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor status after stop.

Value	Stop Mode
0	Coast to stop, keeping 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 position lock status
6	Ramp to stop as defined by 6085h, keeping position lock status
7	Stop at emergency-stop torque, keeping position lock status

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	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the 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	-	Int16	At stop	Real-time

Defines the deceleration mode of the motor for stopping rotating upon halt and the motor status after stop.

PV/PP/HM Mode:

Value	Stop Mode
1	Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock status
2	Ramp to stop as defined by 6085h, keeping position lock status
3	Stop at emergency-stop torque, keeping position lock status

Profile torque mode:

Value	Stop Mode
1/2/3	Ramp to stop as defined by 6087h, keeping position lock status

10 Adjustment

10.1 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.

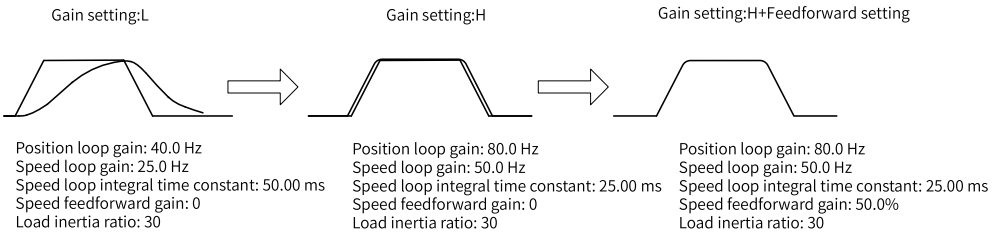


Figure 10-1 Example of gain tuning

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 a trial run through jogging to ensure the motor operates properly.

The following figure shows the general flowchart for gain tuning.

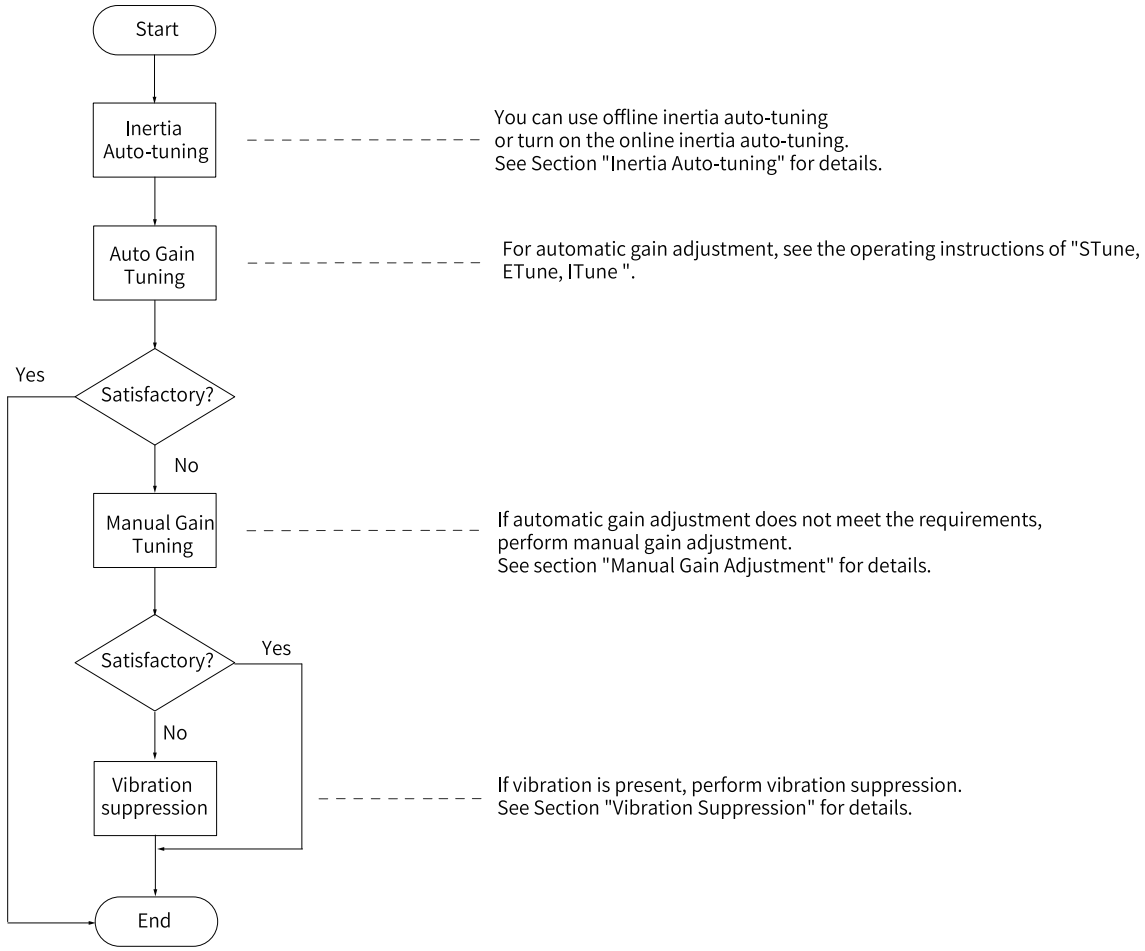


Figure 10-2 Steps

Table 10–1 Description of gain tuning

Steps			Function	Reference
1	Inertia Auto-tuning	Offline	The servo drive calculates the load inertia ratio automatically through inertia auto-tuning.	*"10.2.1 Offline Inertia Auto-tuning" on page 159*
		Online	The host controller sends a command to make the motor rotate, and the servo drive calculates the load inertia ratio in real time.	*"10.2.2 Online Inertia Auto-tuning" on page 161*
2	Auto Gain Tuning		The servo drive generates a group of gain parameters based on the correct inertia ratio.	*"10.3.1 ETune" on page 163* and *"10.3.2 STune" on page 168*

Steps			Function	Reference
3	Manual Gain Tuning	Basic gains	If the auto-tuned gain values fail to deliver desired performance, fine-tune the gains manually to improve the performance.	*"10.4.1 Basic Parameters" on page 176*
		Reference filter	Smoothens the position, speed, and torque references.	*"10.4.3 Position Reference Filter" on page 185*
		Feedforward gain	Improves the follow-up behavior.	*"10.4.4 Feedforward gain" on page 186*
		Pseudo differential regulator	Adjusts the speed loop control mode to improve the anti-interference capability at low frequency range.	*"10.4.5 PDFF Control" on page 189*
		Torque disturbance observer	Improves the resistance against torque disturbance.	*"10.4.6 Torque disturbance observer" on page 190*
4	Vibration suppression	Mechanical resonance	Suppresses mechanical resonance through the notch.	*"10.6.1 Mechanical Resonance Suppression" on page 201*

10.2 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.

10.2.1 Offline Inertia Auto-tuning

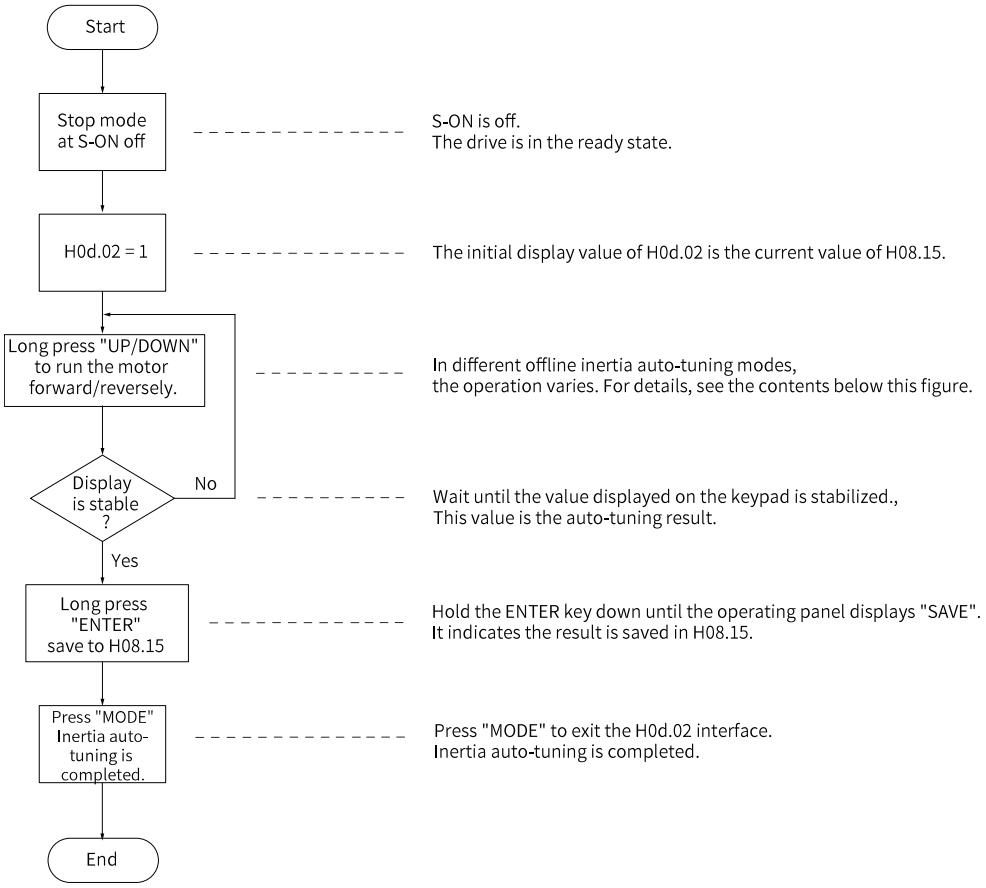


Figure 10-3 Offline inertia auto-tuning flowchart

Check the following 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.
  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 the values of H09.06 (Maximum speed of inertia auto-tuning), H09.07 (Time constant for accelerating to the maximum speed during inertia auto-tuning), and H09.09 (Number of revolutions per inertia auto-tuning) to ensure the travel distance that starts from the stop position is larger than

the value of H09.09. Otherwise, decrease the value of H09.06 or H09.07 until this requirement is met.

Steps:

1. Switch off the S-ON signal.
2. In parameter display mode, switch to H0d.02 and press ENTER 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 ENTER key down until the operating panel displays "SAVE".
7. Press the MODE key to exit.

For applications requiring 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 general flowchart for offline inertia auto-tuning.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.05	2009-06h	Offline inertia auto-tuning mode	0: Bi-directional 1: Unidirectional	Defines the offline inertia auto-tuning mode. The offline inertia auto-tuning function can be enabled through H0d.02.	1	-	UInt16	At stop	Real-time
H09.06	2009-07h	Max. speed of inertia auto-tuning	100 RPM to 1000 RPM	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.	500	rpm	UInt16	At stop	Real-time
H09.07	2009-08h	Time constant for accelerating to max. speed during inertia auto-tuning	20 ms–800 ms	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.	125	ms	UInt16	At stop	Real-time
H09.08	2009-09h	Interval time after an individual inertia auto-tuning	50 ms–10000 ms	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).	800	ms	UInt16	At stop	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.09	2009-0Ah	Number of motor revolutions per inertia auto-tuning	0.00 to 100.00	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.	1.00	-	UInt16	Real-time	Real-time
H0d.02	200d-03h	Inertia auto-tuning enable	0 to 65	Used to enable offline inertia auto-tuning through the keypad. In the parameter display mode, switch to H0d.02 and press the ENTER key to enable offline inertia auto-tuning.	0	-	UInt16	Real-time	Real-time

10.2.2 Online Inertia Auto-tuning

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

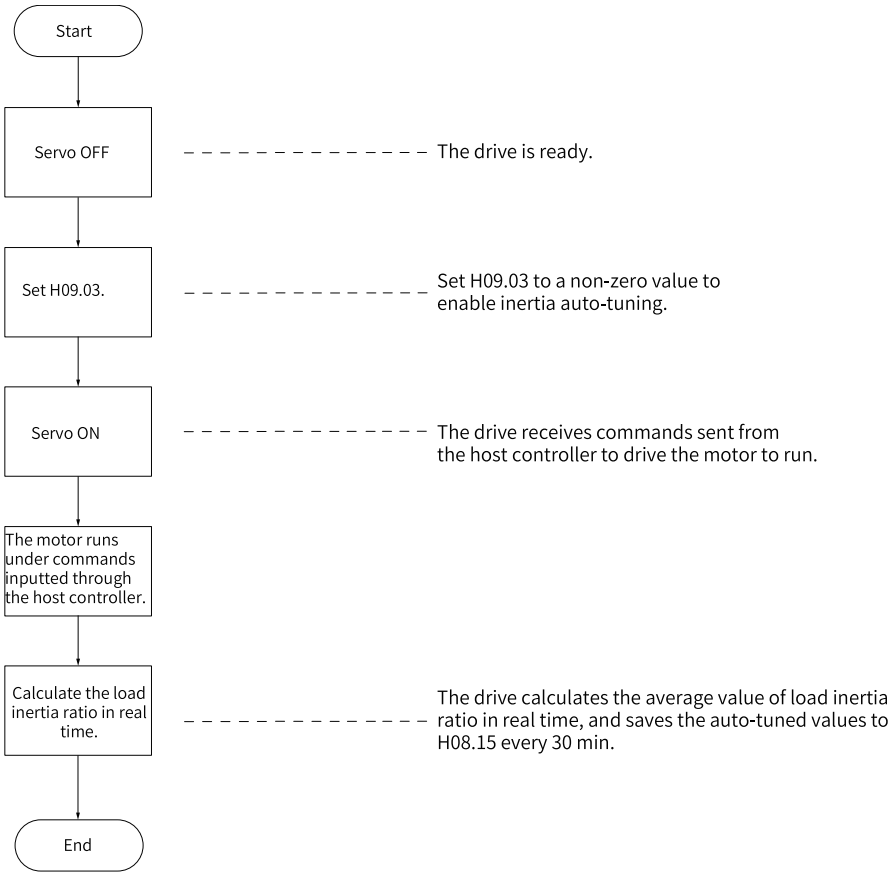


Figure 10-4 Online inertia auto-tuning flowchart

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 parameter

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.03	2009-04h	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	Defines whether to enable online inertia auto-tuning and the inertia ratio update speed during online inertia auto-tuning.	2	-	UInt16	Real-time	Real-time

10.3 Auto Gain Tuning

10.3.1 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 performs auto-tuning automatically 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 applications featuring slight load inertia change.

Description of ITune operation

- **Operation flowchart**

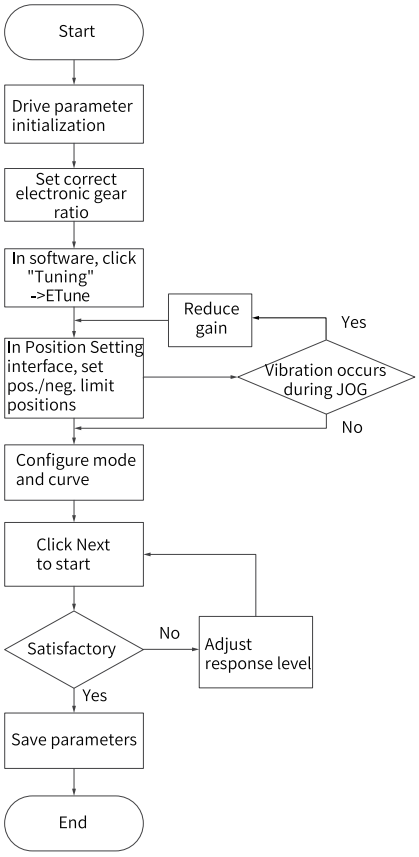
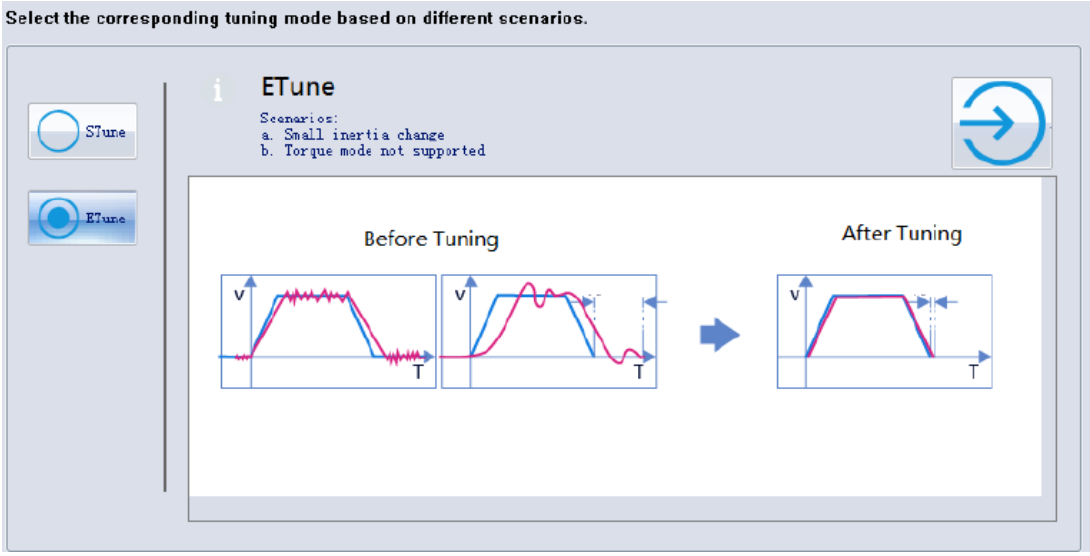


Figure 10-5 Operation flowchart

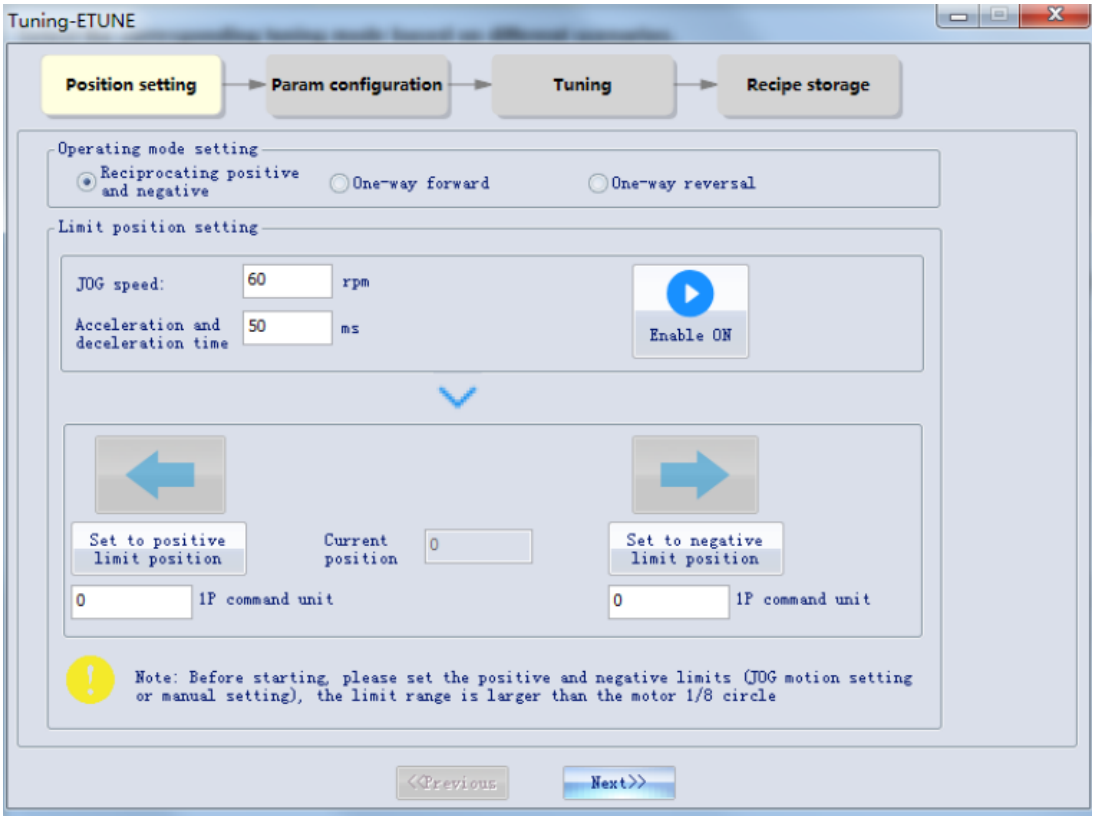
- **Description**

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



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

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



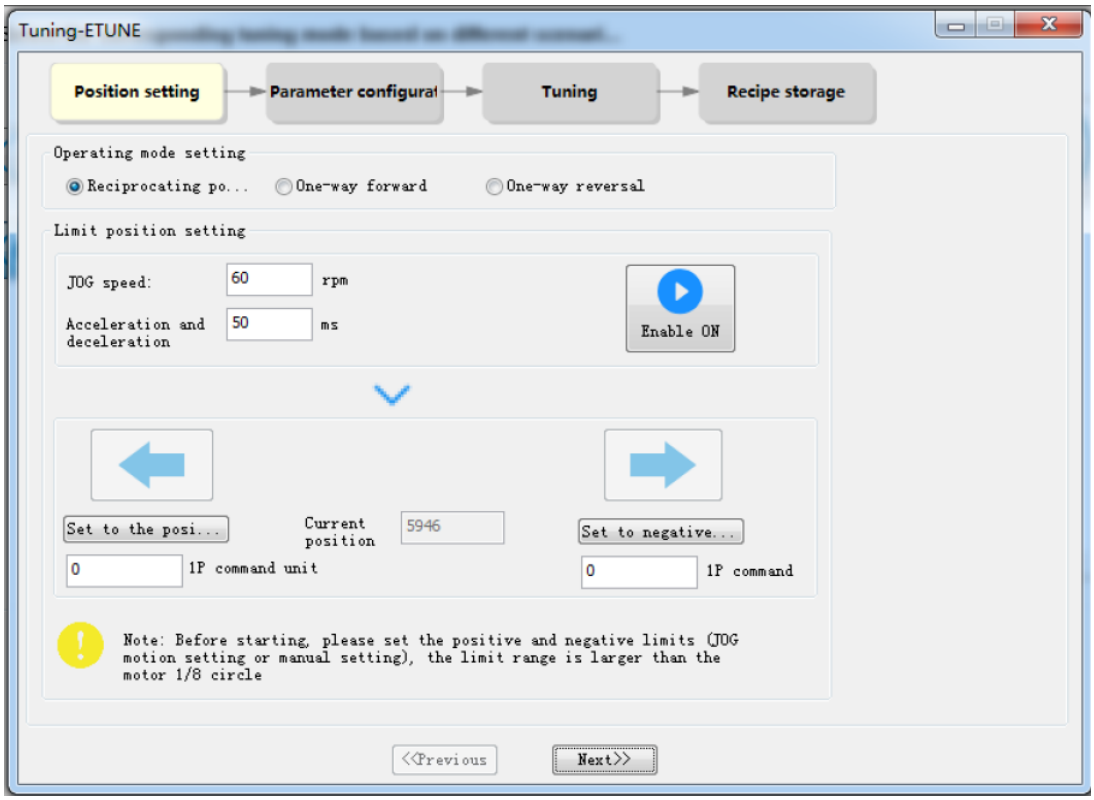
3. Designate the positive and negative limit positions allowed by the motor. The difference between the positive and negative limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio.

   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: Enter the positive and negative limits directly.

Note

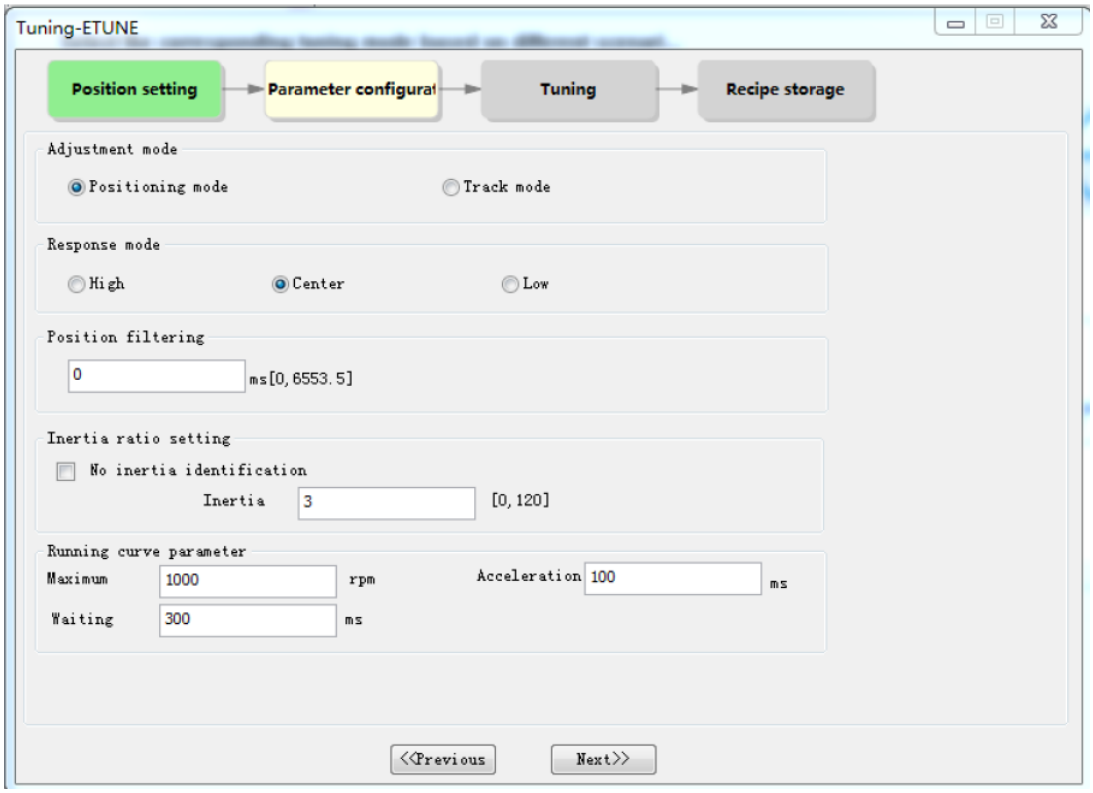
The difference between the positive and negative position limits must be larger than 1/8 of one revolution. The larger the value of the limit position, the better the adaptability of the auto-tuned parameters, but the longer will ETune adjustment take.



4. Click Next to switch to the mode parameter setting interface.

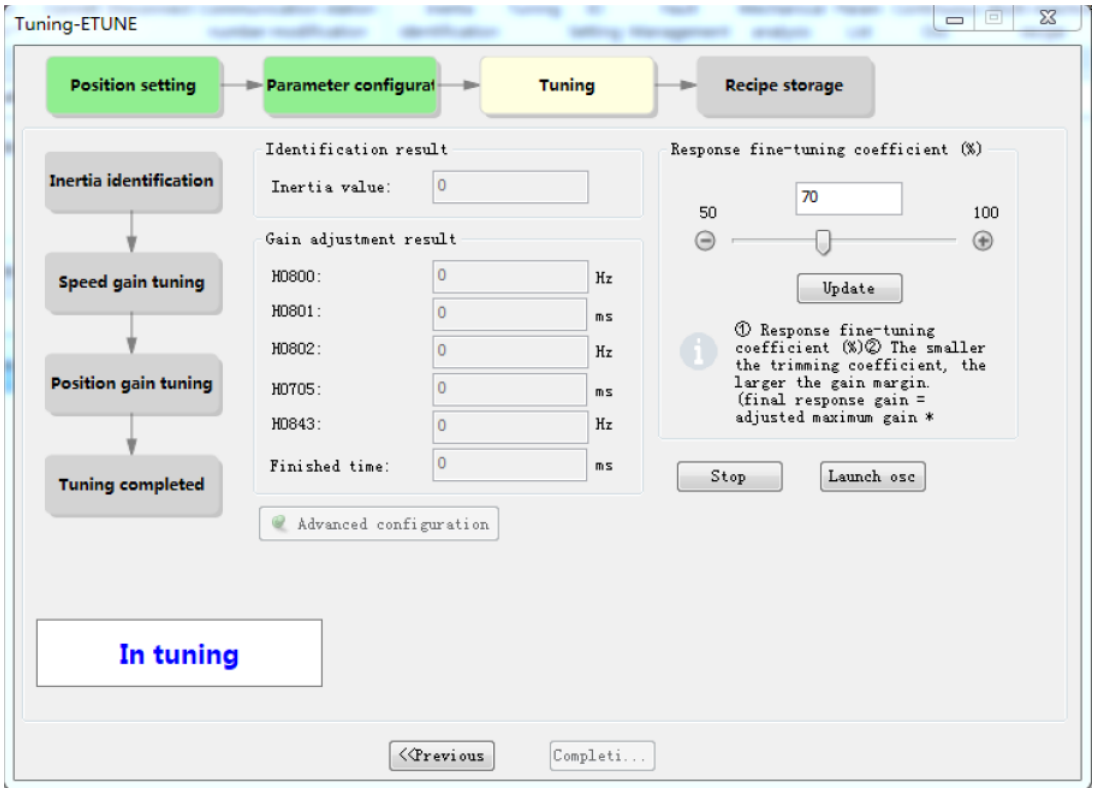
   The adjustment mode is divided into Positioning mode and Track mode.

   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 responsiveness needed 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.

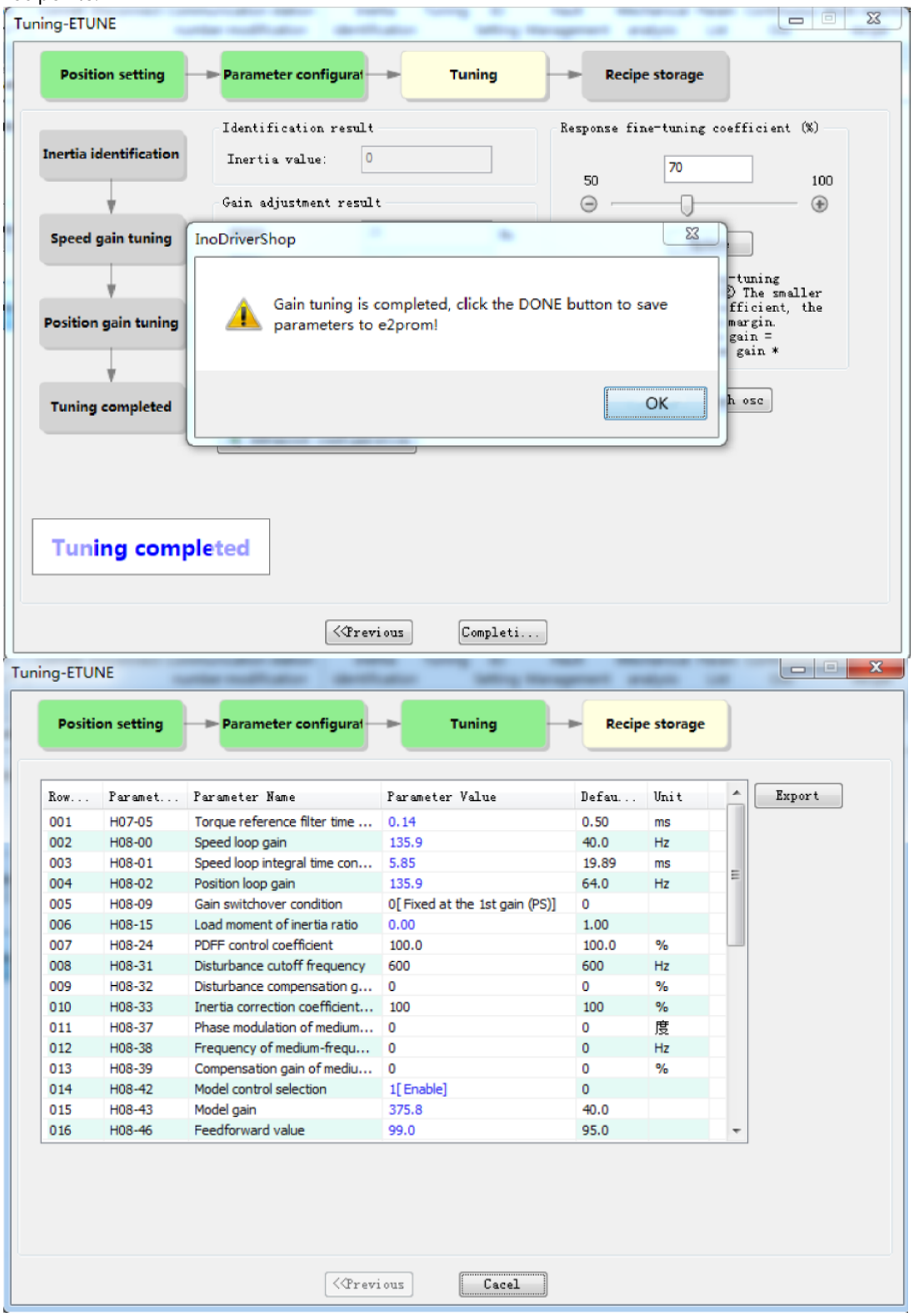


5. Click " Next " to start auto-tuning.

- 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 done, the drive starts gain auto-tuning.
- If you choose not to perform inertia auto-tuning on the start page, the drive starts gain auto-tuning directly after start.



6. During gain auto-tuning, if you modify the Response fine-tuning coefficient and click " Update ", gain auto-tuning will be continued based on the fine-tuning coefficient entered. After gain auto-tuning is done, you can click " Done " to save parameters to EEPROM and export 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 quickened after auto-tuning.
- If the acceleration/deceleration time is too short, overload may occur. In this case, increase the acceleration/deceleration time properly.
- For vertical axes, take anti-drop measures beforehand and set the stop mode upon fault to "Stop at zero speed".
- For lead screw transmission, shorten the travel distance if the tuning duration is too long.

Solutions to Common Faults

Fault	Cause	Solution
E662.0: Gains too low	Vibration cannot be suppressed.	Enable vibration suppression manually.
	Excessive overshoot occurs during positioning.	Check whether the positioning threshold is too low. Increase the acceleration/deceleration time and reduce the response level.
	The command suffers from noise.	Modify the electronic gear ratio to improve the command resolution, or increase the command filter time constant in the parameter configuration interface.
	The current fluctuates.	Check whether the current of the machine fluctuates periodically.
E600.0: Inertia auto-tuning failure	Vibration cannot be suppressed.	Enable vibration suppression manually and perform the ETune operation.
	The auto-tuned values fluctuate dramatically.	Increase the maximum operating speed and decrease the acceleration/deceleration time. For the lead screws, shorten the travel distance.
	Mechanical couplings of the load are loose or eccentric.	Rectify the mechanical faults.
	An alarm occurs during auto-tuning and causes interruption.	Clear the fault and perform ETune again.
	The position reference filter time is set to an excessively high value.	Decrease the values of H05.04...H05.06 and perform ETune again.

10.3.2 STune

Overview

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

Note

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

- The load inertia changes quickly.
- The load torque changes quickly.
- Low-speed operation (less than 100 rpm for ROT, less than 20 rpm for DDR, and less than 20 mm/s for DDL).
- 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, set the correct inertia ratio manually.

Description of ITune operation

- **Operation flowchart**

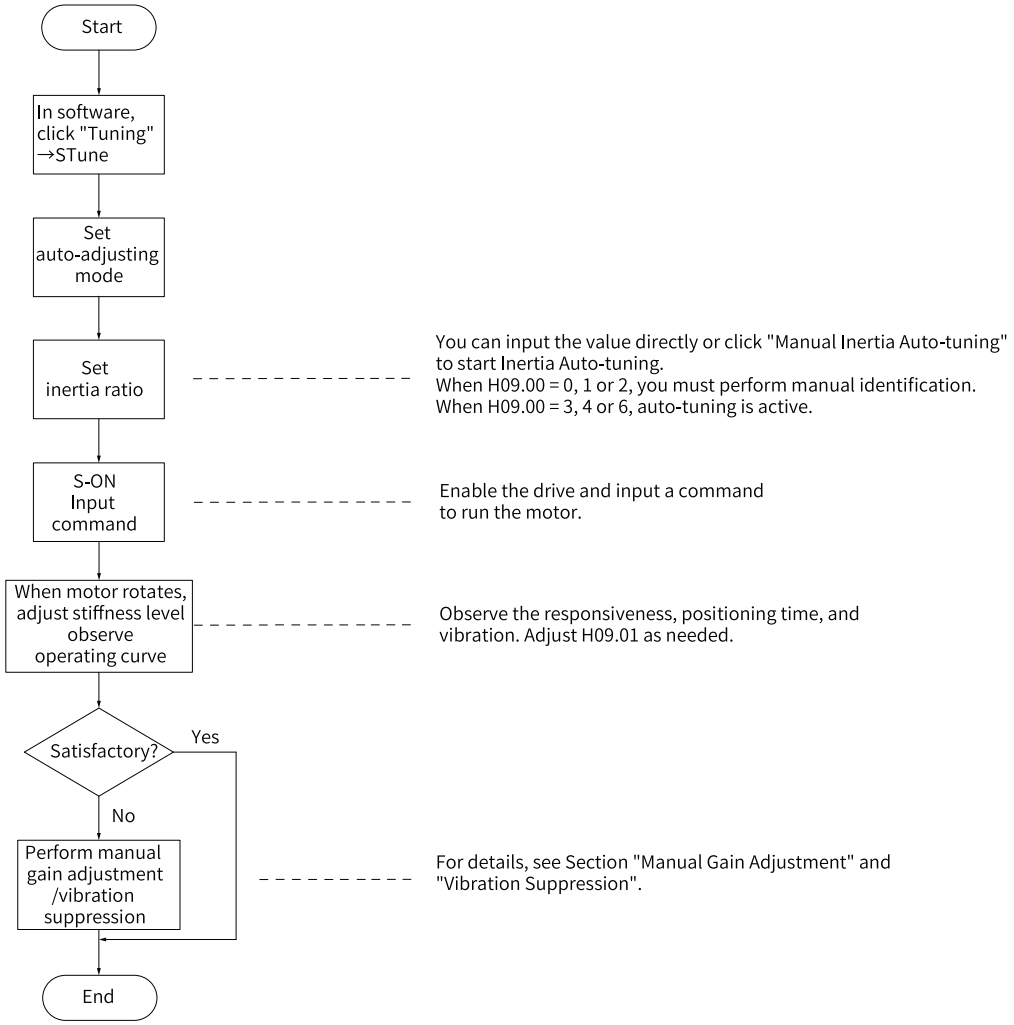


Figure 10-6 Operation flowchart

- **Description**

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

  1. Select the gain auto-tuning mode.

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

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

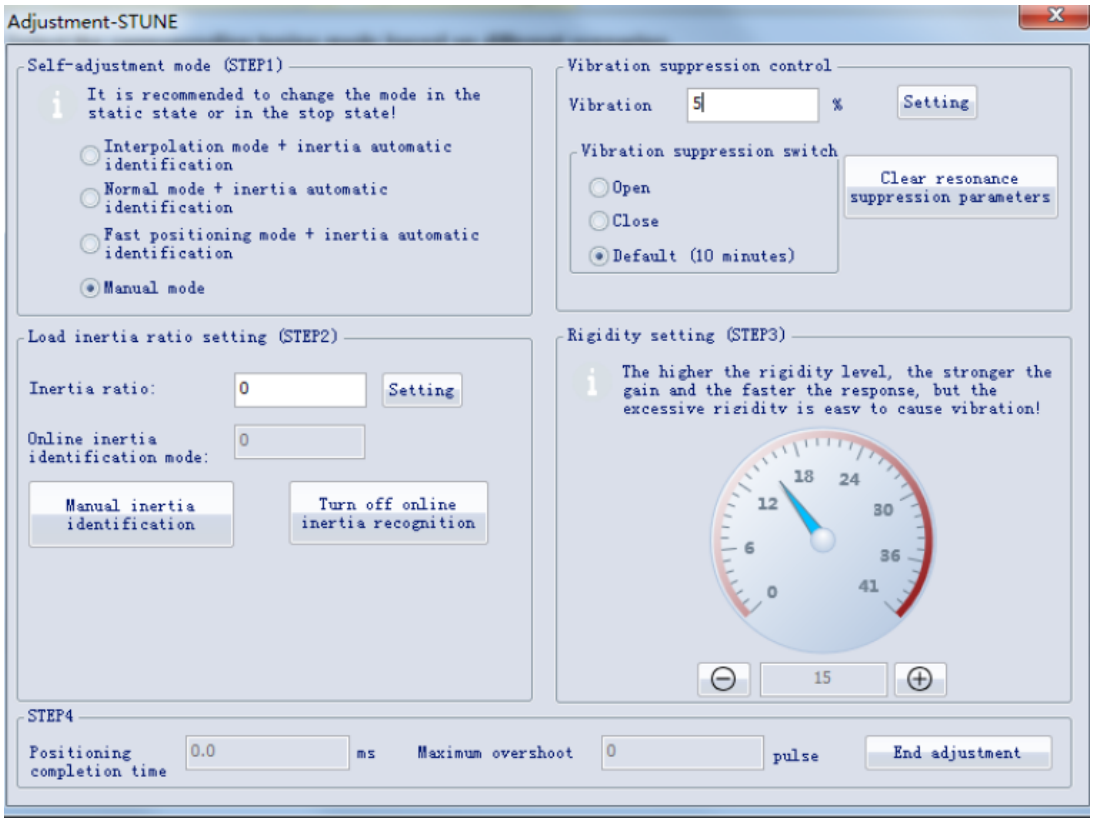
2. Adjust the stiffness level gradually during operation of the load. The present stiffness level value will be written to the drive automatically. Keep monitoring the operating waveform after increasing the stiffness level (increase by one level at a time) until desired performance is achieved.
3. In STune modes 3, 4, and 6, when the speed keeps higher than 100 rpm for more than 5 min, H09.00 returns to 0 automatically. In this case, the drive will exit from 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, and 6, 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. For multi-axis trajectories, perform single-axis commissioning first to determine the highest response of each axis and modify the response of each axis manually to ensure position responses of different axes are consistent.

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

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



Note

To ensure a stable operation of STune modes 3, 4 and 5, 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.

Precautions

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 requiring not high rigidity and accuracy, the inertia ratio should not exceed 1000%.
  - For lead screw or cardan shaft requiring high rigidity 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 hard to adjust and the 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.

Rigidity meter setting

The setting range of H09.01 (Stiffness level selection) is 0–41. The level 0 indicates the weakest stiffness and lowest gain and level 41 indicates the strongest stiffness and highest gain.

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

Table 10–2 Reference of stiffness levels

Recommended Stiffness Level	Load Mechanisms
Level 8 to level 12	Large-scale machineries
Level 12 to level 18	Applications with low stiffness such as the conveyors
Above level 18	Applications with high stiffness such as the ball screws and direct-connected motors

The following 5 gain auto-tuning modes are available.

- Standard rigidity 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 10–3 Parameters updated automatically in the standard 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 = 2)
  Based on *"Table 10–3" on page 172*, the 2nd gain parameters (H08.03 to H08.05 and H07.06) are also automatically updated and saved based on the rigidity level set in H09.01. In addition, the position loop gain in the 2nd gain parameters is two rigidity levels higher than that in the 1st gain parameters.

  Table 10–4 Parameters updated automatically in the 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 have an initial value, which can be modified by the user:

  Table 10–5 Parameters with fixed values in the positioning mode

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

  Gain switchover parameters also have an initial value, which can be modified by the user:

  Gain switchover is activated automatically in the positioning mode.

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

Note

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

- In STune mode 3, 4, or 6,
  resonance suppression will be performed automatically. 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.

  ☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.37	2008-26h	Phase modulation for medium-frequency jitter suppression 2	-90° to +90°	Defines the compensation phase of medium-frequency jitter suppression 2.	0	°	Int16	Real-time	Real-time
H08.38	2008-27h	Medium-frequency suppression 2 frequency	0 Hz–1000 Hz	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.	0	Hz	UInt16	Real-time	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.39	2008-28h	Compensation gain of medium-frequency jitter suppression 2	0% to 300%	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.	0	%	UInt16	Real-time	Real-time
H09.18	2009-13h	Frequency of the 3rd notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.19	2009-14h	Width level of the 3rd notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.21	2009-16h	Frequency of the 4th notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.22	2009-17h	Width level of the 4th notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disabled 1: Enabled	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	-	UInt16	Real-time	Real-time

Note

- If H09.00 is set to 3, 4, 5 or 6, the servo drive will suppress the vibration and perform inertia auto-tuning automatically within 10 min (or other time defined by H09-37) after power-on or stiffness level setting, and then the servo drive exits from automatic adjustment. 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 or 6 will not activate inertia auto-tuning.
- In applications with slow acceleration/deceleration, large vibration, and unstable mechanical connections, do not set H09.00 to 3, 4, or 6.
- 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

When the torque fluctuation detected by the drive exceeds the setpoint of H09.11 and cannot be suppressed, the rigidity level will be reduced automatically until reaching level 10 where E661 is reported.

- Vibration cannot be suppressed. Enable vibration suppression manually.
- The current fluctuates. Check whether the current of the machine fluctuates periodically.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.37	2008-26h	Phase modulation for medium-frequency jitter suppression 2	-90° to +90°	Defines the compensation phase of medium-frequency jitter suppression 2.	0	°	Int16	Real-time	Real-time
H08.38	2008-27h	Medium-frequency suppression 2 frequency	0 Hz–1000 Hz	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.	0	Hz	UInt16	Real-time	Real-time
H08.39	2008-28h	Compensation gain of medium-frequency jitter suppression 2	0% to 300%	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.	0	%	UInt16	Real-time	Real-time
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disabled 1: Enabled	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	-	UInt16	Real-time	Real-time

10.4 Manual Gain Tuning

10.4.1 Basic Parameters

When gain auto-tuning cannot fulfill the application needs, perform manual gain tuning. to achieve better result.

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

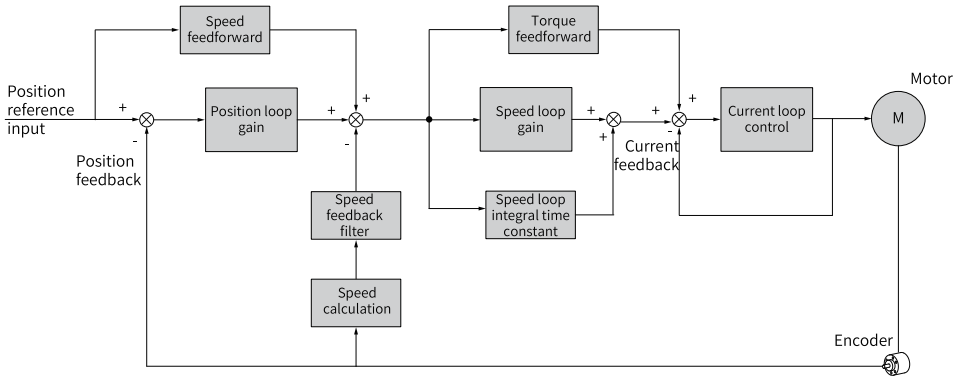


Figure 10-7 Basic control for manual gain tuning

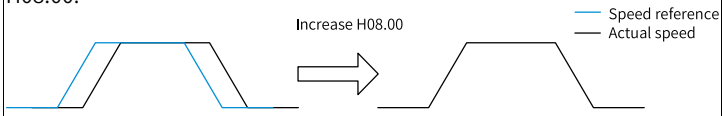
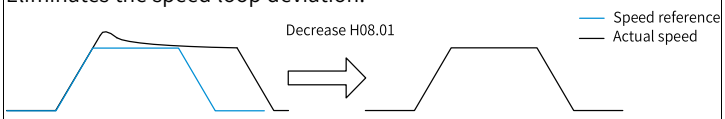
Note

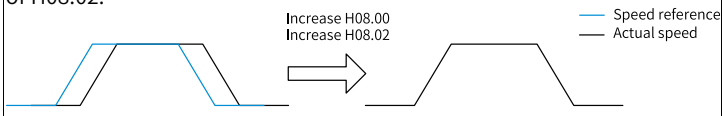
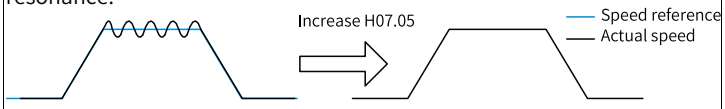
The response level of the inner loop must be higher than that of the outer loop. If it is not observed, the system may be unstable.

The default current loop gain of the drive allows for sufficient responsiveness. When you choose a third party motor, the default current loop gain may not be suitable. You must perform auto-tuning for the current loop gain. Only the position loop gain, the speed loop gain and other auxiliary gains need to be adjusted. Therefore, when the gain is adjusted in the position control mode, in order to ensure the stability of the system and improve the position loop gain, it is necessary to increase the speed loop gain and ensure that the response of the position loop is lower than that of the speed loop.

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

Table 10–6 Adjustment of gain parameters

Step	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 set correctly, 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 200*.
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	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, H08.02 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 200*. An excessively high setpoint weakens the responsiveness of the current loop. To suppress vibration upon stop, increase the setpoint of H08.00 and decrease the setpoint of H07.05. If strong vibration occurs upon stop, decrease the setpoint of H07.05.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.05	2007-06h	Torque reference filter time constant 1	0.00 ms–30.00 ms	Defines the torque reference filter time constant 1.	0.50	ms	UInt16	Real-time	Real-time
H08.00	2008-01h	Speed loop gain	0.1 Hz–2000.0 Hz	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.	40.0	Hz	UInt16	Real-time	Real-time
H08.01	2008-02h	Speed loop integral time constant	0.15 ms–512.00 ms	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.	19.89	ms	UInt16	Real-time	Real-time
H08.02	2008-03h	Position loop gain	0.1 Hz–2000.0 Hz	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).	64.0	Hz	UInt16	Real-time	Real-time

10.4.2 Gain switchover

Gain switchover, which is active in the position control and speed control modes only, It is only effective in position and speed control modes. achieve 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

It is fixed to the first gain (H08.00–H08.02, H07.05), but the speed loop can realize the switching of proportional/proportional integral control through DI function 3 (FunIN.3: GAIN-SEL, gain switching).

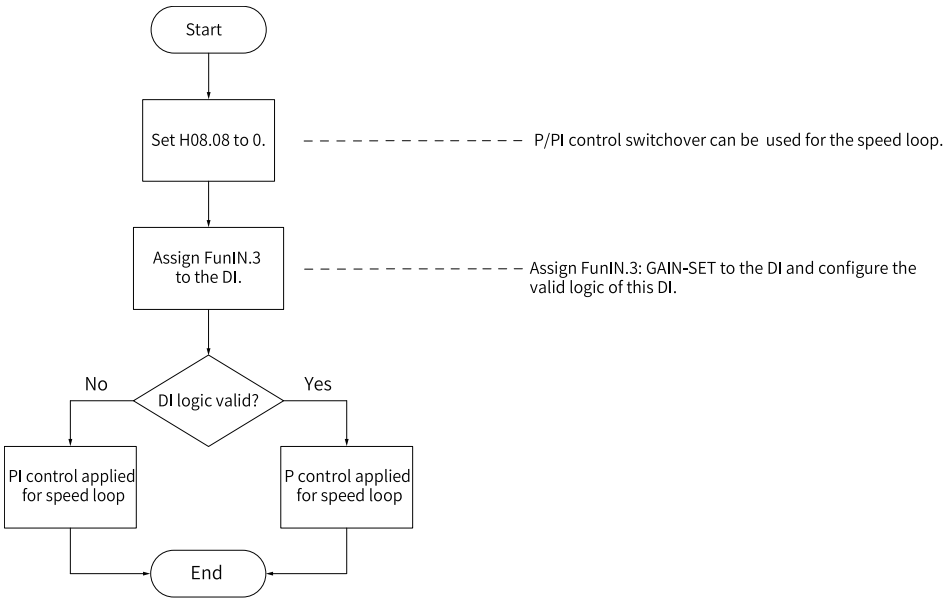


Figure 10-8 Gain switchover flowchart when H08.08 is set to 0

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.

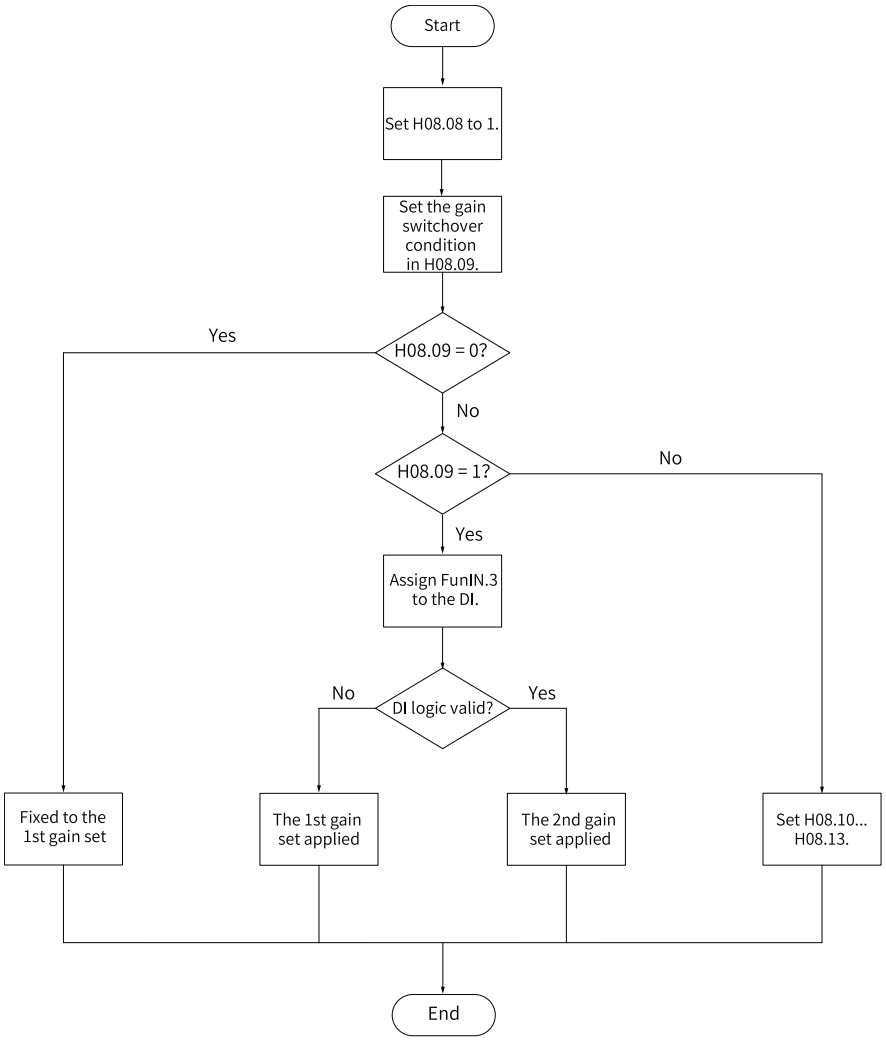
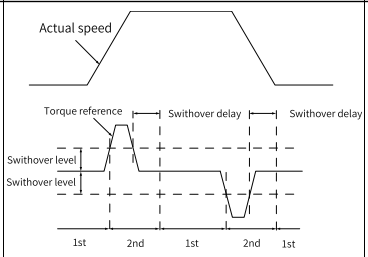
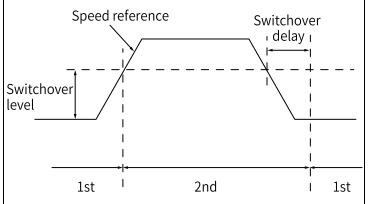
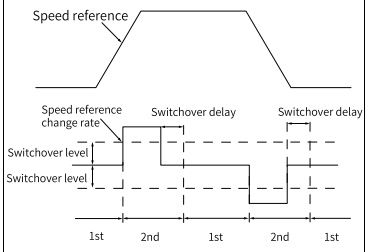
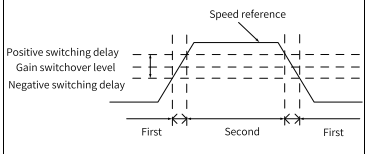
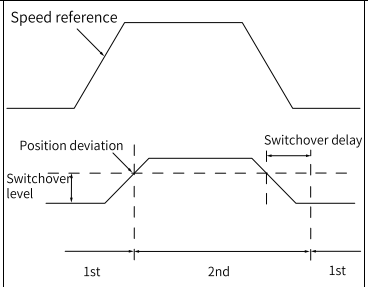
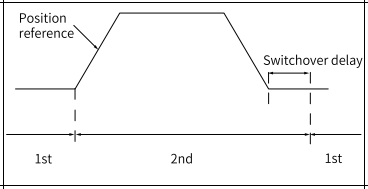
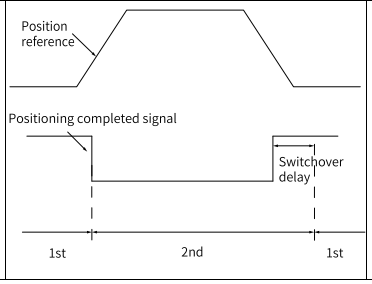


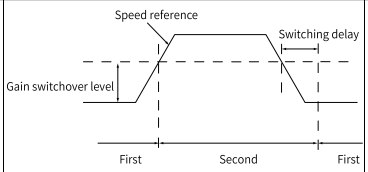
Figure 10-9 Gain switchover flowchart when H08.08 is set to 1

There are 11 2nd gain switchover modes. The following table describes the diagrams and related parameters of different conditions.

Table 10–7 Conditions for gain switchover

Gain Switchover Condition			Related parameters		
H08.09 Value	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	Switched as defined by bit26 of 60FE	-	Inactive	Inactive	Inactive

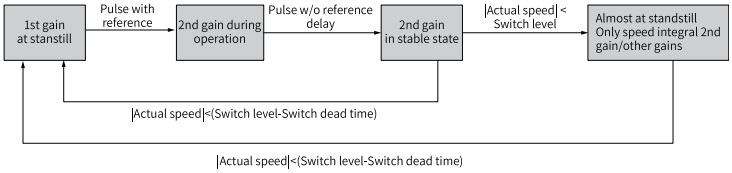
Gain Switchover Condition			Related parameters		
H08.09 Value	Condition	Diagram	Delay Time (H08.10)	Gain switchover level (H08.11)	Switchover Dead Time (H08.12)
2	torque reference		Active	Active (%)	Active (%)
3	Speed reference		Active	Active	Active
4	Speed reference change rate		Active	Active (10 rpm/s)	Active (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 reference		Active	Inactive	Inactive
8	Positioning uncompleted		Active	Inactive	Inactive

Gain Switchover Condition			Related parameters		
H08.09 Value	Condition	Diagram	Delay Time (H08.10)	Gain switchover level (H08.11)	Switchover Dead Time (H08.12)
9	Actual speed		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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the mode for switching to the 2nd gain set.	1	-	UInt16	Real-time	Real-time
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)	Defines the gain switchover condition.	0	-	UInt16	Real-time	Real-time
H08.10	2008-0Bh	Gain switchover delay	0.0 ms–1000.0 ms	Defines the delay when the drive switches from the 2nd gain set to the 1st gain set.	5.0	ms	UInt16	Real-time	Real-time
H08.11	2008-0Ch	Gain switchover level	0 to 20000	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.	50	-	UInt16	Real-time	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.12	2008-0Dh	Gain switchover hysteresis	0 to 20000	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 set value of H08.11 (Gain switchover level) must be no less than that of H08.12; otherwise, the H08.11 will be set to a value equal to H08.12 automatically.	30	-	UInt16	Real-time	Real-time
H08.13	2008-0Eh	Position gain switchover time	0.0 ms–1000.0 ms	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.	3.0	ms	UInt16	Real-time	Real-time

10.4.3 Position Reference Filter

Name	Function	Applicable Occasion	Impact of Excessive Filtering
Position reference filter	Filters the position references (encoder unit) divided or multiplied by the electronic gear ratio to smoothen 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.

10.4.4 Feedforward gain

Speed feedforward

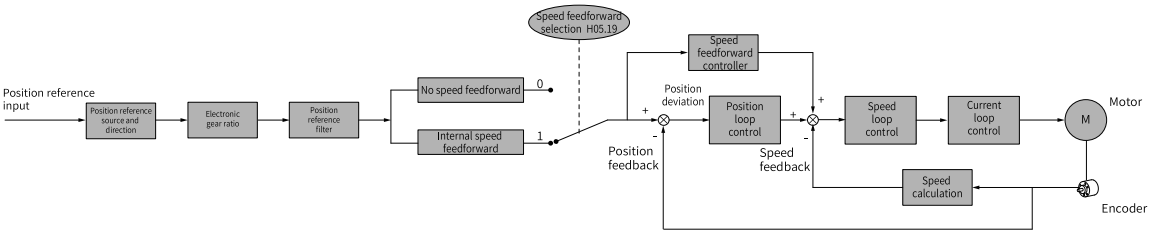


Figure 10-10 Operating procedure for speed feedforward control

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

Operating 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	Name	Value	Remarks
H05.19	Speed feedforward control	0: No speed feedforward	-
		1: Internal speed feedforward	Defines the speed corresponding to the position reference (encoder unit) as the speed feedforward signal source.
		2: 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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.18	2008-13h	Time constant of speed feedforward filter	0.00 ms–64.00 ms	Defines the filter time constant of speed feedforward.	0.50	ms	UInt16	Real-time	Real-time
H08.19	2008-14h	Speed feedforward gain	0.0% to 100.0%	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).	0.0	%	UInt16	Real-time	Real-time

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.

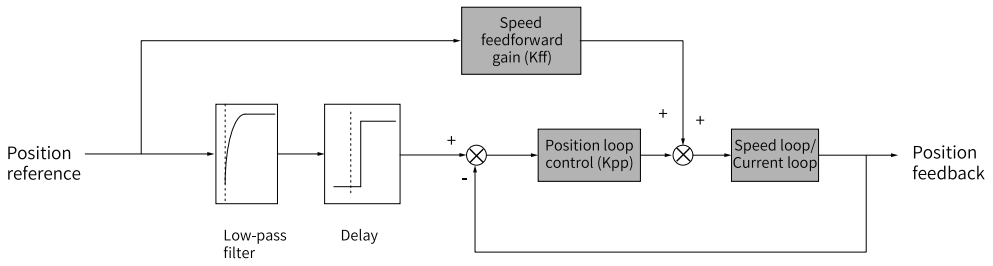


Figure 10-11 Zero phase control

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.04	2005-05h	First-order low-pass filter time constant	0.0 ms–6553.5 ms	Defines the first-order low pass filter time constant of position references.	0.0	ms	UInt16	At stop	Real-time
H05.19	2005-14h	Speed feedforward control	0: No speed feedforward 1: Internal speed feedforward 2: 60B1h 3: Zero phase	Defines the source of the speed loop feedforward signal.	1	-	UInt16	At stop	Real-time
H08.17	2008-12h	Zero phase delay	0.0 ms–4.0 ms	-	0.0	ms	UInt16	Real-time	Real-time

Torque feedforward

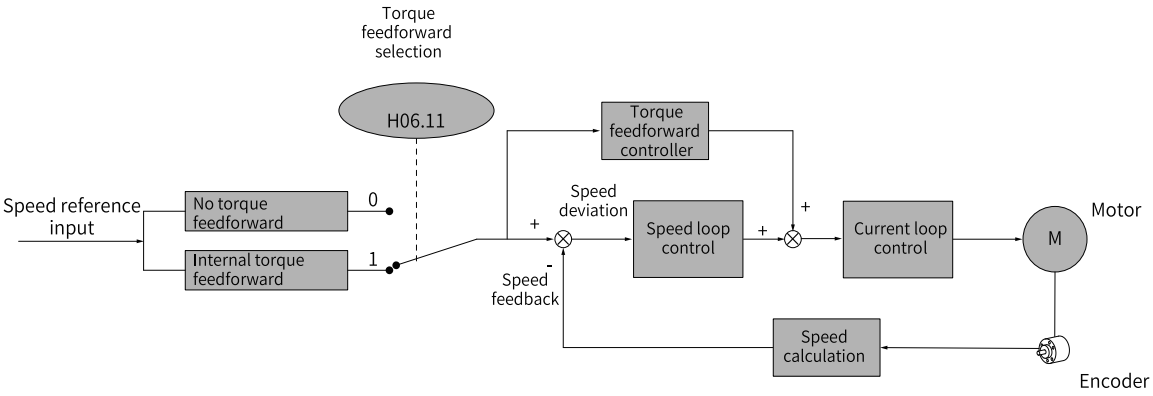


Figure 10-12 Operation diagram of torque feedforward control

In the 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 the speed control mode, torque feedforward can be used to improve speed reference responsiveness and reduce the speed deviation during operation at constant speed.

The procedure for setting torque feedforward is as follows:

1. Set the torque feedforward signal source.
   Set H06.11 (Torque feedforward control) to 1 to enable the torque feedforward function. The corresponding signal source will be selected as well.

Parameter	Name	Value	Remarks
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 the position control mode, the speed reference is outputted from the position controller.

2. Set torque feedforward parameters.

Parameter	Name	Description
H08.20	Torque feedforward filter time constant	Function: • Increasing the value of H08.21 improves the response but may cause overshoot during acceleration/ deceleration. • Decreasing the value of H08.20 suppresses overshoot during acceleration/deceleration. Increasing the value of H08.20 suppresses the noise. Note: • Keep H08.20 to the default value, and then gradually increase the value of H08.21 from 0 to a certain value at which torque feedforward achieves the desired effect. • Adjust H08.20 and H08.21 repeatedly until a balanced performance is achieved.
H08.21	Torque feedforward gain	See this section for details.

10.4.5 PDFF Control

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

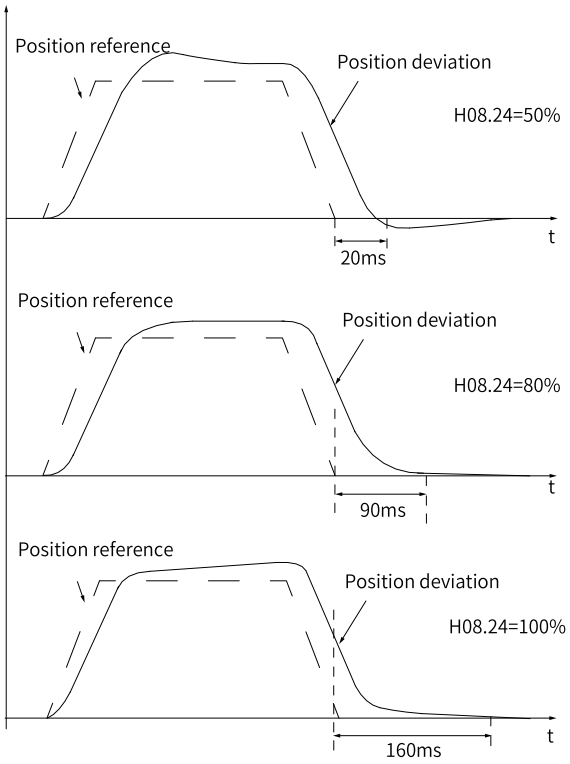


Figure 10-13 Example of PDFF control

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.

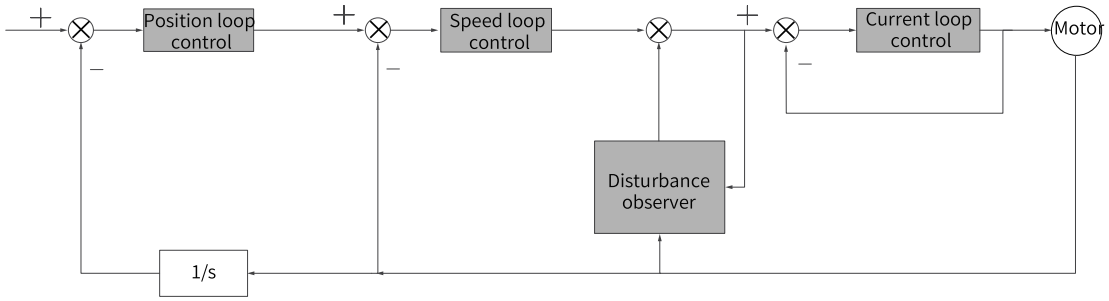
10.4.6 Torque disturbance observer

This function is intended to be used in the 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 depicts the control block diagram for disturbance observer.



Note

1/s: Integral element

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

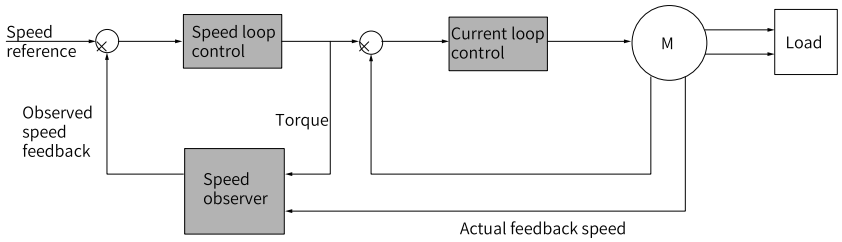
Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.31	2008-20h	Disturbance cutoff frequency	10 Hz–4000 Hz	Defines the cutoff frequency of the disturbance observer. Increasing the setpoint improves the responsiveness of the disturbance observer and the compensation effect. Note that an excessively high setpoint may incur resonance.	600	Hz	UInt16	Real-time	Real-time
H08.32	2008-21h	Disturbance compensation gain	0% to 100%	Defines the compensation gain of the disturbance observer. The setpoint 100% indicates full compensation.	0	%	UInt16	Real-time	Real-time
H08.33	2008-22h	Disturbance observer inertia correction coefficient	1% to 1600%	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.	100	%	UInt16	Real-time	Real-time

10.4.7 Speed Observer

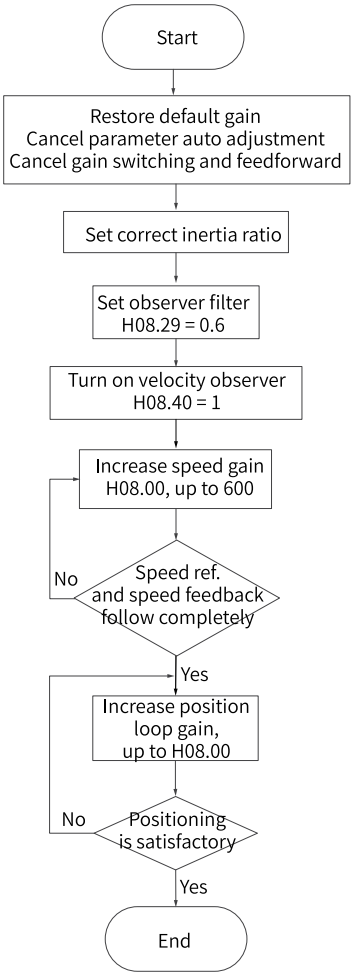
The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.

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

The block diagram for the speed observer is as follows.



Commissioning Steps



Related parameters

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.00	2008-01h	Speed loop gain	0.1 Hz–2000.0 Hz	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.	40.0	Hz	UInt16	Real-time	Real-time
H08.27	2008-1Ch	Speed observer cutoff frequency	50 Hz–600 Hz	Defines the cutoff frequency of the speed observer. Note that an excessively high setpoint may incur resonance. Decrease the setpoint properly in case of large speed feedback noise.	170	Hz	UInt16	Real-time	Real-time
H08.28	2008-1Dh	Speed observer inertia correction coefficient	1% to 1600%	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.	100	%	UInt16	Real-time	Real-time
H08.29	2008-1Eh	Speed observer filter time	0.00 ms–10.00 ms	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.	0.80	ms	UInt16	Real-time	Real-time
H08.40	2008-29h	Speed observer selection	0: Disabled 1: Enabled	Used to set the enable bit for speed observer.	0	-	UInt16	Real-time	Real-time

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.
- The speed observer is not suitable for belt drive and large backlash occasions.

10.4.8 Model Tracking

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

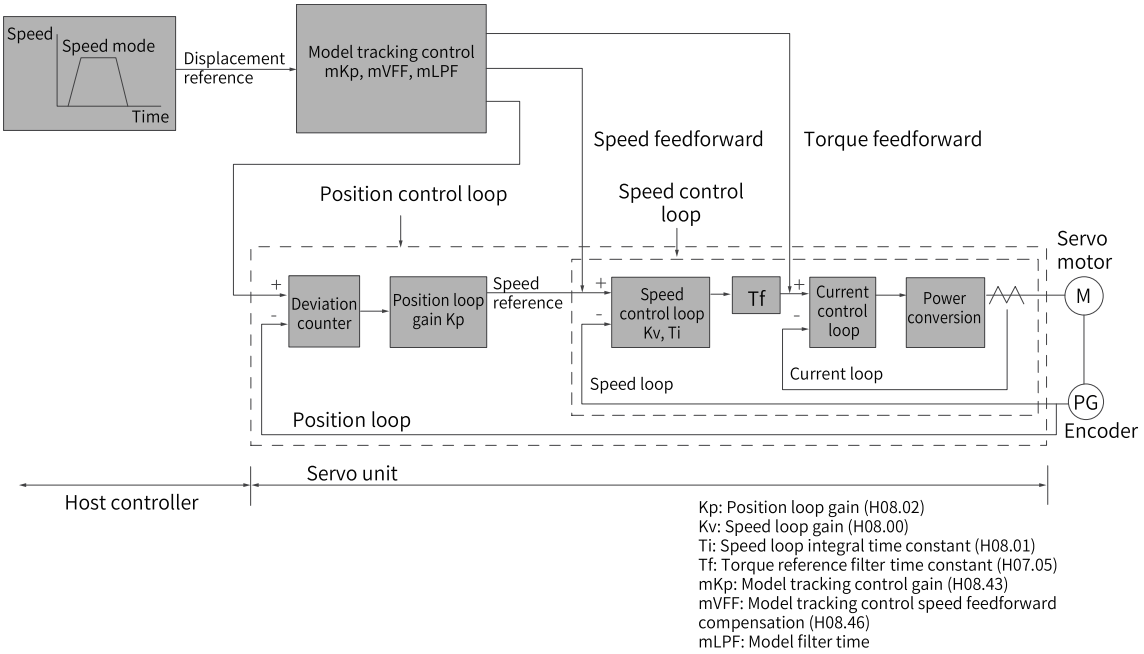
Parameters used by model tracking are normally set automatically through ITune or ETune along with the gain parameters.

However, manual tuning is needed in the following situations:

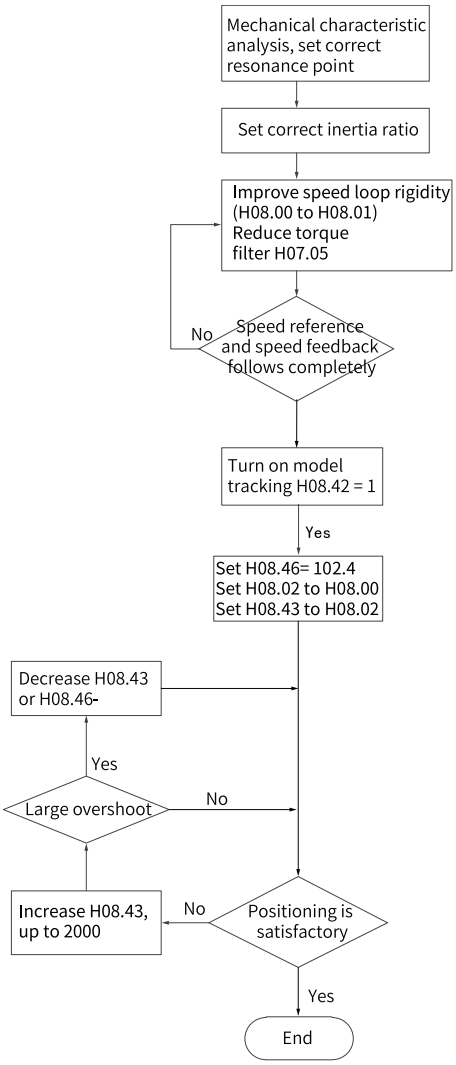
- The auto-tuned values cannot deliver desired performance.

- 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.



Commissioning Steps



Related parameters

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.05	2007-06h	Torque reference filter time constant 1	0.00 ms–30.00 ms	Defines the torque reference filter time constant 1.	0.50	ms	UInt16	Real-time	Real-time
H08.00	2008-01h	Speed loop gain	0.1 Hz–2000.0 Hz	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.	40.0	Hz	UInt16	Real-time	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.01	2008-02h	Speed loop integral time constant	0.15 ms–512.00 ms	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.	19.89	ms	UInt16	Real-time	Real-time
H08.02	2008-03h	Position loop gain	0.1 Hz–2000.0 Hz	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).	64.0	Hz	UInt16	Real-time	Real-time
H08.42	2008-2Bh	Model control selection	0: Disable 1: Enable 2: Dual-inertia model	Used to enable model tracking control.	0	-	UInt16	Real-time	Real-time
H08.43	2008-2Ch	Model gain	0.1 to 2000.0	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.	40.0	-	UInt16	Real-time	Real-time
H08.46	2008-2Fh	Feedforward value	0.0 to 102.4	Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.	95.0	-	UInt16	Real-time	Real-time

Note

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

10.4.9 Friction Compensation

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

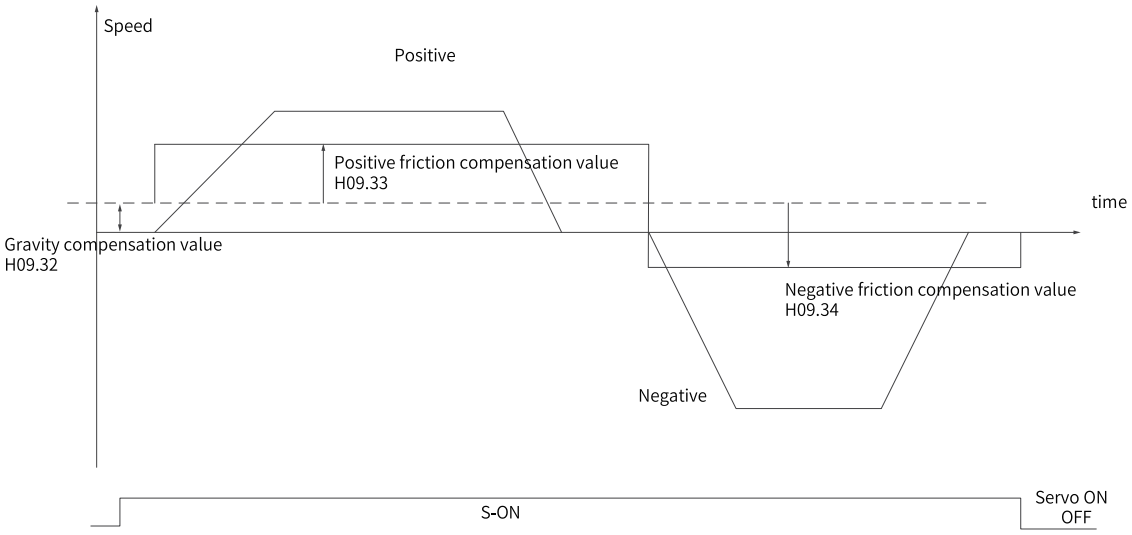
Note

Friction compensation is effective only in the position mode.

☆Related parameters

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.32	2009-21h	Gravity compensation value	0.0% to 100.0%	Defines the gravity compensation value. Setting this parameter properly in vertical axis applications can reduce the falling amplitude upon start.	0.0	%	UInt16	Real-time	Real-time
H09.33	2009-22h	Positive friction compensation value	0.0% to 100.0%	Defines the forward friction compensation value.	0.0	%	UInt16	Real-time	Real-time
H09.34	2009-23h	Negative friction compensation value	-100.0% to 0.0%	Defines the reverse direction friction compensation value.	0.0	%	Int16	Real-time	Real-time
H09.35	2009-24h	Friction compensation speed	0.0 to 20.0	Defines the friction compensation speed.	2.0	-	UInt16	Real-time	Real-time
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	-	0	-	UInt16	Real-time	Real-time

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.

10.5 Parameter Adjustment in Different Control Modes

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

10.5.1 Parameter Adjustment in the Position Control Mode

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

2) Perform gain adjustment.

- 1st gain set:

Parameter	Name	Function	Default
H07.05	Torque reference filter time constant 1	Defines the torque reference filter time constant.	0.50ms
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.	19.89ms
H08.02	Position loop gain	Defines the position loop proportional gain.	64.0 Hz

- 2nd gain set:

Parameter	Name	Function	Default
H07.06	Torque reference filter time constant 2	Defines the torque reference filter time constant.	0.27ms
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.	10.61ms
H08.05	2nd position loop gain	Defines the position loop proportional gain.	120.0ms
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.	5.0ms
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.	3.0ms

- Common gain set

Parameter	Name	Function	Default
H08.18	Time constant of speed feedforward filter	Defines the filter time constant of the speed feedforward signal.	0.50ms
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.	0.50ms
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.	0.5ms
H09.04	Low-frequency resonance suppression mode	Defines the low-frequency resonance suppression mode.	0

Perform gain auto-tuning to get the initial values of the 1st gain set (or 2nd gain set) and the common gain set.

Fine-tune the following gains manually.

Parameter	Name	Function	Default
H07.05	Torque reference filter time constant 1	Defines the torque reference filter time constant.	0.50ms
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.	19.89ms
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%

10.5.2 Parameter Adjustment in the Speed Control Mode

Parameter adjustment in the speed control mode is the same as that in the position control mode, except for the position loop gain (H08.02 and H08.05). For details, see *"10.5.1 Parameter Adjustment in the Position Control Mode" on page 198*.

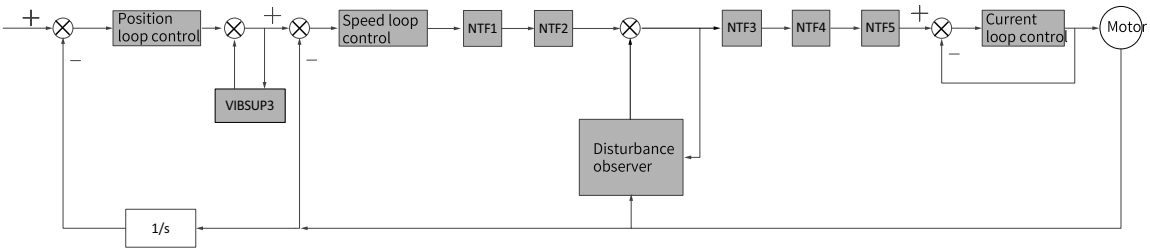
10.5.3 Parameter Adjustment in the Torque Control Mode

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

- If the actual speed reaches the speed limit, the adjustment method is the same as that described in *"10.5.2 Parameter Adjustment in the Speed Control Mode" on page 200*.
- If the actual speed does not reach the speed limit, the adjustment method is the same as that described in *"10.5.2 Parameter Adjustment in the Speed Control Mode" on page 200*, except the position/speed loop gain and speed loop integral time constant.

10.6 Vibration suppression

The block diagram for 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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.53	2008-36h	Medium- and low-frequency jitter suppression frequency 3	0.0 Hz–300.0 Hz	Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.	0.0	Hz	UInt16	Real-time	Real-time
H08.54	2008-37h	Medium- and low-frequency jitter suppression compensation 3	0% to 200%	Defines the compensation gain for medium- and low-frequency suppression compensation 3. The setpoint 200% indicates full compensation.	0	%	UInt16	Real-time	Real-time
H08.56	2008-39h	Medium- and low-frequency jitter suppression phase modulation 3	0% to 600%	Adjust this parameter based on the actual compensation effect.	100	%	UInt16	Real-time	Real-time

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.

10.6.1 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 operating principle of the notch is shown in the following figure.

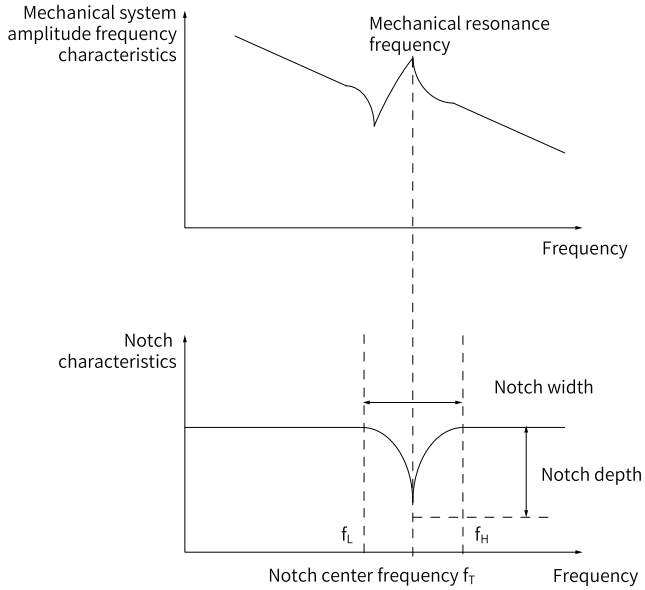


Figure 10-14 Operating principle of the notch

A total of 5 notches can be used, and each notch is defined by three parameters: frequency, width level, and depth level. The 1st, 2nd and fifth 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 notch (H09.02 =1 or 2).

Table 10–8 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.

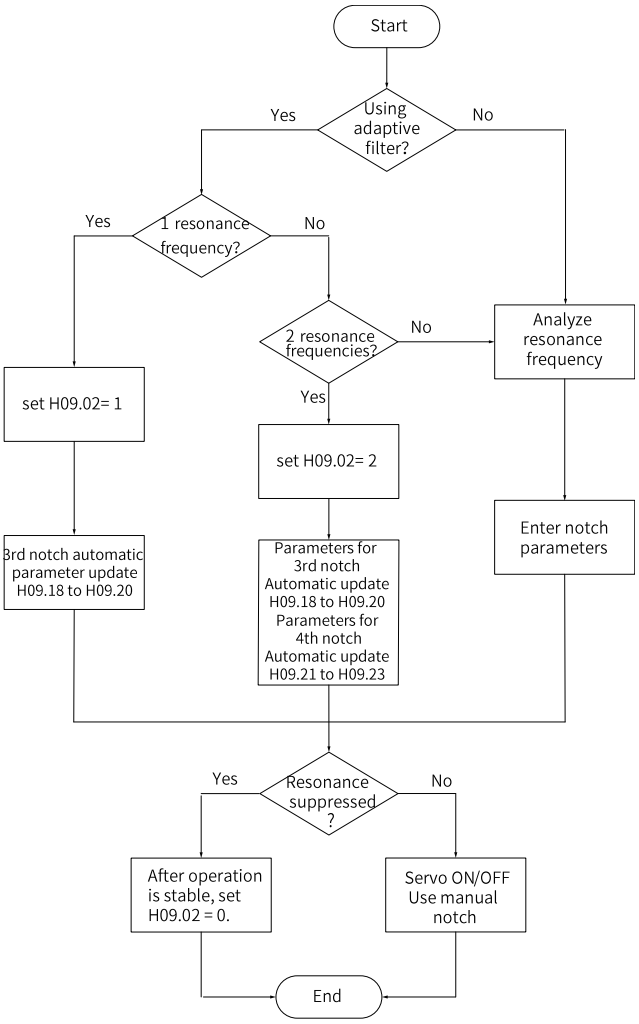


Figure 10-15 Using the notch

- 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 min.
  4. If the resonance is suppressed, the adaptive notch filter is effective. When the system runs stably and reaches the time (in seconds) of H09.37, H09.02 will be automatically set to 0. After the servo drive runs stably for a period of time, you can also set H09.02 to 0 manually and the parameters of the adaptive notch are fixed to the last updated value.

     This is to prevent notch parameters from being updated to wrong values due to misoperation. Wrong values will intensity resonance.
  5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.
  6. If there are more than two resonance frequencies, the problem cannot be solved by only using the adaptive notches. In this case, add a manual notch, Additionally use the manual notch, or use all the 5 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 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 (Adaptive notch mode) to 3. The drive detects the resonance frequency and saves the detected value to H09.24 automatically during operation.

  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, the lower the depth level is, the higher the notch depth is, and the stronger the suppression effect will be. Note that an excessively low depth level may lead to system oscillation.

Note

If the amplitude frequency characteristic curve obtained 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.

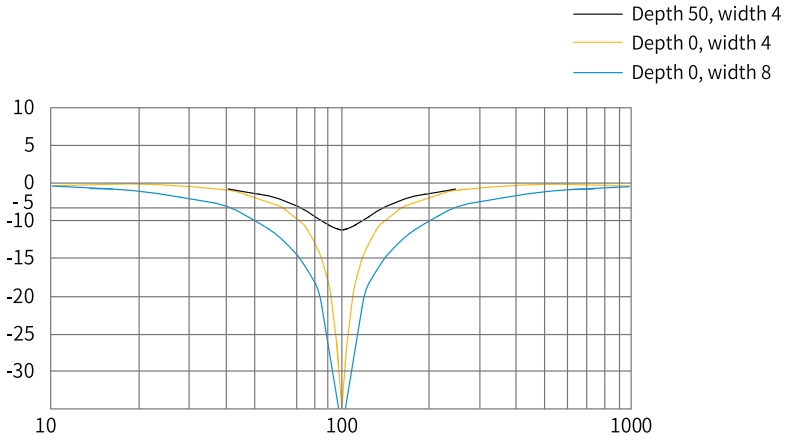


Figure 10-16 Notch frequency characteristics

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the operation mode of the adaptive notch. When the system runs stably and reaches the time (in seconds) of H09.37, H09.02 will be automatically set to 0.	3	-	UInt16	Real-time	Real-time
H09.12	2009-0Dh	Frequency of the 1st notch	50 Hz–8000 Hz	Defines the center frequency of the notch, which is the mechanical resonance frequency. In the torque control mode, setting the notch frequency to 4000 Hz deactivates the notch function.	8000	Hz	UInt16	Real-time	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.13	2009-0Eh	Width level of the 1st notch	0 to 20	Defines the center frequency of the notch, which is the mechanical resonance frequency. In the torque control mode, setting the notch frequency to 4000 Hz or 8000HZ deactivates the notch function. If the notch frequency that needs to be set is 4000HZ, it needs to be adjusted to 3999HZ or 4001HZ.	2	-	UInt16	Real-time	Real-time
H09.14	2009-0Fh	Depth level of the 1st notch	0 to 99	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.	0	-	UInt16	Real-time	Real-time
H09.15	2009-10h	Frequency of the 2nd notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.16	2009-11h	Width level of the 2nd notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.17	2009-12h	Depth level of the 2nd notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.18	2009-13h	Frequency of the 3rd notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.19	2009-14h	Width level of the 3rd notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.21	2009-16h	Frequency of the 4th notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.22	2009-17h	Width level of the 4th notch	0 to 20	-	2	-	UInt16	Real-time	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.24	2009-19h	Auto-tuned resonance frequency	0 Hz–5000 Hz	When H09.02 (Adaptive notch mode) is set to 3, the current mechanical resonance frequency is displayed.	0	Hz	UInt16	Unchangeable	-
H09.41	2009-2Ah	Frequency of the 5th notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.42	2009-2Bh	Width level of the 5th notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.43	2009-2Ch	Depth level of the 5th notch	0 to 99	-	0	-	UInt16	Real-time	Real-time

10.7 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

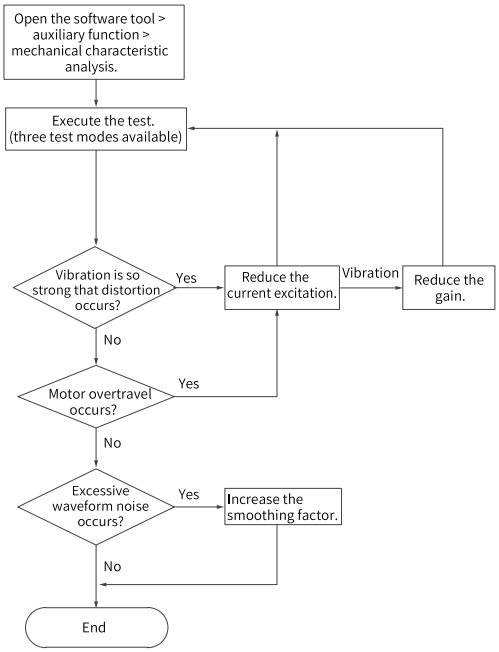


Figure 10-17 Operating procedure for mechanical characteristic analysis

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.

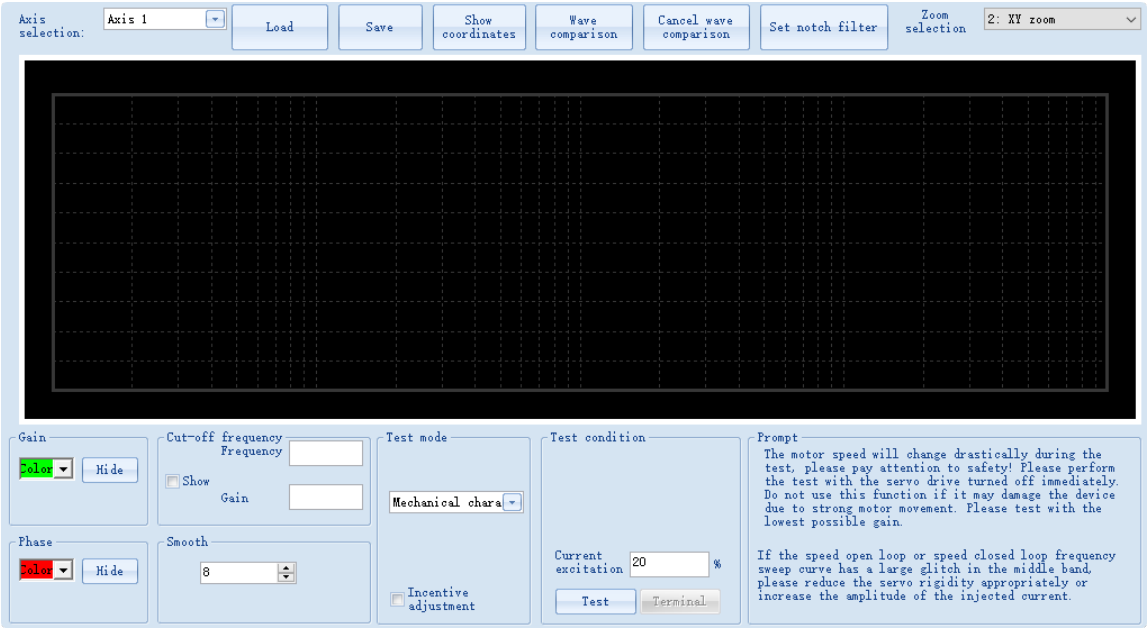


Figure 10-18 Example of the waveform obtained

An example of the waveform obtained with the mechanical characteristic analysis is shown in *"Figure 10–18 Example of the waveform obtained" on page 209*.

11 Function Overview

Function	Description
High-resolution encoder	The servo drive is equipped with a high-performance encoder with resolution up to 2^{23} (8388608) PPR.
DI signal assignment	DI functions such as emergency stop can be assigned 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.
Status display	Used to display the drive status through the LED on the keypad.
External I/O display	Used to display ON/OFF status of external I/O signals.
Alarm history	Used to record the latest 20 alarms, which can also be cleared.
Alarm code output	Used to output a four-digit alarm code when an alarm occurs.
Second encoder	Supports quadrature pulse feedback encoders.
Black box	The servo drive captures the data before and after the designated condition and cooperates with the software tool to read the data for further analysis.
Built-in brake function[1]	Used to monitor the brake status in real time.
STO	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start.
Trial run mode	Used to enable the motor through the keypad without a start signal.
Inovance servo commissioning software	Used to set parameters, perform trial run, and check status through a PC.
Mechanical characteristics analysis	Used to analyze the resonance frequency and characteristics of the mechanical system through a PC installed with Inovance software tool.
Auto Gain Tuning	STune and ETune.
Gain switchover	Used to apply different gains to different status (operating or stop) of the motor. Gains can also be switched by external terminals during operation.
Torque disturbance observer	Used to estimate the disturbance torque suffered by the system and make corresponding compensation.
Resonance suppression	Used to suppress resonance at high, medium, and low frequencies.
Touch Probe	The servo drive latches the position information when an external DI signal or motor Z signal changes.
Torque Reference Filter	Used to suppress the mechanical resonance that may be generated when the response speed is excessively high.
Position first-order low-pass filter	Used to achieve smooth acceleration and deceleration.
Torque limit	The servo drive limits the output torque of the servo motor.
Speed limit	The servo drive limits the servo motor speed.

Note

[1]: Built-in brake function is only available on Size 1 and Size 2 models.

12 Basic Functions of the Servo Drive

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

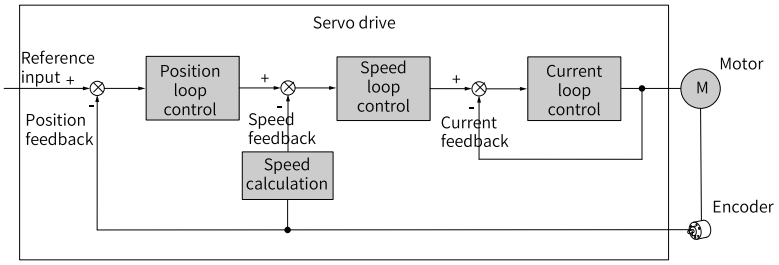


Figure 12-1 Structure of a basic servo system

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 In the 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 applications requiring positioning control, such as manipulators, SMT machines, engraving and milling machines, and CNC machine tools.
- Speed control In the speed control mode, the servo drive performs quick and accurate speed control through the speed reference sent through communication. The speed control mode mainly applies to applications (such as engraving and milling machines) requiring speed control or where a host controller is used for position control or the commands sent from the host controller are used as speed references for the servo drive.
- In the 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. The torque control mode mainly applies in applications requiring strict tension control. For example, in winding/unwinding devices, torque references are used to prevent the material from being affected by changes in the winding radius.

12.1 Conversion Factor

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

The gear ratio is comprised of the numerator 6091.01h and denominator 6091.02h. It determines the proportional relation between the load shaft displacement (reference unit) and the motor displacement (encoder unit), as shown below.

Motor displacement = Load shaft displacement x Gear ratio

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

The calculation formula is as follows.

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

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6091.01h	Motor resolution	1 to 4294967295	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.	1	-	UInt32	At stop	Real-time
The relation between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows. Motor position feedback = Load shaft position feedback x Gear ratio The relation between the motor speed (RPM) and the load shaft speed (reference unit/s) is as follows: $\text{Motor speed(rpm)} = \frac{\text{Rotational speed of the load axis} \times \text{gear ratio 6091h}}{\text{Motor encoder resolution}} \times 60$ The motor acceleration (RPM/ms) and the load shaft acceleration (reference unit/s2) is in the following relationship: $\text{Motor acceleration} = \frac{\text{Load axis acceleration} \times \text{gear ratio6091h}}{\text{Motor encoder resolution}} \times \frac{1000}{60}$								
6091.02h	Shaft resolution	1 to 4294967295	Defines the denominator of the gear ratio.	1	-	UInt32	At stop	Real-time
The gear ratio is within the following range: 0.001 x Encoder resolution/10000 to 4000 x Encoder resolution/10000. If this range is exceeded, EB03.0 (Gear ratio overlimit) will occur.								

Take the load ball screw as an example.

Minimum reference unit f_c = 1 mm

Lead P_B = 10 mm/r

Reduction ratio n = 3:1

Resolution of Inovance motor equipped with 23-bit serial-type encoder (P) = 8388608 (p/r)

The position factor is therefore calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P} \times \text{n}}{P_B}$$

$$= \frac{8388608 \times 3}{10}$$

$$= \frac{25165824}{10}$$

$$= 2516582.4$$

Therefore, 6091.01h = 2516582.4; 6091.02h = 1. That means when the load shaft displacement is 1 mm, the motor displacement is 2516582.4.

Reduce the values of 6091.01h and 6091.02h to a point where there is no common divisor, and take the final value.

12.2 Servo State

To make the servo drive run in the designated state, observe the process stipulated in the standard CiA402 protocol when operating the drive.

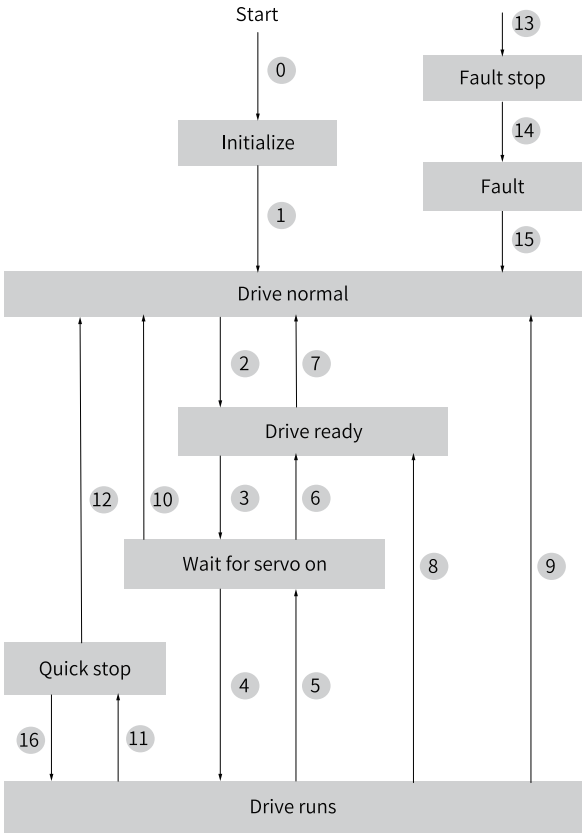


Figure 12-2 Switchover of CiA402 state machine

See the following table for descriptions of different status.

state	Description
Initialization	Initialization of the servo drive and internal self-inspection are done. Parameters cannot be set. Drive functions cannot be executed.
No fault	No fault exists in the servo drive or the fault has been cleared. Parameters can be set.

state	Description
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.
Enable operation	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.
Fault reaction	A fault occurs and the servo drive is in the process of stop. Only parameters whose "Setting Condition" is "During running" can be set.
Fault	The stop process is done and all the drive functions are disabled. Parameters can be modified for troubleshooting purpose.

The following table describes the control commands and status switchover.

CiA402 Status Switchover		Control Word 6040h	bit0 to bit9[1] of status word 6041h
0	Power-on → Initialization	Natural transition, control command not required	0x0000
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly enters status 13.	0x0250/0x270
2	No fault → Servo ready	0x0006	0x0231
3	Servo ready→Waiting for the S-ON signal	0x0007	0x0233
4	Waiting for the S-ON signal→Servo running	0x000F	0x0237
5	Servo running→Waiting for the S-ON signal	0x0007	0x0233
6	Waiting for the S-ON signal→Servo ready	0x0006	0x0231
7	Servo ready → No fault	0x0000	0x0250
8	Servo running → Servo ready	0x0006	0x0231
9	Servo running → No fault	0x0000	0x0250
10	Waiting for the S-ON signal → No fault	0x0000	0x0250
11	Servo running → Quick stop	0x0002	0x0217
12	Quick stop → No fault	Set 605A to a value between 0 and 3. Natural transition applies after stop and no control command is required.	0x0250

CiA402 Status Switchover		Control Word 6040h	bit0 to bit9[1] of status word 6041h
13	→ Stop at fault	If a fault occurs in any status other than "fault", the servo drive automatically switches to the stop-at-fault state, without the need for a control command.	0x021F
14	Stop at fault→Fault	Natural transition applies after stop and no control command is required.	0x0218
15	Fault→No fault	0x80 Bit7 is rising edge-triggered. 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 operating state of the servo drive, and their values are represented as "0" in the preceding table. For details on the status of these bits, check the operation mode of the servo drive.

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6040h	Control word	0 to 65535	The description of control words is detailed in the table below.	0	-	UInt16	Real-time	Real-time

Defines the control command.

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.

bit	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 to 6	Operation mode specific	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault reset	Fault reset	0: Inactive 0 -> 1: Fault reset is available only for faults and warnings that can be reset. 1: Other control commands are invalid. 1->0: Inactive
8	Halt	Halt	1: Active, 0: Inactive
9	Operation mode specific	Operation mode specific	Related to the operation mode of the servo drive.
10	Reserved	Reverse	Undefined
11 to 15	Manufacturer-specific	Manufacturer-specific	Manufacturer-specific

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6041h	Status word	0 to 65535	The description of control words is detailed in the table below.	0	-	UInt16	Unchangeable	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms		oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso

MSB LSB

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

Table 12–1 Description of each bit of 6041h

bit	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	Alarm	Alarm	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	1: Active, 0: Inactive

Table 12–2 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

- The meanings of bit0 to bit9 are the same in each mode of the servo drive. After commands in 6040h are sent in sequence, the servo drive returns a feedback on the servo state.
- The meanings of bit12 to bit13 vary with the servo drive modes. For details, see parameters related to each mode.
- The meanings of bit10, bit11, and bit15 are the same in each mode of the servo drive and indicate the servo drive status after a certain control mode is implemented.

12.3 Servo mode

Introduction to the operation modes

The drive supports 7 servo modes. The pre-operational mode is set in 6060h. The current operation mode of the servo drive can be viewed in 6061h.

☆Related parameters

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6060h	Servo drive 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	Select servo operation mode: 1: Profile Position Mode (PP) 3: Profile velocity mode (PV) 4: Profile Torque Mode (PT) 6: Homing mode (HM) 8: CSP mode 9: CSV mode 10: CST mode Other: NA An unsupported servo mode is selected by SDO and an SDO error will be returned. If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.	0	-	UInt16	Real-time	Real-time
6061h	Operation mode display	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	Reflect the actual operating mode of the servo: 1: Profile Position Mode (PP) 3: Profile velocity mode (PV) 4: Profile Torque Mode (PT) 6: Homing mode (HM) 8: CSP mode 9: CSV mode 10: CST mode	0	-	UInt16	Unchangeable	-

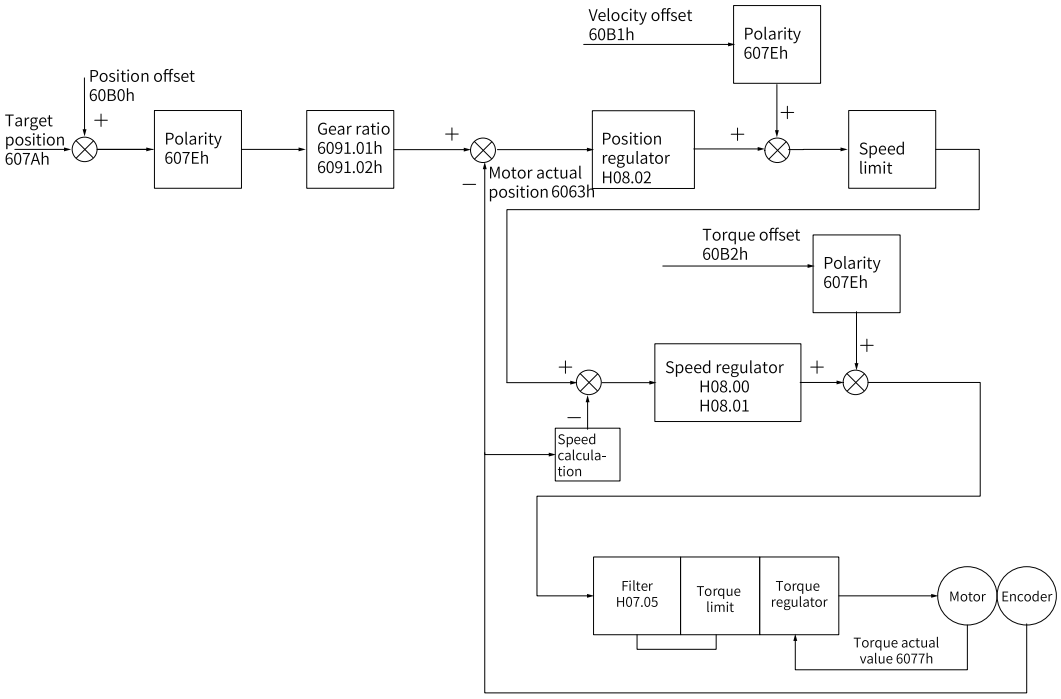
Communication cycle supported by each mode

For the IS810N-INT, the min. sync period is 1 ms and the max. sync period is 20 ms.

12.4 Cyclic Synchronous Position Mode (CSP)

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

12.4.1 Function Block Diagram



12.4.2 Configuration Block Diagram

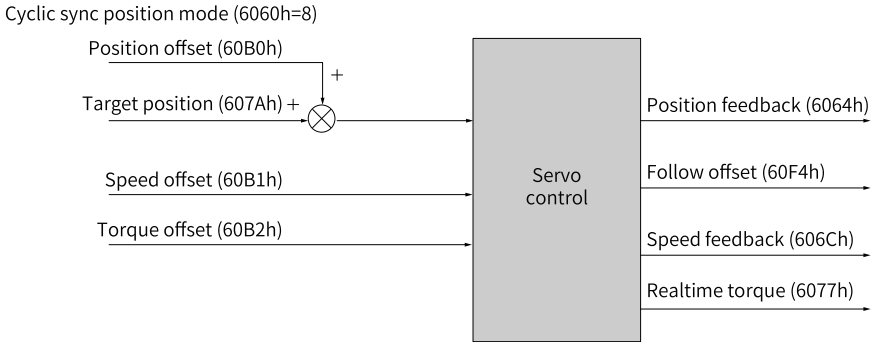


Figure 12-3 Cyclic synchronous position mode

12.4.3 Recommended Configuration

RPDO	TPDO	Remarks
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

12.4.4 Related Parameters

6040h **Control word**

Address: 0x3502

Min.: 0 Unit: -

Max.: 65535 Data Type: Uint16
Default: - Change: Real-time
Access: RW Mapping: RPDO

Value Range:
0 to 65535

Description:
Defines the control command.

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

The CSP mode only supports absolute position references.

6041h Status word

Address: 0x3504
Min.: - Unit: -
Max.: - Data Type: Uint16
Default: - Change: -
Access: RO Mapping: TPDO

Value Range:
-

Description:
Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
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	Following error	Following error	0: EB00.0 (Excessive position deviation) not reported 1: EB00.0 (Excessive position deviation) reported

bit	Name		Description
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	Home find	Home find	0: Home not found 1: Home found

☆ Related parameters:

For detailed description of related parameters 6060h; 6061h; 6064h; 6065h; 6066h; 606Ch; 6077h; 607Ah; 607Eh; 60B0h; 60B1h; 60B2h; 60F4h, see *"16.23 6000h Parameters" on page 475*.

12.4.5 Related Functions

Position deviation monitoring function

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6065h	Following error window	0 to 4294967295	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.	21989 5608	reference unit	UInt32	Real-time	Real-time
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 ms–65535 ms	Defines the time lapse to trigger excessive position deviation (EB00.0), which must be used together with 6065h.	0	ms	UInt16	Real-time	Real-time

Position reference polarity

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

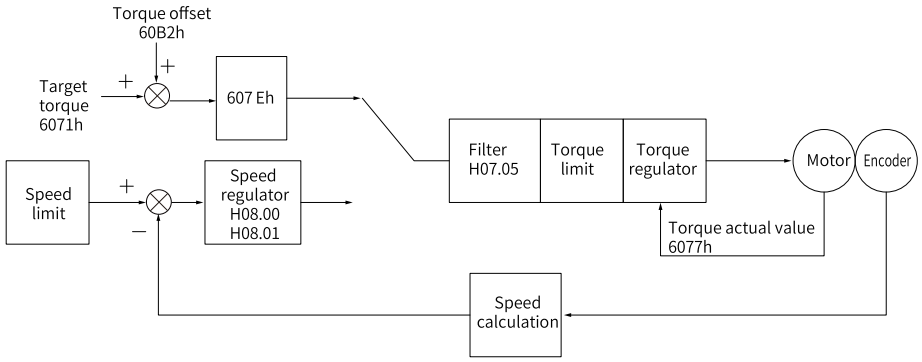
☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque command (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time

12.5 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 executes torque control.

12.5.1 Function Block Diagram



12.5.2 Configuration Block Diagram

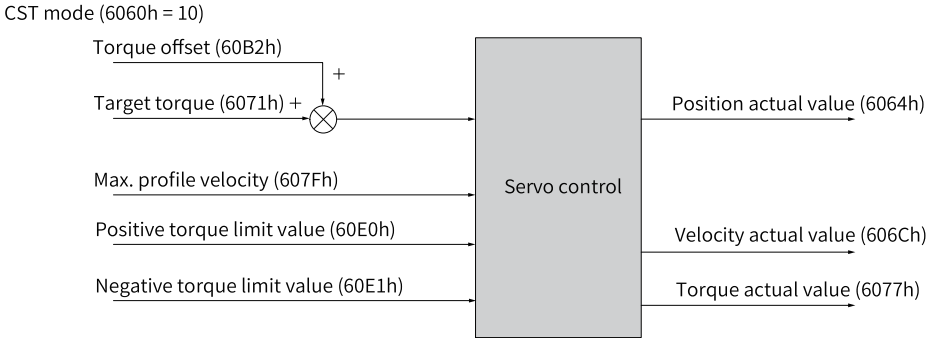


Figure 12-4 CST mode

12.5.3 Recommended Configuration

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

RPDO	TPDO	Remarks
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

12.5.4 Related Parameters

6040h **Control word**

Address: 0x3502
Min.: 0
Max.: 65535
Default: -
Access: RW
Unit: -
Data Type: Uint16
Change: Real-time
Mapping: RPDO

Value Range:
0 to 65535

Description:
Defines the control command.

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

6041h **Status word**

Address: 0x3504
Min.: -
Max.: -
Default: -
Unit: -
Data Type: Uint16
Change: -

Access: RO Mapping: TPDO

Value Range:

-

Description:

Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
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

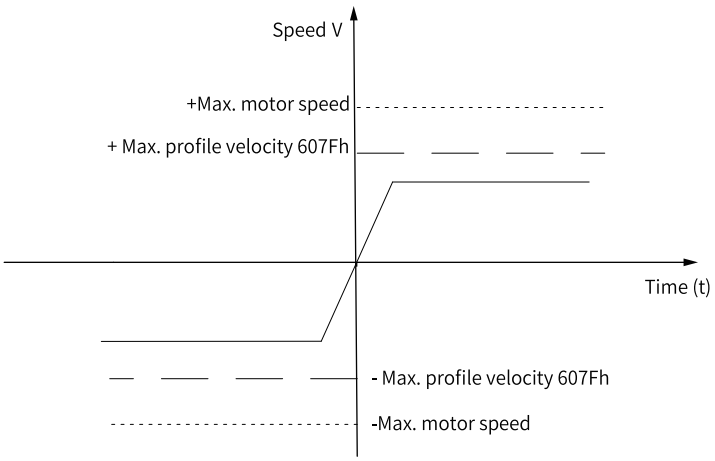
☆ Related parameters:

For detailed description of related parameters 6060h；6061h；6071h；6072h；6074h；6077h；607Eh；607Fh；60B2h；60E0h；60E1h, please see *"16.23 6000h Parameters" on page 475*.

12.5.5 Related Functions

Speed limit in the torque control mode

In torque 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.

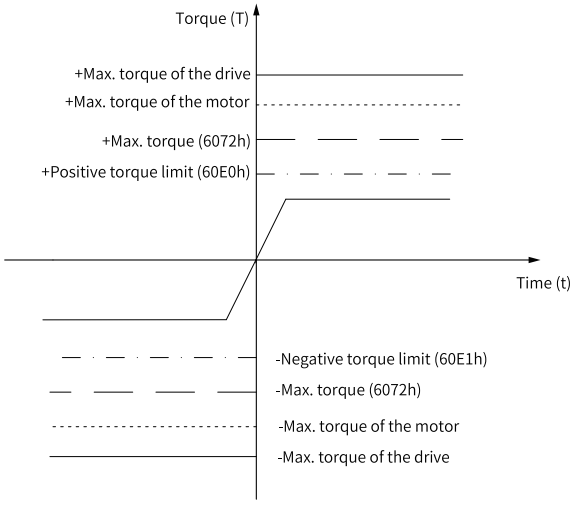


☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Fh	Max. speed	0 to 4294967295	Defines the maximum user running speed. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 RPM.	4294967295	Reference unit/s	UInt32	Real-time	Real-time

Torque limit

To protect the mechanical devices, you can limit the torque references of the 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 drive cannot be exceeded.



☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6072h	Max. torque reference	0 to 5000	Maximum torque command limit; 1000 corresponds to 1 times the rated torque of the motor.	3500	0.001	UInt16	Real-time	Real-time
60E0h	Positive torque limit	0 to 5000	It sets the maximum positive torque in the motor.	3500	0.001	UInt16	Real-time	Real-time
60E1h	Negative torque limit	0 to 5000	It sets the maximum negative torque in the motor.	3500	0.001	UInt16	Real-time	Real-time

Torque reference polarity

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

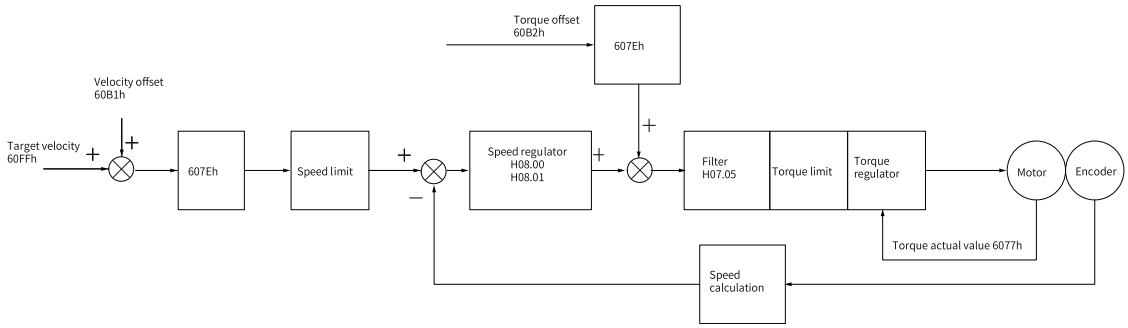
☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque command (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time

12.6 Cyclic Synchronous Velocity Mode (CSV)

In this mode, the host controller sends the target speed to the servo drive synchronously. Speed control and torque control are performed by the servo drive.

12.6.1 Function Block Diagram



12.6.2 Configuration Block Diagram

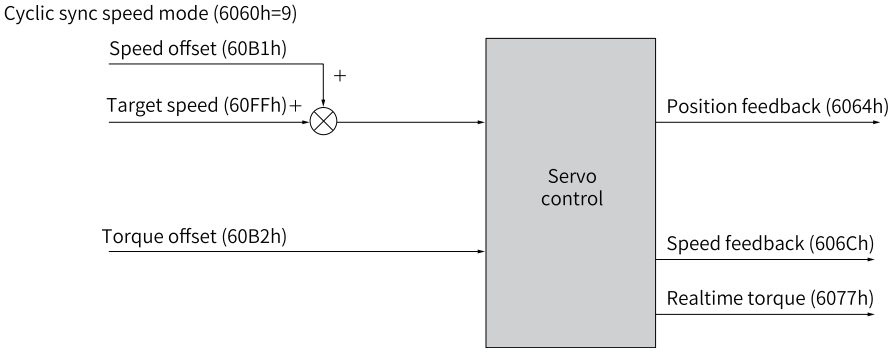


Figure 12-5 CSV mode

12.6.3 Recommended Configuration

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

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity	-	Mandatory
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

12.6.4 Related Parameters

6040h **Control word**

Address: 0x3502
Min.: 0
Max.: 65535
Default: -
Access: RW
Unit: -
Data Type: Uint16
Change: Real-time
Mapping: RPDO

Value Range:

0 to 65535

Description:

Defines the control command.

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

6041h **Status word**

Address: 0x3504
Min.: -
Max.: -
Default: -
Access: RO
Unit: -
Data Type: Uint16
Change: -
Mapping: TPDO

Value Range:
-

Description:
Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
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:

For a detailed description of related parameters 6060h; 6061h; 6064h; 606Ch; 6077h; 607Eh; 60B1h; 60B2h; 60FFh, see *"16.23 6000h Parameters" on page 475*.

12.6.5 Related Functions

Velocity reference polarity

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

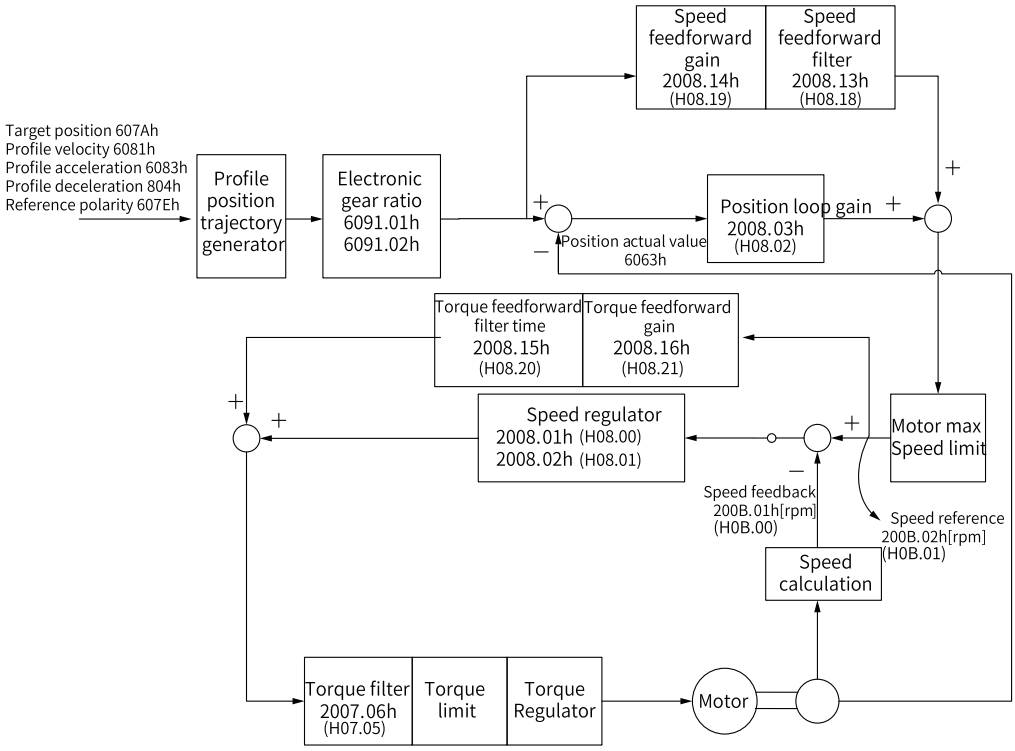
☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque command (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time

12.7 Profile Position Mode (PP)

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

12.7.1 Function Block Diagram



12.7.2 Configuration Block Diagram

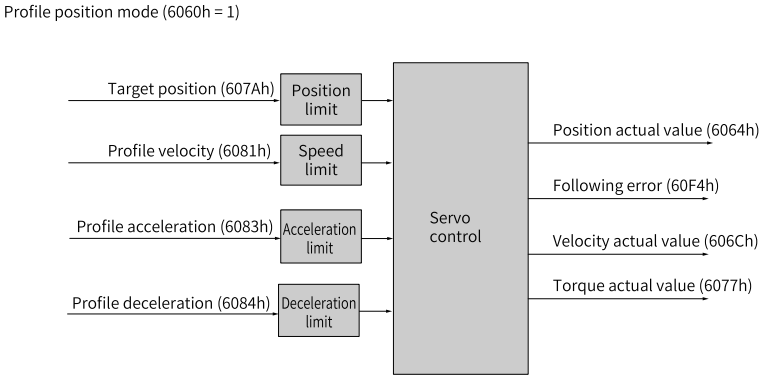


Figure 12-6 PP mode

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

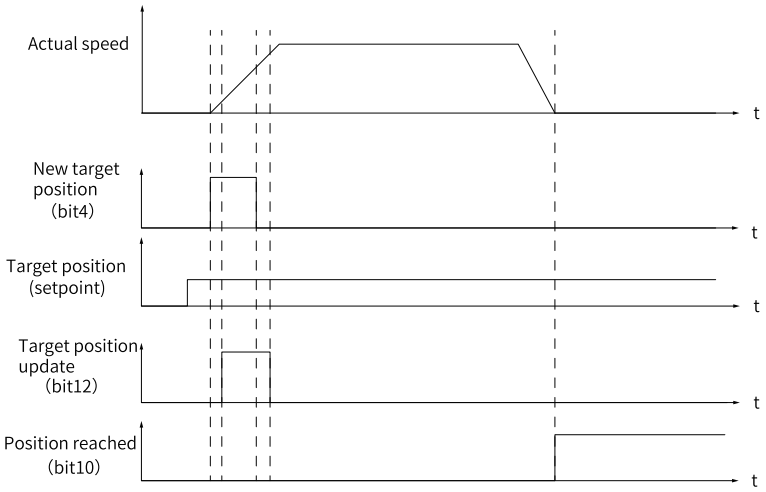


Figure 12-7 Sequence in sequential mode

The linkage mode of position references is determined by bit5 (Change set immediately) of the control word. When bit5 is set to 1 (Sequential mode), sequential linkage applies 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:

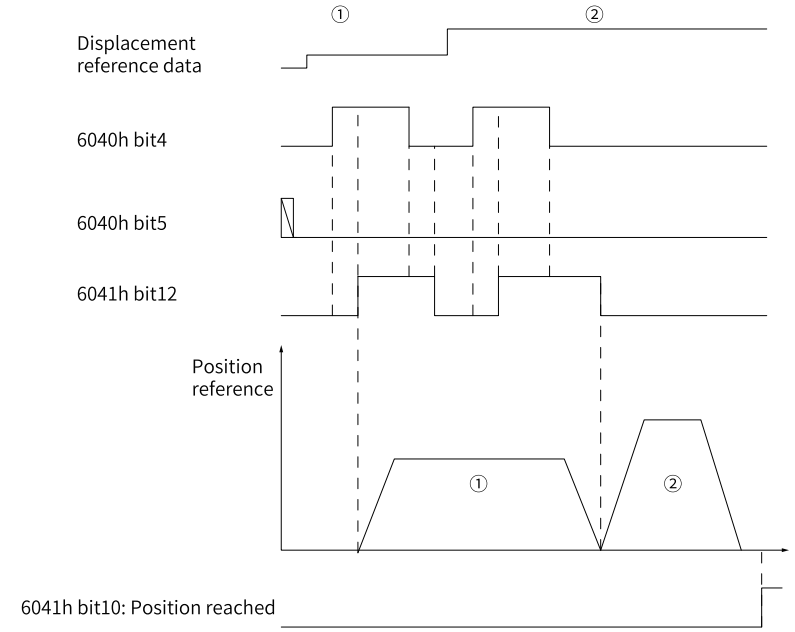
The target position of present segment is in the process of positioning. After the new target position is generated, the controller sets bit4 (New set-point) of the control word to 1, and the servo drive executes positioning towards the new target position.

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.

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.

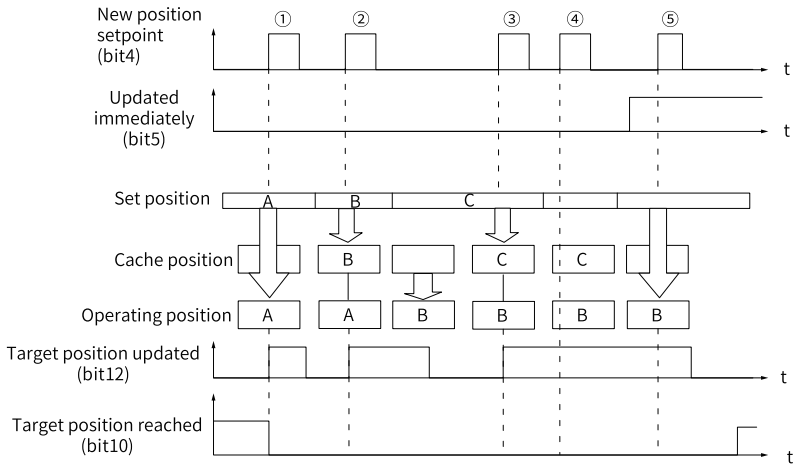
The sequence of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word is as follows.



Note: If you need to change any parameter of the displacement reference, send the trigger signal again.

Figure 12-8 Sequence in the single-point mode

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



- ① If the cache position is empty, the set position will be executed immediately.
- ②③ If a position reference is under execution currently, the new position setpoint will be saved in the cache. After current position reference is done transmitting, the cached setpoint will be executed, after which a new setpoint can be received.
- ④⑤ The new 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.

12.7.3 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

12.7.4 Related Parameters

6040h **Control word**

Address: 0x3502
Min.: 0
Max.: 65535
Default: -
Access: RW
Unit: -
Data Type: Uint16
Change: Real-time
Mapping: RPDO

Value Range:

0 to 65535

Description:

Defines the control command.

bit	Name		Description
0	Switch on	Switch on	1: Enabled, 0: Disabled
1	Enable voltage	Enable voltage	1: Enabled, 0: Disabled
2	Quick stop	Quick stop	0: Enabled, 1: Disabled
3	Enable operation	Enable operation	1: Enabled, 0: Disabled
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: Target set-point can be updated immediately
6	abs/rel	Abs/rel	0: abs 1: rel
8	Halt	Halt	0: Keep present operating state 1: Halt

6041h **Status word**

Address: 0x3504
Min.: -
Max.: -
Default: -
Access: RO
Unit: -
Data Type: Uint16
Change: -
Mapping: TPDO

Value Range:

-

Description:

Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
10	Target reach	Target reach	0: Target position not reached 1: Target position 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: 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:

For detailed description of related parameters 6060h; 6061h; 6064h; 6065h; 6066h; 6067h; 6068h; 607Ah; 607Eh; 607Fh; 6081h; 6083h; 6084h, see *"16.23 6000h Parameters" on page 475*.

12.7.5 Related Functions

Positioning completed

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

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6067h	Position window	0 to 4294967295	Defines the threshold for position reach. If the difference between 6062h and 6064h is within ±6067h and the time reaches 6068h, the position is reached. In this case, bit 10 of 6041h is set to 1 in the profile position mode. This flag bit is valid only when the S-ON signal is valid in profile position control mode.	46976	reference unit	UInt32	Real-time	Real-time
6068h	Position window time	0 ms–65535 ms	Defines the window time for position reach, which must be used together with 6067h.	0	ms	UInt16	Real-time	Real-time

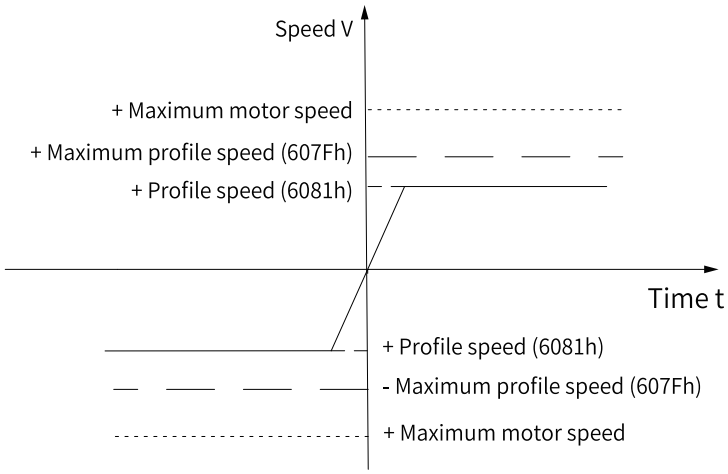
Position deviation monitoring function

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6065h	Following error window	0 to 4294967295	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.	21989 5608	reference unit	UInt32	Real-time	Real-time
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 ms–65535 ms	Defines the time lapse to trigger excessive position deviation (EB00.0), which must be used together with 6065h.	0	ms	UInt16	Real-time	Real-time

Speed limit

In PP 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	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Fh	Max. speed	0 to 4294967295	Defines the maximum user running speed. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 RPM.	4294967295	Reference unit/s	UInt32	Real-time	Real-time

Acceleration and deceleration limits

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

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6083h	Profile acceleration	0 to 4294967295	Defines the acceleration rate in the acceleration stage of the displacement reference in the profile position mode. When a 23-bit motor is used and the gear ratio is set to 1: 1, the motor speed is required to be 400rpm (6081h corresponds to 400 * 8388608/60), the user acceleration is required to be 400rpm/s (6083h corresponds to 400 * 8388608/60), and the user deceleration is required to be 200rpm/s (6084h corresponds to 200 * 8388608/60), then: acceleration time tup = Δ6081h/Δ6083h = 1 (s); Deceleration time tdown = Δ6081h/Δ6084h = 2 (s)	4294967295	Reference unit/s^2	UInt32	Real-time	Real-time
6084h	Profile deceleration	0 to 4294967295	Defines the deceleration rate in the deceleration stage of the displacement reference in the profile position mode. When a 23-bit motor is used and the gear ratio is set to 1: 1, the motor speed is required to be 400rpm (6081h corresponds to 400 * 8388608/60), the user acceleration is required to be 400rpm/s (6083h corresponds to 400 * 8388608/60), and the user deceleration is required to be 200rpm/s (6084h corresponds to 200 * 8388608/60), then: acceleration time tup = Δ6081h/Δ6083h = 1 (s); Deceleration time tdown = Δ6081h/Δ6084h = 2 (s)	4294967295	Reference unit/s^2	UInt32	Real-time	Real-time

Reference polarity

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

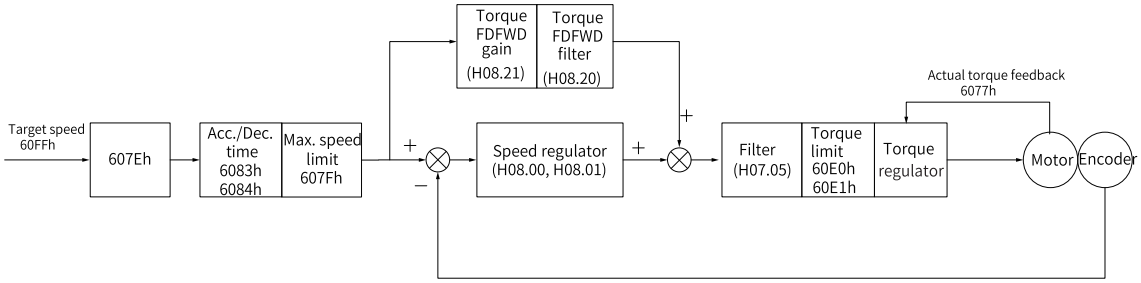
☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque command (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time

12.8 Profile Velocity Mode (PV)

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

12.8.1 Function Block Diagram



12.8.2 Configuration Block Diagram

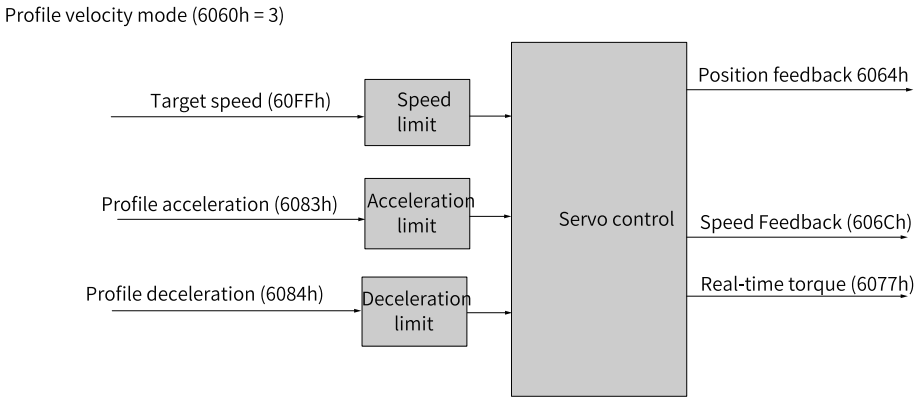


Figure 12-9 PV mode

12.8.3 Recommended Configuration

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

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity	-	Mandatory
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
6083h: profile acceleration	-	Optional
6084h: profile deceleration	-	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

12.8.4 Related Parameters

6040h **Control word**

Address: 0x3502
Min.: 0
Max.: 65535
Default: -
Access: RW
Unit: -
Data Type: Uint16
Change: Real-time
Mapping: RPDO

Value Range:

0 to 65535

Description:

Defines the control command.

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

6041h **Status word**

Address: 0x3504

Min.:	-	Unit:	-
Max.:	-	Data Type:	Uint16
Default:	-	Change:	-
Access:	RO	Mapping:	TPDO

Value Range:

-

Description:

Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
10	Target reach	Target reach	0: Target velocity not reached 1: Target velocity 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 not being 0 1: Speed being 0
13	-	N/A	N/A
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	-	N/A	N/A

☆ Related parameters:

For a detailed description of related parameter 606Ch; 606Dh; 606Eh; 606Fh; 6070h; 607Eh; 607Fh; 6083h; 6084h; 60FFh, see *"16.23 6000h Parameters" on page 475*.

12.8.5 Related Functions

Monitoring on speed reach status

It is used to check whether the speed reference of the servo drive is consistent with the motor speed feedback.

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
606Dh	Velocity window	0 RPM to 65535 RPM	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 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.	10	rpm	UInt16	Real-time	Real-time
606Eh	Velocity window time	0 ms–65535 ms	Defines the time window for speed reach, which must be used together with 606Dh.	0	ms	UInt16	Real-time	Real-time

Monitoring on zero speed

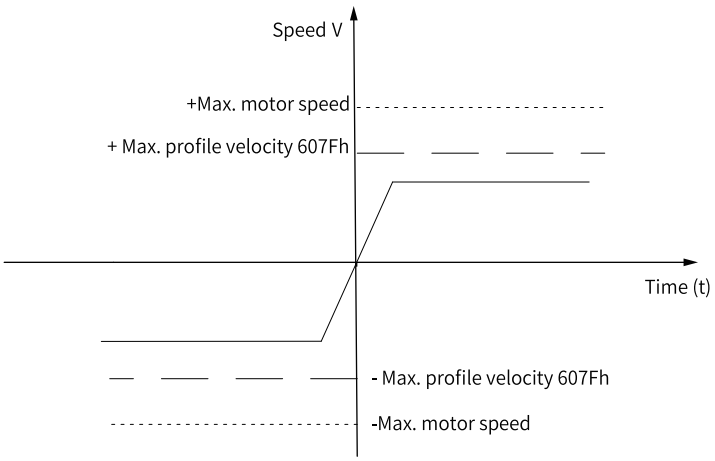
It is used to check whether the absolute value of motor speed feedback is lower than the set threshold. If yes, the motor is close to a standstill (zero speed) and bit12 of the status word is set to 1.

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
606Fh	Zero speed signal threshold	0 RPM to 65535 RPM	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.	10	rpm	UInt16	Real-time	Real-time
6070h	Velocity threshold time	0 ms–65535 ms	Defines the time window for determining whether the user velocity is 0, which must be used together with 606Fh.	0	ms	UInt16	Real-time	Real-time

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	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Fh	Max. speed	0 to 4294967295	Defines the maximum user running speed. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 RPM.	4294967295	Reference unit/s	UInt32	Real-time	Real-time

Acceleration and deceleration limits

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

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60C5h	Max. acceleration	0 to 4294967295	Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.	4294967295	Reference unit/s^2	UInt32	Real-time	Real-time
60C6h	Max. deceleration	0 to 4294967295	Defines the maximum permissible deceleration in the profile position mode, profile velocity mode, and homing mode.	4294967295	Reference unit/s^2	UInt32	Real-time	Real-time

Reference polarity

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

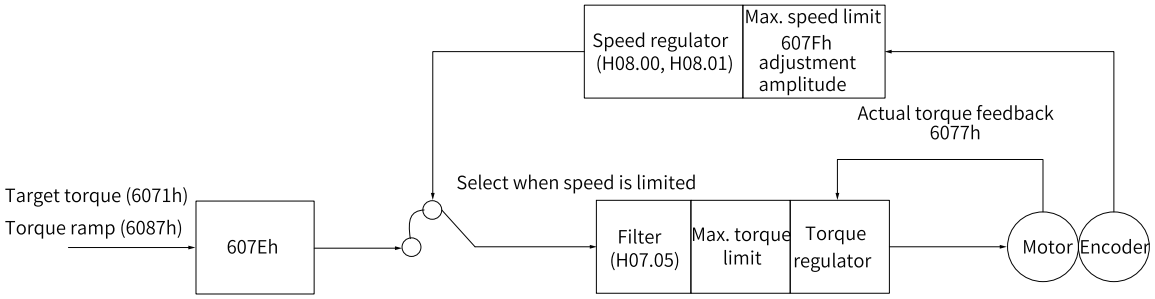
☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque reference (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time

12.9 Profile Torque Mode (PT)

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

12.9.1 Function Block Diagram



12.9.2 Configuration Block Diagram

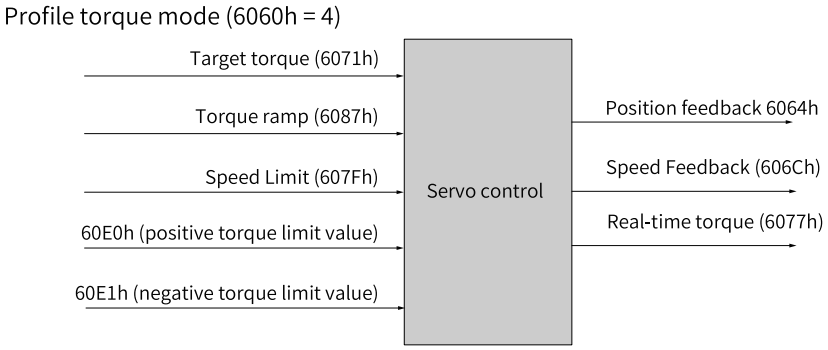


Figure 12-10 PT mode

12.9.3 Recommended Configuration

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

RPDO	TPDO	Remarks
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

12.9.4 Related Parameters

6040h **Control word**

Address: 0x3502
Min.: 0
Max.: 65535
Default: -
Access: RW
Unit: -
Data Type: Uint16
Change: Real-time
Mapping: RPDO

Value Range:
0 to 65535

Description:
Defines the control command.

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

6041h **Status word**

Address: 0x3504
Min.: -
Max.: -
Default: -
Access: RO
Unit: -
Data Type: Uint16
Change: -
Mapping: TPDO

Value Range:
-

Description:
Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled

bit	Name		Description
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
10	Target reach	Target reach	0: Target velocity not reached 1: Target velocity 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:

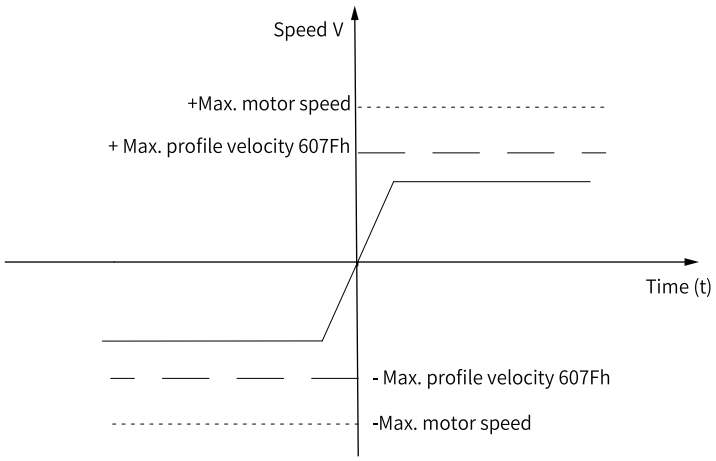
For detailed description of relevant parameter H07.17, please refer to *"16.8 H07 Parameters" on page 398*.

For detailed description of related parameters 6060h；6061h；6071h；6072h；6074h；6077h；607Eh；607Fh；6087h；60E0h；60E1h, please see *"16.23 6000h Parameters" on page 475*.

12.9.5 Related Functions

Speed limit in the torque control mode

In torque 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.

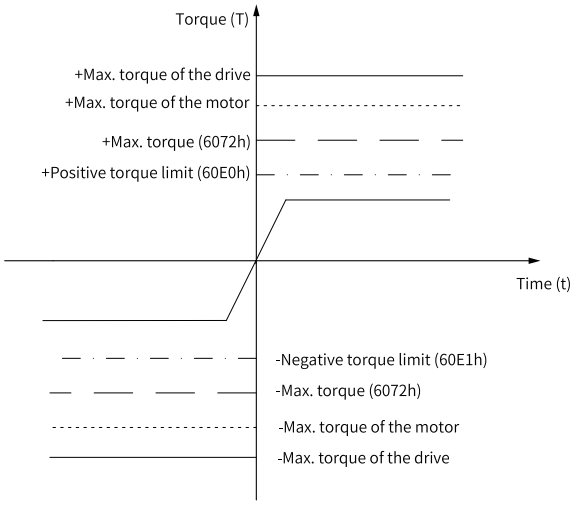


☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Fh	Max. speed	0 to 4294967295	Defines the maximum user running speed. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 RPM.	4294967295	Reference unit/s	UInt32	Real-time	Real-time

Torque limit

To protect the mechanical devices, you can limit the torque references of the 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 drive cannot be exceeded.



☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6072h	Max. torque reference	0. to 5000.	Maximum torque reference limit; 1000 corresponds to 1 time of the rated torque of the motor.	3500	0.001	UInt16	Real-time	Real-time
60E0h	Positive torque limit	0. to 5000.	It sets the maximum positive torque in the motor.	3500	0.001	UInt16	Real-time	Real-time
60E1h	Negative torque limit	0. to 5000.	It sets the maximum negative torque in the motor.	3500	0.001	UInt16	Real-time	Real-time

Torque reference polarity

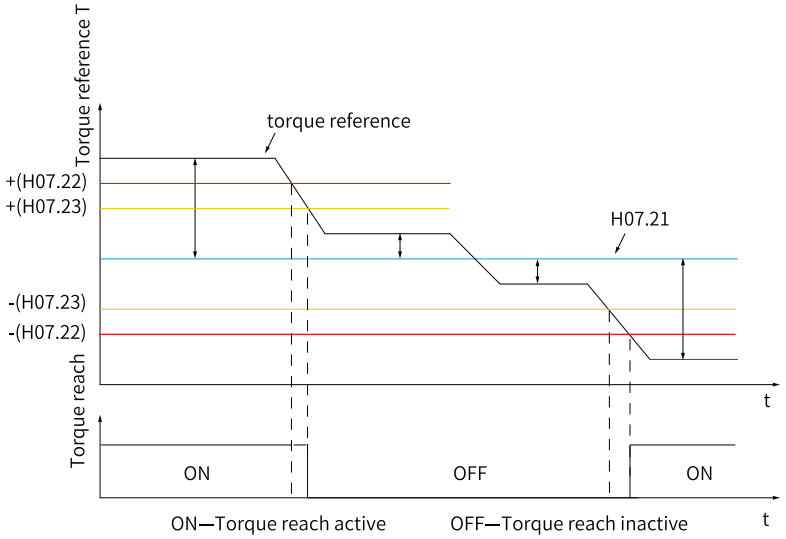
You can change the torque reference direction through setting the torque reference polarity.

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque command (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time

Monitoring on torque reach

It is used to determine whether the torque reference value reaches the set torque base value. If yes, a corresponding torque reach signal will be output to the host controller.



If the absolute difference between the torque reference and H07.21 (Base value for torque reach) is higher than H07.22 (Threshold for valid torque reach), the torque reach signal is active. Otherwise, the original status applies.

If the absolute difference between the torque reference and H07.21 (Base value for torque reach) is lower than H07.23 (Threshold for invalid torque reach), the torque reach signal is inactive. Otherwise, the original status applies.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.21	2007-16h	Torque reach base value	0.0% to 500.0%	Defines the torque reference of the base value for torque reach.	0.0	%	UInt16	Real-time	Real-time
H07.22	2007-17h	Torque reach valid value	0.0% to 500.0%	Defines the torque reference for torque reach DO active.	20.0	%	UInt16	Real-time	Real-time
H07.23	2007-18h	Torque reach invalid value	0.0% to 500.0%	Defines the torque reference for torque reach DO inactive.	10.0	%	UInt16	Real-time	Real-time

12.10 Homing Mode (HM)

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

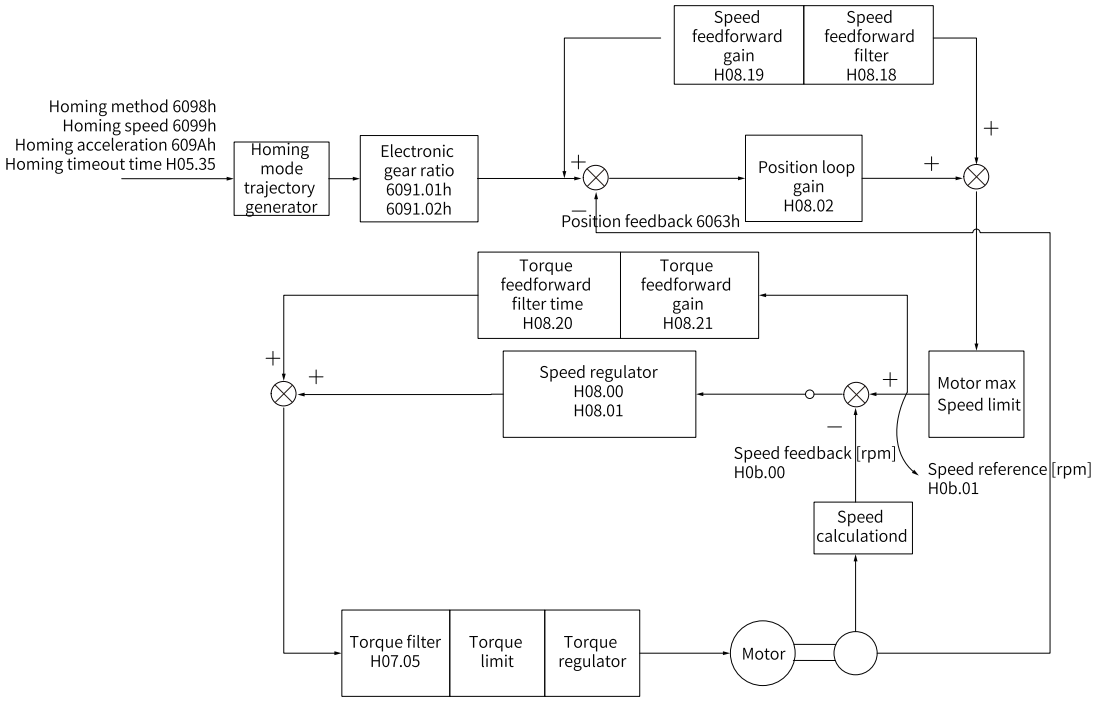
- Home: mechanical home reference point, that is, the motor Z signal.
- Mechanical zero: absolute zero point on the machine

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

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

When 607Ch = 0, the zero is the same as the home.

12.10.1 Function Block Diagram



12.10.2 Configuration Block Diagram

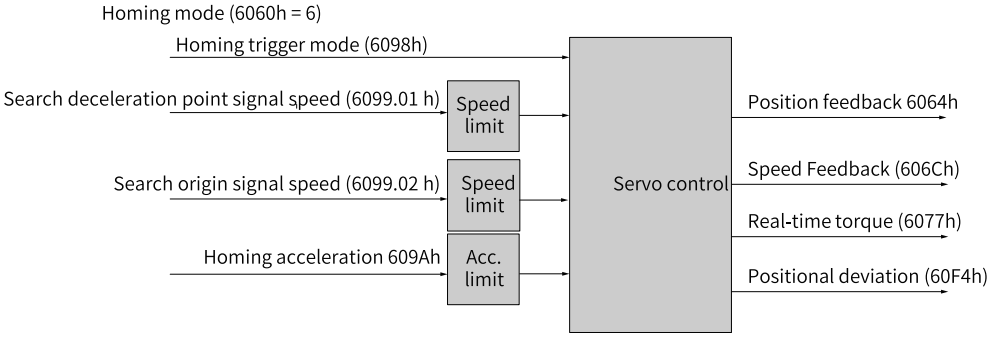


Figure 12-11 HM mode

12.10.3 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

12.10.4 Related Parameters

6040h **Control word**

Address: 0x3502
Min.: 0
Max.: 65535
Default: -
Access: RW
Unit: -
Data Type: Uint16
Change: Real-time
Mapping: RPDO

Value Range:
0 to 65535

Description:
Defines the control command.

bit	Name		Description
0	Switch on	Switch on	1: Enabled, 0: Disabled
1	Enable voltage	Enable voltage	1: Enabled, 0: Disabled
2	Quick stop	Quick stop	0: Enabled, 1: Disabled
3	Enable operation	Enable operation	1: Enabled, 0: Disabled
4	Enable homing	Enable homing	0→1: Start, 1→0: Stop
8	Halt	Halt	0: Keep present operating state, 1: Halt

6041h **Status word**

Address: 0x3504
Min.: -
Max.: -
Default: -
Access: RO
Unit: -
Data Type: Uint16
Change: -
Mapping: TPDO

Value Range:
-

Description:
Indicates the servo drive status.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Enabled, 0: Disabled
1	Switch on	Switch on	1: Enabled, 0: Disabled
2	Enable operation	Operation enabled	1: Enabled, 0: Disabled
3	Fault	Fault	1: Enabled, 0: Disabled
4	Voltage enabled	Voltage enabled	1: Enabled, 0: Disabled
5	Quick stop	Quick stop	0: Enabled, 1: Disabled
6	Switch on disabled	Switch on disabled	1: Enabled, 0: Disabled
7	Alarm	Alarm	1: Enabled, 0: Disabled
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Enabled, control word activated 0: Disabled
10	Target reach	Target reach	1: Home located or homing interrupted
12	Homing attained	Homing attained	0: Home signal not found 1: Home signal found

bit	Name		Description
13	Homing error	Homing error	0: Homing error not occurred 1: Homing error occurred
15	Home find	Home find	0: Home not found 1: Home found

☆ Related parameters:

For detailed description of related parameters 6060h; 6061h; 6065h; 6066h; 607Ch; 607Fh; 6098h; 6099.01 h; 6099.02 h; 609Ah; 60C5h, please see *"16.23 6000h Parameters" on page 475*.

12.10.5 Related Functions

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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.35	2005-24h	Home search time limit	0 ms–65535 ms	Defines the maximum homing time.	10000	ms	UInt16	Real-time	Real-time

Actual position calculation method

After homing, the calculation method for the present mechanical position can be defined by 607Ch.

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Ch	Home offset	-2147483648 to 2147483647	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 takes effect in the following conditions: The device is powered on, the homing operation is complete, and bit15 of 6041h is set to 1. After homing: the user's current position 6064h = 607Ch If 607Ch is mistakenly set outside 607Dh (software absolute position limit), E09.1 (home offset setting error) will occur.	0	reference unit	Int32	Real-time	At stop

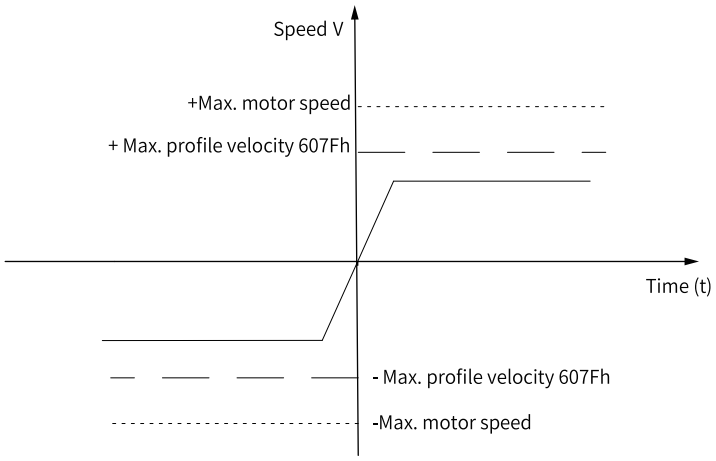
Position deviation monitoring function

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6065h	Following error window	0 to 4294967295	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.	21989 5608	reference unit	UInt32	Real-time	Real-time
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 ms–65535 ms	Defines the time lapse to trigger excessive position deviation (EB00.0), which must be used together with 6065h.	0	ms	UInt16	Real-time	Real-time

Speed limit

In HM 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	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607Fh	Max. speed	0 to 4294967295	Defines the maximum user running speed. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 RPM.	42949 67295	Reference unit/s	UInt32	Real-time	Real-time

Acceleration limit

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

☆ Related parameters:

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60C5h	Max. acceleration	0 to 4294967295	Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.	4294967295	Reference unit/s^2	UInt32	Real-time	Real-time

12.10.6 Homing Operation

6098h = 1

Mechanical home: motor Z signal

Deceleration point: negative limit switch

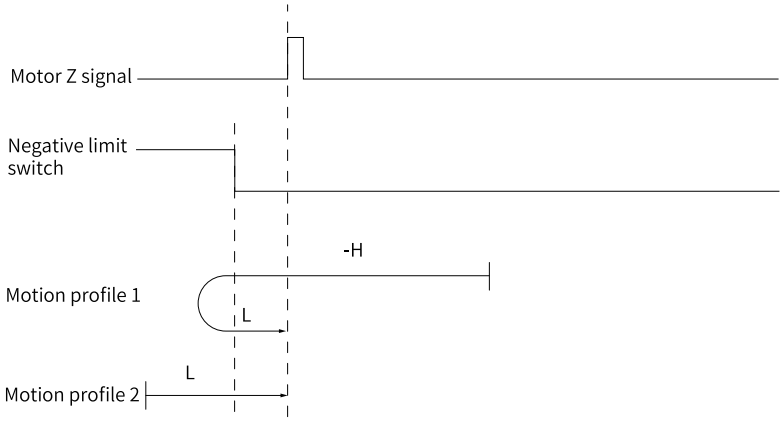


Figure 12-12 Motor running curve and speed in mode 1

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

Note

In the figure, "H" represents high speed 6099.01h, and "L" represents low speed 6099.02h, and “-” indicates reverse run.

6098h = 2

Home: Z signal

Deceleration point: positive limit switch

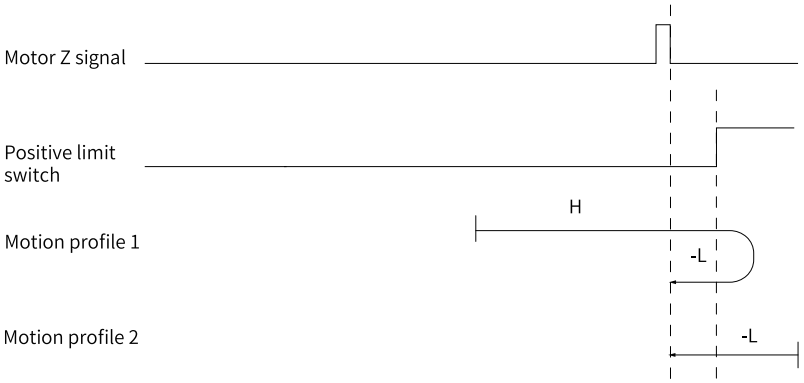


Figure 12-13 Motor running curve and speed in mode 2

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 3

Home: Z signal

Deceleration point: home switch (HW)

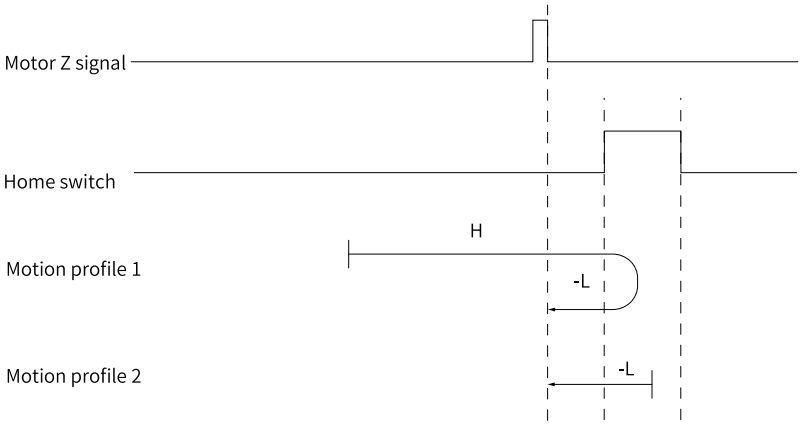


Figure 12-14 Motor running curve and speed in mode 3

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 4

Home: Z signal

Deceleration point: home switch (HW)

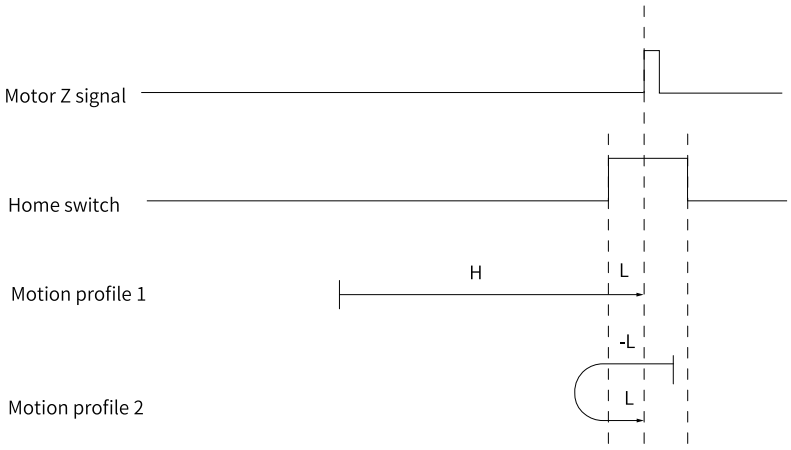


Figure 12-15 Motor running curve and speed in mode 4

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 5

Home: Z signal

Deceleration point: home switch (HW)

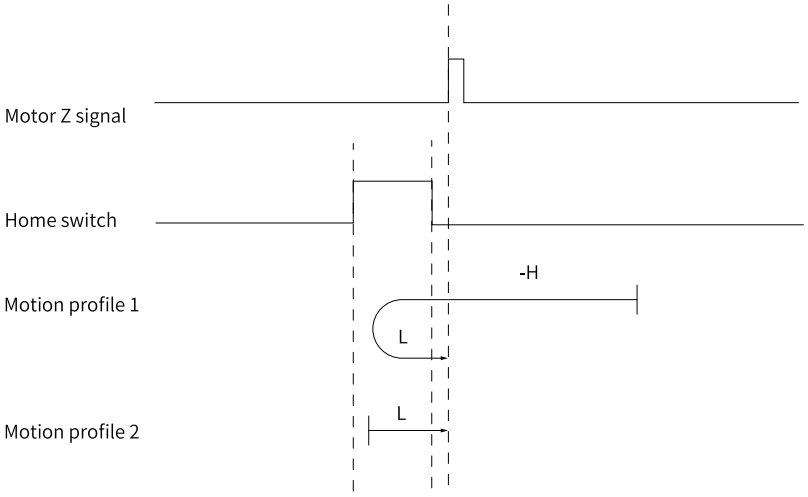


Figure 12-16 Motor running curve and speed in mode 5

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 6

Home: Z signal

Deceleration point: home switch (HW)

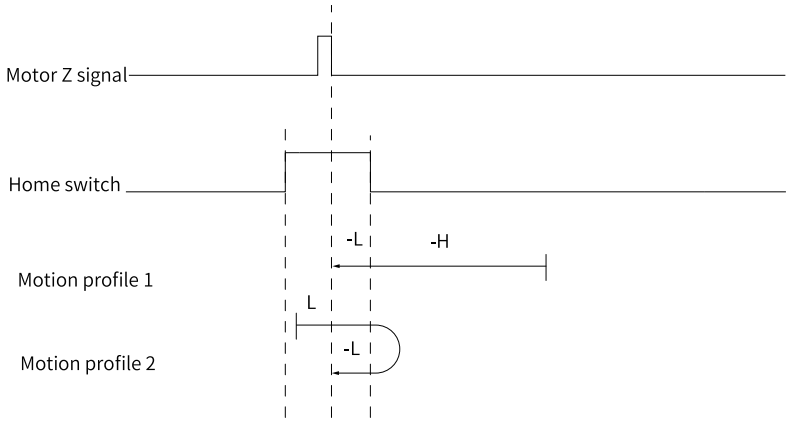


Figure 12-17 Motor running curve and speed in mode 6

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 7

Home: Z signal

Deceleration point: home switch (HW)

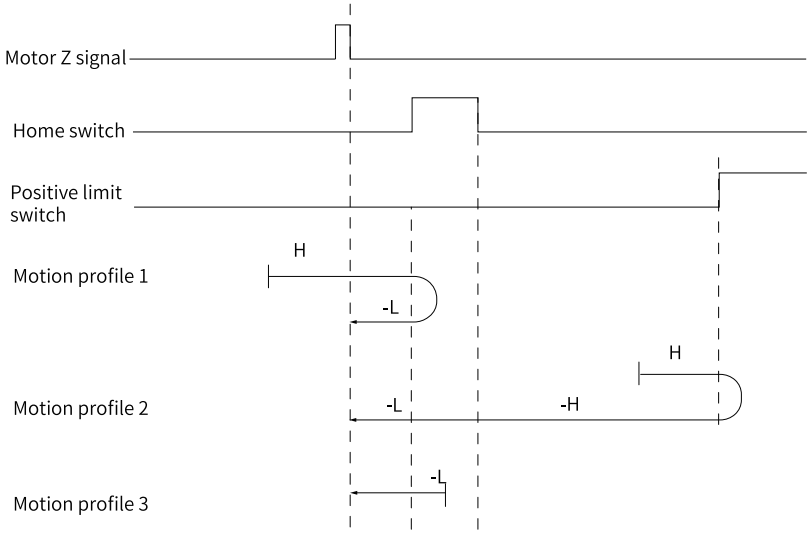


Figure 12-18 Motor running curve and speed in mode 7

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 8

Home: Z signal

Deceleration point: home switch (HW)

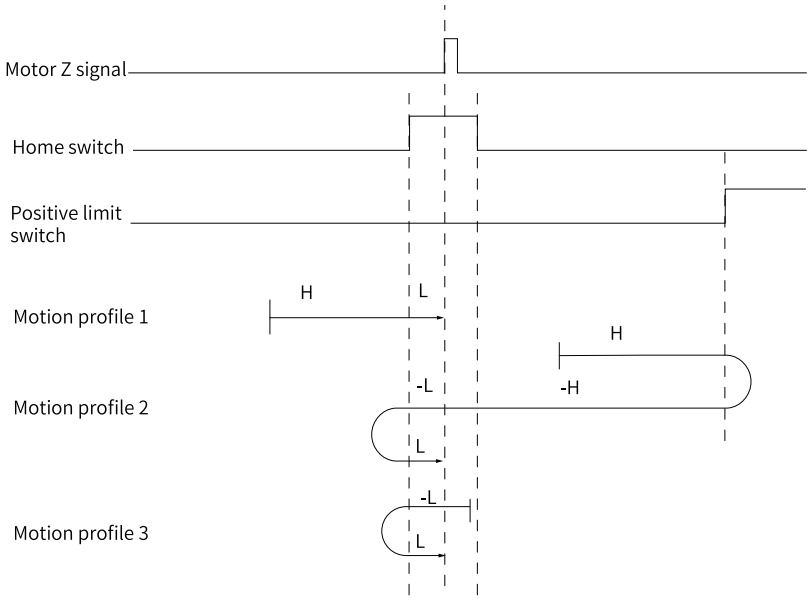


Figure 12-19 Motor running curve and speed in mode 8

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 9

Home: Z signal

Deceleration point: home switch (HW)

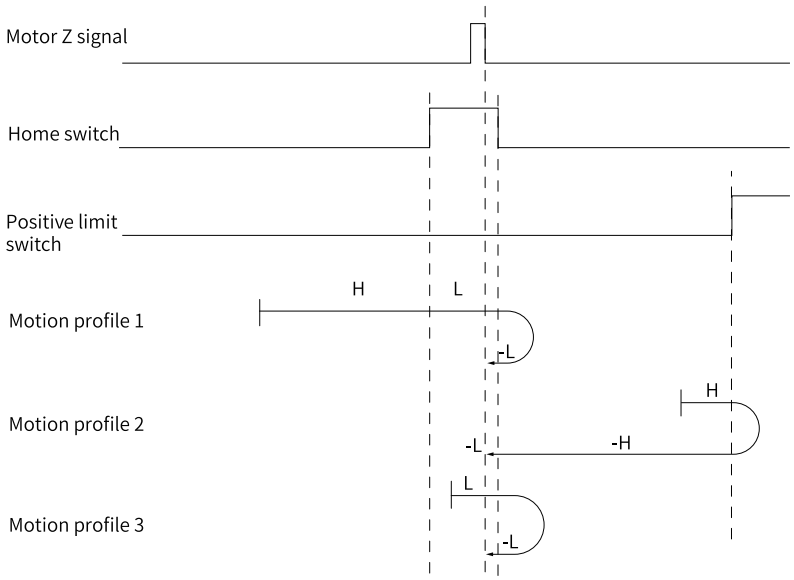


Figure 12-20 Motor running curve and speed in mode 9

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 10

Home: Z signal

Deceleration point: home switch (HW)

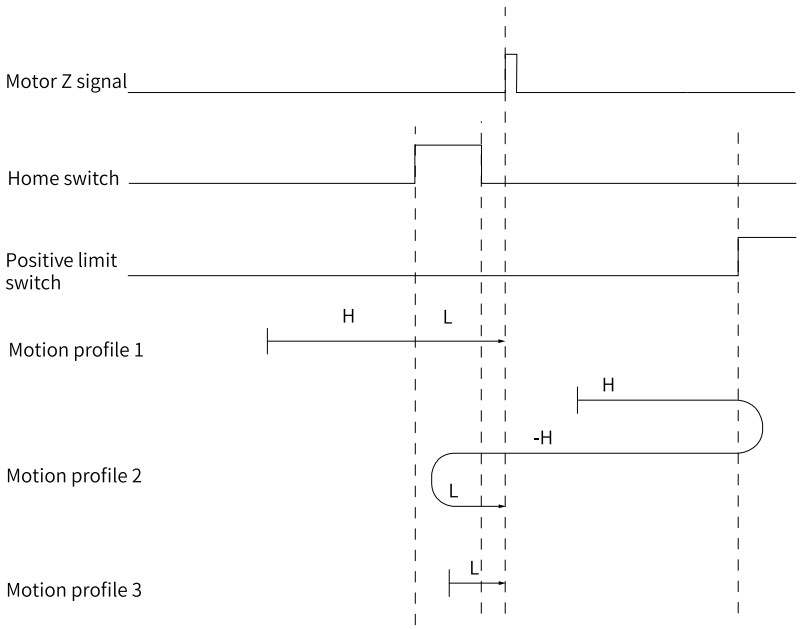


Figure 12-21 Motor running curve and speed in mode 10

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 11

Home: Z signal

Deceleration point: home switch (HW)

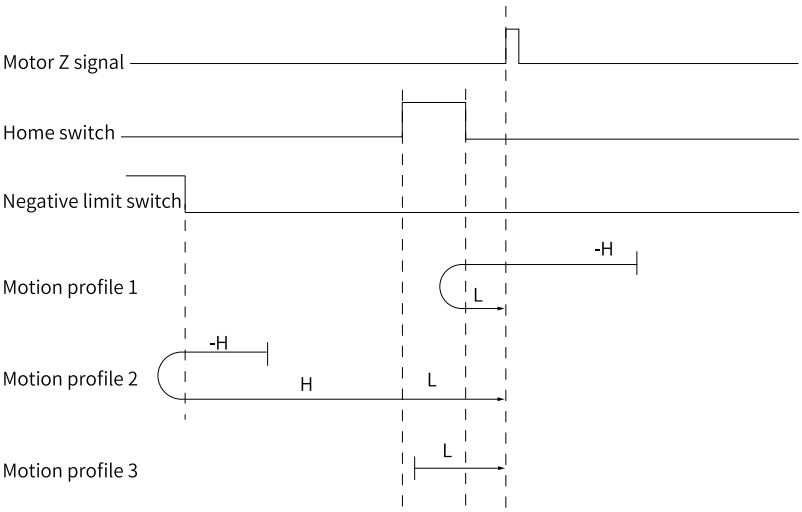


Figure 12-22 Motor running curve and speed in mode 11

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.

- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 12

Home: Z signal

Deceleration point: home switch (HW)

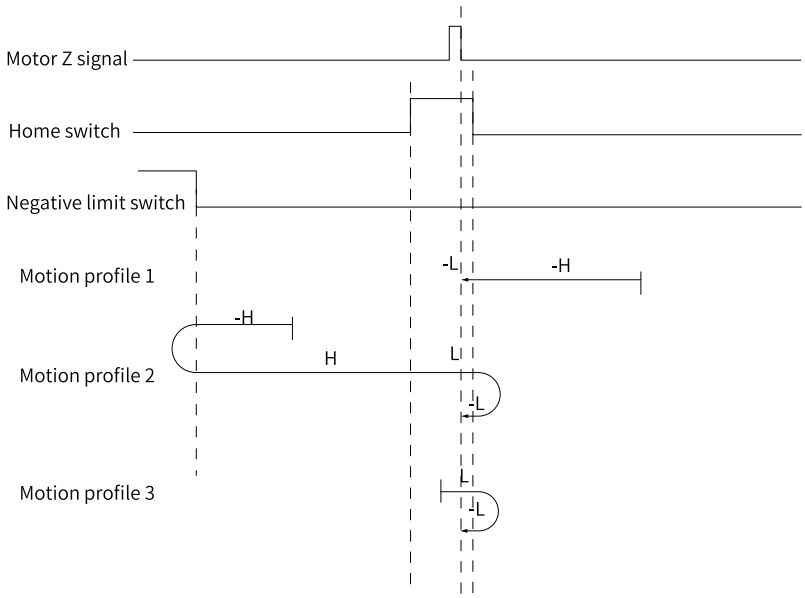


Figure 12-23 Motor running curve and speed in mode 12

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 13

Home: Z signal

Deceleration point: home switch (HW)

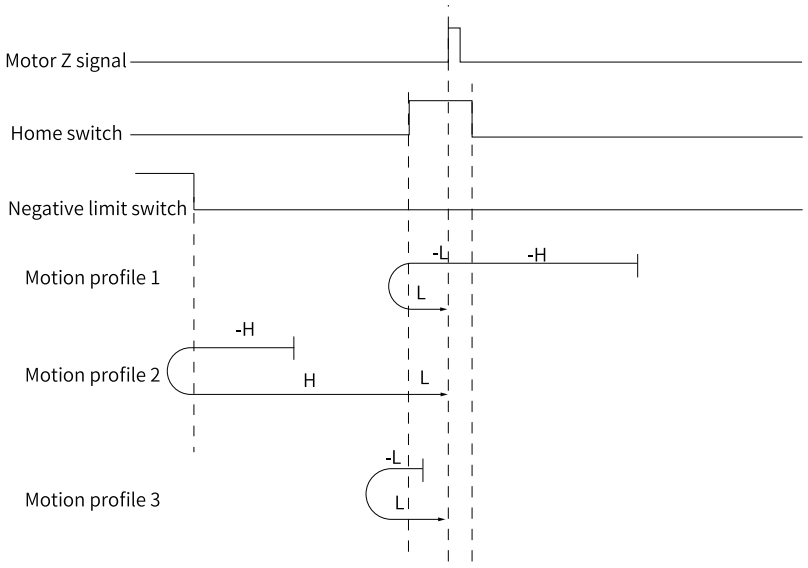


Figure 12-24 Motor running curve and speed in mode 13

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 14

Home: Z signal

Deceleration point: home switch (HW)

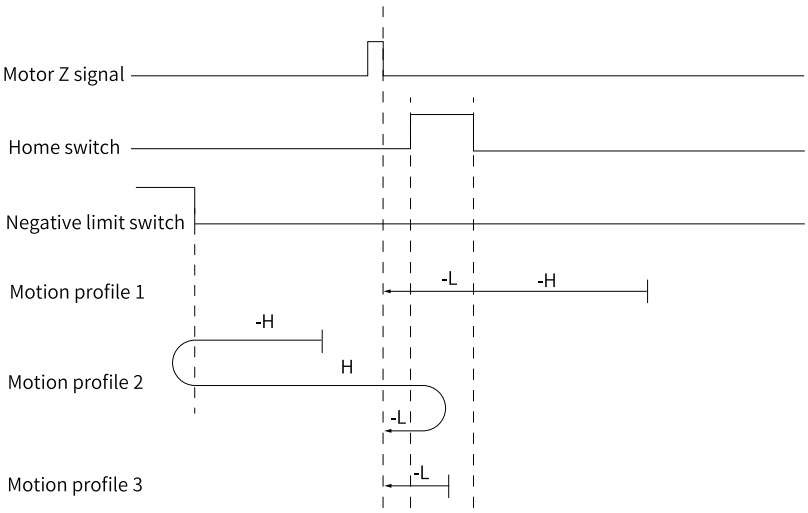


Figure 12-25 Motor running curve and speed in mode 14

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 17

Home: negative limit switch

Deceleration point: negative limit switch

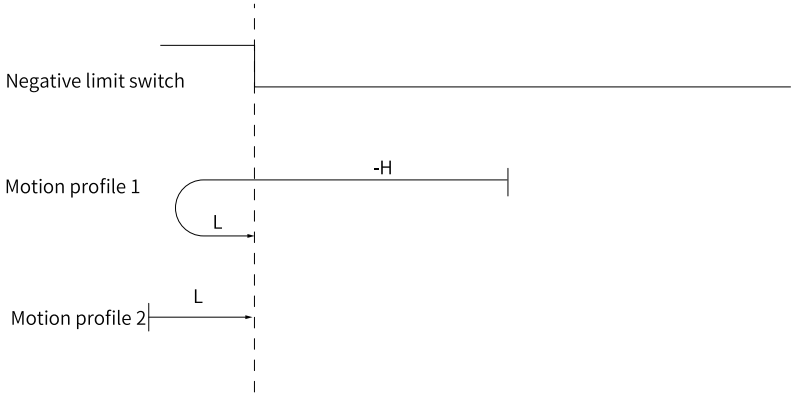


Figure 12-26 Motor running curve and speed in mode 17

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 18

Home: positive limit switch

Deceleration point: positive limit switch

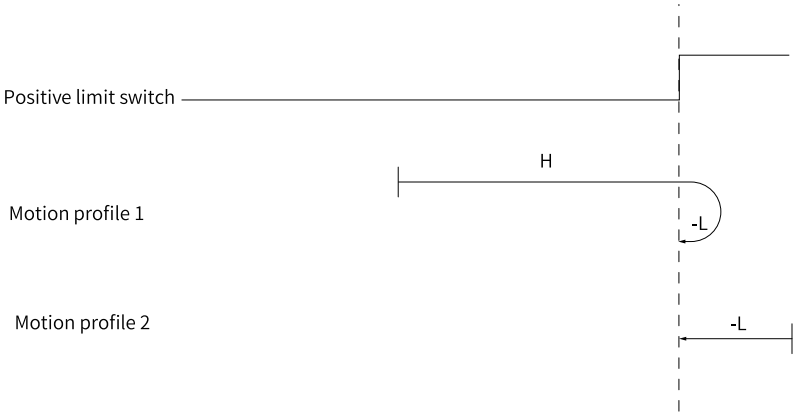


Figure 12-27 Motor running curve and speed in mode 18

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 19

Home: home switch (HW)

Deceleration point: home switch (HW)

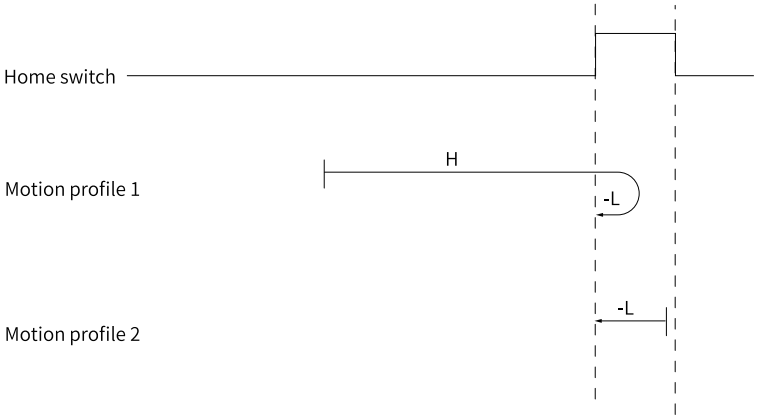


Figure 12-28 Motor running curve and speed in mode 19

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 20

Home: home switch (HW)

Deceleration point: home switch (HW)

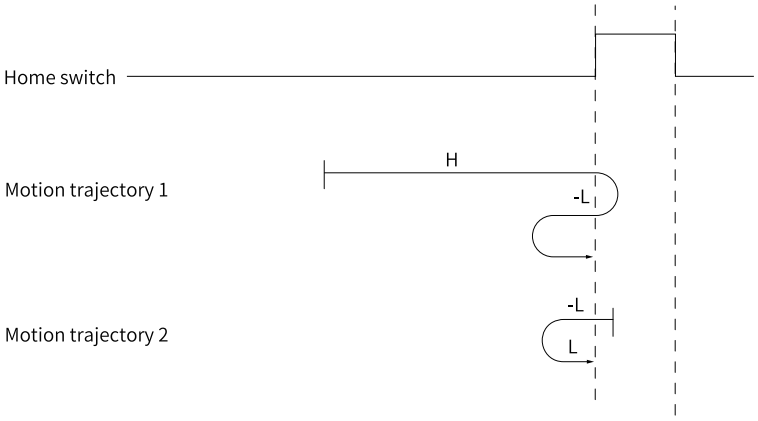


Figure 12-29 Motor running curve and speed in mode 20

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 21

Home: home switch (HW)

Deceleration point: home switch (HW)

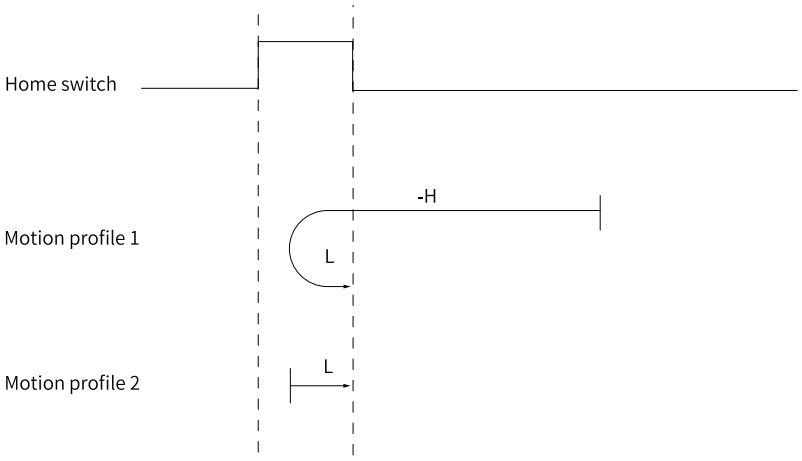


Figure 12-30 Motor running curve and speed in mode 21

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 22

Home: home switch (HW)

Deceleration point: home switch (HW)

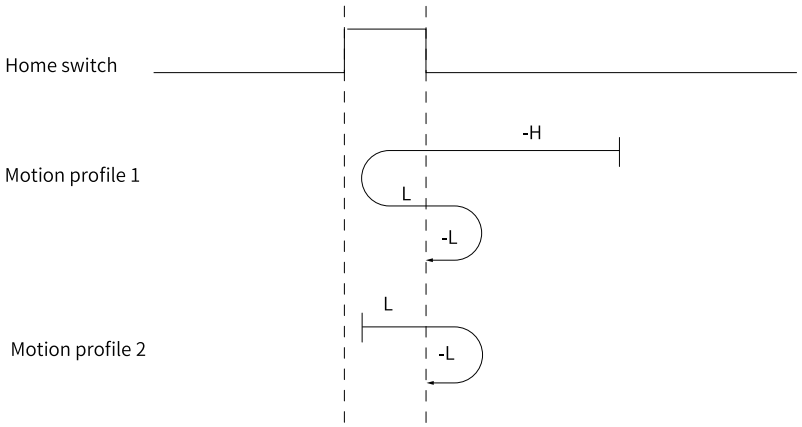


Figure 12-31 Motor running curve and speed in mode 22

- Motion profile 1: Deceleration point signal inactive at start.
- Motion profile 2: Deceleration point signal active at start.

6098h = 23

Home: home switch (HW)

Deceleration point: home switch (HW)

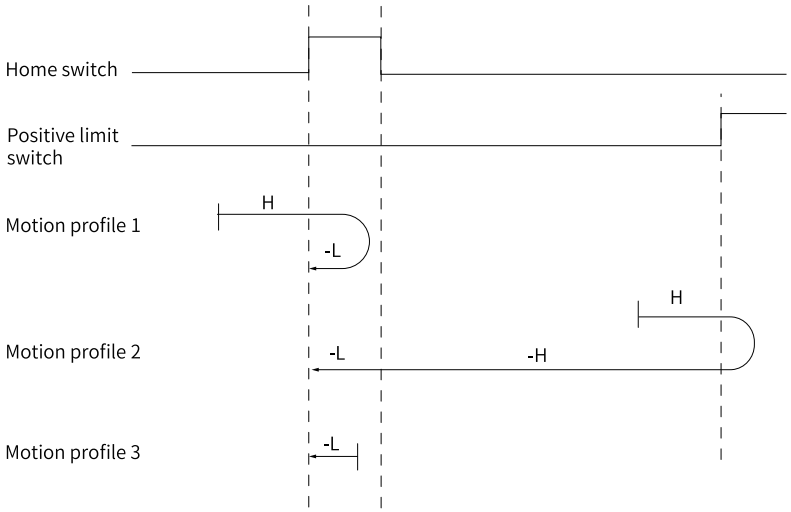


Figure 12-32 Motor running curve and speed in mode 23

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 24

Home: home switch (HW)

Deceleration point: home switch (HW)

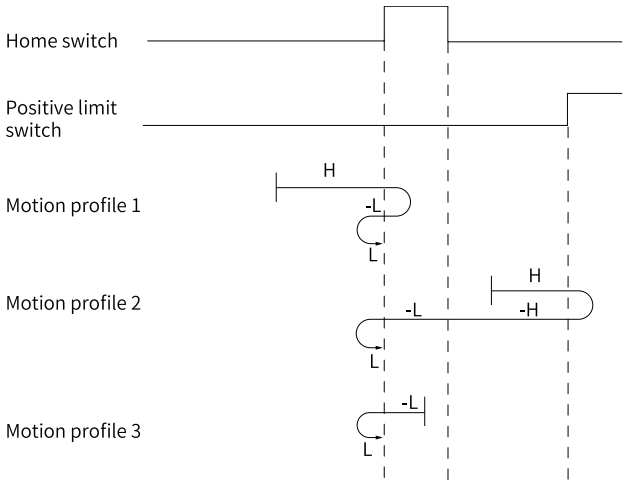


Figure 12-33 Motor running curve and speed in mode 24

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 25

Home: home switch (HW)

Deceleration point: home switch (HW)

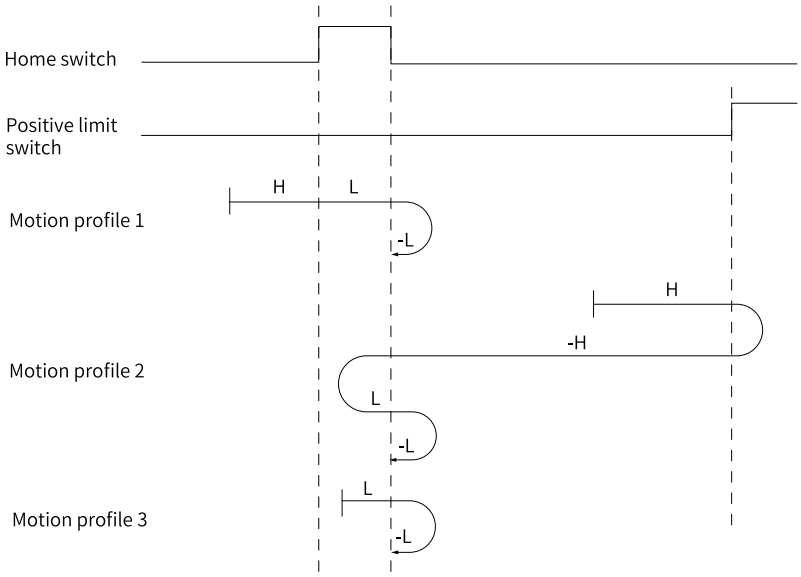


Figure 12-34 Motor running curve and speed in mode 25

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 26

Home: home switch (HW)

Deceleration point: home switch (HW)

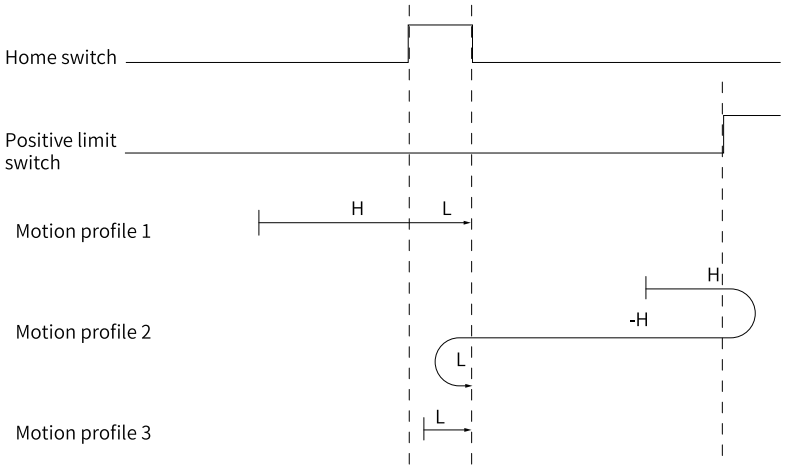


Figure 12-35 Motor running curve and speed in mode 26

- Motion profile 1: Deceleration point signal inactive at start, not hitting the positive limit switch.
- Motion profile 2: HW signal inactive at start, hitting the positive limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 27

Home: home switch (HW)

Deceleration point: home switch (HW)

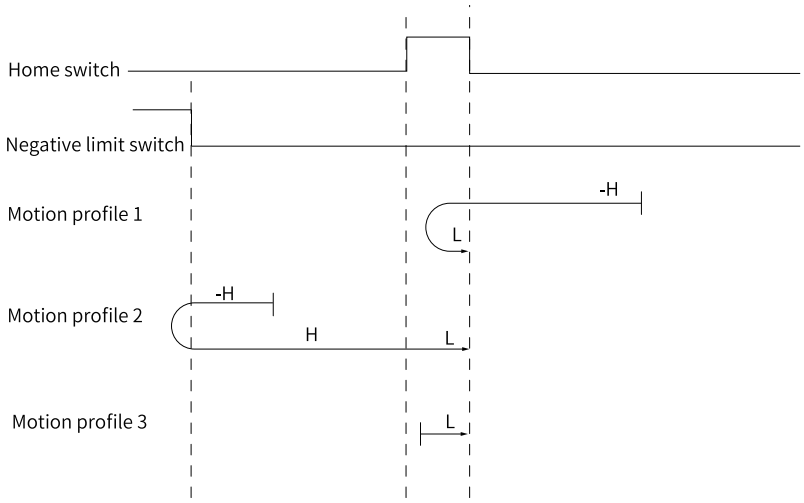


Figure 12-36 Motor running curve and speed in mode 27

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 28

Home: home switch (HW)

Deceleration point: home switch (HW)

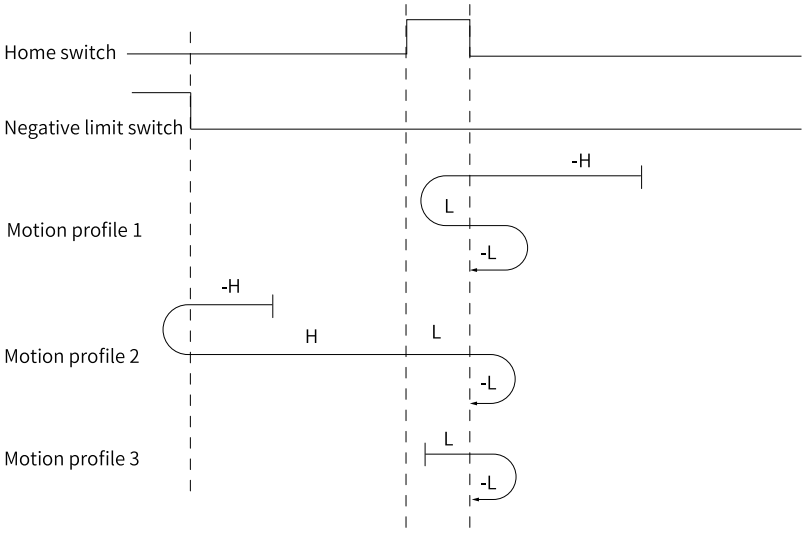


Figure 12-37 Motor running curve and speed in mode 28

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 29

Home: home switch (HW)

Deceleration point: home switch (HW)

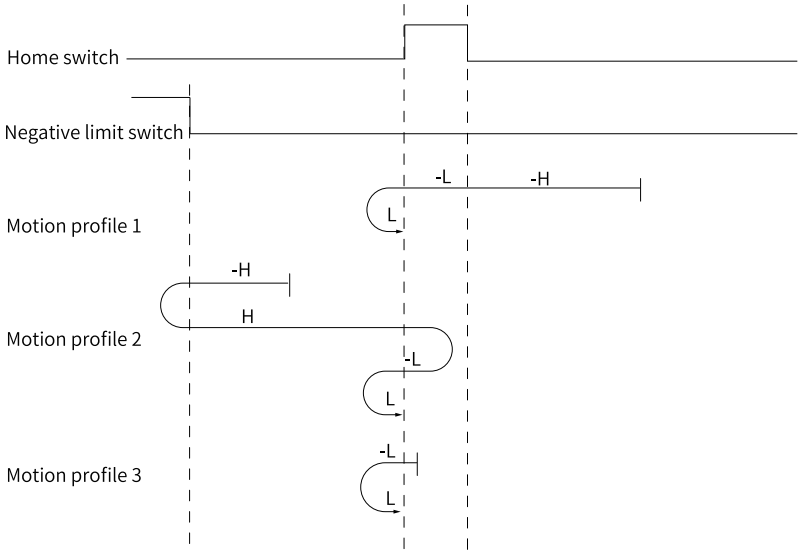


Figure 12-38 Motor running curve and speed in mode 29

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 30

Home: home switch (HW)

Deceleration point: home switch (HW)

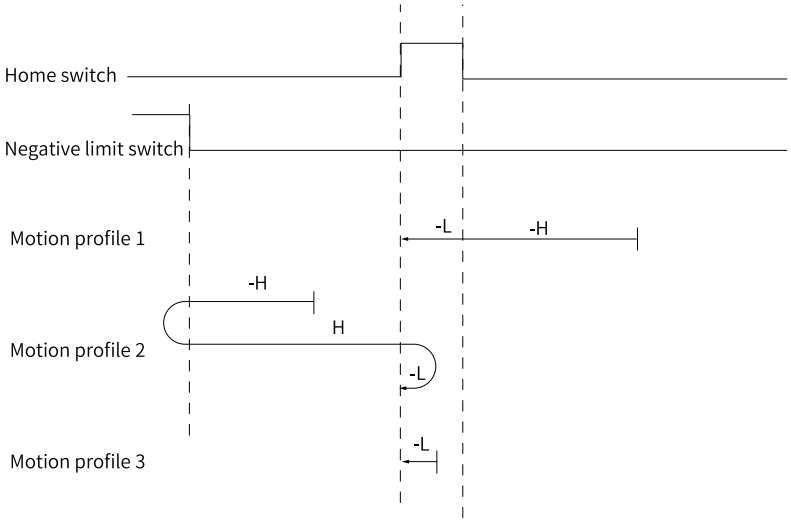


Figure 12-39 Motor running curve and speed in mode 30

- Motion profile 1: Deceleration point signal inactive at start, not hitting the reverse limit switch.
- Motion profile 2: HW signal inactive at start, hitting the reverse limit switch.
- Motion profile 3: Deceleration point signal active at start.

6098h = 31 and 32

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

6098h = 33 and 34

Home: Z signal

Deceleration point: None

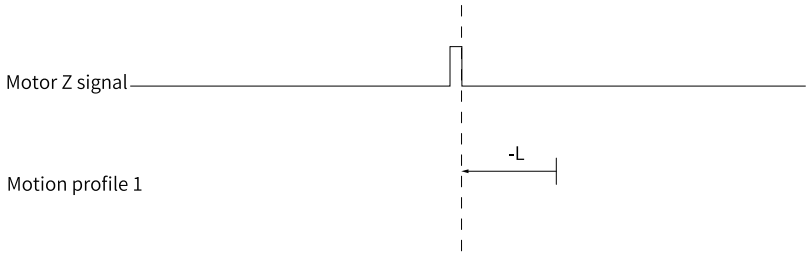


Figure 12-40 Motor running curve and speed in mode 33

- Motion profile 1: The motor runs in the reverse direction at low speed and stops at the first Z signal.

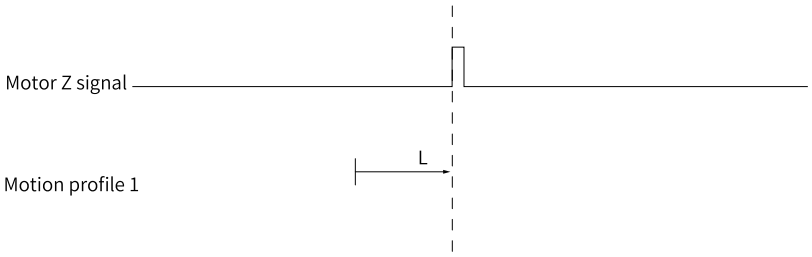


Figure 12-41 Motor running curve and speed in mode 34

- Motion profile 1: The motor runs in the forward direction at low speed and stops at the first Z signal.

6098h = 35

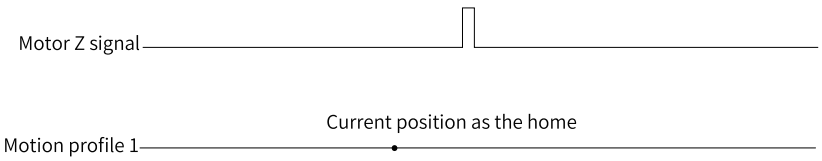


Figure 12-42 Motor running curve and speed in mode 35

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

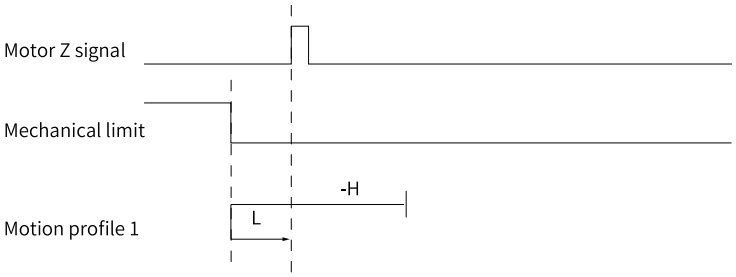


Figure 12-43 Motor running curve and speed in mode -1

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 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.

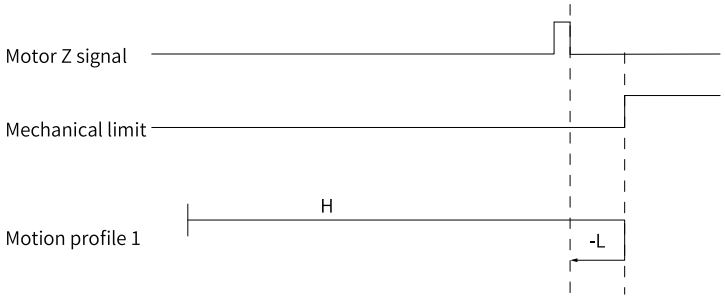


Figure 12-44 Motor running curve and speed in mode -2

13 Applications

13.1 Absolute System

13.1.1 Overview

The absolute encoder, which features a single-turn resolution of 8388608 (2^{23}), is used to detect the motor position within one turn and count the number of motor revolutions, with 23-bit multi-turn data recorded. 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 IS810N series servo drives, H00.00 (Motor code) to 14101 (Inovance 23-bit absolute encoder). Then set H02.01 (Absolute system selection) based on actual conditions. 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.

- 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.
- After H0d.20 is operated on the dual-axis model, the software needs to be reset or power-on again to take effect.

13.1.2 Related Parameters

Absolute encoder system settings

Set H00.00 (Motor code) to 14101 (Inovance motor with 23-bit absolute encoder), and select the absolute position mode in H02.01.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H00.00	2000-01h	Motor SN	0 to 65535	14000: Inovance motor with 20-bit incremental encoder 14101: Inovance motor with 23-bit absolute encoder	14101	-	UInt16	At stop	Upon the next power-on
H00.08	2000-09h	Bus encoder type	0 to 65535	14100: Multi-turn absolute encoder Others: Single-turn absolute encoder	0	-	UInt16	At stop	-
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 alarm) 4: Absolute position single-turn mode	Used to set the absolute position function.	0	-	UInt16	At stop	Upon the next power-on

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, the number of revolutions is not recorded.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.70	200b-47h	Number of absolute encoder revolutions	0Rev to 65535Rev	Indicates the number of revolutions of the absolute encoder.	0	Rev	UInt16	Unchangeable	-
H0b.71	200b-48h	Single-turn position fed back by the absolute encoder	0p to 2147483647p	Displays the position feedback of the absolute encoder within one turn.	0	p	UInt32	Unchangeable	-

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.77	200b-4Eh	Encoder position (low 32 bits)	-2147483648P to +2147483647p	Displays the low 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangeable	-
H0b.79	200b-50h	Encoder position (high 32 bits)	-2147483648P to +2147483647p	Displays the high 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangeable	-

Absolute position linear mode

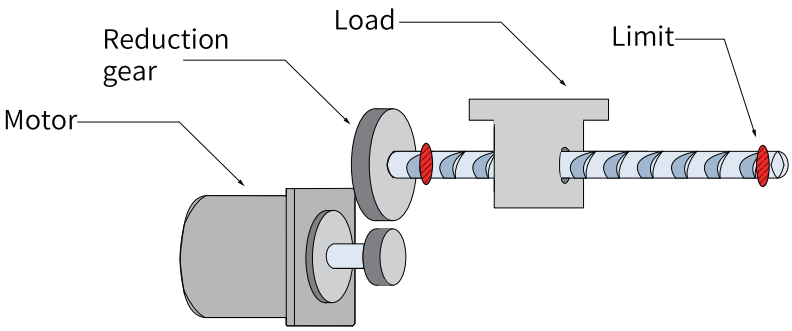


Figure 13-1 Application of the linear mode

Assume the absolute mechanical position (H0b.58 and H0b.60) is PM, the encoder absolute position is PE, the position offset in the absolute position linear mode is P_O, their relationship will be: $P_M = P_E$ - PO.

If the electronic gear ratio is B ÷ A, then the following formula applies: H0b.07 (Absolute position counter) = P_M ÷ (B ÷ A) H0b.07 indicates present mechanical absolute position (in reference unit).

The multi-turn data range in the absolute position linear mode is -32768 to +32767. If the number of forward revolutions is higher than 32767 or the number of reverse revolutions is lower than -32768, E735.0 (Encoder multi-turn counting overflow) 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 hide E735.0 or use absolute position linear mode 2.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.36	2005-25h	Mechanical home offset	-2147483648 to +2147483647	Defines the absolute position of the motor after homing.	0	reference unit	Int32	Real-time	Real-time
H05.46	2005-2Fh	DI selection of multi-turn frequency-division Z starting point	0: No selection 1: DI1 2: DI2 3: DI3 4: DI4 5: DI5 6: DI6 7: DI7 8: DI8	In the absolute position linear mode, the position offset is the difference between absolute position of current encoder and the mechanical position.	0	-	UInt16	Real-time	Upon the next power-on
H0b.07	200b-08h	Absolute position counter	-2147483648p to 2147483647p	Displays current absolute position of the motor (reference unit). This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.	0	p	Int32	Unchangeable	-
H0b.58	200b-3Bh	Mechanical absolute position (low 32 bits)	-2147483648p to 2147483647p	Displays the low 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.	0	p	Int32	Unchangeable	-
H0b.60	200b-3Dh	Mechanical absolute position (high 32 bits)	-2147483648p to 2147483647p	Displays the high 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.	0	p	Int32	Unchangeable	-

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.

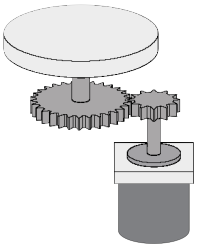
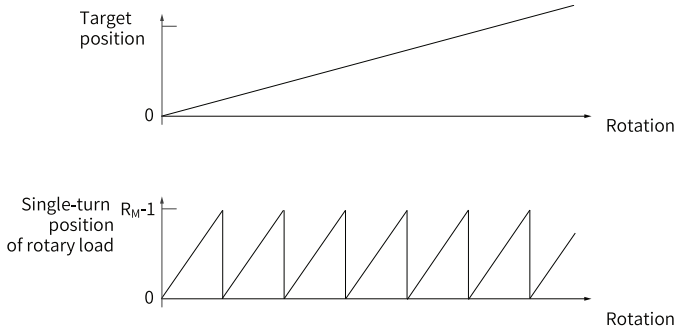
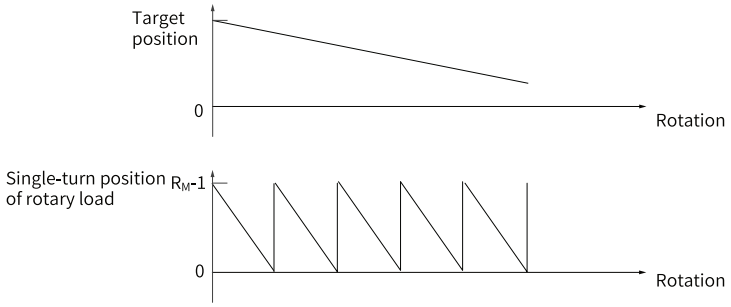


Figure 13-2 Application of the linear mode

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 the absolute rotation mode and the drive operates in the 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 the absolute position rotation mode. Therefore, E735.0 (Encoder multi-turn counting overflow) is hidden automatically.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.50	2005-33h	Mechanical gear ratio in absolute position rotation mode (numerator)	1 to 65535	Defines the transmission ratio between the mechanical rotary load and the motor in the absolute position rotation mode.	1	-	UInt16	At stop	Real-time
H05.51	2005-34h	Mechanical gear ratio in absolute position rotation mode (denominator)	1 to 65535	Defines the transmission ratio between the mechanical rotary load and the motor in the absolute position rotation mode.	1	-	UInt16	At stop	Real-time

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.52	2005-35h	Pulses per revolution of the load in absolute position rotation mode (low 32 bits)	0 to 4294967295	Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode.	0	encoder unit	UInt32	At stop	Real-time
H05.54	2005-37h	Pulses per revolution of the load in absolute position rotation mode (high 32 bits)	0 to 4294967295	Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode.	0	encoder unit	UInt32	At stop	Real-time
H0b.81	200b-52h	Single-turn position of the rotary load (low 32 bits)	-2147483648P to +2147483647p	Displays the low 32-bit value of the position feedback of the rotary load when the absolute system works in the rotation mode.	0	p	Int32	Unchangeable	-
H0b.83	200b-54h	Single-turn position of the rotary load (high 32 bits)	-2147483648P to +2147483647p	Displays the high 32-bit value of the position feedback of the rotary load when the absolute system works the rotation mode.	0	p	Int32	Unchangeable	-
H0b.85	200b-56h	Single-turn position of the rotary load (reference unit)	-2147483648P to +2147483647p	Displays the high 32-bit value of the position feedback of the rotary load when the absolute system works the rotation mode.	0	p	Int32	Unchangeable	-

Single-turn absolute mode

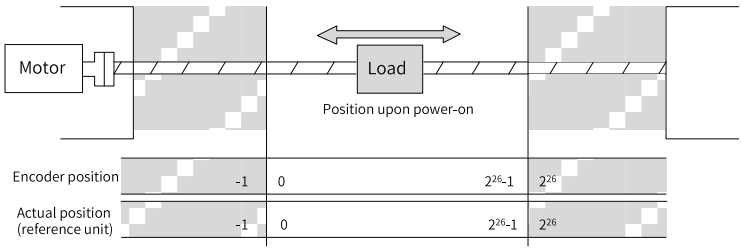
This mode applies to applications where the load travel range is within the single-turn range of the encoder. In this case, the absolute encoder needs no battery as it records the single-turn data only.

- Target position input range
  If a 23-bit absolute encoder is used in the single-turn absolute mode, the drive operates in the position control mode, and the electronic gear ratio 1:1, then:

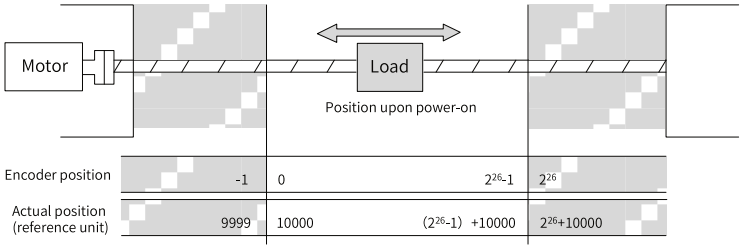
  When H05.36 (Mechanical home offset) is set to 0, the target position range is 0 to (2^{23} - 1).

  After homing is done, the target position range is H05.36 to (2^{23} - 1 + H05.36).

- Example
  Gear ratio: 1:1; H05.36 = 0:



Gear ratio: 1:1; H05.36 = 10000:



13.1.3 Precautions for Using the Battery Box

E731.0 (Encoder battery failure) will occur at initial power-on of the battery. Set H0d.20 (Absolute encoder reset function) to 1 to reset E731.0 before further operations.

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 stay in the non-operational state.
2. Replace the battery.
3. After the servo drive resets E730.0 automatically. If no other alarm occurs, 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.
- After H0d.20 is operated on the dual-axis model, the software needs to be reset or power-on again to take effect.
- 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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	You can reset the encoder error or the multi-turn data fed back by the encoder by setting H0d.20.	0	-	UInt16	At stop	Real-time

Note

- The absolute position recorded by the encoder changes abruptly after multi-turn data reset. In this case, perform mechanical homing.
- After H0d.20 is operated on the dual-axis model, the software needs to be reset or power-on again to take effect.

13.2 Fully closed-loop function

13.2.1 Full Closed-loop Parameter Setting

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

AB quadrature pulse encoder is supported in fully closed loop.

- To use AB quadrature pulse encoder, set H05.38 to 2 to inhibit frequency-division output. 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 alarm.
- If the feedback type of the external encoder is AB quadrature pulses without Z signal, set H0F.22 to 1 to hide the 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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0F.00	200F-01h	Encoder feedback mode	0: Internal encoder feedback 1: External encoder feedback 2: Inner/Outer loop switchover	Defines the encoder feedback signal source in fully closed-loop control. 0 The internal encoder feedback position feedback signal comes from the servo motor's own encoder; 1 The external encoder feedback position feedback signal comes from the fully closed-loop external encoder. Use the first group of electronic gear ratio 2 The internal and external encoder feedback switching is performed when the electronic gear ratio is switched Use DI function 24 (FunIN.24: GEAR _ SEL, electronic gear switching) to perform closed-loop switching between internal and external positions, DI function: Invalid, internal encoder feedback, active using group 1 electronic gear ratio, external encoder feedback, using group 2 electronic gear ratio	0	-	UInt16	Real-time	Upon the next power-on

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; if not, set H0F.01 to 1.

- Before running the motor, please be sure to check before trial operation. For specific operations, see Section "Commissioning and Operation".
- Set H0F.01 properly. If H0F.01 is set improperly, runaway fault may occur.

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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0F.04	200F-05h	External encoder pulses per revolution	0 to 2147483647	See the description below for details of setting instructions	10000	-	UInt32	At stop	Upon the next power-on

Defines the pulses fed back by the external encoder per revolution of the motor.

It 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) in the meantime. After ensuring that the motor has rotated for a full turn (H0F.18 = Motor resolution), calculate the change of H0F.20 (Feedback pulse counter of external encoder) and use the absolute value of the change as the value of H0F.04.

2 Assume values of H0F.18 and H0F.20 are X1 and Y1 before the motor rotates and X2 and Y2 after the motor rotates, then the following formula applies: H0F.04 = 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: Ensure H0F.04 is set properly. Otherwise, EB02.0 (Position deviation too large in fully closed loop) may occur after the drive operates.

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:

$$\text{H0F.04} = \text{Number of internal encoder pulses per motor revolution} \times \frac{Y_2-Y_1}{X_2-X_1}$$

- 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 H05.11/H05.13 for outer loop.

   See *"12.1 Conversion Factor" on page 211* 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).
  H0F.08 defines the position deviation threshold at which the servo drive reports EB02.0 (Position deviation too large in fully closed-loop mode). Its unit is one reference unit (same as one external encoder unit).

  ☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0F.08	200F-09h	Excessive deviation threshold in compound control mode	0 to 2147483647	Defines the position deviation threshold at which the servo drive reports EB02.0 (Position deviation too large in fully closed-loop mode). When H0F.08 is set to 0, the drive does not detect EB02.0 and always clears the fully closed-loop position deviation.	1000	-	UInt32	Real-time	Real-time

For example, if H0F.08 is set to 1000, EB02.0 (Position deviation too large in fully closed-loop mode) will be outputted 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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0F.10	200F-0Bh	Clear deviation in compound control mode	0 RPM –100 RPM	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 reflected by H0F.18 (Feedback pulse counter of internal encoder). The number of motor revolutions will not be cleared when the drive is not in the operational state.	1	rpm	UInt16	Real-time	Real-time

If its value is set to 0, the deviation in compound control will not be cleared.

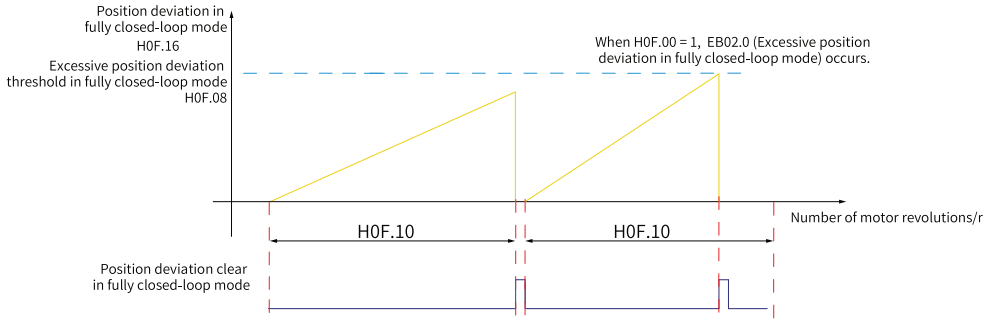


Figure 13-3 Description of position deviation clear in the fully closed-loop mode

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 turns, and then starts monitoring again.

- Set the first-order low-pass filter for deviation in compound control.
  ☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0F.13	200F-0Eh	Compound vibration suppression filter time	0.0 ms–6553.5 ms	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. When the stiffness of the transmission mechanism between fully closed loop and internal loop is insufficient, set H0F.13 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. When the stiffness is sufficient, there is no need to adjust this parameter.	0.0	ms	UInt16	At stop	Real-time

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	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	-	UInt16	Real-time	Real-time

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.

13.2.2 Enable Fully Closed-loop

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:

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Default	Unit	Data type	Change method	Effective Time
H03.02	2003-03h	DI1 function	0: Undefined 101: servo enabled 102: alarm reset signal 114: forward overtravel switch 115: reverse overtravel switch 124: electronic gear selection 131: origin switch 134: emergency shutdown 138: probe 1 139: probe 2 201: servo enable 202: alarm reset signal 214: forward overtravel switch 215: reverse overtravel switch 224: electronic gear selection 231: origin switch 234: emergency shutdown 238: probe 1 239: probe 2	0	-	UInt16	Real-time	Real-time
Defines the function of DI1.								

Parameter	Hexadecimal parameter	Name	Value	Default	Unit	Data type	Change method	Effective Time
H0F.00	200F-01h	Encoder feedback mode	0: Internal encoder feedback 1: External encoder feedback 2: Inner/Outer loop switchover	0	-	UInt16	Real-time	Upon the next power-on

Defines the encoder feedback signal source in fully closed-loop control.

0: Internal encoder feedback: The position feedback signals come from the motor encoder.

1: External encoder feedback The position feedback signals come from the fully closed-loop external encoder and electronic gear ratio 1 is used.

2: Internal/External encoder switchover at electronic gear ratio switchover. The DI function 24 (FunIN.24: GEAR_SEL, electronic gear switchover) is used to perform internal/external position closed-loop switchover. Invalid, internal encoder feedback, active using group 1 electronic gear ratio, external encoder feedback, using group 2 electronic gear ratio

13.3 Software position limit

Function

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

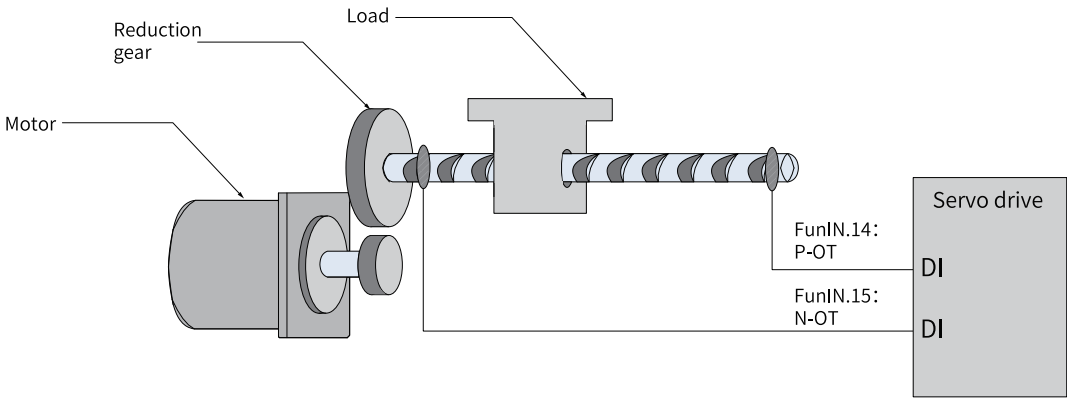


Figure 13-4 Installation of limit switches

Software position limit is implemented through a comparison between the internal position feedback and the set limit value. If the set limit value is exceeded, the servo drive reports an alarm and stops immediately. Software position limit is available both in the absolute position mode and the incremental position mode. To use the software position limit in the 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 13–1 Comparison between the hardware position limit and software position limit

Hardware Position Limit		Software position limit	
1	Restricted to linear motion and single-turn rotational motion.	1	Applicable to both the linear motion and the rotational motion.
2	Requires an external mechanical limit switch.	2	Removes the need for hardware wiring, preventing malfunction due to poor cable contact.

Hardware Position Limit		Software position limit	
3	Suffered from the risk of mechanical slip.	3	Prevents malfunction due to mechanical slip through internal position comparison.
4	Unable to sense or detect an overtravel fault after power-off.		

Related objects

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.01	200A-02h	Absolute position limit	0: Disabled 1: Enabled 2: Enabled after homing	Used to set the activation condition for enabling the software position limit function and the software limit.	0	-	UInt16	Real-time	Real-time
H0A.41	200A-2Ah	Forward position of software position limit	-2147483648 to 2147483647	When the absolute position counter (H0b.07) is larger than H0A.41, the servo drive reports E950.0 (Forward limit switch alarm) and executes stop at forward limit.	2147483647	encoder unit	Int32	At stop	Real-time
H0A.43	200A-2Ch	Reverse position of software position limit	-2147483648 to 2147483647	When the absolute position counter (H0b.07) is smaller than H0A.43, the servo drive reports alarm E952.0 (Reverse limit switch alarm) and executes stop at reverse limit.	-2147483648	encoder unit	Int32	At stop	Real-time

- When H0A.01 is set to 0, software position limit is disabled.
- When H0A.01 is set to 1, software position limit is enabled immediately upon power-on. 607D.01h and 607D.02h are used by the function. Ensure the value of 607D.01h is lower than or equal to 607D.02h. If 607D.01h is set to a value higher than 607D.02h, EE09.0 (Software position limit setting error) will occur.
- If H0A.01 is set to 2, software position limit is not enabled after homing upon power-on. When the value of the absolute position counter is higher than the value of 607D.02h after homing, E950.0 (Forward overtravel warning) occurs and the drive stops accordingly. When the value of the absolute position counter is lower than the value of 607D.01h 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.

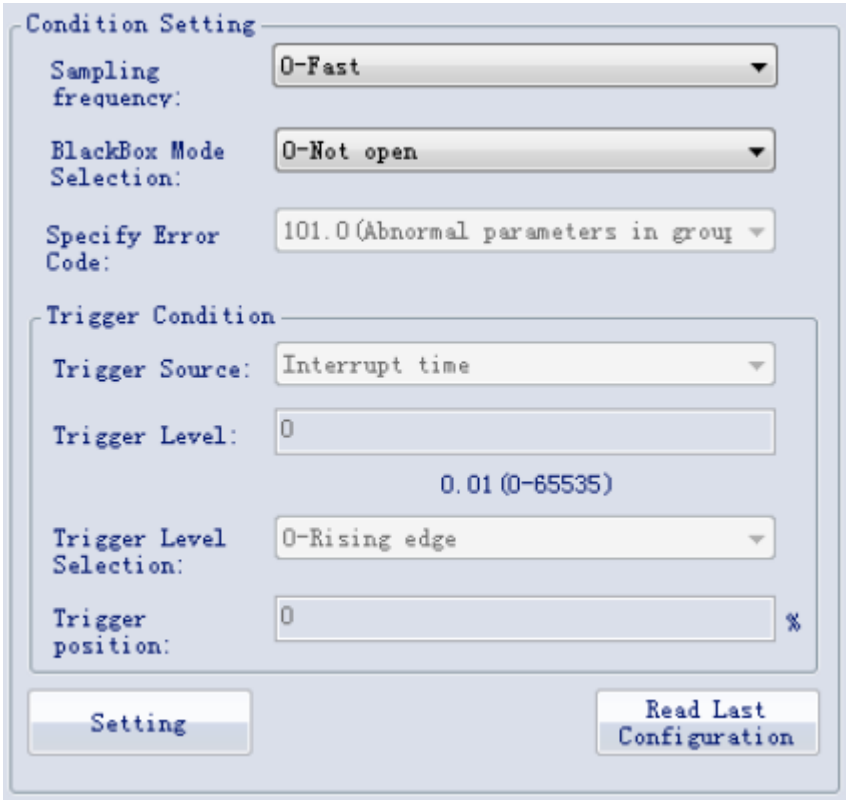
13.4 Black Box

Function

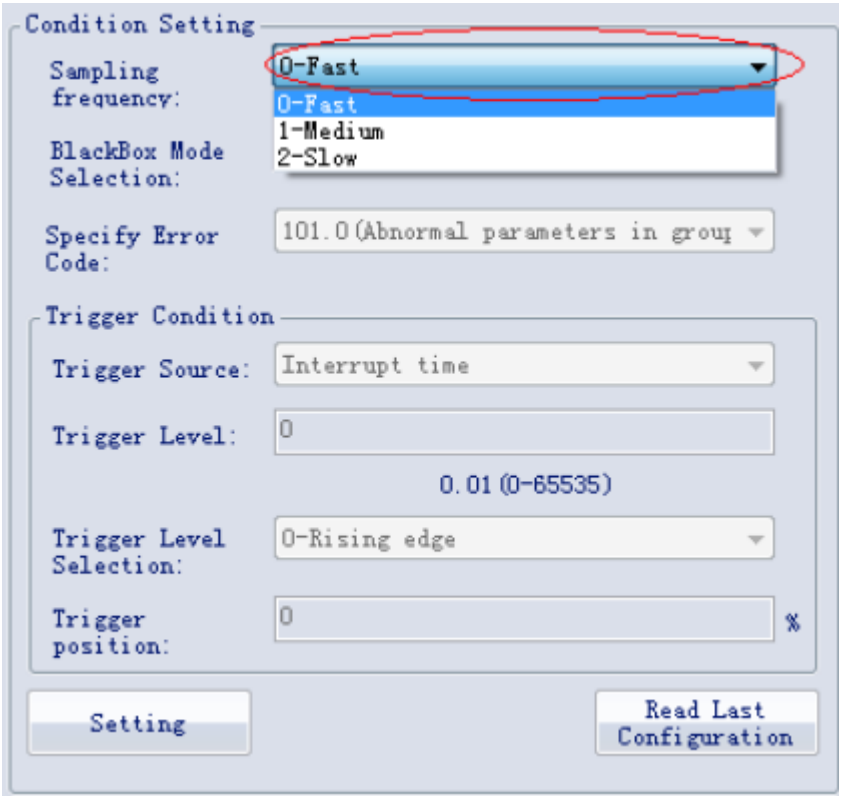
The black box function is used to capture and save the data generated upon occurrence of faults or under designated conditions. Such data can be read and uploaded by users through the software tool to facilitate troubleshooting.

The black box is disabled by default. It is triggered upon occurrence of a fault or a sampling frequency of 8k. The black box function will be turned off automatically after it is being triggered. It does not turn on automatically upon fault reset or power cycling.

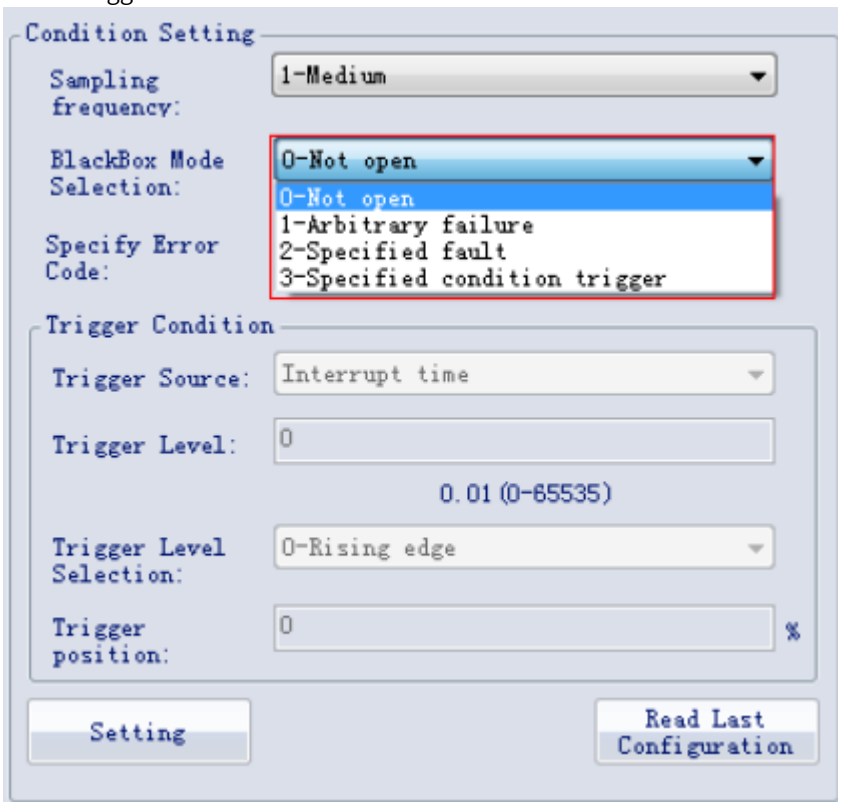
Triggering the black box



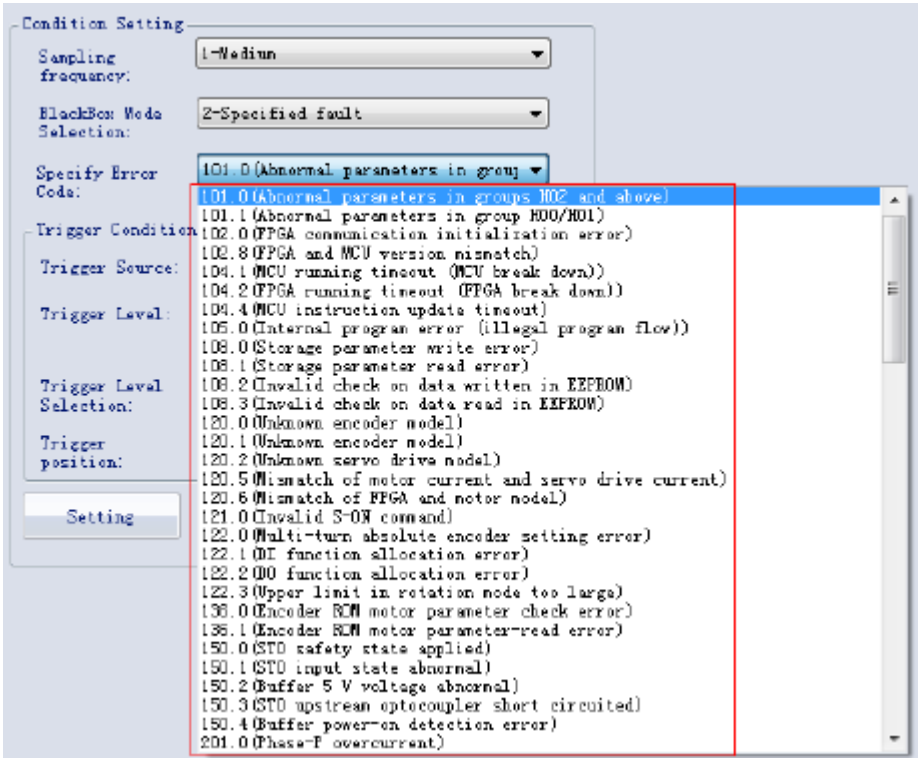
1. Sampling frequency: including three sampling frequencies, namely 8k (Fast), 4k (Medium), and 0.25k (Slow).



2. Black box mode selection: including three modes, namely Arbitrary failure, Specified fault, and Specified condition trigger.



3. Select designated fault in the combo box, as shown below.

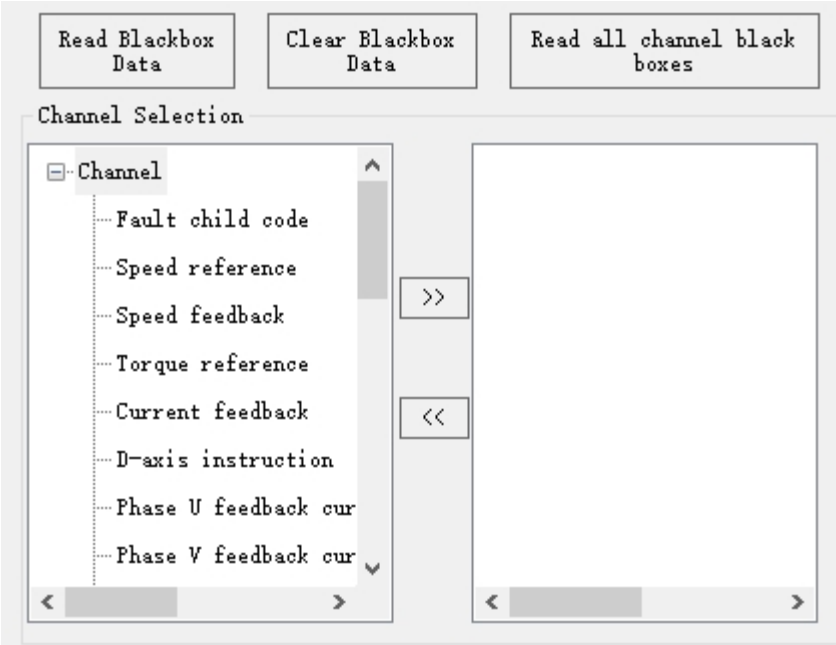


4. The Trigger Condition includes Trigger Source, Trigger Level, and Trigger Level Selection, as shown below.

5. Trigger position is 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.



13.5 Touch Probe

Function

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 (in reference unit) when an DI signal or Z signal changes.

The drive offers two touch probes to record position values corresponding to the rising edge and falling edge of each touch probe signal, which means four position values can be latched simultaneously.

When a DI is used to trigger the touch probe, the relation between the DI logic and the touch probe edge is shown in the following table.

Table 13–2 Description of bit3 of H0A.40

Bit3 of H0A.40	Touch Probe Edge	DI logic	DI switch
0	Rising Edge	NO	OFF→ON
		NC	ON→OFF
	Falling Edge	NO	ON→OFF
		NC	OFF→ON
1	Rising Edge	NO/NC	OFF→ON
	Falling Edge	NO/NC	ON→OFF

When the DI terminal is used as the probe trigger signal (only the high-speed DI terminal supports the probe function), the filtering window of the probe signal can be set through 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 switch off→on)
H0A.54		DI probe DI off compensation time (DI switch 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.

The Z probe trigger sources include the motor Z signal and the frequency-division output Z signal. See the following table for details.

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.

Related objects

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60B8h	Touch probe function	0 to 65535	See the section related to the probe "*Steps" on page 292* for details.	0	-	UInt16	Real-time	Real-time
60B9h	Touch probe status	0 to 65535	See the section related to the probe "*Steps" on page 292* for details.	0	-	UInt16	Unchangeable	-
60BAh	Touch probe 1 positive edge position value	-2147483648 to +2147483647	Indicates the position feedback value (reference unit) latched at positive edge of touch probe 1 signal.	0	reference unit	Int32	Unchangeable	-
60BBh	Touch probe 1 negative edge position value	-2147483648 to +2147483647	Indicates the position feedback value (reference unit) latched at negative edge of touch probe 1 signal.	0	reference unit	Int32	Unchangeable	-
60BCh	Touch probe 2 positive edge position value	-2147483648 to +2147483647	Indicates the position feedback value (reference unit) latched at positive edge of touch probe 2 signal.	0	reference unit	Int32	Unchangeable	-
60BDh	Touch probe 2 negative edge position value	-2147483648 to +2147483647	Indicates the position feedback value (reference unit) latched at negative edge of touch probe 2 signal.	0	reference unit	Int32	Unchangeable	-
60D5h	Touch probe 1 positive edge counter	0 to 65535	The counting value is added by "1" each time this object is triggered.	0	-	UInt16	Unchangeable	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60D6h	Touch probe 1 negative edge counter	0 to 65535	The counting value is added by "1" each time this object is triggered.	0	-	UInt16	Unchangeable	-
60D7h	Touch probe 2 positive edge counter	0 to 65535	The counting value is added by "2" each time this object is triggered.	0	-	UInt16	Unchangeable	-
60D8h	Touch probe 2 negative edge counter	0 to 65535	The counting value is added by "2" each time this object is triggered.	0	-	UInt16	Unchangeable	-

Steps

Example:

Use DI4 to trigger the touch probe. Background: touch probe 1 positive edge, continuous latching

Observe the following steps:

1. Set the function of DI4 (H03.08 = 38). Set the DI4 logic to NO (H03.10 = 0).
2. Set the touch probe function in 60B8h.
   Assignment of each bit of the touch probe function (60B8h) is shown in the following table.

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60B8h	Touch probe function	0 to 65535	See the table below for details.	0	-	UInt16	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time

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	-

Set 60B8h to 0x0013 in this example.

3. Read the touch probe status in 60B9h.
   Assignment of each bit of 60B9h is shown in the following table.

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60B9h	Touch probe status	0 to 65535	See the table below for details.	0	-	UInt16	Unchangeable	-

bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	Bit0 to bit2: States 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	When the function of probe 1 is selected as continuous sampling, the total number of times the probe is triggered	When the function of probe 1 is selected as continuous sampling, the total number of times (0–3) the probe is triggered
8	Probe 2 enable: 0: Probe 2 disabled 1: Probe 2 enabled	Bit8 to bit10: States 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	When the function of probe 2 is selected as continuous sampling, the total number of times the probe is triggered	When the function of probe 2 is selected as continuous sampling, the total number of times (0–3) the probe is triggered

In this example, you can read bit1 of 60B9h to check whether the touch probe 1 positive edge value is latched.

4. Read latch position of touch probe
   The four position values of the touch probe are recorded in 60BAh to 60BDh.

   In this example, if the function of position latch at 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 DI4 is used as the trigger signal in case of latching at positive edge and continuous triggering.

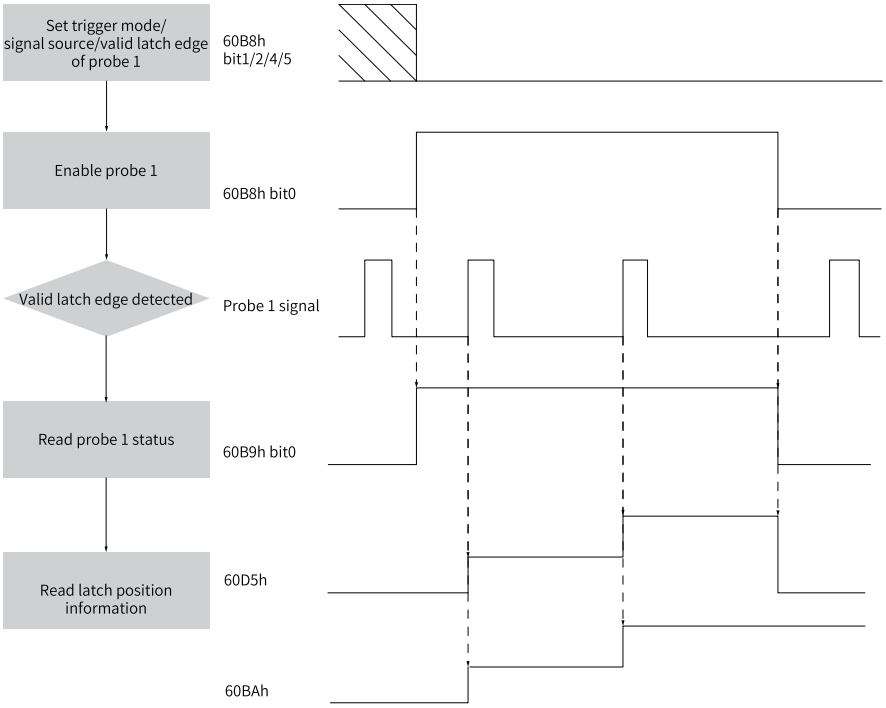


Figure 13-5 Procedure for use of the touch probe

13.6 Forced EtherCAT DO

Function

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

See the following for related parameter settings.

☆ Related parameters:

Parameter	Hexadecimal parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H04.23	2004-18h	ECAT communication-forced DO logic in non-OP status	Bit0: DO1 0: Maintain output 1: No output Bit1: DO2 0: Maintain output 1: No output	Sets DO state upon ECAT communication failure.	0	-	UInt16	Real-time	Real-time

For parameter value settings, see *"Table 13–3" on page 297**Description of setpoints*.

Table 13–3 Description of setpoints

Value	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...bit18 to control the DO.

13.7 Motor Temperature Detection

Function

Matched with Inovance ISMG series motors or third-party motors, it can detect motor temperature and prevent problems such as stator winding burnout after motor overload; Among them, motor temperature detection supports three modes, namely PTC mode, KTY mode, and PT1000 mode.

Description

- **PTC mode**
  The PTC resistor is a switching thermistor; The motor temperature cannot be displayed in real time, and it can only give an alarm when the motor stator winding is over-temperature; You can set H0C.32 = 1 to select PTC mode, and set H0C.33 = 0 to select the motor temperature detection function failure not to shield; Inovance ISMG series motors select PTC resistors with typical values of 130 °C; When the motor stator winding temperature is > 130 °C, the first type of resettable fault E660.0 alarm occurs. The motor temperature is too high.
- **KTY mode**
  KTY resistor is a KTY84 series positive temperature coefficient temperature sensor. The measurement temperature range is-20 °C to + 200 °C, and the resistance value is roughly around 300Ω to 2000Ω, showing a linear change.

You can set H0C.32 = 2 to select KTY mode, then set H0C.34 = 0 to select KTY _ 84 mode, and set H0C.33 = 0 to select the motor temperature detection function failure not to shield; The motor overtemperature threshold can be modified through H0C.36. The default value is 130 °C. Modification is not recommended.

H0C.37 can display the motor temperature in real time. When the motor stator winding temperature is > H0C.36 motor overtemperature threshold, the first type of resettable fault E660.0 alarm occurs. The motor temperature is too high.

- **PT1000 mode**
  The PT1000 mode mainly matches the PT1000 platinum thermal resistor, and its resistance is proportional to the temperature change. When the PT1000 temperature is 0 °C, its resistance is 1000Ω (± 1%), and when the PT1000 temperature is 100 °C, its resistance is 1385 Ω (± 1%).

  You can set H0C.32 = 2 to select KTY mode, then set H0C.34 = 1 to select PT1000 mode, and set H0C.33 = 0 to select the motor temperature detection function failure not to shield; The motor overtemperature threshold can be modified through H0C.36. The default value is 130 °C. Modification is not recommended.

  H0C.37 can display the motor temperature in real time. When the motor stator winding temperature is > H0C.36 motor overtemperature threshold, the first type of resettable fault E660.0 alarm occurs. The motor temperature is too high.

Note

- For parameters, see *"16.13 H0C Parameters" on page 438*.
- The hardware interfaces are pin5 and pin6 of CN6/CN8, see *"7.11.4 Wiring for Motor Temperature Detection" on page 104*

14 STO

14.1 General

14.1.1 Terms and Abbreviations

Terms and Abbreviations	Description
STO (safe torque off)	The STO function puts the machine safely into a torque-free state and prevents accidental start-up. When the STO function is activated, the servo drive stops according to the preset stop mode (H02.08).
SIL	Safety integrity level
SC	Systematic capability
PL	Performance Level
Cat.	Safety category It includes B, 1, 2, 3, and 4.
SFF	Safe failure fraction
HFT	Hardware fault tolerance
DCavg	Average diagnostic coverage (%)
CCF	Common cause failure
β	Common cause failure factor
PFH	Probability of a dangerous Failure per Hour
MTTFd	Mean time to dangerous failure (in years)
T1	Proof test interval time
DTI	Diagnostic test interval time
λS	Failure rate of safety failures that put the system into a safe state
λDD	Failure rate of hazardous faults that can be diagnosed by the diagnostic subsystem
λDU	Failure rate of hazardous faults that cannot be diagnosed by the diagnostic subsystem
DI	Digital inputs
DO	Digital output

14.1.2 Safety Standards

Standards compliance

- EC directives and standards
  Low Voltage Directive 2014/35/EU Standard EN 61800-5-1

  EMC Directive 2014/30/ EU Standard EN 61800-3

  Machinery Directive 2006/42/EC (Safety Functions) Standard EN 61800-5-2
- Safety standard

Safety standard	Reference
Functional safety	IEC 61508: 2010 EN 61508: 2010 ISO 13849-1:2015 ISO 13849-2:2012 EN ISO 13849-1:2015 EN ISO 13849-2:2012 EN 62061: 2021 EN IEC 62061:2021 IEC 61800-5-2:2016 EN 61800-5-2:2017
EMC	IEC 61000-6-7:2014 EN 61000-6-7:2015 IEC 61326-3-1:2017 EN 61326-3-1:2017 EN 61800-3:2004/A1:2012 EN IEC 61800-3:2018 EN 55011:2016/A1:2017 EN 55011:2016/A11:2020 EN 61000-6-2:2005 EN IEC 61000-6-2:2019 EN 61000-6-4:2007/A1:2011 EN IEC 61000-6-4:2019 EN 60034-1:2010
LVD	IEC 61800-5-1:2007/AMD1:2016 EN 61800-5-1:2007/A1:2017

- Safety data

Item	Safety data
IEC 61508/IEC 62061	
SIL	3
SC	3
SFF	93.64%
HFT	1
DC	Not required[1]
CCF	β = 5%
PFH	PFH⩽1.55x10^{-10}[1/h] (0.16% of SIL3)
T1	20 year
DTI	3 months
λS	45.66×10^{-9} [1/h]
λDD	0
λDU	3.10×10^{-9} [1/h]
operation mode	High demand or continuous mode
Device type	Type A
ISO 13849	
PL	e

Item	Safety data
Cat.	3
DCavg	Not required[1]
MTTFd	36824.27 years (high)

Note

- [1]: Fault control only adopts troubleshooting measures, so DC is not required.
- For the failure mode of the device, see ISO 13849-2:2012.
- 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.

14.1.3 Precautions for Use

Safety Instructions

The chapter contains the warning symbols used in this manual and the safety instructions which you must obey when you install or connect an option module to a drive or 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 manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.

Table 14–1 Warnings, Cautions and Notes

Icon	Signal word	Description	Consequences in case of disregard
Example: DANGER Hazardous voltage e.g. electric shock	DANGER	DANGER	Indicates that failure to comply with the notice will result in death or severe personal injuries
	WARNINGS	Alarm	Indicates that failure to comply with the notice may result in death or severe personal injuries
	CAUTION	Note	Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage
	STOP	Prohibit	Indicates that failure to comply with the notice will result in equipment or environmental damage

Note

- Users should attach great importance to safety analysis during electrical installation and system design phases to prevent injuries during normal operation or equipment failure.
- The design, installation, commissioning and maintenance of the system must only be performed by experienced persons who have received functional safety training. These personnel should read the operating instructions and this safety information carefully.

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. Risk analysis and risk assessment is needed before using a product. Make sure that adequate measures are taken to eliminate/reduce the relating risks and components chosen must meet the safety requirements.

This section describes the information that needs to be noted before starting operation. Read the following safety precautions, risk assessment information, and limitations before starting operation.

Use the safety function STO after properly understanding all of this information. Incorrect use of safety functions or use of safety functions that are not sufficient to meet the safety requirements of the site may result in personal injury.

Safety Precautions

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

- The 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, the power supply cannot be cut off in emergencies and high-current parts of the motor and drive are still energized, incurring the risk of electric shock or other risks result in electric energy. Therefore maintenance work on electrical parts of the drive or motor can only be carried out after isolating the drive system from the main supply.
- Depending on the standards and requirements for a particular application, it may be possible to use STO as an integral part of an E-stop system. However, its main purpose is for use in a dedicated safety control arrangement whose purpose is to prevent any hazard from occurring, without the use of an E-stop.
- An E-stop is often provided in a machine to allow for unexpected situations where an operator sees a hazard and can take action to prevent an accident.
- The design requirement for an E-stop differs from that of a safety interlock. Generally, the E-stop is required to be independent from any complex or "intelligent" control. It may use purely electromechanical devices to either disconnect the power or initiate a controlled rapid stop using other means such as dynamic or regenerative braking.

Note

- 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 Inovance SV660 series 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 the 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 can be present even when the safety functions operate. Therefore, safety must always be given consideration during risk assessment.
- If external forces (such as gravitational force with a vertical axis) are applied when the safety functions are operating, the motor will rotate due to the action of these external forces. Therefore, you must use a separate mechanical brake to secure the motor.

Note

In the event of multiple IGBT power transistor failures, the servo drive may generate alignment torque. Whether or not the STO function is enabled, this torque may cause the motor shaft to rotate up to 180/p (p: the number of motor pole pairs). If the motor is a synchronous magnetic motor, the rotation range is 180/(2p).

To ensure safety, users should decide 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 complying with a European machinery directive, the system must acquire safety standards certification, and the whole equipment or system is subject to all risk assessments and safety class certification. It is recommended that a Certification Body final safety certification of the system be used.

Common residual risks

- At the shipment to end-users, check the settings of safety related components with 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 them using a check sheet, etc.
- The safety will not be ensured such as in assembling machine until installing, wiring, and adjustment are completed properly. Install, wire, and adjust your system referring to Section "Installation" for each unit.
- Only qualified personnel are authorized to install, start-up, repair or adjust the machines in which these components are installed. Only trained engineers should install and operate the equipment.
- Separate the wiring for safety observation function from other signal wiring.
- Protect the cables with appropriate ways (routing them in a cabinet, using a cable guard, etc.).
- It is recommend to use a switch, relay, sensor, etc. which comply with safety standards. When using a switch, relay, sensor, etc. which do not comply with safety standards, perform a safety confirmation.
- Keep the required clearance/creepage distance depending on voltage you use.
- The time to a safety observation error depends on parameter settings.

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/inverter. Before servicing the servo/inverter, cut off the power supply and ensure that the servo/inverter are not energized.

14.2 Safety Function

14.2.1 Overview

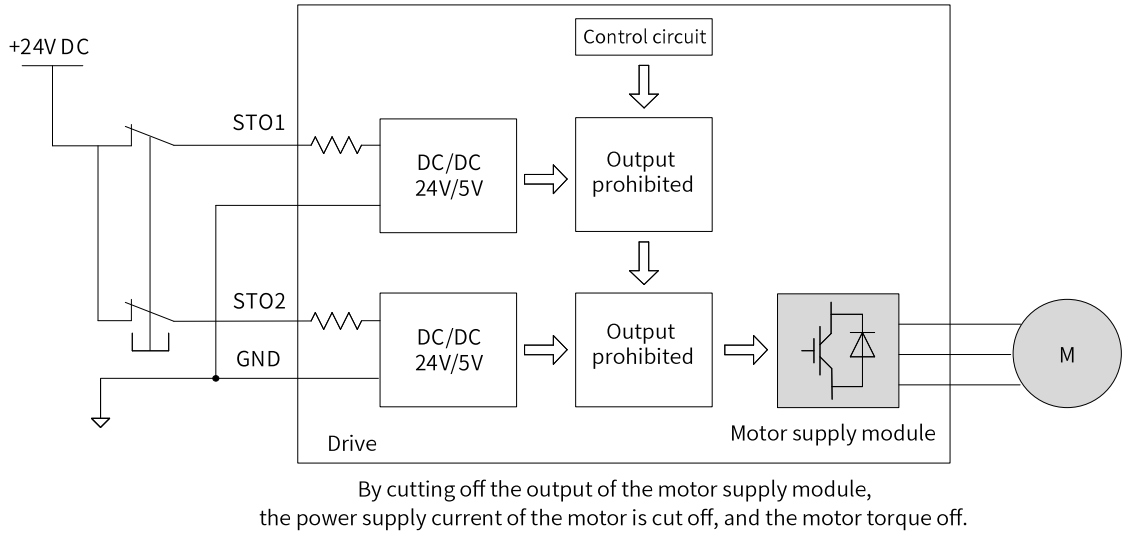


Figure 14-1 Schematics of the STO function

Safety torque off (STO) is a safety feature that meets the IEC 61800-5-2: 2016 standard. The STO function ensures safety by disabling the control signal of the power semiconductor at the output of the drive to prevent the drive from generating torque at the motor shaft end. The STO function is integrated in the IS810 series drive.

The STO function relies on external redundant hardware terminals STO1 and STO2, which provide dual-channel 24V input signals. When the input signals of STO1 and STO2 terminals are disconnected at the same time, the PWM signal output to the drive power layer will be cut off, thereby preventing the motor from moving. The drive will operate normally only when the input signals to both the STO1 and STO2 terminals are active (24V).

See the following table for the STO function.

STO1 Input	STO2 Input	PWM Signal
24 V	24 V	Normal
0 V	24 V	Prohibit
24 V	0 V	Prohibit
0 V	0 V	Prohibit

STO (safety torque off)	
Description	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 servo drive stops according to the preset stop mode (H02.08).
Safe state	Disables the PWM gating signal of the drive.
Operation mode	High demand mode or continuous mode

14.2.2 Function Use and Monitoring

Function Use

The keypad displays the STO function state and error information.

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

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

Fault Code	state	Description	Cause	Solution
E150.0	STO safety state applied	The STO input protection applies (safety state).	Two 24 V inputs are disconnected simultaneously, triggering the STO function.	The STO function triggers normally and requires no further action.
E150.1	Status of STO1 and STO2 inconsistent	The signal of only one terminal of STO1/STO2 is disconnected, and the status of STO1/STO2 is inconsistent.	The input states of STO1 and STO2 are inconsistent.	1. Ensure the requests for disconnecting the voltage of STO1 and STO2 are triggered simultaneously. 2. The input circuit is abnormal and a certain STO input signal is still in the"24V" state after the 24 V signal is disconnected. Contact Inovance for technical support.
E150.2	STO activated	OV/UV of the 5V power supply is detected.	OV/UV of the 5V power supply.	Restore the 5 V power supply to normal state. Contact Inovance for technical support.
E150.3	STO activated	The input circuit of STO works improperly.	The input circuit of STO works improperly.	Fix the input circuit fault. Contact Inovance for technical support.
E150.4	STO activated	The buffer circuit of STO works improperly.	The buffer circuit of STO works improperly.	Fix the input circuit fault. Contact Inovance for technical support.

EDM DO signal

When STO1 and STO2 input 24V voltage are cut off, the EDM DO signal is active, otherwise the EDM DO signal is inactive.

At this time, STO1 and STO2 are filtered signals. When EDM is active, the servo drive blocks the PWM signal.

Signal Name	Mark	Photo coupler logic			
Safety input	STO1	ON	ON	OFF	OFF
	STO2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

- 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.

Application Example of Safety Function

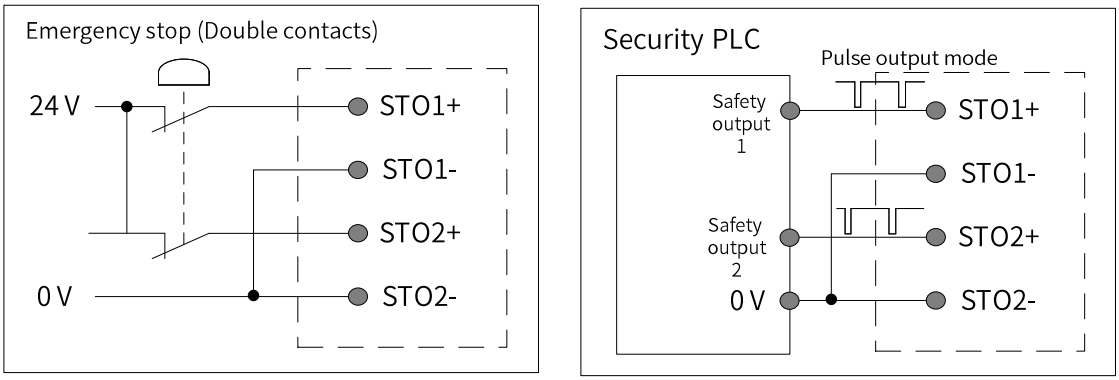


Figure 14-2 Examples 1, 2

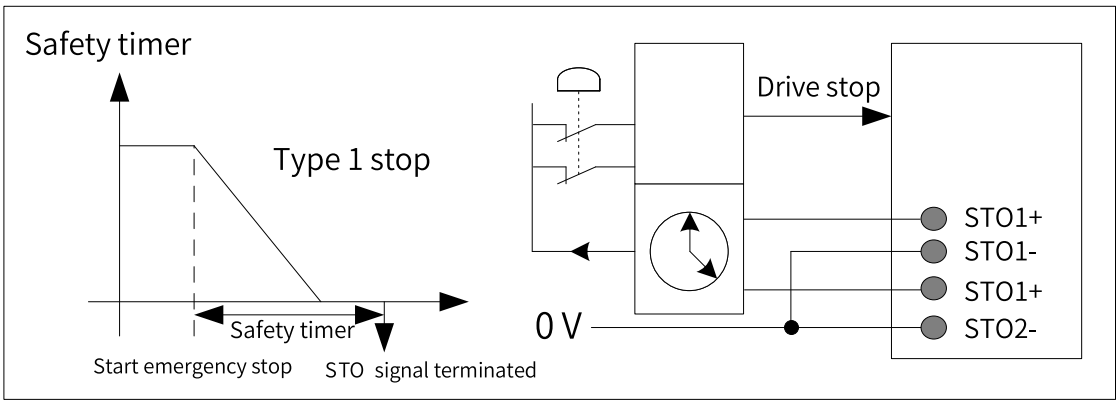


Figure 14-3 Example 3

Disabling STO:

When the STO safety function is not enabled, it is necessary to provide external 24V power supply for the STO safety function terminal. The specific wiring method of a single drive is shown in the figure below. If multiple drive have STO safety features, the STO terminals of each drive need to be connected to an external 24V switching power supply separately.

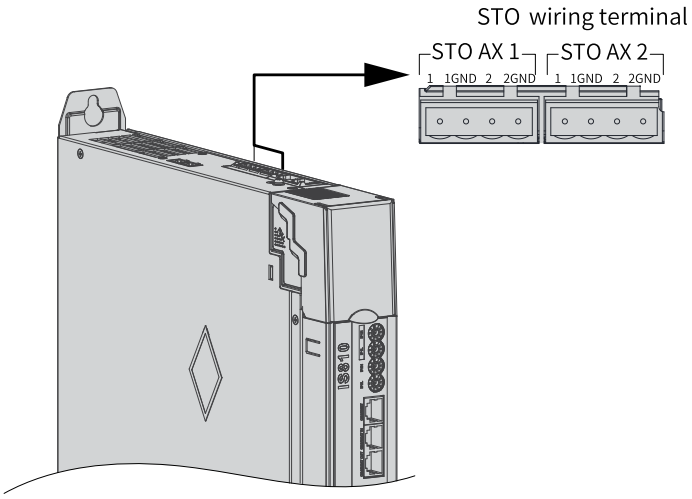


Figure 14-4 STO terminal

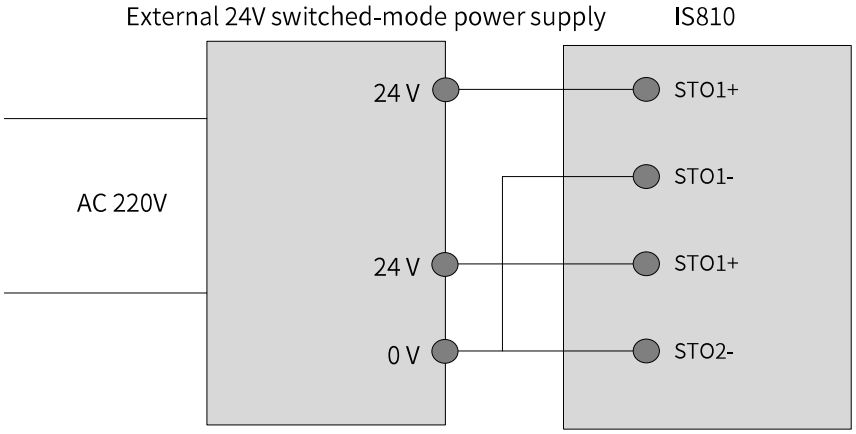


Figure 14-5 Wiring of drive unit STO terminal

The figure below shows the wiring diagram of the STO functions of multiple drive units sharing an external switching power supply.

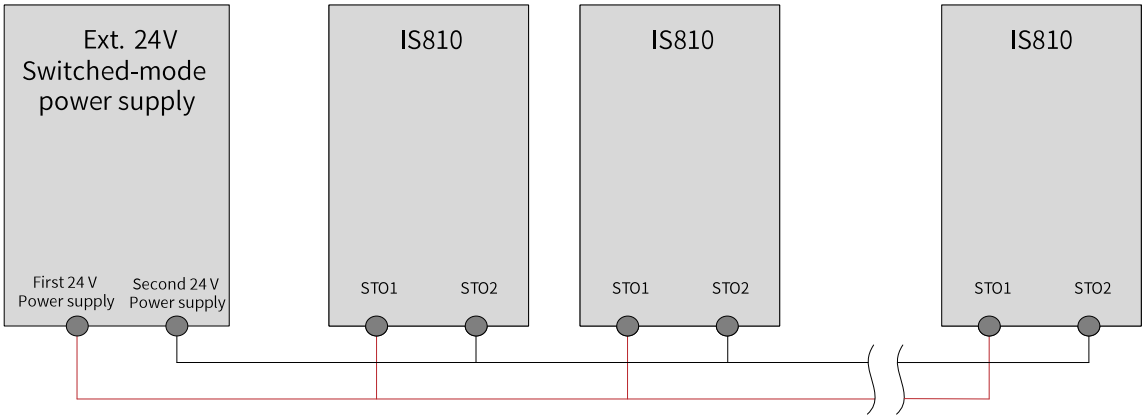


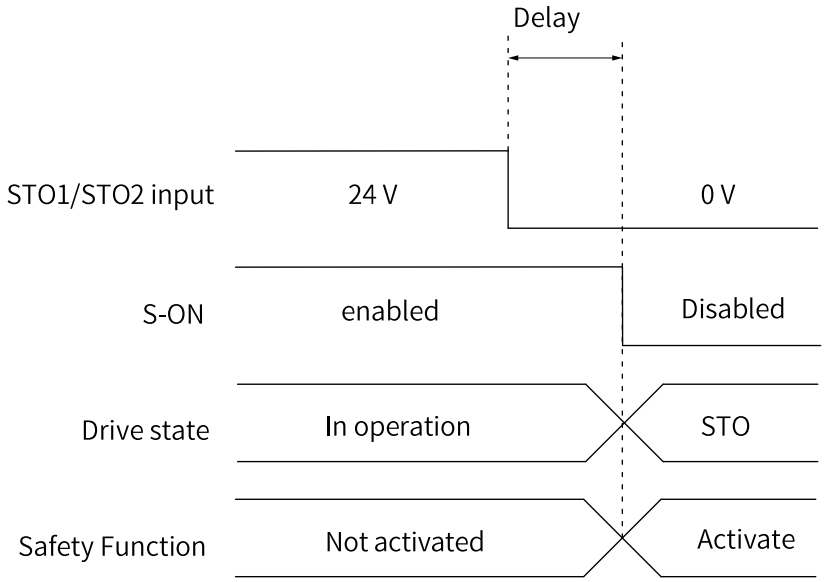
Figure 14-6 Wiring of drive parallel STO terminal

14.2.3 Safety Function Response Time

The STO function provides dual-channel 24V input signals through external redundant hardware terminals STO1 and STO2. When the input signals of these two terminals are disconnected at the same time, the PWM signal output to the drive power layer will be cut off, thus stopping the motor movement. The input signals of STO1 and STO2 terminals must be in active state (24V) at the same time to ensure the normal operation of the drive.

Definition of response time

If the signal at any one of the STO terminals is disconnected, the PWM signal will be cut off in **5ms** to stop motor movement.



14.3 Acceptance

Basic requirements

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

Commissioning Checklist

- Start-up test and validation
  IEC/EN 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. This acceptance test is described in the drive manual. The testing of optional safety features is described in the corresponding manuals.

  The acceptance test must be performed:

- at initial start-up of the safety function
- After any changes related to safety functions (wiring, assembly, settings, or other related operations)
- after any maintenance work related to the safety function.

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

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

- Checklist of integrated STO functions

Step	Action	Result
1	Ensure that the drive runs and stops freely during commissioning.	
2	Stop the drive (if running), switch the input power supply off and isolate the drive from the power line by a disconnector.	
3	Check the STO circuit connections against the circuit diagram.	
4	Check that the shield of the STO input cable is grounded to the drive frame.	
5	Close the disconnector and switch the power supply on.	
5.1	Test the STO signal #1 when the motor is stopped: STO1 and STO2 are in the active state "24V". Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Wake up the STO function by disconnecting STO input signal 1 and issue a start command for the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	
5.2	STO1 is in active state "24V", disables drive's ON/RUN command, then automatically restarts drive, enables drive's ON/RUN command, and checks if the motor is running properly.	
5.3	Test the STO signal #2 when the motor is stopped: STO1 and STO2 are in the active state "24V". Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Wake up the STO function by disconnecting STO input signal 2 and issue a start command for the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	
5.4	STO2 is in active state "24V", disables drive's ON/RUN command, then automatically restarts drive, enables drive's ON/RUN command, and checks if the motor is running properly.	

Step	Action	Result
6.1	Test the STO channel 1 when the motor is running: STO1 and STO2 are in the active state "24V". Start the drive and ensure the motor is running. Wake up the STO function by disconnecting 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	STO1 is in active state "24V", disables drive's ON/RUN command, then automatically restarts drive, enables drive's ON/RUN command, and checks if the motor is running properly.	
6.3	Test the STO channel 2 when the motor is running: STO1 and STO2 are in the active state "24V". Start the drive and ensure the motor is running. Wake up the STO function by disconnecting 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	STO2 is in active state "24V", disables drive's ON/RUN command, then automatically restarts drive, enables drive's ON/RUN command, and checks if the motor is running properly.	
7	Document and sign 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.

There are two ways to perform STO diagnosis:

- Power off the servo drive and then power it on again.
- Trigger and then cancel STO.

You can use either of them.

14.4 Troubleshooting

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

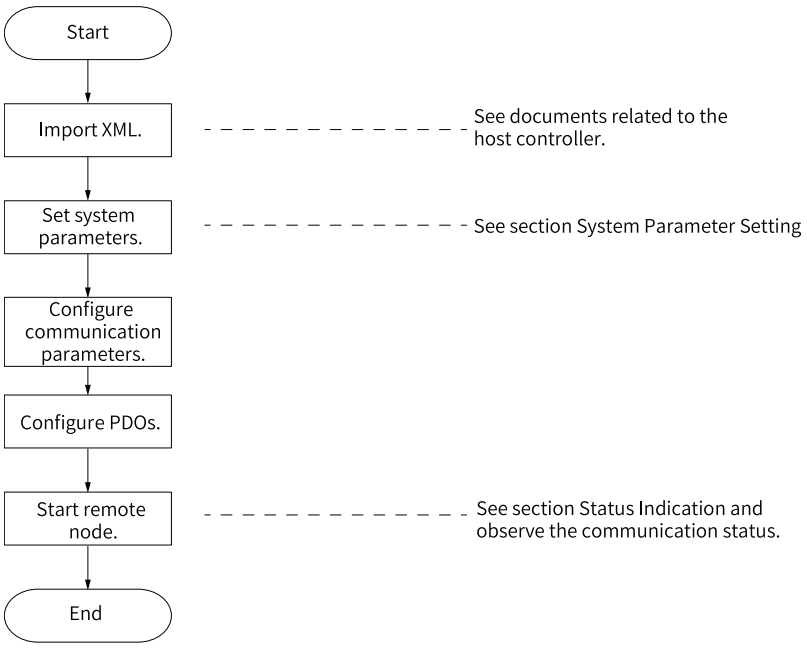
Error code	Cause	Corrective Action
E150.0	Two 24 V inputs are disconnected simultaneously, triggering the STO function.	The STO function triggers normally and requires no processing.
E150.1	The input states of STO1 and STO2 are inconsistent.	1 Ensure the requests for disconnecting the voltage of STO1 and STO2 are triggered simultaneously. 2 The input circuit is abnormal. After the 24V signal is turned off, a certain STO input signal is in the effective state "24V". Contact Inovance for technical support.
E150.2	OV/UV of the 5V power supply.	Restore the 5 V power supply to normal state. Contact Inovance for technical support.
E150.3	The input circuit of STO works improperly.	Fix the input circuit fault. Contact Inovance for technical support.
E150.4	The buffer circuit of STO works improperly.	Fix the input circuit fault. Contact Inovance for technical support.

15 Communication

15.1 Communication

15.1.1 Overview of the EtherCAT Protocol

EtherCAT features high performance, low cost, ease of use, and flexible topology. It is applicable to ultra high-speed I/O networks in the industrial field, and adopts standard EtherNet physical layer with twisted pair or optical fiber (100Base-TX or 100Base-FX) as the transmission media.



An EtherCAT system consists of the master and the slave. The master requires a common network adapter, and the slave requires a special slave control chip, such as ET1100, ET1200, and FPGA.

EtherCAT can process data at the I/O layer,

- without any sub-bus
- or gateway delay
- One system covers all devices, including input/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)

Update time:

256 digital I/O: 11 μs

1000 digital I/Os distributed in 100 nodes: 30 μs = 0.03 ms

200 AI/AOs (16-bit): 50 μs, sampling rate: 20 kHz

100 servo axis (8-byte IN + OUT each): 100 μs = 0.1 ms

12000 digital I/O: 350 μs

To support more types of devices and applications, EtherCAT establishes the following application protocols:

- CANopen over EtherCAT (CoE)
- Safety over EtherCAT (SoE, compliant with IEC 61800-7-204)
- EtherNet over EtherCAT (EoE)
- File over EtherCAT (FoE)

The slave only needs to support the suitable application protocol.

Note

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

15.1.2 Technical Data of EtherCAT Communication

Item		Specification
EtherCAT Basic performance 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
	Min. sync period	250μs
	Communication code error rate	10^{-10} EtherNet standard
EtherCAT 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 kbits

15.1.3 Specifications of EtherCAT Communication

Item		Specification
Communication protocol		IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile
Application layer	SDO	SDO request, SDO response
	PDO	a. 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)

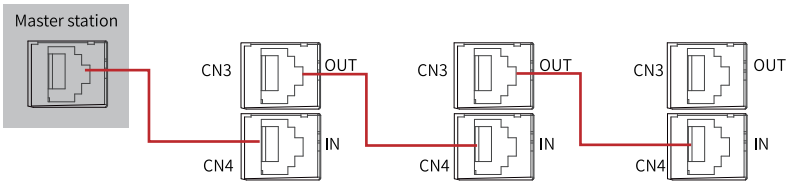
15.2 Hardware Configuration

Terminal Arrangement

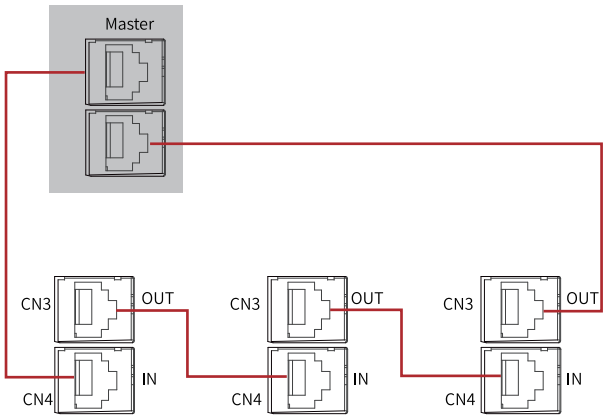
For details of EtherCAT hardware, see *"7.9.1 Terminal Arrangement" on page 91*.

Topology

Linear



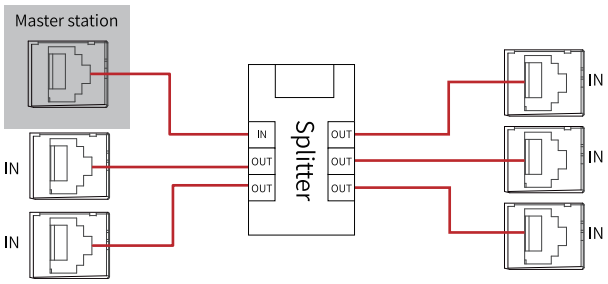
Ring



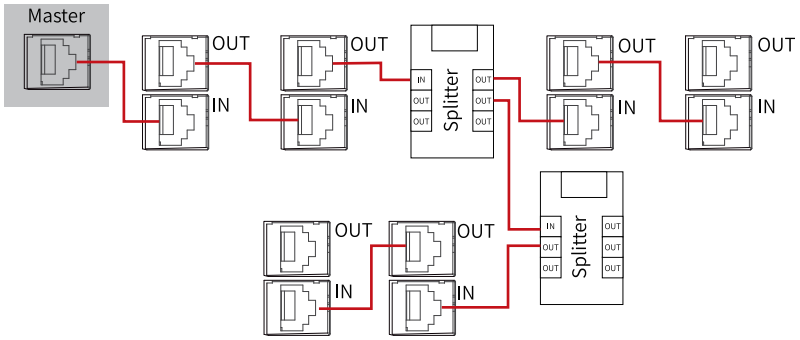
Note

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



Tree



15.3 Communication Transmission Mode

15.3.1 Structure of EtherCAT Communication

Multiple kinds of application protocols are available for EtherCAT communication. The IEC 61800-7 (CiA 402)-CANopen motion control profile is used for the drive. The following figure shows the EtherCAT communication structure at the CANopen application layer.

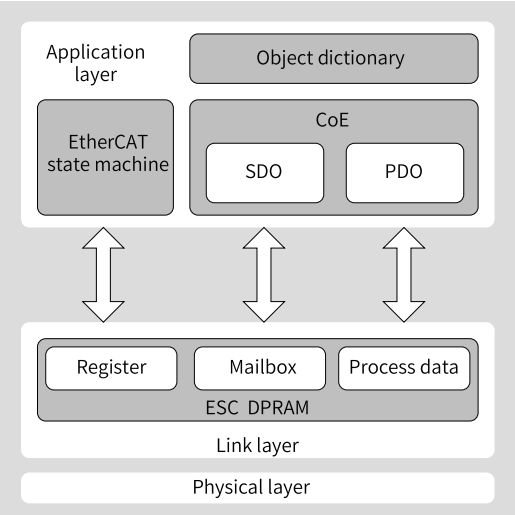


Figure 15-1 EtherCAT communication structure at CANopen application layer

The object dictionary in the application layer contains parameters and application data as well as information on the PDO mapping between the process data servo interface and Servo Drive application. The process data object (PDO) includes the real-time data generated during operation, which is read and written cyclically. In the SDO mailbox communication, the communication objects and PDO objects are being accessed and modified non-cyclically.

15.3.2 Communication State Machine

The following figure shows the state transition diagram of the EtherCAT module.

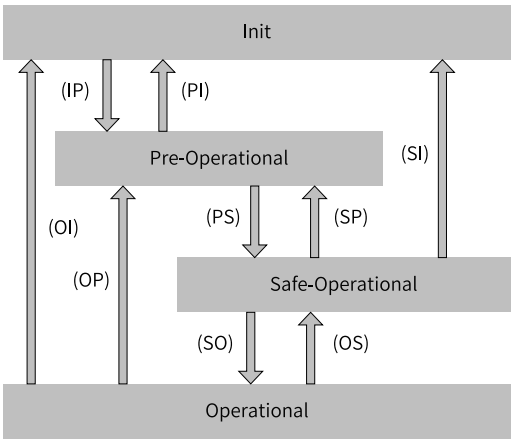


Figure 15-2 EtherCAT state machine

The EtherCAT module must support four states and coordinates the state relationship 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: operation, shortened as O

Transition from Init state to Operational state must be in the sequence of Init→Pre-Operational→Safe→Operational, and then 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)	✓	×	×	Mailbox data communication in the application layer (SDO).
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.
Operational (O)	✓	✓	✓	Normal operational state Both input and output are valid. Mailbox communication can still be used.

15.3.3 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 produces the synchronization signal according to the synchronized system time. The drive only support the DC sync mode. The synchronization period, which is controlled by SYNC0, 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. Generally, it is to synchronize the 0x910 register of ESC.
- SYNC starting time = 0x990 register (with ESC) - 0x920 Note that the DC mode (0x981 = 0x03) can be enabled only after 0x910 reaches the starting time. If the starting time of SYNC is set improperly, the 0x134 status register of ESC will report the error code of 0x2D.

15.3.4 Status Indication

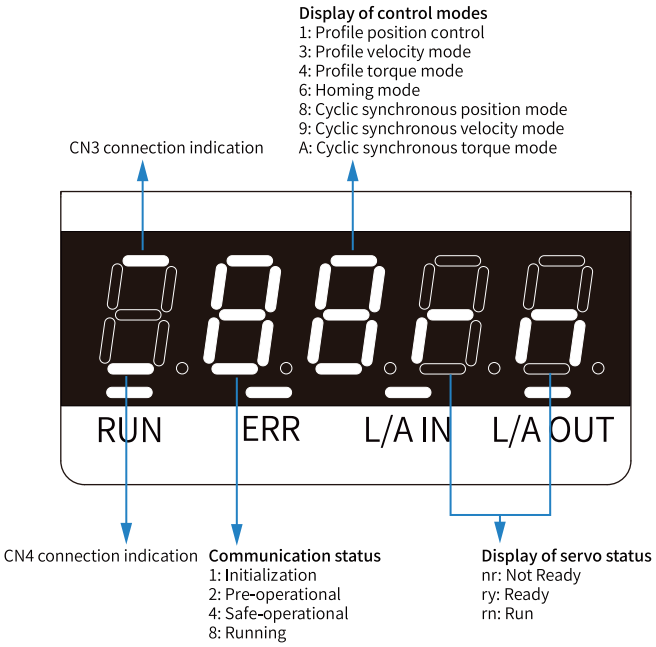


Figure 15-3 Status indication diagram

If the value 0 is displayed, it indicates no value is written or the value 0 is written to 6060h, or H02.00 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 first LED on the keypad. 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.

State of EtherCAT state machine:

state	SDO	RPDO	TPDO	Description	Panel Display
Initialization	No	No	No	Communication initialization	1: Steady off
Pre-operational	Yes	No	No	Network configuration initialized SDO is available	2: Blinks at an interval of 400 ms
Safe-operational	Yes	No	Yes	SDO, TPDO, and distributed clock mode are available	4: Blinks with a period of 1200 ms, on for 200 ms and off for 1000 ms
Operation	Yes	Yes	Yes	Normal operation state	8: Steady on

Display of control modes

The 3rd LED indicates the operation mode of the servo drive in the form of hexadecimal without blinking, 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.

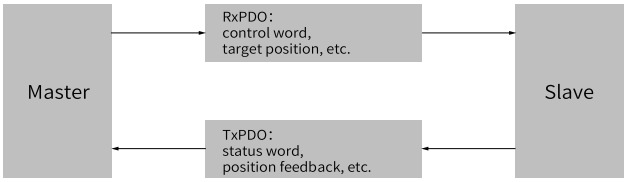
The statuses include the following:

state	Description	Panel Display
Reset	Initialization	reset
Not ready	Initialization is done. The control circuit is switched on but the main circuit is not switched on. Not ready	nr
Ready	The main circuit is switched on, but the S-ON signal is inactive. Ready	ry When the absolute value of the speed exceeds 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 characters "2" or "4" (see "communication status" in this section for details). When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.
Operation	The S-ON signal is active and the motor is energized. Run	rn The character "n" blinks when the absolute value of the speed exceeds the value of H06-16. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of characters "2" or "4" (see "communication status" in this section for details). When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.

15.4 Data Frame Structure

15.4.1 Process Data

The real-time data transmission of EtherCAT is achieved through PDO. 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.



The IS810N series servo drive allows users to assign the PDO list and define the PDO mapping objects.

PDO Mapping

The PDO mapping is used to establish the mapping relation between the object dictionary and the PDO. 1600h to 17FFh are RPDOs, and 1A00h to 1BFFh are TPDOs. The drive comes with two axes. Each axis has 1 mapping-variable RPDO and 1 mapping-variable TPDO, as listed in the following table.

Axis 1	RPDO1	1600h	Variable mapping
	TPDO1	1A00h	Variable mapping
Axis 2	RPDO2	1610h	Variable mapping
	TPDO2	1A10h	Variable mapping

Note

In PDO configuration, RPDO1 and TPDO1 (or RPDO2 and TPDO2) must appear in pairs.

Variable PDO mapping

Each axis provides1 mapping-variable RPDO and 1 mapping-variable TPDO.

Variable PDO	Index	Max. Length of the Byte	Default Mapping Object
RPDO1	1600h	40	6040h (control word) 607Ah (target position) 60B8h (touch probe function)
TPDO1	1A00h	40	603Fh (error code) 6041h (status word) 6064h (position actual value) 60BCh (probe 2 positive edge) 60B9h (probe status) 60BAh (probe 1 positive edge) 60FDh (DI state)

Variable PDO	Index	Max. Length of the Byte	Default Mapping Object
RPDO2	1610h	40	6840h (control word) 687Ah (target position) 68B8h (touch probe function)
TPDO2	1A10h	40	683Fh (error code) 6841h (status word) 6864h (position actual value) 68BCh (probe 2 positive edge) 68B9h (probe status) 68BAh (probe 1 positive edge) 68FDh (DI state)

Variable mapping PDO configuration can be configured differently according to the servo operation mode to be used. The IS810N supports 9 operation modes, including CSP/CSV, CSP, CST, CSP/CST, CSP/CSV/CST, CST (Speed Limited), PP TP, PP/PV/PT, CSP/CSV/CST + TP + LMT.

The configuration of all modes are as follows:

Available Servo Mode		CSP/CSV
Axis 1	1600h	Mapping objects (5 mapping objects, 13 bytes)
		6040h (control word) 6060h (mode selection) 607Ah (target position) 60B8h (touch probe function) 60FFh (target velocity)
	1A00h	Mapping objects (10 mapping objects, 31 bytes)
		603Fh (control word) 6041h (status word) 6061h (Mode display) 6064h (position actual value) 606Ch (actual speed) 60B9h (probe status) 60BAh (probe 1 positive edge) 60BCh (probe 2 positive edge) 60F4h (following error actual value) 60FDh (DI state)
Axis 2	1610h	Mapping objects (5 mapping objects, 13 bytes)
		6840h (control word) 6860h (mode selection) 687Ah (target position) 68B8h (touch probe function) 68FFh (target velocity)
	1A10h	Mapping objects (10 mapping objects, 31 bytes)
		683Fh (control word) 6841h (status word) 6861h (Mode display) 6864h (position actual value) 686Ch (actual speed) 68B9h (probe status) 68BAh (probe 1 positive edge) 68BCh (probe 2 positive edge) 68F4h (following error actual value) 68FDh (DI state)

Available Servo Mode		CSP
Axis 1	1600h	Mapping objects (3 mapping objects, 8 bytes)
		6040h (control word)
		607Ah (target position)
		60B8h (touch probe function)
	1A00h	Mapping objects (8 mapping objects, 26 bytes)
		603Fh (control word)
		6041h (status word)
		6064h (position actual value)
		60B9h (probe status)
		60BAh (probe 1 positive edge)
		60BCh (probe 2 positive edge)
		60F4h (following error actual value)
		60FDh (DI state)
Axis 2	1610h	Mapping objects (3 mapping objects, 8 bytes)
		6840h (control word)
		687Ah (target position)
		68B8h (touch probe function)
	1A10h	Mapping objects (8 mapping objects, 26 bytes)
		683Fh (control word)
		6841h (status word)
		6864h (position actual value)
		68B9h (probe status)
		68BAh (probe 1 positive edge)
		68BCh (probe 2 positive edge)
		68F4h (following error actual value)
		68FDh (DI state)

Available Servo Mode		CST
Axis 1	1600h	Mapping objects (2 mapping objects, 4 bytes)
		6040h (control word)
		6071h (target torque)
	1A00h	Mapping objects (6 mapping objects, 18 bytes)
		603Fh (control word)
		6041h (status word)
		6064h (position actual value)
		606Ch (actual speed)
		6077h (torque actual value)
		60FDh (DI state)
Axis 2	1610h	Mapping objects (2 mapping objects, 4 bytes)
		6840h (control word)
		6871h (target torque)
	1A10h	Mapping objects (6 mapping objects, 18 bytes)
		683Fh (control word)
		6841h (status word)
		6864h (position actual value)
		686Ch (actual speed)
		6877h (torque actual value)
		68FDh (DI state)

Available Servo Mode		PP+TP
Axis 1	1600h	Mapping objects (6 mapping objects, 20 bytes)
		6040h (control word)
		607Ah (target position)
		6081h (profile velocity)
		6083h (profile acceleration)
		6084h (profile deceleration)
		60B8h (touch probe function)
	1A00h	Mapping objects (8 mapping objects, 26 bytes)
		603Fh (control word)
		6041h (status word)
		6064h (position actual value)
		606Ch (actual speed)
		60B9h (probe status)
		60BAh (probe 1 positive edge)
		60BCh (probe 2 positive edge)
		60F4h (following error actual value)
Axis 2	1610h	Mapping objects (6 mapping objects, 20 bytes)
		6840h (control word)
		687Ah (target position)
		6881h (profile velocity)
		6883h (profile acceleration)
		6884h (profile deceleration)
		68B8h (touch probe function)
	1A10h	Mapping objects (8 mapping objects, 26 bytes)
		683Fh (control word)
		6841h (status word)
		6864h (position actual value)
		686Ch (actual speed)
		68B9h (probe status)
		68BAh (probe 1 positive edge)
		68BCh (probe 2 positive edge)
		68F4h (following error actual value)

Available Servo Mode		PP/PV/PT
Axis 1	1600h	Mapping objects (9 mapping objects, 27 bytes)
		6040h (control word)
		6060h (mode selection)
		6071h (target torque)
		607Ah (target position)
		6081h (profile velocity)
		6083h (profile acceleration)
		6084h (profile deceleration)
		60B8h (touch probe function)
		60FFh (target velocity)
	1A00h	Mapping objects (10 mapping objects, 29 bytes)
		603Fh (control word)
		6041h (status word)
		6061h (Mode display)
		6064h (position actual value)
		606Ch (actual speed)
		6077h (torque actual value)
		60F4h (following error actual value)
		60B9h (probe status)
		60BAh (probe 1 positive edge)
		60FDh (DI state)
Axis 2	1610h	Mapping objects (9 mapping objects, 27 bytes)
		6840h (control word)
		6860h (mode selection)
		6871h (target torque)
		687Ah (target position)
		6881h (profile velocity)
		6883h (profile acceleration)
		6884h (profile deceleration)
		68B8h (touch probe function)
		68FFh (target velocity)
	1A10h	Mapping objects (10 mapping objects, 29 bytes)
		683Fh (control word)
		6841h (status word)
		6861h (Mode display)
		6864h (position actual value)
		686Ch (actual speed)
		6877h (torque actual value)
		68F4h (following error actual value)
		68B9h (probe status)
		68BAh (probe 1 positive edge)
		68FDh (DI state)

Available Servo Mode		CSP/CSV/CST+TP+LMT
Axis 1	1600h	Mapping objects (9 mapping objects, 23 bytes)
		6040h (control word)
		6060h (mode selection)
		6071h (target torque)
		607Ah (target position)
		6081h (profile velocity)
		6083h (profile acceleration)
		6084h (profile deceleration)
		60B8h (touch probe function)
		60FFh (target velocity)
	1A00h	Mapping objects (10 mapping objects, 29 bytes)
		603Fh (control word)
		6041h (status word)
		6061h (Mode display)
		6064h (position actual value)
		606Ch (actual speed)
		6077h (torque actual value)
		60F4h (following error actual value)
		60B9h (probe status)
		60BAh (probe 1 positive edge)
		60FDh (DI state)
Axis 2	1610h	Mapping objects (9 mapping objects, 23 bytes)
		6840h (control word)
		6860h (mode selection)
		6871h (target torque)
		687Ah (target position)
		6881h (profile velocity)
		6883h (profile acceleration)
		6884h (profile deceleration)
		68B8h (touch probe function)
		68FFh (target velocity)
	1A10h	Mapping objects (10 mapping objects, 29 bytes)
		683Fh (control word)
		6841h (status word)
		6861h (Mode display)
		6864h (position actual value)
		686Ch (actual speed)
		6877h (torque actual value)
		68F4h (following error actual value)
		68B9h (probe status)
		68BAh (probe 1 positive edge)
		68FDh (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 using data objects 1C10h to 1C2Fh. Multiple PDOs can be mapped to different sub-indexes. The IS810N drive supports assignment of one RPDO and one TPDO, as described in the following table.

Index	Sub-index	Description
1C12h	01h	Select 1600h and 1610h as the used RPDOs.
1C13h	01h	Select 1A00h and 1A10h as the used TPDOs.

Configuring PDO

PDO mapping parameters include pointers of process data that corresponds to PDO and that is to be sent or received by PDO, including index, sub-index, and mapping object length. The sub-index 0 indicates the number (N) of mapping objects in the PDO, and the maximum length of each PDO is 4 x N bytes. One or multiple objects can be mapped simultaneously. Sub-indexes 1 to N indicate the mapping content, The mapping parameters are described as follows.

Places	31	...	16	15	...	8	7	...	0
Descrip-tion	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.

- PDO mapping steps:
  Abide by the following procedures for PDO mapping:

  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 mapping group according to application needs. Pre-write values of 1600h and 1610h to 1C12h and values of 1A00h and 1A10h to 1C13h.
     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, 1610h, 1A00h, and 1A10h.

     a. Clear the original mapping objects. Write 0 to sub-index 00h of 1600h, 1610h, 1A00h, and 1A10h to clear the original mapping objects.
     b. Write the PDO mapping content. Write the mapping content to sub-index 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.

An SDO fault code will be returned when the following operations are under execution:

- Modify PDO parameters in status other than pre-operational.
- Write a value other than 1600h and 1610h to 1C12h. Write a value other than 1A00h and 1A10h to 1C13h.

15.4.2 Mailbox Data

The EtherCAT SDO is used to transfer non-cyclic data, such as communication or running parameter configurations of the drive. The CoE service type includes the following:

- Emergency message
- SDO request:
- SDO response
- TxPDO
- RxPDO
- Remote TxPDO transmission request
- Remote RxPDO sending request
- SDO information

The IS810N supports SDO request and SDO response.

15.5 Communication Parameters

Parameter address structure

Parameter access address: index+subindex, both are hexadecimal.

The 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 Setting

Set related parameters to allow the IS810N servo drive to be connected to the EtherCAT fieldbus network.

Parameter	Name	Value Range	Default
H02.00h	Control mode	0: Speed control mode 1: Position control mode 2: Torque control mode 9: EtherCAT mode	9
H0E.02h	Save objects written through communication to EEPROM	0: Do not save 1: Save parameters 2: Only object dictionaries written through communication saved to EEPROM 3: Save all 4: Save object dictionaries written before communication	4
H0E.21h	EtherCAT slave alias	0 to 65535	0

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.

15.6 Communication Configuration Instance

15.6.1 Cyclic Synchronous Position Mode with AM600

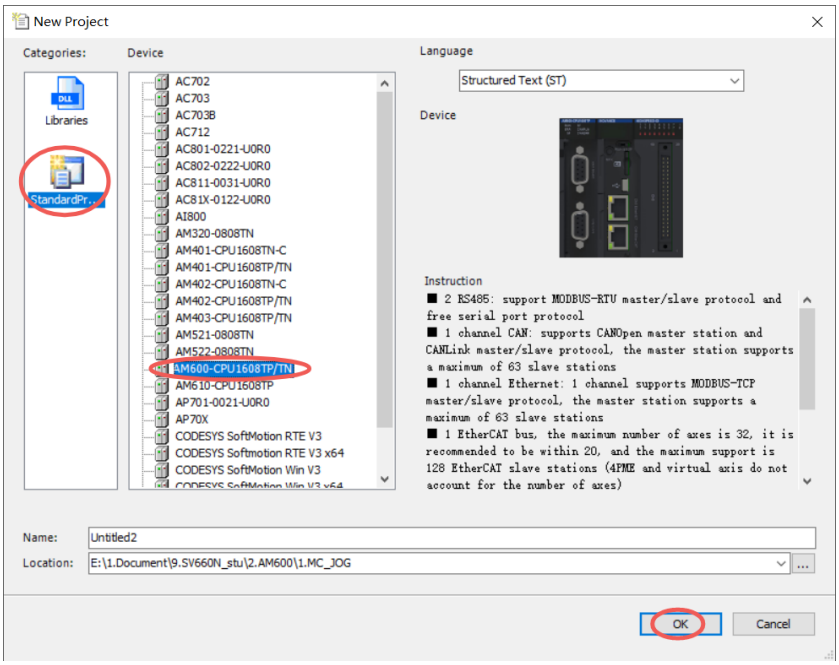
The following description takes Inovance AM600 controller as the master to introduce the communication settings of IS810N series servo drives.

Note

Note: For better usability, it is recommended to use version 1.10 or higher versions of the AM600 software tool.

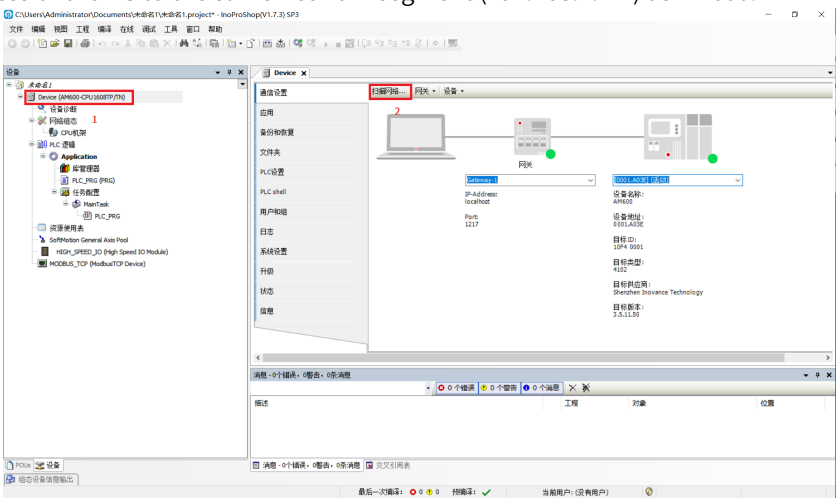
1. Creating a project

Create an AM600 project. Select **AM600-CPU1608TP/TN**, as shown in the following interface.

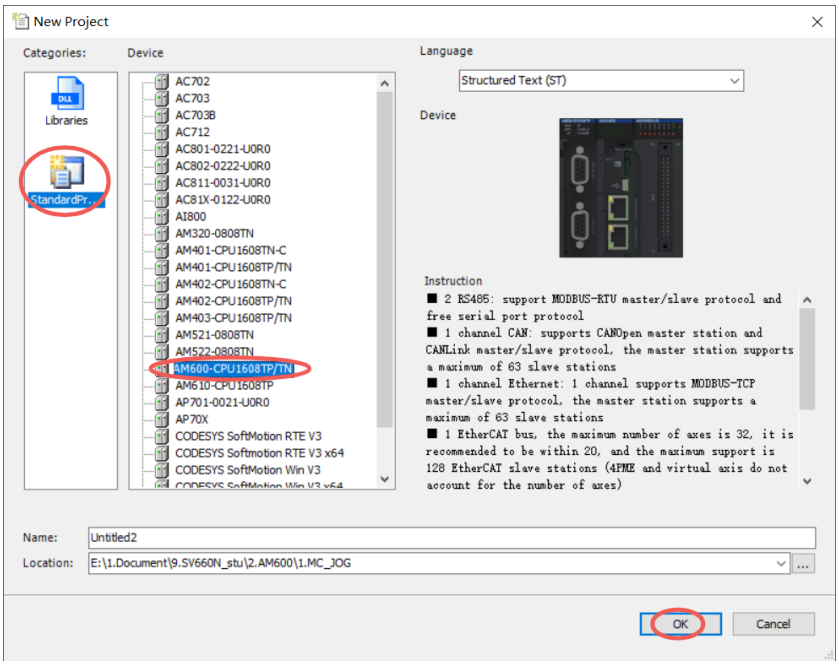


2. Communication setting

a. Connect the communication cables properly. To set up a normal communication connection, set the IP address of the PC to the same network segment (192.168.1.xxx) as AM600.



b. Click Scan Network.



c. Select the scanned AM600 device. Now the communication connection between PLC and PC is completed. Next, perform the device configuration.

Note

- If the AM600 device cannot be scanned in InoPro, check whether the CoDeSys gateway is started. If not, start the gateway and perform scanning again.
-

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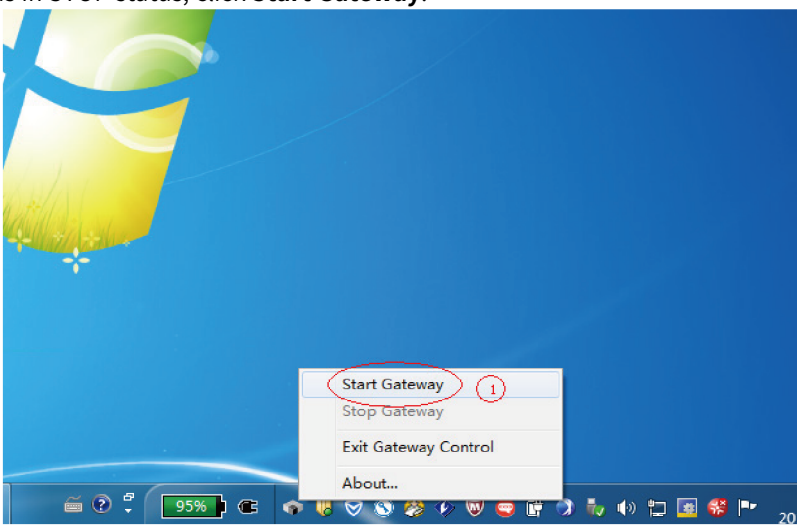
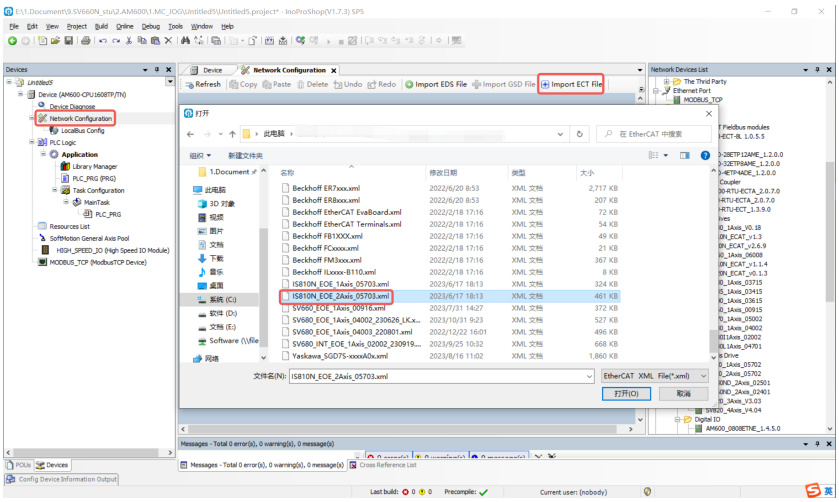
d. Check whether the CoDeSys gateway in the task at the bottom right of the PC is turned on (shown in color). If it is in STOP status, click **Start Gateway**.

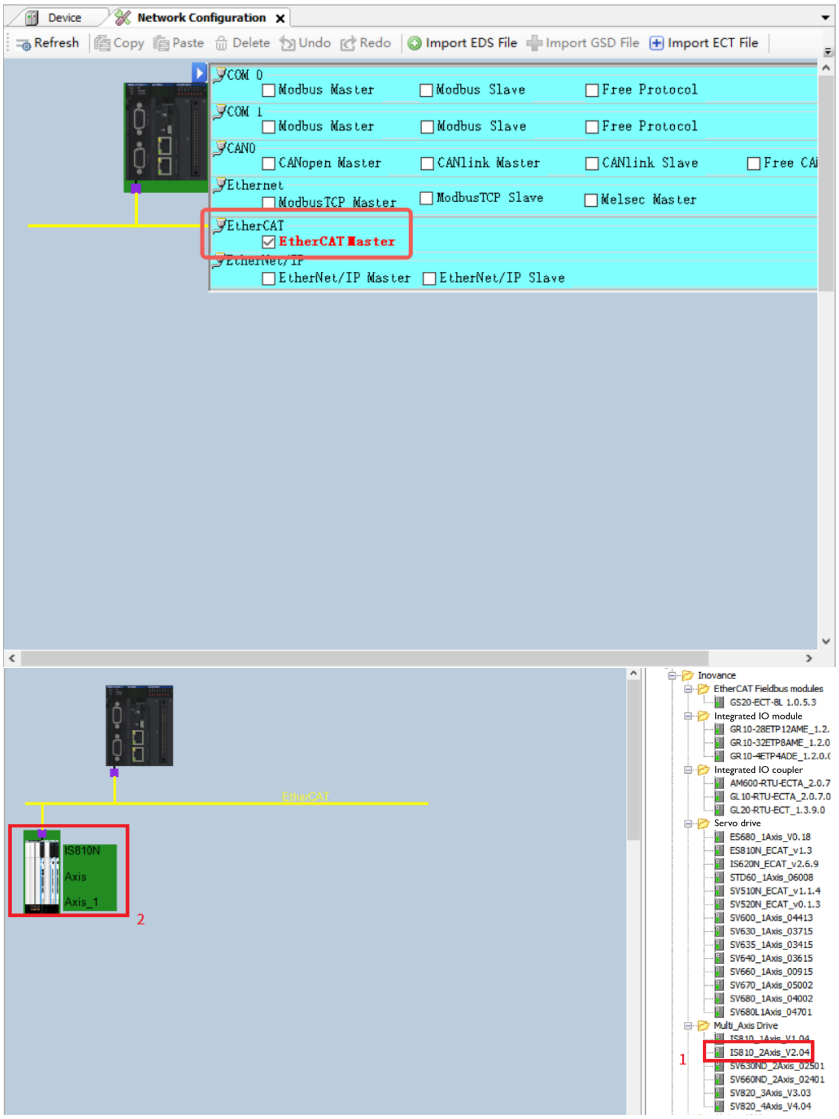


3. Add devices to perform configurations

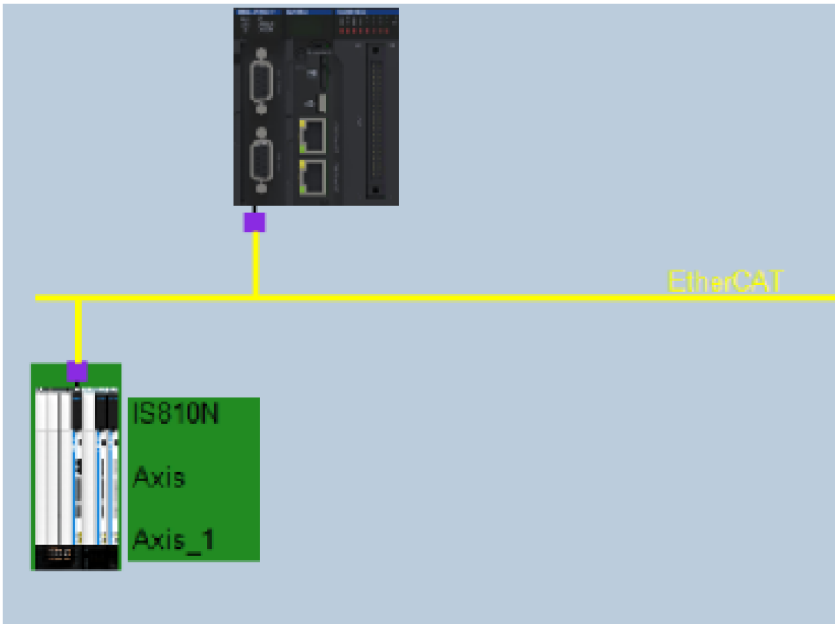
a. Add the XML file of IS810N-INT: Click **Import ECT File** in **Network Configuration** to add XML files. Visit the official website of Inovance to download the XML files.



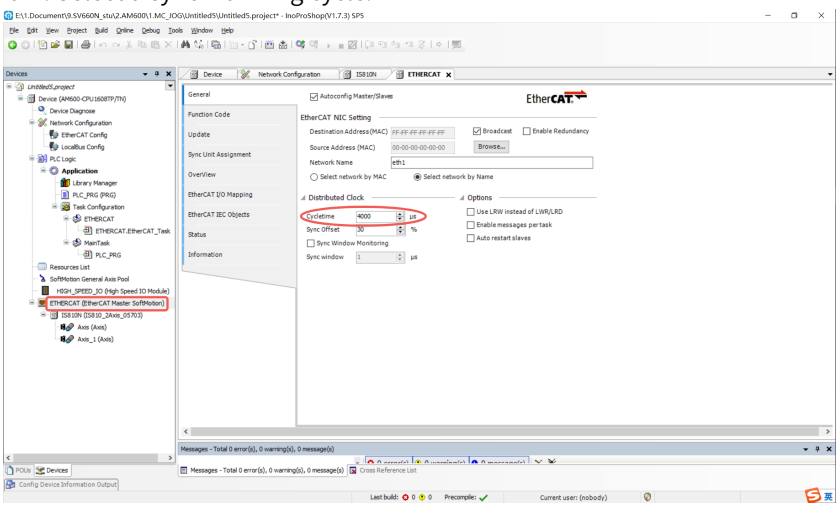
b. Then, configure the system. First, configure the PLC as the EtherCAT master station, and then add the IS810N-INT device (double-click or drag IS810 _ 2Axis _ V2.04. xml into the configuration interface).



c. If the axes are not automatically added after adding the servo drive, please add 2 motor axes manually, right-click on IS810N-INT device options to add 2 CiA402 motor axes.

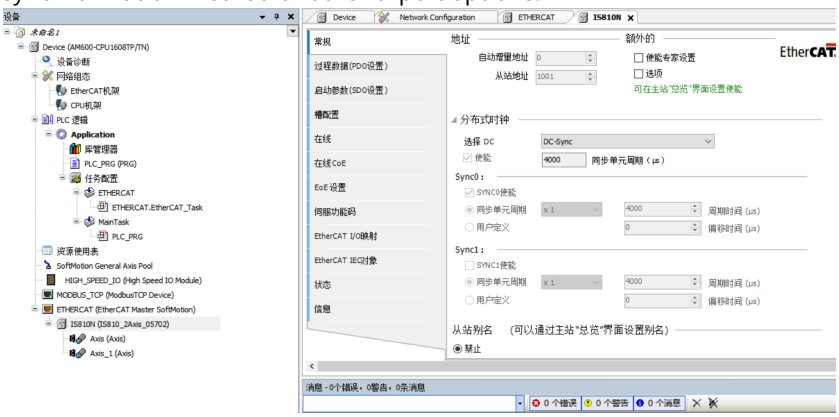


d. Configure EtherCAT master communication parameters by maintaining the default. Select **eth1** for the network. Select a synchronizing cycle.



4. Configure the PDO mapping for the slave

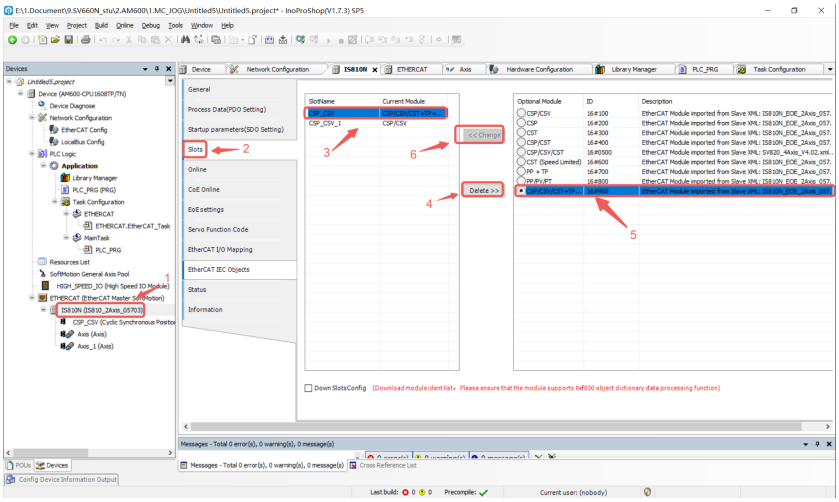
a. Slaves do not need to enable Expert Settings by default, but need to be enabled if you want to change the synchronization method or other expert options.



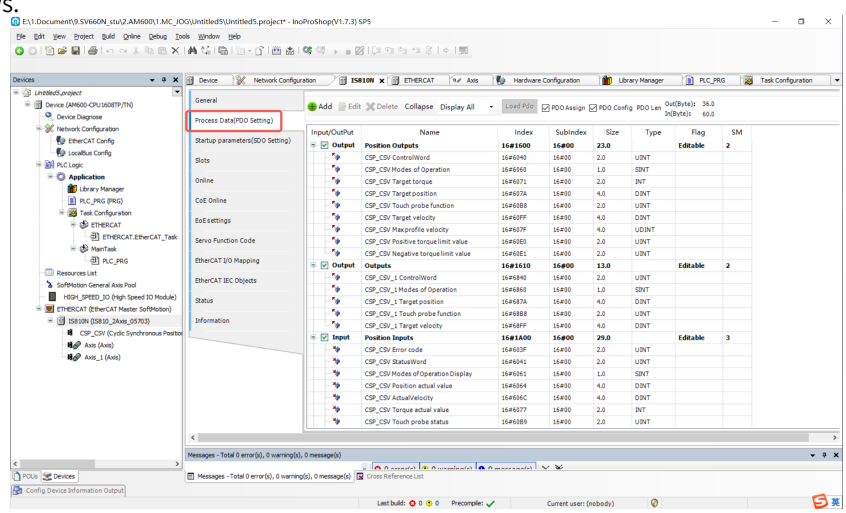
b. Check the corresponding PDO list.

In the PDO configuration interface, you can add corresponding PDO objects according to the corresponding modes of two axes running. IS810N's slot configuration options plan the PDO list for each axis for ease of use. Just select the mode you are running, from "CSP/CSV + TP, CSP + TP, CST, CSP/CST + TP, CSP/CSV + TP, PP + TP, PP\ PV\ PT + TP". The XML file will be combined with the controller to select the PDO configuration required by the current mode for you. The existing slot configuration needs to be deleted before inserting a new slot configuration.

The following is configured in CSP (Position)/CSV (Speed) + TP (Probe) mode.

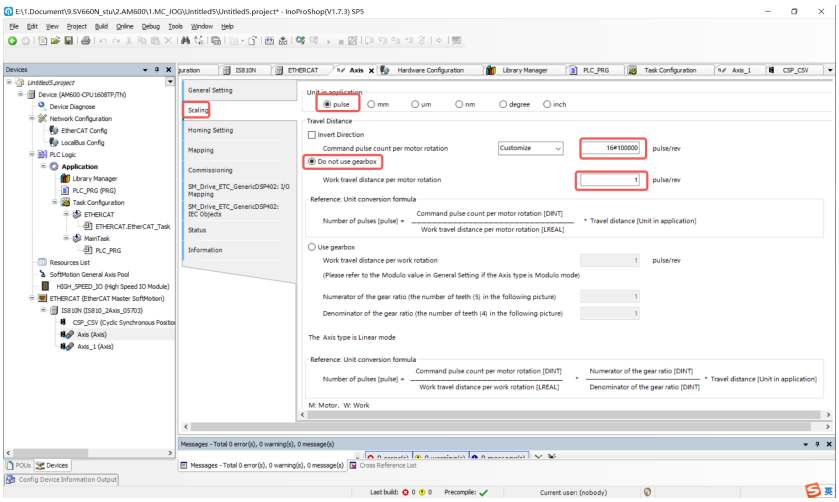


c. The PDO list configured according to the CSP (Position) + CSV (Velocity) + TP (Touch Probe) mode is as follows.



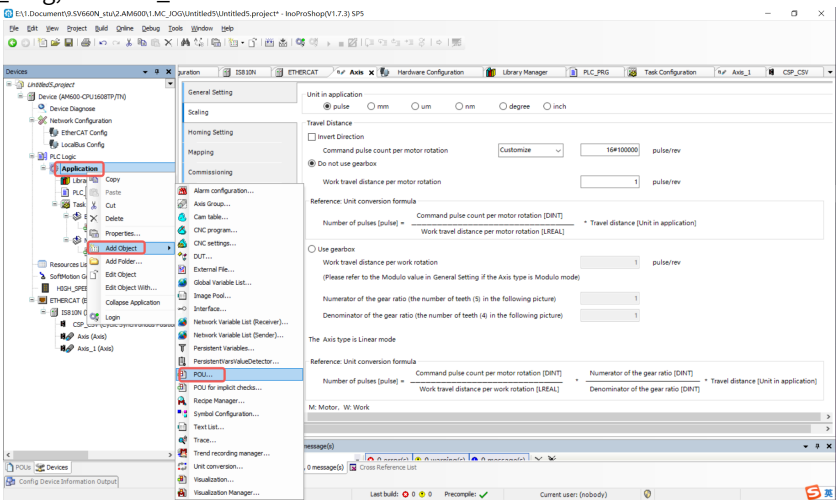
5. Axis scaling settings

The shaft uses a 23BIT encoder, and one rotation is 8388608 pulses, corresponding to a hexadecimal number of 800000. At the same time, the working stroke is configured according to one rotation per 1000 command units. This option actually performs electronic gear conversion on the host computer, and there is no need to set the conversion ratio inside the servo.

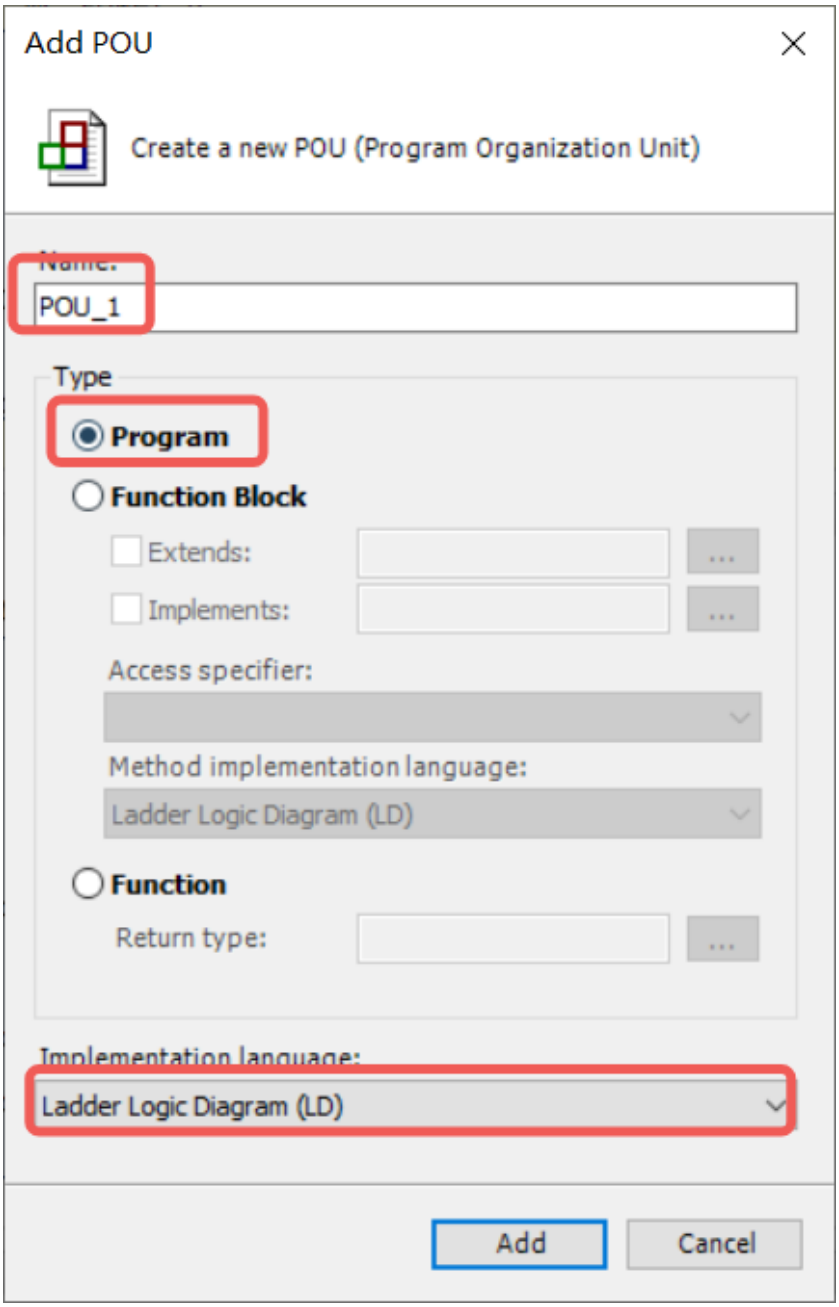


6. PLC program

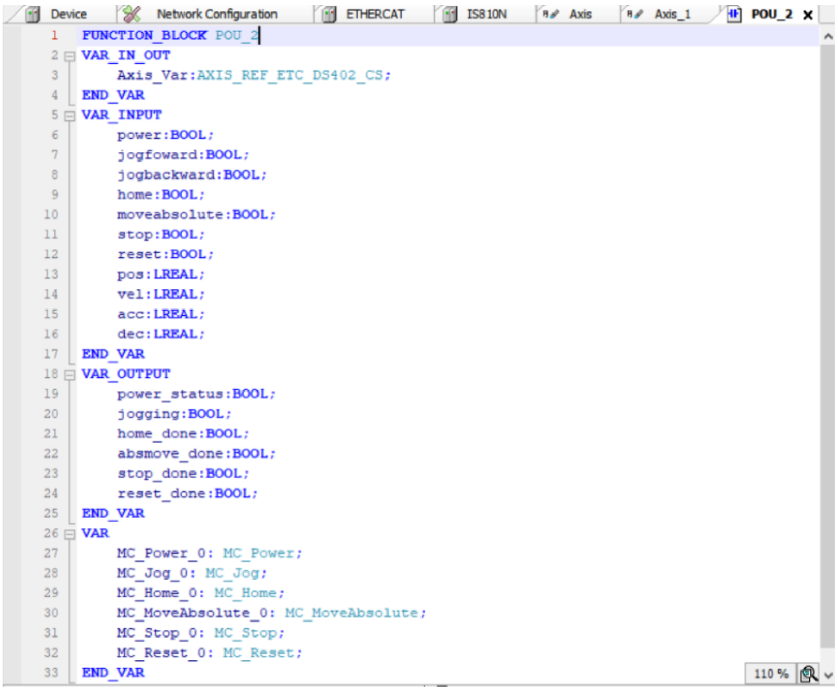
a. Add an FB file of editing function block in Application, and add function blocks such as MC _ Power, MC _ Jog, and MC _ MoveAbsolute.



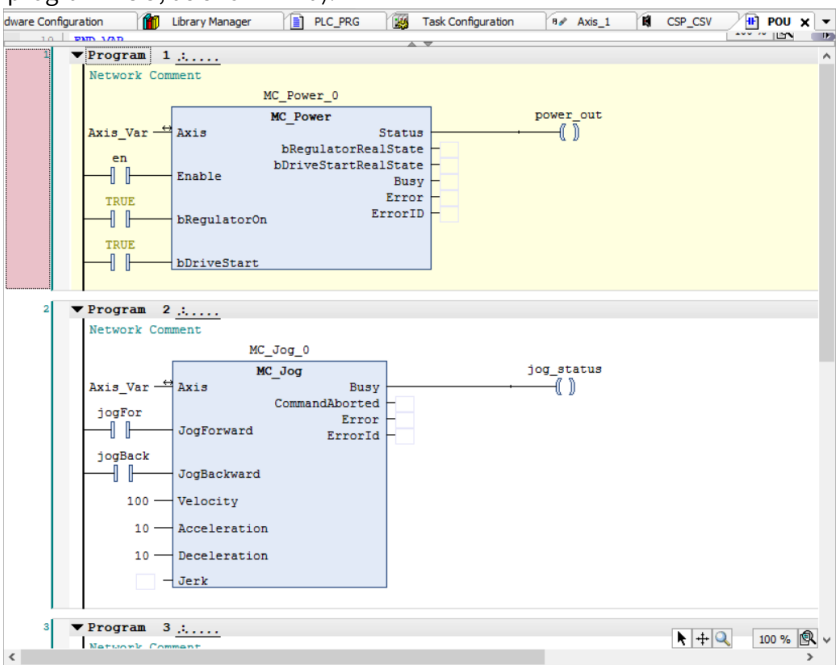
b. Definition part of FB



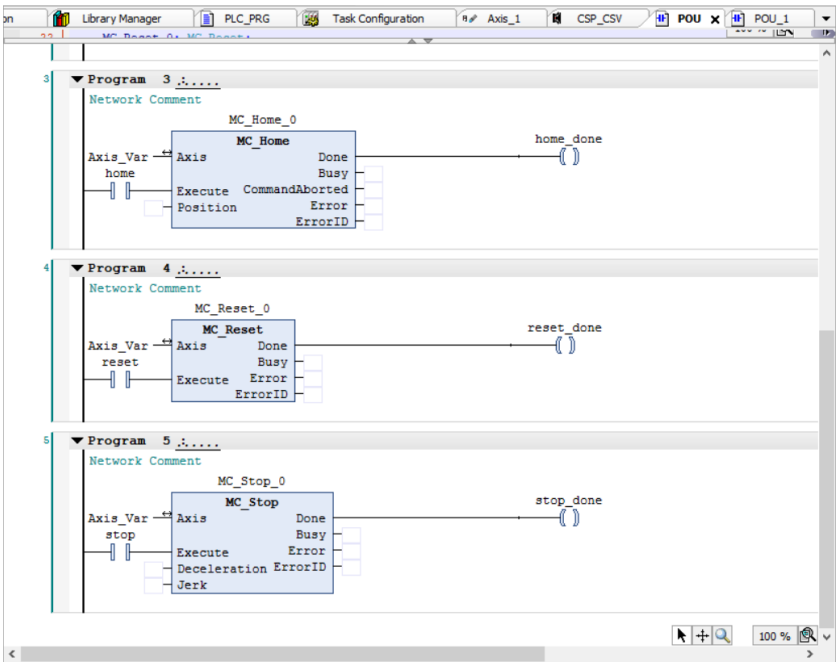
c. Five function blocks in FB



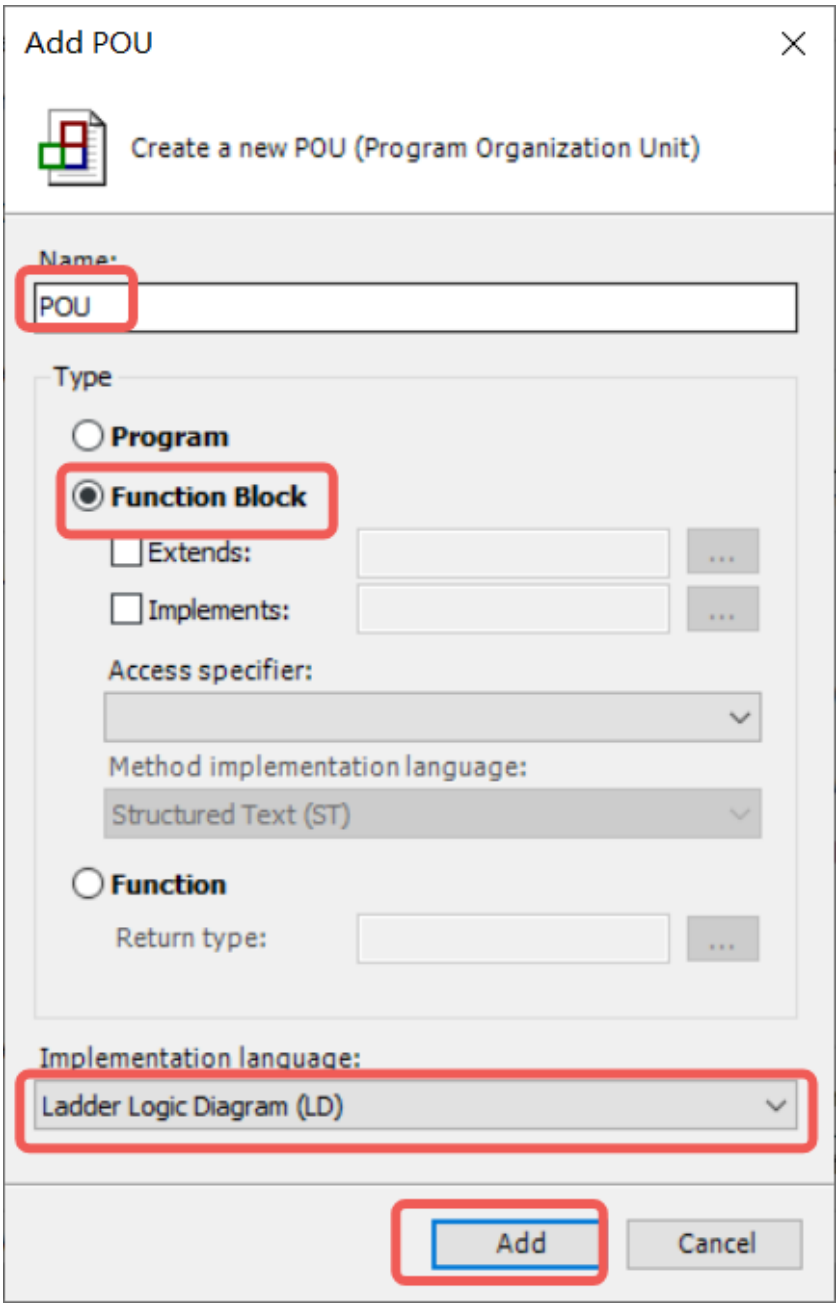
d. Add a main program POU, as shown in a).

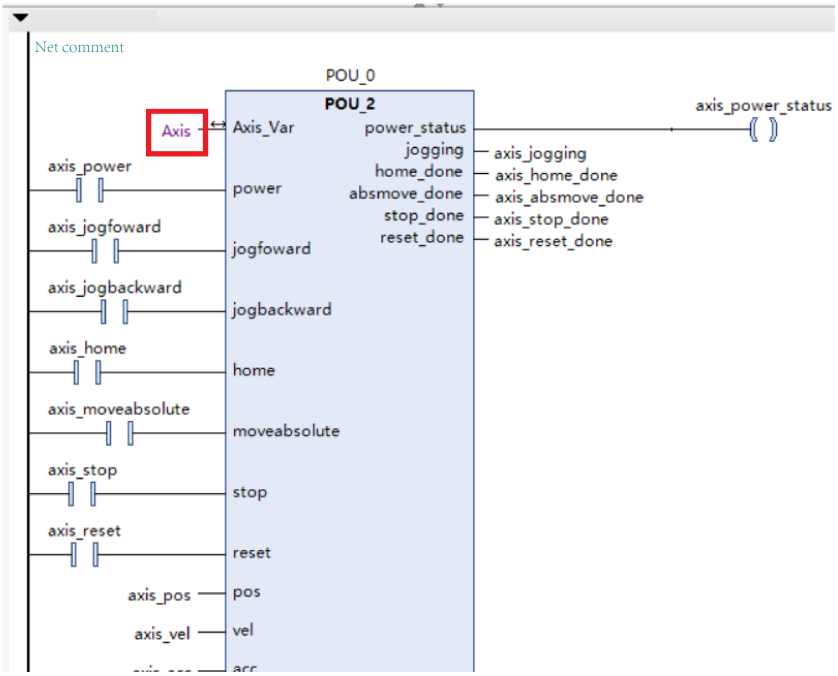


e. Add the FB function block to the newly created POU.

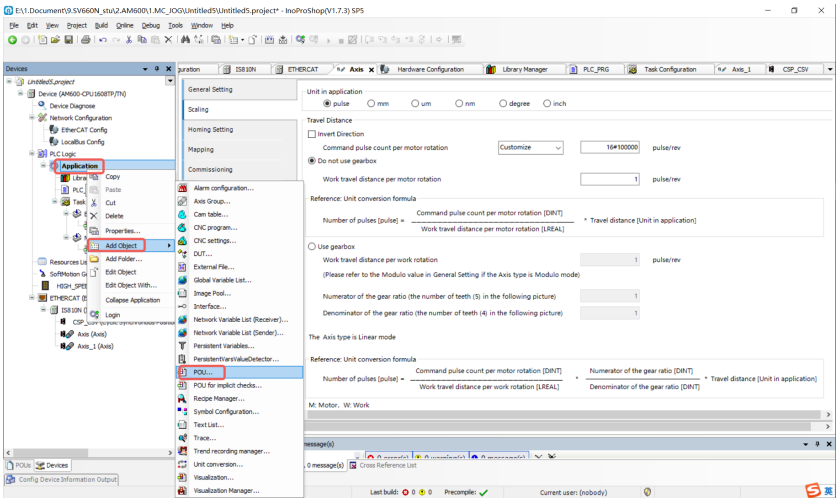


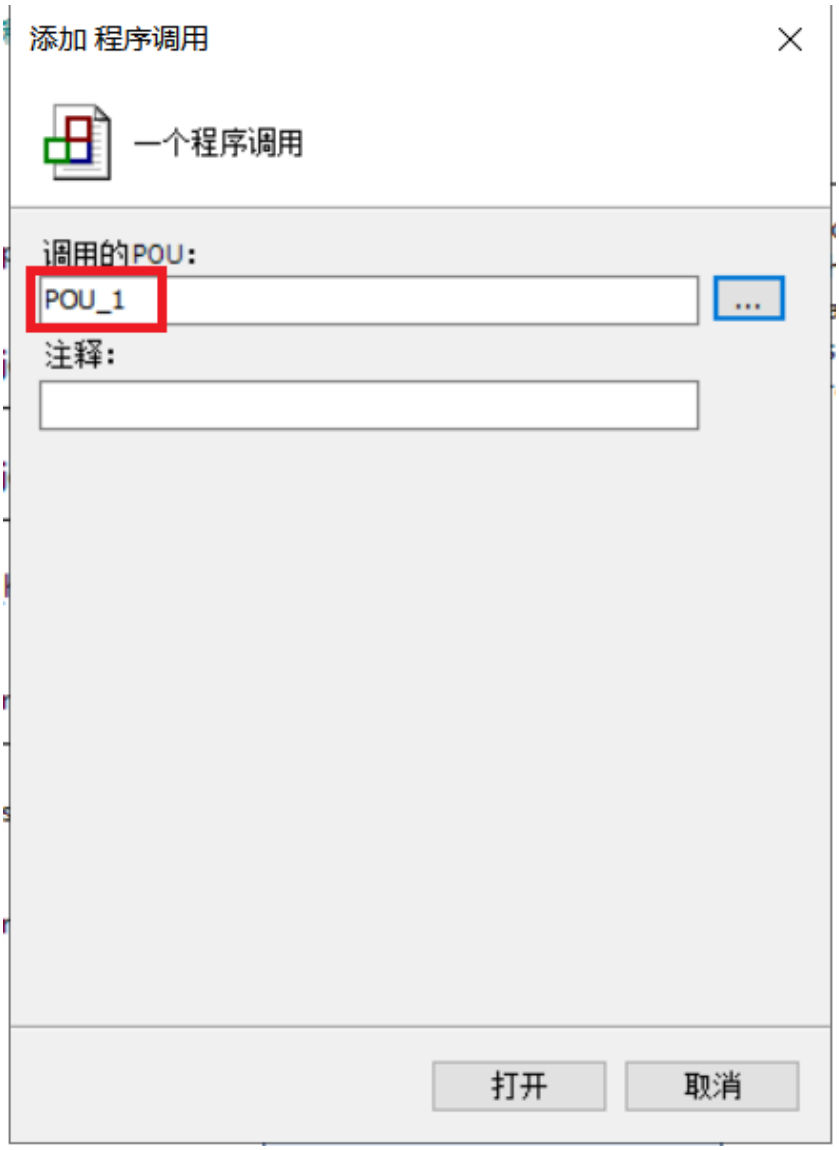
f. Add a program to Application to instantiate the previous FB into two function blocks, which are bound to the two axes respectively.


Add POU
Create a new POU (Program Organization Unit)
Name:
POU
Type
Program
Function Block
Extends:
Implements:
Access specifier:
Method implementation language:
Structured Text (ST)
Function
Return type:
Implementation language:
Ladder Logic Diagram (LD)
Add
Cancel

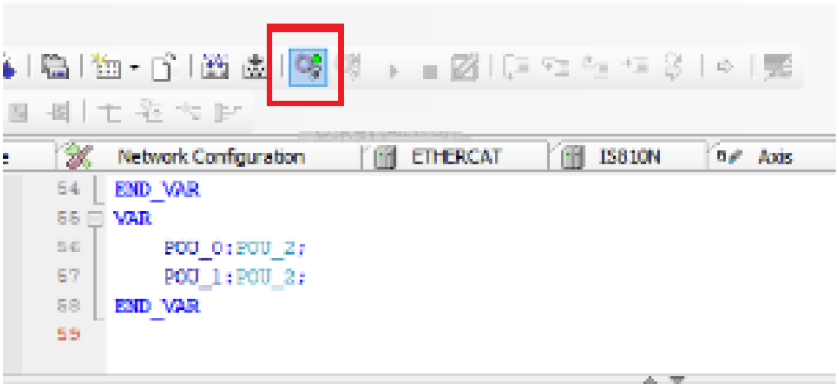


g. After calling this program in an EtherCAT task, you can run simple enable, jog, homing, and absolute position.





h. Click Log in to PLC, compile and upload the program to the PLC, and then you can manually operate the running bus.

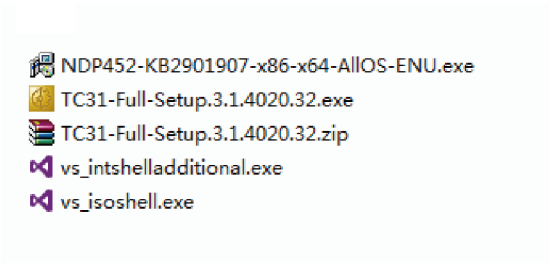


15.6.2 Beckhoff Controller as the Master

The following section describes how to configure the IS810N-INT servo drive with Beckhoff TwinCAT3 master used in CSP mode.

1. Installing the TwinCAT software

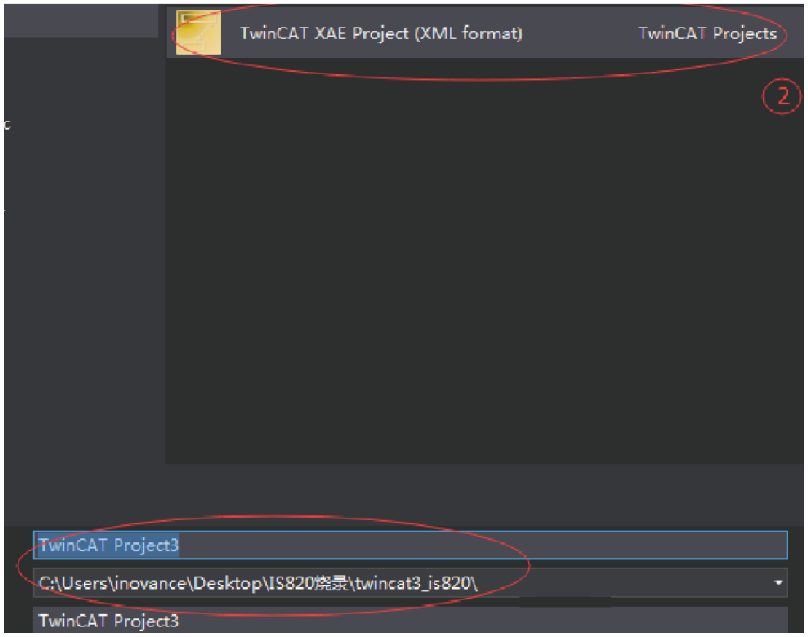
   You can obtain TwinCAT3 software at Beckhoff official website, which supports win7 32-bit system or win7 64-bit system (this example takes a 32-bit system as an example).



Note

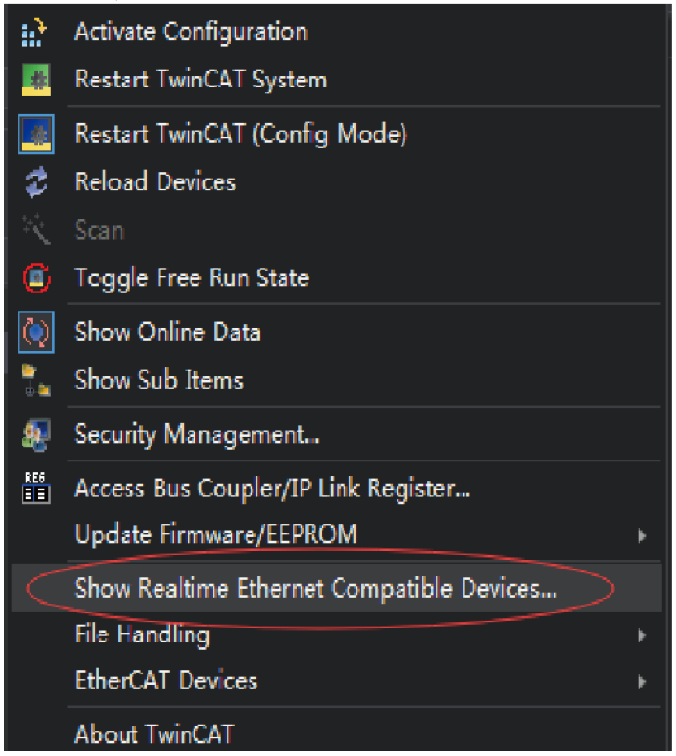
A Fast Ethernet (FE) card with Intel chip must be used in the case of direct drive by a PC. If the network card of other brands is used, the EtherCAT communication may fail.

2. Copy the IS810N-INT EtherCAT configuration file (Ino_MultiAxesDrive_ECAT_V0.10.xml) of SV820N to the TwinCAT installation directory: TwinCAT\3.1\Config\Io\EtherCAT.
3. Open Visual studio, and create a New Twincat3 Project.

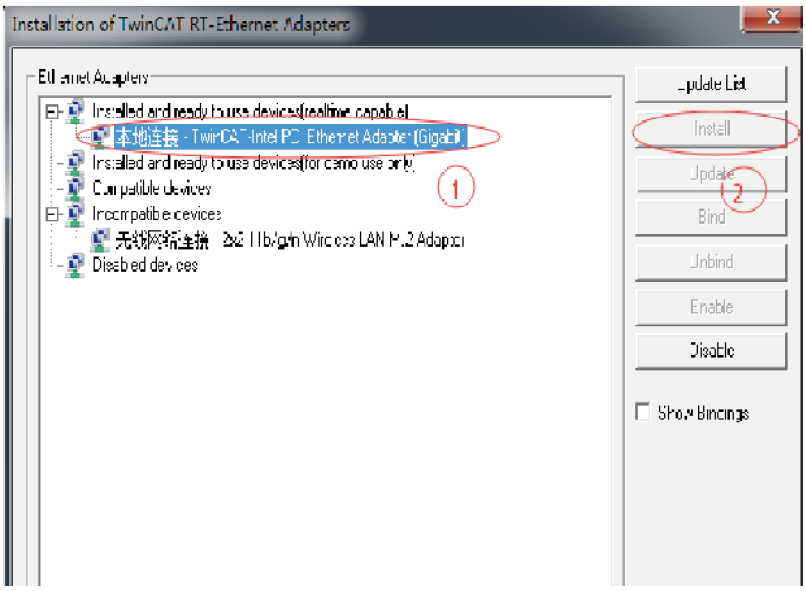


4. Install the TwinCAT network adapter driver.

   a. Go to **TWINCAT** > **Show Real Time EtherNet Compatible Devices**. Select the local connection under **Incompatible devices**, and then click **Install**.

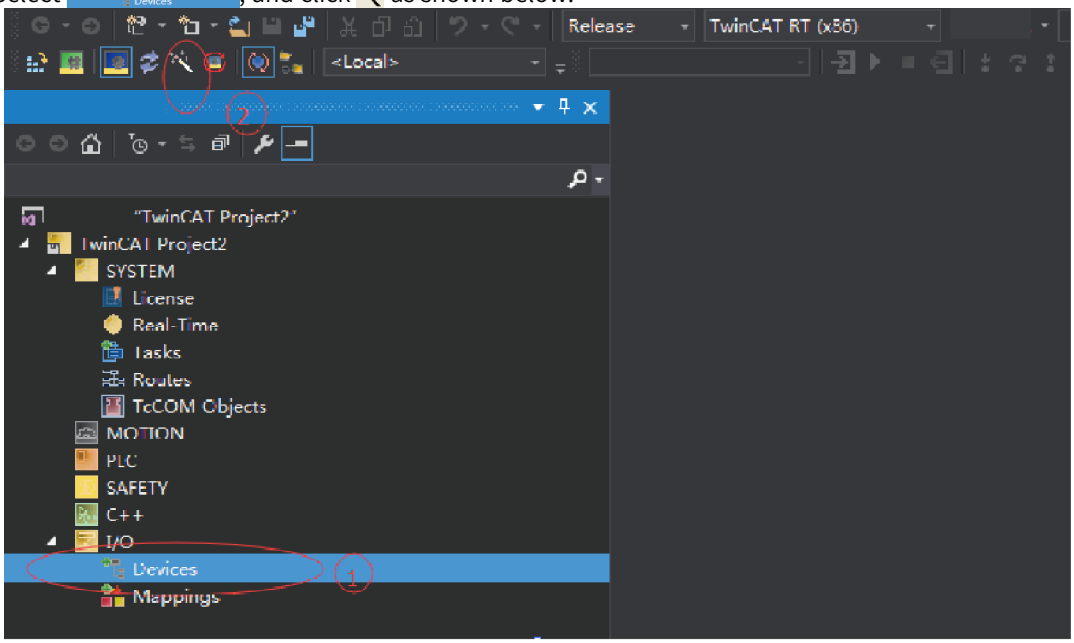


   b. After installation is done, the network adapter installed will be displayed under **Installed and ready to use devices(realtime capable)**.

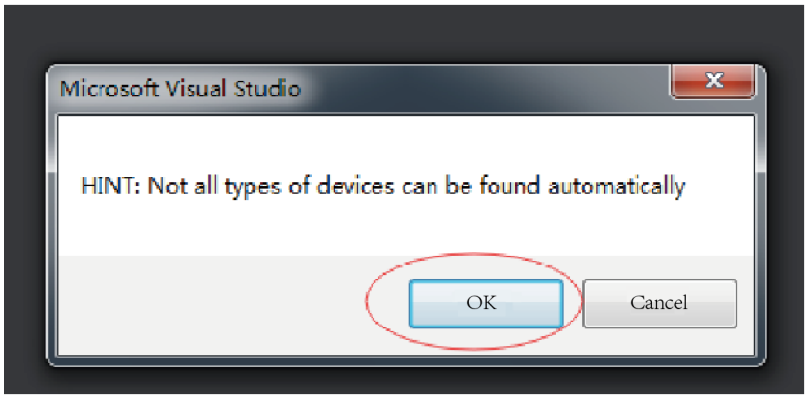


5. Search for devices.

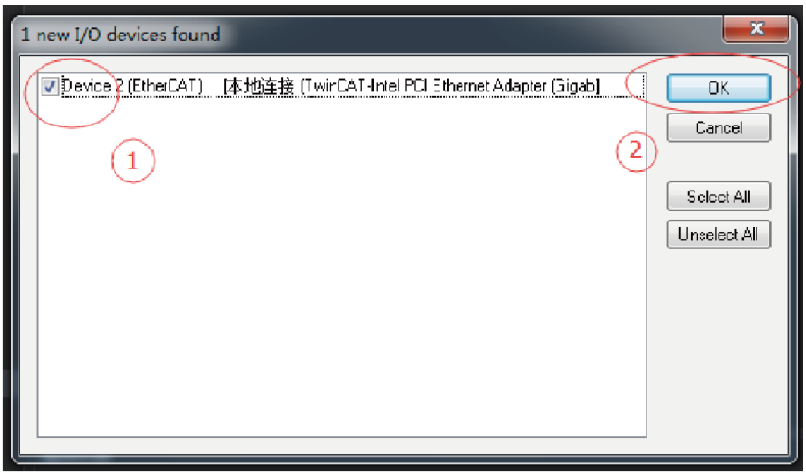
a. Select , and click as shown below.



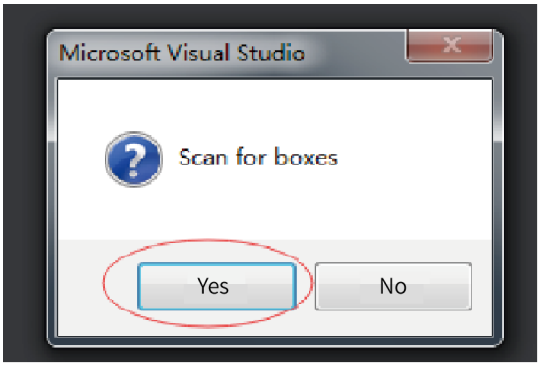
b. Click **OK**.



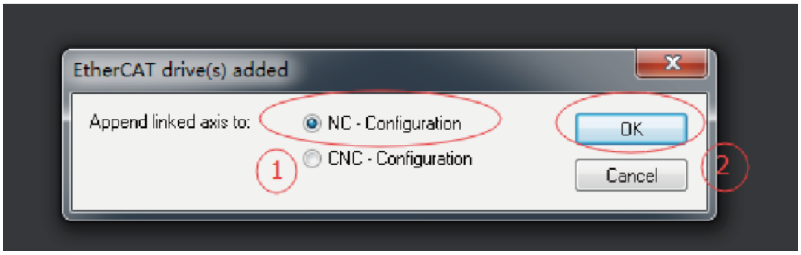
c. Click **OK**.



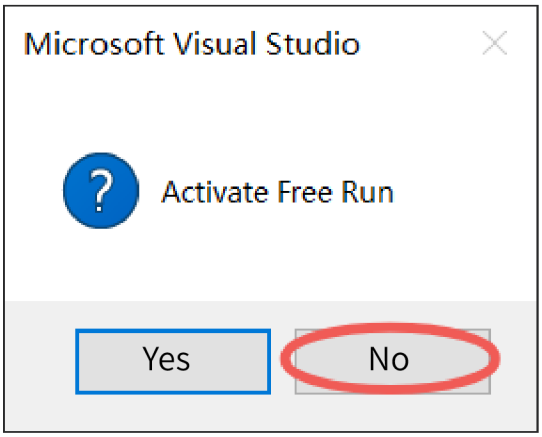
d. Click **OK**.



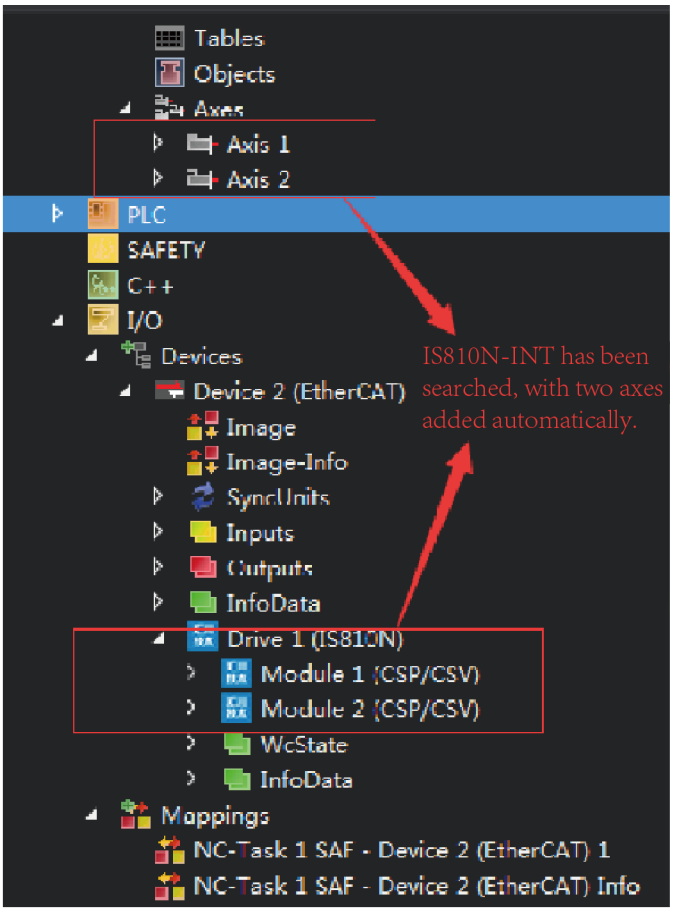
e. Click **OK**.



f. Click **Cancel**.



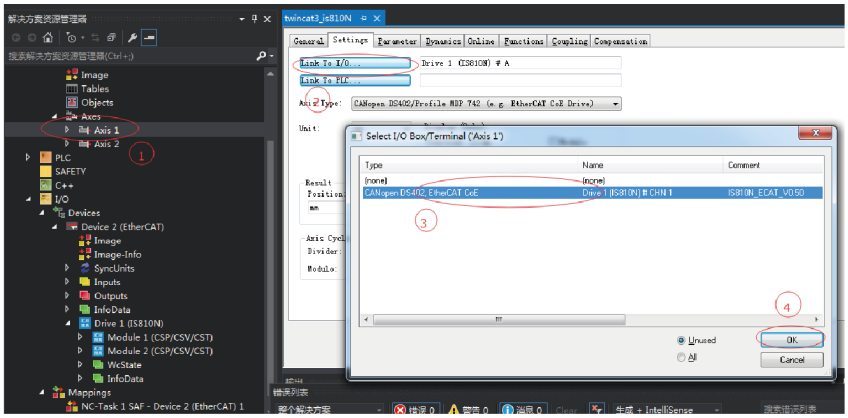
g. The equipment search is completed, as shown in the following:



6. Configure PDO contents

To take implementing CSP (position) + CSV (speed) + CST (torque) mode as an example:

Quickly select a running mode in **Slots**.



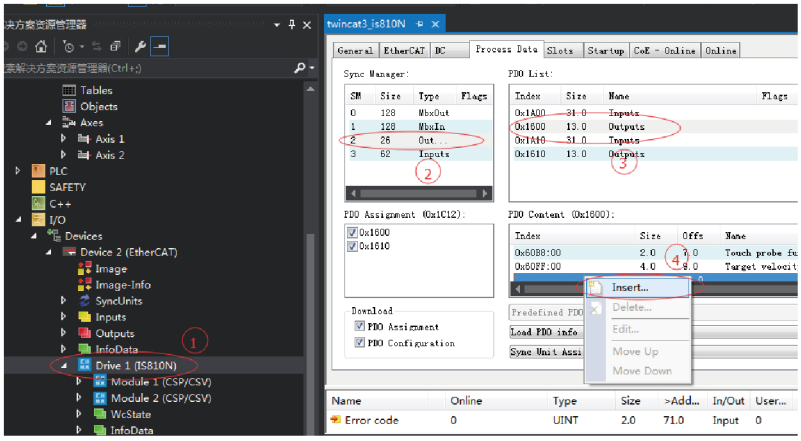
Note

Attention: If anything is changed here, then the axis must be reconnected to the device. Otherwise, the bus cannot be started.

a. Configure RPDO: If you use two axes, check 0x1600 and 0x1610.

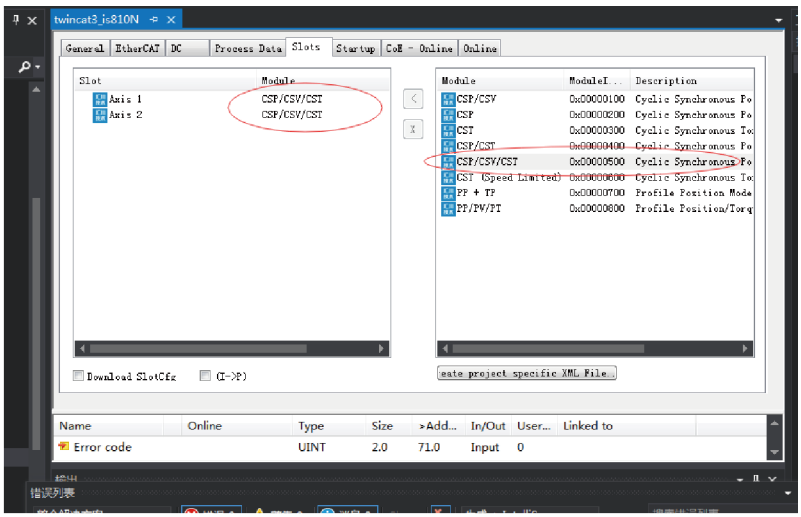
b. The procedures for configuring RPDO are as follows:

If the current PDO meets your requirements, you do not need to change it, otherwise you need to simply change the PDO list to suit your mode. To modify the PDO, right-click on the PDO Content window, click Delete to delete the redundant PDO or click Insert to add the PDO needed.

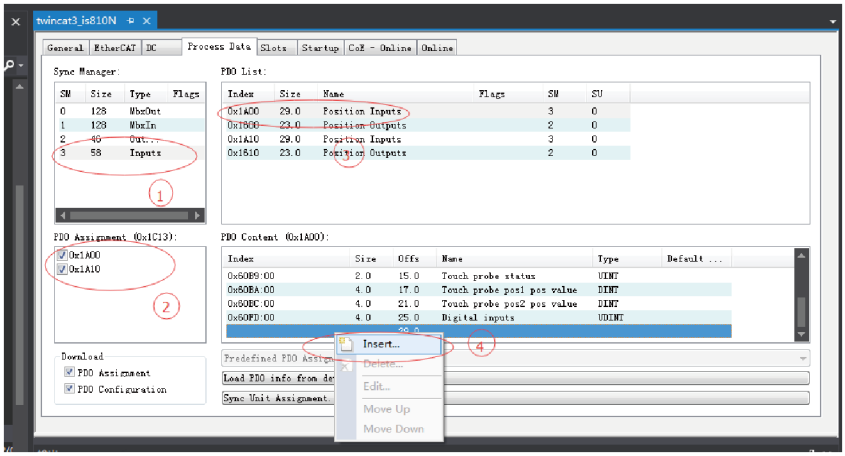


c. To take implementing CSP (position) + CSV (speed) + CST (torque) mode as an example:
Configure TPDO: If two axes are used, check 0x1A00 and 0x1A10 for both.

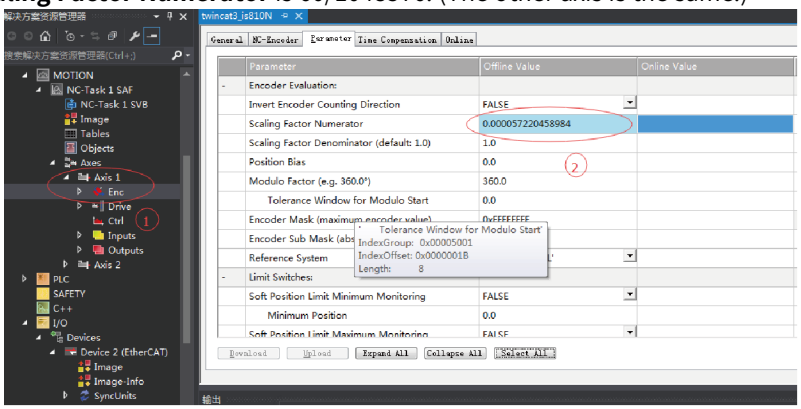
The procedures for configuring RPDO are as follows:



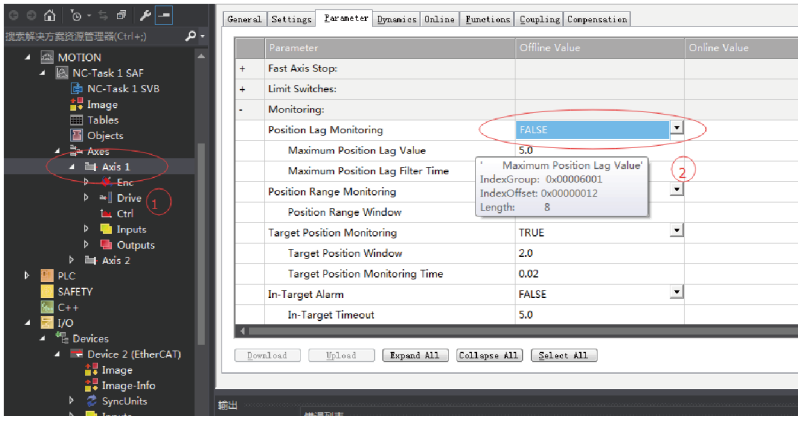
1). If the current PDO meets your requirements, you do not need to change it, otherwise you need to simply change the PDO list to suit your mode. To modify the PDO, right-click on the PDO Content window, click Delete to delete the redundant PDO or click Insert to add the PDO needed.



2). Click **Axis 1** in **Axes**, select **Parameter** and set the scaling parameter of the device axis. In this example, set the required movement unit 60 mm per revolution of the servo motor, and the value of **Scaling Factor Numerator** is 60/1048576. (The other axis is the same.)

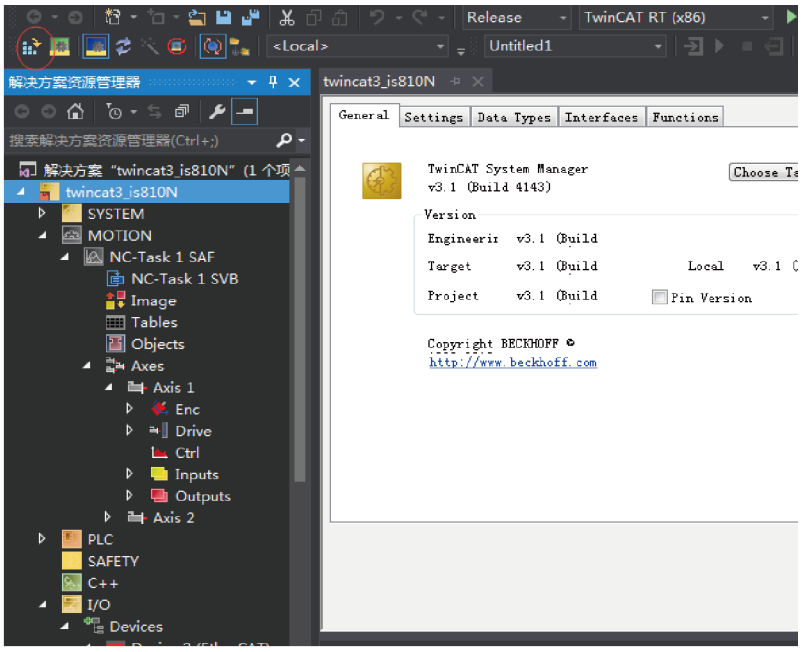


3). Click **Axis 1** in **Axes**, select **Parameter**, and hide the system deviation temporarily (same as other axes).

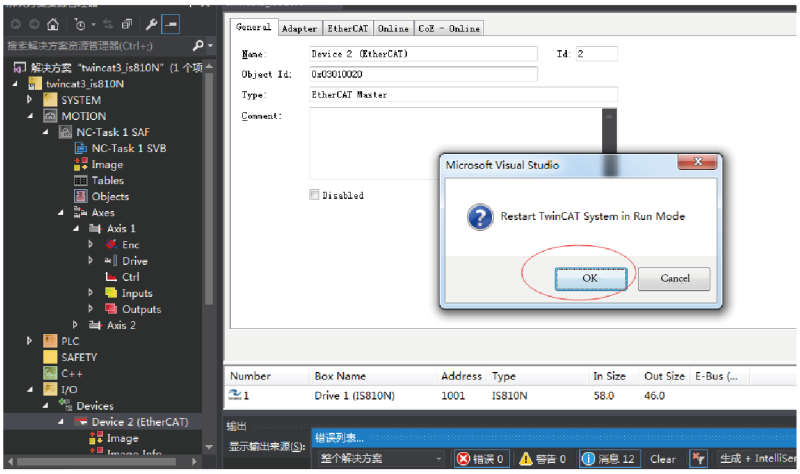


7. Activate the configuration and switch to the running mode.

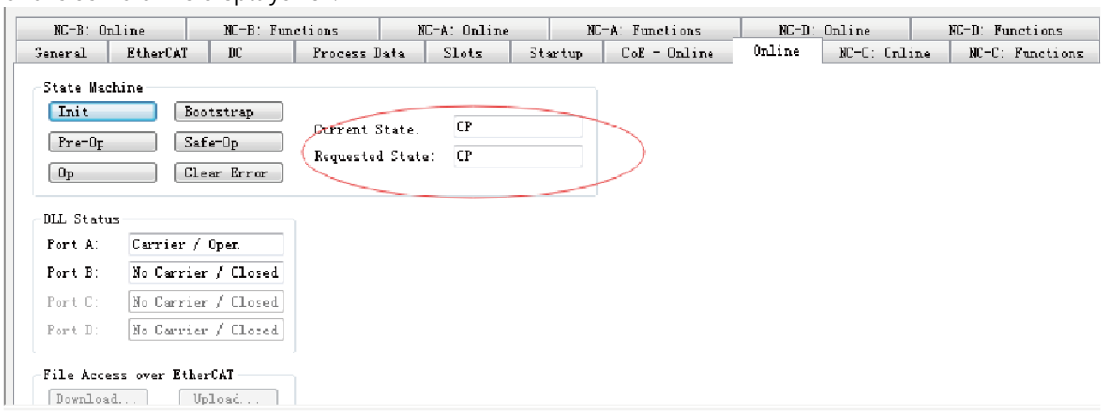
a. Click " ".



b. Click **OK**.

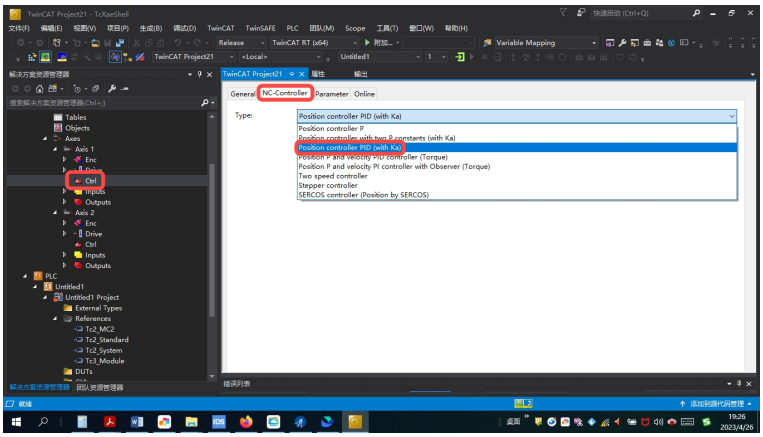


c. On the Online interface, you can view that the current state is OP, and the 2nd LED on the keypad of the servo drive displays "8".



8. Servo drive controlled through NC axis or PLC

- Setting the control type



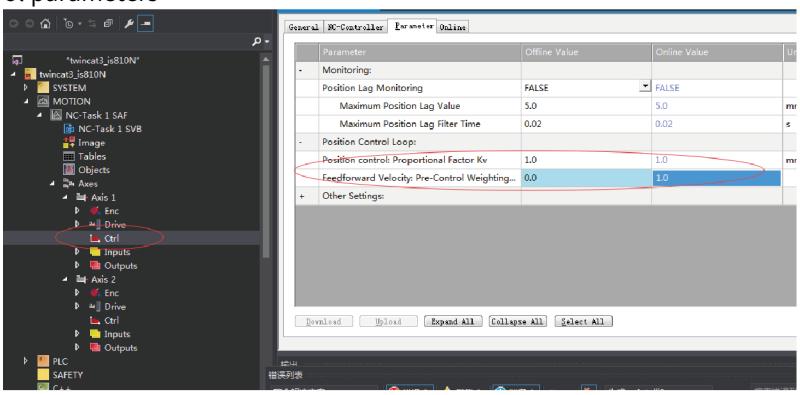
The PID types of the control loop are shown in the following table.

Control loop	mode	PID type
Position loop: servo drive Speed loop: servo drive	Drive: position mode	Position Controller P
Position loop: TWinCAT NC Speed loop: servo drive	Drive: Velocity mode	Position Controller PID (With Ka)

Note

The TWinCAT NC controller can also implement the speed loop, and sends the target torque to the drive in each cycle. This method, however, actually increases the CPU and network load, and is not recommended.

- Setting control parameters



Adjust the proportion of the position loop based on actual response.

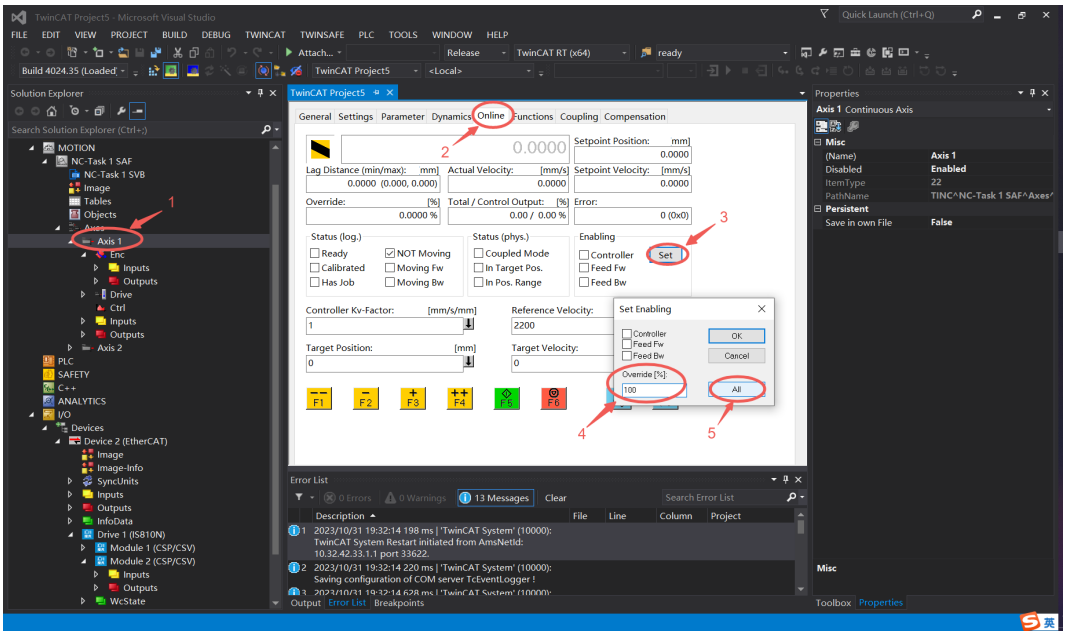
Position control: Proportional Factor Kv	1.0

Adjust the speed feedforward coefficient based on actual response.

Feedforward Velocity: Pre-Control Weighting [0.0 ...	0.0

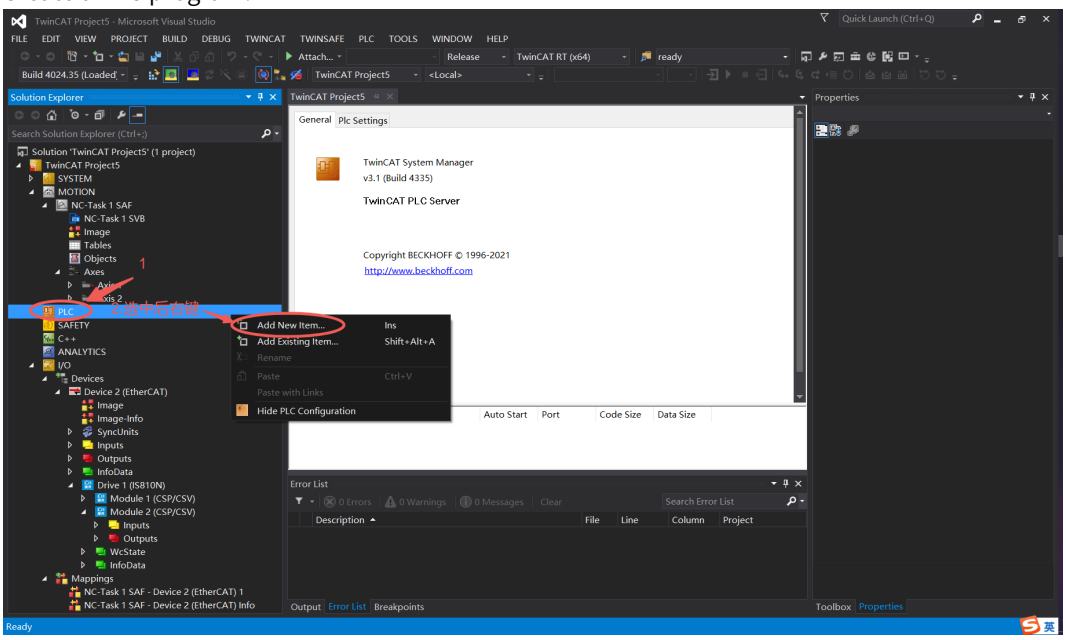
a. Jogging of NC axis

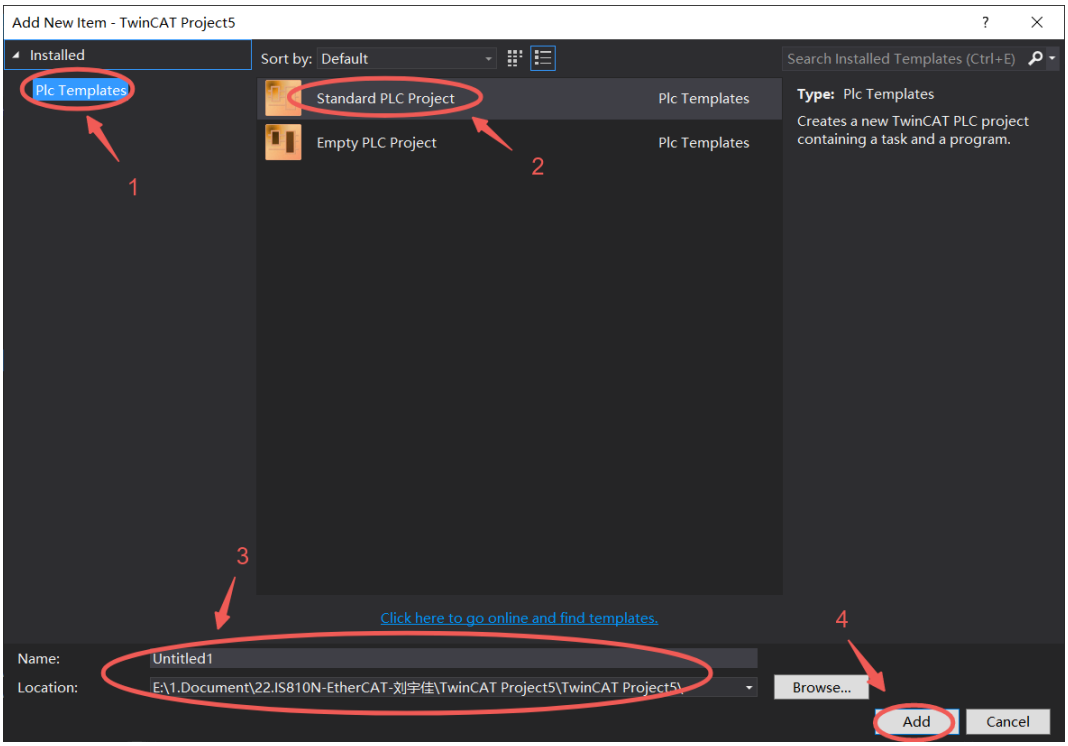
1). Click Set to display a dialog box and then click All to enable the servo drive. Perform jogging through F1 to F4.



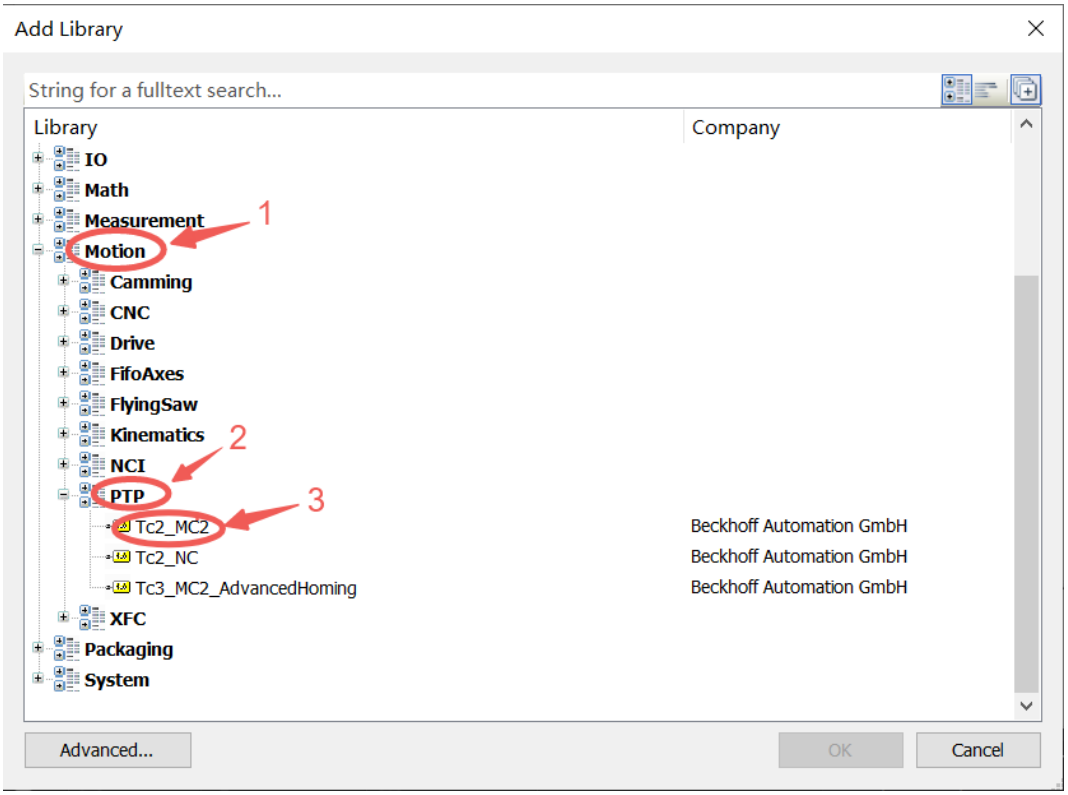
2). PLC program.

3). Create a PLC program.

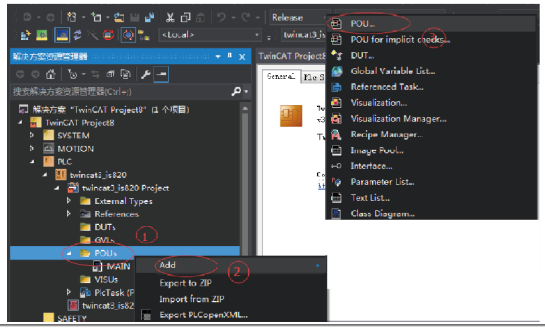


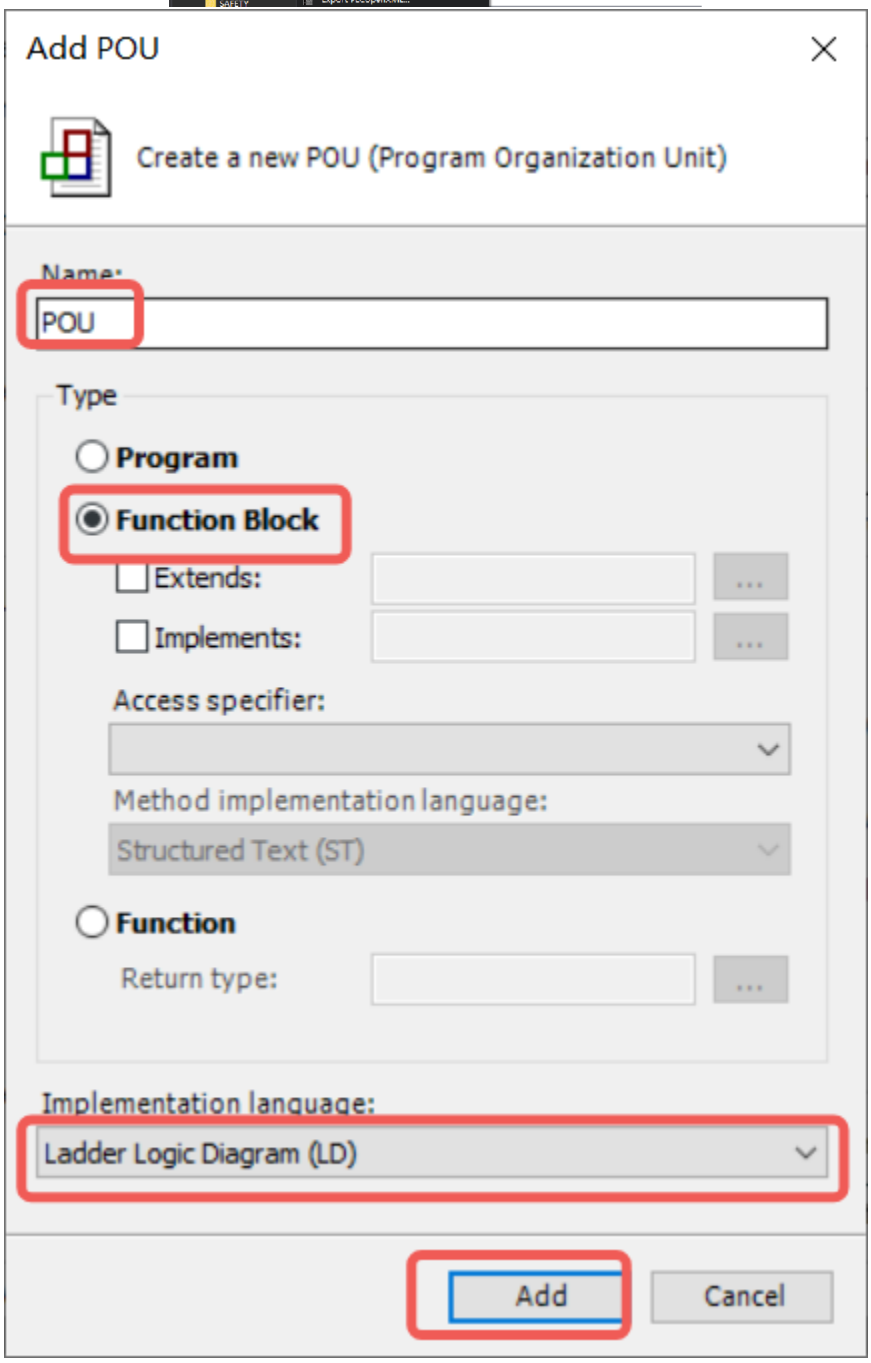


Add a motion control library for calling the motion control function blocks.

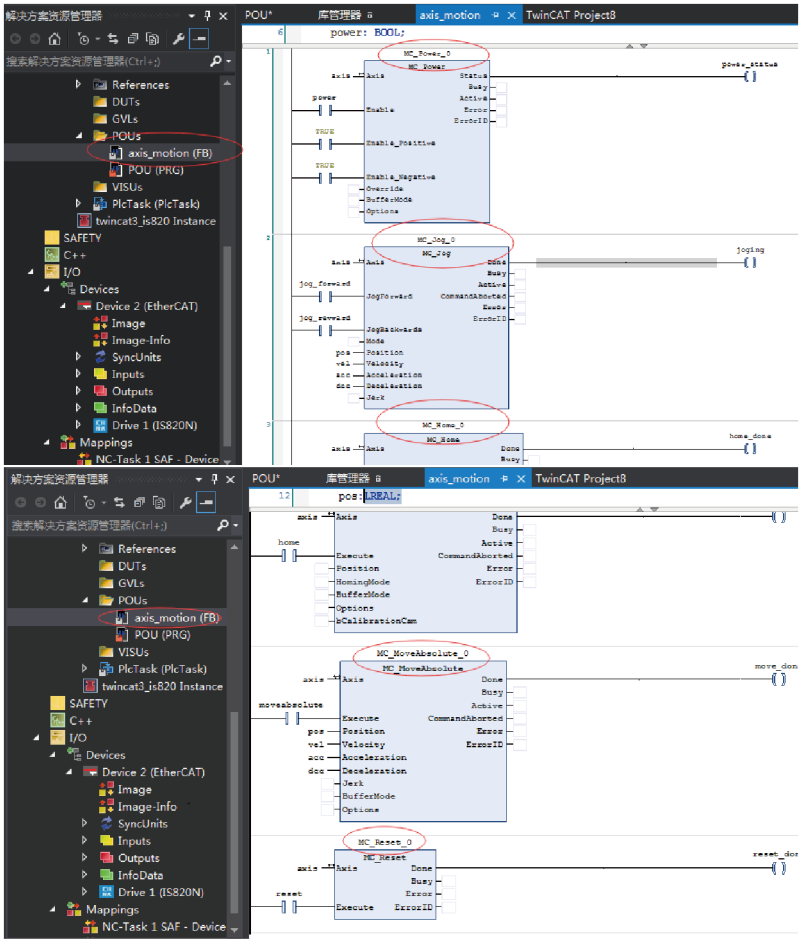


Create a new POU.



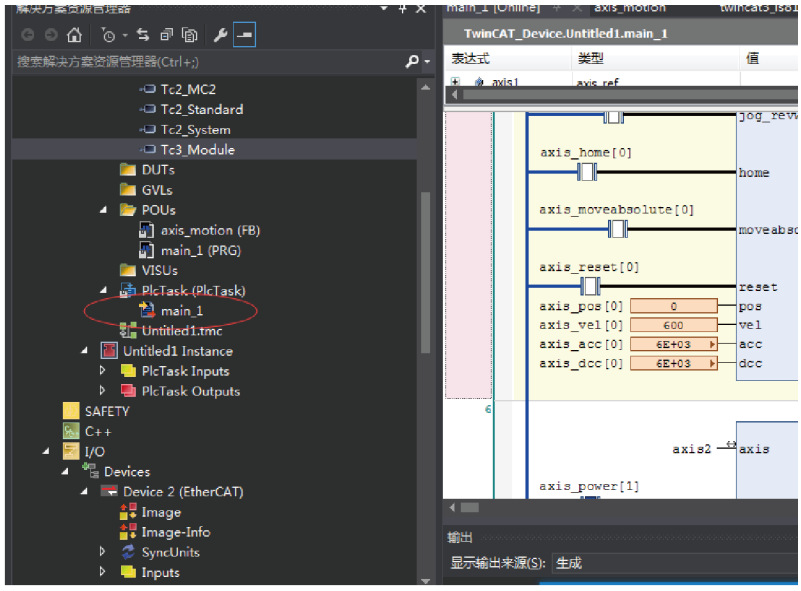


4). Create a new **FB** and add **MC_power**, **MC_jog**, **MC_home**, **MC_absolute** and **MC_reset** to **FB**.

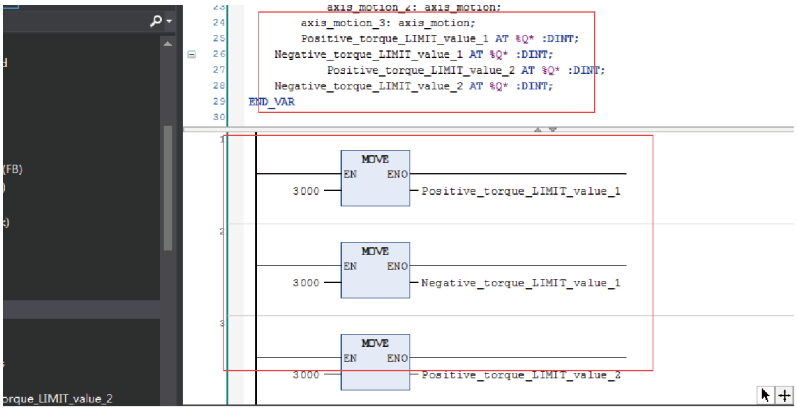


Call **axis_motion** in **main**.

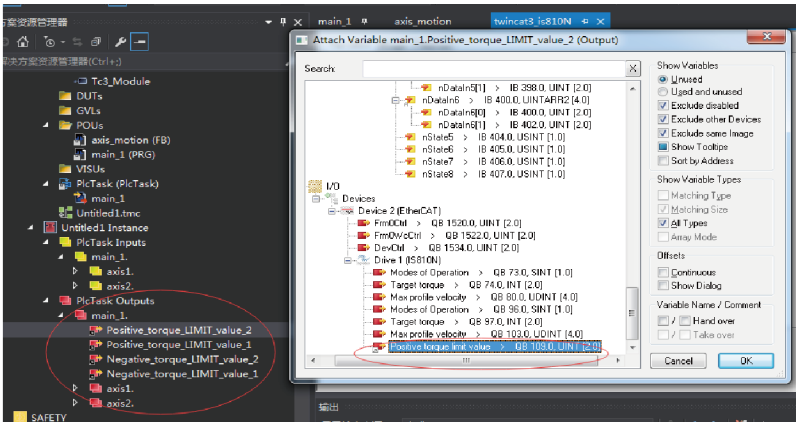
Call the program in **PLCTASK**.



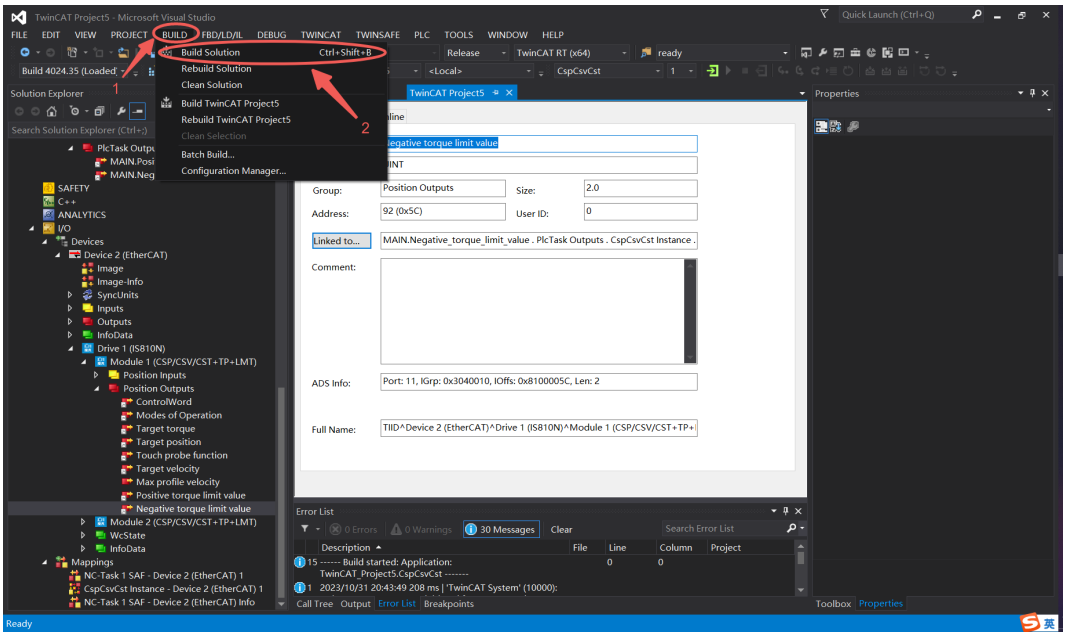
Because there are positive and negative maximum torque limits 60E1 and 60E0 in the CSP (position) +CSV (velocity) +CST (torque) mode, initial values must be assigned to them.

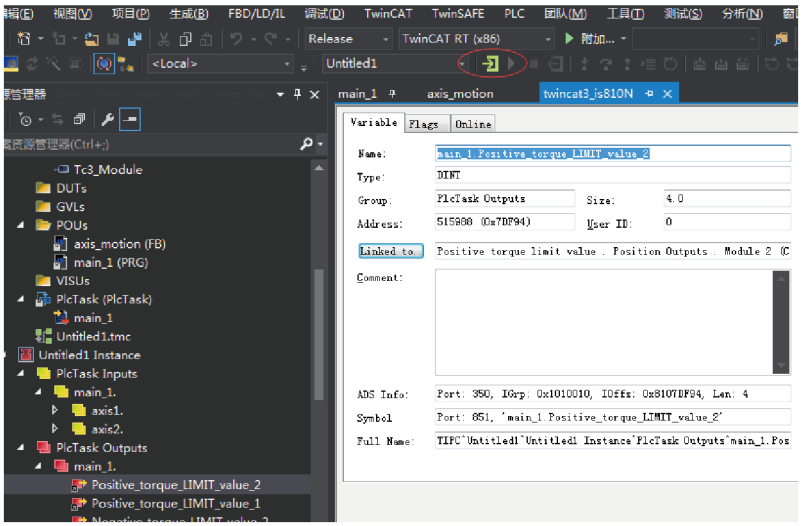


After compilation, perform variable link to 60E0 and 60E1.

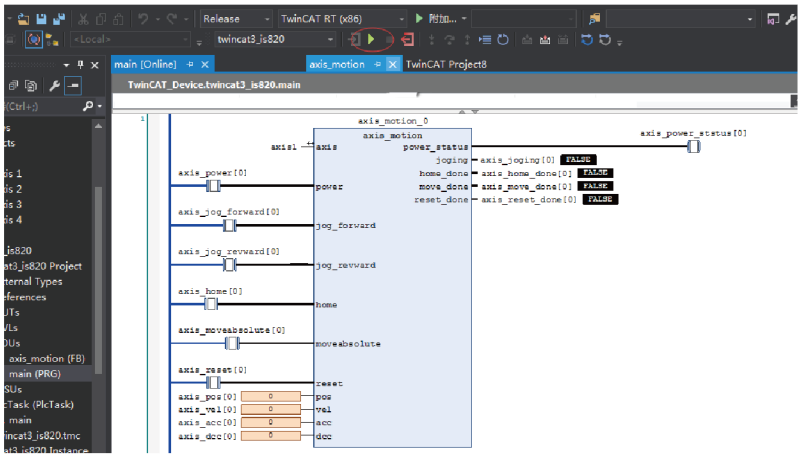


Compile the program. If there is no fault, configuration can be activated, and then log onto the PLC.



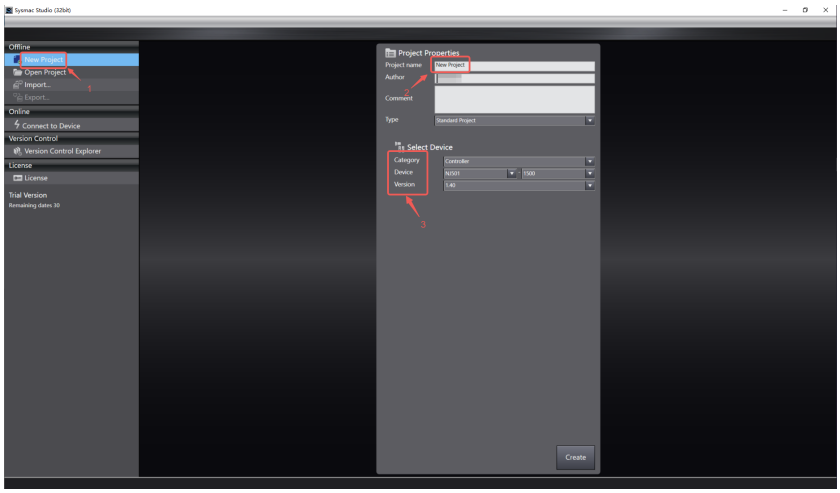


Click Run PLC to start the servo running via the bus.



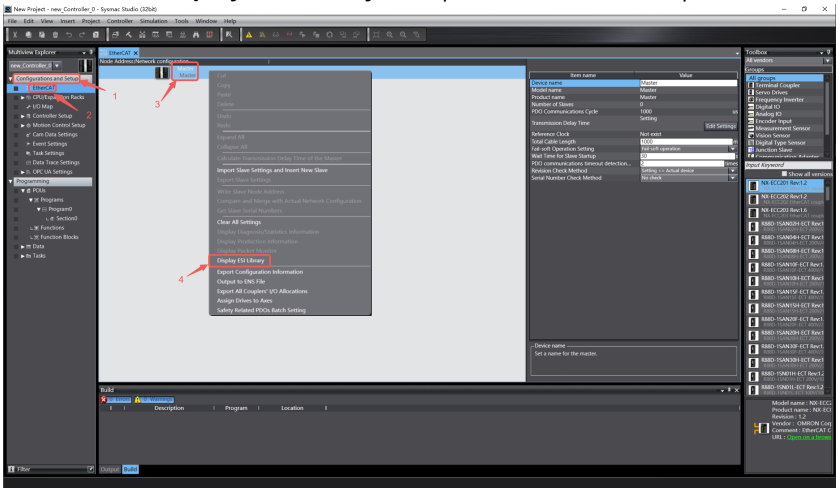
15.6.3 IS810N-INT with Omron EtherCAT series PLC background software configuration

1. Create a project and modify the project name and the model and version information of the controller. Note: The model and version information of the controller can be obtained at the nameplate of the controller.



2. Network configuration

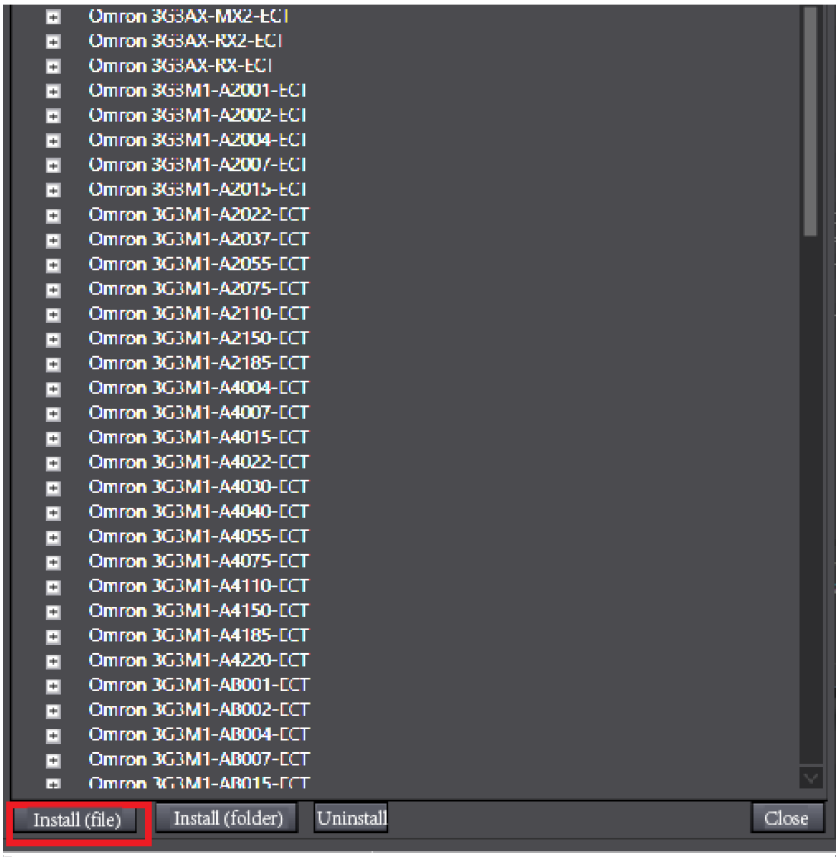
a. After creating a project, select the master icon on the EtherCAT device interface, and right-click to open the menu bar. Click **Display ESI Library** to import the device description file.



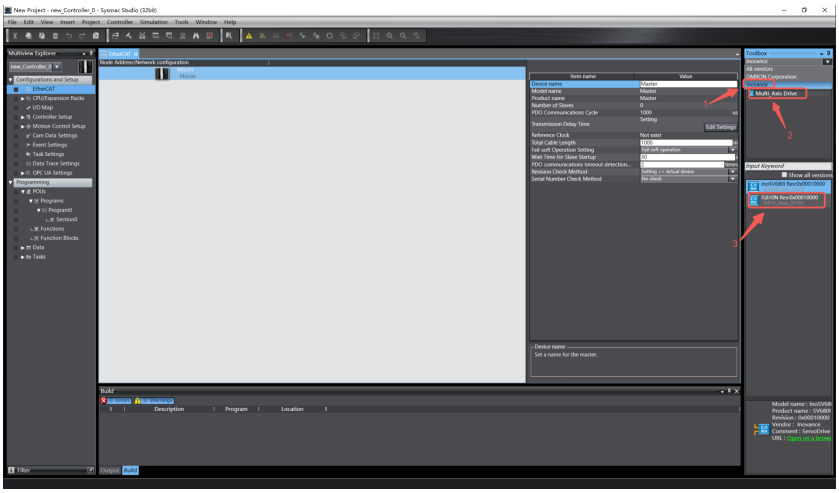
Note

Please download the latest XML file of IS810N-INT from Inovance's official website.

b. In the ESI library list, click Install (File) below, open the XML file of IS810N in the pop-up browse box, and the software will prompt that the installation is successful.

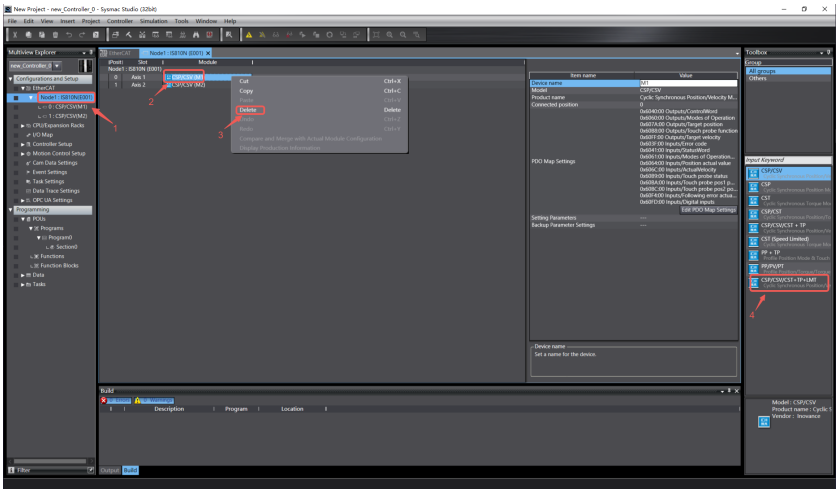


c. At the top right of the software, click All Suppliers and select "Multi-Axis Servo drive" in the menu below. Next, double click IS810N in the device list to add the device to the configuration list. (If the network is already configured, skip to this step and use the online upload configuration.)

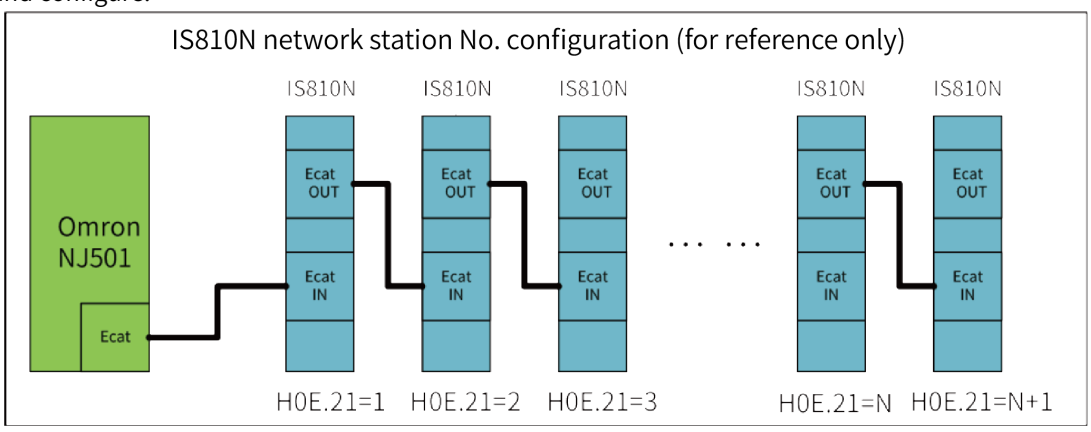


IS810N-INT has made an ease-of-use plan for the PDO list of each axis. Select the mode you run according to your needs. You can select a certain mode from "CSP/CSV + TP, CSP/CST/CSV + TP, PP + TP, PP\ PV\ PT + TP". The XML file will be combined with the PDO list required by the controller to select the current mode for you. The existing slot configuration needs to be deleted before inserting.

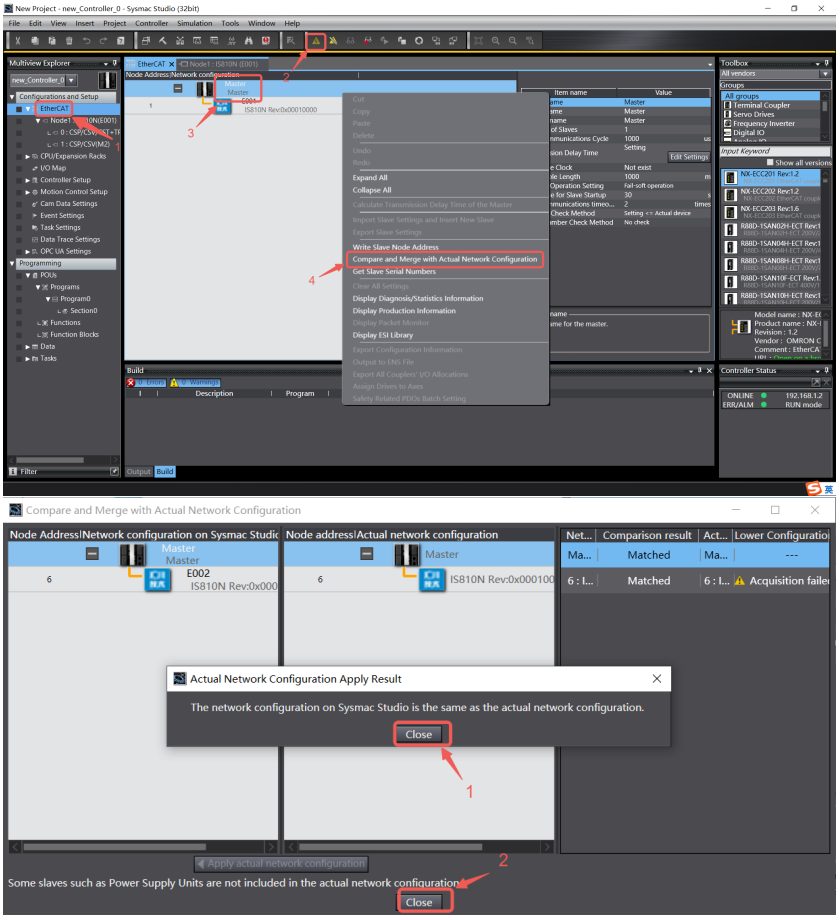
All the axes in this application example are selected with CSP/CSV+TP mode.



d. For Omron NJ/NX series PLC, the EtherCAT communication site address needs to be set through H0E.21. After the setting is completed, it needs to be powered on again. It is recommended that the setting be set according to the actual physical connection sequence, which is easier to manage and configure.



e. Configure the master modification as online mode, and compare and merge with the physical network configuration in the menu bar. Configure the actual physical network to the network configuration of Sysmac software.



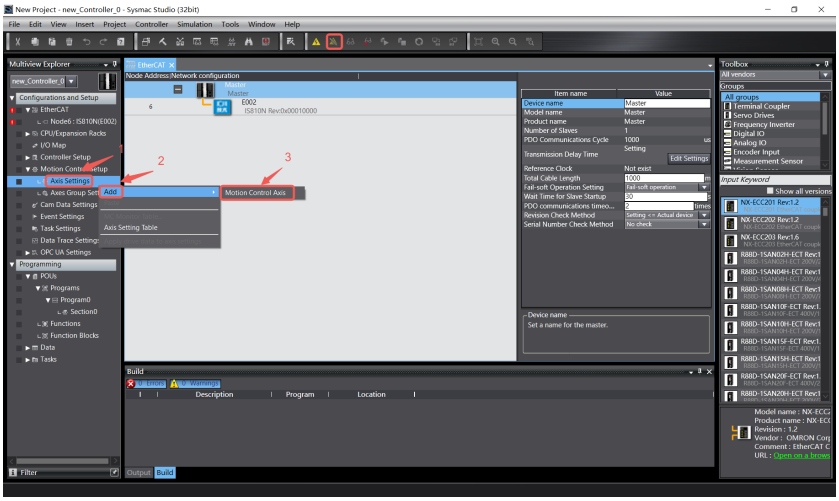
Note

If it shows that the acquisition failed, just click Apply directly.

3. Communication data configuration

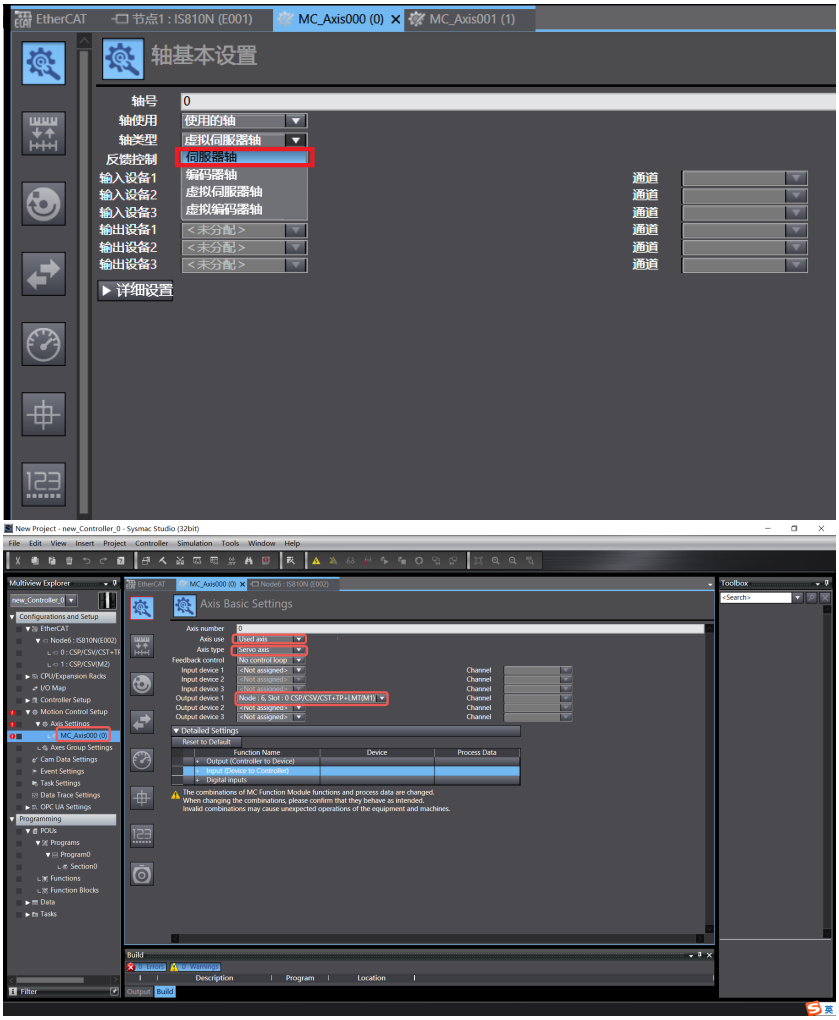
a. Motion control axis settings

Exit the online mode. Add **Axis Settings** in **Motion Control Setup**. Double-click **MC_Axis000** and configure the IS810N-INT device at the corresponding site in the corresponding axis setting interface, as shown in the following figure. Among them, "MC _ Axis000" can be renamed (Chinese is also available), and this naming representative will be used in the NJ program to control the IS810N-INT servo axis.



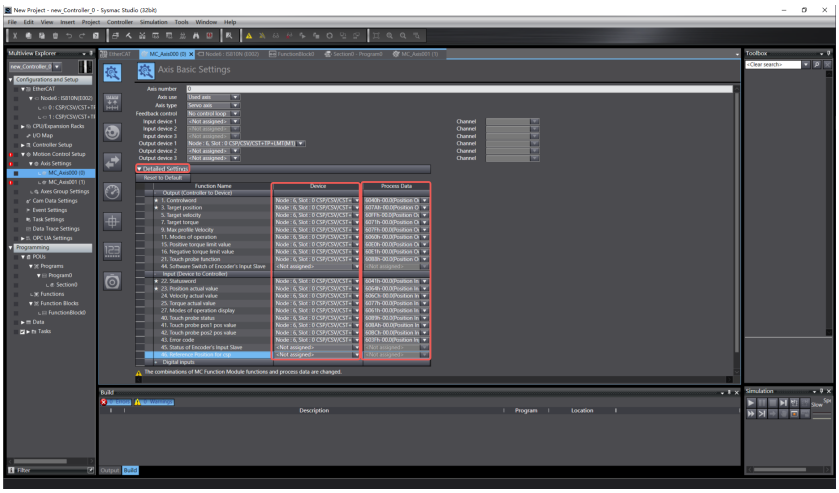
b. Motion control axis settings

Perform detailed configurations for the axis parameters: Every axis under each slave need to be configured in the same configuration process. If the number of axes used is less than 2, you only need to set the H02.00 of the IS810N-INT drive to 255 to shield this axis, and the axes used normally can be configured normally. The following example shows how to configure one of the axes.



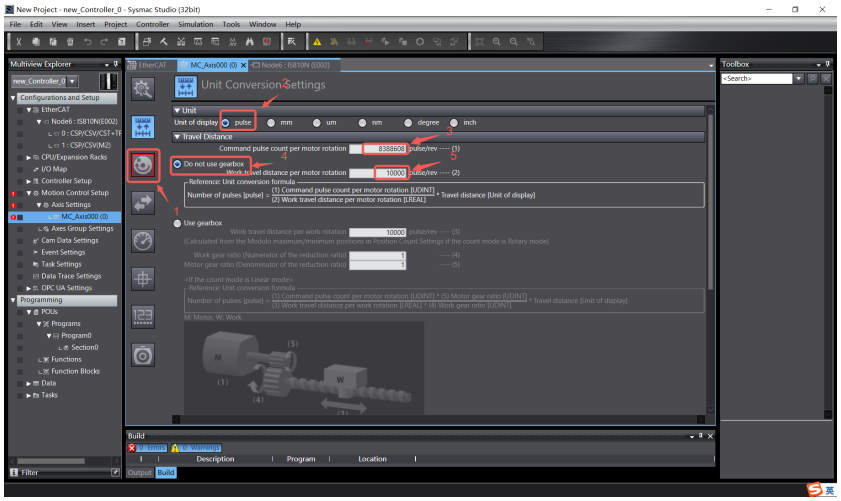
c. Configuration of mapping variables in servo axis communication

Click Detailed Settings to expand parameter configuration. Please select the corresponding process data for mapping configuration according to the input and output function names, and check carefully. As restricted by configurations of Omron software tool, axis configuration for the drive needs to be performed manually. The following is a configuration case of Axis 2.

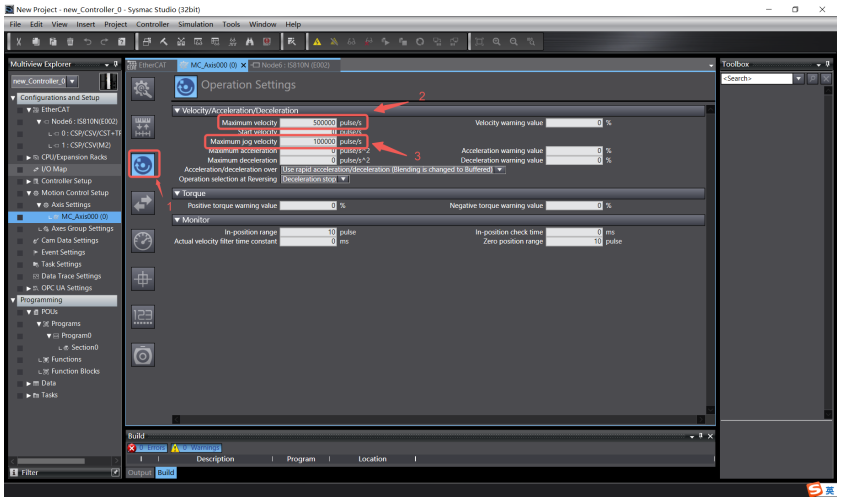


d. Servo axis parameter configurations

- Unit conversion setting
  IS810N-INT is paired with a 23BIT encoder. One motor rotation is 8388608 pulses, which needs to be set correctly. The working stroke of the motor for one revolution is set here to 10,000 pulses. This option actually performs electronic gear conversion on the host controller, and there is no need to set the conversion ratio inside the servo.



- Operation settings
  After the electronic gear ratio is set, an alarm will be reported upon the maximum speed, requiring a reset of parameters. Set the unit to the converted speed unit. 10000 pulses/s represents 1 R/S (60 RPM) of the actual servo motor. Set the maximum speed and jogging speed according to actual running. If there is no special requirement, other parameters can be left unset.

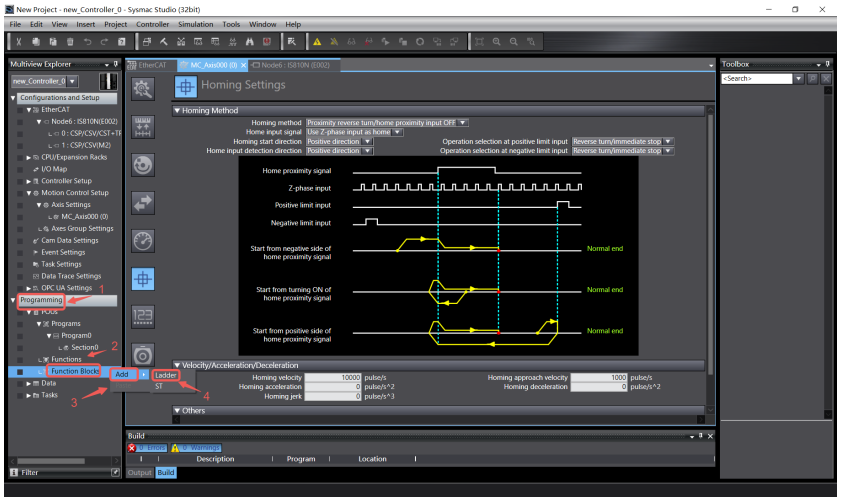


- Setting the homing method
  Pay high attention to the setting of the homing mode because it involves the cooperation between the servo drive and the host controller. Set the homing mode according to the following table.

Description of NJ Software	Servo Drive Function	Terminal Configuration
Home proximity signal	Home switch (FUN31)	DI9
External home input	Probe 1 (FUN38)	DI8
Phase Z signal input	Motor encoder phase Z signal	N/A
Positive limit input	P-OT (FUN14)	DI1
Negative limit input	N-OT (FUN15)	DI2

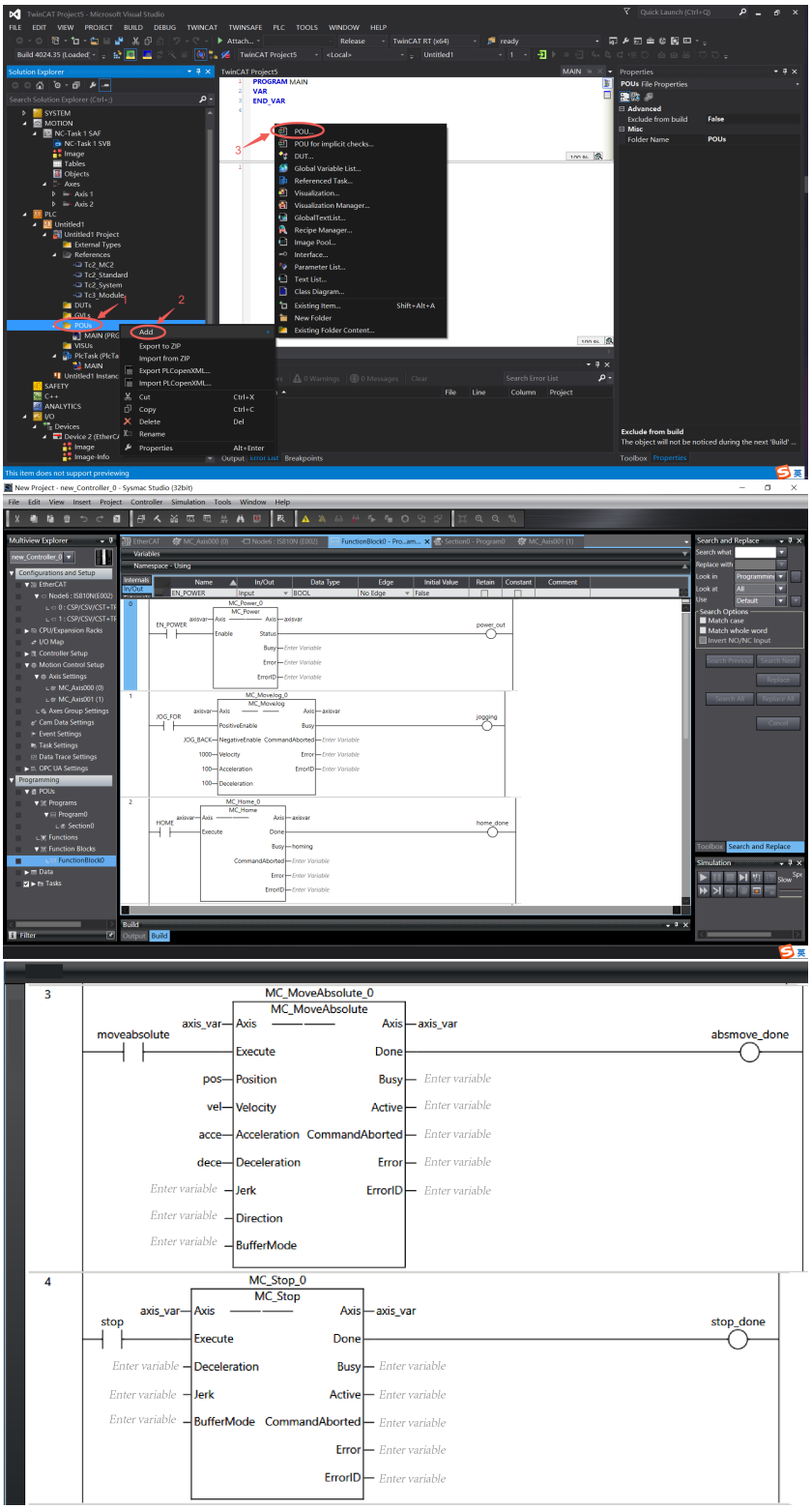
Note

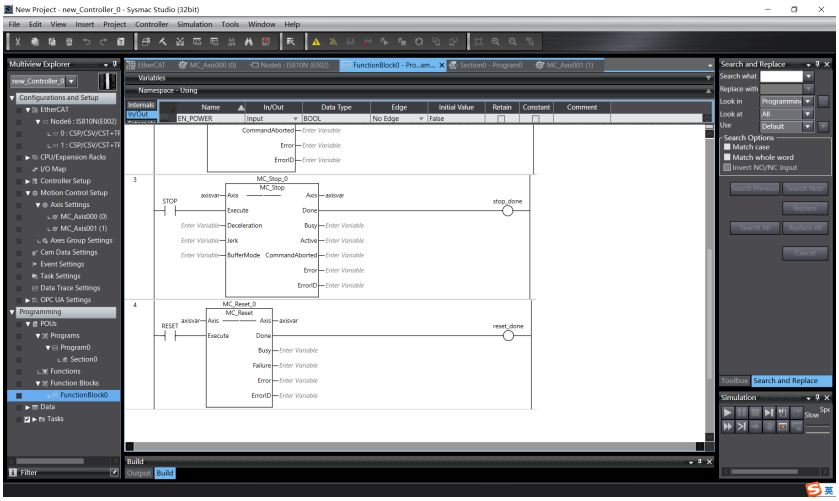
Phase Z signal and external home switch signal cannot be used at the same time.



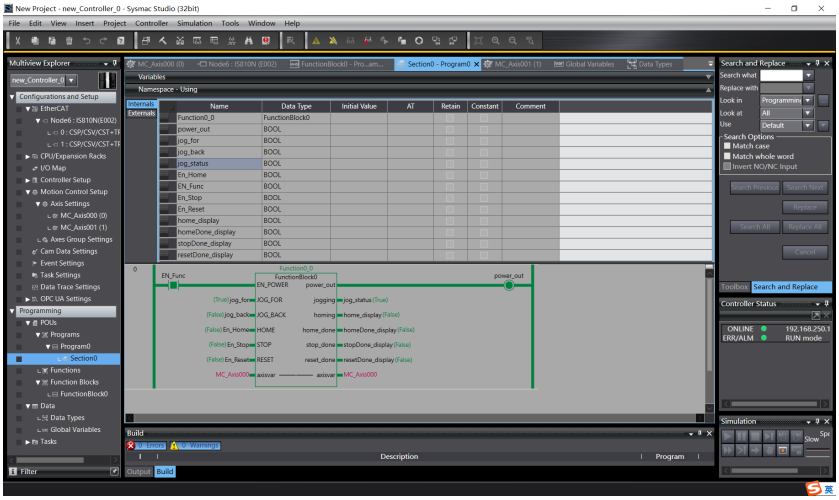
4. Program-controlled operation

a. After configurations are done, you can control the servo drive operations through the PLC program. For easier programming, the 2 axes are first packaged with a function block. Includes MC _ Power, MC _ MoveAbsolute, MC _ MoveJog, MC _ Home, MC _ Reset, and MC _ Stop.


3
MC_MoveAbsolute_0
MC_MoveAbsolute
moveabsolute
axis_var
Axis
Execute
pos
Position
vel
Velocity
acce
Acceleration
dece
Deceleration
Enter variable
Jerk
Enter variable
Direction
Enter variable
BufferMode
Axis
axis_var
Done
Busy
Enter variable
Active
Enter variable
CommandAborted
Enter variable
Error
Enter variable
ErrorID
Enter variable
absmove_done
4
MC_Stop_0
MC_Stop
stop
axis_var
Axis
Execute
Enter variable
Deceleration
Enter variable
Jerk
Enter variable
BufferMode
Axis
axis_var
Done
Busy
Enter variable
Active
Enter variable
CommandAborted
Enter variable
Error
Enter variable
ErrorID
Enter variable
stop_done



b. In section0, instantiate the function block just completed and bind it to each axis. After that, you can make the axis move through the bus.



c. After uploading the program to the PLC, set the axis _ power variable to True to enable the corresponding axis, and then set the axis _ jogfoward variable to True, and the axis can rotate.

15.6.4 IS810N-INT with AC801 to realize CSP mode operation

The following description takes Inovance AC801 controller as the master to introduce the communication settings of IS810N series servo drives.

For specific communication configuration procedures, see *"15.6.1 Cyclic Synchronous Position Mode with AM600" on page 330*.

16 Parameter List

The mapping relation between the parameter displayed on the keypad (in decimal) and the object dictionary operated by the host controller (in hexadecimal, "Index" and "Sub-index") is 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 only describes 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.

16.1 H00 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H00.00	2000-01h	Motor SN	0 to 65535	14000: Inovance 20-bit incremental encoder motor 14101: Inovance 23-bit absolute encoder motor	14101	-	UInt16	At stop	Upon the next power-on
H00.02	2000-03h	Customized No.	0.00 to 4294967295.00	Differentiates the customized MCU software version, which is not applicable to standard models.	0.00	-	UInt32	Unchangeable	-
H00.04	2000-05h	Encoder version	0.0 to 6553.5	Saved in the encoder and used to differentiate the encoder software version.	0.0	-	UInt16	Unchangeable	-
H00.05	2000-06h	Serial-type motor code	0 to 65535	Displays the code of the serial-type motor, which is determined by the motor model and unchangeable.	0	-	UInt16	Unchangeable	-
H00.06	2000-07h	FPGA customized SN	0.00 to 655.35	Differentiates the customized FPGA software version, which is not applicable to standard models.	0.00	-	UInt16	Unchangeable	-
H00.07	2000-08h	STO version	0.0 to 655.4	Display the software version number of STO function.	0.0	-	UInt16	Unchangeable	-
H00.08	2000-09h	Bus encoder type	0 to 65535	14100: Multi-turn absolute encoder; Others: Single-turn absolute encoder	0	-	UInt16	At stop	-
H00.09	2000-0Ah	Rated voltage	0: 220 V 1: 380 V	0：220V 1：380V	0	-	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H00.10	2000-0Bh	Rated power	0.01 kW–655.35 kW	-	0.75	kW	UInt16	At stop	Upon the next power-on
H00.11	2000-0Ch	Rated current	0.01 A to 655.35 A	-	4.70	A	UInt16	At stop	Upon the next power-on
H00.12	2000-0Dh	Rated torque	0.10N·m to 655.35N·m	-	2.39	N·m	UInt16	At stop	Upon the next power-on
H00.13	2000-0Eh	Max. torque	0.10N·m to 655.35N·m	-	7.16	N·m	UInt16	At stop	Upon the next power-on
H00.14	2000-0Fh	Rated speed	100rpm to 10000rpm	-	3000	rpm	UInt16	At stop	Upon the next power-on
H00.15	2000-10h	Maximum speed	100rpm to 10000rpm	-	6000	rpm	UInt16	At stop	Upon the next power-on
H00.16	2000-11h	Moment of inertia	0.01 kg·cm^2 to 655.35 kg·cm^2	-	1.30	kg·cm^2	UInt16	At stop	Upon the next power-on
H00.17	2000-12h	Number of PMSM pole pairs	2 to 65535	-	5	-	UInt16	At stop	Upon the next power-on
H00.18	2000-13h	Stator resistance	0.001Ω to 65.535Ω	-	0.500	Ω	UInt16	At stop	Upon the next power-on
H00.19	2000-14h	Stator inductance Lq	0.01mH to 655.35mH	-	3.27	mH	UInt16	At stop	Upon the next power-on
H00.20	2000-15h	Stator inductance Ld	0.01mH to 655.35mH	-	3.87	mH	UInt16	At stop	Upon the next power-on
H00.21	2000-16h	Linear back EMF coefficient	0.01 mV/RPM to 655.35 mV/RPM	-	33.30	mV/rpm	UInt16	At stop	Upon the next power-on
H00.22	2000-17h	Torque coefficient Kt	0.01 N·m/Arms to 655.35 N·m/Arms	-	0.51	N·m/Arms	UInt16	At stop	Upon the next power-on
H00.23	2000-18h	Electrical constant Te	0.01 ms–655.35 ms	-	6.54	ms	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H00.24	2000-19h	Mechanical constant Tm	0.01 ms–655.35 ms	-	0.24	ms	UInt16	At stop	Upon the next power-on
H00.25	2000-1Ah	Interpolater temperature detection enable and threshold	0 to 65535	Used to enable temperature detection of the interpolator and upload the encoder temperature to the drive.	0	-	UInt16	At stop	Upon the next power-on
H00.26	2000-1Bh	Configuration for connecting the interpolator to encoder	0 to 65535	-	0	-	UInt16	At stop	Upon the next power-on
H00.27	2000-1Ch	Input PPR of the interpolator	0 to 65535	Defines the pulses per revolution inputted from the encoder to the interpolator.	0	-	UInt16	At stop	Upon the next power-on
H00.28	2000-1Dh	Absolute encoder position offset	0 to 4294967295	Saves the values obtained from angle auto-tuning.	8192	-	UInt32	At stop	Upon the next power-on
H00.30	2000-1Fh	Encoder selection (HEX)	00: Regular incremental encoder (UVW-ABZ) 1: Wire-saving encoder (ABZ[UVW]) 2: Regular incremental encoder (ABZ, without UVW) 16: TAMAGAWA encoder 18: Nikon encoder 19: Inovance encoder	0x00: Regular incremental encoder (UVW-ABZ) 0x01: Wire-saving encoder (ABZ[UVW]) 0x02: Regular incremental encoder (ABZ, without UVW) 0x10: TAMAGAWA encoder 0x12: Nikon encoder 0x13: Inovance encoder	19	-	UInt16	At stop	Upon the next power-on
H00.31	2000-20h	Encoder PPR	1 P/Rev–1073741824 P/Rev	Defines the number of pulses fed back by the encoder per motor revolution.	67108864	PPR	UInt32	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H00.33	2000-22h	Electrical angle of Z signal	0.0° to 360.0°	-	180.0	°	UInt16	At stop	Upon the next power-on
H00.34	2000-23h	Electrical angle of phase U rising edge	0.0° to 360.0°	-	180.0	°	UInt16	At stop	Upon the next power-on
H00.35	2000-24h	Serial-type motor model	0 to 65535	-	0	-	UInt16	At stop	Upon the next power-on
H00.37	2000-26h	Absolute encoder function setting bit	0 to 65535	-	0	-	UInt16	At stop	Upon the next power-on
H00.60	2000-3Dh	Motor attribute	0 to 65535	-	0	-	UInt16	At stop	Upon the next power-on
H00.61	2000-3Eh	Brake close time	0 ms–65535 ms	-	0	ms	UInt16	At stop	Upon the next power-on
H00.62	2000-3Fh	Brake release time	0 ms–65535 ms	-	0	ms	UInt16	At stop	Upon the next power-on
H00.63	2000-40h	Maximum motor current	0.00 A to 65535.00 A	-	0.00	A	UInt32	At stop	Upon the next power-on
H00.65	2000-42h	Motor rated current	0.00 A to 65535.00 A	-	0.00	A	UInt32	At stop	Upon the next power-on
H00.67	2000-44h	Moment of inertia	0 kgc㎡–42950 kgc㎡	-	0	kgc m^2	UInt32	At stop	Upon the next power-on
H00.69	2000-46h	Linear back EMF coefficient	0.01 mV/RPM to 42949672.95 mV/RPM	-	0.01	mV/rpm	UInt32	At stop	Upon the next power-on
H00.71	2000-48h	Motor carrier frequency	0 Hz–65535 Hz	Sets the carrier frequency of the motor. It is effective when bit13 of H00-60 is 1.	8000	Hz	UInt16	At stop	Upon the next power-on
H00.72	2000-49h	Max. motor allowable demagnetizing current	0% to 65535%	Effective when greater than 0. Assigns H00.72 to H07.25 when the motor field weakening is on.	0	%	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H00.73	2000-4Ah	Bit01 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.74	2000-4Bh	Bit23 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.75	2000-4Ch	Bit45 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.76	2000-4Dh	Bit67 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.77	2000-4Eh	Bit89 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.78	2000-4Fh	Bit11 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.79	2000-50h	Bit13 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.80	2000-51h	Bit15 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.98	2000-63h	Motor attribute check	0 to 65535	-	0	-	UInt16	At stop	-

16.2 H01 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.00	2001-01h	MCU software version	0.0 to 6553.5	Displays MCU software version (with one decimal place).	0.0	-	UInt16	Unchangeable	-
H01.01	2001-02h	FPGA software version	0.0 to 6553.5	Displays the FPGA software version, with 1 decimal place.	0.0	-	UInt16	Unchangeable	-
H01.02	2001-03h	Servo drive series No.	0 to 65535	Display servo drive serial number, with 0 decimal place.	0	-	UInt16	Unchangeable	-
H01.07	2001-08h	Software test version	0.00 to 655.35	Displays the software test version, with 2 decimal places.	0.00	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.08	2001-09h	Model parameter version	0.0 to 6553.5	Displays model parameter version, with 1 decimal place.	0.0	-	UInt16	Unchangeable	-
H01.10	2001-0Bh	Drive series No.	10001：DT3R5 10002：DT5R4 10003：DT8R4 10004：DT012 10005：DT017 10006：DT021 10007：DT026 10008：DT032 10009：DT037 10012：ST075 10013：ST091 10014：ST112 10015：ST152 10016：ST240	Displays the drive series number, with no decimal place.	10004	-	UInt16	At stop	Upon the next power-on
H01.11	2001-0Ch	DC-AC voltage class	0 V to 65535 V	Display inverter voltage level, with 0 decimal place.	220	V	UInt16	Unchangeable	-
H01.12	2001-0Dh	Drive rated power	0.00 kW–10737418.24 kW	Display the rated power of the drive, with 2 decimal places.	0.40	kW	UInt32	Unchangeable	-
H01.14	2001-0Fh	Max. output power of the drive	0.00 kW–10737418.24 kW	Displays the maximum output power of the drive, with 2 decimal places.	0.40	kW	UInt32	Unchangeable	-
H01.16	2001-11h	Rated output current of the drive	0.00 A to 10737418.24 A	Displays the rated output current of the drive, with 2 decimal places.	2.80	A	UInt32	Unchangeable	-
H01.18	2001-13h	Max. output current of the drive	0.00 A to 10737418.24 A	Displays the maximum output current of the drive, with 2 decimal places.	10.10	A	UInt32	Unchangeable	-
H01.20	2001-15h	Carrier frequency	2500 Hz–20000 Hz	Displays the carrier frequency, with no decimal place.	8000	Hz	UInt16	At stop	Upon the next power-on
H01.21	2001-16h	Dead zone time	0.01μs to 20.00μs	Displays the dead zone time, with two decimal places.	2.00	μs	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.22	2001-17h	D-axis coupling voltage compensation coefficient	0.0% to 1000.0%	Display D-axis coupling voltage compensation coefficient, with 1 decimal place.	50.0	%	UInt16	Real-time	Real-time
H01.23	2001-18h	Q-axis back EMF compensation coefficient	0.0% to 1000.0%	Display Q-axis back EMF compensation coefficient, with 1 decimal place.	50.0	%	UInt16	Real-time	Real-time
H01.24	2001-19h	D-axis current loop gain	0 Hz–20000 Hz	Displays D-axis current loop gain, with no decimal place.	500	Hz	UInt16	Real-time	Real-time
H01.25	2001-1Ah	D-axis current loop integral compensation factor	0.01 to 100.00	Display D-axis current loop integral compensation factor, with 2 decimal places.	1.00	-	UInt16	Real-time	Real-time
H01.26	2001-1Bh	Sinc3 filter data extraction rate in current sampling	0: Extraction rate 32 1: Extraction rate 64 2: Extraction rate 128 3: Extraction rate 256	Displays Sinc3 filter data extraction rate in current sampling, with no decimal place.	0	-	UInt16	At stop	Upon the next power-on
H01.27	2001-1Ch	Q-axis current loop gain	0 Hz–20000 Hz	Displays Q-axis current loop gain, with no decimal place.	500	Hz	UInt16	Real-time	Real-time
H01.28	2001-1Dh	Q-axis current loop integral compensation factor	0.01 to 100.00	Displays Q-axis current loop integral compensation factor, with 2 decimal places.	1.00	-	UInt16	Real-time	Real-time
H01.29	2001-1Eh	Q-axis coupling voltage compensation coefficient	0.0% to 1000.0%	Display Q-axis coupling voltage compensation coefficient, with 1 decimal place.	50.0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.30	2001-1Fh	Bus voltage gain tuning	50.0% to 150.0%	Displays bus voltage gain adjustment, with 1 decimal place.	100.0	%	UInt16	At stop	Real-time
H01.31	2001-20h	Minimum ON time of bootstrap circuit lower bridge	0.0μs to 20.0μs	Displays the minimum ON time of bootstrap circuit lower bridge, with 1 decimal place.	0.0	μs	UInt16	At stop	Upon the next power-on
H01.32	2001-21h	Relative gain of UV sampling	1 to 65535	Displays the relative gain of UV sampling, with no decimal place.	32768	-	UInt16	At stop	Upon the next power-on
H01.34	2001-23h	Drive over-temperature threshold	0°C–150°C	Displays the drive over-temperature threshold, with no decimal place.	95	°C	UInt16	Real-time	Upon the next power-on
H01.36	2001-25h	Current sensor range	0.00 A to 9999.99 A	Displays the current sensor range, with 2 decimal places.	21.33	A	UInt32	At stop	Upon the next power-on
H01.38	2001-27h	FPGA phase current protection threshold	0.0% to 100.0%	Displays FPGA phase current protection threshold, with 1 decimal place.	90.0	%	UInt16	At stop	Upon the next power-on
H01.39	2001-28h	Current loop version	0 to 65535	Displays the current loop version, with no decimal place.	0	-	UInt16	At stop	Upon the next power-on
H01.40	2001-29h	DC bus overvoltage protection threshold	0 V to 820 V	Displays DC bus overvoltage protection threshold, with 0 decimal place.	800	V	UInt16	Real-time	Real-time
H01.41	2001-2Ah	DC bus voltage discharge threshold	0 V to 820 V	Display DC bus voltage discharge threshold, with no decimal place.	700	V	UInt16	Real-time	Real-time
H01.42	2001-2Bh	DC bus undervoltage threshold	0 V to 820 V	Displays DC bus undervoltage threshold, with no decimal place.	350	V	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.52	2001-35h	D-axis proportional gain in performance priority mode	0 Hz–20000 Hz	Display D-axis proportional gain in performance priority mode, with no decimal place.	2000	Hz	UInt16	Real-time	Real-time
H01.53	2001-36h	D-axis integral gain in performance priority mode	0.01 to 100.00	Displays D-axis integral gain in performance priority mode, with 2 decimal places.	1.00	-	UInt16	Real-time	Real-time
H01.54	2001-37h	Q-axis proportional gain in performance priority mode	0 Hz–20000 Hz	Displays Q-axis proportional gain in performance priority mode, with no decimal place.	2000	Hz	UInt16	Real-time	Real-time
H01.55	2001-38h	Q-axis integral gain in performance priority mode	0.01 to 100.00	Displays Q-axis integral gain in performance priority mode, with 2 decimal places.	1.00	-	UInt16	Real-time	Real-time
H01.56	2001-39h	Current loop low-pass cutoff frequency	0 Hz–65535 Hz	Displays current loop low-pass cutoff frequency, with no decimal place.	11000	Hz	UInt16	At stop	Upon the next power-on
H01.59	2001-3Ch	Serial encoder data transmission compensation time	0.000μs to 10.000μs	Display the data transmission compensation time of the serial encoder, with three decimal places.	0.000	μs	UInt16	At stop	Upon the next power-on
H01.60	2001-3Dh	FPGA scheduling frequency selection	1: 16 kHz 2: 8 kHz	Selects FPGA scheduling frequency, with no decimal place.	1	-	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.61	2001-3Eh	Command scheduling frequency	0：4kHz 1：2kHz 2：1kHz 3：8kHz	Selects the command scheduling frequency, with no decimal place.	3	-	UInt16	At stop	Upon the next power-on
H01.62	2001-3Fh	Auto-tuning of drive model	0 to 65535	Displays the auto-tuned drive model, with no decimal place.	0	-	UInt16	Unchangeable	-
H01.64	2001-41h	Heidenhain encoder recovery time	0.000 to 65.535	Displays PL and CPL filter time, with no decimal place.	0.500	-	UInt16	At stop	Upon the next power-on
H01.65	2001-42h	Heidenhain encoder baud rate	0 to 32767	Heidenhain recovery time	4000	-	UInt16	At stop	Upon the next power-on
H01.66	2001-43h	Current loop configuration	0 kHz–31 kHz	Displays current loop configuration, with no decimal place.	12	kHz	UInt16	Real-time	Real-time
H01.67	2001-44h	Dead zone compensation coefficient	0.00 to 2.00	Displays the dead zone compensation coefficient, with two decimal places.	1.00	-	UInt16	Real-time	Upon the next power-on
H01.68	2001-45h	Current observer cutoff frequency	200 to 5000	Displays current observer cutoff frequency, with no decimal place.	2000	-	UInt16	Real-time	Real-time
H01.69	2001-46h	Current observer correction coefficient	0.00 to 9.00	Displays current observer correction coefficient, with 2 decimal places.	1.00	-	UInt16	Real-time	Real-time
H01.72	2001-49h	Hide IGBT model identification	0 to 65535	Displays whether to hide IGBT model identification, with no decimal place.	0	-	UInt16	Real-time	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H01.73	2001-4Ah	Sigma-delta signal phase compensation time	0μs to 65535μs	Displays Sigma-delta signal phase compensation time, with no decimal place.	1	μs	UInt16	At stop	Upon the next power-on
H01.75	2001-4Ch	Current loop amplification factor	0.00 to 655.35	Displays current loop amplification coefficient, with 2 decimal places.	1.00	-	UInt16	Real-time	Real-time
H01.78	2001-4Fh	Control voltage undervoltage threshold	0 V to 2000 V	Displays control power undervoltage threshold, with no decimal place.	200	V	UInt16	Real-time	Real-time
H01.79	2001-50h	Control voltage gain adjustment	50.0% to 150.0%	Displays control voltage gain adjustment, with 1 decimal place.	100.0	%	UInt16	At stop	Upon the next power-on
H01.82	2001-53h	Filter time of PL and CPL	0 to 32767	Displays PL and CPL filter time, with no decimal place.	4000	-	UInt16	At stop	Real-time
H01.87	2001-58h	Single-turn bits of Heidenhain encoder	0 to 32	Heidenhain single turn data bit	0	-	UInt16	At stop	Upon the next power-on
H01.88	2001-59h	Multi-turn bits of Heidenhain encoder	0 to 32	Heidenhain multi-turn data bit	0	-	UInt16	At stop	Upon the next power-on

16.3 H02 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.00	2002-01h	Control mode	0: Velocity mode 1: Position mode 2: Torque mode 9: EtherCAT mode 255: Axis hidden	0: Velocity mode 1: Position mode 2: Torque mode 9: EtherCAT mode 255: Axis hidden	9	-	UInt16	At stop	Real-time
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 alarm) 4: Absolute position single-turn mode	Used to set the absolute position function.	0	-	UInt16	At stop	Upon the next power-on
H02.02	2002-03h	Rotation direction selection	0: Counterclockwise (CCW) as forward direction 1: Clockwise (CW) as forward direction	Defines the forward direction of the motor when viewed from the motor shaft side.	0	-	UInt16	At stop	Upon the next power-on
H02.03	2002-04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	Defines the relationship between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.	0	-	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.05	2002-06h	Stop mode at S-ON OFF	–4: Ramp to stop as defined by 6085h, keeping dynamic braking state –3: 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	Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.	0	-	Int16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 2 fault occurs.	2	-	Int16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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: Stop based on ramp, keeping de-energized state 4: Stop based on ramp, 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	Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when overtravel occurs.	1	-	UInt16	At stop	Real-time
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	Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 1 fault occurs.	2	-	UInt16	At stop	Real-time
H02.09	2002-0Ah	Delay from brake output ON to command received	0 ms–500 ms	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.	250	ms	UInt16	Real-time	At stop

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.10	2002-0Bh	Delay from brake output OFF to motor de-energized	50 ms–1000 ms	Defines the delay from the moment brake output is OFF to the moment when the motor at standstill enters the de-energized status.	150	ms	UInt16	Real-time	Real-time
H02.11	2002-0Ch	Motor speed threshold at brake output OFF in rotation state	20 rpm to 3000 rpm	Defines the motor speed threshold when brake (BK) output is OFF in the rotating state.	30	rpm	UInt16	Real-time	Real-time
H02.12	2002-0Dh	Delay from S-ON OFF to brake output OFF in rotation state	1 ms–65535 ms	Sets the delay time from BK OFF to S-ON OFF when the motor is in rotating state.	500	ms	UInt16	Real-time	Real-time
H02.15	2002-10h	LED Alarm Display	0: Output alarm information immediately 1: Not output alarm information	Defines whether to switch the keypad to the fault display mode when a No. 3 fault occurs.	0	-	UInt16	Real-time	Real-time
H02.16	2002-11h	Brake enable switch	0: OFF 1: ON	Turn on or off the brake function.	0	-	UInt16	Real-time	At stop
H02.17	2002-12h	Stop mode 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	Defines the stop mode of the motor for stopping rotating upon main circuit power failure.	2	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor status after stop.	2	-	UInt16	Real-time	At stop
H02.20	2002-15h	Dynamic brake relay coil ON delay	10 ms–30000 ms	-	30	ms	UInt16	Real-time	Real-time
H02.21	2002-16h	Permissible minimum resistance of braking resistor	1Ω to 1000Ω	-	40	Ω	UInt16	Unchangeable	-
H02.30	2002-1Fh	User password	0 to 65535	-	0	-	UInt16	Real-time	Real-time
H02.31	2002-20h	System parameter initialization	0: No operation 1: Restore default settings 2: Clear fault records	Used to restore default values or clear fault records.	0	-	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H02.32	2002-21h	Selection of parameters in group H0b	0 to 99	Sets the offset of H0b parameters 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.	50	-	UInt16	Real-time	Real-time
H02.35	2002-24h	Keypad data update frequency	0 Hz–20 Hz	-	2	Hz	UInt16	Real-time	Real-time
H02.41	2002-2Ah	Manufacturer password	0 to 65535	-	0	-	UInt16	Real-time	Real-time

16.4 Parameter Group H03

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H03.02	2003–03h	DI1 function selection	0: No assignment 101: Servo ON 102: Alarm reset signal 114: Positive limit switch 115: Negative limit switch 124: Electronic gear ratio 131: Home switch 134: Emergency stop 138: Touch probe 1 139: Touch probe 2 201: Servo ON 202: Alarm reset signal 214: Positive limit switch 215: Negative limit switch 224: Electronic gear ratio 231: Home switch 234: Emergency stop 238: Touch probe 1 239: Touch probe 2	Defines the function of DI1.	0	-	UInt16	Real time	Real time
H03.03	2003–04h	DI1 logic selection	0: Normally open 1: Normally closed	Used to set the level logic of DI1 when the function assigned to DI is active.	0	-	UInt16	Real time	Real time
H03.04	2003–05h	DI2 function selection	See H03.02.	Defines the function of DI2.	0	-	UInt16	Real time	Real time
H03.05	2003–06h	DI2 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.06	2003–07h	DI3 function selection	See H03.02.	Defines the function of DI3.	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H03.07	2003–08h	DI3 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.08	2003–09h	DI4 function selection	See H03.02.	Defines the function of DI4.	0	-	UInt16	Real time	Real time
H03.09	2003–0Ah	DI4 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.10	2003–0Bh	DI5 function selection	See H03.02.	Defines the function of DI5.	0	-	UInt16	Real time	Real time
H03.11	2003–0Ch	DI5 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.12	2003–0Dh	DI6 function selection	See H03.02.	Defines the function of DI6.	0	-	UInt16	Real time	Real time
H03.13	2003–0Eh	DI6 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.14	2003–0Fh	DI7 function selection	See H03.02.	Defines the function of DI7.	0	-	UInt16	Real time	Real time
H03.15	2003–10h	DI7 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.16	2003–11h	DI8 function selection	See H03.02.	Defines the function of DI8.	0	-	UInt16	Real time	Real time
H03.17	2003–12h	DI8 logic selection	0: Normally open 1: Normally closed	-	0	-	UInt16	Real time	Real time
H03.60	2003–3Dh	DI1 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time
H03.61	2003–3Eh	DI2 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H03.62	2003–3Fh	DI3 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time
H03.63	2003–40h	DI4 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time
H03.64	2003–41h	DI5 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time
H03.65	2003–42h	DI6 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time
H03.66	2003–43h	DI7 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time
H03.67	2003–44h	DI8 filter time	0.00 to 500.00	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.	3.00	ms	UInt16	Real time	Real time

16.5 H04 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H04.00	2004-01h	DO1 function	0: Undefined 101: servo ready 102: motor rotation signal 109: brake grip output signal 110: warning 111: failure 121: DB 131: Communication forced DO output 132: EDM output 201: Servo ready 202: motor rotation signal 209: brake hold output signal 210: Warning 211: failure 221: DB 231: Communication forced DO output 232: EDM output	Defines the function of DO1.	0	-	UInt16	Real-time	Real-time
H04.01	2004-02h	DO1 logic selection	0: Normally open 1: Closed	Defines the level logic of DO1 when the function assigned to DO is active.	0	-	UInt16	Real-time	Real-time
H04.02	2004-03h	DO2 function	Consistent with parameter H04.00.	Defines the function of DO2.	0	-	UInt16	Real-time	Real-time
H04.03	2004-04h	DO2 logic selection	0: Normally open 1: Closed	Defines the level logic of DO2 when the function assigned to DO is active.	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H04.22	2004-17h	DO source selection	Bit0: DO1 output source 0: DO1 function output 1: Bit0 of H31.04 Bit1: DO2 output source 0: DO2 function output 1: Bit1 of H31.04	Defines whether the logic of a physical DO terminal is defined by the actual state of the drive or by communication.	0	-	UInt16	Real-time	Real-time
H04.23	2004-18h	ECAT communication-forced DO logic in non-OP status	Bit0: DO1 0: Maintain output 1: No output Bit1: DO2 0: Maintain output 1: No output	Sets DO state upon ECAT communication failure.	0	-	UInt16	Real-time	Real-time

16.6 H05 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.02	2005-03h	Pulses per revolution	0 PPR to 4294967295 PPR	Defines the number of pulses required per revolution of the motor.	0	PPR	UInt32	At stop	Upon the next power-on
H05.04	2005-05h	First-order low-pass filter time constant	0.0 ms–6553.5 ms	Defines the first-order low pass filter time constant of position references.	0.0	ms	UInt16	At stop	Real-time
H05.06	2005-07h	Moving average filter time constant 1	0.0 ms–128.0 ms	Defines the moving average filter time constant of position references.	0.0	ms	UInt16	At stop	Real-time
H05.07	2005-08h	Electronic gear ratio 1 (numerator)	1 to 1073741824	Defines the numerator of electronic gear ratio 1.	1	-	UInt32	Real-time	Real-time
H05.09	2005-0Ah	Electronic gear ratio 1 (denominator)	1 to 1073741824	Defines the denominator of electronic gear ratio 1.	1	-	UInt32	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.11	2005-0Ch	Electronic gear ratio 2 (numerator)	1 to 1073741824	Defines the numerator of electronic gear ratio 2.	1	-	UInt32	Real-time	Real-time
H05.13	2005-0Eh	Electronic gear ratio 2 (denominator)	1 to 1073741824	Defines the denominator of electronic gear ratio 2.	1	-	UInt32	Real-time	Real-time
H05.16	2005-11h	Clear action	0: Position deviation cleared upon S-OFF or non-RUN state 1: Position deviation cleared upon fault or non-RUN state	Defines the condition for clearing the position deviation.	0	-	UInt16	At stop	Real-time
H05.17	2005-12h	Number of encoder frequency-division pulses	1 P/Rev–4194303 P/Rev	Defines the number of pulses output by PAO or PBO per revolution. Pulse output resolution per revolution = (H05.17) x 4	2500	PPR	UInt32	At stop	Upon the next power-on
H05.19	2005-14h	Speed feedforward control	0: No speed feedforward 1: Internal speed feedforward 2: 60B1h 3: Zero phase	Defines the source of the speed loop feedforward signal.	1	-	UInt16	At stop	Real-time
H05.30	2005-1Fh	Homing enable selection	0: Disabled 6: Current position as home	Defines the homing mode and the trigger signal source.	0	-	UInt16	Real-time	Real-time
H05.35	2005-24h	Home search time limit	0 ms–65535 ms	Defines the maximum homing time.	10000	ms	UInt16	Real-time	Real-time
H05.36	2005-25h	Mechanical home offset	-2147483648 to 2147483647	Defines the absolute position of the motor after homing.	0	reference unit	Int32	Real-time	Real-time
H05.38	2005-27h	Frequency-division output source	0: Encoder frequency division output 2: Prohibit frequency division output	Defines the output source of the pulse output terminal.	0	-	UInt16	Real-time	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.39	2005-28h	Electronic gear ratio switch over condition	0: Switchover after position reference is kept 0 for 2.5 ms 1: Switched in real time	Defines the condition for switching the electronic gear ratio.	0	-	UInt16	At stop	Real-time
H05.40	2005-29h	Mechanical home offset and action upon overtravel	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	Defines the offset relationship between the mechanical home and mechanical zero point, and the action upon overtravel during homing.	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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 signal 1: Frequency-division output Z signal	Defines the output level when the Z pulse of pulse output terminal is active.	1	-	UInt16	At stop	Upon the next power-on
H05.44	2005-2Dh	Numerator of frequency-division output reduction ratio	1 to 16383	Defines the numerator of frequency-division output reduction ratio.	1	-	UInt16	At stop	Real-time
H05.45	2005-2Eh	Denominator of frequency-division output reduction ratio	1 to 8191	Defines the denominator of frequency-division output reduction ratio.	1	-	UInt16	At stop	Real-time
H05.46	2005-2Fh	DI selection of multi-turn frequency-division Z starting point	0: No selection 1: DI1 2: DI2 3: DI3 4: DI4 5: DI5 6: DI6 7: DI7 8: DI8	In the absolute position linear mode, the position offset is the difference between absolute position of current encoder and the mechanical position.	0	-	UInt16	Real-time	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.47	2005-30h	Frequency-division Z pulse width	0μs to 400μs	Defines the minimum output width (μs) of frequency-division output PZ.	0	μs	UInt16	Real-time	Real-time
H05.50	2005-33h	Mechanical gear ratio in absolute position rotation mode (numerator)	1 to 65535	Defines the transmission ratio between the mechanical rotary load and the motor in the absolute position rotation mode.	1	-	UInt16	At stop	Real-time
H05.51	2005-34h	Mechanical gear ratio in absolute position rotation mode (denominator)	1 to 65535	Defines the transmission ratio between the mechanical rotary load and the motor in the absolute position rotation mode.	1	-	UInt16	At stop	Real-time
H05.52	2005-35h	Pulses per revolution of the load in absolute position rotation mode (low 32 bits)	0 to 4294967295	Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode.	0	encoder unit	UInt32	At stop	Real-time
H05.54	2005-37h	Pulses per revolution of the load in absolute position rotation mode (high 32 bits)	0 to 4294967295	Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode.	0	encoder unit	UInt32	At stop	Real-time
H05.58	2005-3Bh	Torque threshold in homing upon hit-and-stop	0.0% to 400.0%	Defines the maximum positive/negative torque limit in homing upon hit-and-stop.	100.0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H05.60	2005-3Dh	Hold time of positioning completed	0 ms–30000 ms	Defines the hold time of an active positioning completed signal.	0	ms	UInt16	Real-time	Real-time
H05.66	2005-43h	Homing time unit	0：1ms 1：10ms 2：100ms	Defines the homing time unit. The actual timeout time is H05.35 x H05.66 ms.	2	-	UInt16	At stop	Real-time
H05.67	2005-44h	Offset between zero point and single-turn absolute position	-2147483648 to 2147483647	-	0	encoder unit	Int32	At stop	Real-time
H05.70	2005-47h	Moving average filter time constant 2	0.0 ms–1000.0 ms	Defines the moving average filter time constant for the second group of position references.	0.0	ms	UInt16	At stop	Real-time
H05.71	2005-48h	Motor Z signal width	1 ms–100 ms	Output pulse width when motor Z signal is active.	4	ms	UInt16	Real-time	Real-time
H05.72	2005-49h	Inner and outer loop switching deviation threshold	0 to 4294967295	-	32767	-	UInt32	At stop	Real-time

16.7 H06 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H06.00	2006-01h	Source of main speed reference A	0: Digital setting (H06.03)	Defines the source of main speed reference A.	0	-	UInt16	At stop	Real-time
H06.01	2006-02h	Source of auxiliary speed reference B	0: Digital setting (H06.03) 5: Multi-speed reference	Defines the source of auxiliary speed reference B.	0	-	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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: Switched between A and B 4: Communication	Defines the source of speed references.	0	-	UInt16	At stop	Real-time
H06.03	2006-04h	Speed reference set through keypad	-10000 rpm to +10000 rpm	Defines the speed reference value set through the keypad.	200	rpm	Int16	Real-time	Real-time
H06.04	2006-05h	DI jog speed reference	0 rpm to 10000 rpm	Defines the DI jog speed reference.	150	rpm	Int16	Real-time	Real-time
H06.05	2006-06h	Acc. ramp time of speed reference	0 ms–65535 ms	Sets acceleration ramp time of speed reference. The acceleration/deceleration time constant of multi-speed references are defined only by parameters in group H12. 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. Therefore, the actual acceleration and deceleration time calculation formula is as follows: Actual acceleration time t1 = speed reference ÷ 1000 × speed command acceleration ramp time Actual deceleration time t2 = speed reference ÷ 1000 × speed command deceleration ramp time	0	ms	UInt16	Real-time	Real-time
H06.06	2006-07h	Dec. ramp time of speed reference	0 ms–65535 ms	Sets deceleration ramp time of speed reference.	0	ms	UInt16	Real-time	Real-time
H06.07	2006-08h	Maximum speed limit	0 rpm to 10000 rpm	Defines the maximum speed limit.	7000	rpm	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H06.08	2006-09h	Forward speed threshold	0 rpm to 10000 rpm	Defines the forward speed threshold.	7000	rpm	UInt16	Real-time	Real-time
H06.09	2006-0Ah	Reverse speed threshold	0 rpm to 10000 rpm	Defines the reverse speed threshold.	7000	rpm	UInt16	Real-time	Real-time
H06.10	2006-0Bh	Deceleration unit in emergency stop	0: Multiplied by 1 1: Multiplied by 10 2: Multiplied by 100	Sets the deceleration unit in emergency stop.	0	-	UInt16	At stop	Real-time
H06.11	2006-0Ch	Torque feedforward control	0: No torque feedforward 1: Internal torque feedforward 2: 60B2h as external torque feedforward	Defines the source for torque feedforward control.	1	-	UInt16	Real-time	Real-time
H06.12	2006-0Dh	Acceleration ramp time of jog speed	0 ms–65535 ms	Sets the acceleration ramp time of jog speed.	10	ms	UInt16	Real-time	Real-time
H06.13	2006-0Eh	Speed feedforward smoothing filter	0μs to 65535μs	Defines the speed feedforward smoothing filter time.	0	μs	UInt16	Real-time	Real-time
H06.15	2006-10h	Zero clamp speed threshold	0 rpm to 10000 rpm	Defines the zero clamp speed threshold.	10	rpm	UInt16	Real-time	Real-time
H06.16	2006-11h	Threshold of TGON (motor rotation) signal	0 rpm to 1000 rpm	Sets the threshold of TGON (motor rotation) signal.	20	rpm	UInt16	Real-time	Real-time
H06.17	2006-12h	Threshold of V-Cmp (speed matching) signal	0 RPM –100 RPM	Defines the threshold of speed match signal.	10	rpm	UInt16	Real-time	Real-time
H06.18	2006-13h	Threshold of speed reach signal	20rpm to 10000rpm	Defines the threshold of speed reached signal.	1000	rpm	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H06.19	2006-14h	Threshold of zero speed output signal	1 rpm to 10000 rpm	Defines the threshold of zero speed output signal.	10	rpm	UInt16	Real-time	Real-time
H06.26	2006-1Bh	Torque ripple auto-tuning enable	0 to 1	Disables/enables torque ripple auto-tuning.	0	-	UInt16	Real-time	Real-time
H06.28	2006-1Dh	Cogging torque ripple compensation	0 to 1	Used to enable the cogging torque fluctuation compensation function.	0	-	UInt16	At stop	Upon the next power-on
H06.31	2006-20h	Sine reference frequency	0 to 16000	Set the sinusoidal command frequency.	50	-	UInt16	Real-time	Real-time
H06.32	2006-21h	Sine reference amplitude	0 to 30000	Sets sine reference amplitude.	30	-	UInt16	Real-time	Real-time
H06.33	2006-22h	Sine reference enable	0 to 3	Enables sine reference.	0	-	UInt16	Real-time	Real-time
H06.34	2006-23h	Sine reference initial phase	0.0 to 360.0	Set the sinusoidal command initial phase.	0.0	-	UInt16	Real-time	Real-time
H06.35	2006-24h	Sine reference offset	-9900 to 9900	Set the sinusoidal instruction bias.	0	-	Int16	Real-time	Real-time

16.8 H07 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.00	2007-01h	Source of main torque reference A	0: Keypad (H07.03)	Defines the source of the main torque reference A.	0	-	UInt16	At stop	Real-time
H07.01	2007-02h	Source of auxiliary torque reference B	0: Keypad (H07.03)	Defines the source of auxiliary torque references.	0	-	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Selects torque reference.	0	-	UInt16	At stop	Real-time
H07.03	2007-04h	Torque reference set through keypad	-500.0% to 500.0%	Sets torque reference set through keypad.	0.0	%	Int16	Real-time	Real-time
H07.05	2007-06h	Torque reference filter time constant 1	0.00 ms–30.00 ms	Defines the torque reference filter time constant 1.	0.50	ms	UInt16	Real-time	Real-time
H07.06	2007-07h	Torque reference filter time constant 2	0.00 ms–30.00 ms	Defines the torque reference filter time constant 2.	0.27	ms	UInt16	Real-time	Real-time
H07.07	2007-08h	Torque Limit source	0: Positive/ Negative internal torque limit 2: T_LMT limit	Sets the torque limit source.	0	-	UInt16	Real-time	Real-time
H07.09	2007-0Ah	Positive internal torque limit	0.0% to 500.0%	Sets the forward run internal torque limit.	350.0	%	UInt16	Real-time	Real-time
H07.10	2007-0Bh	Negative internal torque limit	0.0% to 500.0%	Sets the reverse run internal torque limit.	350.0	%	UInt16	Real-time	Real-time
H07.11	2007-0Ch	Positive external torque limit	0.0% to 500.0%	Sets the positive external torque limit.	350.0	%	UInt16	Real-time	Real-time
H07.12	2007-0Dh	Negative external torque limit	0.0% to 500.0%	Sets the negative external torque limit.	350.0	%	UInt16	Real-time	Real-time
H07.15	2007-10h	Emergency-stop torque	0.0% to 500.0%	Set torque command source for emergency stop.	100.0	%	UInt16	Real-time	At stop

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT	Sets the speed limit source.	0	-	UInt16	Real-time	Real-time
H07.19	2007-14h	Positive speed limit/ Speed limit 1 in torque control	0rpm to 10000rpm	Defines the positive speed limit in torque control.	3000	rpm	UInt16	Real-time	Real-time
H07.20	2007-15h	Negative speed limit/ Speed limit 2 in torque control	0rpm to 10000rpm	Defines the negative speed limit in torque control.	3000	rpm	UInt16	Real-time	Real-time
H07.21	2007-16h	Torque reach base value	0.0% to 500.0%	Defines the torque reference of the base value for torque reach.	0.0	%	UInt16	Real-time	Real-time
H07.22	2007-17h	Torque reach valid value	0.0% to 500.0%	Defines the torque reference for torque reach DO active.	20.0	%	UInt16	Real-time	Real-time
H07.23	2007-18h	Torque reach invalid value	0.0% to 500.0%	Defines the torque reference for torque reach DO inactive.	10.0	%	UInt16	Real-time	Real-time
H07.24	2007-19h	Field weakening depth	60% to 115%	Set the flux weakening depth.	115	%	UInt16	Real-time	Real-time
H07.25	2007-1Ah	Max. permissible demagnetizing current	0% to 300%	Set the maximum allowable demagnetization current value.	100	%	UInt16	Real-time	Real-time
H07.26	2007-1Bh	Field weakening selection	0: Disabled 1: Enabled	Disable or enable field weakening.	1	-	UInt16	At stop	Real-time
H07.27	2007-1Ch	Flux weakening gain	0.001 Hz–1.000 Hz	Set the gain of flux weakening.	0.030	Hz	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.28	2007-1Dh	Speed of flux weakening point	0 to 65535	Set the speed of flux weakening point.	0	-	UInt16	Unchangeable	Real-time
H07.31	2007-20h	MTPA enabling	0 to 1	MTPA enabling.	0	-	UInt16	At stop	Real-time
H07.32	2007-21h	Slicer non-standard feature 6077 content change	0 to 1	-	0	-	UInt16	Real-time	Real-time
H07.34	2007-23h	Flux weakening single deviation threshold	100 to 10000	Set flux weakening single deviation threshold.	300	-	UInt16	Real-time	Real-time
H07.35	2007-24h	Flux weakening single deviation limit	1 to 10000	Sets flux weakening single deviation limit.	100	-	UInt16	Real-time	Real-time
H07.36	2007-25h	Time constant of low-pass filter 2	0.00 ms–10.00 ms	Sets the time constant of low-pass filter 2.	0.00	ms	UInt16	Real-time	Real-time
H07.37	2007-26h	Torque reference filter selection	0: First-order filter 1: Biquad filter	Select torque reference Filter.	0	-	UInt16	Real-time	Real-time
H07.38	2007-27h	Biquad filter attenuation ratio	0 to 50	Set the attenuation ratio of biquad filter.	16	-	UInt16	At stop	Real-time
H07.40	2007-29h	Speed limit threshold in torque control mode	0 ms–300 ms	Sets speed limit window in the torque control mode.	10	ms	UInt16	Real-time	Real-time
H07.43	2007-2Ch	80D motor back EMF coefficient K1	0.000 to 6.000	Sets the 80D motor back EMF coefficient to calculate the output torque.	1.000	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H07.44	2007-2Dh	80D motor temperature coefficient K2	0.000 to 6.000	Sets the 80D motor temperature coefficient to calculate the output torque.	0.943	-	UInt16	Real-time	Real-time
H07.45	2007-2Eh	Motor torque output correction enable	0: Disabled 1: Enabled	Enables or disables motor torque output correction.	0	-	UInt16	At stop	Real-time

16.9 H08 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.00	2008-01h	Speed loop gain	0.1 Hz–2000.0 Hz	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.	40.0	Hz	UInt16	Real-time	Real-time
H08.01	2008-02h	Speed loop integral time constant	0.15 ms–512.00 ms	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.	19.89	ms	UInt16	Real-time	Real-time
H08.02	2008-03h	Position loop gain	0.1 Hz–2000.0 Hz	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).	64.0	Hz	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.03	2008-04h	2nd speed loop gain	0.1 Hz–2000.0 Hz	-	75.0	Hz	UInt16	Real-time	Real-time
H08.04	2008-05h	2nd speed loop integral time constant	0.15 ms–512.00 ms	-	10.61	ms	UInt16	Real-time	Real-time
H08.05	2008-06h	2nd position loop gain	0.1 Hz–2000.0 Hz	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).	120.0	Hz	UInt16	Real-time	Real-time
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	Defines the mode for switching to the 2nd gain set.	1	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.09	2008-0Ah	Gain switch over 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)	Defines the gain switchover condition.	0	-	UInt16	Real-time	Real-time
H08.10	2008-0Bh	Gain switch over delay	0.0 ms–1000.0 ms	Defines the delay when the drive switches from the 2nd gain set to the 1st gain set.	5.0	ms	UInt16	Real-time	Real-time
H08.11	2008-0Ch	Gain switch over level	0 to 20000	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.	50	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.12	2008-0Dh	Gain switch over hysteresis	0 to 20000	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 set value of H08.11 (Gain switchover level) must be no less than that of H08.12; otherwise, the H08.11 will be set to a value equal to H08.12 automatically.	30	-	UInt16	Real-time	Real-time
H08.13	2008-0Eh	Position gain switch over time	0.0 ms–1000.0 ms	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.	3.0	ms	UInt16	Real-time	Real-time
H08.15	2008-10h	Load moment of inertia ratio	0.00 to 120.00	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.	1.00	-	UInt16	Real-time	Real-time
H08.16	2008-11h	ITune parameter save	0 to 65535	-	0	-	UInt16	Real-time	Real-time
H08.17	2008-12h	Zero phase delay	0.0 ms–4.0 ms	-	0.0	ms	UInt16	Real-time	Real-time
H08.18	2008-13h	Time constant of speed feedforward filter	0.00 ms–64.00 ms	Defines the filter time constant of speed feedforward.	0.50	ms	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.19	2008-14h	Speed feedforward gain	0.0% to 100.0%	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).	0.0	%	UInt16	Real-time	Real-time
H08.20	2008-15h	Torque feedforward filter time constant	0.00 ms–64.00 ms	Defines the filter time constant of torque feedforward.	0.50	ms	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.21	2008-16h	Torque feedforward gain	0.0% to 300.0%	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).	0.0	%	UInt16	Real-time	Real-time
H08.22	2008-17h	Speed feedback filtering option	0: Inhibited 1: 2 times 2: 4 times 3: 8 times 4: 16 times	Defines the moving average filtering times for speed feedback. The higher the setpoint, the weaker the speed feedback fluctuation, but the longer the feedback delay will be.	0	-	UInt16	At stop	Real-time
H08.23	2008-18h	Cutoff frequency of speed feedback low-pass filter	100 Hz–8000 Hz	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 4000 Hz negates the filtering effect.	8000	Hz	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.24	2008-19h	PDFF control coefficient	0.0% to 200.0%	Defines the control mode of the speed loop. When this coefficient is set to 100.0, the speed loop adopts PI control (the default control mode of the speed loop), and the dynamic response is fast; When set to 0.0, the speed loop integration effect is obvious, which can filter out low-frequency interference, but the dynamic response is slow. 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.	100.0	%	UInt16	Real-time	Real-time
H08.27	2008-1Ch	Speed observer cutoff frequency	50 Hz–600 Hz	Defines the cutoff frequency of the speed observer. Note that an excessively high setpoint may incur resonance. Decrease the setpoint properly in case of large speed feedback noise.	170	Hz	UInt16	Real-time	Real-time
H08.28	2008-1Dh	Speed observer inertia correction coefficient	1% to 1600%	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.	100	%	UInt16	Real-time	Real-time
H08.29	2008-1Eh	Speed observer filter time	0.00 ms–10.00 ms	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.	0.80	ms	UInt16	Real-time	Real-time
H08.30	2008-1Fh	Disturbance compensation time	0.00 ms–100.00 ms	Defines the compensation time of the disturbance observer. Increase the setpoint properly in case of large speed feedback noise.	0.20	ms	UInt16	Real-time	Real-time
H08.31	2008-20h	Disturbance cutoff frequency	10 Hz–4000 Hz	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.	600	Hz	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.32	2008-21h	Disturbance compensation gain	0% to 100%	Defines the compensation gain of the disturbance observer. The setpoint 100% indicates full compensation.	0	%	UInt16	Real-time	Real-time
H08.33	2008-22h	Disturbance observer inertia correction coefficient	1% to 1600%	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.	100	%	UInt16	Real-time	Real-time
H08.37	2008-26h	Phase modulation for medium-frequency jitter suppression 2	-90deg to 90deg	Defines the compensation phase of medium-frequency jitter suppression 2.	0	deg	Int16	Real-time	Real-time
H08.38	2008-27h	Medium-frequency suppression 2 frequency	0 Hz–1000 Hz	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.	0	Hz	UInt16	Real-time	Real-time
H08.39	2008-28h	Compensation gain of medium-frequency jitter suppression 2	0% to 300%	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.	0	%	UInt16	Real-time	Real-time
H08.40	2008-29h	Speed observer selection	0: Disabled 1: Enabled	Used to set the enable bit for speed observer.	0	-	UInt16	Real-time	Real-time
H08.42	2008-2Bh	Model control selection	0: Disabled 1: Enabled 2: Dual-inertia model	Used to enable model tracking control.	0	-	UInt16	Real-time	Real-time
H08.43	2008-2Ch	Model gain	0.1 to 2000.0	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.	40.0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.45	2008-2Eh	Model feedforward position	0 to 1	Sets the single inertia model feedforward position.	1	-	UInt16	Real-time	Real-time
H08.46	2008-2Fh	Feedforward value	0.0 to 102.4	Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.	95.0	-	UInt16	Real-time	Real-time
H08.48	2008-31h	Forward torque feedforward	0.0 to 202.4	Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.	102.4	-	UInt16	Real-time	Real-time
H08.49	2008-32h	Reverse torque feedforward	0.0 to 202.4	Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.	102.4	-	UInt16	Real-time	Real-time
H08.50	2008-33h	Model torque feedforward differential time	0.00 ms–655.35 ms	Sets the single inertia model control torque feedforward differential time.	0.00	ms	UInt16	Real-time	Real-time
H08.51	2008-34h	Model speed feedforward differential time	0.00 ms–20.00 ms	Sets the single inertia model control speed feedforward differential time.	0.00	ms	UInt16	Real-time	Real-time
H08.53	2008-36h	Medium- and low-frequency jitter suppression frequency 3	0.0 Hz–300.0 Hz	Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.	0.0	Hz	UInt16	Real-time	Real-time
H08.54	2008-37h	Medium- and low-frequency jitter suppression compensation 3	0% to 200%	Defines the compensation gain for medium- and low-frequency suppression compensation 3. The setpoint 200% indicates full compensation.	0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.56	2008-39h	Medium- and low-frequency jitter suppression phase modulation 3	0% to 600%	Adjust this parameter based on the actual compensation effect.	100	%	UInt16	Real-time	Real-time
H08.59	2008-3Ch	Medium- and low-frequency jitter suppression frequency 4	0.0 Hz–300.0 Hz	Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.	0.0	Hz	UInt16	Real-time	Real-time
H08.60	2008-3Dh	Medium- and low-frequency jitter suppression compensation 4	0% to 200%	Defines the compensation gain for medium- and low-frequency suppression compensation 4. The setpoint 200% indicates full compensation.	0	%	UInt16	Real-time	Real-time
H08.61	2008-3Eh	Medium- and low-frequency jitter suppression phase modulation 4	0% to 600%	Adjust this parameter based on the actual compensation effect.	100	%	UInt16	Real-time	Real-time
H08.62	2008-3Fh	Position loop integral time constant	0.15 to 512.00	Defines the position loop integral time constant.	512.00	-	UInt16	Real-time	Real-time
H08.63	2008-40h	2nd position loop integral time constant	0.15 to 512.00	Defines the 2nd position loop integral time constant.	512.00	-	UInt16	Real-time	Real-time
H08.64	2008-41h	Speed observer feedback source	0: Disabled 1: Enabled	-	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.65	2008-42h	Zero deviation control selection	0: Disabled 1: Enabled	Used to enable/disable zero deviation control.	0	-	UInt16	Real-time	Real-time
H08.66	2008-43h	Zero deviation control position average filter	0.0 ms–320.0 ms	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.	5.0	ms	UInt16	Real-time	Real-time
H08.67	2008-44h	Zero deviation control position low-pass filter	0.0μs to 5120.0μs	Sets the zero deviation control position low-pass filter time.	190.0	μs	UInt16	Real-time	Real-time
H08.68	2008-45h	Speed feedforward of zero deviation control	0.0% to 100.0%	Defines the speed feedforward of zero deviation control.	100.0	%	UInt16	Real-time	Real-time
H08.69	2008-46h	Torque feedforward of zero deviation control	0.0% to 100.0%	Defines the torque feedforward of zero deviation control.	100.0	%	UInt16	Real-time	Real-time
H08.71	2008-48h	Zero deviation control encoder delay	0.00μs to 512.00μs	Sets zero deviation control encoder delay time.	31.25	μs	UInt16	Real-time	Real-time
H08.81	2008-52h	Anti-resonance frequency of dual-inertia model	1.0 Hz–400.0 Hz	Used to set the anti-resonance frequency of dual-inertia model. You can set this parameter based on the frequency sweeping analysis of mechanical characteristics.	20.0	Hz	UInt16	Real-time	Real-time
H08.82	2008-53h	Resonance frequency of dual-inertia model	0.0 Hz–6553.5 Hz	Used to set the resonance frequency of dual-inertia model. You can set this parameter based on the frequency sweeping analysis of mechanical characteristics. If accurate resonance frequency is unknown, set H08.84 based on the inertia ratio of the resonance model.	0.0	Hz	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H08.83	2008-54h	Dual-inertia model gain	0.1/s to 300.0/s	Defines the dual-inertia model gain.	60.0	1/s	UInt16	Real-time	Real-time
H08.84	2008-55h	Inertia ratio of dual-inertia model	0.00 to 120.00	If the resonance frequency of dual-inertia model is set accurately, there is no need to set this parameter.	1.00	-	UInt16	Real-time	Real-time
H08.88	2008-59h	Speed feedforward value of dual-inertia model	0.0 to 6553.5	Set this parameter to 100% in general cases.	100.0	-	UInt16	Real-time	Real-time
H08.89	2008-5Ah	Torque feedforward value of dual-inertia model	0.0 to 6553.5	Set this parameter to 100% in general cases.	100.0	-	UInt16	Real-time	Real-time

16.10 H09 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.00	2009-01h	Auto-adjustment mode	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 6: Quick positioning mode+Inertia auto-tuning	Defines different gain tuning modes. Related gain parameters can be set manually or automatically according to the stiffness level.	0	-	UInt16	Real-time	Real-time
H09.01	2009-02h	Stiffness level selection	0 to 41	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.	15	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	Defines the operation mode of the adaptive notch.	3	-	UInt16	Real-time	Real-time
H09.03	2009-04h	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	Defines whether to enable online inertia auto-tuning and the inertia ratio update speed during online inertia auto-tuning.	2	-	UInt16	Real-time	Real-time
H09.05	2009-06h	Offline inertia auto-tuning mode	0: Bi-directional 1: Unidirectional	Defines the offline inertia auto-tuning mode. The offline inertia auto-tuning function can be enabled through H0d.02.	1	-	UInt16	At stop	Real-time
H09.06	2009-07h	Max. speed of inertia auto-tuning	100 RPM to 1000 RPM	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.	500	rpm	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.07	2009-08h	Time constant for accelerating to max. speed during inertia auto-tuning	20 ms–800 ms	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.	125	ms	UInt16	At stop	Real-time
H09.08	2009-09h	Interval time after an individual inertia auto-tuning	50 ms–10000 ms	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).	800	ms	UInt16	At stop	Real-time
H09.09	2009-0Ah	Number of motor revolutions per inertia auto-tuning	0.00 to 100.00	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.	1.00	-	UInt16	Real-time	Real-time
H09.11	2009-0Ch	Vibration threshold	0.0% to 100.0%	Alarm threshold for current feedback oscillation.	5.0	%	UInt16	Real-time	Real-time
H09.12	2009-0Dh	Frequency of the 1st notch	50 Hz–8000 Hz	Defines the center frequency of the notch, which is the mechanical resonance frequency. In the torque control mode, setting the notch frequency to 4000 Hz deactivates the notch function.	8000	Hz	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.13	2009-0Eh	Width level of the 1st notch	0 to 20	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.	2	-	UInt16	Real-time	Real-time
H09.14	2009-0Fh	Depth level of the 1st notch	0 to 99	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.	0	-	UInt16	Real-time	Real-time
H09.15	2009-10h	Frequency of the 2nd notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.16	2009-11h	Width level of the 2nd notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.17	2009-12h	Depth level of the 2nd notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.18	2009-13h	Frequency of the 3rd notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.19	2009-14h	Width level of the 3rd notch	0 to 20	-	2	-	UInt16	Real-time	Real-time
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.21	2009-16h	Frequency of the 4th notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.22	2009-17h	Width level of the 4th notch	0 to 20	-	2	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	-	0	-	UInt16	Real-time	Real-time
H09.24	2009-19h	Auto-tuned resonance frequency	0 Hz–5000 Hz	When H09.02 (Adaptive notch mode) is set to 3, the current mechanical resonance frequency is displayed.	0	Hz	UInt16	Unchangeable	-
H09.32	2009-21h	Gravity compensation value	-100.0% to 100.0%	Defines the gravity compensation value. Setting this parameter properly in vertical axis applications can reduce the falling amplitude upon start.	0.0	%	Int16	Real-time	Real-time
H09.33	2009-22h	Positive friction compensation value	0.0% to 100.0%	Defines the forward friction compensation value.	0.0	%	UInt16	Real-time	Real-time
H09.34	2009-23h	Negative friction compensation value	-100.0% to 0.0%	Defines the reverse direction friction compensation value.	0.0	%	Int16	Real-time	Real-time
H09.35	2009-24h	Friction compensation speed	0.0 to 20.0	Defines the friction compensation speed.	2.0	-	UInt16	Real-time	Real-time
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	-	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.37	2009-26h	Vibration monitoring time	0 to 65535	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 65536. ***Note*** The unit is "second". When the adaptive notch (H09.02) is enabled, if the system keeps operating stably after the time defined by H09.37 elapses, H09.02 will be set to 0 automatically.	600	s	UInt16	Real-time	Real-time
H09.41	2009-2Ah	Frequency of the 5th notch	50 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.42	2009-2Bh	Width level of the 5th notch	0 to 20	-	2	-	UInt16	At stop	Real-time
H09.43	2009-2Ch	Depth level of the 5th notch	0 to 99	-	0	-	UInt16	At stop	Real-time
H09.44	2009-2Dh	Frequency of low-frequency resonance suppression 2 at mechanical load end	0.0 to 100.0	Set this parameter based on the actual jitter frequency.	0.0	-	UInt16	Real-time	Real-time
H09.45	2009-2Eh	Responsiveness of low-frequency resonance suppression 2 at mechanical load end	0.01 to 5.00	Use the default setpoint in general cases. To increase the setpoint, reduce the delay time.	1.00	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.47	2009-30h	Width of low-frequency resonance suppression 2 at mechanical load end	0.00 to 2.00	Use the default setpoint in general cases. To increase the setpoint, increase the delay time.	1.00	-	UInt16	Real-time	Real-time
H09.49	2009-32h	Frequency of low-frequency resonance suppression 3 at mechanical load end	0.0 to 100.0	-	0.0	-	UInt16	Real-time	Real-time
H09.50	2009-33h	Responsiveness of low-frequency resonance suppression 3 at mechanical load end	0.01 to 5.00	-	1.00	-	UInt16	Real-time	Real-time
H09.52	2009-35h	Width of low-frequency resonance suppression 3 at mechanical load end	0.00 to 2.00	-	1.00	-	UInt16	Real-time	Real-time
H09.54	2009-37h	Vibration threshold	0.0% to 300.0%	If the torque fluctuation exceeds the setpoint, an error will be reported. Setting this parameter to 0 hides the resonance detection function.	50.0	%	UInt16	Real-time	Real-time
H09.56	2009-39h	Max. overshoot allowed by ETune	0 to 65535	Defines the maximum overshoot value allowed during ETune adjustment.	2936	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.57	2009-3Ah	STune resonance suppression switch over frequency	0 Hz–4000 Hz	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.	900	Hz	UInt16	Real-time	Real-time
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disabled 1: Enabled	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	-	UInt16	Real-time	Real-time
H09.71	2009-48h	Starting frequency	0 Hz–8000 Hz	-	15	Hz	UInt16	Real-time	Real-time
H09.72	2009-49h	End frequency	0 Hz–8000 Hz	-	4000	Hz	UInt16	Real-time	Real-time
H09.73	2009-4Ah	Frequency subdivision	0 to 1000	-	50	-	UInt16	Real-time	Real-time
H09.74	2009-4Bh	Excitation amplitude	0.0% to 400.0%	-	5.0	%	UInt16	Real-time	Real-time
H09.75	2009-4Ch	Starting frequency 2	0 Hz–8000 Hz	-	500	Hz	UInt16	Real-time	Real-time
H09.76	2009-4Dh	Frequency subdivision 2	0 to 1000	-	500	-	UInt16	Real-time	Real-time
H09.77	2009-4Eh	Biquard1 mode	0: Disabled 1: First order low pass 2: Second order low pass 4: Lead lag 5: Custom	Setting H09.27 to 1 enables the ITune function. Note: ITune mode 2 is manufacturer commissioning mode, which should be used with caution.	0	-	UInt16	Real-time	Real-time
H09.78	2009-4Fh	Biquard1 numerator frequency	0 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.79	2009-50h	Biquard1 numerator damping coefficient	0.100 to 10.000	-	0.707	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H09.80	2009-51h	Biquard1 dominator frequency	0 Hz–8000 Hz	-	8000	Hz	UInt16	Real-time	Real-time
H09.81	2009-52h	Biquard1 denominator damping coefficient	0.100 to 10.000	-	0.707	-	UInt16	Real-time	Real-time

16.11 H0A Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.01	200A-02h	Absolute position limit	0: Disabled 1: Enabled 2: Enabled after homing	Used to set the activation condition for enabling the software position limit function and the software limit.	0	-	UInt16	Real-time	Real-time
H0A-03	200A-04h	Power-off memory	0: Disable power-off memory 1: Enable power-off memory 2: Disable power-off memory and hide control power supply undervoltage fault	-	0	-	UInt16	Real-time	Real-time
H0A.04	200A-05h	Motor overload protection gain	50 to 300	Determines the motor overload duration before E620.0 (Motor overload) is reported. You can change the setpoint to advance or delay the time when overload protection is triggered based on the motor temperature. The setpoint 50% indicates the time is cut by half; 150% indicates the time is increased by 50%. Set this parameter based on the actual temperature of the motor.	100	-	UInt16	Real-time	Real-time
H0A.08	200A-09h	Over speed threshold	0rpm to 20000rpm	Defines the overspeed threshold of the motor.	0	rpm	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.10	200A-0Bh	Threshold of excessive local position deviation	0 to 4294967295	Defines the threshold for excessive position deviation in the position control mode. When the position deviation exceeds this threshold, the drive reports EB00.0 (Position deviation too large).	2198955608	-	UInt32	Real-time	Real-time
H0A.12	200A-0Dh	Runaway protection enable	0: Disabled 1: Enabled	Defines whether to enable runaway protection. 0: Disables E234.0 detection when the motor drives a vertical axis or is driven by the load 1: Enables runaway protection	1	-	UInt16	Real-time	Real-time
H0A.18	200A-13h	IGBT over-temperature threshold	120°C–175°C	Defines the threshold for reporting E640.0 (IGBT overtemperature) and E640.1 (Flywheel diode overtemperature).	140	°C	UInt16	Real-time	Real-time
H0A.19	200A-14h	Filter time constant of touch probe 1	0.00 µs–6.30 µs	Defines the filter time of touch probe 1. An active input must last for the time defined by H0A.19.	2.00	µs	UInt16	Real-time	Real-time
H0A.20	200A-15h	Filter time constant of touch probe 2	0.00 µs–6.30 µs	Defines the filter time of touch probe 2. An active input must last for the time defined by H0A.20.	2.00	µs	UInt16	Real-time	Real-time
H0A.22	200A-17h	Sigma_Delta filter time	0 to 65535	-	1	-	UInt16	At stop	Upon the next power-on
H0A.23	200A-18h	TZ signal filter time	0 ns–31 ns	-	15	25ns	UInt16	At stop	Upon the next power-on
H0A.25	200A-1Ah	Speed display DO low-pass filter time	0 ms–5000 ms	Defines the low-pass filter time constant of the speed information for speed feedback and position references.	0	ms	UInt16	Real-time	Real-time
H0A.26	200A-1Bh	Motor overload detection	0: Show motor overload alarm (E909.0) and fault (E620.0) 1: Hide motor overload alarm (E909.0) and fault (E620.0)	Defines whether to enable motor overload detection.	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.27	200A-1Ch	Average filter time for speed display DO	0 ms–100 ms	Defines the average filter time constant of the speed information for speed feedback and position references.	50	ms	UInt16	Real-time	Real-time
H0A.29	200A-1Eh	Fully closed-loop encoder (ABZ) filter time	0 ns–255 ns	-	15	25ns	UInt16	At stop	Upon the next power-on
H0A.32	200A-21h	Time threshold for locked motor overheat protection	10 ms–65535 ms	Defines the overtemperature 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.	200	ms	UInt16	Real-time	Real-time
H0A.33	200A-22h	Locked motor overheat protection	0: Disabled 1: Enabled	Enables or disables the detection for E630.0 (Motor stall overtemperature protection).	1	-	UInt16	Real-time	Real-time
H0A.35	200A-24h	3rd-party encoder reading ROM upon power-on	0: Not prohibited 1: Prohibited	Not prohibited: The motor parameters are read from the encoder. Prohibited: The motor parameters are read from the drive.	0	-	UInt16	Real-time	Upon the next power-on
H0A.36	200A-25h	Encoder multi-turn overflow fault selection	0: Not hide 1: Hide	Defines whether to hide the encoder multi-turn overflow fault in the absolute position linear mode (H02.01 = 1).	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.40	200A-29h	Compensation function selection	bit0: Overtravel compensation 0: Enabled 1: Disabled bit1: Touch probe rising edge compensation 0: Disabled 1: Enabled bit2: Touch probe falling edge compensation 0: Disabled 1: Enabled bit3: Touch probe solution 0: New solution 1: Old solution (same as SV660N)	-	6	-	UInt16	At stop	Real-time
H0A.41	200A-2Ah	Forward position of software position limit	-2147483648 to 2147483647	When the absolute position counter (H0b.07) is larger than H0A.41, the servo drive reports E950.0 (Forward limit switch alarm) and executes stop at forward limit.	2147483647	encoder unit	Int32	At stop	Real-time
H0A.43	200A-2Ch	Reverse position of software position limit	-2147483648 to 2147483647	When the absolute position counter (H0b.07) is smaller than H0A.43, the servo drive reports alarm E952.0 (Reverse limit switch alarm) and executes stop at reverse limit.	-2147483648	encoder unit	Int32	At stop	Real-time
H0A.46	200A-2Fh	Resonance alarm threshold	0.0 to 100.0	Sets the resonance alarm threshold.	30.0	-	UInt16	Real-time	Real-time
H0A.49	200A-32h	Braking resistor overtemperature threshold	100°C–175°C	Defines the temperature threshold for braking resistor overload.	115	°C	UInt16	Real-time	Real-time
H0A.50	200A-33h	Encoder communication fault tolerance threshold	0 to 31	When the number of communication failures between the encoder and the drive exceeds H0A.50, the communication between the encoder and the drive fails.	31	-	UInt16	Real-time	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.52	200A-35h	Encoder temperature protection threshold	0deg to 175deg	Defines the temperature threshold for encoder overtemperature protection.	125	deg	UInt16	Real-time	Real-time
H0A.53	200A-36h	Probe DI ON compensation time	-3000 to 3000	Used to compensate for the action time when the touch probe is switched on. Example: 3000 is the maximum value that can be set, the unit is 25ns, and the maximum time is 3000 × 25 = 75,000ns	200	25ns	Int16	Real-time	Real-time
H0A.54	200A-37h	Probe DI OFF compensation time	-3000 to 3000	Used to compensate for the action time when the touch probe is switched off. Example: 3000 is the maximum value that can be set, the unit is 25ns, and the maximum time is 3000 × 25 = 75,000ns	1512	25ns	Int16	Real-time	Real-time
H0A.55	200A-38h	Runaway current threshold	100.0% to 400.0%	Defines the current threshold for runaway protection detection.	200.0	%	UInt16	Real-time	Real-time
H0A.56	200A-39h	Fault reset delay	0 ms–60000 ms	-	10000	ms	UInt16	Real-time	Real-time
H0A.57	200A-3Ah	Runaway speed threshold	1 rpm to 1000 rpm	Defines the overspeed threshold for runaway protection detection.	50	rpm	UInt16	Real-time	Real-time
H0A.58	200A-3Bh	Runaway speed filter time	0.1 ms–100.0 ms	Defines the speed feedback filter time for runaway protection detection.	2.0	ms	UInt16	Real-time	Upon the next power-on
H0A.59	200A-3Ch	Runaway protection detection time	10 ms–1000 ms	The runaway fault will be reported when runaway keeps active for a period longer than H0A.59.	30	ms	UInt16	Real-time	Real-time
H0A.60	200A-3Dh	Black box function mode	0: Disabled 1: Any fault 2: Designated fault 3: Triggered based on designated condition	Defines the condition for triggering black box sampling.	1	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.61	200A-3Eh	Designated fault code	0.0 to 6553.5	Defines the fault code for triggering the black box function.	0.0	-	UInt16	Real-time	Real-time
H0A.62	200A-3Fh	Trigger source	0 to 25	Defines the fault code for triggering the black box function through designated channel.	0	-	UInt16	Real-time	Real-time
H0A.63	200A-40h	Trigger level	-2147483648 to 2147483647	Defines the trigger level for triggering the black box function through designated channel.	0	-	Int32	Real-time	Real-time
H0A.65	200A-42h	Trigger level	0: Rising edge 1: Equal 2: Falling edge 3: Edge-triggered	Defines the trigger mode for triggering the black box function through H0A.63.	0	-	UInt16	Real-time	Real-time
H0A.66	200A-43h	Trigger position	0% to 100%	Defines the pre-trigger position for triggering black box sampling.	75	%	UInt16	Real-time	Real-time
H0A.67	200A-44h	Sampling frequency	0: Current loop 1: Position loop 2: Main cycle	Defines the frequency sampling mode during black box sampling.	0	-	UInt16	Real-time	Real-time
H0A.70	200A-47h	Over speed threshold 2	0rpm to 20000rpm	Defines the speed threshold for reporting E500.2 (Position feedback pulse overspeed).	0	rpm	UInt16	Real-time	Real-time
H0A.71	200A-48h	MS1 motor overload curve switch over	0 to 65535	bit0: Motor overload curve selection 0: New motor overload curve 1: Old motor overload curve bit12: Whether the homing completion flag bit is powered down and saved 0: Disabled 1: Enabled	4098	-	UInt16	Real-time	Real-time
H0A.72	200A-49h	Maximum stop time in ramp-to-stop	0 ms–65535 ms	Defines the time for the motor to decelerate from the maximum speed to 0rpm during ramp-to-stop.	10000	ms	UInt16	At stop	Real-time
H0A.73	200A-4Ah	STO 24 V disconnection filter time	1 ms–5 ms	Defines the delay from the moment when 24V is disconnected to the moment when the STO state applies.	5	ms	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.74	200A-4Bh	Filter time for two inconsistent STO channels	1 ms–1000 ms	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.	100	ms	UInt16	Real-time	Real-time
H0A.75	200A-4Ch	Servo OFF delay after STO triggered	0 ms–25 ms	Defines the delay from the moment the STO state is triggered to the moment the S-ON signal is switched off.	0	ms	UInt16	Real-time	Real-time
H0A.81	200A-52h	Enable voltage drop protection	0: No operation 1: Host controller executes torque limit 2: Servo executes torque limit	-	0	-	UInt16	At stop	Upon the next power-on
H0A.82	200A-53h	Voltage drop torque limit	0.0% to 100.0%	-	50.0	%	UInt16	Real-time	Real-time
H0A.83	200A-54h	Torque limit cancel time	0 ms–1000 ms	-	100	ms	UInt16	Real-time	Real-time
H0A.84	200A-55h	Instantaneous power failure holding time	20 ms–50000 ms	-	1000	ms	UInt16	Real-time	Real-time
H0A.85	200A-56h	Wire breakage torque reference	4.0% to 400.0%	-	5.0	%	UInt16	At stop	Real-time
H0A.86	200A-57h	Wire breakage detection filter time	5 ms–1000 ms	-	30	ms	UInt16	At stop	Real-time
H0A.87	200A-58h	UWV Hall state monitoring window	0 to 1000	Defines the Hall signal filter time.	1	-	UInt16	Real-time	Real-time
H0A.90	200A-5Bh	Moving average filter time for speed display values	0 ms–2 ms	Defines the moving average filter time constant for speed display values.	0	ms	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0A.91	200A-5Ch	Moving average filter time for torque display values	0 ms–2 ms	Defines the moving average filter time constant for torque display values.	0	ms	UInt16	At stop	Real-time
H0A.92	200A-5Dh	Moving average filter time for position display values	0 ms–2 ms	Defines the moving average filter time constant for position display values.	0	ms	UInt16	At stop	Real-time
H0A.93	200A-5Eh	Low-pass filter time for voltage display values	0 ms–2 ms	Defines the low-pass filter time constant for voltage display values.	0	ms	UInt16	Real-time	Real-time
H0A.94	200A-5Fh	Low-pass filter time for thermal display values	0 ms–2 ms	Defines the filter time constant for thermal display values.	0	ms	UInt16	Real-time	Real-time

16.12 H0b Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.00	200b-01h	Motor speed actual value	-32767rpm to 32767rpm	It displays the actual speed of the servo motor after round-off, in unit of 1 RPM. Set in H0A.25 (Filter time constant of speed feedback display) the filter time constant for H0b.00.	0	rpm	Int16	Unchangeable	-
H0b.01	200b-02h	Speed reference	-32767rpm to 32767rpm	Indicates the present speed reference (accurate to 1rpm) of the drive in the position and speed control modes.	0	rpm	Int16	Unchangeable	-
H0b.02	200b-03h	Internal torque reference	-500.0% to 500.0%	Displays present torque reference (accurate to 0.1%). The value 100.0% corresponds to the rated torque of the motor.	0.0	%	Int16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.03	200b-04h	Input (DI) signal monitoring	0 to 65535	Displays the level status of eight DI terminals without filtering. Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0")	0	-	UInt16	Unchangeable	-
H0b.05	200b-06h	Output (DO) signal monitoring	0 to 65535	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")	0	-	UInt16	Unchangeable	-
H0b.07	200b-08h	Absolute position counter	-2147483648p to 2147483647p	Displays current absolute position of the motor (reference unit). This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.	0	p	Int32	Unchangeable	-
H0b.09	200b-0Ah	Mechanical angle	0.0° to 360.0°	Displays present mechanical angle (encoder unit) of the motor. The setpoint 0 indicates the mechanical angle is 0°. Actual mechanical angle = 360 ° × H0b.09/ (H0b.09 max +1) Absolute encoder H0b.09 max: 65535	0.0	°	UInt16	Unchangeable	-
H0b.10	200b-0Bh	Electrical angle	0.0° to 360.0°	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°.	0.0	°	UInt16	Unchangeable	-
H0b.12	200b-0Dh	Average load ratio	0.0% to 800.0%	Displays the percentage of the average load torque to the rated torque of the motor, which is accurate to 0.1%. The value 100.0% corresponds to the rated torque of the motor.	0.0	%	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.15	200b-10h	Position following error (encoder unit)	-2147483648p to 2147483647p	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 clear when the condition defined in H05.16 (Clear action) is met.	0	p	Int32	Unchangeable	-
H0b.17	200b-12h	Feedback pulse counter	-2147483648p to 2147483647p	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.	0	p	Int32	Unchangeable	-
H0b.19	200b-14h	Total power-on time	0.0s–429496729.5 s	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.	0.0	s	UInt32	Unchangeable	-
H0b.24	200b-19h	Phase current RMS value	0.00 A–655.35 A	Displays the RMS value of the phase current of the motor, accurate to 0.01 A.	0.00	A	UInt16	Unchangeable	-
H0b.26	200b-1Bh	Bus voltage	0.0 V to 6553.5 V	Displays the DC bus voltage of the main circuit input voltage after rectification, which is accurate to 0.01 V.	0.0	V	UInt16	Unchangeable	-
H0b.27	200b-1Ch	Module temperature	-20°C–200°C	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.	0	°C	Int16	Unchangeable	-
H0b.28	200b-1Dh	Absolute encoder fault information given by FPGA	0 to 65535	-	0	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.29	200b-1Eh	Axis status information given by FPGA	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.30	200b-1Fh	Axis fault information given by FPGA	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.31	200b-20h	Encoder fault information	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.33	200b-22h	Fault log	0: Present fault 1: Last fault 2: 2nd to last fault 3: 3rd to last fault 4: 4th to last fault 5: 5th to last fault 6: 6th to last fault 7: 7th to last fault 8: 8th to last fault 9: 9th to last fault 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	Used to view the latest 20 faults of the drive.	0	-	UInt16	Real-time	Real-time
H0b.34	200b-23h	Fault code of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.35	200b-24h	Time stamp of the selected fault	0.0s–429496729.5 s	-	0.0	s	UInt32	Unchangeable	-
H0b.37	200b-26h	Motor speed upon occurrence of the selected fault	-32767rpm to 32767rpm	-	0	rpm	Int16	Unchangeable	-
H0b.38	200b-27h	Motor phase U current upon occurrence of the selected fault	-3276.7 A to 3276.7 A	-	0.0	A	Int16	Unchangeable	-
H0b.39	200b-28h	Motor phase V current upon occurrence of the selected fault	-3276.7 A to 3276.7 A	-	0.0	A	Int16	Unchangeable	-
H0b.40	200b-29h	Bus voltage upon occurrence of the selected fault	0.0 V to 6553.5 V	-	0.0	V	UInt16	Unchangeable	-
H0b.41	200b-2Ah	Input terminal state on selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.43	200b-2Ch	Output terminal status upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.45	200b-2Eh	Internal fault code	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.46	200b-2Fh	Absolute encoder fault information given by FPGA upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.47	200b-30h	System status information given by FPGA upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.48	200b-31h	System fault information given by FPGA upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.49	200b-32h	Encoder fault information upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.51	200b-34h	Internal fault code upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.52	200b-35h	FPGA timeout fault standard bit upon occurrence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.53	200b-36h	Position following error (reference unit)	-2147483648p to 2147483647p	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.	0	p	Int32	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.55	200b-38h	Motor speed actual value	-2147483648.0rpm to 2147483647.0rpm	Indicates the actual value of motor speed, which is accurate to 0.1 rpm. This parameter is a 32-bit integer, which is displayed as a decimal on the keypad. H0A.25 (Filter time constant of speed feedback display) can be used to set the filter time constant of the speed feedback.	0.0	rpm	Int32	Unchangeable	-
H0b.57	200b-3Ah	Control circuit bus voltage	0.0 V to 6553.5 V	Displays the bus voltage of the control circuit.	0.0	V	UInt16	Unchangeable	-
H0b.58	200b-3Bh	Mechanical absolute position (low 32 bits)	-2147483648p to 2147483647p	Displays the low 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.	0	p	Int32	Unchangeable	-
H0b.60	200b-3Dh	Mechanical absolute position (high 32 bits)	-2147483648p to 2147483647p	Displays the high 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.	0	p	Int32	Unchangeable	-
H0b.63	200b-40h	NotRdy state	1: Control circuit error 2: Main circuit power input error 3: Bus undervoltage 4: Soft start failed 5: Encoder initialization undone 6: Short circuit to ground failed 7: Others	Displays the reason for the NRD state.	0	-	UInt16	Unchangeable	-
H0b.66	200b-43h	Encoder temperature	-32768deg to 32767deg	-	0	deg	Int16	Unchangeable	-
H0b.67	200b-44h	Load rate of braking resistor	0.0% to 200.0%	-	0.0	%	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.70	200b-47h	Number of absolute encoder revolutions	0Rev to 65535Rev	Indicates the number of revolutions of the absolute encoder.	0	Rev	UInt16	Unchangeable	-
H0b.71	200b-48h	Single-turn position fed back by the absolute encoder	0p to 2147483647p	Displays the position feedback of the absolute encoder within one turn.	0	p	UInt32	Unchangeable	-
H0b.74	200b-4Bh	System fault information given by FPGA	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.77	200b-4Eh	Encoder position (low 32 bits)	-2147483648p to 2147483647p	Displays the low 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangeable	-
H0b.79	200b-50h	Encoder position (high 32 bits)	-2147483648p to 2147483647p	Displays the high 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangeable	-
H0b.81	200b-52h	Single-turn position of the rotary load (low 32 bits)	-2147483648p to 2147483647p	Displays the low 32-bit value of the position feedback of the rotary load when the absolute system works in the rotation mode.	0	p	Int32	Unchangeable	-
H0b.83	200b-54h	Single-turn position of the rotary load (high 32 bits)	-2147483648p to 2147483647p	Displays the high 32-bit value of the position feedback of the rotary load when the absolute system works the rotation mode.	0	p	Int32	Unchangeable	-
H0b.85	200b-56h	Single-turn position of the rotary load (reference unit)	-2147483648p to 2147483647p	Displays the high 32-bit value of the position feedback of the rotary load when the absolute system works the rotation mode.	0	p	Int32	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0b.87	200b-58h	IGBT junction temperature	0 to 200	-	0	-	UInt16	Unchangeable	-
H0b.90	200b-5Bh	Group No. of the abnormal parameter	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.91	200b-5Ch	Offset within the group of the abnormal parameter	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0b.92	200b-5Dh	80D motor torque display	0.0 to 6553.5	-	0.0	-	Int16	Unchangeable	Real-time
H0b.94	200b-5Fh	Individual power-on time	0.0s–429496729.5 s	Display the individual power-on time of the drive.	0.0	s	UInt32	Unchangeable	-
H0b.96	200b-61h	Individual power-on time upon occurrence of the selected fault	0.0s–429496729.5 s	-	0.0	s	UInt32	Unchangeable	-
H0b.98	200b-63h	Fan speed level display	0s to 3s	-	0	s	UInt16	Unchangeable	-

16.13 H0C Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0C.00	200C-01h	Wire breakage enable detection	0 to 3	-	0	-	UInt16	At stop	Real-time
H0C.01	200C-02h	Wire breakage detection gain	1.0 to 100.0	-	2.5	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0C.02	200C-03h	Wire breakage detection filter time	5 to 1000	-	30	-	UInt16	At stop	Real-time
H0C.31	200C-20h	Drive overload protection method	0: Overload curve 1: Junction temperature estimation	Used to switch drive protection mode	0	-	UInt16	At stop	At stop
H0C.32	200C-21h	PTC and KTY selection	0: Disabled 1: PTC 2: KTY	Motor PTC and KTY selection.	0	-	UInt16	At stop	At stop
H0C.33	200C-22h	Hide PTC and KTY faults	0: Not hide 1: Hide	Hides motor PTC and KTY faults.	0	-	UInt16	Real-time	Real-time
H0C.34	200C-23h	KTY mode selection	0: KTY_84 1: PT1000	KTY mode selection	0	-	UInt16	At stop	At stop
H0C.37	200C-26h	Motor temperature	-40 to 200	-	0	-	Int16	Unchangeable	Real-time
H0C.36	200C-25h	Motor overtemperature threshold	-40 to 200	-	130	-	Int16	Real-time	Real-time
H0C.71	200C- 48h	Function switch	0 to 65535	bit6: TPDO communication after the main power is cut off during 24V connection 0: Disabled 1: Enabled bit7: H0D20 automatic software reset 0: Disabled 1: Enabled	0	-	UInt16	At stop	Next power-on

16.14 H0d Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0d.00	200d-01h	Software Reset	0: No operation 1: Reset	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.	0	-	UInt16	At stop	Real-time
H0d.01	200d-02h	Fault reset	0: No operation 1: Reset	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.	0	-	UInt16	At stop	Real-time
H0d.02	200d-03h	Inertia auto-tuning enable	0 to 65	Used to enable offline inertia auto-tuning through the keypad. In the parameter display mode, switch to H0d.02 and press the ENTER key to enable offline inertia auto-tuning.	0	-	UInt16	Real-time	Real-time
H0d.03	200d-04h	Encoder initial angle auto-tuning	0: No operation 1: Enabled	-	0	-	UInt16	At stop	Real-time
H0d.04	200d-05h	Read/ write in encoder ROM	0: No operation 1: Write ROM 2: Read ROM 3: ROM failure	-	0	-	UInt16	At stop	Real-time
H0d.05	200d-06h	Emergency stop	0: No operation 1: Emergency stop	-	0	-	UInt16	Real-time	Real-time
H0d.12	200d-0Dh	Phase U/V current balance correction	0: Disabled 1: Enabled	-	0	-	UInt16	At stop	Upon the next power-on

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0d.17	200d-12h	Forced DI/DO enable switch	bit0: Forced DI enable switch 0: Disabled 1: Enabled bit1: Forced DO enable switch 0: Disabled 1: Enabled	Forced DI/DO selection.	0	-	UInt16	Real-time	Real-time
H0d.18	200d-13h	Forced DI value	0 to 255	Defines whether the DI functions set in group H03 is active when forced DI is activated (H0d.17 = 1 or 3). The value of H0d.18 is displayed as a hexadecimal on the keypad. When it is converted to a binary value, "bit(n) = 1" indicates the level logic of DI function is high level; "bit(n) = 0" indicates the level logic of the DI function is low level.	255	-	UInt16	Real-time	Real-time
H0d.19	200d-14h	Forced DO value	0 to 3	Defines whether the DO functions assigned in group H04 are active when forced DO is active (H0d.17 = 2 or 3). The value of H0d.19 is displayed as a hexadecimal on the keypad. When it is converted to a binary value, "bit(n) = 1" indicates the DO function is active; "bit(n) = 0" indicates the DO function is inactive.	0	-	UInt16	Real-time	Real-time
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	You can reset the encoder error or the multi-turn data fed back by the encoder by setting H0d.20.	0	-	UInt16	At stop	Real-time
H0d.23	200d-18h	Torque fluctuation auto-tuning	0 to 1	-	0	-	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0d.25	200d-1Ah	Dead-zone auto-tuning	0 to 65535	-	0	-	UInt16	At stop	Real-time
H0d.26	200d-1Bh	Brake and dynamic brake started forcibly	0: No forcible operations 1: Dynamic brake deactivated forcibly 2: Brake released forcibly 3: Dynamic brake deactivated and brake released forcibly	-	0	-	UInt16	At stop	Real-time

16.15 H0E Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.00	200E-01h	Node address	1 to 127	Indicates the slave node address. Ensure this parameter is consistent with the configuration of the host controller.	1	-	UInt16	At stop	Real-time
H0E.01	200E-02h	Save objects written through communication to EEPROM	0: Not save 1: Save parameters written through communication to EEPROM 2: Save object dictionaries written through communication to EEPROM 3: Save parameters and object dictionaries written through communication to EEPROM 4: Save object dictionaries written before communication (OP) to EEPROM	You can use this parameter to select a data saving operation when parameters and object dictionaries are written through a serial port or SDO.	4	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.07	200E-08h	Object dictionary unit selection	0: Reference unit system (p/s, p/s2) 1: User unit system (0.01 RPM, ms)	Servo unit system switching function: 0: Using the instruction unit system, the speed object dictionary unit is p/s, and the acceleration object dictionary is p/s2. 1: Use the user unit system. The speed type object dictionary unit is 0.01 rpm, and the acceleration type object dictionary unit is the time (ms) taken to change from 0 rpm to 1000 rpm.	0	-	UInt16	At stop	Real-time
H0E.08	200E-09h	Servo node address selection	0: Node address determined by H0E.00 1: Node address determined by DIP switch 1	-	0	-	UInt16	Real-time	Real-time
H0E.15	200E-10h	Select group 6000 index (last 2 bits)	0 to 255	Sets the index.	255	-	UInt16	Real-time	Real-time
H0E.16	200E-11h	Select group 6000 sub-index	0 to 2	Sets the sub-index.	0	-	UInt16	Real-time	Real-time
H0E.20	200E-15h	EtherCAT slave name	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.21	200E-16h	EtherCAT slave alias	0 to 65535	-	0	-	UInt16	At stop	Upon the next power-on
H0E.22	200E-17h	Number of synchronous loss events allowed by EtherCAT	1 to 20	-	8	-	UInt16	Real-time	Real-time
H0E.24	200E-19h	Sync loss count	0 to 65535	-	0	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.25	200E-1Ah	Max. error value and invalid frames of EtherCAT port 0 per unit time	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.26	200E-1Bh	Max. error value and invalid frames of EtherCAT port 1 per unit time	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.27	200E-1Ch	Max. transfer error of EtherCAT port per unit time	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.28	200E-1Dh	Max. EtherCAT data frame processing unit error per unit time	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.29	200E-1Eh	Max. link loss value of EtherCAT port 0 per unit time	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.31	200E-20h	EtherCAT synchronization mode setting	0 to 2	-	2	-	UInt16	At stop	Upon the next power-on
H0E.32	200E-21h	EtherCAT synchronization error threshold	100 ns–8000 ns	-	3000	ns	UInt16	At stop	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.33	200E-22h	EtherCAT state machine status and port connection status	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.34	200E-23h	Excessive CSP position command increment count	1 to 30	-	20	-	UInt16	Real-time	Real-time
H0E.35	200E-24h	AL fault code	0 to 65535	-	0	-	UInt16	Unchangeable	-
H0E.36	200E-25h	EtherCAT enhanced link enable	0: Disabled 1: Enabled	-	0	-	UInt16	Real-time	Upon the next power-on
H0E.37	200E-26h	EtherCAT XML reset selection	0: Disabled 1: Enabled	-	0	-	UInt16	Real-time	Upon the next power-on
H0E.40	200E-29h	EOE enabling	0: Disabled 1: Enabled	-	0	-	UInt16	Real-time	Real-time
H0E.41	200E-2Ah	Most significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.42	200E-2Bh	Second most significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.43	200E-2Ch	Second least significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.44	200E-2Dh	Least significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.45	200E-2Eh	Most significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.46	200E-2Fh	Second most significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.47	200E-30h	Second least significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.48	200E-31h	Least significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.49	200E-32h	Most significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.50	200E-33h	Second most significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.51	200E-34h	Second least significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.52	200E-35h	Least significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.53	200E-36h	Most significant byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.54	200E-37h	2nd byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.55	200E-38h	3rd byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.56	200E-39h	4th byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.57	200E-3Ah	5th byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.58	200E-3Bh	Least significant byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.60	200E-3Dh	Automatic EtherNet IP address identification	0: Disabled 1: Enabled	-	0	-	UInt16	Real-time	Real-time
H0E.61	200E-3Eh	Most significant byte of EtherNet IP address	0 to 255	-	192	-	UInt16	Real-time	Real-time
H0E.62	200E-3Fh	Second most significant byte of EtherNet IP address	0 to 255	-	168	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.63	200E-40h	Second least significant byte of EtherNet IP address	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.64	200E-41h	Least significant byte of EtherNet IP address	0 to 255	-	2	-	UInt16	Real-time	Real-time
H0E.65	200E-42h	Most significant byte of EtherNet subnet mask	0 to 255	-	255	-	UInt16	Real-time	Real-time
H0E.66	200E-43h	Second most significant byte of EtherNet subnet mask	0 to 255	-	255	-	UInt16	Real-time	Real-time
H0E.67	200E-44h	Second least significant byte of EtherNet subnet mask	0 to 255	-	255	-	UInt16	Real-time	Real-time
H0E.68	200E-45h	Least significant byte of EtherNet subnet mask	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.69	200E-46h	Most significant byte of default EtherNet gateway	0 to 255	-	192	-	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.70	200E-47h	Second most significant byte of default EtherNet gateway	0 to 255	-	168	-	UInt16	Real-time	Real-time
H0E.71	200E-48h	Second least significant byte of default EtherNet gateway	0 to 255	-	0	-	UInt16	Real-time	Real-time
H0E.72	200E-49h	Least significant byte of default EtherNet gateway	0 to 255	-	1	-	UInt16	Real-time	Real-time
H0E.80	200E-51h	Modbus baud rate	0：300bps 1：600bps 2：1200bps 3：2400bps 4：4800bps 5：9600bps 6：19200bps 7：38400bps 8：57600bps 9：115200bps	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.	9	-	UInt16	Real-time	Real-time
H0E.81	200E-52h	Modbus data format	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)	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.	3	-	UInt16	Real-time	Real-time
H0E.82	200E-53h	Modbus response delay	0 ms–20 ms	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.	0	ms	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H0E.83	200E-54h	Modbus communication timeout	0 ms–600 ms	-	0	ms	UInt16	Real-time	Real-time
H0E.84	200E-55h	Sequence of Modbus communication data bits	0: High bits before low bits 1: Low bits before high bits	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	1	-	UInt16	Real-time	Real-time
H0E.90	200E-5Bh	Modbus version	0.00 to 655.35	-	0.00	-	UInt16	Unchangeable	-
H0E.93	200E-5Eh	EtherCAT COE version	0.00 to 655.35	-	0.00	-	UInt16	Unchangeable	-
H0E.96	200E-61h	XML version information	0.00 to 655.35	-	0.00	-	UInt16	Unchangeable	-

16.16 Parameter Group H0F

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0F.00	200F-01h	Encoder feedback mode	0: Internal encoder feedback 1: External encoder feedback 2: Inner/Outer loop switchover	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) Use electronic gear ratio 1. 2: Internal/External encoder feedback switchover during electronic gear ratio switchover (The DI assigned with FunIN.24 (GEAR_SEL, electronic gear ratio switchover) is used to switch between inner and outer position closed loops. DI function: Inactive: Internal encoder feedback, with electronic gear ratio 1 used Active: External encoder feedback, with electronic gear ratio 2 used	0	-	UInt16	Real time	Next power-on
H0F.01	200F-02h	External encoder usage mode	0: Standard operating direction 1: Reverse operating direction	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.	0	-	UInt16	Real time	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0F.03	200F-04h	External encoder feedback type	0: Quadrature pulse	-	0	-	UInt16	At stop	Next power-on
H0F.04	200F-05h	External encoder pulses per revolution	1 to 2147483647	Defines the pulses fed back by the external encoder per revolution of the motor. It 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 encoder (grating scale), the following setting mode can also be used: Manually rotate the motor and observe H0F.18 (Feedback pulse counter of internal encoder) in the meantime. After ensuring that the motor has rotated for a full revolution (H0F.18 = Motor resolution), calculate the change of H0F.20 (Feedback pulse counter of external encoder) and use the absolute value of the change as the value of H0F.04. 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).	10000	-	UInt32	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0F.08	200F-09h	Excessive deviation threshold in com pound control mode	0 to 2147483647	It sets 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.	1000	-	UInt32	Real time	Real time
H0F.10	200F-0Bh	Clear deviation in com pound control mode	0 rpm to 100 rpm	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 will not be cleared when the drive is not in the operational state.	1	rpm	UInt16	Real time	Real time
H0F.13	200F-0Eh	Com pound vibration suppres sion filter time	0.0 to 6553.5	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. When the stiffness of the transmission mechanism between fully closed loop and internal loop is insufficient, set H0F.13 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. When the stiffness is sufficient, there is no need to adjust this parameter.	0.0	ms	UInt16	At stop	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0F.16	200F-11h	Pulse deviation display in com pound control mode	-2147483648 to +2147483647	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	0	Refer ence unit	Int32	Unchangea ble	-
H0F.18 models	200F-13h	Internal position pulse feedback display	-2147483648 to +2147483647	Used to count and display the number of feedback pulses of the internal encoder (after being divided or multiplied by electronic gear ratio, in internal encoder unit).	0	Refer ence unit	Int32	Unchangea ble	-
H0F.20	200F-15h	External position pulse feedback display	-2147483648 to +2147483647	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).	0	Refer ence unit	Int32	Unchangea ble	-
H0F.22	200F-17h	External encoder phase Z detection invalid (quadra ture pulse feedback)	0: Detected 1: Not detected	-	0	-	UInt16	Real time	Real time
H0F.23	200F-18h	Absolute homing offset in fully closed-loop mode	-2147483648 to +2147483647	-	0	-	Int32	Real time	Real time
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	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0F.26	200F-1Bh	Absolute zero offset in fully closed-loop mode	-2147483648 to +2147483647	-	0	-	Int32	Real time	Real time
H0F.45	200F-2Eh	Positioning completion/ Position deviation threshold in fully closed-loop mode	0: Threshold scaled to outer loop unit 1: Same threshold used for inner and outer loops	0: Fully closed-loop positioning completion threshold 6067/Excessive position deviation threshold 6065 (scaled to outer loop unit) 1: Same threshold used for inner and outer loops	0	-	UInt16	At stop	Real time

16.17 Parameter Group H12

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.00	2012–01h	Multi-speed operation mode	0: Individual operation (number of speeds defined by H12.01) 1: Cyclic operation (number of speeds defined by H12.01)	Used to set the multi-reference operation mode when the multi-speed reference is selected as the speed reference source in speed control mode. 0: Individual operation (stop after one cycle of operation), with speed no. changed automatically 1: Individual operation (stop after one cycle of operation), with speed no. changed automatically. The cyclic operation state keeps active as long as the S-ON signal is active. Speed arrival (FunOUT.19: V-Arr) signal is valid when a certain speed reference reaches the set value.	1	-	UInt16	At stop	Real time
H12.01	2012–02h	Number of speed references in multi-speed mode	1 to 16	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, 2...H12.01.	2	-	UInt16	At stop	Real time
H12.02	2012–03h	Operating time unit	0: s 1: min	Defines the time unit of multi-speed operation. 0: s 1: min	0	-	UInt16	At stop	Real time
H12.03	2012–04h	Acceleration time 1	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Acceleration time: the time for the servo motor to accelerate from 0 rpm to 1000 rpm.	10	ms	UInt16	Real time	Real time
H12.04	2012–05h	Deceleration time 1	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Deceleration time: the time for the servo motor to decelerate from 1000 rpm to 0 rpm.	10	ms	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.05	2012–06h	Accelera tion time 2	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Acceleration time: the time for the servo motor to accelerate from 0 rpm to 1000 rpm.	50	ms	UInt16	Real time	Real time
H12.06	2012–07h	Decelera tion time 2	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Deceleration time: the time for the servo motor to decelerate from 1000 rpm to 0 rpm.	50	ms	UInt16	Real time	Real time
H12.07	2012–08h	Accelera tion time 3	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Acceleration time: the time for the servo motor to accelerate from 0 rpm to 1000 rpm.	100	ms	UInt16	Real time	Real time
H12.08	2012–09h	Decelera tion time 3	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Deceleration time: the time for the servo motor to decelerate from 1000 rpm to 0 rpm.	100	ms	UInt16	Real time	Real time
H12.09	2012–0Ah	Accelera tion time 4	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Acceleration time: the time for the servo motor to accelerate from 0 rpm to 1000 rpm.	150	ms	UInt16	Real time	Real time
H12.10	2012–0Bh	Decelera tion time 4	0 to 65535	Four groups of acceleration/ deceleration time can be set for each speed reference. Deceleration time: the time for the servo motor to decelerate from 1000 rpm to 0 rpm.	150	ms	UInt16	Real time	Real time
H12.20	2012–15h	Speed 1	-10000 to +10000	-	0	rpm	Int16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.21	2012–16h	Operating time of speed 1	0.0s(m) to 6553.5s(m)	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.	5.0	s (m)	UInt16	Real time	Real time
H12.22	2012–17h	Acceleration/ Deceleration time of speed 1	0: Zero acceleration/ deceleration time 1: Acceleration/ Deceleration time 1 2: Acceleration/ Deceleration time 2 3: Acceleration/ Deceleration time 3 4: Acceleration/ Deceleration time 4	Defines the acceleration/ deceleration time of speed 1. 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)	0	-	UInt16	Real time	Real time
H12.23	2012–18h	Reference 2	-10000 to +10000	-	100	rpm	Int16	Real time	Real time
H12.24	2012–19h	Operating time of speed 2	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.25	2012–1Ah	Accelera tion/ Decelera tion time of speed 2	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.26	2012–1Bh	Reference 3	-10000 to +10000	-	300	rpm	Int16	Real time	Real time
H12.27	2012–1Ch	Operating time of speed 3	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.28	2012–1Dh	Accelera tion/ Decelera tion time of speed 3	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.29	2012–1Eh	Reference 4	-10000 to +10000	-	500	rpm	Int16	Real time	Real time
H12.30	2012–1Fh	Operating time of speed 4	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.31	2012–20h	Accelera tion/ Decelera tion time of speed 4	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.32	2012–21h	Reference 5	-10000 to +10000	-	700	rpm	Int16	Real time	Real time
H12.33	2012–22h	Operating time of speed 5	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.34	2012–23h	Accelera tion/ Decelera tion time of speed 5	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.35	2012–24h	Reference 6	-10000 to +10000	-	900	rpm	Int16	Real time	Real time
H12.36	2012–25h	Operating time of speed 6	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.37	2012–26h	Accelera tion/ Decelera tion time of speed 6	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.38	2012–27h	Reference 7	-10000 to +10000	-	600	rpm	Int16	Real time	Real time
H12.39	2012–28h	Operating time of speed 7	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.40	2012–29h	Acceleration/ Deceleration time of speed 7	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.41	2012–2Ah	Reference 8	-10000 to +10000	-	300	rpm	Int16	Real time	Real time
H12.42	2012–2Bh	Operating time of speed 8	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.43	2012–2Ch	Acceleration/ Deceleration time of speed 8	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.44	2012–2Dh	Reference 9	-10000 to +10000	-	100	rpm	Int16	Real time	Real time
H12.45	2012–2Eh	Operating time of speed 9	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.46	2012–2Fh	Acceleration/ Deceleration time of speed 9	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.47	2012–30h	Reference 10	-10000 to +10000	-	-100	rpm	Int16	Real time	Real time
H12.48	2012–31h	Operating time of speed 10	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.49	2012–32h	Acceleration/ Deceleration time of speed 10	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.50	2012–33h	Reference 11	-10000 to +10000	-	-300	rpm	Int16	Real time	Real time
H12.51	2012–34h	Operating time of speed 11	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.52	2012–35h	Accelera tion/ Decelera tion time of speed 11	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.53	2012–36h	Reference 12	-10000 to +10000	-	-500	rpm	Int16	Real time	Real time
H12.54	2012–37h	Operating time of speed 12	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.55	2012–38h	Accelera tion/ Decelera tion time of speed 12	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.56	2012–39h	Reference 13	-10000 to +10000	-	-700	rpm	Int16	Real time	Real time
H12.57	2012–3Ah	Operating time of speed 13	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.58	2012–3Bh	Accelera tion/ Decelera tion time of speed 13	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.59	2012–3Ch	Reference 14	-10000 to +10000	-	-900	rpm	Int16	Real time	Real time
H12.60	2012–3Dh	Operating time of speed 14	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.61	2012–3Eh	Accelera tion/ Decelera tion time of speed 14	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.62	2012–3Fh	Reference 15	-10000 to +10000	-	-600	rpm	Int16	Real time	Real time
H12.63	2012–40h	Operating time of speed 15	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H12.64	2012–41h	Accelera tion/ Decelera tion time of speed 15	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time
H12.65	2012–42h	Reference 16	-10000 to +10000	-	-300	rpm	Int16	Real time	Real time
H12.66	2012–43h	Operating time of speed 16	0.0s(m) to 6553.5s(m)	-	5.0	s (m)	UInt16	Real time	Real time
H12.67	2012–44h	Accelera tion/ Decelera tion time of speed 16	Same as H12.22	Same as H12.22	0	-	UInt16	Real time	Real time

16.18 Parameter Group H15

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H15.37	2015–26h	Carrier frequency display	2500: 2500 3000: 3000 3500: 3500 5000: 5000 6000: 6000 7000: 7000 8000: 8000	Displays the carrier frequency (without decimal place).	8000	Hz	UInt16	Real time	-
H01.38	2001–27h	FPGA phase current protection threshold	0% to 20000%	Displays FPGA phase current protection threshold (with one decimal place).	2000	%	UInt16	Real time	Real time
H01.39	2001–28h	Current loop version	0 to 65535	Displays current loop version (without decimal place).	0	-	UInt16	At stop	Next power-on
H15.40	2015–29h	Carrier frequency switch over	0: Not switched 1: 1st group of carrier frequency 2: 2nd group of carrier frequency	Displays the carrier frequency (without decimal place).	0	Hz	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H15.41	2015–2Ah	1st group of carrier frequency	2500: 2500 3000: 3000 3500: 3500 5000: 5000 6000: 6000 7000: 7000 8000: 8000	Displays the carrier frequency (without decimal place).	0	-	Int16	Real time	Real time
H15.42	2015–2Bh	2nd group of carrier frequency	2500: 2500 3000: 3000 3500: 3500 5000: 5000 6000: 6000 7000: 7000 8000: 8000	Displays the carrier frequency (without decimal place).	0	-	Int16	Real time	Real time
H01.43	2001–2Ch	1st group of D-axis propor tional gain	0 to 20000	Display D-axis proportional gain in performance priority mode (without decimal place).	2000	Hz	UInt16	Real time	Real time
H01.44	2001–2Dh	1st group of Q-axis propor tional gain	0 to 20000	Displays Q-axis proportional gain in performance priority mode (without decimal place).	2000	Hz	UInt16	Real time	Real time
H01.45	2001–2Eh	2nd group of D-axis propor tional gain	0 to 20000	Display D-axis proportional gain in performance priority mode (without decimal place).	2000	Hz	UInt16	Real time	Real time
H01.46	2001–2Fh	2nd group of Q-axis propor tional gain	0 to 20000	Displays Q-axis proportional gain in performance priority mode (without decimal place).	2000	Hz	UInt16	Real time	Real time

16.19 H21 Parameters

Parame ter	Hex	Name	Value	Description	De fault	Unit	Data type	Change method	Effective Time
H21.00	2021-01h	Current loop gain switch over	0: No operation 1: Enabled	Turn on or off current loop gain switching function 0: No operation, disabled 1: Enabled	0	-	UInt16	Real-time	Real-time
H21.01	2021-02h	25% current command gain coefficient	0.1% to 200.0%	00% to 25% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H21.02	2021-03h	50% current command gain coefficient	0.1% to 200.0%	25% to 50% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.03	2021-04h	75% current command gain coefficient	0.1% to 200.0%	50% to 75% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.04	2021-05h	100% current command gain coefficient	0.1% to 200.0%	75% to 100% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.05	2021-06h	125% current command gain coefficient	0.1% to 200.0%	100% to 125% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.06	2021-07h	150% current command gain coefficient	0.1% to 200.0%	125% to 150% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.07	2021-08h	175% current command gain coefficient	0.1% to 200.0%	150% to 175% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.08	2021-09h	200% current command gain coefficient	0.1% to 200.0%	175% to 200% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.09	2021-0Ah	225% current command gain coefficient	0.1% to 200.0%	200% to 225% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.10	2021-0Bh	250% current command gain coefficient	0.1% to 200.0%	225% to 250% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H21.11	2021-0Ch	275% current command gain coefficient	0.1% to 200.0%	250% to 275% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.12	2021-0Dh	300% current command gain coefficient	0.1% to 200.0%	275% to 300% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.13	2021-0Eh	325% current command gain coefficient	0.1% to 200.0%	300% to 325% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.14	2021-0Fh	350% current command gain coefficient	0.1% to 200.0%	325% to 350% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.15	2021-10h	375% current command gain coefficient	0.1% to 200.0%	350% to 375% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.16	2021-11h	400% current command gain coefficient	0.1% to 200.0%	375% to 400% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.17	2021-12h	425% current command gain coefficient	0.1% to 200.0%	400% to 425% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.18	2021-13h	450% current command gain coefficient	0.1% to 200.0%	425% to 450% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.19	2021-14h	475% current command gain coefficient	0.1% to 200.0%	450% to 475% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H21.20	2021-15h	500% current command gain coefficient	0.1% to 200.0%	475% to 500% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.21	2021-16h	525% current command gain coefficient	0.1% to 200.0%	500% to 525% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.22	2021-17h	550% current command gain coefficient	0.1% to 200.0%	525% to 550% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.23	2021-18h	575% current command gain coefficient	0.1% to 200.0%	550% to 575% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.24	2021-19h	600% current command gain coefficient	0.1% to 200.0%	575% to 600% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.25	2021-1Ah	625% current command gain coefficient	0.1% to 200.0%	600% to 625% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.26	2021-1Bh	650% current command gain coefficient	0.1% to 200.0%	625% to 650% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.27	2021-1Ch	675% current command gain coefficient	0.1% to 200.0%	650% to 675% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.28	2021-1Dh	700% current command gain coefficient	0.1% to 200.0%	675% to 700% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H21.29	2021-1Eh	725% current command gain coefficient	0.1% to 200.0%	700% to 725% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.30	2021-1Fh	750% current command gain coefficient	0.1% to 200.0%	725% to 750% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.31	2021-20h	775% current command gain coefficient	0.1% to 200.0%	750% to 775% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H21.32	2021-21h	800% current command gain coefficient	0.1% to 200.0%	775% to 800% current command gain coefficient	100.0	%	UInt16	Real-time	Real-time
H12.25	2012-1Ah	Acc./dec. time of speed 2	0: Zero acceleration/ deceleration time 1: Acceleration/ Deceleration time 1 2: Acceleration/ Deceleration time 2 3: Acceleration/ Deceleration time 3 4: Acceleration/ Deceleration time 4	Same as H12.22.	0	-	UInt16	Real-time	Real-time

16.20 H30 Parameters

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H30.00	2030-01h	Servo state read by communication	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.01	2030-02h	DO function state 1 read through communication	0 to 65535	bit0 corresponds to DO function 1 bit1 corresponds to DO function 2 bit2 corresponds to DO function 3 ... and so on	0	-	UInt16	Unchangeable	-
H30.02	2030-03h	DO function state 2 read through communication	0 to 65535	bit0 corresponds to DO function 17 bit1 corresponds to DO function 18 bit2 corresponds to DO function 19 ... and so on	0	-	UInt16	Unchangeable	-
H30.16	2030-11h	Encoder communication timeout count	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.17	2030-12h	Encoder communication CRC error count	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.18	2030-13h	Encoder communication frame stop bit count	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.20	2030-15h	ASCII code of servo SN code BIT1 and BIT0	0 to 65535	H30.20–H30.27 are servo 16-bit SN codes, which are displayed in the form of ASCII codes.	0	-	UInt16	Unchangeable	-
H30.21	2030-16h	ASCII code of servo SN code BIT3 and BIT2	0 to 65535	-	0	-	UInt16	Unchangeable	-

Parameter	Hex	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
H30.22	2030-17h	ASCII code of servo SN code BIT5 and BIT4	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.23	2030-18h	ASCII code of servo SN code BIT7 and BIT6	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.24	2030-19h	ASCII code of servo SN code BIT9 and BIT8	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.25	2030-1Ah	ASCII code of servo SN code BIT11 and BIT10	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.26	2030-1Bh	ASCII code of servo SN code BIT13 and BIT12	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.27	2030-1Ch	ASCII code of servo SN code BIT15 and BIT14	0 to 65535	-	0	-	UInt16	Unchangeable	-

16.21 Parameter Group H31

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H31.04	2031–05h	DO state set through communi cation	0 to 65535	Sets DO output status.	0	-	UInt16	Real time	Real time
H31.09	2031–0Ah	Speed reference set through communi cation	-10000.000 to +10000.000	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).	0.000	rpm	Int32	Real time	Real time
H31.11	2031–0Ch	Torque reference set through communi cation	-100.000% to 100.000%	Set H07.02 to 4 to define the torque reference in the torque control mode through H31.11 (unit: 0.001%). The setpoint 100.000% corresponds to the rated torque of the motor.	0.000	%	Int32	Real time	Real time

16.22 1000h Parameters

Parame ter	Name	Value	Description	De fault	Unit	Data type	Change method	Effective Time
1000.00 h	Device type	0 to 65535	-	0	-	UInt16	Unchangea ble	-
1001.00 h	Error Register	0 to 255	-	0	-	UInt16	Unchangea ble	-
1018.01 h	Vendor ID	0 to 65535	-	0	-	UInt32	Unchangea ble	-
1018.02 h	Product Code	0 to 65535	-	0	-	UInt32	Unchangea ble	-
1018.03 h	Revision	0 to 65535	-	0	-	UInt32	Unchangea ble	-
1600.00 h	Number of valid mapped objects in RPDO1	0 to 20	This object can be modified only when PDO is inactive. When 0 is written, the mapping objects of other sub-indexes are cleared.	3	-	UInt16	Real-time	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
1600.01h	Mapped object 1 in RPDO1	0 to 2147483647	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-bit16: index bit15-bit8: sub-index bit7-bit0: object length	1614807040	-	UInt32	Real-time	-
1600.02h	Mapped object 2 in RPDO1	0 to 2147483647	Same as 1600.01h.	1618608128	-	UInt32	Real-time	-
1600.03h	Mapped object 3 in RPDO1	0 to 2147483647	Same as 1600.01h.	1622671360	-	UInt32	Real-time	-
1600.04h	Mapped object 4 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.05h	Mapped object 5 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.06h	Mapped object 6 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.07h	Mapped object 7 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.08h	Mapped object 8 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.09h	Mapped object 9 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.0Ah	Mapped object 10 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.0Bh	Mapped object 11 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.0Ch	Mapped object 12 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.0Dh	Mapped object 13 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
1600.0Eh	Mapped object 14 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.0Fh	Mapped object 15 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.10h	Mapped object 16 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.11h	Mapped object 17 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.12h	Mapped object 18 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.13h	Mapped object 19 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1600.14h	Mapped object 20 in RPDO1	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real-time	-
1A00.00h	Number of valid mapped objects in TPDO1	0 to 20	This object can be modified only when PDO is inactive. When 0 is written, the mapping objects of other sub-indexes are cleared.	7	-	UInt16	Real-time	-
1A00.01h	Mapped object 1 in TPDO1	0 to 2147483647	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-bit16: index bit15-bit8: sub-index bit7-bit0: object length	1614872576	-	UInt32	Real-time	-
1A00.02h	Mapped object 2 in TPDO1	0 to 2147483647	Same as 1A00.01h.	1617166336	-	UInt32	Real-time	-
1A00.03h	Mapped object 3 in TPDO1	0 to 2147483647	Same as 1A00.01h.	1622736896	-	UInt32	Real-time	-
1A00.04h	Mapped object 4 in TPDO1	0 to 2147483647	Same as 1A00.01h.	1622802432	-	UInt32	Real-time	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
1A00.05h	Mapped object 5 in TPDO1	0 to 2147483647	Same as 1A00.01h.	1622933504	-	UInt32	Real-time	-
1A00.06h	Mapped object 6 in TPDO1	0 to 2147483647	Same as 1A00.01h.	1614741504	-	UInt32	Real-time	-
1A00.07h	Mapped object 7 in TPDO1	0 to 2147483647	Same as 1A00.01h.	1627193344	-	UInt32	Real-time	-
1A00.08h	Mapped object 8 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.09h	Mapped object 9 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.0Ah	Mapped object 10 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.0Bh	Mapped object 11 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.0Ch	Mapped object 12 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.0Dh	Mapped object 13 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.0Eh	Mapped object 14 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.0Fh	Mapped object 15 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.10h	Mapped object 16 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.11h	Mapped object 17 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.12h	Mapped object 18 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1A00.13h	Mapped object 19 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
1A00.14h	Mapped object 20 in TPDO1	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real-time	-
1C12.00h	Number of assigned PDOs	0 to 2	-	1	-	UInt8	Real-time	-
1C12.01h	PDO mapping object index of assigned RxPDO1	5632 to 5898	-	0	-	UInt16	Real-time	-
1C12.02h	PDO mapping object index of assigned RxPDO2	5632 to 5898	-	5632	-	UInt16	Real-time	-
1C13.00h	Number of assigned PDOs	0 to 2	-	5632	-	UInt8	Real-time	-
1C13.01h	PDO mapping object index of assigned TxPDO1	6656 to 6922	-	0	-	UInt16	Real-time	-
1C13.02h	PDO mapping object index of assigned TxPDO1	6656 to 6922	-	6656	-	UInt16	Real-time	-
1C32.01h	Sync mode	0 to 65535	-	6656	-	UInt16	Real-time	-
1C32.02h	Cycle time	0 to 4294967295	-	0	-	UInt32	Real-time	-
1C32.04h	Sync modes supported	0 to 65535	-	0	-	UInt16	Real-time	-
1C32.05h	Minimum cycle time	0 to 4294967295	-	0	-	UInt32	Real-time	-
1C33.01h	Sync mode	0 to 65535	-	0	-	UInt16	Real-time	-
1C33.02h	Cycle time	0 to 4294967295	-	0	-	UInt32	Real-time	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
1C33.04h	Sync modes supported	0 to 65535	-	0	-	UInt16	Real-time	-
1C33.05h	Minimum cycle time	0 to 4294967295	-	0	-	UInt32	Real-time	-

16.23 6000h Parameters

Note

Axis 2 object dictionary requires +0x800 offset.

Example: Axis 2 error code object dictionary: 603Fh+0x800h=683Fh

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
603Fh	Error code	0 to 65535	When there is an abnormal situation not specified by DS402 protocol in drive, 603Fh is 0xFF00, and the 603F value is hexadecimal data. 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.	0	-	UInt16	Unchangeable	-
6040h	Control word	0 to 65535	The control word description is detailed in the section "Basic Drive Functions".	0	-	UInt16	Real-time	Real-time
6041h	Status word	0 to 65535	The description of the status word is detailed in Section "Basic Servo Functions".	0	-	UInt16	Unchangeable	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
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	0: Coast to stop, keep de-energized state1: 6084h/609Ah(HM) ramp stop, keep de-energized state 2: 6085h ramp stop, keep de-energized state 3: Emergency stop torque stop, keep de-energized state 5: 6084h/609Ah(HM) ramp stop, keep position locked state 6: 6085h ramp stop, keep position locked state 7: Emergency stop torque stop, keep position locked state	2	-	Int16	At stop	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
605Ch	Stop mode at S-OFF	–4: Ramp to stop as defined by 6085h, keeping dynamic braking state –3: 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	–4: Ramp to stop as defined by 6085h, keeping dynamic braking state –3: 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	-	Int16	At stop	Real-time
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	Set the stop mode: 1: Stop at 6084h/609Ah (HM) ramp, keep position locked 2: Stop at 6085h ramp and keep the position locked. 3: Stop at emergency stop torque, keeping position lock state	1	-	Int16	At stop	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
605Eh	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	–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	-	Int16	At stop	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6060h	Servo drive 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	Select servo operation mode: 1: Profile Position Mode (PP) 3: Profile velocity mode (PV) 4: Profile Torque Mode (PT) 6: Homing mode (HM) 8: CSP mode 9: CSV mode 10: CST mode Other: NA An unsupported servo mode is selected by SDO and an SDO error will be returned. If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.	0	-	UInt16	Real-time	Real-time
6061h	Operation mode display	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	Reflect the actual operating mode of the servo: 1: Profile Position Mode (PP) 3: Profile velocity mode (PV) 4: Profile Torque Mode (PT) 6: Homing mode (HM) 8: CSP mode 9: CSV mode 10: CST mode	0	-	UInt16	Unchangeable	-
6062h	Position reference	-2147483648 to 2147483647	Indicates the real-time position reference (reference unit).	0	reference unit	Int32	Unchangeable	-
6063h	Position actual value	–2147483648 to +2147483647	Indicates the absolute position feedback (encoder unit) of the motor in real time.	0	Pulse	Int32	Unchangeable	-
6064h	Position actual value	-2147483648 to 2147483647	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)	0	reference unit	Int32	Unchangeable	-
6065h	Following error window	0 to 4294967295	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.	219895608	reference unit	UInt32	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 ms–65535 ms	Defines the time lapse to trigger excessive position deviation (EB00.0), which must be used together with 6065h.	0	ms	UInt16	Real-time	Real-time
6067h	Position window	0 to 4294967295	Defines the threshold for position reach. If the difference between 6062h and 6064h is within ±6067h and the time reaches 6068h, the position is reached. In this case, bit 10 of 6041h is set to 1 in the profile position mode. This flag bit is valid only when the S-ON signal is valid in profile position control mode.	46976	reference unit	UInt32	Real-time	Real-time
6068h	Position window time	0 ms–65535 ms	Defines the window time for position reach, which must be used together with 6067h.	0	ms	UInt16	Real-time	Real-time
606Ch	Actual speed	–2147483648 to +2147483647	It indicates the velocity actual value.	0	Reference unit/s	Int32	Unchangeable	-
606Dh	Velocity window	0 RPM to 65535 RPM	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 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.	10	rpm	UInt16	Real-time	Real-time
606Eh	Velocity window time	0 ms–65535 ms	Defines the time window for speed reach, which must be used together with 606Dh.	0	ms	UInt16	Real-time	Real-time
606Fh	Zero speed signal threshold	0 RPM to 65535 RPM	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.	10	rpm	UInt16	Real-time	Real-time
6070h	Velocity threshold time	0 ms–65535 ms	Defines the time window for determining whether the user velocity is 0, which must be used together with 606Fh.	0	ms	UInt16	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6071h	Target torque	-5000. to 5000.	Defines the target torque of the servo drive in the profile torque mode. The value 1000 corresponds to the rated torque of the motor.	0	0.001	Int16	Real-time	Real-time
6072h	Max. torque reference	0. to 5000.	Defines the maximum torque reference limit. The value 1000 corresponds to the rated torque of the motor.	3500	0.001	UInt16	Real-time	Real-time
6074h	torque reference	-5000. to 5000.	Defines the target torque value. The value 1000 corresponds to the rated torque of the motor.	0	0.001	Int16	Unchangeable	-
6077h	Actual torque	-5000. to 5000.	It displays the internal actual torque of the servo drive. The value 1000 corresponds to the rated torque of the motor.	0	0.001	Int16	Unchangeable	-
607Ah	Target position	-2147483648 to 2147483647	Defines the target position of the servo drive in the profile position mode. bit6 of 6040h = 0: 607Ah is the target absolute position of the current segment. After the current segment is positioned, the user absolute position 6064h = 607Ah bit6 of 6040h = 1: 607Ah is the target incremental displacement of the current segment. After the current segment positioning is completed, the user displacement increment = 607Ah	0	reference unit	Int32	Real-time	Real-time
607Ch	Home offset	-2147483648 to 2147483647	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 takes effect in the following conditions: The device is powered on, the homing operation is complete, and bit15 of 6041h is set to 1. After homing: the user's current position 6064h = 607Ch If 607Ch is mistakenly set outside 607Dh (software absolute position limit), E09.1 (home offset setting error) will occur.	0	reference unit	Int32	Real-time	At stop

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
607D.01h	Min. position limit	-2147483648 to 2147483647	Defines the minimum software position limit relative to the mechanical zero point. Minimum software absolute position limit = (607D. 01h) The software internal position exceeding the limit is to judge the absolute position. When the servo does not perform the origin regression operation, the software internal position limit is meaningless. The condition for activating the software position limit is set in H0A.01 (object dictionary 0x200A.02h).	-2147483648	reference unit	Int32	Real-time	Real-time
607D.02h	Max. position limit	-2147483648 to 2147483647	Defines the maximum software position limit relative to the mechanical zero. Maximum software position limit = (607D.02h)	2147483647	reference unit	Int32	Real-time	Real-time
607Eh	Reference polarity	0 to 127	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 bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the velocity mode. bit5 = 1, indicating that in the torque mode, the torque command (6071h) × (-1) and the motor steering reverse other bit bits are undefined.	0	-	UInt16	Real-time	Real-time
607Fh	Max. speed	0 to 4294967295	Defines the maximum user running speed. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 RPM.	4294967295	Reference unit/s	UInt32	Real-time	Real-time
6081h	Profile velocity	0 to 4294967295	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.	111848106	Reference unit/s	UInt32	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6083h	Profile acceleration	0 to 4294967295	Defines the acceleration rate in the acceleration stage of the displacement reference in the profile position mode. The following formula applies if a motor equipped with 23-bit encoder needs to run at 400 RPM (6081h: 400 x 8388608/ 60) with acceleration rate being 400 RPM/s (6083h: 400 x 8388608/60) and deceleration rate being 200 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).	4294967295	Reference unit/ s^2	UInt32	Real-time	Real-time
6084h	Profile deceleration	0 to 4294967295	Defines the deceleration rate in the deceleration stage of the displacement reference in the profile position mode. The following formula applies if a motor equipped with 23-bit encoder needs to run at 400 RPM (6081h: 400 x 8388608/ 60) with acceleration rate being 400 RPM/s (6083h: 400 x 8388608/60) and deceleration rate being 200 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).	4294967295	Reference unit/ s^2	UInt32	Real-time	Real-time
6085h	Quick stop deceleration	0 to 4294967295	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.	2147483647	Reference unit/ s^2	UInt32	Real-time	Real-time
6087h	Torque slope	0.%/ s–4294967295.%/ s	It sets the rate of change of torque in profile torque mode, in unit of torque increment per second. In the profile torque mode, if 605Ah is set to 1, 2, 5, or 6, or 605Dh is set to 1 or 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.	4294967295	0.1%/ s	UInt32	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6091.01h	Motor resolution	1 to 4294967295	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 × gear ratio Relationship between motor speed (rpm) and load shaft speed (command unit/s): motor speed (rpm) = load shaft speed * 6091h * 60/motor encoder resolution Relationship between motor acceleration (rpm/ms) and load shaft acceleration (command unit/s2): motor acceleration (rpm/ms) = load shaft acceleration * 6091h * 1000/motor encoder resolution/60	1	-	UInt32	At stop	Real-time
6091.02h	Shaft resolution	1 to 4294967295	Defines the denominator of the gear ratio.	1	-	UInt32	At stop	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6098h	Homing method	-2 to 35	Select the origin return to zero method: -2: Forward return to zero, the deceleration point is the forward mechanical limit position, and the origin is the motor Z signal. -1: Reverse, negative mechanical limit as deceleration point and Z signal as home. 1: Reverse, negative limit switch as deceleration point and Z signal as home, falling edge of the negative limit switch signal must be reached before Z signal 2: Forward, positive limit switch as deceleration point and Z signal as home, falling edge of positive limit switch signal must be reached before Z signal 3: Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal 4: Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal 5: Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal 6: Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal 7: Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal 8: Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal 9: Forward, home switch as deceleration point and Z signal as home, rising edge on the other side of the home switch signal must be reached before Z signal	1	-	Int16	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
6098h	Homing method	-2 to 35	10: Forward, home switch as deceleration point and Z signal as home, falling edge on the other side of the home switch signal must be reached before Z signal 11: Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal 12: Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal 13: Reverse, home switch as deceleration point and Z signal on the other side of the home switch signal as home, rising edge on the other side of the home switch signal must be reached before Z signal 14: Reverse, home switch as deceleration point and Z signal on the other side of the home switch signal as home, falling edge on the other side of the home switch signal must be reached before Z signal. 17–32 are similar to 1–14 except that the deceleration point coincides with the home. 33: Reverse, Z signal as home. 34: Forward, Z signal as home. 35: Current position as home. When 6098h is set to 15, 16, 31 or 32, it is meaningless and the servo drive does not perform the homing operation.	1	-	Int16	Real-time	Real-time
6099.01h	Speed during search for switch	0 to 4294967295	Defines the speed during search for the deceleration point signal. A large setpoint helps prevent E601.0 (Homing timeout).	111848106	Reference unit/s	UInt32	At stop	Real-time
6099.02h	Speed during search for zero	0 to 4294967295	Defines the speed in searching for the home signal. Set this sub-index to a low value to avoid overshoot during stop at high speed, preventing excessive deviation between the stop position and the preset mechanical home.	11184810	Reference unit/s	UInt32	At stop	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
609Ah	Homing acceleration	0 to 4294967295	It sets the acceleration during the homing operation.	4294967295	Reference unit/s²	UInt32	Real-time	Real-time
60B0h	Position offset	-2147483648 to 2147483647	-	0	reference unit	Int32	Real-time	Real-time
60B1h	Velocity offset	–2147483648 to +2147483647	-	0	Reference unit/s	Int32	Real-time	Real-time
60B2h	Torque offset	-5000 to 5000	-	0	0.001	Int16	Real-time	Real-time
60B8h	Touch probe function	0 to 65535	For 60B8h setting instructions, see *"Table 16–1 Setting of 60B8h" on page 490*.	0	-	UInt16	Real-time	Real-time
60B9h	Touch probe status	0 to 65535	For 60B9h setting instructions, see *"Table 16–2 Setting of 60B9h" on page 491*.	0	-	UInt16	Unchangeable	-
60BAh	Touch probe 1 positive edge position value	-2147483648 to 2147483647	Indicates the position feedback value (reference unit) latched at positive edge of touch probe 1 signal.	0	reference unit	Int32	Unchangeable	-
60BBh	Touch probe 1 negative edge position value	-2147483648 to 2147483647	Indicates the position feedback value (reference unit) latched at negative edge of touch probe 1 signal.	0	reference unit	Int32	Unchangeable	-
60BCh	Touch probe 2 positive edge position value	-2147483648 to 2147483647	Indicates the position feedback value (reference unit) latched at positive edge of touch probe 2 signal.	0	reference unit	Int32	Unchangeable	-
60BDh	Touch probe 2 negative edge position value	-2147483648 to 2147483647	Indicates the position feedback value (reference unit) latched at negative edge of touch probe 2 signal.	0	reference unit	Int32	Unchangeable	-
60C5h	Max. acceleration	0 to 4294967295	Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.	4294967295	Reference unit/s²	UInt32	Real-time	Real-time

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60C6h	Max. deceleration	0 to 4294967295	Defines the maximum permissible deceleration in the profile position mode, profile velocity mode, and homing mode.	4294967295	Reference unit/s^2	UInt32	Real-time	Real-time
60D5h	Touch probe 1 positive edge counter	0 to 65535	The counting value is added by "1" each time this object is triggered.	0	-	UInt16	Unchangeable	-
60D6h	Touch probe 1 negative edge counter	0 to 65535	The counting value is added by "1" each time this object is triggered.	0	-	UInt16	Unchangeable	-
60D7h	Touch probe 2 positive edge counter	0 to 65535	The counting value is added by "2" each time this object is triggered.	0	-	UInt16	Unchangeable	-
60D8h	Touch probe 2 negative edge counter	0 to 65535	The counting value is added by "2" each time this object is triggered.	0	-	UInt16	Unchangeable	-
60E0h	Positive torque limit	0. to 5000.	It sets the maximum positive torque in the motor.	3500	0.001	UInt16	Real-time	Real-time
60E1h	Negative torque limit	0. to 5000.	It sets the maximum negative torque in the motor.	3500	0.001	UInt16	Real-time	Real-time
60F4h	Position deviation	-2147483648 to 2147483647	Indicates the position deviation (reference unit).	0	reference unit	Int32	Unchangeable	-
60FCh	Position reference	–2147483648 to +2147483647	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	0	Pulse	Int32	Unchangeable	-

Parameter	Name	Value	Description	Default	Unit	Data type	Change method	Effective Time
60FDh	DI state	0 to 4294967295	Reflect drive's current situation DI Terminal Logic: 0: Invalid logic 1: Logic is valid Each bit represents separately The DI signal is as follows: Bit signal 0: Reverse overtravel signal active 1: Forward overtravel signal active 2: Home signal active 3–15: N/A 16: DI1 input active 17: DI2 input active 18: DI3 input active 19: DI4 input active 20: DI5 input active 21: DI6 input active 22: DI7 input active 23: DI8 input active 24–26: N/A 27: STO1 signal input 28: STO2 signal input 29: EDM output active 30: Z signal active 31: N/A	0	-	UInt32	Unchangeable	Real-time
60FFh	PV, CSV mode speed reference	–2147483648 to +2147483647	Defines the target speed in the cyclic synchronous velocity mode/profile velocity mode.	0	Reference unit/s	Int32	Real-time	Real-time
60FE.01h	Physical output	0 to 4294967295	Reflects the DO output logic. The signals represented by each bit are as follows: Bit-related signal description 0 to 15: NA 16: DO1 forced output (0: off, 1: on), when bit16 of 60FE. 02 is set to 1 17: DO2 forced output (0: off, 1: on), when bit17 of 60FE. 02 is set to 1 18 to 25: NA 26: Gain switching performs P/PI switching, only when bit26 of 60FE. 02 is set to 1 27 to 31: NA	0	-	UInt32	Real-time	Real-time
60FE.02h	Bitmask	0 to 4294967295	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	0	-	UInt32	Real-time	Real-time

Table 16–1 Setting of 60B8h

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	-

Table 16–2 Setting of 60B9h

bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	Bit0 to bit2: States 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	When the function of probe 1 is selected as continuous sampling, the total number of times the probe is triggered	When the function of probe 1 is selected as continuous sampling, the total number of times (0–3) the probe is triggered
8	Probe 2 enable: 0: Probe 2 disabled 1: Probe 2 enabled	Bit8 to bit10: States 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	When the function of probe 2 is selected as continuous sampling, the total number of times the probe is triggered	When the function of probe 2 is selected as continuous sampling, the total number of times (0–3) the probe is triggered

17 Troubleshooting

17.1 Fault Level and Display

17.1.1 Fault and Alarm Levels

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 fault
- No. 1 resettable fault
- No. 2 resettable fault
- No. 3 resettable alarm

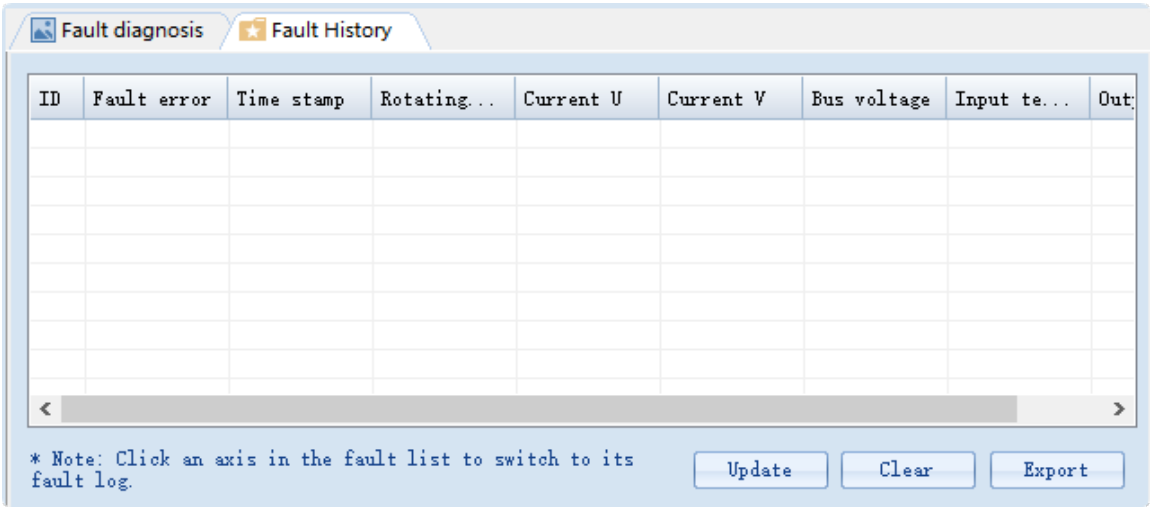
Note

"Resettable" means the keypad stops displaying the fault/warning 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 fault/alarm. Among the latest 5 faults/alarms, if a fault/alarm occurs repetitively, the servo drive records the fault/alarm code and the drive status only once.

A fault/alarm will still be saved in the fault log after reset. To remove the fault/alarm from the fault log, set H02.31 to 2. See the following figure for details.



Read the value of H0b.34 through InoDriverShop to get the fault/alarm code. See examples in the following table.

H0b.34 (hex)	Description of H0b.34 (hex)
0101	0: Fault subcode 101: Fault code

17.2 Fault Reset

17.2.1 Fault Reset

Operating procedure:

- 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 allocated with DI function 2.
- To reset No. 3 alarms, set H0d.01 to 1 or activate the DI terminal allocated with DI function 2.

Note

- Some faults and warnings can be reset only after the fault causes are rectified by modifying the settings. However, a reset operation does not necessarily activate the modifications to settings.
- For modifications activated at next power-on (R, S, T/L1C, L2C), perform a power cycle.
- For modifications activated after stop, switch off the S-ON signal. The servo drive can operate normally only after modifications are activated.

☆Related function No.:

Start Process	Fault	Cause	Troubleshooting
FunIN.2	ALM-RST	Fault/alarm reset signal	The servo drive may, depending on the alarm types, continue running after alarm reset. When FunIN.2 is assigned to a low-speed DI, the effective level change of this DI must be kept for more than 3 ms. Otherwise, fault reset will be inactive. Do not assign FunIN.2 to a high-speed DI. Otherwise, fault/alarm reset will be inactive. • Inactive: Not resetting the fault/alarm • Active: Resetting the fault/alarm

17.3 List of Alarm Codes

Fault Code	Fault Name	Fault level	Resettable	Error code	Aux. Code
E108.0	Storage parameter write error	3	Yes	0x5530	0x0108E108
E108.1	Storage parameter read error	3	Yes	0x5530	0x1108E108
E108.2	Invalid check on data written in EEPROM	3	Yes	0x5530	0x2108E108
E108.3	Invalid check on data read in EEPROM	3	Yes	0x5530	0x3108E108
E108.4	Single data is stored too many times	3	Yes	0x0108	0x4108E108
E110.0	Frequency-division pulse output setting error	3	Yes	0x0110	0x0110E110
E120.3	The motor and drive do not match in the power	3	Yes	0x7122	0x3120E120
E121.0	Invalid S-ON command	3	Yes	0x0121	0x0121E121
E122.0	Multi-turn absolute encoder setting error	3	Yes	0x6320	0x0122E122

Fault Code	Fault Name	Fault level	Resettable	Error code	Aux. Code
E122.6	Absolute function setting fault of 2nd encoder	3	Yes	0x6320	0x6122E122
E510.0	Frequency division pulse output overspeed	3	Yes	0x0510	0x0510E510
E600.0	Inertia auto-tuning failure	3	Yes	0x0600	0x0600E600
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
E631.4	P-MOS disconnection	3	Yes	0x0631	0x46310631
E631.5	N-MOS disconnection	3	Yes	0x0631	0x56310631
E730.0	Encoder battery alarm	3	Yes	0x7305	0x0730E730
E730.1	Inovance 2nd encoder battery voltage low	3	Yes	0x7305	0x1730E730
E900.0	DI emergency braking	3	Yes	0x0900	0x0900E900
E902.0	DI setting invalid	3	Yes	0x6320	0x0902E902
E902.1	DO setting invalid	3	Yes	0x0902	0x1902E902
E902.2	Torque reach setting invalid	3	Yes	0x0902	0x2902E902
E909.0	Motor overload	3	Yes	0x3230	0x0909E909
E909.2	KTY short circuit warning	3	Yes	0x3230	0x2909E909
E910.0	Control circuit overvoltage	3	Yes	0x3210	0x0910E910
E920.0	Braking resistor overload	3	Yes	0x3210	0x09200920
E921.0	Dynamic brake resistor overload alarm	3	Yes	0x3210	0x0921E921
E922.0	Resistance of the external braking resistor too small	3	Yes	0x6320	0x09220922
E924.0	Regenerative transistor over-temperature	3	Yes	0x3230	0x09240924
E941.0	Modified parameters activated at next power-on	3	Yes	0x6320	0x0941E941
E942.0	Parameter storage too frequent	3	Yes	0x7600	0x0942E942
E950.0	Positive limit switch alarm	3	Yes	0x5443	0x0950E950
E952.0	Negative limit switch alarm	3	Yes	0x5444	0x0952E952
E954.0	Position reference overflow	3	Yes	0x0954	0x0954E954
E971.0	Undervoltage alarm for voltage drop protection	3	Yes	0x0971	0x0971E971
E980.0	Encoder algorithm error	3	Yes	0x0980	0x0980E980
E999.E	Resonance alarm	3	Yes	0x0FFF	0xE9990999

17.4 List of Fault Codes

Fault Code	Fault Name	Fault level	Resettable	Error code	Aux. Code
E101.0	Abnormal parameters in groups H02 and above	1	No	0x6320	0x01010101
E101.1	Parameter error 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
E102.1	FPGA initialization start error	1	No	0x7500	0x11020102
E102.8	FPGA and MCU software version mismatch	1	No	0x7500	0x81020102
E104.1	MCU running timeout (MCU break down)	1	No	0x7500	0x11040104
E104.2	FPGA running timeout (FPGA break down)	1	No	0x7500	0x21040104
E104.4	MCU command update timeout	1	No	0x7500	0x41040104
E120.0	Unknown encoder model	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
E122.1	DI function allocation error	2	Yes	0x6320	0x11226122
E122.4	VDI function allocation error	2	Yes	0x0122	0x41226122
E122.2	DO function allocation error	2	Yes	0x6320	0x21226122
E122.3	Upper limit in the rotation mode too high	2	Yes	0x6320	0x31226122
E122.5	DI and VDI assigned with the same function	2	Yes	0x0122	0x51226122
E122.7	Fully closed-loop parameter setting error	2	Yes	0x6320	0x71226122
E122.9	Fully closed-loop function pin conflict	2	Yes	0x6320	0x91226122
E135.0	Chip 3.3V signal diagnosis exception	1	Yes	0x0FFF	0x01352135
E136.0	Encoder ROM motor parameter check error	1	No	0x7305	0x01360136
E136.1	Encoder ROM motor parameter read error	1	No	0x7305	0x11360136
E140.0	Encryption chip check fault	1	No	0x0140	0x01400140
E140.1	MCU key calculation failed	1	No	0x0140	0x02400140
E140.2	Wrong encryption chip version	1	No	0x0140	0x03400140
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	0x21500150
E150.3	STO input circuit hardware diagnosis failure	1	Yes	0x0150	0x31500150
E150.4	PWM buffer hardware diagnosis failure	1	Yes	0x0150	0x41500150

Fault Code	Fault Name	Fault level	Resettable	Error code	Aux. Code
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
E201.3	Phase-W overcurrent	1	No	0x2312	0x32010201
E201.4	Phase-N overcurrent	1	No	0x2312	0x42010201
E208.2	Encoder communication timeout	1	Yes	0x0208	0x22082208
E208.4	FPGA current loop operation timeout	1	Yes	0x0208	0x42082208
E210.0	Output short-circuited to ground	1	No	0x2330	0x02100210
E234.0	Runaway	1	No	0x0234	0x02340234
E320.0	Braking resistor overload	1	Yes	0x0320	0x03200320
E321.0	Dynamic brake resistor overload	1	Yes	0x0321	0x03212321
E400.0	Main circuit overvoltage	1	Yes	0x3210	0x04002400
E410.0	Main circuit undervoltage	1	Yes	0x3220	0x04100410
E410.1	Main circuit de-energized	1	Yes	0x0410	0x14102410
E430.0	Control power supply undervoltage	2	Yes	0x3120	0x04306430
E500.0	Motor overspeed	1	Yes	0x8400	0x05002500
E500.1	Speed feedback overflow	1	Yes	0x8400	0x15002500
E500.2	FPGA position feedback pulse overspeed	1	Yes	0x0500	0x25002500
E610.0	Drive overload	1	Yes	0x0610	0x06102610
E602.0	Angle auto-tuning failure	1	Yes	0x0602	0x06022602
E602.2	U/V/W phase sequence reversed	1	Yes	0x0602	0x26022602
E605.0	Speed too fast upon S-ON	1	Yes	0x8400	0x06052605
E620.0	Motor overload	1	Yes	0x3230	0x06202620
E630.0	Motor stall over-temperature protection	1	Yes	0x7121	0x06300630
E631.0	SBC brake circuit diagnosis exception	1	Yes	0x0631	0x06310631
E631.1	24 V power supply or brake not connected	1	Yes	0x0631	0x16310631
E631.2	P-MOS open circuit	1	Yes	0x0631	0x26310631
E631.3	N-MOS disconnection	1	Yes	0x0631	0x36310631
E640.0	High IGBT junction overtemperature	1	Yes	0x4210	0x06402640
E640.1	Flywheel diode overtemperature	1	Yes	0x0640	0x16402640
E650.0	Heatsink overtemperature	1	Yes	0x4210	0x06502650
E660.0	Motor overtemperature	1	Yes	0x4210	0x06602660
E660.1	KTY sensor wire breakage	1	Yes	0x4210	0x16602660
E661.0	STune failure	2	Yes	0x0661	0x06616661
E662.0	ETune failure	2	Yes	0x0662	0x06626662
E663.0	ITune failure	2	Yes	0x0663	0x06636663
E664.0	Resonance too strong	2	Yes	0x0664	0x06646664
E731.0	Encoder battery failure	2	Yes	0x7305	0x07316731

Fault Code	Fault Name	Fault level	Resettable	Error code	Aux. Code
E731.1	Inovance 2nd encoder battery failure	2	Yes	0x7305	0x17316731
E733.0	Encoder multi-turn counting error	2	Yes	0x7305	0x07336733
E733.1	Inovance 2nd encoder multi-turn counting error	2	Yes	0x7305	0x17336733
E735.0	Encoder multi-turn counting overflow	2	Yes	0x7305	0x07356735
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
E755.0	Nikon encoder communication fault	1	No	0x0FFF	0x07550755
E760.0	Encoder over-temperature	2	Yes	0x4210	0x07606760
E765.0	3rd party encoder over-temperature or overspeed	1	No	0x0765	0x07650765
E770.0	Fully-closed loop input phase A wire breakage	1	Yes	0x7305	0x07702770
E770.1	Fully-closed loop input phase B wire breakage	1	Yes	0x7305	0x17702770
E770.2	Fully-closed loop input phase Z wire breakage	1	Yes	0x7305	0x27702770
E770.6	Fully closed-loop Inovance 2nd encoder initialization communication error	1	Yes	0x7305	0x67700770
E770.7	Fully closed-loop 2nd encoder communication error	1	Yes	0x7305	0x77700770
E939.0	Motor power cables disconnected	1	Yes	0x0939	0x09392939
E939.1	Phase-U power cable disconnected	1	Yes	0x0939	0x19390939
E939.2	Phase-V power cable disconnected	1	Yes	0x0939	0x29390939
E939.3	Phase-W power cable disconnected	1	Yes	0x0939	0x39390939
EA33.0	Encoder read/write check error	1	No	0x7305	0x0A330A33
EA33.1	Fully closed-loop Inovance 2nd encoder data read/write error	1	No	0x7305	0x1A330A33
EB00.0	Excessive position deviation	1	Yes	0x8611	0x0B002B00
EB00.1	Position deviation overflow	1	Yes	0x8611	0x1B002B00
EB01.0	Position reference increment too large	2	Yes	0x6320	0x0B016B01
EB01.1	Individual position reference increment too large	2	Yes	0x6320	0x1B016B01
EB01.3	Reference overflow	2	Yes	0x6320	0x3B016B01
EB02.0	Position deviation too large in fully closed-loop mode	2	Yes	0x8611	0x0B026B02
EB02.1	Fully closed-loop position deviation overflow	2	Yes	0x8611	0x1B026B02

Fault Code	Fault Name	Fault level	Resettable	Error code	Aux. Code
EB03.0	Electronic gear ratio setpoint beyond the limit - H05.02	2	Yes	0x0B03	0x0B036B03
EB03.1	Electronic gear ratio beyond the limit - 1st group of electronic gear ratio	2	Yes	0x0B03	0x1B036B03
EB03.2	Electronic gear ratio beyond the limit - 2nd group of electronic gear ratio	2	Yes	0x0B03	0x2B036B03
EE08.0	Synchronization signal loss	2	Yes	0x0E08	0x0E086E08
EE08.1	Status switchover error	2	Yes	0x0E08	0x1E086E08
EE08.3	Network cable connected improperly	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
EE09.3	Homing method setting error	2	Yes	0x6320	0x3E096E09
EE09.2	Gear ratio beyond the limit	2	Yes	0x6320	0x2E096E09
EE09.5	PDO mapping beyond the limit	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 incomplete PLL	2	Yes	0x0E10	0x4E106E10
EE11.0	ESI check 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	ESI and drive mismatch	2	Yes	0x0E11	0x3E116E11
EE12.0	EtherCAT initialization failure	1	No	0x0E12	0x0E120E12
EE13.0	EtherCAT sync period setting error	2	Yes	0x6320	0x0E136E13
EE14.0	SYNC signal pulse width abnormal	2	Yes	0x0E14	0x0E146E14
EE15.0	Large EtherCAT sync period error	2	Yes	0x0E15	0x0E156E15
EE16.0	MCU and ESC communication error	1	No	0x0E16	0x0E160E16
EE21.0	MAC address not programmed	2	Yes	0x0FFF	0x0E216E21
EE21.1	EtherNetPHY configuration error	2	Yes	0x0FFF	0x1E216E21

17.5 Description of Alarm Codes

E108.0: Parameter write error

Description:

Parameter values cannot be written to EEPROM.

Troubleshooting

Cause	Troubleshooting	Solution
An error occurs during parameter-writing.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on repeatedly, replace the servo drive.

E108.1: Parameter read error

Description:

Parameter values cannot be read from EEPROM.

Troubleshooting

Cause	Troubleshooting	Solution
The parameter-read operation is abnormal, and the system indicates an EEPROM read failure.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on repeatedly, replace the servo drive.

E108.2: EEPROM write check error

Description:

The check on the data written in EEPROM failed.

Troubleshooting

Cause	Troubleshooting	Solution
An error occurs during parameter-writing.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on repeatedly, replace the servo drive.

E108.3: EEPROM read check error

Description:

The check on the data read in EEPROM failed.

Troubleshooting

Cause	Troubleshooting	Solution
1. The check on the data read in EEPROM fails.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on repeatedly, replace the servo drive.

E108.4: Single data stored too many times

Description:

Single data is stored too frequently.

Troubleshooting

Cause	Troubleshooting	Solution
That may damage EEPROM over time.	1 Check H0b.90 and H0b.91. H0b.90 shows the parameter in question or object dictionaries (in hexadecimal). If H0b.91=15, H0b.90 shows internal variables of software. 2 Check "Func Test 1" through the oscilloscope channel. Be sure to display it in hexadecimal. This channel displays the address that EEPROM is storing. 3 Check the storage count through the oscilloscope channel "Func Test 2".	1 If the alarm is caused by manually modifying a certain parameter or object dictionary, there will be no frequent storage of a certain data during operation, and you can reset the fault. 2 Check the abnormal parameter through H0b. 90 or oscilloscope channel, and find out the cause. For example, if the host controller program frequently writes parameters through SDO, you can modify the program to stop it.

E110.0: Frequency-division pulse output setting error

Description:

The frequency-division output setpoint (H05.17) exceeds the encoder resolution.

Troubleshooting

Cause	Troubleshooting	Solution
The number of frequency divisions (quadrupled) exceeds the motor revolutions	Check the setpoint of H05.17.	Adjust the value of H05.17 on the basis of the motor revolutions.

E120.3: The motor and drive do not match in the power

Description:

the motor and drive do not match in the rated power.

Troubleshooting

Cause	Troubleshooting	Solution
The motor and drive do not match in the rated power.	Check rated motor voltage and current (H00.09, H00.11) and rated drive power (H01.10, H01.16).	1 Replace the motor or drive. 2 If the motor and drive can work properly in spite of the mismatch, set bit4 of H0A.71 to 1 to disable the alarm.

E121.0: Invalid S-ON command

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
The S-ON signal is activated through communication when the servo drive is already enabled internally.	Check whether an S-ON signal is sent from the host controller when auxiliary functions (H0d.02, H0d.03, H0d.11) are used.	Switch off the S-ON signal sent from the host controller.

E122.0: Multi-turn absolute encoder setting error

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
The motor does not match the absolute position mode or the motor code is set incorrectly.	1 Check the motor nameplate to see whether the motor is configured with a multi-turn absolute encoder. 2 Check whether H00.00 (motor code) is set properly.	Reset H00.00 (motor code) according to the motor nameplate or use a suitable motor.

E122.6: Absolute function setting fault of the 2nd encoder

Description:

The motor does not match the absolute mode.

Troubleshooting

Cause	Troubleshooting	Solution
The motor does not match the absolute mode.	Check the motor nameplate to see whether the motor is configured with a multi-turn absolute encoder.	Set H0F.02 to 0.

E510.0: Frequency division pulse output overspeed

Description:

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	Troubleshooting	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 (2nd 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 x 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: Inertia auto-tuning failure

Description:

Vibration cannot be suppressed. You can set notch parameters (H09.12...H09.23) manually to suppress vibration. The auto-tuned values fluctuate dramatically. Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation. Mechanical couplings of the load are loose or eccentric. Rectify the mechanical faults. An alarm occurs during auto-tuning and causes interruption. Rectify the fault causes and perform inertia auto-tuning again. The vibration cannot be suppressed if the load carries large inertia. In this case, increase the acceleration/deceleration time to ensure the motor current is unsaturated.

Troubleshooting

Cause	Troubleshooting	Solution
1 Continuous vibration occurs during auto-tuning. 2 The auto-tuned values fluctuate dramatically. 3 Mechanical couplings of the load are loose 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.	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 Rectify the fault and perform inertia auto-tuning again. 2 For vibration that cannot be suppressed, enable vibration suppression. 3 Ensure mechanical couplings are connected securely. 4 Increase the maximum operating speed, reduce the acceleration/ deceleration time, and shorten the stroke of the lead screw during ETune operation.

E601.0: Homing alarm

Description:

Homing time exceeds the setpoint.

Troubleshooting

Cause	Troubleshooting	Solution
1. The home switch is faulty.	There is only high-speed searching but no low-speed searching during homing. After high-speed searching, low-speed searching in the reverse direction applies.	If 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 homing time limit is too short.	Check whether the value of H05.35h (Time limit for homing) is too small.	Increase the value of H05.35.
3. The speed in high-speed searching for the home switch signal is too low.	Check the distance between the start position of homing and the home switch. Then check whether the setpoint of 6099.01h (Speed in high-speed searching for the home switch signal) is too low, resulting in a long homing process.	Increase the value of 6099.01h.

E601.1: Homing switch error

Description:

The home switch is set improperly.

Troubleshooting

Cause	Troubleshooting	Solution
The home switch is set improperly.	Check whether the limit signals at both sides are activated. Check whether the limit signal and the deceleration point signal/home signal are both activated. Check whether the positive and negative position limits are activated successively.	Set the position of the physical switch properly.

E601.2: Homing mode setting error

Description:

The homing method value is too large.

Troubleshooting

Cause	Troubleshooting	Solution
The homing method value is too large.	Check the homing method value (object dictionary 6098h).	Change the value of 6098h.

E631.4: P-MOS short circuit

Description:

The brake circuit is faulty.

Troubleshooting

Cause	Troubleshooting	Solution
When braking is used, the P-MOS short circuit occurred on the brake circuit.	Check whether short circuit occurs on the brake circuit P-MOS.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

E631.5: N-MOS short circuit

Description:

The brake circuit is faulty.

Troubleshooting

Cause	Troubleshooting	Solution
When braking is used, the N-MOS short circuit occurred on the brake circuit.	Check whether short circuit occurs on the brake circuit N-MOS.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

E730.0: Encoder battery alarm

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
The voltage of the absolute encoder battery is lower than 3.0 V.	Measure the battery voltage.	Use a new battery with the matching voltage.

E730.1: Inovance 2nd encoder battery voltage low

Description:

Inovance 2nd encoder battery voltage is lower than 3.0 V.

Troubleshooting

Cause	Troubleshooting	Solution
Inovance 2nd encoder battery voltage is too low.	Measure the battery voltage.	Use a new battery with the matching voltage.

E900.0: DI emergency braking

Description:

The logic of the DI terminal (including the hardware DI and virtual DI) allocated with DI function 34 (FunIN.34) is effective.

Troubleshooting

Cause	Troubleshooting	Solution
The logic of the DI terminal (including the hardware DI and virtual DI) allocated with DI function 34 (FunIN.34) is effective.	Check whether the logic of the DI allocated with DI function 34 (FunIN.34: Emergency stop) is valid.	Check the operation mode and clear the active DI braking signal without affecting the safety performance.

E902.0: DI setting invalid

Description:

DI function parameters are set to invalid values.

Troubleshooting

Cause	Troubleshooting	Solution
The DI function setting is invalid.	H0b.45 = 0x0902 Check H03.02, H03.04, H03.06... H03.16 for invalid DI function numbers	Set the DI function No. correctly.

E902.1: DO setting invalid

Description:

DO function parameters are set to invalid values.

Troubleshooting

Cause	Troubleshooting	Solution
The DO function setting is invalid.	H0b.45=0x1902, check H04.00 and H04.02 to see whether they are allocated with invalid DO function numbers.	Ensure the DO function No. is valid.

E902.2: Invalid setting for torque reach

Description:

The DO parameters set for torque reach in the torque control mode are invalid.

Troubleshooting

Cause	Troubleshooting	Solution
The DO parameters set for torque reach in the torque control mode are invalid.	Check whether the value of H07.22 is lower than or equal to the value of H07.23 (unit: 0.1%).	Set H07.22 to a value higher than that of H07.23.

E909.0: Motor overload alarm

Description:

The accumulative heat of the motor reaches 90% of the fault threshold.

Troubleshooting

Cause	Troubleshooting	Solution
1. The motor cables and encoder cable are connected improperly or in poor contact.	Check the wiring among the servo drive, servo motor and the encoder according to the correct wiring diagram.	Connect cables according to the correct wiring diagram. 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 so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Check the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive keeps exceeding 100.0%.	Use a servo drive of higher capacity and a matching servo motor, or reduce the load and increase the acceleration/deceleration time.

Cause	Troubleshooting	Solution
3. Acceleration/Deceleration is too frequent or the load inertia is too large.	Check the mechanical inertia ratio or perform inertia auto-tuning. View the value of H08.15 (load moment of inertia ratio). Confirm the individual operation cycle when the servo motor operates cyclically.	Increase the acceleration/ deceleration time.
4. Gains are improper or the stiffness level is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Readjust the gain.
5. The servo drive model or motor model is set improperly.	View the model of the motor equipped with a serial-type encoder in H00.05 and the servo drive model in H01.10.	Read the servo drive nameplate and set the Servo servo drive model (H01.10) and motor model properly according to section "Servo Drive Model and Nameplate" in SV680N Series Servo Drive Selection Guide.
6. The motor is stalled due to mechanical factors, resulting in overload during operation.	Check the reference and the motor speed (H0b.00) through the software tool or the keypad: 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 or very large but the motor speed is 0 in the corresponding mode.	Rectify the mechanical-related problem.
7. The servo drive is faulty.	Power off and on the servo drive.	Replace the servo drive.

E909.2: KTY short circuit warning

Description:

KTY sensor short circuit

Troubleshooting

Cause	Troubleshooting	Solution
KTY sensor short circuit	Check both ends of the KTY sensor for short circuit.	Replace the KTY sensor.

E910.0: Control circuit overvoltage

Description:

The voltage of the control circuit exceeds the overvoltage threshold.

Troubleshooting

Cause	Troubleshooting	Solution
Overvoltage occurred on the control circuit of the drive.	1 Measure whether the input voltage in the control circuit cable is within the following range: • 220 V servo drive: Effective value: 220 V to 240 V Allowable deviation: -10% to +10% (198 V to 264 V) • 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: -10% to +10% (342 V to 484 V) 2 Check whether control circuit cables are connected properly and whether the voltage of control circuit cables (L1C, L2C) is within the specified range.	Re-connect or replace the cables.

E920.0: Braking resistor overload

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
1. The cable of the external bleeder resistor is in poor connection, becomes loose or breaks.	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 terminals P and C. Connect the external braking resistor between terminals P and C with a new cable.
2. The setting of H02.25 is incorrect when an external bleeder resistor is used. 3. The resistance of the external bleeder resistor used is too large. 4. The value of H02.27 (Resistance of external bleeder resistor) is larger than the resistance of the external bleeder resistor actually used.	Check the value of H02.25. Measure the resistance of the external braking resistor used, and compare it with the braking resistor specification table. Check whether the value of H02.27 is larger than the resistance of the external braking resistor used.	Set H02.25 correctly. H02.25 = 1 (external, naturally ventilated) H02.25 = 2 (external, forcible air cooling) Select a proper braking resistor according to the braking resistor specification table. Set H02.27 according to the resistance of the external braking resistor used.
5. The input voltage of the main circuit is beyond the specified range.	Measure whether the input voltage on the driver side of the main circuit cable meets the following specifications: 220V drive: effective value: 220V–240V, allowable deviation:-10% to +10% (198V–264V); 380V drive: effective value: 380V–440V, allowable deviation:-10% to +10% (342V–484V).	Replace or adjust the power supply according to the specified range.

Cause	Troubleshooting	Solution
6. The load moment of inertia ratio is too large. 7. 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. 8) The capacity of the servo drive or the bleeder resistor is insufficient.	Perform inertia auto-tuning according to Inertia Auto-tuning or calculate total inertia of machine according to mechanical parameters. Check whether actual load inertia ratio exceeds 30. View the motor speed curve in cycle running and check whether the motor is in deceleration status for a long period. View the motor's single cycle speed curve and calculate whether 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 operation cycle if allowed.
9. The servo drive is faulty.	No#	Replace with a new servo drive.#

E921.0: Dynamic brake resistor overload alarm

Description:

The dynamic braking resistor is close to overload.

Troubleshooting

Cause	Troubleshooting	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 exceeds 70%.	Ensure that the motor cannot be driven reversely in the dynamic braking state.

E922.0: Resistance of the external braking resistor too small

Description:

The value of H02.27 (resistance of external braking resistor) is lower than the value of H02.21 (permissible min. resistance of external braking resistor).

Troubleshooting

Cause	Troubleshooting	Solution
When an external braking resistor is used (H02.25 = 1 or 2), the resistance of this resistor is lower than the minimum permissible value.	1 Measure the resistance of the external braking resistor between P and C and check whether it complies with the value of H02.27. 2 Check whether the resistance of the external braking resistor defined by H02.27 is smaller than the value of H02.21.	If yes, connect an external braking resistor that matches the servo drive between terminals P and C and set H02.27 according to the resistance of the resistor selected. If not, set H02.27 according to the resistance of the resistor used.

E924.0: Regenerative transistor overtemperature

Description:

The estimated temperature of the regenerative transistor is higher than H0A.18 (IGBT overtemperature threshold).

Troubleshooting

Cause	Troubleshooting	Solution
1. The junction temperature of the regenerative transistor is too high. 2. The regenerative transistor will be turned off automatically after overload occurs.	The regenerative transistor temperature exceeds the threshold defined by H0A.49.	Control the working conditions and usage of the regenerative transistor.

E941.0: Parameter modifications activated at next power-on

Description:

When the parameter effective mode of the drive is set to "Re-power-on", after the parameter value is changed, the servo drive prompts the user to power on again.

Troubleshooting

Cause	Troubleshooting	Solution
The parameters modified are those whose "Effective time" is "Next power-on".	Check whether parameters you modified are those whose "Effective Time" is "Next power-on".	Power off and on the servo drive again.

E942.0: Parameter saved frequently

Description:

The number of parameters modified at a time exceeds 200.

Troubleshooting

Cause	Troubleshooting	Solution
Too many parameters are modified and saved to EEPROM (H0C.13 = 1) 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 H0C.13 to 0.

E950.0: Forward overtravel alarm

Description:

The logic of the DI allocated with FunIN.14: P-OT (positive limit switch) is valid.

Troubleshooting

Cause	Troubleshooting	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 effective.	Check the running mode. On the prerequisite of safety, send a reverse command or rotate the motor to deactivate the logic of the DI terminal allocated with DI function 14.
2. The servo position feedback reaches the positive software position limit.	Check whether the position feedback (H0b.17) is close to the value of H0A.41. Check whether the software position limit is set in H0A.40.	Ensure the servo drive references are proper, allowing the load travel range to be within the software position limit.

E952.0: Reverse overtravel alarm

Description:

The logic of the DI allocated with FunIN.15: N-OT (negative limit switch) is valid.

Troubleshooting

Cause	Troubleshooting	Solution
1. The logic of the DI assigned with FunIN.15 is effective.	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 effective.	Check the operation mode. On the prerequisite of ensuring safety, send a forward run command or rotate the motor to deactivate the logic of DI assigned with FunIN.15.
2. The servo position feedback reaches the negative software position limit.	Check whether the position feedback (H0b.17) is close to the value of H0A.43. Check whether the software position limit is set in H0A.40.	Ensure the servo drive references are proper, allowing the load travel range to be within the software position limit.

E954.0: Position command overflow

Description:

in PR mode, the position command is beyond the limit.

Troubleshooting

Cause	Troubleshooting	Solution
in PR mode, the position command is beyond the limit.	1 Check the position command. 2 Check the limit value.	Change the value of the position command and the limit.

E971.0: Undervoltage alarm for voltage drop protection

Description:

The bus voltage is lower than the undervoltage threshold.

Troubleshooting

Cause	Troubleshooting	Solution
The bus voltage is lower than the undervoltage threshold.	Check the bus voltage.	Check the power supply.

E980.0: Encoder algorithm error

Description:

An encoder algorithm error occurs.

Troubleshooting

Cause	Troubleshooting	Solution
An encoder algorithm error occurs	Check the wiring. If the fault persists after the servo drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

E999.E: Resonance alarm

Description:

A resonance was detected.

Troubleshooting

Cause	Troubleshooting	Solution
Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H0A.46.	Check whether there is abnormal noise or torque fluctuation during operation.	Check whether the inertia ratio or loop gain parameters are set properly. 1 Check whether resonance parameters are set properly. 2 Increase the value of H0A.46 or set H09.54 to 0 to disable this function.

17.6 Description of Fault Codes

17.6.1 Solutions to Faults

E101.0: Abnormal parameters in groups H02 and above

Description:

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	Troubleshooting	Solution
1. The voltage of the control circuit power supply drops instantaneously.	1 Check whether the control circuit (L1C, L2C) is in the process of power-off or instantaneous power failure occurs. 2 Measure whether the input voltage of the control circuit cable on the non-drive side is within the following range: • 220 V servo drive: Effective value: 220 V to 240 V Allowable deviation: -10% to +10% (198 V to 264 V) • 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: -10% to +10% (342 V to 484 V)	1 Restore system parameters to default settings (H02.31 = 1) and write parameters again. 2 Increase the power supply capacity or replace with a power supply of higher capacity. Restore system parameters to default settings (H02.31 = 1), and write parameters again.
2. Instantaneous power failure occurs when saving parameters.	Check whether instantaneous power failure occurs when saving parameters.	Power on the system again, restore system parameters to default settings (H02.31 = 1), and write parameters again.

Cause	Troubleshooting	Solution
3. The number of write operations within a certain period of time exceeds the limit.	1 Check whether instantaneous power failure occurs when saving parameters. 2 Check whether parameters are updated frequently through the host controller.	1 If the servo drive is faulty, replace the servo drive. 2 Change the parameter writing method and write parameters again. 3 Power on the system again, restore system parameters to default settings (H02.31 = 1), and write parameters again.
4. The software is updated.	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 settings (H02.31 = 1).
5. The servo drive is faulty.	If the fault persists though parameters are restored to default settings and the servo drive is powered off and on repeatedly, the servo drive is faulty.	Replace the servo drive.

E101.1: parameter error in group H00/H01

Description:

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	Troubleshooting	Solution
The servo drive detects whether parameter values in groups H00 and H01 exceed the upper/lower limit during initialization upon power-on. If yes, the keypad displays E101.1. Motor parameters in group H00 are read from the encoder. Servo drive parameters in group H01 are mapped based on the servo drive model defined by H01.10.	Check groups H00 and H01 to find the parameter whose value exceeds the limit. Confirm whether this parameter range is abnormal. Read H0B.90 and H0B.91 and obtain the abnormal parameter group number	Replace the motor or drive. Rectify the wrong value or restore the factory settings.

E101.2: Address error in read/write operation after the number of parameters changes

Description:

Address error in read/write operation after the number of parameters changes.

Troubleshooting

Cause	Troubleshooting	Solution
Address error in read/write after total number of parameters changes	Read H0B.90 and H0B.91 and obtain the abnormal parameter group number	Rectify the wrong value or restore the factory settings.

E101.9: Parameter attribute initialization check error

Description:

Parameter attribute initialization check error.

Troubleshooting

Cause	Troubleshooting	Solution
Parameter attribute initialization check error	Check that H0A.99 = AA5C.	If the problems persists, replace the drive.

E102.0: FPGA communication establishment error

Description:

The communication between MCU and FPGA cannot be established.

Troubleshooting

Cause	Troubleshooting	Solution
1 FPGA fault 2 The communication between MCU and FPGA cannot be established.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

E102.1: FPGA initialization start error

Description:

FPGA failed.

Troubleshooting

Cause	Troubleshooting	Solution
FPGA cannot start.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

E102.8: FPGA and MCU software version mismatch

Description:

FPGA and MCU version mismatch.

Troubleshooting

Cause	Troubleshooting	Solution
FPGA and MCU software version mismatch	View the FPGA software version (H01.01) and MCU software version (H01.00) through the keypad or Inovance software tool. Check whether the non-zero values of the most significant bit of these software version numbers are consistent.	Contact Inovance for technical support. Update the FPGA or MCU software.

E104.1: MCU running timeout (MCU break down)

Description:

The access to MCU times out.

Troubleshooting

Cause	Troubleshooting	Solution
1 FPGA fault 2 The communication handshake between FPGA and HOST is abnormal. 3 Access timeout between HOST and coprocessor	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

E104.2: FPGA running timeout (FPGA break down)

Description:

The MCU torque interrupt scheduling time is abnormal. This fault is reported only during commissioning.

Troubleshooting

Cause	Troubleshooting	Solution
1 FPGA fault 2 The communication handshake between FPGA and MCU is abnormal.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

E104.4: MCU command update timeout

Description:

Take the moment when interrupt 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	Troubleshooting	Solution
The system reports that the encoder communication time is set improperly or the command calculation time is too long.	The fault persists after the servo drive is powered off and on repeatedly.	1 Hide the unnecessary functions. 2 Replace the servo drive.

E120.0: Unknown encoder model

Description:

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	Troubleshooting	Solution
1. The product (motor or servo drive) code does not exist.	Read the nameplates of the servo drive and motor to check whether IS810N series servo drive and 26-bit servo motor are used. Meanwhile, check whether H00.00 (motor code) is set to 14102. Check the servo drive code (H01.02) to see whether this servo drive code exists.	If the motor code is unknown, set H00.00 to 14102 when the IS810N series servo drive and 23-bit servo motor are used. If the drive code is absent, set the servo drive model correctly according to the nameplate.
2. The power rating of the motor does not match that of the servo drive.	Check whether the servo drive code (H01.02) matches the serial-type motor code (H00.05).	Replace the unmatched products.

E120.1: Unknown motor model

Description:

The servo drive detects the motor model defined by H00.00 during initialization upon power-on. If the motor model does not exist, E120.1 occurs.

Troubleshooting

Cause	Troubleshooting	Solution
The motor model defined by H00.00 is abnormal	Check whether the value of H00.00 matches the used motor.	Rectify the value of H00.00.

E120.2: Unknown drive model

Description:

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	Troubleshooting	Solution
H01.10 is incorrect	Check the value of H01.10.	Disable servo drive model auto detection and set H01.10 to a proper value manually.

E120.5: Motor and drive current mismatch

Description:

The rated output of the servo drive is far 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	Troubleshooting	Solution
The internal scale value is abnormal.	Check whether the servo drive model is correct. If the set current sampling coefficient is too large, calculation overflow will occur.	Replace the servo drive.

E120.6: FPGA and motor model mismatch

Description:

- The motor model is set improperly, causing mismatch and malfunction of the servo drive.
- The motor model is set properly, but the motor encoder is not supported by the servo drive.

Troubleshooting

Cause	Troubleshooting	Solution
FPGA software version and H00.00 mismatch	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 or replace the motor.

E120.7: Model check error

Description:

The servo drive model parameter cannot be identified.

Troubleshooting

Cause	Troubleshooting	Solution
Model parameter CRC check failed	Check that the model parameter is present.	Write the model parameter again.

E120.8: Junction temperature parameter check error

Description:

The junction temperature parameter is identified incorrectly.

Troubleshooting

Cause	Troubleshooting	Solution
Junction temperature parameter CRC check failed	Check that the junction temperature parameter is present.	Rewrite the junction temperature parameter.

E122.1: Different DIs assigned with the same function

Description:

- The same function is assigned to different DIs.
- The DI function No. exceeds the maximum number allowed for DI functions.

Troubleshooting

Cause	Troubleshooting	Solution
1. The same function is allocated to different DIs.	Check whether parameters in groups H03 (H03.02, H03.04... H03.20) and H17 (H17.00, H17.02... H17.30) are assigned with the same non-zero DI function No.	Assign different DI function numbers to parameters in groups H03 or H17, and then restart the control circuit to activate the assignment, or switch off the S-ON signal and send a "RESET" signal to activate the assignment.
2. The DI function No. exceeds the maximum 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.

E122.4: Different VDIs assigned with the same function

Description:

The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Troubleshooting

Cause	Troubleshooting	Solution
1. The same function is assigned to different VDIs	Check whether parameters in groups H03 (H03.02, H03.04... H03.20) and H17 (H17.00, H17.02... H17.30) are assigned with the same non-zero DI function No.	Assign different DI function numbers to parameters in groups H03 or H17, and then restart the control circuit to activate the assignment, or switch off the S-ON signal and send a "RESET" signal to activate the assignment.
2. The 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.

E122.2: Different DOs assigned with the same function

Description:

The DO function No. exceeds the maximum number allowed for DO functions.

Troubleshooting

Cause	Troubleshooting	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: Upper limit in the rotation mode invalid

Description:

The upper limit of mechanical single-turn position exceeds 231 in the absolute rotation mode.

Troubleshooting

Cause	Troubleshooting	Solution
The upper limit (reference range) of the mechanical single-turn position exceeds 231 in the absolute position rotation mode.	Check the setting of the mechanical gear ratio, the upper limit of mechanical single-turn position and the electronic gear ratio when the servo drive runs in the 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 the mechanical single-turn position (reference range) does not exceed 231.

E122.5: DI and VDI assigned with the same function

Description:

The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Troubleshooting

Cause	Troubleshooting	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.	Change any repetitive number.

E122.7: Fully closed-loop parameter setting error

Description:

In fully closed-loop applications, the inner loop is set to rotation mode.

Troubleshooting

Cause	Troubleshooting	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.

E122.9: Fully closed-loop function pin conflict

Description:

The frequency division output pin conflicts with the fully closed loop second encoder pin.

Troubleshooting

Cause	Troubleshooting	Solution
The frequency division output pin conflicts with the fully closed loop second encoder pin.	Check the setpoint of H05.38 and H0F.03.	Disable frequency-division output.

E135.0: Chip 3.3V signal diagnosis error

Description:

The two chips diagnose whether the supply voltage of each other is within the allowed range of 3.0 V to 3.6 V.

Troubleshooting

Cause	Troubleshooting	Solution
The chip voltage is out of the range of 3.0 V to 3.6 V.	Check whether the power supply voltage of the chip is normal.	Replace the safety module.

E136.0: Encoder ROM motor parameter check error

Description:

When reading parameters in the encoder ROM, the servo drive detects that no parameters are saved there or parameter values are inconsistent with the setpoints.

Troubleshooting

Cause	Troubleshooting	Solution
1. The servo Servo drive model does not match the motor model.	View the servo drive and servo motor nameplates to check whether the IS810N 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 ROM of the serial incremental encoder.	1 Check whether the encoder cable provided by Inovance is used. For cable specifications, see "Matching Cables". The cable must be 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 pin assignment, see the section related to wiring.	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 (RST, UVW) through different routes.
3. The servo drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

E136.1: Encoder ROM motor parameter read error

Description:

The encoder cable is not connected properly. A communication error occurs on the encoder due to interference.

Troubleshooting

Cause	Troubleshooting	Solution
1. The encoder cable connections are incorrect or loosened.	Check the encoder cable connection. Check whether ambient vibration is too large, which loosens the encoder cable and even damages the encoder.	1 Connect the encoder cables according to the correct wiring diagram. 2 Re-connect encoder cables 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.

E140.0: encryption chip check error

Description:

Encryption chip check failure

Troubleshooting

Cause	Troubleshooting	Solution
Encryption software is not flashed	Check whether the error persists after restart.	Ask the manufacturer to flash the encryption software.

E140.1: MCU key calculation failed

Description:

The version of the encryption chip is incorrect.

Troubleshooting

Cause	Troubleshooting	Solution
Communication failure between MCU and the encryption chip	Check whether the error persists after restart.	Ask the manufacturer to flash the encryption software.

E140.2: wrong encryption chip version

Description:

The MCU failed to establish communication with the encryption chip.

Troubleshooting

Cause	Troubleshooting	Solution
Encryption software is not flashed	Check whether the error persists after restart.	Ask the manufacturer to flash the encryption software.

E150.0: STO safety state applied

Description:

The STO input protection applies (safety state).

Troubleshooting

Cause	Troubleshooting	Solution
Two 24 V inputs are disconnected simultaneously, triggering the STO function.	Check whether the external 24 V power signal is normal.	When the external 24 V signal is cut off, the servo drive enters STO safety state and the motor coasts to stop.

E150.1: STO input state abnormal

Description:

The single-channel input of STO is ineffective.

Troubleshooting

Cause	Troubleshooting	Solution
The 24V input signal of STO1 or STO2 is abnormal. Only one STO input signal is disconnected.	Check whether the external 24 V power signal is normal.	1. The 24V input signal is normal, but the servo drive reports E150.1 after restart. This may be caused by an abnormal 24 V input circuit. It is recommended to replace the servo drive.

E150.2: Buffer 5 V supply error

Description:

The MCU monitors the 5 V power supply of the PWM Buffer to detect whether overvoltage or undervoltage occurs. If the voltage is abnormal, E150.2 occurs.

Troubleshooting

Cause	Troubleshooting	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

Description:

The photocoupler of the front hardware circuit for STO input is inspected. If the photocoupler is short-circuited, the servo will display E150.3.

Troubleshooting

Cause	Troubleshooting	Solution
The STO upstream input optocoupler is short circuited.	The fault persists and the keypad displays E150.3 after restart.	Replace the servo drive.

E150.4: PWM buffer hardware diagnosis failure

Description:

An error occurs on the PWM buffer integrated circuit during initialization detection upon power-on (the PWM signal cannot be blocked).

Troubleshooting

Cause	Troubleshooting	Solution
STO Buffer power-on test error	The fault persists and the keypad displays E150.4 after restart.	Replace the servo drive.

E201.0: Phase-P overcurrent

Description:

An excessively high current flows through the positive pole of the DC-AC circuit.

Troubleshooting

Cause	Troubleshooting	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	1 The motor parameters are set improperly, modify the motor parameters. 2 The current loop parameters are set improperly, re-adjust the current loop parameters. 3 Improper speed loop parameters cause vibration. 4 Servo drive operates improperly. Replace it.
2. The encoder cable is aged or corroded, or connected incorrectly or loosely.	Check whether you have used the standard encoder cable provided by Inovance. Check the cable for aging, corrosion and looseness. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17h (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten or replace the encoder cable.
3. 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 but the fault persists after the servo drive is powered off and on again. 3 Check whether resistance of the external braking resistor is too small or the braking resistor is short-circuited (between terminals P⊕, C).	1 Replace with a braking 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 too small or the braking resistor is short-circuited (between terminals P, C).	Replace with a braking resistor of matching resistance. Perform wiring again.

E201.1: Phase-U overcurrent

Description:

A current higher than the threshold is collected in the phase-U current.

Troubleshooting

Cause	Troubleshooting	Solution
1. Motor cables are in poor contact.	Check whether the servo drive power cables and motor cables on the U, V, and W sides of the servo 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 in case of poor insulation.
3. U/V/W cables of the motor 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 UVW phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.2: Phase-V overcurrent

Description:

A current higher than the threshold is collected in the phase-V current.

Troubleshooting

Cause	Troubleshooting	Solution
1. Motor cables are in poor contact.	Check whether the servo drive power cables and motor cables on the U, V, and W sides of the servo 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 in case of poor insulation.
3. U/V/W cables of the motor 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 UVW phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.3: Phase-W overcurrent

Description:

A current higher than threshold is collected in the phase-W current.

Troubleshooting

Cause	Troubleshooting	Solution
1. Motor cables are in poor contact.	Check whether the servo drive power cables and motor cables on the U, V, and W sides of the servo 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 in case of poor insulation.
3. U/V/W cables of the motor 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 UVW phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.4: Phase-N overcurrent

Description:

An excessively high current flows through the negative pole of the DC-AC circuit.

Troubleshooting

Cause	Troubleshooting	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	Adjust the gains.
2. The encoder cable is aged or corroded, or connected incorrectly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely.	Re-solder, tighten or replace the encoder cable.
3. Overcurrent occurs on the braking resistor.	Check whether resistance of the external braking resistor is too small or the braking resistor is short-circuited (between terminals P⊕, C).	Replace with a braking resistor of matching resistance. Perform wiring again.
4. Overcurrent is caused by the superposition of the braking current and phase current.	Check if the drive accelerates abruptly during braking. Check if the voltage feedback exceeds the release threshold through the Inovance drive commissioning platform, and if the torque command 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 cable but the fault persists after the servo drive is powered off and on again.	Replace the servo drive.

E208.2: Encoder communication timeout

Description:

The FPGA detected a communication timeout with the encoder.

Troubleshooting

Cause	Troubleshooting	Solution
The servo drive fails to receive the data fed back by the encoder in three consecutive cycles.	Check H0b.30 parameter bit12; Encoder wiring errors; Encoder cable is loose; The encoder cable is too long; Encoder communication is interfered; Encoder failure.	1 Check whether the motor model is correct. 2 Check whether encoder cables are in proper condition. 3 Check whether the encoder version (H00-04) is set properly. 4 The servo drive operates improperly. Replace it.

E208.4: FPGA current loop operation timeout

Description:

The operating time of the current loop exceeds the interval threshold.

Troubleshooting

Cause	Troubleshooting	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 short-circuited to ground

Description:

An abnormal motor phase current or bus voltage is detected during power-on self-testing. The DC bus voltage exceeds the discharge threshold. U phase current for Size 1/2/3/4 is greater than 1/4 of the H01.07 setting

Troubleshooting

Cause	Troubleshooting	Solution
The servo drive power cables (U/V/W) are short-circuited to ground.	Disconnect the motor cables, and measure whether the servo drive power cables (U/V/W) are short-circuited to ground (PE).	Re-connect or replace the servo drive power cables.
2. The motor is short-circuited to ground.	After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	Replace the motor.
The servo drive is faulty.	Disconnect the power cables from the servo drive, but the fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

E234.0: Runaway

Description:

In the torque control mode, the direction of the torque reference is opposite to that of the speed feedback. The speed feedback direction is in reverse to the speed reference direction in the position or speed control mode.

Troubleshooting

Cause	Troubleshooting	Solution
1. The phase sequence of the U, V, and W cables is incorrect.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the U, V, and W cables according to correct phase sequence.
2. The interference signal causes an error in the initial phase detection of the motor mover upon power-on.	The UVW phase sequence is correct. But E234 occurs when the servo drive is enabled.	Power off and on the servo drive again.
3. The encoder model is wrong or the encoder is wired improperly.	View the servo drive and servo motor nameplates to check whether the devices used are IS810N series servo drive and servo motor equipped with 20-bit absolute encoder.	Replace with the mutually-matching servo drive and servo motor. Check the motor model, encoder type, and encoder cable connection again.
4. The encoder cable is aged or corroded, or connected incorrectly 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.
5. Improper parameter settings lead to excessive vibration.	The stiffness level is set to an excessively high value, leading to excessive vibration.	Set a proper stiffness level to avoid excessive vibration.#

E320.0: Braking resistor overload

Description:

The braking resistor is overloaded.

Troubleshooting

Cause	Troubleshooting	Solution
The accumulative heat of the braking resistor is too great.	Cut off the power and check the braking resistor for over-temperature.	1 Check if large discharge current is present due to high bus voltage. 2 Ensure that the motor cannot be driven reversely. 3 Replace the servo drive.

E321.0: Dynamic brake resistor overload

Description:

The dynamic braking resistor is overloaded.

Troubleshooting

Cause	Troubleshooting	Solution
The accumulative heat of exceed braking resistor exceeds the maximum thermal capacity of the resistor.	Check whether the value of H0b.98 exceeds 100%.	Ensure that the motor cannot be driven reversely in the dynamic braking state.

E400.0: Main circuit overvoltage

Description:

The DC bus voltage between P ⊕ and N ⊖ exceeds the fault value: 220V Servo driver: normal value: 310V, fault value: 420V; 380V servo drive: normal value: 540V, fault value: 760V.

Troubleshooting

Cause	Troubleshooting	Solution
1. The voltage input to the main circuit is too high.	Check the input power supply specifications of the servo driver and measure whether the input voltage of the servo driver side (RST) of the main loop cable meets the following specifications: 220V servo driver: effective value: 220V ~ 240V, allowable deviation:-10% ~ +10% (198V ~ 264V); 380V servo driver: effective value: 380V ~ 440V, allowable deviation:-10% ~ +10% (342V ~ 484V).	Replace or adjust the power supply according to the specified range.
2. The power supply is unstable or affected by lightning.	Check whether the power supply is unstable, affected by lightning, or complies with the preceding range.	Connect a surge protection device (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 the built-in braking resistor (H02.25 = 0) is used, confirm whether P ⊕ and D are reliably connected by wires. If so, measure the resistance value between C and D; If an external braking resistor (H02.25 = 1/2) is used, measure the resistance value of the external braking resistor between P ⊕ and C. For details, see table "Specifications of the braking resistor".	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 it with a new one and connect the new one 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.

Cause	Troubleshooting	Solution
4. The resistance of the external braking resistor is too large, resulting in insufficient energy absorption during braking.	Measure the resistance of the external braking resistor connected between terminals P⊕ and C. Compare the measured value with the recommended value.	1 Connect a new external braking resistor with recommended resistance 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 and the maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/ deceleration time during running and measure the DC bus voltage between P ⊕ and N ⊖ to check whether the voltage exceeds the fault threshold during deceleration.	After confirming the input voltage of the main circuit is within the specified range, increase the acceleration/deceleration time if the operating conditions allow.
6. The bus voltage sampling value deviates greatly from the measured value.	Observe whether the parameter H0b.26 (bus voltage value) is in the following range: 220V servo driver: H0b.26 > 420V; 380V servo drive: H0b.26 > 760V. Measure whether the DC bus voltage N between P ⊕ and N ⊖ is normal and less than the value of H0b.26.	Contact Inovance for technical support.
7. The servo drive is faulty.	The fault persists after the main circuit is powered off and on repeatedly.	Replace the servo drive.

E410.0: Main circuit undervoltage

Description:

The DC bus voltage between P ⊕ and N ϑ is lower than the fault value: 220V Servo driver: normal value: 310V, fault value: 200V (the fault value of S5R5 model is 180V). 380 V servo drive: Normal value 540 V Overvoltage threshold 380 V.

Troubleshooting

Cause	Troubleshooting	Solution
1. The power supply of the main circuit is unstable or power failure occurs. 2. Instantaneous power failure occurs.	Check the driver input power specifications and measure whether the non-driver side and driver side (RST) input voltages of the main circuit cable meet the following specifications: 220V Driver: effective value: 220V ~ 240V, allowable deviation:-10% ~ +10% (198V ~ 264V) All three phases need to be measured.	Increase the capacity of the power supply.
3. The power voltage drops during running.	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.	Increase the capacity of the power supply.

Cause	Troubleshooting	Solution
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 properly.
5. The servo drive is faulty.	Observe whether the parameter H0b.26 (bus voltage value) is in the following range: 220V servo drive: H0b.26 < 200V; 380V servo drive: H0b.26 < 380V. The fault persists after the main circuit is powered off and on repeatedly.	Replace the servo drive.

E410.1: Main circuit de-energized

Description:

Phase loss occurs on the three-phase servo drive.

Troubleshooting

Cause	Troubleshooting	Solution
The power supply is disconnected during operation.	1 Check the power input specifications of the servo drive and measure whether the input voltage at the power supply side of the main circuit cables and R/S/T on the drive side is within the following range: • 220V servo drive: effective value: 220V ~ 240V, allowable deviation:-10% ~ +10%. • 380V servo drive: effective value: 380V ~ 440V, allowable deviation:-10% ~ +10%. Measure the voltages of all the three phases. 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: 220 V drive: H0b.27 < 200 V 380 V drive: H0b.27＜ 380 V. 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 (RST/L1L2L3) properly.

E430.0: Control circuit power supply undervoltage

Description:

The drive control power voltage is below the undervoltage threshold.

Troubleshooting

Cause	Troubleshooting	Solution
1. The control power supply of servo drives in size C/D/E are unstable or fails.	Check the input power supply specifications of the servo driver, check the actual input voltage specifications, and measure whether the main circuit input voltage meets the following specifications: 220V servo drive: effective value: 220V ~ 240V, allowable deviation:-10% ~ +10% (198V ~ 264V); 380V servo drive: effective value: 380V ~ 440V, allowable deviation:-10% ~ +10% (342V ~ 484V). Measure the voltages of all the three phases.	Increase the capacity of the power supply.
2. The control power supply of servo drives in size C/D/E are in poor contact.	Check whether control circuit cables are connected properly and whether the voltage of control circuit cables (L1C, L2C) is within the specified range.	Re-connect or replace the cables.

E500.0: motor overspeed

Description:

The actual speed of the motor exceeds the overspeed threshold.

Troubleshooting

Cause	Troubleshooting	Solution
1. The UVW phase sequence of the motor is incorrect.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the UVW cables according to the correct sequence.
2. H0A.08 is set improperly.	Check whether the overspeed threshold is less 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).	Re-set the overspeed threshold according to the mechanical requirements.

Cause	Troubleshooting	Solution
3. The input reference exceeds the overspeed threshold.	Check whether the motor speed corresponding to the input reference exceeds the overspeed threshold. Position control mode: In CSP mode, view the gear ratio 6091.01h/ 6091.02h to check the position reference increment per 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 speed control mode, view the gear ratio 6091-01h/6091-02h, and the values of 60FFh (Target velocity), 2006-H06.06 to 2006-H06.09, and 607Fh (Max profile velocity). In torque control mode, view the value of H07.17 (Speed limit source) and the corresponding speed limit value.	In position control mode: CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when planning references. PP: Decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease the values of 6099.01h and 6099.02h or increase the acceleration/ deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions. Speed mode: Decrease the target velocity, speed limit, and gear ratio. In PV mode, increase the speed ramp (6083h and 6084h). In CSV mode, the host controller should cover the speed ramp. In the torque control mode, set the speed limit to a value lower than the overspeed threshold.
4. The motor speed overshoots.	Check whether the speed feedback exceeds the overspeed threshold by using Inovance servo commissioning software.	Adjust the gain or mechanical running conditions.
5. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

E500.1: Speed feedback overflow

Description:

The FPGA speed measurement overflows.

Troubleshooting

Cause	Troubleshooting	Solution
1. FPGA internal speed overflows.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the UVW cables according to the correct sequence.
2. The motor speed overshoots.	Check whether the speed feedback exceeds the overspeed threshold by using Inovance servo commissioning software.	Adjust the gain or mechanical running conditions.

E500.2: FPGA position feedback pulse overspeed

Description:

Communication error occurred between boards of the drive.

Troubleshooting

Cause	Troubleshooting	Solution
Communication error occurred between boards of the drive.	The alarm persists in spite of repeated power off and on.	Replace the servo drive.

E610.0: Servo drive overload

Description:

When the drive overload protection mode H0C.31 selects the overload curve, the drive output current is greater than the rated current, and the duration is greater than the overload time.

Troubleshooting

Cause	Troubleshooting	Solution
1. The motor parameters are wrong and the angle identification is not done.	Detect the motor parameters of H00 group and H01 group.	Enter the correct motor parameters for angle identification.
2. The load on the motor end is too large, or the inertia ratio setting is unreasonable.	Check whether there is any abnormality in the mechanical connection of the load end, and perform inertia identification.	Ensure that the load is connected properly and perform inertia identification
3. The drive gain parameter setting is unreasonable, or the acceleration and deceleration time is too short.	Check the loop gain of H08 group and check the command acceleration and deceleration time.	Adjust the loop gain and adjust the acceleration and deceleration time.
4. The drive option is too small, and the rated current does not match the motor current.	Check the drive current rating H01.16 and the motor current rating H00.11.	Opt for a larger-spec drive model.
5. Drive hardware fault.	Check whether the current feedback is within the normal range when running at constant speed.	Replacing the drive

E602.0: Angle auto-tuning failure

Description:

Unusual jitter occurs on the encoder feedback during angle auto-tuning.

Troubleshooting

Cause	Troubleshooting	Solution
The data fed back by the encoder is abnormal.	Check whether the encoder communication is being disturbed.	Check the wiring of the encoder.

E602.2: U/V/W phase sequence reversed

Description:

A wrong U/V/W phase sequence is detected during angle auto-tuning.

Troubleshooting

Cause	Troubleshooting	Solution
Incorrect UVW wiring is detected during angle auto-tuning.	Check whether U/V/W phases are wired correctly.	Exchange cables of any two phases among U/V/W and perform auto-tuning again.

E605.0: Motor speed too high upon S-ON

Description:

The motor speed exceeds the rated speed when the servo drive is switched on.

Troubleshooting

Cause	Troubleshooting	Solution
The motor speed exceeds the rated speed when the servo drive is switched on.	Check if the drive is enabled when the motor has been driven.	Switch on the drive when the motor is standstill.

E620.0: Motor overload

Description:

The accumulative heat of the motor reaches the fault threshold.

Troubleshooting

Cause	Troubleshooting	Solution
1. The motor and encoder cables are connected incorrectly 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 so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Check the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive keeps exceeding 100.0%.	Use a servo drive of higher capacity and a matching servo motor, or reduce the load and increase the acceleration/deceleration time.
3. Acceleration/deceleration is too frequent or the load inertia is too large.	Calculate the mechanical inertia ratio or perform inertia auto-tuning and view H08.00 (Inertia ratio). Confirm the single running cycle when the servo motor runs cyclically.	Increase the acceleration/ deceleration time during single-cycle running.
4. The gain adjustment is improper or the stiffness is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Readjust the gain.
5. The servo drive model or motor model is set improperly.	Check the motor model (H00.00) and drive model (H01.10) stored in the bus encoder.	Check the servo drive nameplate, compare the "Drive Model Number and Nameplate", set the correct servo drive model (H01.10) and motor model to update to the matching model.

Cause	Troubleshooting	Solution
6. The motor is stalled due to mechanical factors, resulting in overload 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 the mechanical-related problem.
7. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

E630.0: motor rotor locked over-temperature

Description:

U/V/W output phase loss or incorrect phase sequence occurs on the drive.

Troubleshooting

Cause	Troubleshooting	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the 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 drive U/V/W cables or the encoder cable is disconnected.	Check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
3. The motor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad. References in the position control mode: H0b.00 (Input position reference counter) References in the speed control mode: H0b.01 (Speed reference) References in the torque control mode: H0b.02 (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.

E631.0: SBC brake circuit diagnosis exception

Description:

In the SOS state, the actual speed or position change exceeds the preset monitoring threshold.

Troubleshooting

Cause	Troubleshooting	Solution
1. The SBC circuit is abnormal when the card is powered on.	Check whether the 24 V voltage of the SBC is normal.	Ensure that the 24 V voltage of the SBC is normal.
2. The brake is abnormal during SBC brake release.	SBC brake circuit is faulty.	In case of the SBC circuit hardware failure, it is recommended to return it to the factory for maintenance.

E631.1: 24 V or brake not connected

Description:

The brake circuit is faulty.

Troubleshooting

Cause	Troubleshooting	Solution
The brake or the 24 V power supply is not connected when the brake feature is used.	Check that motor brake wiring is correct.	1 Connect the brake cable and 24 V power supply. 2 Replace the motor. 3 Turn off the brake switch H02.16.

E631.2: P-MOS open circuit

Description:

The brake circuit is faulty.

Troubleshooting

Cause	Troubleshooting	Solution
When braking is used, P-MOS open circuit occurred on the brake circuit.	Check whether open circuit occurs on the brake circuit P-MOS.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

E631.3: N-MOS open circuit

Description:

The brake circuit is faulty.

Troubleshooting

Cause	Troubleshooting	Solution
When braking is used, N-MOS open circuit occurred on the brake circuit.	When braking is used, N-MOS open circuit occurred on the brake circuit.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

E640.0: IGBT over-temperature

Description:

The IGBT temperature reaches the fault threshold defined by H0A.18.

Troubleshooting

Cause	Troubleshooting	Solution
1. The ambient temperature is too high.	Measure the ambient temperature.	Improve the cooling conditions of the servo drive to lower down the ambient temperature.
2. The servo drive is restarted repeatedly to reset the overload fault.	View the fault records (set H0b.33 and view H0b.34) to check whether an overload fault/warning is reported (E610, E620, E630, E650, E909, E920, E922).	Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists even though the servo drive is restarted five minutes after power-off.	Replace the servo drive.

E640.1: Flywheel diode overtemperature

Description:

The temperature of the flywheel diode reaches the fault threshold defined by H0A.18.

Troubleshooting

Cause	Troubleshooting	Solution
The ambient temperature is too high.	Measure the ambient temperature.	Improve the cooling conditions of the servo drive to lower down the ambient temperature.
The servo drive is restarted repeatedly to reset the overload fault.	View the fault records to check whether an overload fault/warning is reported (Er.610, Er.620, Er.630, Er.650, Er.909, Er.920, Er.922).	Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
The servo drive is faulty.	The fault persists even though the servo drive is restarted five minutes after power-off.	Replace the servo drive.

E650.0: Heatsink overtemperature

Description:

The temperature of the servo drive power module is higher than the overtemperature threshold.

Troubleshooting

Cause	Troubleshooting	Solution
1. The ambient temperature is too high.	Measure the ambient temperature.	Improve the cooling conditions of the servo drive to lower down the ambient temperature.
2. The servo drive is restarted repeatedly to reset the overload fault.	View the fault log (set H0b.33 and view H0b.34) and check whether an overload fault or warning (E610, E620, E630, E650) occurs.	Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists even though the servo drive is restarted five minutes after power-off.	Replace the servo drive.

E660.0: Motor overtemperature

Description:

The temperature of the air-cooled motor is too high.

Troubleshooting

Cause	Troubleshooting	Solution
The temperature of the air-cooled motor is too high.	Measure whether the temperature of the air-cooled motor is too high.	Cool the motor down.

E660.1: KTY sensor wire breakage

Description:

KTY sensor wire breakage

Troubleshooting

Cause	Troubleshooting	Solution
KTY sensor wire breakage	Stop the drive and check the resistors at both ends of KTY.	Replace the KTY sensor.

E661.0: STune failure

Description:

The gain drop reaches the lower limit when STune is adjusted: position loop gain < 5; Speed loop gain < 5; Model loop gain < 10

Troubleshooting

Cause	Troubleshooting	Solution
The gain drop reaches the lower limit when STune is adjusted: position loop gain < 5; Speed loop gain < 5; Model loop gain < 10	Check if vibration resonance is properly suppressed in the system. The torque vibration amplitude exceeds the setpoint of H09.11.	Set the notch manually when vibration cannot be suppressed automatically. Modify the electronic gear ratio to improve the command resolution, or increase the command filter time constant in the "Parameter configuration" interface. Check the machine for cyclic fluctuation.

E662.0: ETune failure

Description:

Check whether resonance that occurred during ETune operation cannot be suppressed.

Troubleshooting

Cause	Troubleshooting	Solution
Check whether resonance that occurred during ETune operation cannot be suppressed.	Check if vibration resonance is properly suppressed in the system. The torque vibration 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, increase the command filter time constant or in the parameter configuration interface. 3 Increase the value of H09.11 as appropriate. 4 Check whether the current of the machine fluctuates periodically. 5 Check whether the positioning threshold is too low. Increase the reference acceleration/deceleration time.

E663.0: ITune failure

Description:

Check whether resonance that occurred during ITune operation cannot be suppressed.

Troubleshooting

Cause	Troubleshooting	Solution
Check whether resonance that occurred during ITune operation cannot be suppressed.	Check if vibration resonance is properly suppressed in the system. The torque vibration 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, increase the command filter time constant or in the parameter configuration interface. 3 Increase the value of H09.11 as appropriate. 4 Check whether the current of the machine fluctuates periodically.

E664.0: Resonance too strong

Description:

Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H09.54.

Troubleshooting

Cause	Troubleshooting	Solution
System resonance duration exceeds 1s.	Check whether the torque fluctuation range is greater than the setpoint of H09_54.	1 Suppress the resonance. 2 Increase the value of H09.54 as appropriate.

E731.0: Encoder battery failure

Description:

The voltage of the absolute encoder battery is lower than 2.9 V.

Troubleshooting

Cause	Troubleshooting	Solution
1. The 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 encoder battery voltage is too low.	Measure the battery voltage.	Use a new battery with the matching voltage.

E731.1: Inovance 2nd encoder battery failure

Description:

Inovance 2nd encoder battery voltage is lower than 2.9 V.

Troubleshooting

Cause	Troubleshooting	Solution
Inovance 2nd encoder battery voltage is too low.	Measure the battery voltage.	Use a new battery with the matching voltage.

E733.0: Encoder multi-turn counting error

Description:

An encoder multi-turn counting error occurs.

Troubleshooting

Cause	Troubleshooting	Solution
The encoder is faulty.	Set H0d.20 to 2 to clear the fault, but E733.0 persists after restart.	Replace the motor.

E733.1: Inovance 2nd encoder multi-turn counting error.

Description:

Inovance 2nd encoder multi-turn counting error

Troubleshooting

Cause	Troubleshooting	Solution
Inovance 2nd encoder error	Set H0d.20 to 3 to clear the fault, but E733.1 persists after restart.	Replace the motor.

E735.0: Encoder multi-turn counting overflow

Description:

A multi-turn counting overflow occurs on the absolute encoder.

Troubleshooting

Cause	Troubleshooting	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

Description:

Communication timeout occurs on the absolute encoder.

Troubleshooting

Cause	Troubleshooting	Solution
The communication between the servo drive and the encoder times out.	Check the wiring of the encoder and power on the servo drive again.	1 Check whether the encoder version (H00.04) is set properly. 2 Check whether the servo drive software version (H01.00). 3 Check encoder wiring. 4 Replace the servo motor.

E740.2: Absolute encoder error

Description:

A communication error occurs on the RX side of the encoder.

Troubleshooting

Cause	Troubleshooting	Solution
1. The encoder is wired improperly.	Check encoder wiring.	Connect the encoder cables according to the correct wiring diagram.
2. The encoder cable connections become loose.	Check for strong vibration, which loosens the encoder cable and even damages the encoder.	Re-connect encoder cables and ensure encoder terminals are connected securely.

Cause	Troubleshooting	Solution
3. The encoder Z signal is interfered with.	Check whether ambient devices are generating interference and whether multiple interference sources are present in the cabinet. Make servo drive stay in "Rdy" status and rotate motor shaft counterclockwise (CCW) manually and observer whether H0b.17 (feedback pulse counter) increases/decreases smoothly. Turning one circle corresponds to five 0–360° (for Z series motors). For X series motors, turning one circle corresponds to four 0–360°. If H0b.17 changes abnormally during motor rotating, the encoder is faulty. If no alarm is reported during motor shaft rotating but an alarm is reported during servo drive running, interference may exist.	It is recommended to use the cables provided by Inovance. For use of customized cables, check whether the customized cable complies with specifications and whether it is a shielded twisted pair cable. Route the motor cables and encoder cables through different routes. Ensure the servo motor and servo drive are grounded properly. Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts.
4. The encoder is faulty.	Use a new encoder cable. If the fault disappears, 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 encoder cables are replaced, the encoder may be faulty. In this case, replace the servo motor.

E740.3: Absolute encoder single-turn calculation error

Description:

Internal fault of the encoder.

Troubleshooting

Cause	Troubleshooting	Solution
An internal fault occurs on the encoder.	Check whether bit7 of H0b.28 is set to 1.	1 Check whether the encoder version (H00-04) is proper. 2 Check whether encoder cables are in proper condition. 3 Replace the motor.

E740.6: Encoder data write error

Description:

The attempt to write the encoder data fails.

Troubleshooting

Cause	Troubleshooting	Solution
An error occurs when writing the position offset after angle auto-tuning.	Use a new encoder cable. If the fault disappears, 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.

E755.0: Nikon encoder communication fault

Description:

Nikon encoder communication failure.

Troubleshooting

Cause	Troubleshooting	Solution
Nikon encoder communication error	Perform a power cycle to check if the error is still reported.	Manually reset the encoder error through H0d.21. If the error remains, check the encoder and its wiring.

E760.0: Encoder overtemperature

Description:

The temperature of the absolute encoder is too high.

Troubleshooting

Cause	Troubleshooting	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: 3rd party encoder over-temperature or overspeed

Description:

Encoder over-temperature or overspeed

Troubleshooting

Cause	Troubleshooting	Solution
Motor overtemperature or overspeed.	1 Check if the ambient temperature or the average load rate is too high. 2 Check the motor for overspeed.	Switch off the S-ON signal to wait for the encoder to cool down.

E770.0: Fully-closed loop input phase A wire breakage

Description:

Fully-closed phase A input differential voltage wire breakage

Troubleshooting

Cause	Troubleshooting	Solution
Fully-closed phase A input differential voltage wire breakage	Measure the phase AB differential voltage to check if it is below 2.5 V.	Adjust the fully-closed loop phase A input voltage.

E770.1: Fully-closed loop input phase B wire breakage

Description:

Fully-closed phase B input differential voltage wire breakage

Troubleshooting

Cause	Troubleshooting	Solution
Fully-closed phase B input differential voltage wire breakage	Measure the phase B differential voltage to check if it is below 2.5 V.	Adjust the fully-closed loop phase B input voltage.

E770.2: Fully-closed loop input phase Z wire breakage

Description:

Fully-closed phase Z input differential voltage wire breakage

Troubleshooting

Cause	Troubleshooting	Solution
Fully-closed phase Z input differential voltage wire breakage	Measure the phase Z differential voltage to check if it is below 2.5 V.	Adjust the fully-closed loop phase Z input voltage.

E770.6: Fully closed-loop Inovance 2nd encoder initialization communication error

Description:

The second encoder failed to initialize.

Troubleshooting

Cause	Troubleshooting	Solution
1. The encoder cable connections are incorrect or loosened.	1 Check encoder wiring. 2 Check for strong vibration, which loosens the encoder cable and even damages the encoder.	1 Connect the encoder cables according to the correct wiring diagram. 2 Re-connect encoder cables 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.

E770.7: Fully closed-loop 2nd encoder communication error

Description:

Second encoder communication failed.

Troubleshooting

Cause	Troubleshooting	Solution
1. The encoder is wired improperly.	Check encoder wiring.	Connect the cables again according to the correct wiring diagram. Connect the cables again and ensure encoder terminals are connected securely. It is recommended to use the cables provided by Inovance. For use of customized cables, check whether the customized cable complies with specifications and whether it is a shielded twisted pair cable. Route the motor cables and encoder cables through different routes. Ensure the servo motor and servo drive are grounded properly. Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts. Use a new encoder cable. If the fault persists after encoder cables are replaced, the encoder may be faulty. In this case, replace the servo motor.
2. The encoder cable connections become loose.	Check for strong vibration, which loosens the encoder cable and even damages the encoder. Use a new encoder cable. If the fault disappears, the original encoder cable is damaged.	
3. The encoder Z signal is interfered with.	Check whether ambient devices are generating interference and whether multiple interference sources are present in the cabinet.	
4. The encoder is faulty.	Make servo drive stay in "Rdy" status and rotate motor shaft counterclockwise (CCW) manually and observer whether H0b.17 (electrical angle) increases/ decreases smoothly. Turning one circle corresponds to five 0–360° (for Z series motors). For X series motors, turning one circle corresponds to four 0–360°. If H0b.17 changes abnormally during motor rotating, the encoder is faulty. If no alarm is reported during motor shaft rotating but an alarm is reported during servo drive running, interference may exist. 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.	

E939.0: Motor power cable disconnected

Description:

At least one phase of the motor is disconnected.

Troubleshooting

Cause	Troubleshooting	Solution
One or two phases of the motor power cable are disconnected.	Check the wiring of U/V/W power cables.	1 Check if the power cable are disconnected or in poor contact. Re-connect the power cable. 2 Replace the servo motor.

E939.1: Phase-U power cable disconnected

Description:

Motor U phase power cable breakage

Troubleshooting

Cause	Troubleshooting	Solution
Motor U phase power cable breakage	Check the wiring of the phase-U power cable.	1 Check if the power cable are disconnected or in poor contact. Re-connect the power cable. 2 Replace the servo motor.

E939.2: Phase-V power cable disconnected

Description:

Motor V phase power cable breakage

Troubleshooting

Cause	Troubleshooting	Solution
Motor V phase power cable breakage	Check the wiring of the phase-V power cable.	1 Check if the power cable are disconnected or in poor contact. Re-connect the power cable. 2 Replace the servo motor.

E939.3: Phase-W power cable disconnected

Description:

Motor W phase power cable breakage

Troubleshooting

Cause	Troubleshooting	Solution
Motor W phase power cable breakage	Check the wiring of the phase-W power cable.	1 Check if the power cable are disconnected or in poor contact. Re-connect the power cable. 2 Replace the servo motor.

EA33.0: Encoder read/write check error

Description:

Internal parameters of the encoder are abnormal.

Troubleshooting

Cause	Troubleshooting	Solution
1. The serial incremental encoder cable is disconnected or loose.	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. An error occurs when reading/ writing the serial incremental encoder parameters.	If the fault persists after the servo drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

EA33.1: Fully closed-loop Inovance 2nd encoder data read/write error

Description:

Internal parameters of the encoder are abnormal.

Troubleshooting

Cause	Troubleshooting	Solution
1. The serial incremental encoder cable is disconnected or loose.	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. An error occurs when reading/ writing the serial incremental encoder parameters.	If the fault persists after the servo drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

EB00.0: Position deviation too large

Description:

The position deviation in the position control mode is larger than the setpoint of 6065h (Threshold of excessive position deviation).

Troubleshooting

Cause	Troubleshooting	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 the encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor is stalled due to mechanical factors.	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 the mechanical-related problem.
4. The servo drive gain is too low.	Check the servo drive position loop gain and speed loop gain: first gain: H08.00 ~ H08.02; Second gain: H08.03 to H08.05.	Adjust the gain values manually or perform gain auto-tuning.

Cause	Troubleshooting	Solution
5. The position reference increment is too large.	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 the speed information. In PP mode, check the gear ratio 6091.01h/6091.02h and determine the 6081h (Profile velocity). In HM mode, check the gear ratio 6091.01h/6091.02h, and determine 6099.01h and 6099.02h.	CSP: Decrease the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. PP: Decrease the value 6081h or increase the acceleration/ deceleration ramp (6083h, 6084h). HM: Decrease 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 insufficient for the operating conditions.	Check the value of 6065h.	Increase the setpoint of 6065h.
7. The servo drive/motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position references, position feedback, speed references, and torque references.	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

EB00.1: Position deviation overflow

Description:

The position deviation is too large.

Troubleshooting

Cause	Troubleshooting	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 the encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad. References in the position control mode: H0b.13 (Input position reference counter). References in the speed control mode: H0b.01 (Speed reference). References in the torque control mode: H0b.02 (Internal torque reference). Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.
4. The servo drive gain is too low.	Check the servo drive position loop gain and speed loop gain: first gain: H08.00 ~ H08.02; Second gain: H08.03 to H08.05.	Adjust the gain values manually or perform gain auto-tuning.

Cause	Troubleshooting	Solution
5. The position reference increment is too large.	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 the speed information. In PP mode, check the gear ratio 6091.01h/6091.02h and determine the 6081h (Profile velocity). In HM mode, check the gear ratio 6091.01h/6091.02h, and determine 6099.01h and 6099.02h.	CSP: Decrease the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. PP: Decrease the value 6081h or increase the acceleration/ deceleration ramp (6083h, 6084h). HM: Decrease 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 insufficient for the operating conditions.	Check the value of 6065h.	Increase the setpoint of 6065h.
7. The servo drive/motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position references, position feedback, speed references, and torque references.	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

EB01.0: Position reference increment too large

Description:

The pulse reference increment exceeds the excessive reference threshold three times consecutively.

Troubleshooting

Cause	Troubleshooting	Solution
The pulse reference increment exceeds the excessive reference threshold three times consecutively.	Check whether the baud rate of pulse reference input exceeds H0A.09.	1 Increase the value of H0A.09. 2 Reduce the baud rate of pulse input.

EB01.1: Individual position reference increment too large

Description:

The target position increment is too large.

Troubleshooting

Cause	Troubleshooting	Solution
The target position increment is too large.	Check the variation between two adjacent target positions using the software tool.	1 Check whether the maximum speed of the motor fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profile reference speed. If not, replace the servo motor. 2 Before switching the mode or enabling the servo drive, check whether the target position is aligned with current position feedback. 3 The communication sequence of the host controller is abnormal, leading to slave data error. Check the communication sequence of the host controller.

EB01.3: Command overflow

Description:

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	Troubleshooting	Solution
The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.	Check whether the host controller continues sending commands after overtravel alarm is reported by the servo drive.	1 Detect the servo limit signal (bit0 and bit1 of 60FDh is recommended) through the host controller. 2 Stop sending limit direction commands when an active servo limit signal is detected by the host controller.

EB02.0: Position deviation exceeding threshold in fully closed-loop

Description:

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	Troubleshooting	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 the internal/external encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.

Cause	Troubleshooting	Solution
3. The motor is stalled due to mechanical factors.	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 the mechanical-related problem.
4. The servo drive gain is too low.	Check the servo drive position loop gain and speed loop gain: first gain: H08.00 ~ H08.02; Second gain: H08.03 to H08.05.	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is too large.	Position control mode: IP/CSP mode, check the gear ratio 6091-01h/6091-02h, determine the increment value of the position command corresponding to a single synchronization period, convert to the speed information PP mode, check the gear ratio 6091-01h/6091-02h, determine 6081h (contour speed). In HM mode, view the gear ratio 6091-01h/6091-02h, and define the values of 6099-01h and 6099-02h.	IP/CSP: Decreases the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. PP: Decreases the value of 6081h or decreases the acceleration/ deceleration ramp (6083h, 6084h). HM: Decreases 6099-01h and 6099-02h or decreases the acceleration/ deceleration ramp (609Ah). Reduce the gear ratio as needed.
6. The value of H0F.08 is insufficient for the operating conditions.	Check the value of 6065h.	Increase the setpoint of 6065h.
7. The servo drive/motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position references, position feedback, speed references, and torque references.	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

EB02.1: Fully closed-loop position deviation overflow

Description:

The absolute value of the fully closed-loop position deviation is greater than 231.

Troubleshooting

Cause	Troubleshooting	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 drive U/V/W cables or the encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.

Cause	Troubleshooting	Solution
3. The motor is stalled due to mechanical factors.	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 the mechanical-related problem.
4. The servo drive gain is too low.	Check the servo drive position loop gain and speed loop gain: first gain: H08.00 ~ H08.02; Second gain: H08.03 to H08.05.	Adjust the gain values manually or use gain auto-tuning.
5. The position reference increment is too large.	Position control mode: In IP/CSP mode, view the gear ratio 6091.01h/ 6091.02h to check the position reference increment per 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.	IP/CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when planning references. PP: Decrease the value of 6081h or decrease the acceleration/ deceleration ramp (6083h, 6084h). HM: Decrease the values of 6099.01h and 6099.02h or decrease the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of H0F.08 is insufficient for the operating conditions.	Check the value of 6065h.	Increase the setpoint of 6065h.
7. The servo drive/motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position references, position feedback, speed references, and torque references.	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

EB03.0: Electronic gear ratio beyond the limit-H05.02

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
The electronic gear ratio converted by converted exceeds the maximum gear ratio or is less than the minimum gear ratio.	Check if the electronic gear ratio is within the range of 0.001–4000 x Encoder resolution/10000.	Change the value of H05.02.

EB03.1: Electronic gear ratio beyond the limit-Electronic gear ratio 1

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
Electronic gear ratio 1 exceeds the maximum gear ratio or is less than the minimum gear ratio.	Check if the electronic gear ratio is within the range of 0.001–4000 × Encoder resolution/10000.	Change the values of H05.07/H05.09.

EB03.2: Electronic gear ratio beyond the limit-Electronic gear ratio 2

Description:

Electronic gear ratio 2 exceeds the limit: (0.001–4000 x Encoder resolution/10000).

Troubleshooting

Cause	Troubleshooting	Solution
Electronic gear ratio 2 exceeds the maximum gear ratio or is less than the minimum gear ratio.	Check if the group 2 electronic gear ratio is within the range of 0.001–4000 × Encoder resolution/10000.	Change the values of H05.11/H05.13.

EE08.0: Synchronization (SYNC) signal loss

Description:

The SYNC signal is turned off when the EtherCAT network is in the OP state.

Troubleshooting

Cause	Troubleshooting	Solution
1. During synchronous communication, the slave performs abnormally in terms of receiving.	Check whether the shielded twisted pair is used as communication cable, and whether the servo drive is well grounded. Check whether the EtherCAT 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.
2. During synchronous communication, the master performs abnormally in terms of transmitting.	The host controller synchronization clock does not take effect; The synchronous clock error of the host controller is too large;	Measure the synchronization period through the background oscilloscope or the actual oscilloscope: if it is 0, it means that the synchronization clock of the host computer is not effective. First, check whether the network cable is connected to each slave station IN the order of IN port incoming and OUT port outgoing, and then restart the network; If the network cable connection sequence is correct, restart the network directly. If the synchronization period is not 0 and within the permissible fluctuation range (2 μs) of the drive, increase the synchronization loss threshold of the slave (H0E.32).
3. When the servo drive is enabled, the network status switches from OP to non-OP.	Check whether the network status switches from OP to non-OP.	Check the network status switchover program of the host controller.

EE08.1: Status switchover error

Description:

When the servo drive is enabled, the EtherCAT network status switches from OP to other status.

Troubleshooting

Cause	Troubleshooting	Solution
1. During synchronous communication, the slave performs abnormally in terms of receiving.	Check whether the shielded twisted pair is used as communication cable, and whether the servo drive is well grounded. Check whether the EtherCAT 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.
2. During synchronous communication, the master performs abnormally in terms of transmitting.	The host controller synchronization clock does not take effect; The synchronous clock error of the host controller is too large;	Measure the synchronization period through the background oscilloscope or the actual oscilloscope: if it is 0, it means that the synchronization clock of the host computer is not effective. First, check whether the network cable is connected to each slave station IN the order of IN port incoming and OUT port outgoing, and then restart the network; If the network cable connection sequence is correct, restart the network directly. If the synchronization period is not 0 and within the permissible fluctuation range (2 μs) of the drive, increase the synchronization loss threshold of the slave (H0E.32).
3. When the servo drive is enabled, the network status switches from OP to non-OP.	Check whether the network status switches from OP to non-OP.	Check the network status switchover program of the host controller.

EE08.3: Network cable connected improperly

Description:

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	Troubleshooting	Solution
The physical connection of the data link is unstable or the process data is lost due to plug-in/plug-out of the network cable.	Check: 1) whether the network cable of the servo drive is connected securely. 2) whether strong vibration occurs on site. 3) whether the network cable is plugged in or out. 4) whether the network cable provided by Inovance is used.	Check the connection of the network port through the change of the H0E.29 value. Use a new network cable that can connect reliably.

EE08.4 Data frame loss protection error

Description:

PDO data is corrupted due to EMC interference or an inferior network cable.

Troubleshooting

Cause	Troubleshooting	Solution
The data is lost due to EMC interference, poor quality of the network cable or improper connection.	Check whether the high 16 bits of H0E.25 have values that are increased.	Check whether the servo drive is grounded properly and rectify the EMC problem. Check whether the network cable used is the one designated by Inovance. Check whether the network cable is connected properly.

EE08.5: data frame transfer error

Description:

The upstream slave detects that the data frame has been corrupted and marked, which is then transferred to the downstream slave, leading to an alarm.

Troubleshooting

Cause	Troubleshooting	Solution
The upstream station detects that the data frame has been corrupted and marked, which is then transfered to the slave, leading to an alarm.	Check whether a processing unit error occurs due to transfer error (H0E.27) or invalid frames (H0E.28) upon occurrence of the fault, and check whether no counting is performed in RX-ERR of Port0.	Check the upstream slave to locate the fault cause.

EE08.6: Data update timeout

Description:

The slave is in the OP status and does not receive the data frame in a long time.

Troubleshooting

Cause	Troubleshooting	Solution
The data frame is lost or aborted in the upstream slave or the master performance is not up to standard.	Check through the software tool whether the phase difference between SYNC and IRQ exceeds the value of H0E.22 multiplied by the communication period.	Check whether the operating load of the master CPU is excessive. Increase the communication time or set H0E-22 to a larger value. Check whether link loss occurs on the upstream slave.

EE09.0: Software position limit setting error

Description:

The lower limit of the software limit is equal to or larger than the upper limit.

Troubleshooting

Cause	Troubleshooting	Solution
The lower limit of the software position limit is equal to or larger than the upper limit.	Check the values of 607D.01h and 607D.02h.	Reset the values and ensure the former is smaller than the latter.

EE09.1: Home setting error

Description:

The home offset exceeds the upper/lower limit.

Troubleshooting

Cause	Troubleshooting	Solution
1. The home offset is outside the software position limit.	The home offset is outside the software position limit when the encoder works in the incremental mode, absolute linear mode, and single-turn absolute mode.	Set the home offset to a value within the software position limit.
2. The home offset is beyond the upper/lower limit in the rotation mode.	The home offset is outside the mechanical single-turn upper/lower limit when the encoder works in the rotation mode.	Set the home offset to a value within the mechanical single-turn upper/ lower limit.

EE09.3: Homing mode setting error

Description:

The MCU does not receive the synchronization signal when the servo communication is switched to OP status.

Troubleshooting

Cause	Troubleshooting	Solution
1. The communication synchronization clock is configured improperly.	Use another master (such as Beckhoff or Omron PLC) and perform tests to compare between different masters.	Rectify improper configurations.
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, measure the synchronization signal generated by the slave controller integrated circuit with an oscilloscope. If there is no signal, the slave controller integrated circuit is damaged.	Contact Inovance for replacing the slave controller integrated circuit.
4.The MCU pins are damaged.	Test the synchronization signal generated by the slave controller integrated circuit with an oscilloscope. If there is a signal, the pins of the MCU integrated circuit are damaged.	Contact Inovance for replacing the MCU chip.

EE09.2: Gear ratio beyond the limit

Description:

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

Troubleshooting

Cause	Troubleshooting	Solution
The set electronic gear ratio exceeds the preceding range.	The gear ratio 6091.01h/6091.02h exceeds the preceding range.	Set the gear ratio within the required range.

EE09.5: PDO mapping beyond the limit

Description:

The mapping objects in TPDO or RPDO exceeds 40 bytes.

Troubleshooting

Cause	Troubleshooting	Solution
The mapping objects in TPDO or RPDO exceeds 40 bytes.	Check the number of self-indexes configured in 1600h or 1A00h.	The mapping objects in TPDO or RPDO must not exceed 40 bytes.

EE10.0: Protection against MailBox setting error

Description:

- Check if the SM channel is enabled.
- Check if the read-write direction is configured correctly.
- Check if it is the Mailbox mode (single-cache mode).
- Check if the length of the received data is between the minimum and maximum set lengths.
- Check if the address of the received data is between the minimum and maximum set addresses.
- Check the read-write mailbox memory for overlap.

Troubleshooting

Cause	Troubleshooting	Solution
1 The master station is configured incorrectly. 2 The slave XML file is incorrect.	Fault code is displayed on the panel.	Check the configuration of SM0 and SM1 channels for errors.

EE10.1: SM2 setting error

Description:

- PDO mapping object dictionary index exceeds the set maximum (0x1600–0x170A).
- When SM2 is not enabled, the length of SM and the length of RxPDO are not equal to 0.
- The length of the RxPDO does not match.
- Not writing.
- 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.
- The memory of SM2 overlaps with adjacent SM1 or SM3.

Troubleshooting

Cause	Troubleshooting	Solution
1 The master station is configured incorrectly. 2 The slave XML file is incorrect.	Check the configuration of SM2 for errors. Check whether the index of the RxPDO mapping object dictionary is out of bounds (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 setting error

Description:

- PDO mapping object dictionary index exceeds the set maximum (0x1A00–0x1B0A).
- When SM3 is not enabled, the length of SM and the length of TxPDO are not equal to 0.
- The length of the TxPDO does not match.
- Not reading.
- 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.
- Buffer overruns. The memory of SM2 overlaps SM3 and SM0 or SM1.

Troubleshooting

Cause	Troubleshooting	Solution
1 The master station is configured incorrectly. 2 The slave XML file is incorrect.	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

Description:

1. The watchdog is enabled but the count is 0.

2. The watchdog is not enabled but the count is non-zero.

Troubleshooting

Cause	Troubleshooting	Solution
1 The watchdog is enabled but the count is 0. 2 The watchdog is not enabled but the count is non-zero.	The settings of the master station is incorrect.	Make sure the watchdog time is configured correctly.

EE10.4: Protection against incomplete PLL (no sync signal)

Description:

During SAFEOP-to-OP, DC is enabled, but not running.

Troubleshooting

Cause	Troubleshooting	Solution
During SAFEOP_2_OP, DC is enabled, but not running.	The settings of the master station is incorrect.	Make sure a sync0 signal is generated.

EE11.0: ESI check error

Description:

The attempt to load the XML file fails during EtherCAT communication.

Troubleshooting

Cause	Troubleshooting	Solution
1. The XML configuration file is not downloaded.	Check whether the XML version displayed in H0E.96 is normal.	Download the XML file.
2. The servo drive is faulty. The XML file is modified unexpectedly.	The XML version number is not empty.	H0E. 37 is set to 1 and power on and off again.

EE11.1: EEPROM read failure

Description:

The EEPROM communication of external EtherCAT devices fails.

Troubleshooting

Cause	Troubleshooting	Solution
The EtherCAT data in the EEPROM cannot be read	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

EE11.2: EEPROM update failure

Description:

The communication is normal but the message in the EEPROM is wrong or lost.

Troubleshooting

Cause	Troubleshooting	Solution
The EtherCAT data in the EEPROM cannot be updated.	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

EE11.3: ESI and drive mismatch

Description:

The XML file does not match the drive model.

Troubleshooting

Cause	Troubleshooting	Solution
1. The downloaded XML file is not compatible with the drive. 2. The servo drive is faulty. The XML file is modified unexpectedly.	Check whether the XML version displayed in H0E.96 is normal.	Download the XML file.

EE12.0: EtherCAT initialization failure

Description:

During power-on initialization, EtherCAT peripheral initialization failed.

Troubleshooting

Cause	Troubleshooting	Solution
The device configuration file is not programmed.	The slave ID is null 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

Description:

The synchronization period is not an integer multiple of 125 μs or 250 μs after the network switches to the OP mode.

Troubleshooting

Cause	Troubleshooting	Solution
The synchronization cycle is not a integral multiple of 125 μs or 250 μs.	Check the setting of the synchronization period in the controller.	Modify the synchronization cycle to an integral multiple of 125 μs or 250 μs.

EE14.0: SYNC signal pulse width abnormal

Description:

SYNC signal pulse width abnormal

Troubleshooting

Cause	Troubleshooting	Solution
SYNC signal pulse width abnormal	Servo ECAT communication is normal, but the monitored SYNC period on the software oscilloscope is 0.	Set H0E.37 to 1 to reset XML enabling. This takes effect after a power cycle.

EE15.0: Excessive EtherCAT sync period error

Description:

The synchronization cycle error exceeds the threshold.

Troubleshooting

Cause	Troubleshooting	Solution
The synchronization cycle error of the controller is too large.	Measure the synchronization 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

Description:

MCU and ESC communication times out.

Troubleshooting

Cause	Troubleshooting	Solution
MCU and ESC communication timeout	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

EE21.0: MAC address not programmed

Description:

MAC address not programmed

Troubleshooting

Cause	Troubleshooting	Solution
MAC address not programmed	This fault persists after the servo drive is powered off and on several times.	Program the MAC address.

EE21.1: EtherNet PHY configuration error

Description:

EtherNet PHY configuration error

Troubleshooting

Cause	Troubleshooting	Solution
EtherNet PHY configuration error	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

17.6.2 Internal Fault

When any one of the following fault 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

18 Maintenance

18.1 Maintenance and Repair

Note

- The ON/OFF operations of the power supply can only be performed by professionals.
- Before performing the insulation resistance test on the drive, disconnect all the connections to the drive. Failure to comply can result in equipment fault.
- Do not use the gasoline, diluent, alcohol, acidic or alkaline detergent during cleaning to prevent enclosure discoloration or damage.
- When replacing the servo drive, upload user parameters saved in the old servo drive to the new one before operating the new one. Failure to comply may result in damage.
- Do not change wiring with power supply switched on. Failure to comply may result in electric shock or personal injury.
- Do not dismantle the servo motor. Failure to comply may result in electric shock or personal injury.

Routine Maintenance Items

Standard operating conditions:

The annual average ambient temperature is 30 ℃, the average load rate is less than 80%, and the daily operating time is less than 20h.

Routine Inspection

Check the following items during routine inspection.

Table 18–1 Routine checklist

Type	Period	Item
Routine check	Routine	Check the ambient temperature, humidity, dust, and foreign objects.
		Check whether there is abnormal vibration and noise.
		Check whether the mains voltage is normal.
		Check whether there is any peculiar smell.
		Check whether the air vent is stuck with fiber threads.
		Check whether the front end and connectors of the drive are clean.
		Check whether there are foreign objects on the load side.
Periodic Check	1 year	Check whether the fastening parts get loose.
		Check equipment for signs of overheating.
		Check whether the terminal is damaged.
		Check whether the fastening parts of the terminal become loose.

18.2 Component Replacement

Only technicians from Inovance are allowed to disassembly and repair the device.

The electrical and electronic components inside the servo system will suffer mechanical wearing and aging after a long time of use. To keep the servo drive and servo motor in good condition, perform

parts replacement based on the replacement cycles listed in the following table. When replacing, please contact us or our agents. We will judge whether to replace parts after investigation.

Table 18–2 Standard Replacement Interval

Object	Type	Standard Replacement Interval	Remarks
Drive	Bus filter capacitor	About five years	The standard replacement interval is for reference only. If any device/component works improperly before the replacement interval expires, replace it immediately.
	Fan	2 years to 3 years (10,000 to 30,000 hours)	
	Aluminum electrolytic capacitor on the PCB	About five years	
Motor	Bearing	3 years to 5 years (20,000 to 30,000 hours)	
	Oil seal	5000 h	
	Encoder	3 years to 5 years (20,000 to 30,000 hours)	
	Absolute encoder battery	Depends on the operating condition. See the operation instructions for the encoder battery for details.	

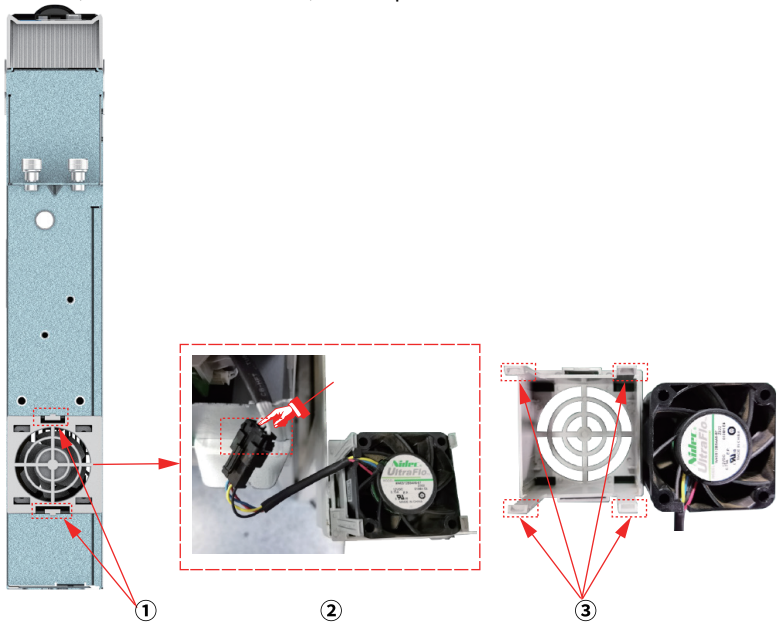
Fan replacement interval

The replacement method of servo drive of different sizes is slightly different due to the change of fan position. Details are as follows.

- **Size 1**

  1. Removing the old fan.

     a. Press and hold the buckle to pull out the fan and protective cover;
     b. Pull out the terminal;
     c. Pull out the buckle, remove the fan unit, and separate the fan cover from the fan.

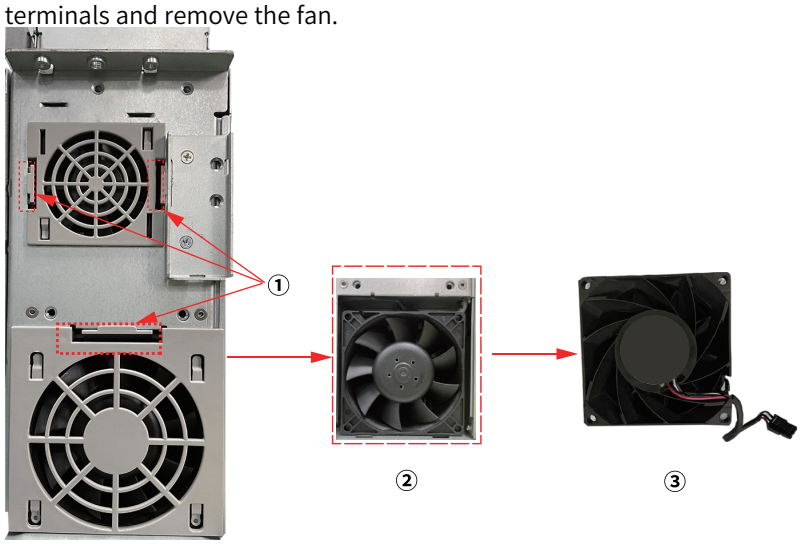


2. Install a new fan in reverse order as described above.

- **Size 2**

1. Removing the old fan.

a. Press and hold the buckle to pull out the fan and protective cover;
b. Pull out the fan;
c. Pull out the terminals and remove the fan.

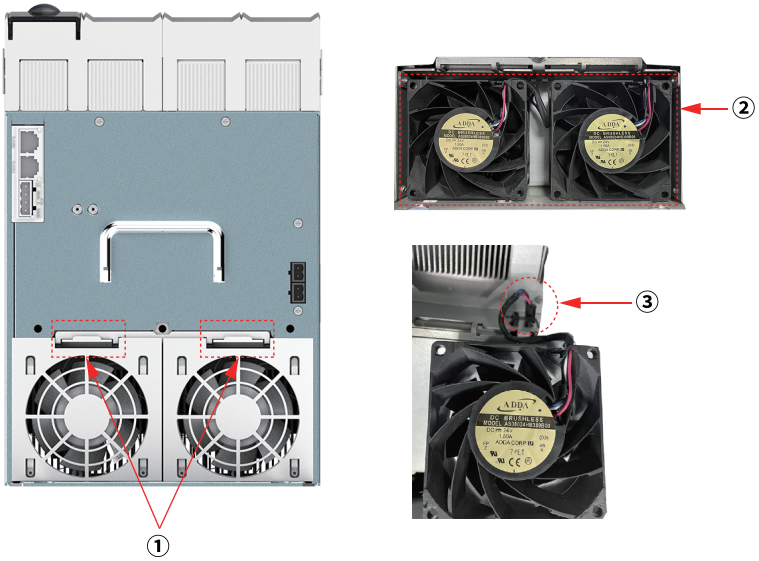


2. Install a new fan in reverse order as described above.

- **Size 3 & Size 4**

1. Removing the old fan.

a. Remove 4 screws to remove the fan and protective cover;
b. Pull out the fan;
c. Remove the fan.



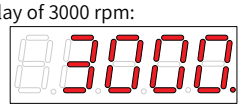
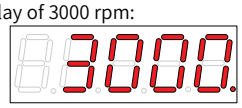
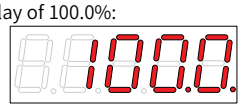
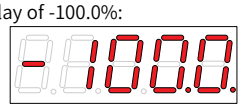
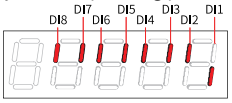
2. Install a new fan in reverse order as described above.

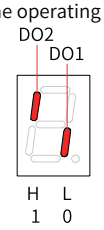
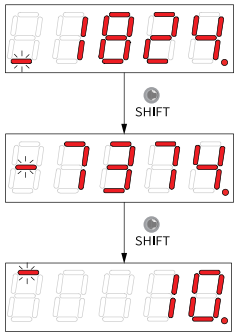
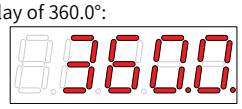
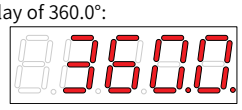
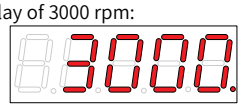
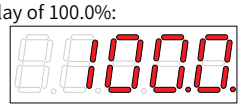
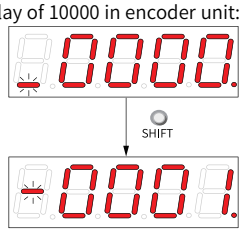
19 Appendix

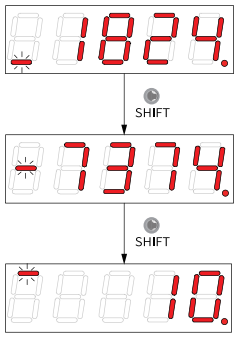
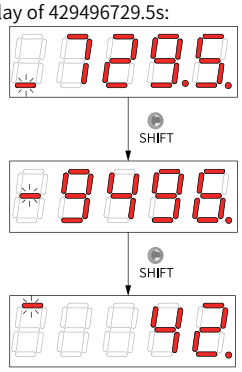
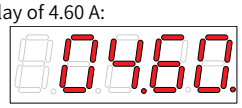
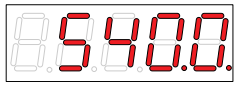
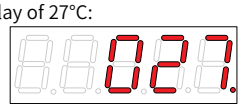
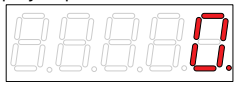
19.1 Display of Monitoring Parameters

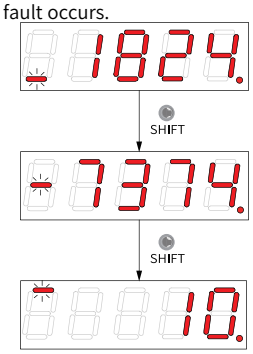
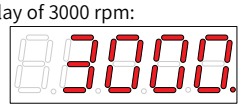
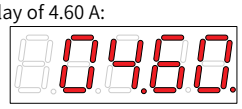
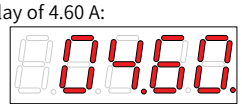
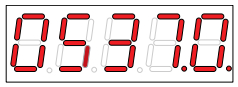
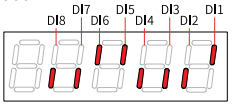
- H0b parameters monitor the operating state of the servo drive. You can enable keypad monitoring display by H02.32. The parameter group number displayed is H0b and the group offset is the setpoint of H02.32.
- When the valid offset is set in H02.32, the keypad enters the "state display" mode if the motor was in the static state, or the "parameter display" mode if the motor was in the rotating state. Mode switchover is not related to whether the servo drive is enabled.
- For example, if you set H02.32 to 00 and the motor changes from the static state to the running state, the keypad switches from the "state display" mode to "parameter display" mode and displays the value of H0b.00.

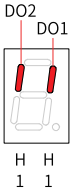
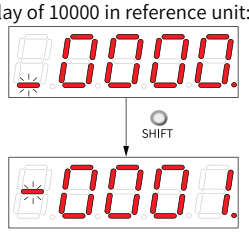
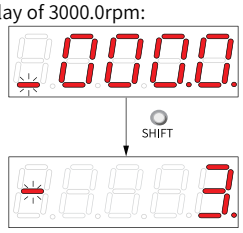
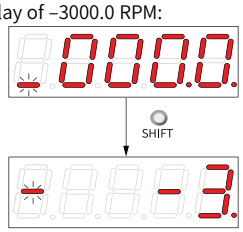
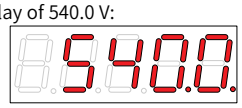
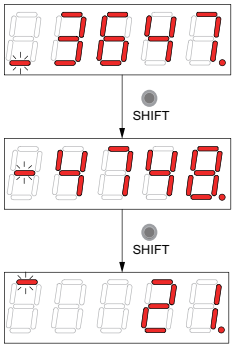
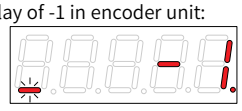
Group H0b monitoring display is described as follows **(Take** the parameter **of the current operation axis** 2 **as an example):**

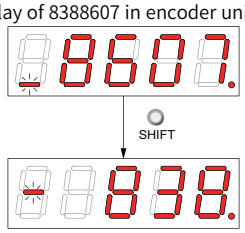
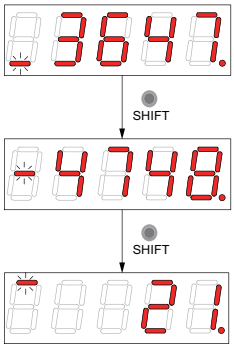
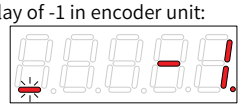
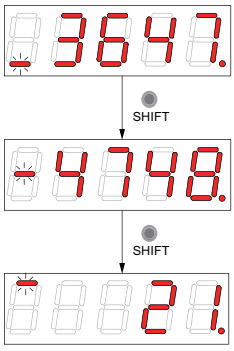
Parameter	Name	Unit	Meaning	Example
H0b.00	Motor speed actual value	rpm	Displays the actual value of the motor speed after round-off, which can be accurate to 1 rpm.	Display of 3000 rpm:  -3000 rpm:
H0b.01	Speed reference	rpm	Displays the present speed reference of the servo drive.	Display of 3000 rpm:  -3000 rpm:
H0b.02	Internal torque reference	0.1%	Displays the ratio of actual torque output of the motor to the rated torque of the motor.	Display of 100.0%:  Display of -100.0%: 
H0b.03	Input (DI) signal monitoring	-	Indicates level status of DI1 to DI8: Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0") The value of H0b.03 read in the software tool is a decimal.	For example, if DI1 is low level and DI2 to DI7 are high level, The corresponding binary value is "11111110", and the value of H0b.03 read in the software tool is 0xFE. Display on the operating panel: 

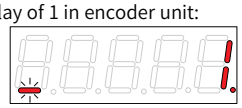
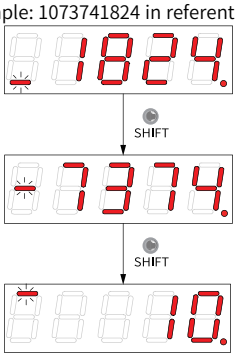
Parameter	Name	Unit	Meaning	Example
H0b.05	Output (DO) signal monitoring	-	Indicates level status of the DO terminals: Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0") The value of H0b.05 read by the software tool is a decimal number.	For example, if DO1 is low level and DO2 is high level, then, the binary value is "10". The value of H0b.05 read in the software tool is 0x2. Display on the operating panel: 
H0b.07	Absolute position counter (32-bit decimal)	reference unit	It indicates the present absolute position of the motor (in reference unit).	Display of 1073741824 in reference unit: 
H0b.09	Mechanical angle	0.1 ° (degree)	Displays current mechanical angle of the motor.	Display of 360.0°: 
H0b.10	Rotation angle (electrical angle)	°	Displays current electrical angle of the motor.	Display of 360.0°: 
H0b.11	Speed corresponding to the input position reference	rpm	Displays the speed corresponding to the position reference per control cycle of the servo drive.	Display of 3000 rpm:  -3000 rpm:
H0b.12	Average load ratio	0.1%	Displays the ratio 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)	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	Meaning	Example
H0b.17	Feedback pulse counter (32-bit decimal)	encoder unit	Counts and displays the number of pulses fed back by the encoder (encoder unit). ***Note*** When the motor with absolute encoder is used, H0b.17 only reflects values of the low 32 bits of the motor position feedback. To get the actual motor position feedback, view H0b.77 (Encoder position (low 32 bits)) and H0b.79 (Encoder position (high 32 bits)).	Display of 1073741824 in encoder unit: 
H0b.19	Total power-on time (32-bit decimal)	0.1s	Counts and displays the total power-on time of the servo drive.	Display of 429496729.5s: 
H0b.24	Phase current RMS value	0.01 A	Displays the RMS value of the phase current of the servo motor.	Display of 4.60 A: 
H0b.26	Bus voltage	0.1 V	Displays the DC bus voltage of the main circuit.	Display of 540.0 V rectified from 380 VAC: 
H0b.27	Module temperature	°C	Displays the temperature of the power module inside the servo drive.	Display of 27°C: 
H0b.33	Fault log	-	Used to select the previous fault to be viewed. 0: Present fault 1: Last fault 2: 2nd to last fault ... 9: 9th to last fault	0: Display of present fault: 
H0b.34	Fault code of the selected fault	-	H0b.34 display the fault you selected with H0b.33. If no fault occurs, the displayed value of H0b.34 is "E + Axis No.000."	If H0b.33 is 0, and H0b.34 is E1.B00, the current fault code is B00. Corresponding display:

Parameter	Name	Unit	Meaning	Example
H0b.35	Timestamp of the selected fault	s	Displays the total operating time of the servo drive when the selected fault occurred. When no fault occurs, the value of H0b.35 is 0.	If H0b.34 is E1.B00 and H0b.35 is 107374182.4, the current fault code is B00 and the total operating time of the servo drive is 107374182.4s when the fault occurs. 
H0b.37	Motor speed upon occurrence of the selected fault	rpm	Indicates the speed of the servo motor upon occurrence of the selected fault. When no fault occurs, the value of H0b.37 is 0.	Display of 3000 rpm:  -3000 rpm:
H0b.38	Motor phase U current upon occurrence of the selected fault	0.01 A	Displays the RMS value of servo motor phase U winding current when the selected fault occurred. When no fault occurs, the value of H0b.38 is 0.	Display of 4.60 A: 
H0b.39	Motor phase V current upon occurrence of the selected fault	0.01 A	Display the RMS value of servo motor phase V winding current when the selected fault occurred. 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	Display the DC bus voltage of the main circuit when the selected fault occurred. When no fault occurs, the value of H0b.40 is 0.	Display of 537.0 V rectified from 380 VAC: 
H0b.41	Input terminal state on selected fault	-	Display the high/low level status of DI1 to DI8 when the selected fault occurred. 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).	Take the corresponding background read H0b.41 = 0x31 as an example: the corresponding binary code is "00110001" 

Parameter	Name	Unit	Meaning	Example
H0b.43	Output terminal status upon occurrence of the selected fault	-	Display the high/low level status of two DO terminals when the selected fault occurred. The method for determining the DO level status is the same as that of H0b.05. When no fault occurs, all DOs are displayed as low level in H0b.43 (indicated by the decimal value 0).	Display of H0b.43 = 3: 
H0b.53	Position deviation counter (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: 
H0b.55	Motor speed actual value	0.1 rpm	Displays the actual value of the motor speed, which can be accurate to 0.1 RPM.	Display of 3000.0rpm:  Display of –3000.0 RPM: 
H0b.57	Control circuit voltage	0.1 V	Displays the DC voltage of the control circuit.	Display of 540.0 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 (high 32 bits)	encoder unit	Displays the mechanical absolute position (high 32 bits) when an absolute encoder is used.	Display of -1 in encoder unit: 

Parameter	Name	Unit	Meaning	Example
H0b.70	Number of absolute encoder revolutions	Rev	Displays the present number of revolutions of an absolute encoder.	Display of 32767:
H0b.71	Single-turn position feedback of an absolute encoder	encoder unit	Displays the single-turn position feedback of an absolute encoder.	Display of 8388607 in encoder unit: 
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	Absolute encoder position (high 32 bits)	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	Single-turn position feedback of the load in rotating mode (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: 

Parameter	Name	Unit	Meaning	Example
H0b.83	Single-turn position feedback of the load in rotating mode (high 32 bits)	encoder unit	Displays the position feedback (high 32 bits) of the mechanical load when the absolute system works in the 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 the rotation mode.	Example: 1073741824 in referent unit 

19.2 DIDO Function Assignment

Code	Name	Function Name	Description	Remarks
Description of DI Signals				
FunIN.1	S-ON	Servo ON	Disabled - Servo motor disabled in local mode. Enabled - Servo motor enabled in local mode.	The S-ON function is only active in non-bus control mode. The corresponding terminal logic must be level-triggered.
FunIN.2	ALM-RST	Servo 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 running after reset.
FunIN.14	P-OT	Positive limit switch	Inactive: Forward drive permitted Active: Forward drive inhibited	Overtravel prevention applies when the load moves beyond the limit. The corresponding terminal logic is recommended to be level-triggered.
FunIN.15	N-OT	Negative limit switch	Inactive: Reverse drive allowed Active: Reverse drive inhibited	Overtravel prevention applies when the load moves beyond the limit. The corresponding terminal logic is recommended to be level-triggered.
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.

Code	Name	Function Name	Description	Remarks
FunIN.31	HomeSwitch	Home switch	Inactive: Mechanical load beyond the home switch range. Active: Mechanical load is within Home switch range.	The corresponding terminal logic must be level-triggered. • 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	Emergence Stop	Emergency stop	Inactive: Current operating state is unaffected. Active: Position lock is applied after stop at zero speed.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.38	TouchProbe1	Touch probe 1	Inactive: Touch probe is not triggered. Active: Touch probe is triggerable.	The touch probe logic is only related to the touch probe function (60B8h).
FunIN.39	TouchProbe2	Touch probe 2	Inactive: Touch probe is not triggered. Active: Touch probe is triggerable.	The touch probe logic is only related to the touch probe function (60B8h).
Description of DO signals				
FunOUT.1	S-RDY	Ready to switch on	Inactive: The servo drive not ready. Active: The servo drive is ready.	The servo drive is ready to run.
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.	-
FunOUT.9	BK	brake output	Inactive: The brake is ineffective. Inactive: The brake is effective.	-
FunOUT.10	WARN	Alarm	Inactive: The servo drive issued no alarm or the alarm has been reset. Active: The servo drive raised an alarm.	-
FunOUT.11	ALM	Fault	Inactive: No fault occurred on the servo drive or the fault has been reset. Active: A fault occurred on the servo drive.	-
FunOUT.21	DB	Dynamic braking	Inactive: Dynamic braking is ineffective. Active: Dynamic braking is effective.	-

Code	Name	Function Name	Description	Remarks
FunOUT.31	Communication-forced DO		For details, see chapter 7 "Motion Control" on page 448. *"Table 19–1 Communication forced DO wire breakage output" on page 572*	-
FunOUT.32	EDM	EDM output	Inactive: STO is not triggered Active: STO is triggered	The EDM outputs active signals only when both the 24 V input voltages for STO1 and STO2 are disconnected.

Table 19–1 Communication forced DO wire breakage output

Type	Data	Description
bit0	0	Maintain DO1 output
	1	DO1 output prohibited
bit1	0	Maintain DO2 output
	1	DO2 output prohibited

19.3 Capacitance

IS810 dual-axis model	Capacitance/μF
IS810N50M4TD3R5INT	390
IS810N50M4TD5R4INT	390
IS810N50M4TD8R4INT	390
IS810N50M4TD012INT	390
IS810N50M4TD017INT	680
IS810N50M4TD021INT	820
IS810N50M4TD026INT	1020
IS810N50M4TD032INT	1230
IS810N50M4TD037INT	1500
IS810N50M4TS3R5INT	390
IS810N50M4TS5R4INT	390
IS810N50M4TS8R4INT	390
IS810N50M4TS012INT	390
IS810N50M4TS017INT	680
IS810N50M4TS021INT	820
IS810N50M4TS026INT	1020
IS810N50M4TS032INT	1230
IS810N50M4TS037INT	1500
IS810N50M4TS075INT	2000
IS810N50M4TS090INT	3750
IS810N50M4TS112INT	4500
IS810N50M4TS152INT	4500
IS810N50M4TS240INT	6750

19.4 Service and Support

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