INOVANCE

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IS810N-INT Series

Standard Servo Drive (Multidrive System)

User Guide

Industrial Automation

Intelligent Elevator

New Energy Vehicle

Industrial Robot

Rail Transit

Data code 19010647C01

Preface

Introduction

Thank you for purchasing the IS810N-INT series servo drive developed by Inovance.

The IS810N-INT series high performance servo drive covers a power range from 0.85 kW to 120 kW. It supports EtherCAT communication to work with the host controller for a networked operation of multiple servo drives, as well as stiffness level setting, inertia auto-tuning, and vibration suppression for ease of use. It allows a quiet and stable operation featuring high positioning accuracy together with an MS1 series high-response servo motor with low or medium inertia and a 23-bit multi-turn absolute encoder, or together with an ISMG series servo motor. The IS810N-INT series servo drive aims to implement fast and accurate position control, speed control and torque control in automation equipment such as slicers, gravure presses, corrugated paper printing equipment, semiconductor manufacturing equipment, chip mounters, PCB punching machines, handling machineries, food processing machineries, machine tools, and transmission machineries.

This user guide presents information concerning the product safety, mechanical and electrical installations, and basic commissioning and maintenance instructions. Read through this user guide before initial use. Contact Inovance technical support for questions concerning product functions or performance.

The drive can be used together with Inovance 810 series power supply unit or 880 series active rectifier unit. For details, see the related user guides.

Documents provided by Inovance are subject to update without notice due to continuous product improvement.

Revision history

Date	Version	Description
October 2023	C01	• Deleted introduction to S_PS and S_PS. • Deleted BiSS-C encoder connection. Deleted E770.3, E770.4, and E770.5. • Updated Chapter Parameter Settings in Fully Closed-loop Mode. • Updated Chapter "List of Applicable Cables". • Updated Chapter "Model List"
July 2023	C00	• Made structural adjustment. • Updated descriptions for communication terminals CN6/CN8 and CN5/CN7. • Added descriptions for the operation modes.
August 2022	B05	• Added the width of drives in size 1. • Modified the power cable model for MS1H3 motors. • Added dual-axis terminal layout. • Modified brake wiring diagram and related descriptions. • Added with the net/gross weight of the drive. • Updated the battery box model.
October 2021	B04	• Added with descriptions for the fan. • Added with parameters H07-24 to H07-31.

Date	Version	Description
July 2021	B03	• Updated PTC wiring diagram. • Updated pin assignment for power cables. • Added with drive model IS810N50M4TS240INT. • Updated section 3.4.1.
January 2021	B02	• Changes TS075 to size 3. • Updated motor information.
November 2020	B01	Made minor corrections.
September 2020	B00	• Updated the motor-related descriptions. • Updated drive modes. • Updated section 3.4.2. • Updated section 5.2. Added with section 5.3.5. • Updated chapter 6 Troubleshooting. • Updated object dictionary group.
August 2020	A03	Removed the customer service hotline.
November 2018	A02	Updated the logo.
November 2017	A01	• Updated certification information in the preface. • Changed the following descriptions in chapter 2. • Modified ISMG motor information and added with brake model description. • Modified electrical specifications of MS1 series motors. • Modified ISMG1 motor drawings and added with brake model parameters. • Changed the following descriptions in chapter 4. • Modified protective grounding diagram in section 4.3.2. • Added with battery box removal diagram in section 4.4.3. • Added with dual-axis absolute encoder battery information in section 4.4.3. • Added with dual-axis absolute encoder battery service life in section 4.4.3. • Added with main circuit wiring in section 4.4. • Modified brake wiring descriptions in section 4.6. • Added with EMC filter model selection instructions in section 4.15. • Added with four size-3 models: T184, T224, T262, T296. • Added with descriptions for DIP switch in chapter 5. • Changed the following descriptions in chapter 6. • Changed the stop mode comparison in table 6-5. • Changed descriptions for 605C and 605E. • Added with the following fault codes in chapter 7: E1.120, E1.206, E1.660, E1.E09. • Changed the following descriptions in appendix 1. • Added with parameters H05-62, H08-06, H0A-38, H0D-23, H0E-35, and H0E-96. • Modified parameters H01-10, H0E-33, H0E-34, 605C-00, 605E-00, 6083, 6084, 6085, 6091, and 609A.
July 2017	A00	First release

Access to the Guide

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

- Visit *http://www.inovance.com*, go to Support > Download, search by keyword, and then download the PDF file.

- Scan the QR code on the product with your smart phone.

Warranty

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that caused during proper operation. Maintenance work will be charged after the warranty period expires.

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

- 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)

Maintenance work 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.

Table of Contents

Fundamental Safety Instructions

Safety Precautions

- 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 injury or property damage caused by improper usage.

Safety Levels and Definitions

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

General Safety Instructions

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

Unpacking

WARNING

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

CAUTION

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

Storage and Transportation
WARNING • Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injury 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 injury 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 injury or equipment damage.
CAUTION • Handle the equipment with care during transportation and mind your steps to prevent personal injury or equipment damage. • When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injury. • Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage. • Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration. • Avoid storing the equipment for more than three months. Long-term storage requires stricter protection and necessary inspections. • Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation. • Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.
Installation
DANGER • The equipment must be operated only by professionals with electrical knowledge. 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 the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing 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.

WARNING

- 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.

CAUTION

- 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

DANGER

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

WARNING

- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injury 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 will 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 injury.

Operation

DANGER

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

WARNING

- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injury.
- 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 is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injury or equipment damage. • When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly. • Replace quick-wear parts of the equipment according to the replacement instructions. • Do not use damaged equipment. Failure to comply may result in death, personal injury, 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 injury, 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.

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. • Do not touch terminals within 15 minutes after disconnecting the power supply to prevent the risk of electric shock. • Do not touch the heatsink with power ON to prevent the risk of burn.

1 List of Models

Table 1–1 MS1 series servo motors

Servo motor				Servo drive (IS810N50M4T*******)		
Brake-less motor model	Brake motor model	Flange size	Rated power (kW)	Size	Recommended drive model	Code defined by H01.10
Ratings of MS1H1 (n_N=3000 rpm, n_{max} =7000 rpm) motors						
MS1H1-05B30CB-A330Z	MS1H1-05B30CB-A332Z	40	0.05	1	S(D)3R5INT	10001
MS1H1-10B30CB-A330Z	MS1H1-10B30CB-A332Z	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			
Ratings of MS1H2 (n_N=3000 rpm, n_{max} =6000 rpm) motors						
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
MS1H2-50C30CD-A331R	MS1H2-50C30CD-A334R	130	5			
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
Ratings of MS1H4 (n_N=3000 rpm, n_{max} =7000 rpm) motors						
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 ISMG series servo motors

<table>
<tr><th colspan="5">Servo motor</th><th colspan="2">Servo drive (IS810N50M4T*******)</th></tr>
<tr><th>Brake-less motor model</th><th>Brake motor model</th><th>Flange size</th><th>Rated current (*) (A)</th><th>Rated torque (*) (N·m)</th><th>Recommended Drive Model (S1)</th><th>Recommended Drive Model (S4)</th></tr>
<tr><td>ISMG1-95C15CD-A331FA</td><td>ISMG1-95C15CD-A334FA</td><td rowspan="11">200</td><td>14.5(18.5)</td><td>50(60)</td><td>S(D)017INT</td><td>S(D)021INT</td></tr>
<tr><td>ISMG1-11D30CD-A331FA-GL</td><td>ISMG1-11D30CD-A334FA-GL</td><td>20.3(26)</td><td>35(41)</td><td rowspan="4">S(D)021INT</td><td rowspan="2">S(D)026INT</td></tr>
<tr><td>ISMG1-11D30CD-A311FA-GL</td><td>-</td><td>20.3(25.78)</td><td>35(41)</td></tr>
<tr><td>ISMG1-11D30CD-A3A1L-GL</td><td>-</td><td>21.3(27.05)</td><td>35(41)</td><td>S(D)032INT</td></tr>
<tr><td>ISMG1-12D20CD-A331FA</td><td>ISMG1-12D20CD-A334FA</td><td>20.3(26)</td><td>50(60)</td><td>S(D)026INT</td></tr>
<tr><td>ISMG1-12D30CD-A331FA-GL</td><td>-</td><td>24.3(30.86)</td><td>37.5(43.9)</td><td rowspan="2">S(D)026INT</td><td rowspan="2">S(D)032INT</td></tr>
<tr><td>ISMG1-14D15CD-A331FA</td><td>ISMG1-14D15CD-A334FA</td><td>22.9(29.2)</td><td>75(90)</td></tr>
<tr><td>ISMG1-17D15CD-A331FA</td><td>ISMG1-17D15CD-A334FA</td><td>28.1(35.7)</td><td>92(110)</td><td rowspan="3">S(D)032INT</td><td rowspan="3">S(D)037INT</td></tr>
<tr><td>ISMG1-17D33CD-A3A1F-GL</td><td>-</td><td>30(38.1)</td><td>50(58.5)</td></tr>
<tr><td>ISMG1-18D20CD-A331FA</td><td>ISMG1-18D20CD-A334FA</td><td>28.6(36.4)</td><td>75(90)</td></tr>
<tr><td>ISMG1-45D30CD-A3A1L-GL</td><td>-</td><td>87.4(111)</td><td>143.4(167.8)</td><td>S090INT</td><td>S112INT</td></tr>
<tr><td>ISMG2-52D15CD-A331FA</td><td>-</td><td rowspan="4">266</td><td>87.2(104.4)</td><td>285(335)</td><td rowspan="2">S090INT</td><td rowspan="2">S112INT</td></tr>
<tr><td>ISMG2-57D20CD-A331FA</td><td>-</td><td>87.8(109.3)</td><td>230(270)</td></tr>
<tr><td>ISMG2-60D15CD-A331FA</td><td>-</td><td>98.8(118.8)</td><td>340(385)</td><td>S112INT</td><td>S152INT</td></tr>
<tr><td>ISMG2-92D38CD-A3B1L-GL</td><td>-</td><td>122(154.94)</td><td>233(272.6)</td><td>S240INT</td><td>-</td></tr>
</table>

Note

- The rated current and rated torque under S1 duty apply by default. The asterisk symbol (*) represents the rated current and rated torque under S4 duty.
- 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): Single-axis (S) or D (dual-axis)

2 IS810N Series Drive unit

2.1 Product Information

2.1.1 Model and Nameplate

Model and nameplate

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

① **Product 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 ③ **Unit type** 50M: Drive unit ④ **Voltage class** 4T: 380 V to 480 V	⑥ **Rated current (A)** [1] Dual-axis (rated current per axis) 3R5: 3.5 A　032: 32 A 5R4: 5.4 A　037: 37 A 8R4: 8.4 A　090: 90 A 012: 12 A　112: 112 A 017: 16.5 A　152: 152 A 021: 20.8 A　240: 240 A 026: 25.7 A	

Note

[1] Single-axis: 3R5–240; Dual-axis: 3R5–037

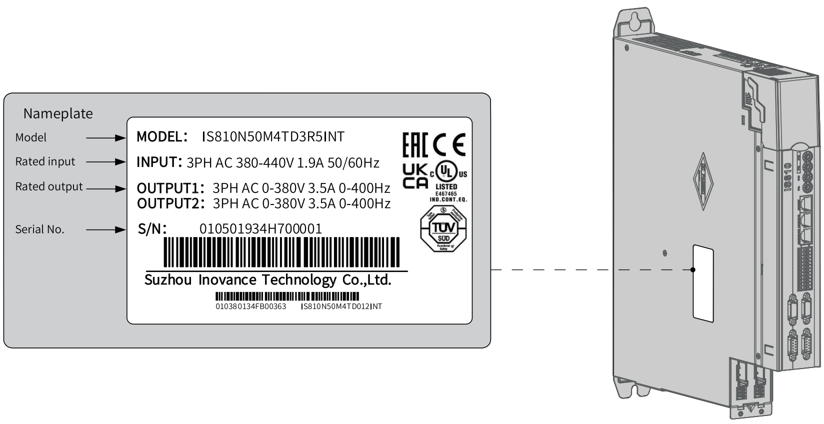


Figure 2-1 Nameplate

Encryption of the production serial number

01050193 4 H 7 00001
① ② ③ ④ ⑤

① **Internal code** Article material code	③ **Year** 9: 2009 A: 2010 ... N: 2021 ... 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 010502024H700001 indicates the drive is manufactured in July, 2017.

2.1.2 Components

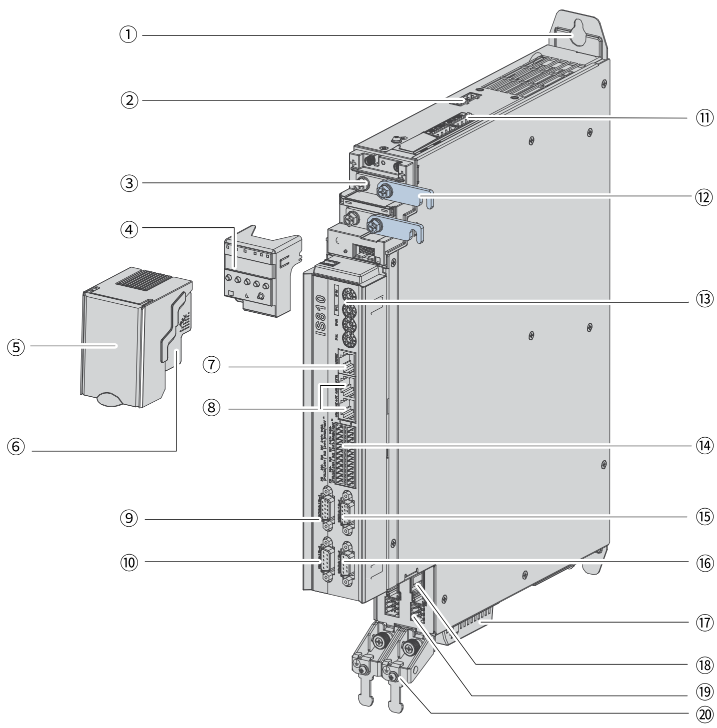


Figure 2-2 Components of dual-axis drives

Table 2–1 Components

No.	Components	No.	Components
①	Mounting hole	⑪	STO terminal
②	24 V power supply input	⑫	Busbar
③	Built-in busbar	⑬[1]	Hardware DIP switch of the communication address
④	Keypad	⑭	DI/DO terminal
⑤	Top cover	⑮	Fully closed-loop input and frequency-division output terminal
⑥	Bus baffle	⑯	Encoder terminal
⑦	Ethernet terminal	⑰	Absolute encoder battery (optional)
⑧	EtherCAT terminal	⑱	Power cable terminals
⑨	Fully closed-loop input and frequency-division output terminal	⑲	Brake output terminal
⑩	Encoder terminal	⑳	Shield bracket

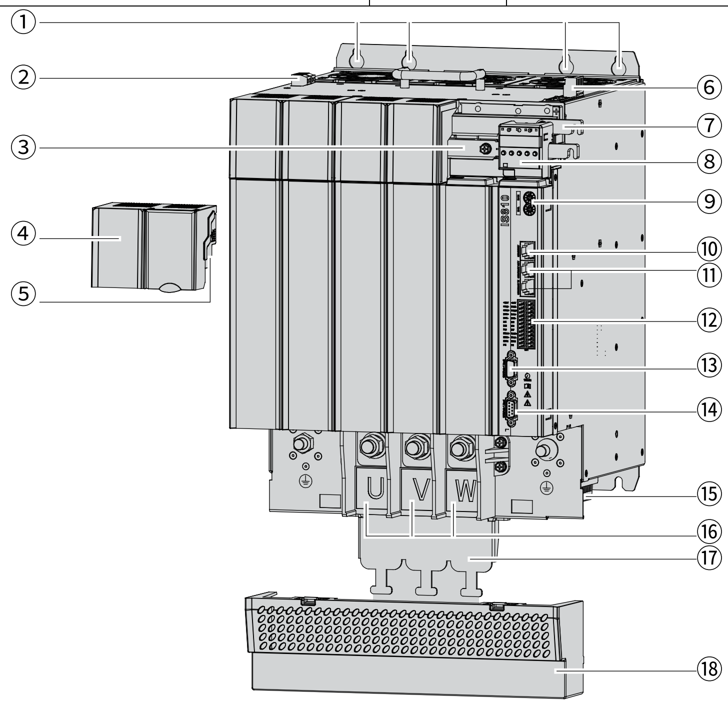


Figure 2-3 Components of single-axis drive

Table 2–2 Components

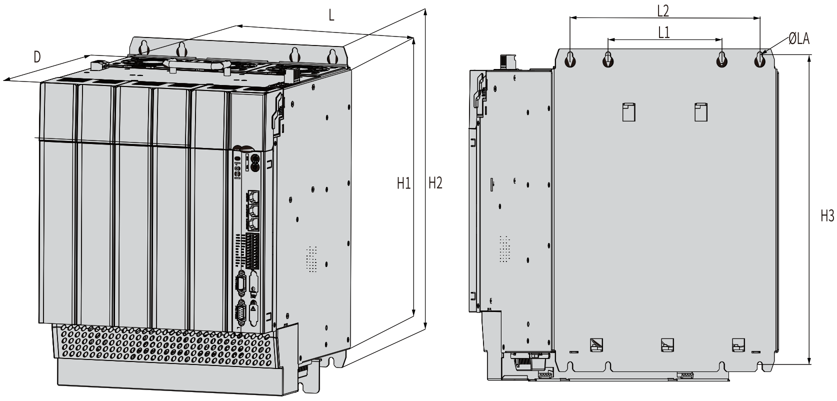
No.	Components	No.	Components
①	Mounting hole	⑩	Ethernet terminal
②	24 V power supply input	⑪	EtherCAT terminal
③	Built-in busbar	⑫	DI/DO terminal
④	Top cover	⑬	Fully closed-loop input and frequency-division output terminal
⑤	Bus baffle	⑭	Encoder terminal
⑥	STO terminal	⑮	Absolute encoder battery (optional)
⑦	Busbar	⑯	Power cable terminals

No.	Components	No.	Components
⑧	Keypad	⑰	Shield bracket
⑨[1]	Hardware DIP switch of the communication address	⑱	Terminal cover

Note

For details of Hardware DIP switches, see " *DIP switch" on page 145*.

2.1.3 Product Dimensions



Size	L	H1	H2	D	L1	L2	H3	ϕLA	Recommended tightening torque	Weight
	Unit: (mm)								Unit: (N·m)	Unit: (kg)
Size-1 (Dual-axis)	50	350	400	305	-	-	384	2-ϕ7	4.8	5.25
Size-2 (dual-axis)	100	350	400	305	50	-	384	4-ϕ7	4.8	9.56
Size-1 (single-axis)	50	350	400	305	-	-	384	2-ϕ7	4.8	5.25
Size-2 (single-axis)	100	350	400	305	50	-	384	4-ϕ7	4.8	9.56
Size-3 (single-axis)	200	350	400	305	150	-	384	4-ϕ7	4.8	18.6
Size-4 (single-axis)	300	350	400	302	150	250	384	8-ϕ7	4.8	25

2.2 Product Specifications

2.2.1 Electrical Specifications

Electrical specifications of drives in size-1

Item	Size-1							
Drive model IS810N	S3R5	D3R5	S5R4	D5R4	S8R4	D8R4	S012	D012
Drive power (kW)	0.85		1.3		1.8		2.9	

Item	Size-1							
Max. applicable motor capacity (kW)	0.85		1.3		1.8		2.9	
Continuous output current (Arms)	3.5		5.4		8.4		11.9	
Max. output current (Arms)	8.5		14		20		28	
Main circuit power supply	537 VDC to 679 VDC							
Energy loss (w)	57	94	80	140	96	171	139	258
Control circuit power supply	21.6 VDC to 26.4 VDC							
Energy loss (w)	12							

Electrical specifications of drives in size-2

Item	Size-2									
Drive model IS810N	S017	D017	S021	D021	S026	D026	S032	D032	S037	D037
Drive power (kW)	4.4		5.5		7.5		15		18.5	
Max. applicable motor capacity (kW)	9.5		12		14		18		23	
Continuous output current (Arms)	16.5		20.8		25.7		32		37	
Max. output current (Arms)	42		55		65		57.6		66.6	
Main circuit power supply	537 VDC to 679 VDC									
Energy loss (w)	146	258	172	311	209	384	253	473	291	549
Control circuit power supply	21.6 VDC to 26.4 VDC									
Energy loss (w)	12									

Electrical specifications of drives in size-3 and size-4

Item	SIZE-3			Size-4
Drive model IS810N	S090	S112	S152	S240
Drive power (kW)	45	55	75	120
Max. applicable motor capacity (kW)	57	60	80	90
Continuous output current (Arms)	90	112	152	240
Max. output current (Arms)	225	280	380	384

Item	SIZE-3			Size-4
Main circuit power supply	537 VDC to 679 VDC			
Energy loss (w)	765	936	1253	2030
Control circuit power supply	21.6 VDC to 26.4 VDC			
Energy loss (w)	12			

2.2.2 Technical Specifications

Item			Description
Basic 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	Ambient temperature [1]	0–40°C (For temperatures higher than 40°C but lower than 50°C (maximum temperature), derate 1.5% for every additional 1°C.)
		Storage temperature	-25°C to +70°C
		Ambient/Storage humidity	5% to 90% (without condensation)
		Vibration/Shock resistance	The vibration acceleration must be lower than or equal to 0.6 g.
		IP rating	IP20 (Except the power terminal)
		Pollution degree	PD2
		Altitude	Below 1000 m (For altitudes higher than 1000 m but lower than 3000 m, derate 1% for every additional 100 m.)
		Ambient environment	Not applicable to vacuum environments
Input/ Output signal	DI signal	Signal assignment change available	8 DIs (HDI4 and HDI8 are high-speed DI.) DI functions Servo ON, alarm reset, positive limit switch, negative limit switch, electronic gear ratio selection, touch probe 1, touch probe 2, and emergency stop functions
	DO signal	Signal assignment change available (shared by both axes)	2 DOs DO functions: Servo ready, motor rotating, brake, alarm output, fault output, dynamic brake, communication-forced DO, and EDM output
Built-in functions	Overtravel (OT) prevention		The servo drive stops immediately when P-OT or N-OT signal is active.
	Electronic gear ratio		0.1048576 ⩽ B/A ⩽ 419430.4
	Protective functions		Providing protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overtemperature, overspeed, encoder error, CPU error, and parameter error
	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 it is installed inside a control cabinet, the temperature inside the cabinet must also be within this range.

2.2.3 Technical Data of EtherCAT Communication

Item			Description
Specifications of EtherCAT slave	Basic performance of EtherCAT slave	Communication protocol	EtherCAT
		Service supported	CoE (PDO, SDO)
		Synchronization mode	DC - Distributed clock
		Physical layer	100BASE-TX
		Baud rate	100 Mbit/s (100Base-TX)
		Duplex mode	Full duplex
		Topology	Ring and linear
		Transmission medium	Shielded cables of Cat 5e or higher
		Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
		Number of slaves	Up to 65535 by protocol, not exceeding 100 in actual use
		EtherCAT frame length	44 bytes to 1498 bytes
		Process data	Max. 1,486 bytes per Ethernet frame
		Synchronous jitter of two slaves	< 1 us
		Refresh time	About 30 us for 1,000 digital inputs and outputs About 100 µs for 100 servo axes
		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 Motors

3.1 Product Information

3.1.1 Model and Nameplate

Model description

MS1 H1 - 75B 30C B A3 3 1 R - *
① ② ③ ④ ⑤ ⑥ ⑦⑧⑨ ⑩

① **MS1 series servo motor**	② **Inertia and Capacity** H1: low inertia, small capacity H2: low inertia, medium capacity H3: medium inertia, medium capacity H4: medium inertia, small capacity	③ **Rated power (W)** One letter and two digits B: x 10 C: x 100 Example: 75B: 750 W
④ **Rated speed (rpm)** One letter and two digits B: x 10 C: x 100 Example: 30C: 3,000 rpm	⑤ **Voltage class (V)** B: 220 D: 380	⑥ **Encoder type** One letter and one digit A3: 23-bit multi-turn absolute encoder
⑦ **Shaft connection mode** 3: Solid and keyed,, with tapped hole in the shaft center	⑧ **Brake, reducer and oil seal** [1] 0: Without oil seal or brake 1: With oil seal but no brake 2: With brake but no oil seal 4: With oil seal and brake	⑨ **Sub-series No.** R: R version ⑩ **Non-standard functions** _: standard S: Flying leads type -**: Other non-standard function

Note

- [1] The standard configuration of the motor in flange size 40 does not include the oil seal. Motors of other models carry the oil seal as standard.

Nameplate

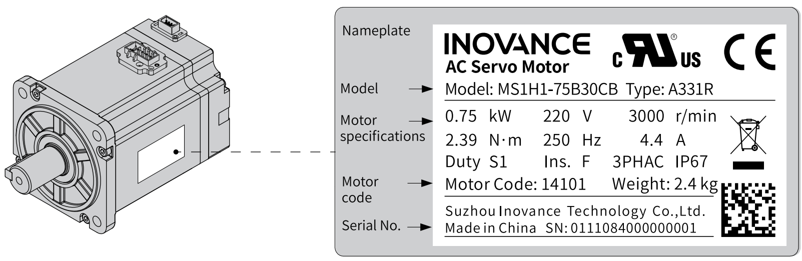


Figure 3-1 Model and nameplate

3.1.2 Components

Motor (40-flange)

- **Terminal-type servo motor**

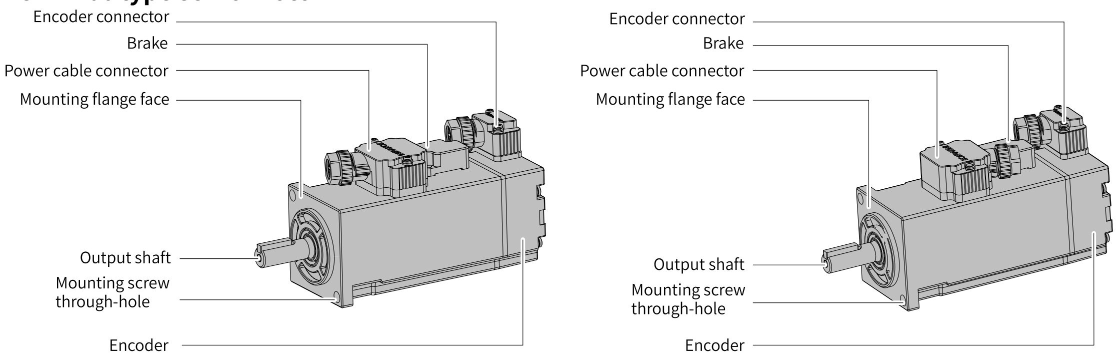


Figure 3-2 Components of a terminal-type servo motor (Left: motor with front cable outlet; Right: motor with rear cable outlet)

- **Flying leads type servo motors**

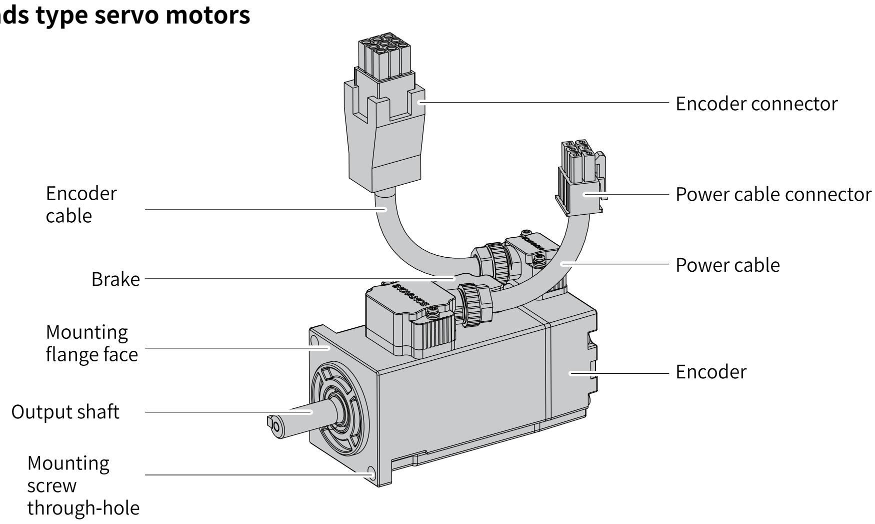


Figure 3-3 Components of flying leads type motors

Note

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

Motor (60- and 80-flange)

- **Terminal-type servo motor**

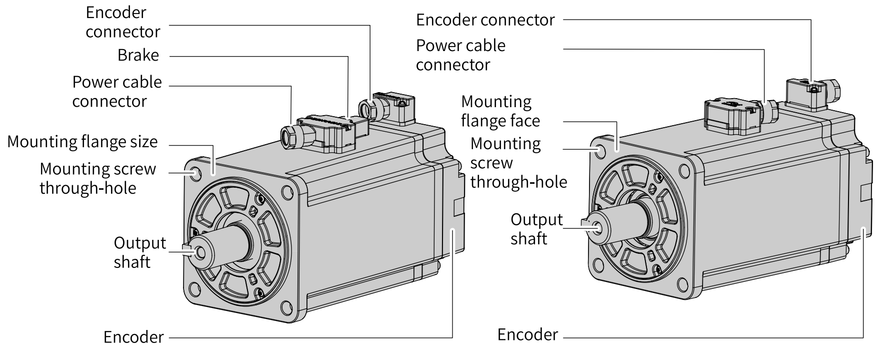


Figure 3-4 Components of a terminal-type servo motor (Left: motor with front cable outlet; Right: motor with rear cable outlet)

- **Flying leads type servo motors**

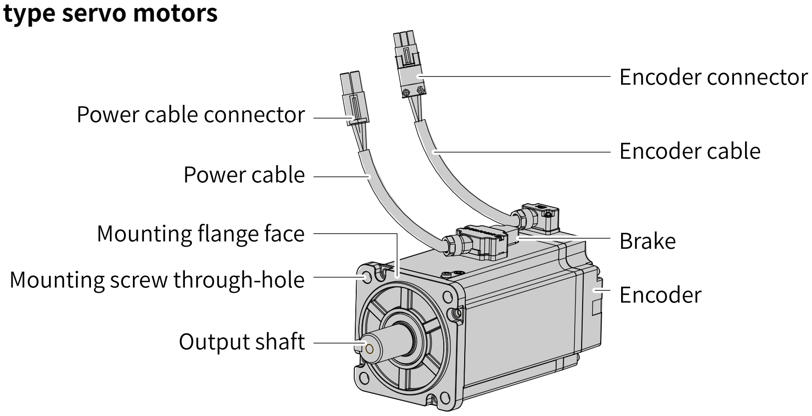


Figure 3-5 Components of flying leads type motors

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

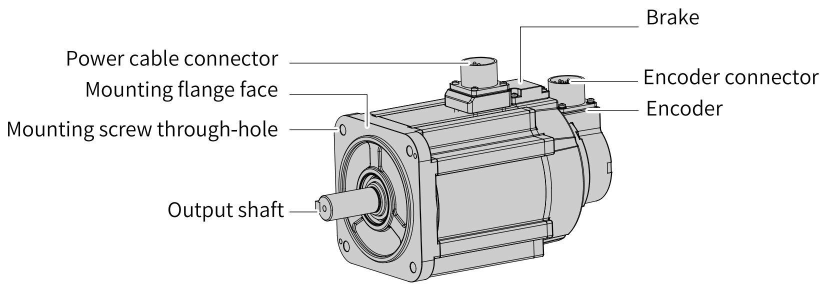
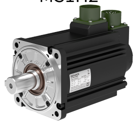


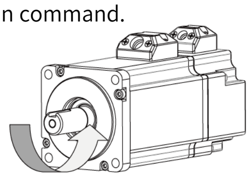
Figure 3-6 Components of servo drives in flange sizes 100/130/180

3.1.3 Motor Models

Motor type		Rated Output Capacity (kW)	Rated speed (max. speed) (RPM)	Encoder	IP rating of the enclosure
Low inertia, small capacity	MS1H1 	0.05, 0.1, 0.2, 0.4, 0.55, 0.75, 1.0	3000 (6000)	A3: 23-bit multi-turn absolute encoder	IP67
Low inertia, medium capacity	MS1H2 	1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0	3000 (6000)	A3: 23-bit multi-turn absolute encoder	IP67
Medium inertia, medium capacity	MS1H3 	0.85, 1.3, 1.8, 2.9, 4.4, 5.5, 7.5	1500 (3000)	A3: 23-bit multi-turn absolute encoder	IP67
Medium inertia, small capacity	MS1H4 	0.1, 0.2, 0.4, 0.55, 0.75, 1.0	3000 (6000)	A3: 23-bit multi-turn absolute encoder	IP67

3.2 Product Specifications

3.2.1 Mechanical Characteristics

Item	Description
Duty type	S1 (Continuous duty)
Vibration level [1]	V15
Insulation resistance	500 VDC, above 10 MΩ
Excitation mode	Permanent magnetic
Installation mode	Flange
Heat resistance level	F
Insulation voltage	1500 VAC for 1 min (220 V class) 1800 VAC for 1 min (380 V class)
Enclosure protection mode	IP67 (excluding shaft opening and flying leads type motor connectors)
Direction of rotation	Rotates counterclockwise (CCW) when viewed from the shaft extension side with the forward run command.  CCW

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td rowspan="4">Environmental conditions</td><td>Ambient temperature</td><td>0°C to 40°C (non-frozen) (Derate based on the derating curve for temperatures above 40°C.)</td></tr>
<tr><td>Ambient humidity</td><td>20% to 80% (without condensation)</td></tr>
<tr><td>Installation location</td><td>• Free from corrosive or explosive gases
• Well ventilated and with minimum amount of dust, waste and moisture.
• Convenient for inspection and cleanup.
• Derating is required only for installation altitudes higher than 1000 m. "3.2.3 Derating Characteristics" on page 37
• Away sources that may generate strong magnetic field
• Away from heating sources such as a heating stove
• Use the motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings.
• The oil seal is only dust-proof. It cannot withstand the intrusion of oil for a long term.
• Not applicable to vacuum environment
• Not applicable to inching condition, which may result in stuck.
• The motor with brake may generate a pattering sound.
• Coupler type and installation alignment requirements
• The system should avoid continuous operation at natural frequency. Exceeding the allowable vibration value may damage the system.</td></tr>
<tr><td>Storage</td><td>Observe the following requirements for storage of a de-energized motor:
• Temperature: -20°C to +60°C (non-frozen)
• Humidity: 20% to 80% RH (without condensation)</td></tr>
<tr><td rowspan="2">Shock resistance [3][4]</td><td>Shock acceleration (taking flange side as standard)</td><td>490 m/s²</td></tr>
<tr><td>Number of shocks</td><td>2</td></tr>
<tr><td>Vibration resistance [2][4]</td><td>Vibration acceleration (taking flange side as standard)</td><td>Radial 49 m/s²
Axial 24.5 m/s²</td></tr>
</table>

Note

- [1] Vibration level V15 indicates that the amplitude of vibration is less than 15 µm when a single servo motor rotates at its rated value.
- [2] For a motor shaft mounted horizontally, the impact resistance level in the up and down directions is shown in the preceding table.
- [3] For a servo motor shaft mounted horizontally, the vibration resistance level in the up/down, left/right, and front/rear directions is shown in the preceding table.
- [4] The vibration intensity applied on the motor is affected by the transmission structure, alignment accuracy, mounting conditions, and external vibration. These factors may enhance the vibration applied on the motor. When the maximum allowable vibration limit is exceeded, the motor may fail. Therefore, take necessary measures to limit resonance.
- The vibration intensity applied on the motor varies with applications.

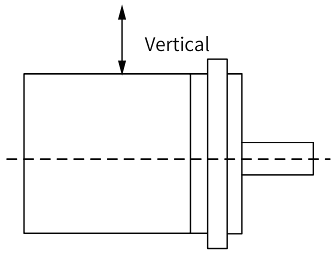


Figure 3-7 Shock that applied to the motor

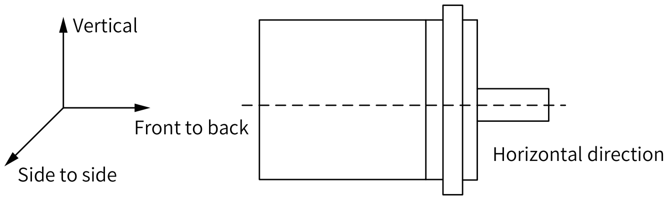


Figure 3-8 Vibration that applied to the motor

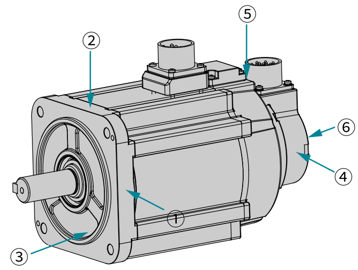


Figure 3-9 Max. allowable vibration limit of the motor

Direction	Measuring point	Limit value (10 Hz to 2000 Hz)
Radial	①②	49 m/s²
	④⑤	49 m/s²
Axial	③	24.5 m/s²
	⑥	24.5 m/s²

Note

The preceding vibration/shock standards cannot be applied for a long term. For long-term application needs, contact Inovance.

3.2.2 Overload Characteristics

The equipment is compliant with NEC and CEC requirements and equipped with protective functions against overload and overtemperature.

The following overload protection curve applies to hot start at an ambient temperature of 40°C, which cannot guarantee continuous duty under 100%+ output. During use, keep the effective torque of the load within the continuous duty zone.

To protect different load motors, set motor overload protection gain based on the overload capacity of the motor. Use the default gains in general conditions, however, when one of the following condition occurs, change the gains based on the temperature rise condition of the motor:

- The motor operates in environments with high temperature.
- The motor is in cyclic motion featuring a short motion cycle and frequent acceleration/ deceleration.
- Overload thermal protection only occurs during continuous energized operation. You need to check the motor temperature when the drive is powered off.

Motor overload protection curve is as follows:

- **MS1H1/H4 (flange size 40)**

Load ratio (%)	Operating time (s)
115	411.98
120	258.22
125	131.05
130	79.80
135	54.13
140	43.04
145	37.33
150	32.79
155	27.17
160	22.16
165	19.28
170	18.55
175	17.62
180	16.31
185	14.70
190	13.14
195	11.95
200	11.03
205	9.97
210	9.18
215	8.36
220	7.61
225	7.03
230	6.58
235	6.27
240	6.06
245	6.06
250	6.06
255	6.06
260	6.06
265	6.06
270	6.06
275	6.06
280	6.01
285	5.84
290	5.61
295	5.31
300	4.96
305	4.61
310	4.27
315	3.97
320	3.69

Load ratio (%)	Operating time (s)
325	3.36
330	3.15
335	2.97
340	2.82
345	2.70
350	2.63

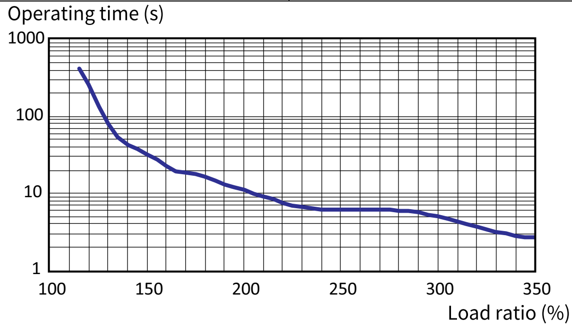


Figure 3-10 MS1H1/H4 (flange size 40) series motor overload curve

- **MS1H1/H4 (flange size 60/80)**

Load ratio (%)	Operating time (s)
120	230
130	80
140	40
150	30
160	20
170	17
180	15
190	12
200	10
210	8.5
220	7
230	6
240	5.5
250	5
300	3
350	2

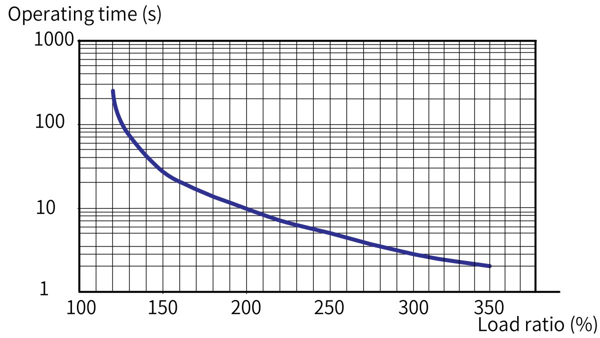


Figure 3-11 MS1H1/H4 (flange size 60/80) series motor overload curve

Note

The maximum torque of H1 and H4 models is the rated torque x 3.5.

- **MS1H2/MS1H3**

Load ratio (%)	Operating time (s)
115	6000
121.4	2000
127.8	1000
134.2	800
140.6	500
147	300
153.4	150
159.8	100
166.2	80
172.6	60
179.0	50
185.4	45
191.8	40
198.2	36
204.6	32
211.0	28
217.4	23
223.8	22
230.2	19
236.6	18
243.0	15
249.4	14
255.8	13
262.2	11
268.6	10
275.0	9
281.4	8
287.8	7
294.2	6

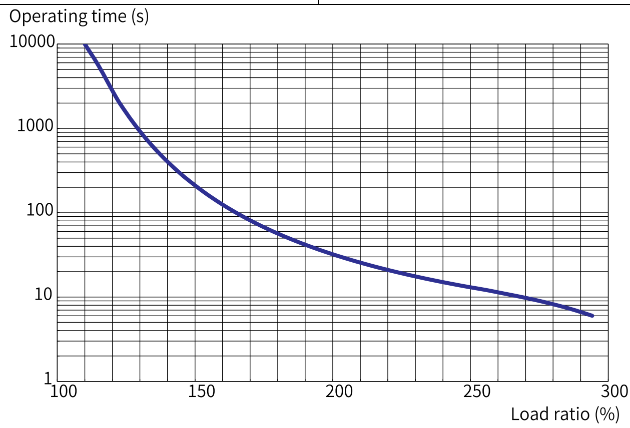


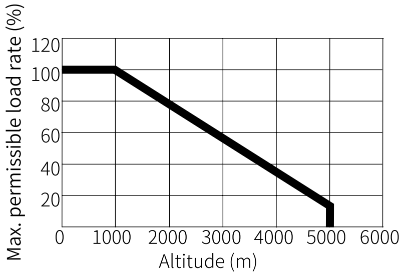
Figure 3-12 Overload curve of MS1H2 and MS1H3 series motors

Note

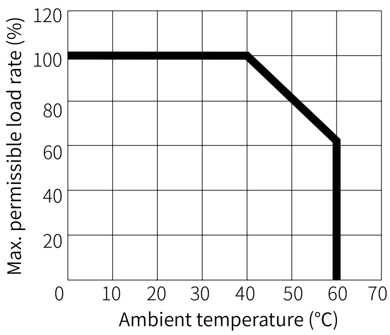
- The maximum torque of H2 models is the rated torque x 3.
- The maximum torque of H3 models is the rated torque x 2.5.

3.2.3 Derating Characteristics

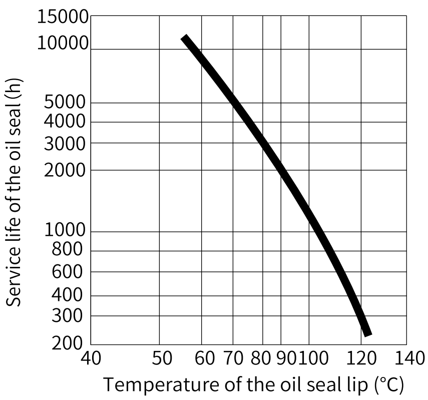
- **Altitude-based derating curve**



- **Temperature-based derating curve**



3.2.4 Temperature Curve of the Oil Seal



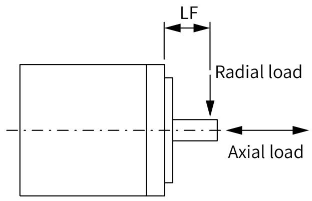
3.3 Selection Instructions

- Description of the torque-speed characteristics curve:

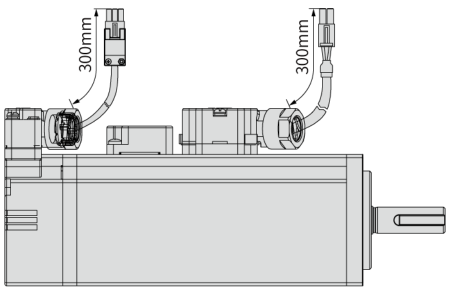
- Technical data and torque/speed characteristic values in the following tables are applicable to motors working with Inovance servo drives with the the armature coil temperature being 20°C.
- Continuous working area: refers to a series of states in which the motor can operate safely and continuously, and the actual torque must be located in this area.
- Short-time working area: refers to a series of states in which the motor can run in a short time when the actual torque is greater than the rated torque.

- The characteristic parameter values are obtained in cases where the motor is installed with the following heatsink:
  - MS1H1/MS1H4: 250 × 250 × 6 (mm) (aluminum)
  - MS1H2-10C to 25C: 400 × 400 × 20 (mm) (steel)
  - MS1H2-30C to 50C: 400 × 400 × 20 (mm) (steel)
  - MS1H3-85B to 18C: 400 × 400 × 20 (mm) (steel)
  - MS1H3-29C to 55C: 550 × 550 × 30 ((mm) (aluminum)
  - MS1H3-75C: 700 × 700 × 30 (mm) (aluminum)

- Radial and axial loads of the motor:



- Dimensions of flying leads type motors
  The 40/60/80-flange flying leads type motor (with "-S") provides a drain wire of about 300 mm long, as shown in the following figure.



- MS1H3 (130-flange and 180-flange) comes with a key slot. When the operating speed is above 3000 rpm, the motor must run with the key. If you need to run the motor without the key, you can ask for customization from Inovance.

Note

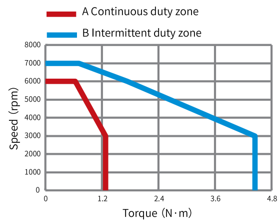
- The data in the () is the value of the servo motor with the brake.
- The motor with oil seal must be derated by 10% during use.
- It is recommended that the cross sectional area of brake cables is above 0.5 mm^2.
- The brake must not share the power supply with other electrical devices. This is to prevent a malfunction of the brake due to a drop in the voltage or current when other electrical devices work in tandem.
- The holding brake cannot be used for braking purpose.
- The release time and operation time of the brake depend on the discharge circuit. Be sure to confirm the operation delay of your equipment before use.
- You need to prepare the 24 VDC power supply yourself.
- The tightening tension for terminal screws must be between **0.19 N·m to 0.21 N·m**, exceeding of which may damage the terminal.

3.4 MS1H1 Motors with Low Inertia and Small Capacity

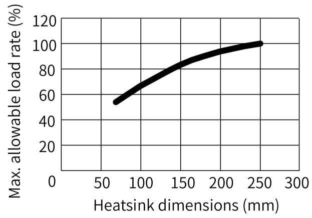
3.4.1 MS1H1-40B30CB-A33*R

Motor specifications		
Flange size (mm)	60	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.4	
Voltage (V)	220	
Rated torque (N·m)	1.27	
Maximum torque (N·m)	4.45	
Rated current (Arms)	2.5	
Maximum current (Arms)	9.8	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.53	
Rotor moment of inertia (kg·cm^2)	Motor without brake	0.145
	Motor with brake	0.157

Torque-Speed characteristics



Heatsink-based derating curve



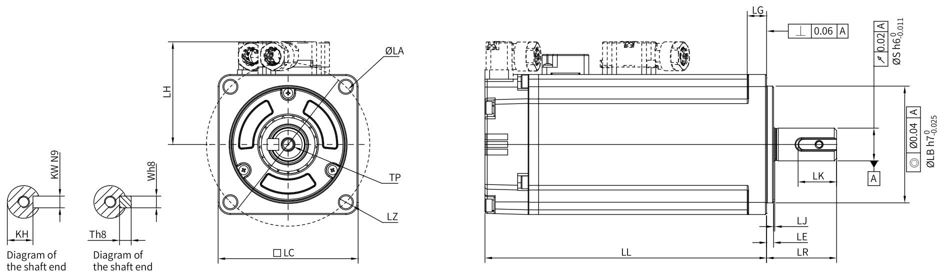
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	⩽ 60	⩽ 20	⩽ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	245	74

Dimensions (mm)

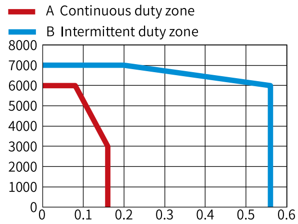


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
60	93 (121)	30 ± 0.5	70	4- Ø 5.5	44	8.0	3 ± 0.5	0.5±0.35
LB	**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
Ø50h7$^{0}_{-0.025}$	14	M5x8	16.5	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

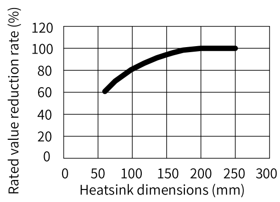
3.4.2 MS1H1-05B30CB-A33*R

Motor model		
Flange size (mm)	40	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.05	
Rated voltage (V)	220	
Rated torque (N·m)	0.16	
Maximum torque (N·m)	0.56	
Rated current (Arms)	1.2	
Maximum current (Arms)	4.8	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.12	
Rotor moment of inertia (kg·cm^2)	Brake-less motor	0.018
	Brake motor	0.0208

Torque-Speed characteristics



Heatsink-based derating curve



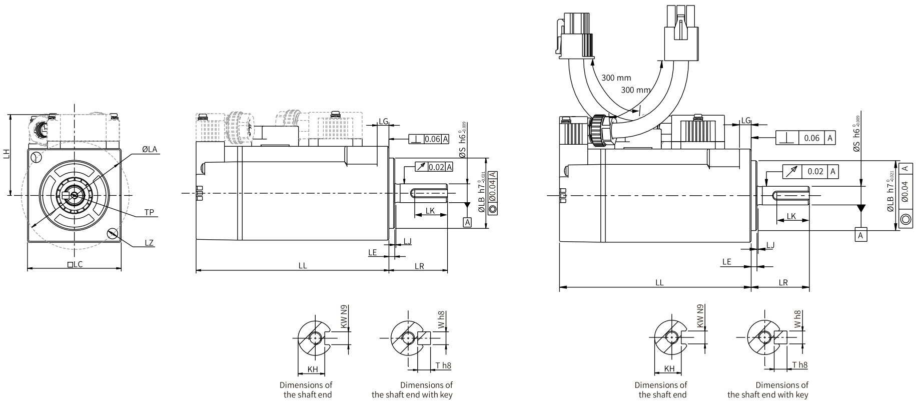
Electrical specifications of the motor with brake

Holding Torque (N·m)	Supply voltage (VDC) ±10%	Rated power (W)	Coil resistance (Ω)(±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	⩽ 40	⩽ 20	⩽ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	78	54

Product dimensions (mm)

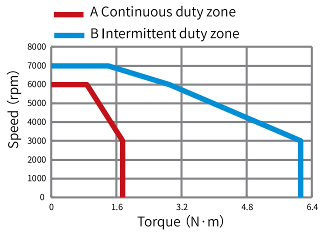


LL	LC	LR	LA	LZ	LH	LG	LE	LJ
55(82.3)	40	25±0.5	46	2-Ø4.5	34.5	5	2.5±0.5	0.5±0.35
S	**LB**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
8	Ø30h7$^{0}_{-0.021}$	M3×6	14	6.2$^{0}_{-0.1}$	3	3	3	0.26(0.43)

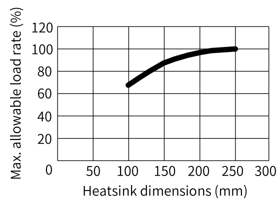
3.4.3 MS1H1-55B30CB-A33*R

Motor specifications		
Flange size (mm)	80	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.55	
Voltage (V)	220	
Rated torque (N·m)	1.75	
Maximum torque (N·m)	6.13	
Rated current (Arms)	3.9	
Maximum current (Arms)	15	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.49	
Rotor moment of inertia (kg·cm^2)	Motor without brake	0.55
	Motor with brake	-

Torque-Speed characteristics



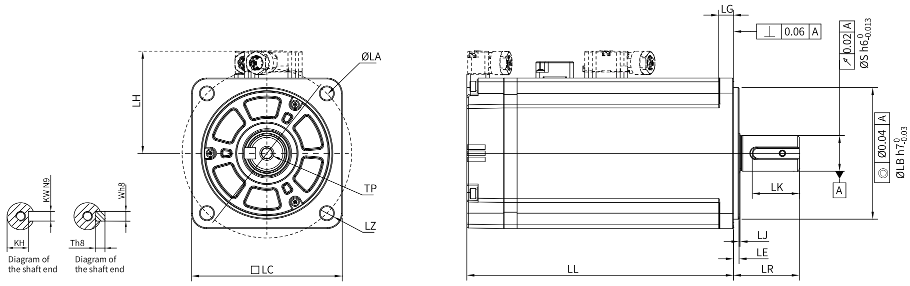
Heatsink-based derating curve



Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	392	147

Dimensions (mm)

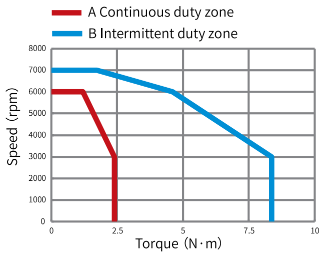


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	25±0.5	90	4- Ø 7	54	7.5	3±0.5	0.5±0.35
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
Ø70h7$^{0}_{-0.03}$	19	M6 x 20	26	15.5$^{0}_{-0.1}$	6	6	6	1.88

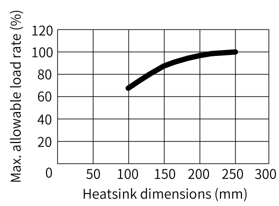
3.4.4 MS1H1-75B30CB-A33*R

Motor specifications		
Flange size (mm)	80	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.75	
Voltage (V)	220	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.37	
Rated current (Arms)	4.4	
Maximum current (Arms)	16.9	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.58	
Rotor moment of inertia (kg·cm^2)	Motor without brake	0.68
	Motor with brake	0.71

Torque-Speed characteristics



Heatsink-based derating curve



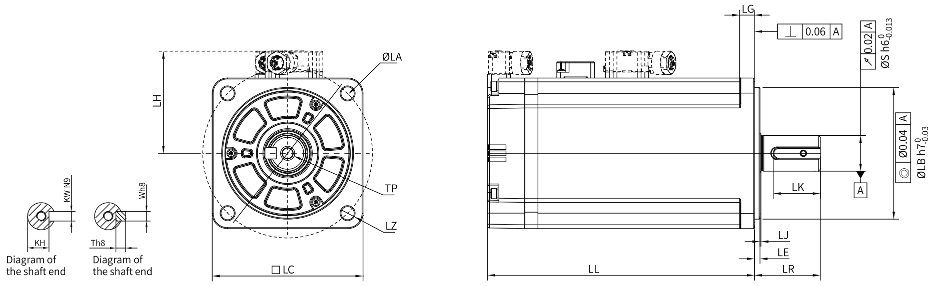
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	⩽ 60	⩽ 40	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	392	147

Dimensions (mm)

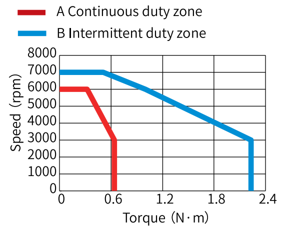


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (141.5)	25±0.5	90	4- Ø 7	54	7.5	3±0.5	0.5±0.35
LB	**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
$\varnothing 70h7^{0}_{-0.03}$	19	M6 × 20	26	$15.5^{0}_{-0.1}$	6	6	6	2.22 (2.88)

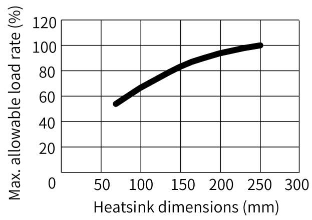
3.4.5 MS1H1-20B30CB-A33*R

Motor specifications		
Flange size (mm)	60	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.2	
Voltage (V)	220	
Rated torque (N·m)	0.64	
Maximum torque (N·m)	2.24	
Rated current (Arms)	1.5	
Maximum current (Arms)	5.8	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.46	
Rotor moment of inertia (kg·cm^2)	Motor without brake	0.094
	Motor with brake	0.106

Torque-Speed characteristics



Heatsink-based derating curve



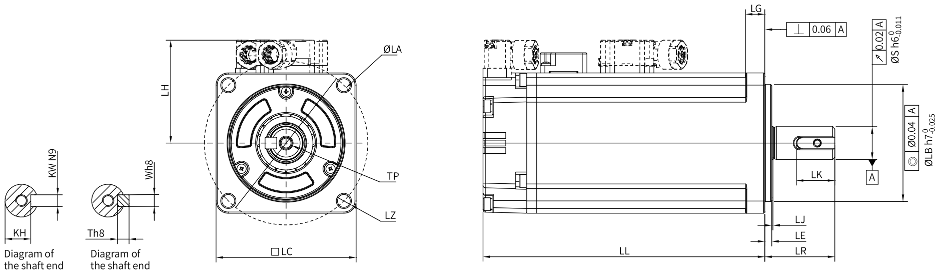
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	⩽ 60	⩽ 20	⩽ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	245	74

Dimensions (mm)

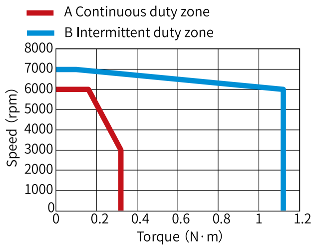


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
60	75.5 (103)	30±0.5	70	4- Ø 5.5	44	8.0	3±0.5	0.5±0.35
LB	**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
Ø50h7$^{0}_{-0.025}$	14	M5x8	16.5	11$^{0}_{-0.1}$	5	5	5	0.80 (1.17)

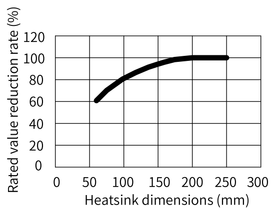
3.4.6 MS1H1-10B30CB-A33*R

Motor model		
Flange size (mm)	40	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.1	
Rated voltage (V)	220	
Rated torque (N·m)	0.32	
Maximum torque (N·m)	1.12	
Rated current (Arms)	1.2	
Maximum current (Arms)	4.8	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.25	
Rotor moment of inertia (kg·cm²)	Brake-less motor	0.0316
	Brake motor	0.0345

Torque-Speed characteristics



Heatsink-based derating curve



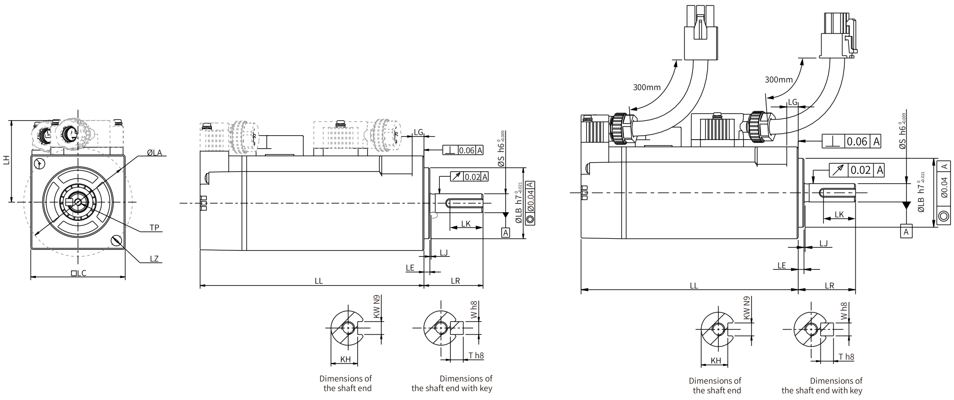
Electrical specifications of the motor with brake

Holding Torque (N·m)	Supply voltage (VDC) ±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	78	54

Product dimensions (mm)



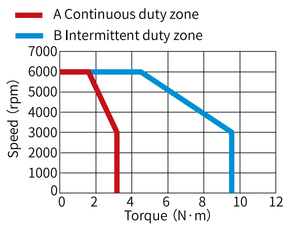
LL	LC	LR	LA	LZ	LH	LG	LE	LJ
67.5(94.8)	40	25±0.5	46	2-Ø4.5	34.5	5	2.5±0.5	0.5±0.35
S	LB	TP	LK	KH	KW	W	T	Weight (kg)
8	Ø30h7$^{0}_{-0.021}$	M3×6	14	6.2$^{0}_{-0.1}$	3	3	3	0.35(0.52)

3.5 MS1H2 Motors with Low Inertia and Medium Capacity

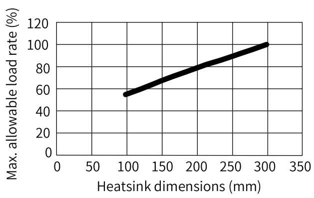
3.5.1 MS1H2-10C30CD-A33*R

Motor specifications		
Flange size (mm)	100	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	1.0	
Voltage (V)	380	
Rated torque (N·m)	3.18	
Maximum torque (N·m)	9.54	
Rated current (Arms)	3.3	
Maximum current (Arms)	11	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.07	
Rotor moment of inertia (kg·cm^2)	Motor without brake	1.78
	Motor with brake	2.6

Torque-Speed characteristics



Heatsink-based derating curve



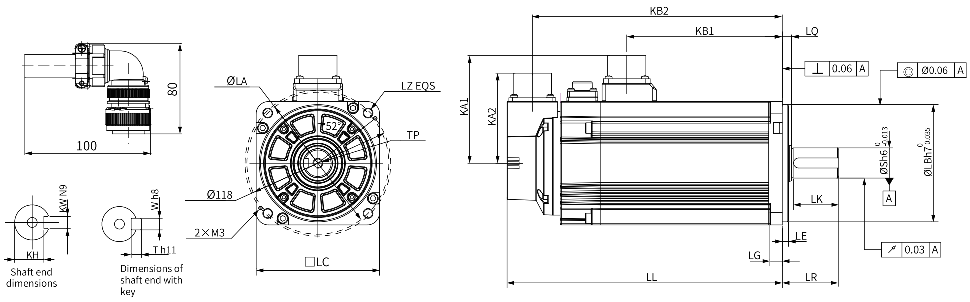
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	686	196

Dimensions (mm)

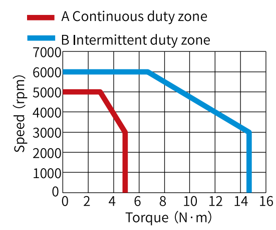


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45±1	115	4-Ø7	88	75	73	123.5 (151.5)	10	5±0.3
LQ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
7.5±0.75	$Ø95h7^{0}_{-0.035}$		24	M8x16	36	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

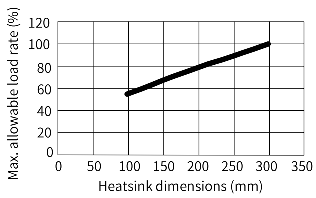
3.5.2 MS1H2-15C30CD-A33*R

Motor specifications		
Flange size (mm)	100	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	1.5	
Voltage (V)	380	
Rated torque (N·m)	4.9	
Maximum torque (N·m)	14.7	
Rated current (Arms)	4.2	
Maximum current (Arms)	14	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.28	
Rotor moment of inertia ($kg\cdot cm^2$)	Motor without brake	2.35
	Motor with brake	3.17

Torque-Speed characteristics



Heatsink-based derating curve



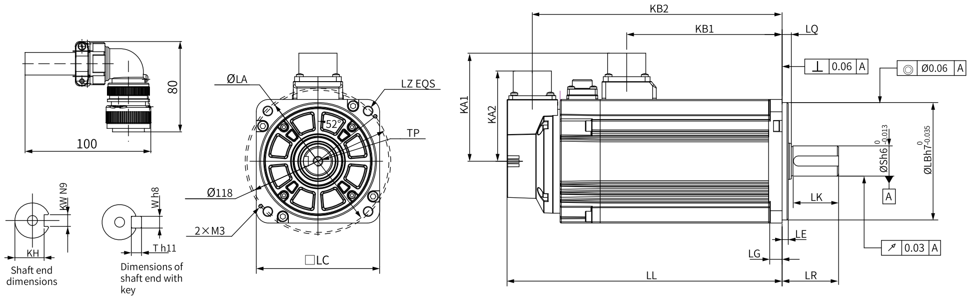
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	⩽ 100	⩽ 40	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	686	196

Dimensions (mm)

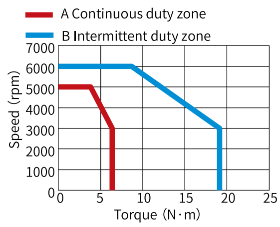


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45±1	115	4-Ø7	88	92	73	140.5 (168.5)	10	5±0.3
LQ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
7.5±0.75	$Ø95h7^{0}_{-0.035}$		24	M8x16	36	$20^{0}_{-0.2}$	8	8	7	4.65 (5.75)

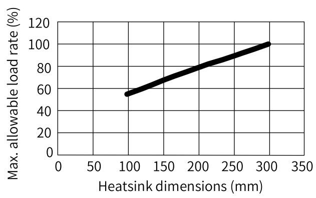
3.5.3 MS1H2-20C30CD-A33*R

Motor specifications		
Flange size (mm)	100	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	2.0	
Voltage (V)	380	
Rated torque (N·m)	6.36	
Maximum torque (N·m)	19.1	
Rated current (Arms)	5.6	
Maximum current (Arms)	20	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.19	
Rotor moment of inertia (kg·cm²)	Motor without brake	2.92
	Motor with brake	3.74

Torque-Speed characteristics



Heatsink-based derating curve



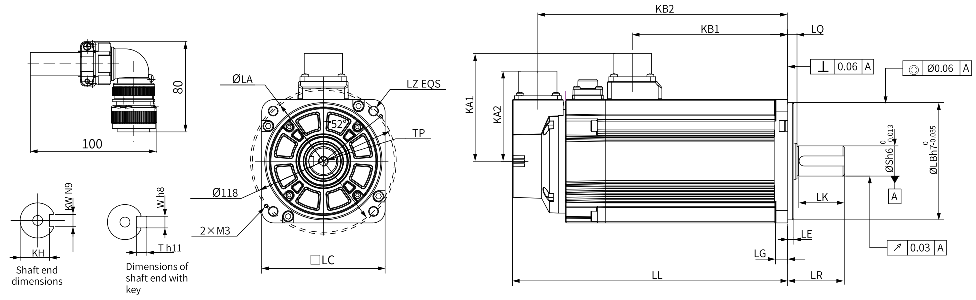
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	⩽ 100	⩽ 40	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	686	196

Dimensions (mm)

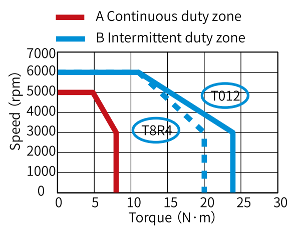


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45±1	115	4-Ø7	88	108	73	156.5 (184.5)	10	5±0.3
LJ	LB		S	TP	LK	KH	KW	W	T	Weight (kg)
7.5±0.75	$Ø95h7^{0}_{-0.035}$		24	M8x16	36	$20^{0}_{-0.2}$	8	8	7	5.5 (6.55)

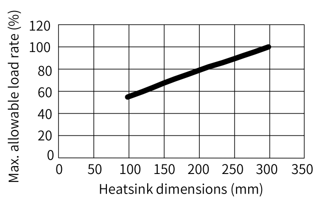
3.5.4 MS1H2-25C30CD-A33*R

Motor model		
Flange size (mm)	100	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	2.5	
Voltage (V)	380	
Rated torque (N·m)	7.96	
Maximum torque (N·m)	23.9	
Rated current (Arms)	7.2	
Maximum current (Arms)	26	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.18	
Rotor moment of inertia (kg·cm^2)	Brake-less motor	3.49
	Brake motor	4.3

Torque-Speed characteristics



Heatsink-based derating curve



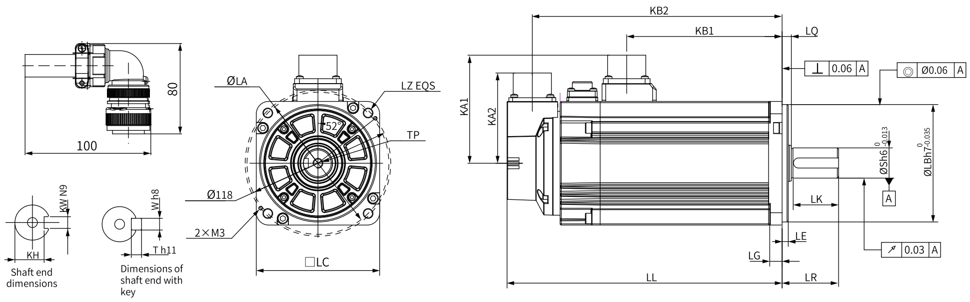
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Coil resistance (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	⩽ 100	⩽ 40	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	686	196

Product dimensions (mm)

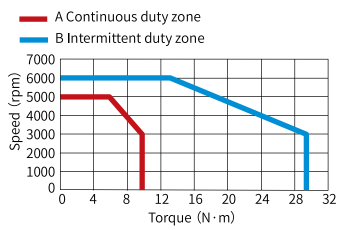


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45±1	115	4-Ø7	88	126	73	174.5 (202.5)	10	5±0.3
LQ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
7.5±0.75	Ø95h7$^{0}_{-0.035}$		24	M8×16	36	$20^{0}_{-0.2}$	8	8	7	6.3 (7.35)

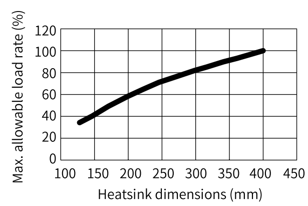
3.5.5 MS1H2-30C30CD-A33*R

Motor specifications		
Flange size (mm)	130	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	3.0	
Voltage (V)	380	
Rated torque (N·m)	9.8	
Maximum torque (N·m)	29.4	
Rated current (Arms)	8.9	
Maximum current (Arms)	29	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.25	
Rotor moment of inertia (kg·cm^2)	Motor without brake	6.4
	Motor with brake	9.38

Torque-Speed characteristics



Heatsink-based derating curve



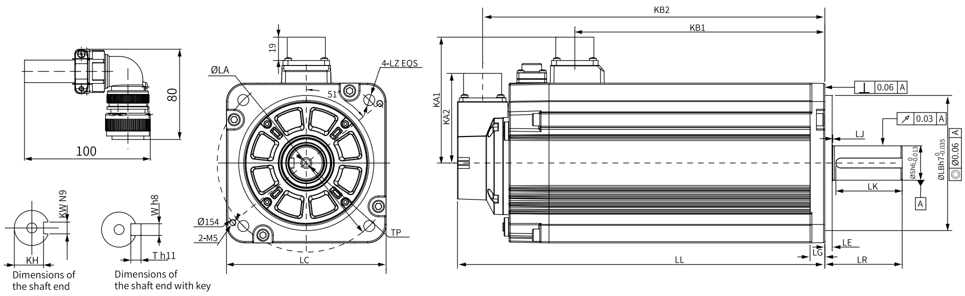
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	⩽ 120	⩽ 60	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	1176	392

Dimensions (mm)

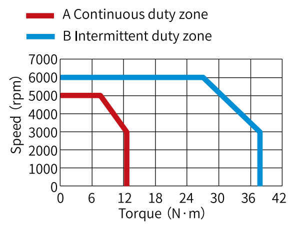


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63±1	145	4-Ø9	102.4	127.5	73	177.5 (202.5)	12	6±0.3
LJ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
0.5±0.75	Ø110h7$^{0}_{-0.035}$		28	M8 × 20	54	24$^{0}_{-0.2}$	8	8	7	10.0 (11.9)

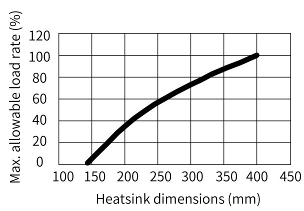
3.5.6 MS1H2-40C30CD-A33*R

Motor specifications		
Flange size (mm)	130	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	4.0	
Voltage (V)	380	
Rated torque (N·m)	12.6	
Maximum torque (N·m)	37.8	
Rated current (Arms)	13.5	
Maximum current (Arms)	42.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.06	
Rotor moment of inertia (kg·cm^2)	Motor without brake	9
	Motor with brake	11.98

Torque-Speed characteristics



Heatsink-based derating curve



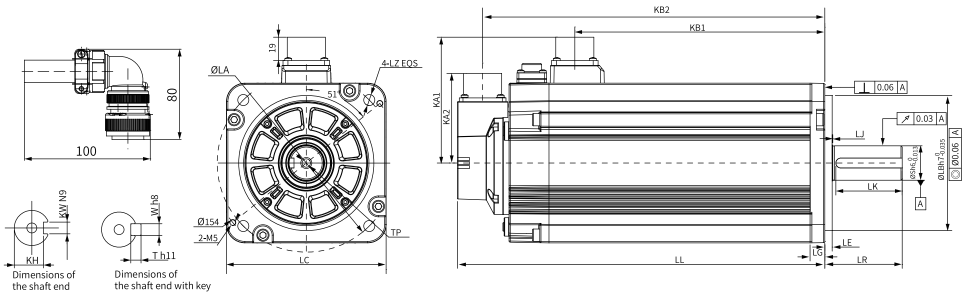
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	⩽ 120	⩽ 60	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	1176	392

Dimensions (mm)

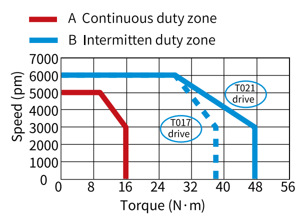


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63±1	145	4-Ø9	102.4	165.5	73	215.5 (240.5)	12	6±0.3
LJ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
0.5±0.75	$Ø110h7^{0}_{-0.035}$		28	M8 × 20	54	$24^{0}_{-0.2}$	8	8	7	13.2 (15.1)

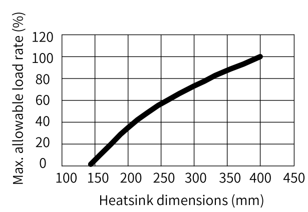
3.5.7 MS1H2-50C30CD-A33*R

Motor model		
Flange size (mm)	130	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	5.0	
Voltage (V)	380	
Rated torque (N·m)	15.8	
Maximum torque (N·m)	47.4	
Rated current (Arms)	17	
Maximum current (Arms)	52.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/Arms)	1.04	
Rotor moment of inertia (kg·cm^2)	Brake-less motor	11.6
	Brake motor	14.58

Torque-Speed characteristics



Heatsink-based derating curve



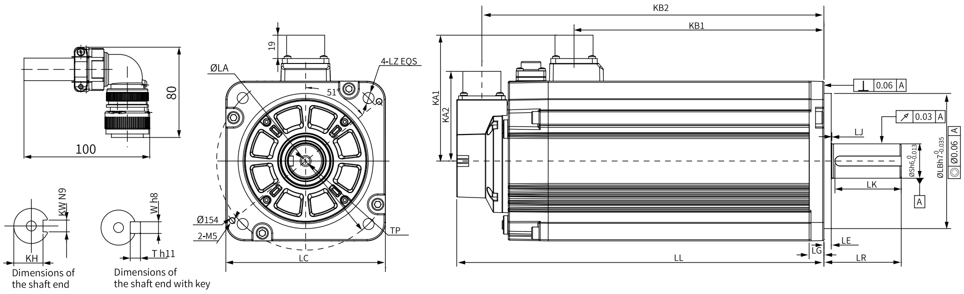
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Coil resistance (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	1176	392

Product dimensions (mm)



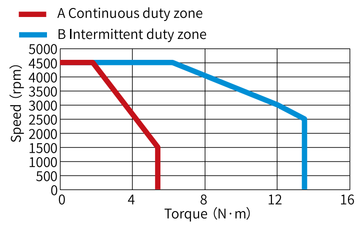
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63±1	145	4-Ø9	102.4	203.5	73	253.5 (278.5)	12	6±0.3
LJ	LB		S	TP	LK	KH	KW	W	T	Weight (kg)
0.5±0.75	Ø110h7$^{0}_{-0.035}$		28	M8×20	54	24$^{0}_{-0.2}$	8	8	7	16.35 (18.25)

3.6 MS1H3 Motors with Medium Inertia and Medium Capacity

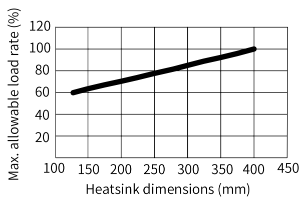
3.6.1 MS1H3-85B15CD-A33*R

Motor specifications		
Flange size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	0.85	
Voltage (V)	380	
Rated torque (N·m)	5.39	
Maximum torque (N·m)	13.5	
Rated current (Arms)	3.5	
Maximum current (Arms)	8.5	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/Arms)	1.84	
Rotor moment of inertia (kg·cm²)	Motor without brake	13.56
	Motor with brake	15.8

Torque-Speed characteristics



Heatsink-based derating curve



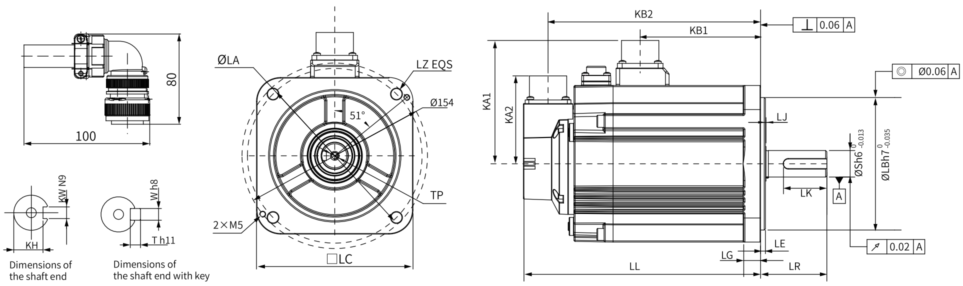
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	⩽ 120	⩽ 60	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	686	196

Dimensions (mm)

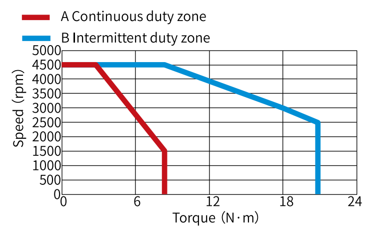


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55±1	145	4-Ø9	103	70	73	121.5 (146.5)	14	4
LJ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
0.5±0.75	$Ø110h7^{0}_{-0.035}$		22	M6 × 20	36	$18^{0}_{-0.2}$	8	8	7	5.8 (7.7)

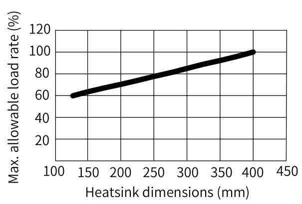
3.6.2 MS1H3-13C15CD-A33*R

Motor specifications		
Flange size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	1.3	
Voltage (V)	380	
Rated torque (N·m)	8.34	
Maximum torque (N·m)	20.85	
Rated current (Arms)	5.1	
Maximum current (Arms)	12.6	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/Arms)	1.85	
Rotor moment of inertia (kg·cm^2)	Motor without brake	19.25
	Motor with brake	21.5

Torque-Speed characteristics



Heatsink-based derating curve



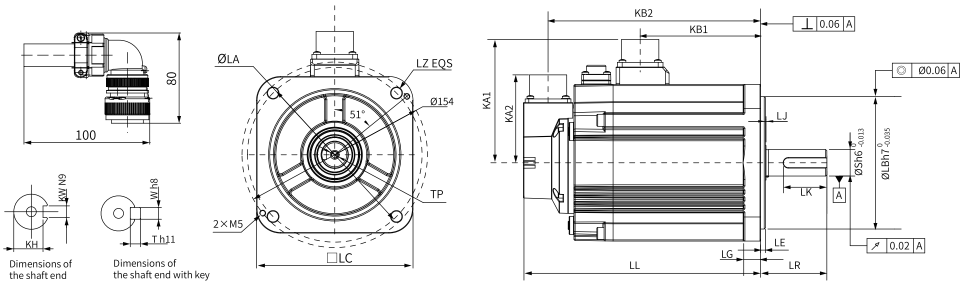
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	⩽ 120	⩽ 60	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	686	196

Dimensions (mm)



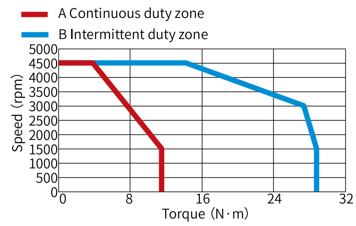
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55±1	145	4-Ø9	103	85	73	136.5 (161.5)	14	4

LJ	LB	S	TP	LK	KH	KW	W	T	Weight (kg)
0.5±0.75	Ø110h7$^{0}_{-0.035}$	22	M6 × 20	36	$18^{0}_{-0.2}$	8	8	7	7.1 (8.9)

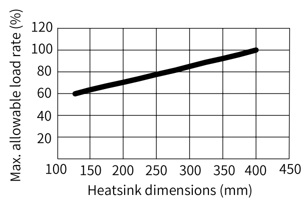
3.6.3 MS1H3-18C15CD-A33*R

Motor specifications		
Flange size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	1.8	
Voltage (V)	380	
Rated torque (N·m)	11.5	
Maximum torque (N·m)	28.75	
Rated current (Arms)	6.75	
Maximum current (Arms)	17.7	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/Arms)	1.87	
Rotor moment of inertia (kg·cm^2)	Motor without brake	24.9
	Motor with brake	27.2

Torque-Speed characteristics



Heatsink-based derating curve



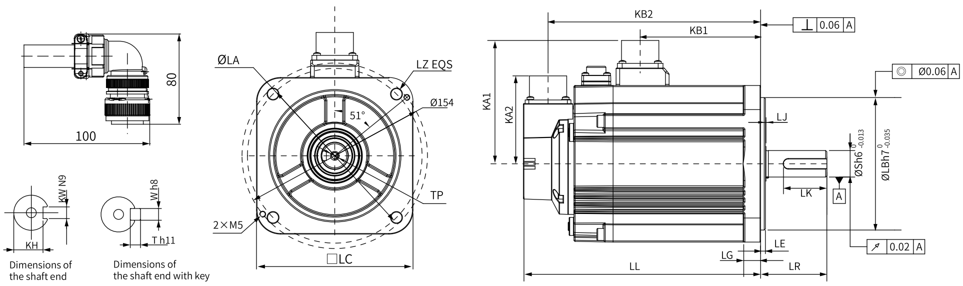
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	⩽ 120	⩽ 60	⩽ 1

Allowable load

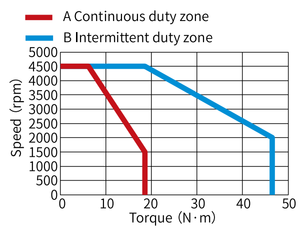
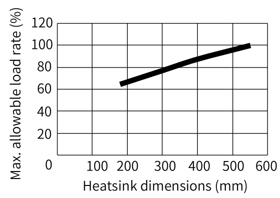
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	686	196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55±1	145	4-Ø9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	KW	W	T	Weight (kg)
0.5±0.75	$Ø110h7^{0}_{-0.035}$		22	M6 × 20	36	$18^{0}_{-0.2}$	8	8	7	8.5 (10.3)

3.6.4 MS1H3-29C15CD-A33*R

Motor specifications			Torque-Speed characteristics
Flange size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	2.9		
Voltage (V)	380		
Rated torque (N·m)	18.6		
Maximum torque (N·m)	46.5		
Rated current (Arms)	10.5		Heatsink-based derating curve
Maximum current (Arms)	29.75		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/Arms)	1.94		
Rotor moment of inertia (kg·cm²)	Motor without brake	44.7	
	Motor with brake	52.35	

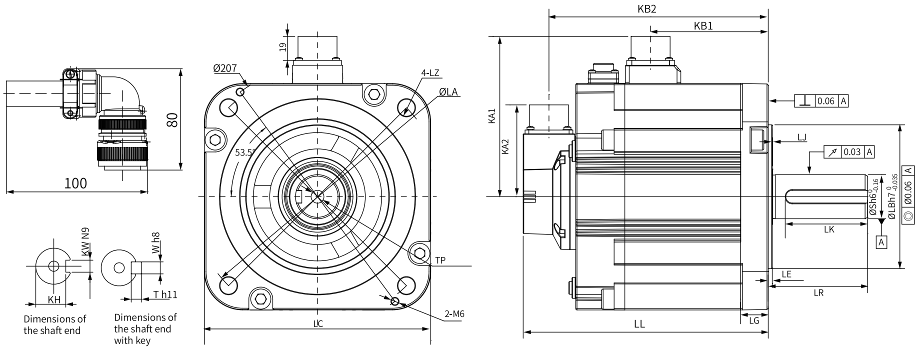
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	⩽ 200	⩽ 100	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	1470	490

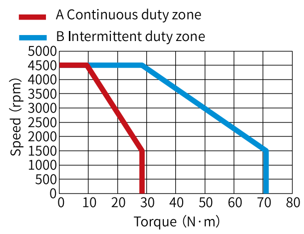
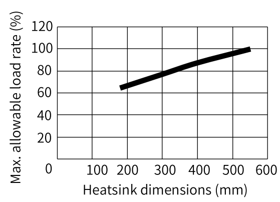
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79±1	200	4-Ø13.5	127.4	93.5	73	140.5 (174.3)	22	3.2±0.3

LJ	LB	S	TP	LK	KH	KW	W	T	Weight (kg)
0.5±0.75	Ø114.3h7$^{0}_{-0.035}$	35	M12x25	65	30$^{0}_{-0.2}$	10	10	8	13.8 (17.9)

3.6.5 MS1H3-44C15CD-A33*R

Motor specifications			Torque-Speed characteristics
Flange size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	380		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated current (Arms)	16		Heatsink-based derating curve
Maximum current (Arms)	42		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/Arms)	1.96		
Rotor moment of inertia (kg·cm^2)	Motor without brake	64.9	
	Motor with brake	72.55	

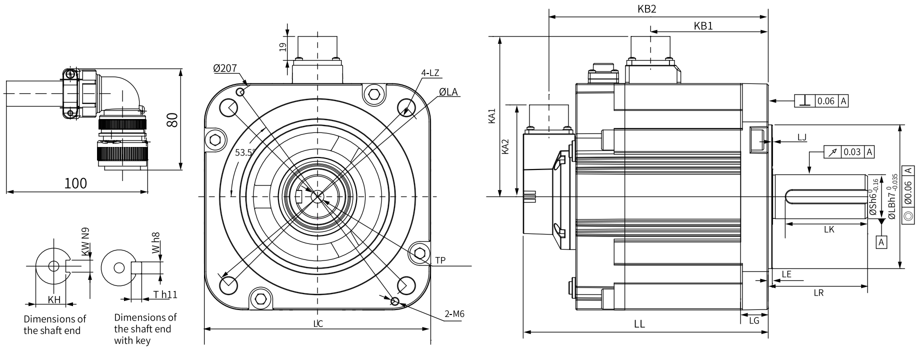
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	⩽ 200	⩽ 100	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	1470	490

Dimensions (mm)

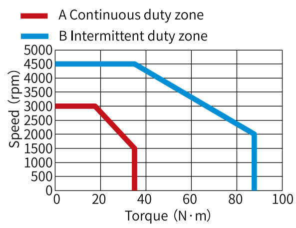


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79±1	200	4-Ø13.5	127.4	117	73	164 (197.8)	22	3.2±0.3
LJ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
0.5±0.75	Ø114.3h7$^{0}_{-0.035}$		35	M12x25	65	30$^{0}_{-0.2}$	10	10	8	17.4 (21.6)

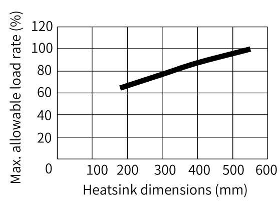
3.6.6 MS1H3-55C15CD-A33*R

Motor specifications		
Flange size (mm)	180	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	5.5	
Voltage (V)	380	
Rated torque (N·m)	35	
Maximum torque (N·m)	87.6	
Rated current (Arms)	20.7	
Maximum current (Arms)	52	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/Arms)	1.92	
Rotor moment of inertia (kg·cm^2)	Motor without brake	86.9
	Motor with brake	94.55

Torque-Speed characteristics



Heatsink-based derating curve



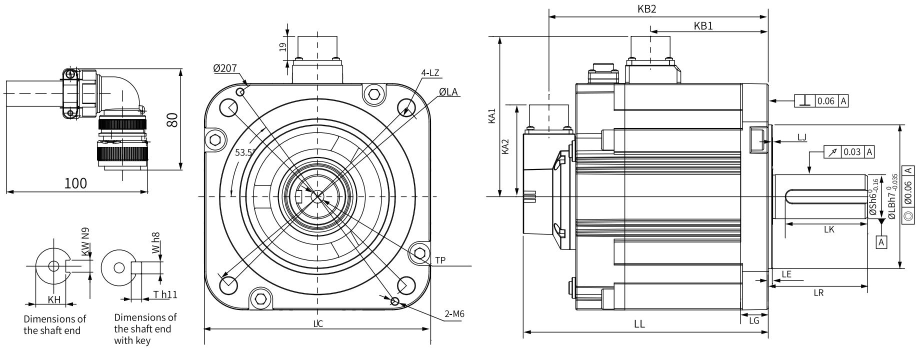
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	⩽ 200	⩽ 100	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	1764	588

Dimensions (mm)



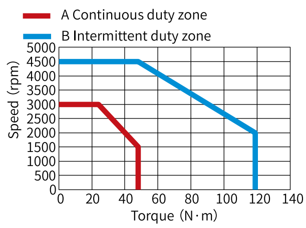
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	208 (241.8)	113±1	200	4-Ø13.5	127.4	140.5	73	187.5 (221.3)	22	3.2±0.3

LJ	LB	S	TP	LK	KH	KW	W	T	Weight (kg)
0.5±0.75	Ø114.3h7$^{0}_{-0.035}$	42	M16x32	97	37$^{0}_{-0.2}$	12	12	8	21.7 (25.9)

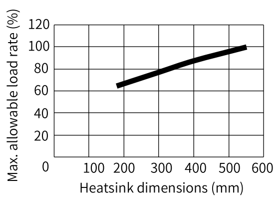
3.6.7 MS1H3-75C15CD-A33*R

Motor specifications		
Flange size (mm)	180	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	7.5	
Voltage (V)	380	
Rated torque (N·m)	48	
Maximum torque (N·m)	119	
Rated current (Arms)	25	
Maximum current (Arms)	65	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/Arms)	2.13	
Rotor moment of inertia (kg·cm^2)	Motor without brake	127.5
	Motor with brake	135.15

Torque-Speed characteristics



Heatsink-based derating curve



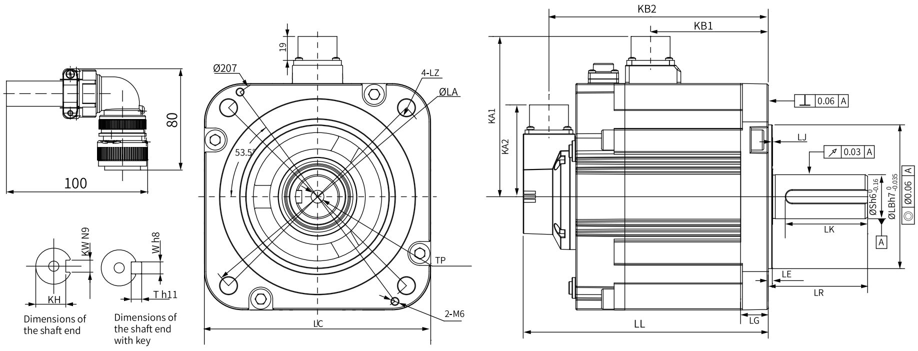
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	1764	588

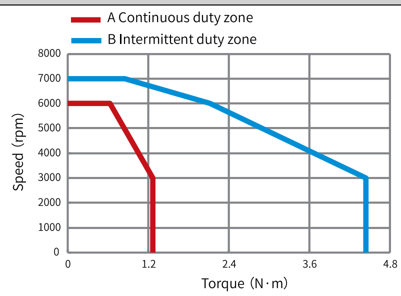
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	255 (288.8)	113±1	200	4-Ø13.5	127.4	187.5	73	234.5 (234.5)	22	3.2±0.3
LJ	**LB**		**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
0.5±0.75	$Ø114.3h7^{0}_{-0.035}$		42	M16x32	97	$37^{0}_{-0.2}$	12	12	8	29 (33.2)

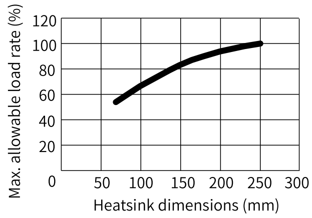
3.7 MS1H4 Motors with Medium Inertia and Small Capacity

3.7.1 MS1H4-40B30CB-A33*R

Motor specifications		Torque-Speed characteristics
Flange size (mm)	60	
Inertia, capacity	Medium inertia, low capacity	
Rated power (kW)	0.4	
Voltage (V)	220	
Rated torque (N·m)	1.27	
Maximum torque (N·m)	4.45	
Rated current (Arms)	2.4	Heatsink-based derating curve

Motor specifications		
Maximum current (Arms)	9.2	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.53	
Rotor moment of inertia (kg·cm²)	Motor without brake	0.43
	Motor with brake	0.44

Torque-Speed characteristics



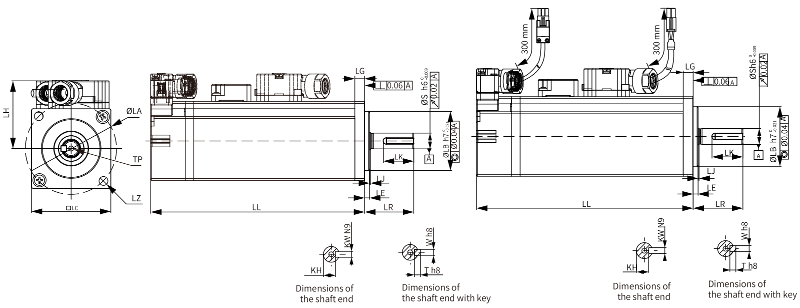
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	⩽ 60	⩽ 20	⩽ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	245	74

Dimensions (mm)

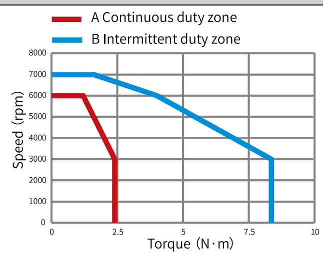


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
60	92 (119.8)	30 ± 0.5	70	4- Ø 5.5	44	8.0	3 ± 0.5	0.5±0.35
LB	**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
Ø50h7$^{0}_{-0.025}$	14	M5x8	16.5	11$^{0}_{-0.1}$	5	5	5	1.11 (1.48)

3.7.2 MS1H4-75B30CB-A33*R

Motor specifications	
Flange size (mm)	80
Inertia, capacity	Medium inertia, low capacity
Rated power (kW)	0.75
Voltage (V)	220
Rated torque (N·m)	2.39
Maximum torque (N·m)	8.37
Rated current (Arms)	4.4

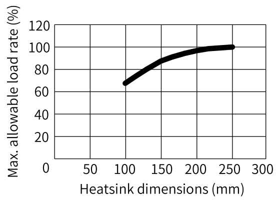
Torque-Speed characteristics



Heatsink-based derating curve

Motor specifications		
Maximum current (Arms)	16.9	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/Arms)	0.58	
Rotor moment of inertia (kg·cm^2)	Motor without brake	1.46
	Motor with brake	1.51

Torque-Speed characteristics



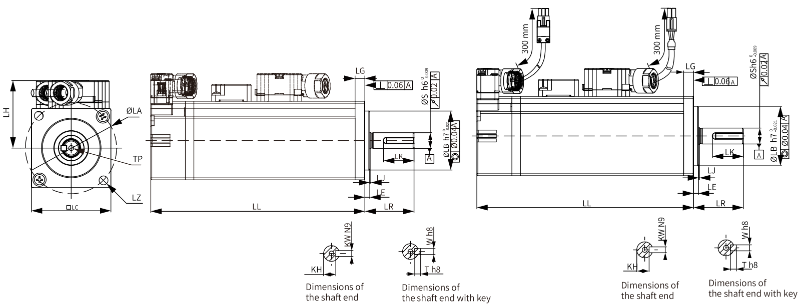
Electrical specifications of the motor with brake

Holding torque (N·m)	Supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω) (±7%)	Exciting current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	⩽ 60	⩽ 40	⩽ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	392	147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (141.5)	25±0.5	90	4- Ø 7	54	7.5	3 ± 0.5	0.5±0.35
LB	**S**	**TP**	**LK**	**KH**	**KW**	**W**	**T**	**Weight (kg)**
Ø 70h7$^{0}_{-0.03}$	19	M6 × 20	26	15.5$^{0}_{-0.1}$	6	6	6	2.18 (2.82)

4 ISMG Series Motors

The ISMG series air-cooling permanent magnet motor is a general-purpose high-power servo motor that comes with two variants, ISMG1 and ISMG2. The ISMG series motor is equipped with a 23-bit encoder and features low temperature rise, low current, and high overspeed capacity. It adopts low rotor inertia design to ensure high responsiveness of the motor.

4.1 Product Information

4.1.1 Model and Nameplate

Model description

Model: ISM G1-30D 15C D   Type: A3 3 1 F A

① ② ③ ④ ⑤   ⑥ ⑦⑧ ⑨ ⑩

① **ISM series servo motor**	④ **Rated speed (rpm)** One letter and two digits B: x 10 C: x 100 Example: 15C: 1,500 rpm	⑦ **Shaft connection mode** 1: Plain shaft 3: Solid and keyed, with tapped holes A: Built-in rotor, solid, keyed, and with tapped holes
② **Flange size** G1: 200 x 200 G2: 266 x 266	⑤ **Voltage class (V)** D: 380	⑧ **Brake, reducer, oil seal** 1: Oil seal 4: Brake (ISMG2 series brake-less model)
③ **Rated power in S4 duty (W)** One letter and two digits C: x 100 D: x 1000 E: x 10000 Example: 30D: 30000 W	⑥ **Encoder type** One letter and one digit A3: 23-bit multi-turn absolute encoder	⑨ **Cooling mode** X: Natural cooling F: Forced air cooling ⑩ **Product code** A: Second generation

Nameplate

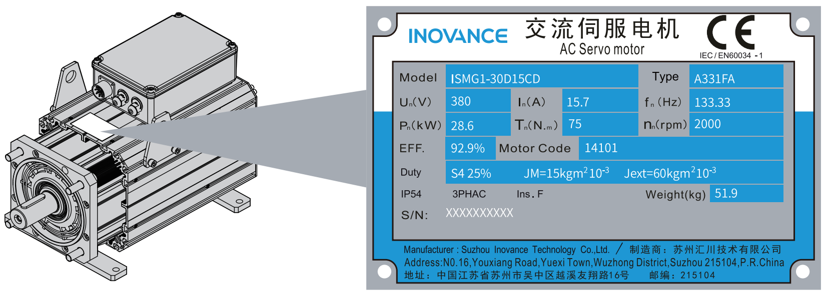


Figure 4-1 Model and nameplate

4.1.2 Components

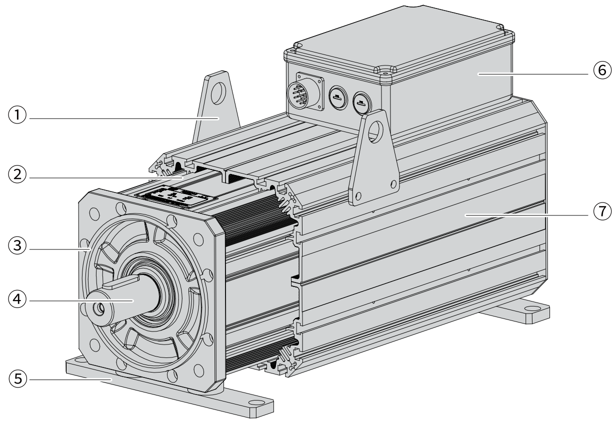


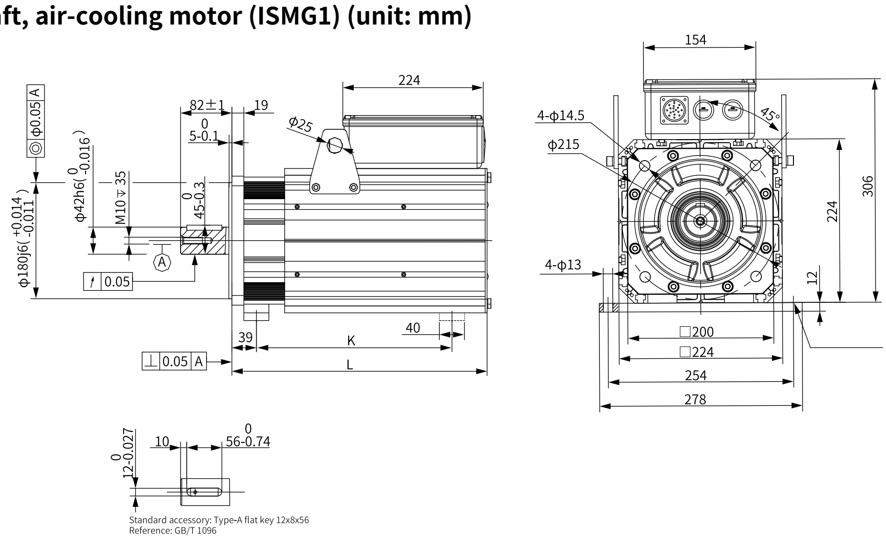
Table 4–1

No.	Name	No.	Name
1	Hanger plate	5	Mounting baseplate
2	Enclosure	6	Junction box
3	Front end cover	7	Air duct
4	Axis	-	-

4.1.3 Product Dimensions

ISMG1 motor

- **Solid shaft, air-cooling motor (ISMG1) (unit: mm)**

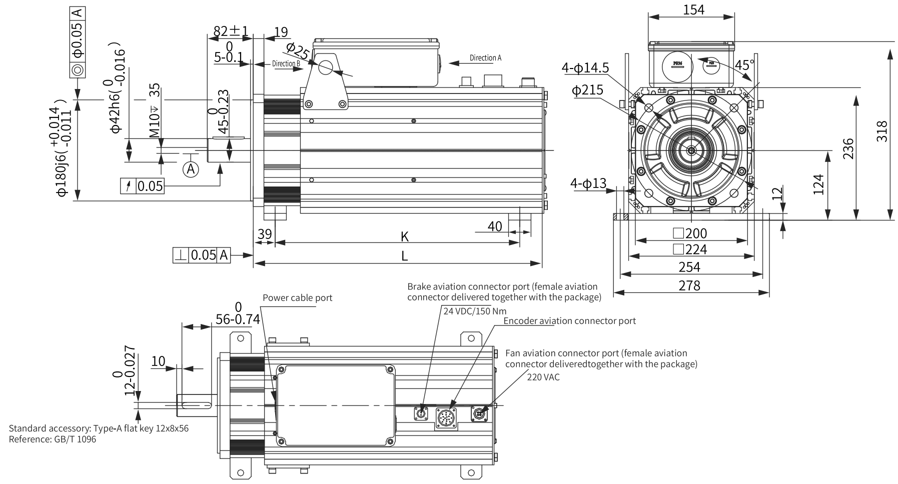


Connector Model	Encoder Side
Aviation connector	MIL-DTL-5015 series 3102E20-29P

Motor model	L (mm)	K (mm)	Weight (kg)
ISMG1-95C15CD-A331FA ISMG1-12D20CD-A331FA	376	285	45.2
ISMG1-14D15CD-A331FA ISMG1-18D20CD-A331FA	410	312	51.9

Motor model	L (mm)	K (mm)	Weight (kg)
ISMG1-17D15CD-A331FA ISMG1-23D20CD-A331FA	445	354	59
ISMG1-22D15CD-A331FA ISMG1-28D20CD-A331FA	482	396	66
ISMG1-30D15CD-A331FA ISMG1-41D20CD-A331FA	553	471	79.8

- **Brake motor (unit: mm)**



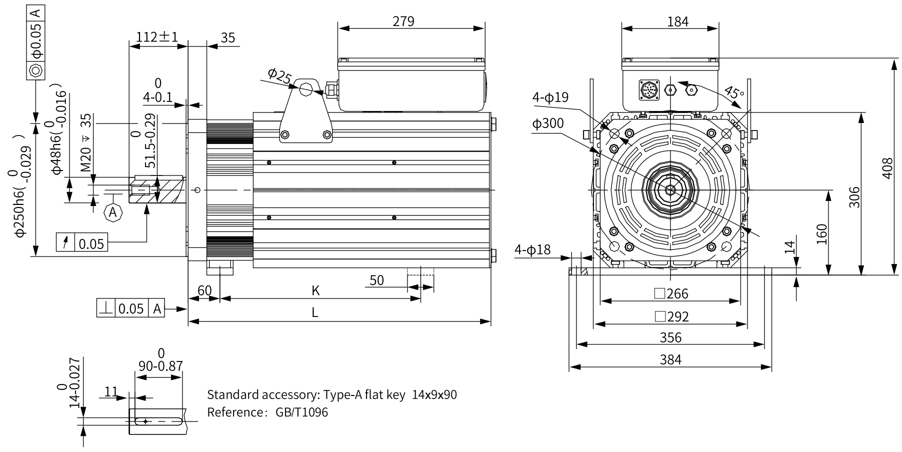
Motor model	L (mm)	K (mm)
ISMG1-95C15CD-A334FA ISMG1-12D20CD-A334FA	484	396
ISMG1-14D15CD-A334FA ISMG1-18D20CD-A334FA	518	436
ISMG1-17D15CD-A334FA ISMG1-23D20CD-A334FA	553	471
ISMG1-22D15CD-A334FA ISMG1-28D20CD-A334FA	590	506
ISMG1-30D15CD-A334FA ISMG1-41D20CD-A334FA	661	576

Note

- The standard model is A3 series.
- The mounting foot is optional. The K value represents the mounting foot clearance.
- The mounting foot is optional and not included in standard configuration.

ISMG2 motor

Solid shaft, air-cooling motor (ISMG2) (unit: mm)



Connector Model	Encoder Side
Aviation connector	MIL-DTL-5015 series 3102E20-29P

Motor model	L (mm)	K (mm)	Weight (kg)
ISMG2-31D15CD-A331FA ISMG2-42D20CD-A331FA	525	360	122
ISMG2-42D15CD-A331FA ISMG2-57D20CD-A331FA	577	370	141.3
ISMG2-52D15CD-A331FA	629	476	158.4
ISMG2-60D15CD-A331FA	680	476	175.4

Note

The standard model is A3 series.

4.2 Product Specifications

4.2.1 Mechanical Characteristics

Item	Description
Duty type	Continuous S1
Insulation resistance	500 VDC, above 50 MΩ
Ambient temperature	-20°C to +40°C (non-frozen)
Ambient humidity	20 %–90% RH (without condensation)
Storage temperature	-20°C to +60°C (non-frozen) (Peak temperature assurance: 80°C for 72 hours)
Storage humidity	20 %–90% RH (without condensation)
Installation mode	IM B35
Insulation class	CLASS-F
Insulation voltage	1800 VAC for 1 min (380 V class)
IP rating of enclosure	IP54
Cooling mode	IC416
Shock	Below 200 m/s^2
Max. vibration in radial direction	Below 200 m/s^2
Max. vibration in axial direction	Below 45 m/s^2

Item	Description
Fan type	Single-phase capacitor-run centrifugal fan
Fan power	ISMG1: 41 W; ISMG2: 134 W
Fan voltage	220/230 VAC
Fan frequency	50 Hz/60 Hz
Threshold of built-in PTC	130°C
KTY resistance at a temperature range of 10°C to 30°C	514 Ω to 652 Ω
Certification	CE
Number of motor pole pairs: 2	8
Winding mode	Y
Excitation mode	Permanent magnetic
Direction of rotation	Rotates counterclockwise when viewed from the load side (CCW) with the forward run command.

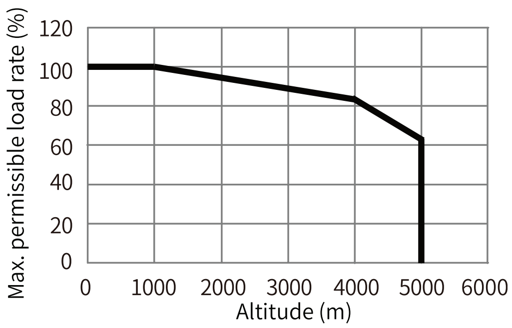
4.2.2 Derating Characteristics

Altitude-based derating

No derating is required if the motor is used in altitudes below 1000 m. Derating is required for altitudes above 1000 m.

Altitude-based derating	1000 m	2000 m	3000 m	4000 m	5000 m
	1	0.947	0.887	0.824	0.645

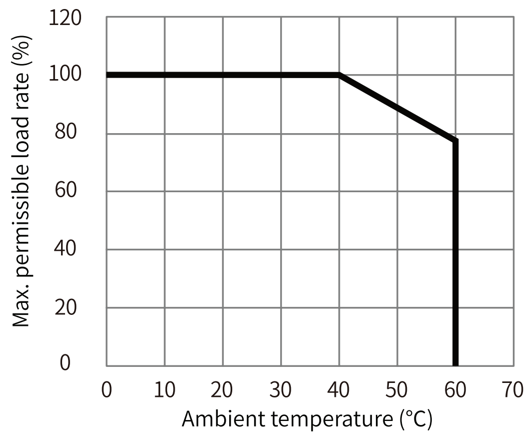
Altitude-based derating curve is shown below.



Temperature-based derating

Temperature-based derating	40°C	45°C	50°C	55°C	60°C
	1	0.952	0.901	0.855	0.781

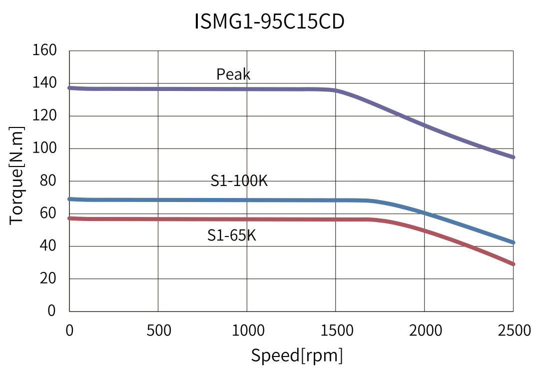
The temperature-based derating curve is shown below.

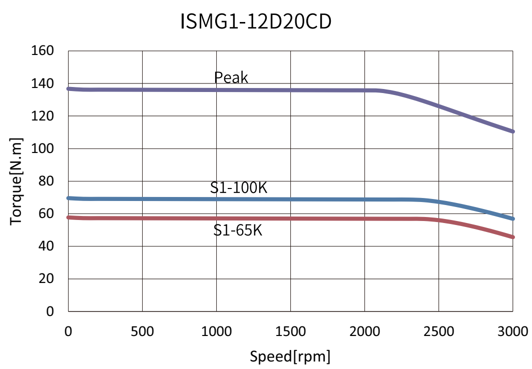


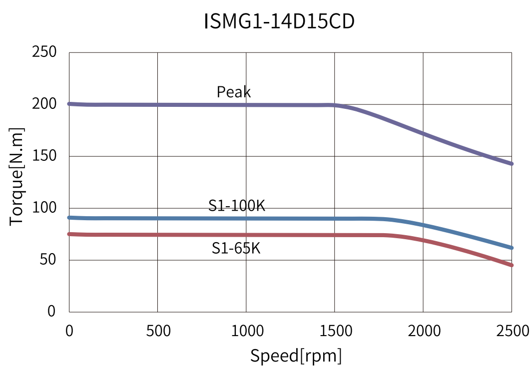
4.2.3 Motor Torque-Speed Characteristics

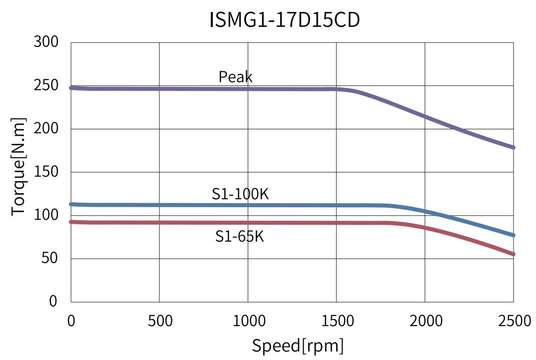
Color	Assignment	Description	Remarks
Purple	Peak	Describes the relation between the peak torque and the motor speed, which demonstrates the short-term overload capacity of the motor.	When selecting the motor model, ensure that the rated operating point of the motor is between S1-65K and S1-100K curves.
Blue	S1-100K	Describes the relation between the torque and the motor speed under a temperature rise of 100 K in S1 duty.	
Red	S1-65K	Describes the relation between the torque and the motor speed under a temperature rise of 65 K in S1 duty.	

ISMG1 torque-speed characteristics

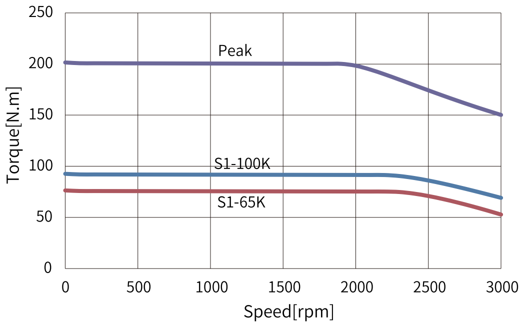




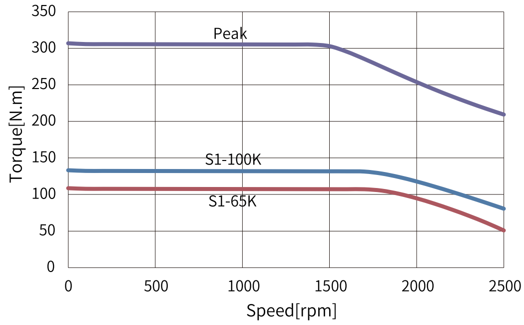




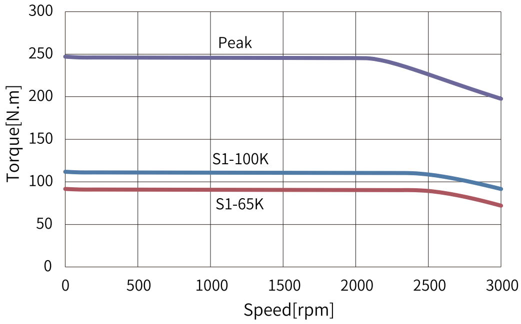
ISMG1-18D20CD



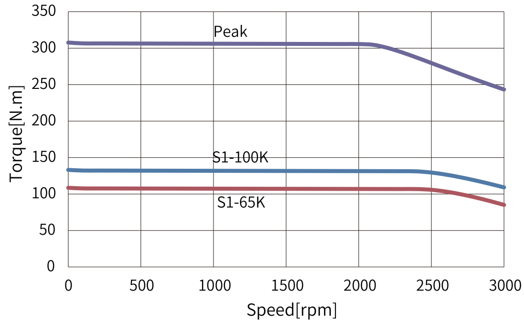
ISMG1-22D15CD



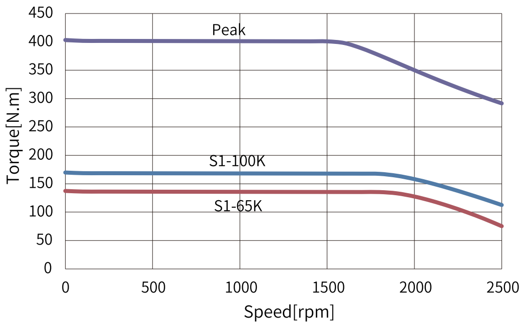
ISMG1-23D20CD



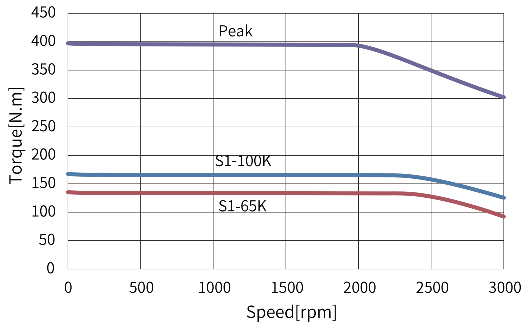
ISMG1-28D20CD



ISMG1-30D15CD

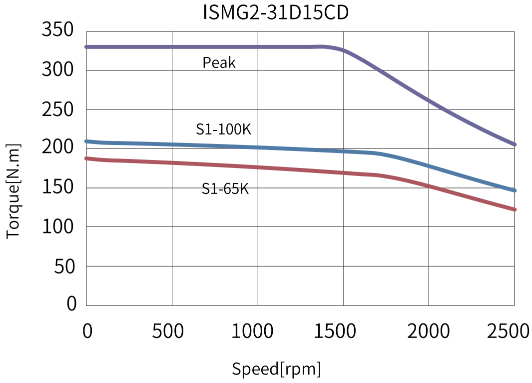


ISMG1-41D20CD

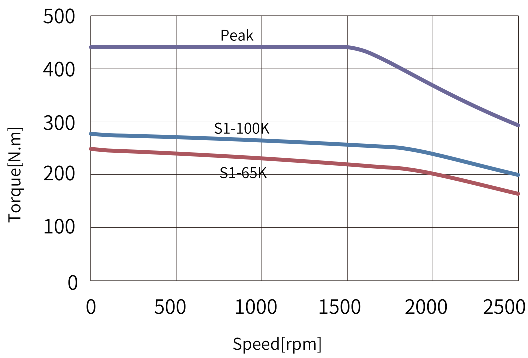


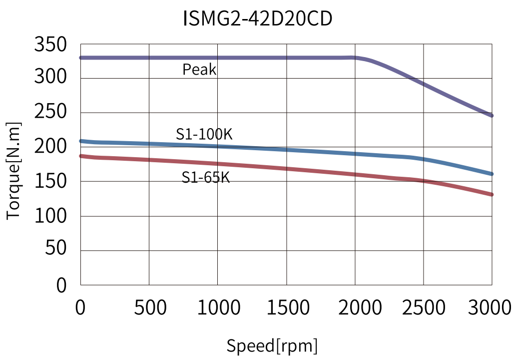
ISMG2 torque-speed characteristics

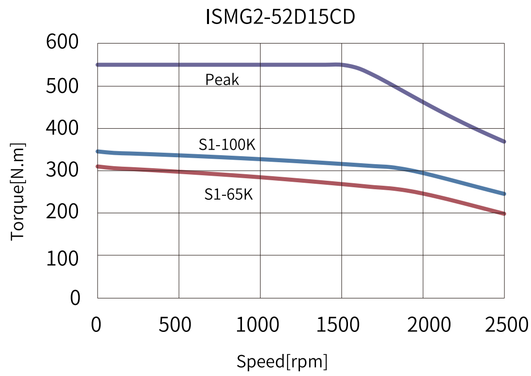
ISMG2-31D15CD

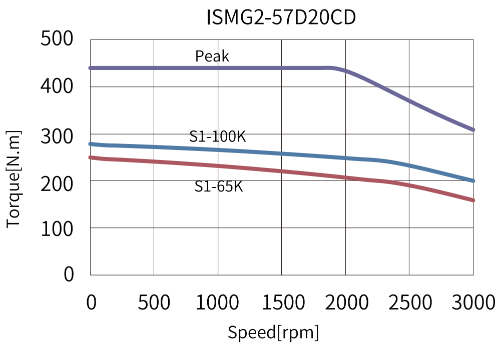


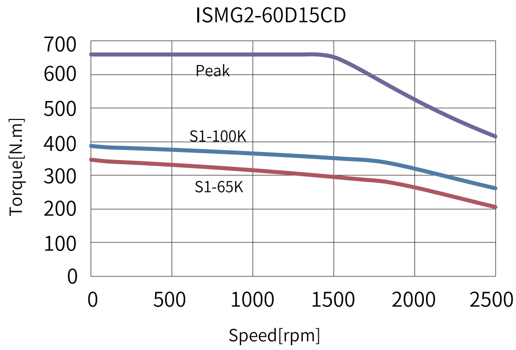
ISMG2-42D15CD











4.2.4 Motor parameters

ISMG1 motor

- **Brake-less motor**

Table 4–2 ISMG1 brake-less motor specifications

Motor model	ISMG1-*******-A331FA									
	95C15CD	12D20CD	14D15CD	17D15CD	18D20CD	22D15CD	23D20CD	28D20CD	30D15CD	41D20CD
Rated power (S1)[1](kW)	7.9	10.5	11.8	14.5	15.7	18.1	19.3	24.1	23.6	31.4
Rated power (S4)[2](kW)	9.5	12.6	14.1	17.3	18.8	22	23	28.3	30.6	41
Rated current (S1)[1](A)	14.5	20.3	22.9	28.1	28.6	33.4	37.4	46.7	45.9	57.3
Rated current (S4)[2](A)	18.5	26	29.2	35.7	36.4	41.7	47.6	58.4	63.3	78.9
Rated torque (S1)[1](N·m)	50	50	75	92	75	115	92	115	150	150
Rated torque (S4)[2](N·m)	60	60	90	110	90	135	110	135	195	195
Rated speed (rpm)	1500	2000	1500	1500	2000	1500	2000	2000	1500	2000
Rated voltage (V)	380	380	380	380	380	380	380	380	380	380
Rated frequency (Hz)	100	133.33	100	100	133.33	100	133.33	133.33	100	133.33

Motor model	ISMG1-*******-A331FA									
	95C15CD	12D20CD	14D15CD	17D15CD	18D20CD	22D15CD	23D20CD	28D20CD	30D15CD	41D20CD
Torque coefficient (N·m/A)	3.44	2.46	3.27	3.27	2.62	3.44	2.46	2.46	3.27	2.62
Maximum speed (rpm)	2500	3000	2500	2500	3000	2500	3000	3000	2500	3000
Maximum torque (N·m)	135	135	203	248	203	311	248	311	405	405
Maximum current (A)	43.2	60.4	68.3	83.4	85.2	99.4	110.9	139.1	136.2	170
Rotor moment of inertia (kg·cm^2)	75	75	90	105	90	120	105	120	150	150
Weight (kg)	45.2	45.2	51.9	59	51.9	66	59	66	79.8	79.8

Note

- Motor models in the preceding table are named based on S4 duty.
- [1] Indicates parameters under S1 duty. S1 (IEC 60034-1): continuous duty The duty type S1 is defined as operation at a constant load maintained for sufficient time to allow the machine to reach thermal equilibrium.
- [2] Indicates parameters under S4 duty. 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.
- Note: For other motor specifications and models, contact Inovance sales staff.

- **Brake motor**

  When determining the length of the motor brake cable, take the voltage drop caused by cable resistance into account. The input voltage must be at least 21.6 V to enable the brake to work properly.

  For performance specifications of ISMG brake motors, see *"Table 4–2 ISMG1 brake-less motor specifications" on page 69*. The brake specifications are as follows.

Table 4–3 ISMG1 brake specifications

Motor model	Holding torque (N·m)	Supply voltage (VDC) ±10%	Rated power (W)	Coil resistance (Ω) at 20°C ±5%	Exciting current (A) at 20°C ±10%	Apply time (ms)	Release time (ms)	Backlash (°)
ISMG1-95C15CD-A334FA	150	24	70	8.2	2.9	225	301	0.3 to 0.5
ISMG1-12D20CD-A334FA								
ISMG1-14D15CD-A334FA								
ISMG1-17D15CD-A334FA								
ISMG1-18D20CD-A334FA								
ISMG1-22D15CD-A334FA								
ISMG1-23D20CD-A334FA								
ISMG1-28D20CD-A334FA								
ISMG1-30D15CD-A334FA								
ISMG1-41D20CD-A334FA								

ISMG2 motor

Table 4–4 ISMG2 motor

Motor model	ISMG2-*******-A331FA					
	31D15CD	42D20CD	42D15CD	52D15CD	57D20CD	60D15CD
Rated power (S1)[1](kW)	26.7	35.6	36.1	44.8	48.2	53.4
Rated power (S4)[2](kW)	31.4	41.9	42.4	52.6	56.5	60.5
Rated current (S1)[1](A)	49.4	69.1	70.3	87.2	87.8	98.8
Rated current (S4)[2](A)	61.7	86.6	87.7	104.4	109.3	118.8
Rated torque (S1)[1](N·m)	170	170	230	285	230	340
Rated torque (S4)[2](N·m)	200	200	270	335	270	385
Rated speed (rpm)	1500	2000	1500	1500	2000	1500
Rated voltage (V)	380	380	380	380	380	380
Rated frequency (Hz)	100	133.33	100	100	133.33	100
Torque coefficient (N·m/A)	3.44	2.46	3.27	3.27	2.62	3.44
Maximum speed (rpm)	2500	3000	2500	2500	3000	2500
Maximum torque (N·m)	330	330	440	550	440	660
Maximum current (A)	117	163.7	166.5	206.2	207.8	233.8
Rotor moment of inertia ($kg\cdot cm^2$)	296	296	368	434	368	500
Weight (kg)	122	122	141.3	158.4	141.3	175.4

Note

- Motor models in the preceding table are named based on S4 duty.
- [1] Indicates parameters under S1 duty. S1 (IEC 60034-1): continuous duty The duty type S1 is defined as operation at a constant load maintained for sufficient time to allow the machine to reach thermal equilibrium.
- [2] Indicates parameters under S4 duty. 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.
- Note: For other motor specifications and models, contact Inovance sales staff.

5 Options

5.1 Applicable Cables

5.1.1 Model description

Power cable

S6-L-M 0 0 0 - 3.0 – T
① ②③④ ⑤ ⑥

① **Cable type** S6-L-B/M: motion control power cable B: with brake M: without brake	③ **Flange size** 0: Flange size 25/40/60/80 1: Flange size 25/100/130/180 2: Flange size 180	⑤ **Cable length (m)** 3.0: 3 m 5.0: 5 m 10.0: 10 m
② **Connector type at drive side** 0: U-shaped cable lug 1: Needle-shaped cable lug	④ **Connector type at motor side** 0: 6-core plastic connector 1: 9-core aviation connector 2: 6-core aviation connector 7: SDC-06T series aviation connector (front outlet) 8: SDC-06T series aviation connector (rear outlet)	⑥ **Special requirements** T: Drag chain TS: Shielded flexible cable

For related power cables, see *“ Power cable for MS1 series motors” on page 74* and *“ Power cable for ISMG series motors” on page 76*.

Model of encoder cables

S6-L-P 0 0 0 - 3.0 - T
① ②③④ ⑤ ⑥

① **Cable type** S6-L-P: Motion control encoder cable	③ **Encoder** 1: Communication-type incremental encoder 2: Communication-type multi-turn absolute encoder	⑤ **Cable length (m)** 3.0: 3 m 5.0: 5 m 10.0: 10 m
② **Connector type at drive side** 0: DB9 1: USB	④ **Connector type at motor side** 0: 9-core plastic connector 1: 9-core aviation connector 4: SDC-06T series aviation connector (front outlet) 5: SDC-06T series aviation connector (rear outlet)	⑥ **Special requirements** T: Drag chain TS: Shielded flexible cable

For related encoder cables, see *“ MS1 series motor encoder cables” on page 76* and *“ ISMG series motor encoder cable” on page 77*.

Model number of communication cables

S6N-L-T 00 - 3.0
① ② ③

① Cable type	② Cable type	③ Cable Length (m)
S6-L-T: Motion control communication cable S6N-L-T: IS620F motion control encoder cable (only for servo drive PC communication cable)	00: Servo drive PC communication cable 01: Servo drive network communication cable (CAN&485) 02: Servo drive and PLC communication cable 03: Servo drive termination resistor cable (CAN&485) 04: Servo drive network communication cable (EtherCAT)	3.0: 3 m 5.0: 5 m 10.0: 10 m

For related communication cables, see *" Communication cables" on page 78*.

5.1.2 Cable Type

Regular cables

Do not bend or move regular cables during use. Bending or moving regular cables may damage the cables and lead to a series of cable-related faults such as poor contact. Secure regular cables by binding them with ties or similar. During binding, reserve certain bending radius for the cables to prevent stress.

Flexible cables

Flexible cables can move along with the drag chain without a high risk of abrasion.

Note

- Do not twist or wind the cables in the drag chain.
- Ensure cables can move freely within the bending radius. Relative movement must be allowed between cables or between cables and the guiding device.
- Cables in the drag chain can be fixed or bundled through the two unmovable ends of the drag chain.

Oil-resistant cables

Oil-resistant cables apply to applications requiring shielded power cables, such as machine tools, cutting fluids, and cutting compounds.

More information

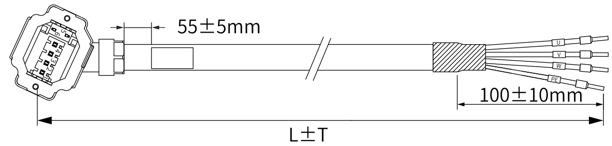
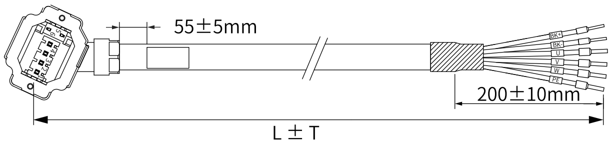
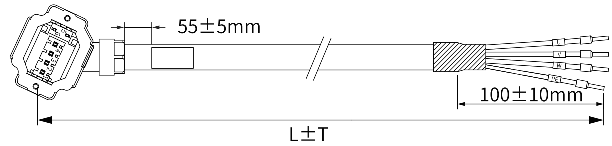
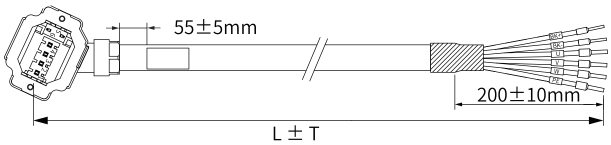
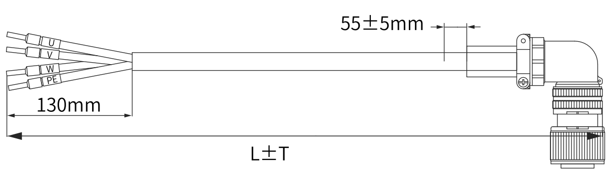
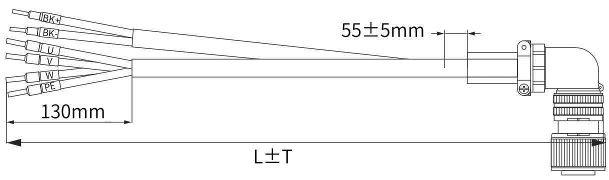
Cables of MS1–R series motors are the same as MS1–Z series motors.

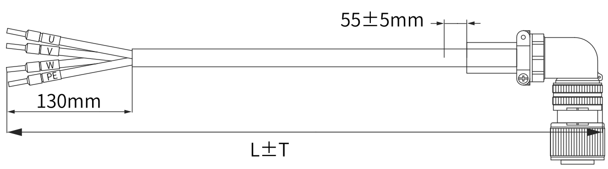
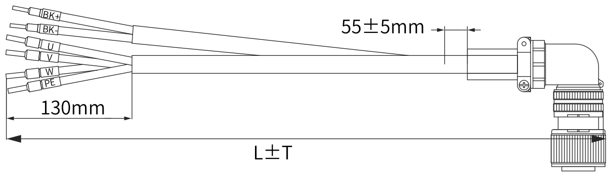
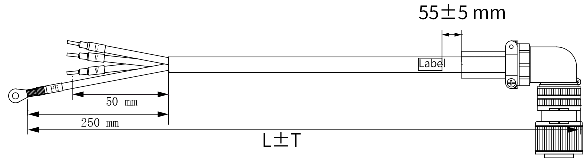
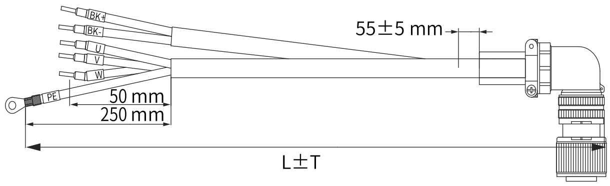
Power cables and encoder cables for terminal-type motors must be installed with specialized devices and jigs. Order the finished cables from distributors authorized by Inovance.

For more cable information, see "Cable Specifications and Models" in the hardware manual for the servo drive.

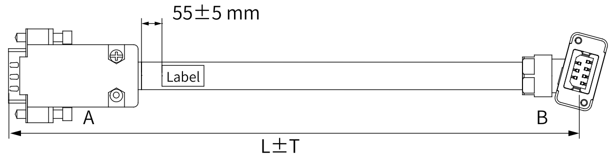
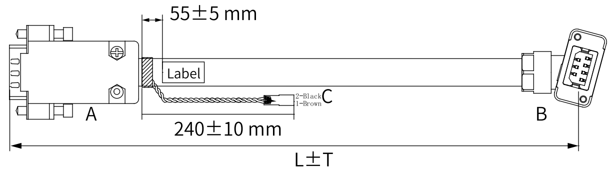
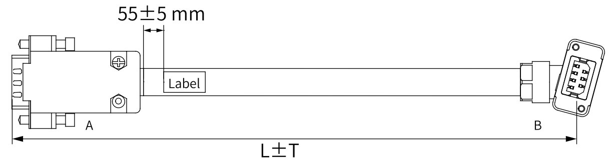
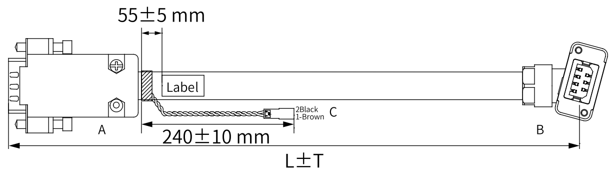
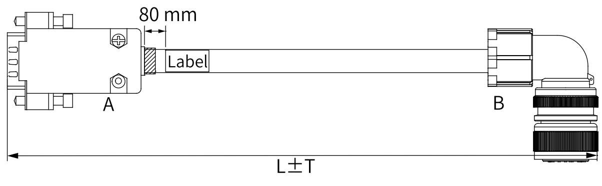
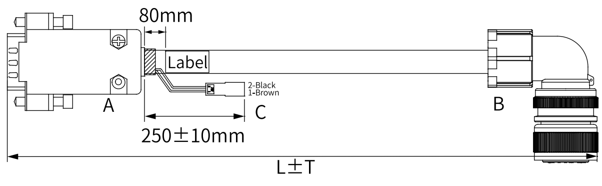
5.1.3 Cable Selection

Power cable for MS1 series motors

Motor model	Cable name		Cable model	Cable length (mm)	Tolerance (T) (mm)	Drawing
MS1H1/MS1H4 motor	Front outlet	Brake-less	S6-L-M107-3.0	3000	(-30.30)	
			S6-L-M107-5.0	5000	(-30.50)	
			S6-L-M107-10.0	10000	(-30.80)	
		Brake	S6-L-B107-3.0	3000	(-30.30)	
			S6-L-B107-5.0	5000	(-30.50)	
			S6-L-B107-10.0	10000	(-30.80)	
	Rear outlet	Brake-less	S6-L-M108-3.0	3000	(-30.30)	
			S6-L-M108-5.0	5000	(-30.50)	
			S6-L-M108-10.0	10000	(-30.80)	
		Brake	S6-L-B108-3.0	3000	(-30.30)	
			S6-L-B108-5.0	5000	(-30.50)	
			S6-L-B108-10.0	10000	(-30.80)	
MS1H2 motors of 3 kW and below, MS1H2 motors of 4 kW/5 kW, and MS1H3 motors of 1.8 kW and below	Brake-less		S6-L-M111-3.0	3000	(-30.30)	
			S6-L-M111-5.0	5000	(-30.50)	
			S6-L-M111-10.0	10000	(-30.80)	
	Brake		S6-L-B111-3.0	3000	(-30.30)	
			S6-L-B111-5.0	5000	(-30.50)	
			S6-L-B111-10.0	10000	(-30.80)	

Motor model	Cable name	Cable model	Cable length (mm)	Tolerance (T) (mm)	Drawing
MS1H3 motors (2.9 kW)	Brake-less	S6-L-M112-3.0	3000	(-30.30)	
		S6-L-M112-5.0	5000	(-30.50)	
		S6-L-M112-10.0	10000	(-30.80)	
	Brake	S6-L-B112-3.0	3000	(-30.30)	
		S6-L-B112-5.0	5000	(-30.50)	
		S6-L-B112-10.0	10000	(-30.80)	
MS1H3 (4.4 kW and above)	Brake-less	S6-L-M122-3.0	3000	(-30.30)	
		S6-L-M122-5.0	5000	(-30.50)	
		S6-L-M122-10.0	10000	(-30.80)	
	Brake	S6-L-B122-3.0	3000	(-30.30)	
		S6-L-B122-5.0	5000	(-30.50)	
		S6-L-B122-10.0	10000	(-30.80)	

MS1 series motor encoder cables

Motor model		Cable name	Cable model	Cable length (mm)	Tolerance (T) (mm)	Drawing
MS1H1/ MS1H4 motor	Front outlet	Single-turn absolute encoder cable	S6-L-P014-3.0	3000	(-30.30)	
			S6-L-P014-5.0	5000	(-30.50)	
			S6-L-P014-10.0	10000	(-30.80)	
		Multi-turn absolute encoder cable	S6-L-P024-3.0	3000	(-30.30)	
			S6-L-P024-5.0	5000	(-30.50)	
			S6-L-P024-10.0	10000	(-30.80)	
	Rear outlet	Single-turn absolute encoder cable	S6-L-P015-3.0	3000	(-30.30)	
			S6-L-P015-5.0	5000	(-30.50)	
			S6-L-P015-10.0	10000	(-30.80)	
		Multi-turn absolute encoder cable	S6-L-P025-3.0	3000	(-30.30)	
			S6-L-P025-5.0	5000	(-30.50)	
			S6-L-P025-10.0	10000	(-30.80)	
MS1H2/MS1H3 motor		Single-turn absolute encoder cable	S6-L-P011-3.0	3000	(-30.30)	
			S6-L-P011-5.0	5000	(-30.50)	
			S6-L-P011-10.0	10000	(-30.80)	
		Multi-turn absolute encoder cable	S6-L-P021-3.0	3000	(-30.30)	
			S6-L-P021-5.0	5000	(-30.50)	
			S6-L-P021-10.0	10000	(-30.80)	

Power cable for ISMG series motors

Inovance does not provide power cables for ISMG series motors. You can select the power cables based on the power cable specifications provided by Inovance.

Table 5–1 Recommended power cable specifications

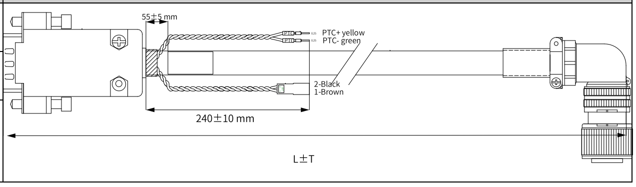
Brake-less motor model	Brake motor model	Rated current (*) (A)	Rated torque (*) (N·m)	AWG specification	Cross sectional area of the cable (mm^2)
ISMG1-95C15CD-A331FA	ISMG1-95C15CD-A334FA	14.5 (18.5)	50 (60)	18	7.8±0.2
ISMG1-11D30CD-A331FA-GL	ISMG1-11D30CD-A334FA-GL	20.3 (26)	35 (41)	16	9.5±0.4

Brake-less motor model	Brake motor model	Rated current (*) (A)	Rated torque (*) (N·m)	AWG specification	Cross sectional area of the cable (mm^2)
ISMG1-11D30CD-A311FA-GL	-	20.3 (25.78)	35 (41)	16	9.5±0.4
ISMG1-11D30CD-A3A1L-GL	-	21.3 (27.05)	35 (41)	16	9.5±0.4
ISMG1-12D20CD-A331FA	ISMG1-12D20CD-A334FA	20.3 (26)	50 (60)	16	9.5±0.4
ISMG1-12D30CD-A331FA-GL	-	24.3 (30.86)	37.5 (43.9)	14	10.5±0.3
ISMG1-14D15CD-A331FA	ISMG1-14D15CD-A334FA	22.9 (29.2)	75 (90)	14	10.5±0.3
ISMG1-17D15CD-A331FA	ISMG1-17D15CD-A334FA	28.1 (35.7)	92 (110)	12	12.2±0.4
ISMG1-17D33CD-A3A1F-GL	-	30 (38.1)	50 (58.5)	12	12.2±0.4
ISMG1-18D20CD-A331FA	ISMG1-18D20CD-A334FA	28.6 (36.4)	75 (90)	12	12.2±0.4
ISMG1-45D30CD-A3A1L-GL	-	87.4 (111)	143.4 (167.8)	6	-
ISMG2-52D15CD-A331FA	-	87.2 (104.4)	285 (335)	6	-
ISMG2-57D20CD-A331FA	-	87.8 (109.3)	230 (270)	6	-
ISMG2-60D15CD-A331FA	-	98.8 (118.8)	340 (385)	6	-
ISMG2-92D38CD-A3B1L-GL	-	122 (154.94)	233 (272.6)	4	-

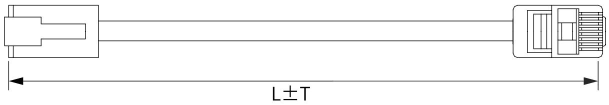
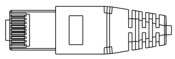
Note

- The rated current and rated torque in S1 duty apply by default. The asterisk symbol (*) represents the rated current and rated torque under S4 duty.
- The cable specifications in S1 duty are the same as those in S4 duty.

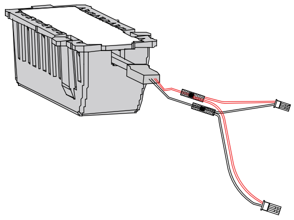
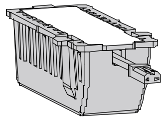
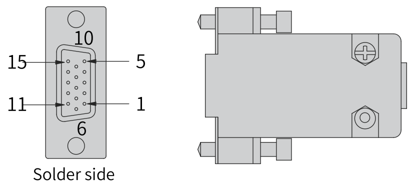
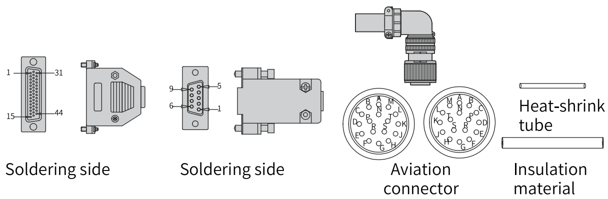
ISMG series motor encoder cable

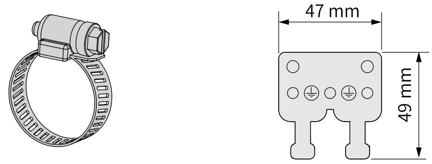
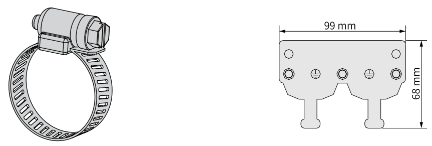
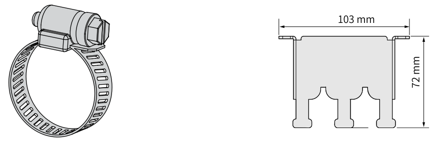
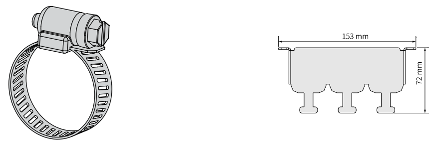
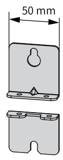
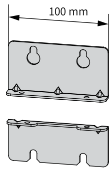
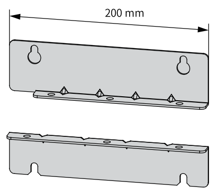
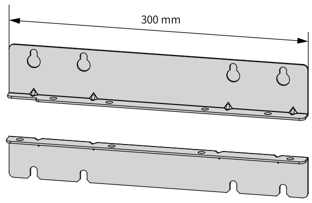
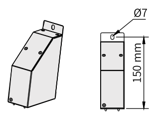
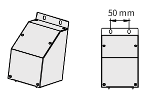
Motor model	Cable model	Cable length (mm)	Tolerance (T) (mm)	Drawing
ISMG1(G2)-*******-A3***	S6-L-P021-3.0-PTC	3000	(-30.30)	
		5000	(-30.30)	
		10000	(-30.30)	

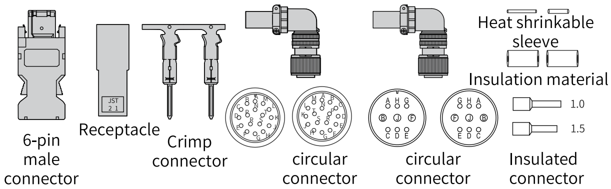
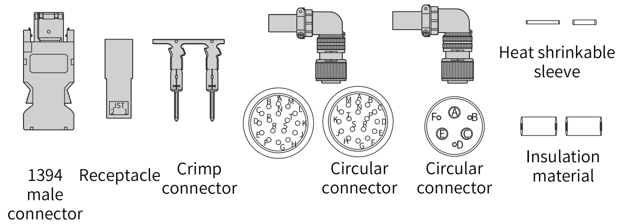
Communication cables

Cable Name	Cable Model	Cable Length (mm)	Tolerance (T) (mm)	Drawing
Servo drive to PC communication cable	S6-L-T04-0.3	300	(-10,10)	
Multi-drive communication cable	S6-L-T04-3.0	3000	(-10.10)	
Servo drive to host controller communication cable				
Servo drive termination resistor connector	S6-L-T03-0.0	-	-	

Connector Kit

Name	Model	Outline Drawing
Dual-axis battery kit	S6-C9A	
Single-axis battery kit	S6-C4A	
CN5/CN7 terminal (DB15)	S6-C6	
ISMG-DB9 terminal 20-29 aviation connector	S6-C5	

Name	Model	Outline Drawing
Shield bracket (hose clamp included)	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)	
Air guide plate	MD810-DLB-W1(SIZE 1 air guide plate)	
	MD810-DLB-W2(SIZE 2 air guide plate)	

Name	Model	Outline Drawing
MS1H2/MS1H3 (1.8 kW and below) motor connectors	S6-C29	
MS1H3 (2.9 kW and above) motor connectors	S6-C39	

Note

[1] The shield bracket (with hose clamp) are included in the standard configuration of drives in size-1 and size-2.

5.2 Absolute Encoder Batteries

Selecting the battery box model

Select an appropriate battery according to the following table.

Table 5–2 Description of the absolute encoder battery

Specification	Item	Rating of single-axis			Rating of dual-axis			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 the standby mode
	Battery alarm voltage (V)	2.85	3	3.15	2.85	3	3.15	-
	Current consumed by the circuit (uA)	-	2	-	-	4	-	In the normal operation mode[2]
		-	10	-	-	20	-	In the standby mode, the axis is at a standstill.
		-	80	-	-	160	-	Shaft rotating in standby state
	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.

Design life of the battery

The following formula considers only the current consumed by the encoder and does not cover the current consumed by the battery itself.

Assume that the drive works normally for T1 in a day, the motor rotates for T2 after the drive is powered off, and the motor stops rotating for T3 after power-off [unit: hour (H)].

Example:

Table 5–3 Design life of the absolute encoder battery

Item	Schedule 1	Schedule 2
Working Days in Different Operating Conditions in One Year	313	52
T1 (h)	8	0
T2 (h)	0.1	0
T3 (h)	15.9	24

Capacity consumed in 1 year = (8 h x 2 uA + 0.1 h x 80 uA + 15.9 h x 10 uA) x 313 + (0 h x 2 uA + 0 h x 80 uA +24 h x 10 uA) x 52 ≈ 70 mAh

Design life = Battery capacity/Capacity consumed in 1 year = 2600 mAh/70 mAh = 37.1 years

For dual-axis drives, the design life of the battery is 18.6 years (37.1/2) as the current is doubled during operation of two axes.

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 electrical 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 motor. 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. See the dimensions of the packing box in *"Table 6–1" on page 82*. The deliverables include the product, cushion, carton box, and screw bag, as shown in *"Figure 6–1" on page 82* .
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 (unit: mm)

Size	Outer width (mm)	Outer height (mm)	Gross 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

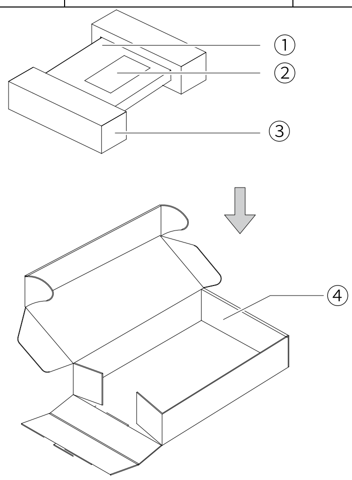


Figure 6-1 Contents inside the packing box

No.	Name
①	AC drive
②	Terminal accessory kit
③	Cushion
④	Carton

6.1 Installation environment

Mounting location

- Service life of the drive is closely related to the ambient temperature. The ambient temperature must be within the allowable temperature range (0°C to +50°C).
- Altitude: When the installation altitude exceeds 1000 m, the drive must be derated according to the recommended capacitance.
- Mounting surface: The installation surface of the drive must be flame retardant, with the surface strength meeting the strength requirements for proper transportation, storage, and operation under normal conditions. This is to prevent the drive from being damaged due to vibration or deformation of the mounting surface. The mounting surface must be perpendicular to the floor and fixed to the cabinet properly. The load-carrying mounting surface must be fourfold the total weight of the equipment at least.
- Heat dissipation: The drive cabinet generates a large amount of heat during operation, requiring a plenty of room in the installation area for heat dissipation. Ensure that the cooling holes in the drive cabinet are not blocked.
- Vibration: Install the drive in a place without vibration. The vibration acceleration must be lower than or equal to 0.6 g. Keep the drive away from equipment which may generate strong vibration, such as punch presses.
- Other requirements: Install the drive in an environment free from: 1. direct sunlight, moisture and water drops 2. corrosive, inflammable or explosive gases; and 3. greasy dirt and dust.
- The drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations and relevant IEC standards.

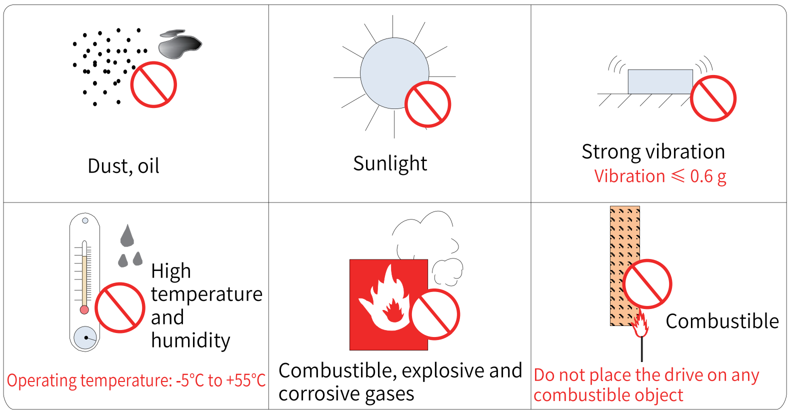


Figure 6-2 Environment requirements

Environment requirements

Table 6–2 Installation environment

Item	Description
Ambient temperature	0°C to 40°C, with temperature change rate lower than 0.5°C/min (Derating is required for temperatures above 40°C. For temperatures above 40°C and lower than 50°C (maximum temperature), derate 1.5% for every additional 1°C.) Storage temperature: –25°C to +70°C Transportation temperature: –25°C to +70°C
Relative ambient humidity	5% to 90% (The standard drive models cannot be used in environments with corrosive gas.) For environments with corrosive gas, use industry-tailored drives with corrosion-proof enclosure. Relative storage humidity: 5% to 90% Relative humidity for transportation: lower than 90% at 40 °C
IP rating	IP20
Altitude	1000 m (For altitudes higher than 1000 m and lower than 3000 m (maximum altitude), derate 1% for every additional 100 m.)

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 clearance around the drive unit to ensure proper heat dissipation. Install the cooling fan onto the top of the drive to avoid excessive temperature rise in a certain region, keeping an even temperature inside the cabinet.

6.2 Installing the Power Supply Unit

For how to install the power supply unit, visit *http://www.inovance.com* to download user guides for MD810.

6.2.1 Installation Dimensions

The power supply unit can be classified into the vertical type and booksize type with equal width and height. The booksize drive unit variants come with a width of 50 mm, 100 mm, 200 mm, and 300 mm respectively, and the vertical drive unit comes with a width of 180 mm. The power supply units are all booksize type, except the 355 kW power supply units which is vertical type.

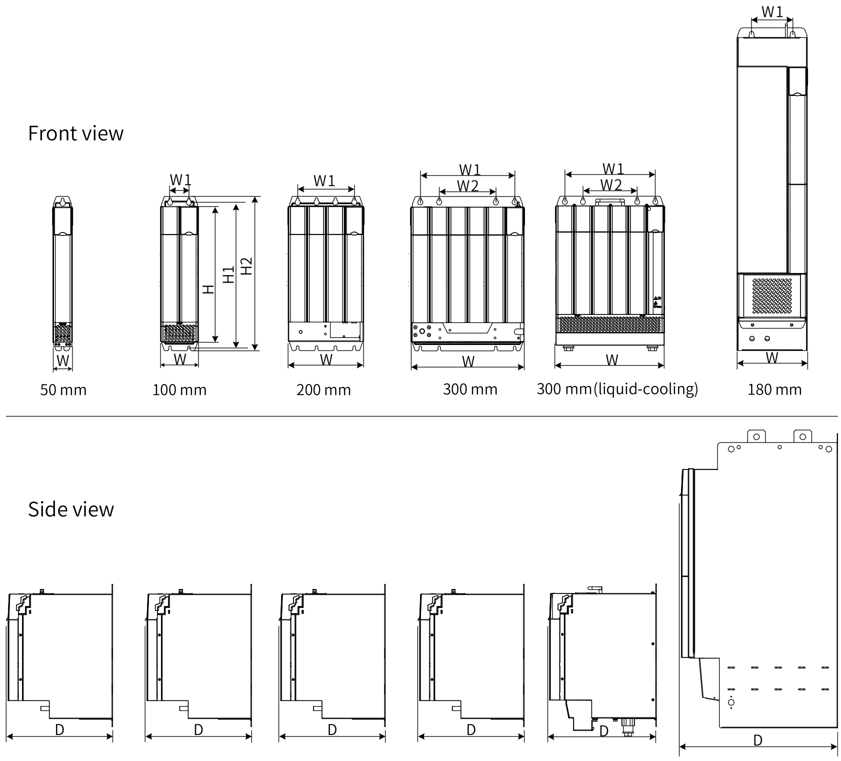


Figure 6-3 Layout and dimension of the power supply unit

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

6.2.2 Installation clearance

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

Table 6–3 Minimum clearance during the installation of the unit

Item	Unit with a width of 100 mm	Unit with a width of 200 mm	Unit with a width of 300 mm	Unit with a width of 180 mm
	Booksize unit			Vertical 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	-

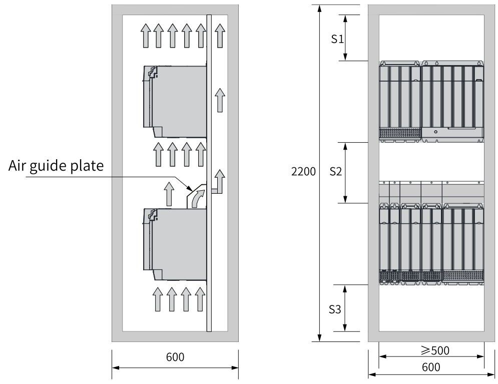


Figure 6-4 Clearance for dual-row installation of booksize power supply units

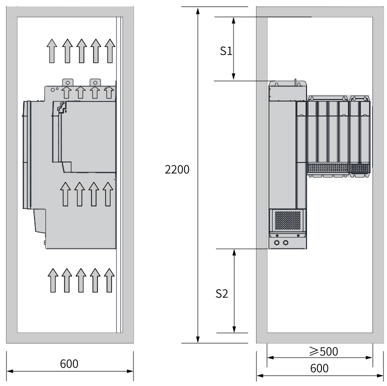


Figure 6-5 Clearance for installing the vertical tower unit

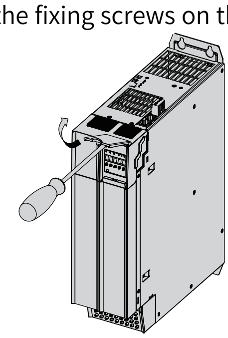
Note

Installation direction: The servo drive must be installed vertically.

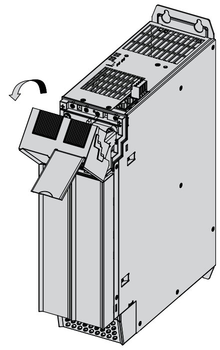
6.2.3 Removing/Installing the Power Supply Unit Cover

Removing the cover

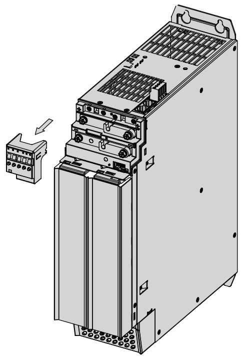
1. Pull up the keypad cover and unscrew the fixing screws on the upper cover.



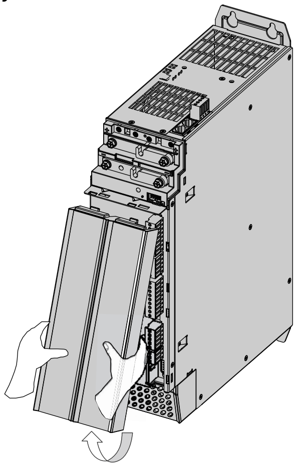
2. Remove the upper cover by turning it forward.



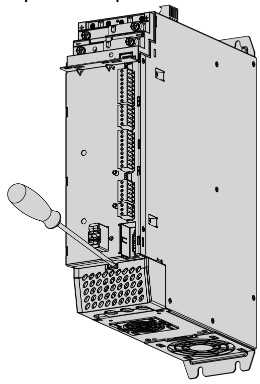
3. Pull the whole keypad box frontward.



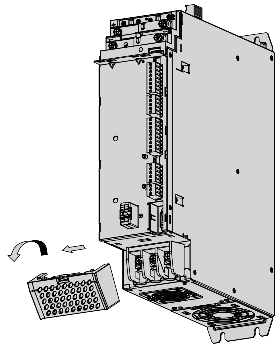
4. Hold the bottom of the lower cover by hands. Remove the lower cover by turning it forward.



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

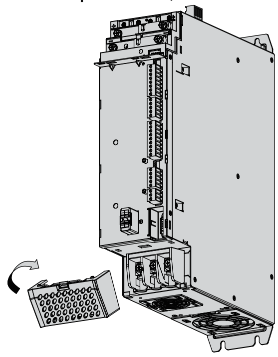


6. Remove the power terminal cover by turning it forward.

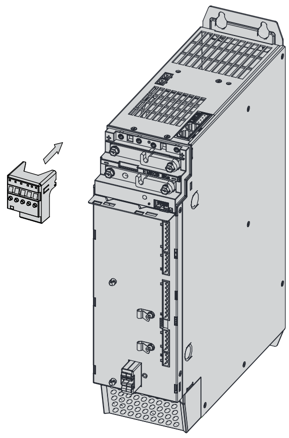


Installing the cover

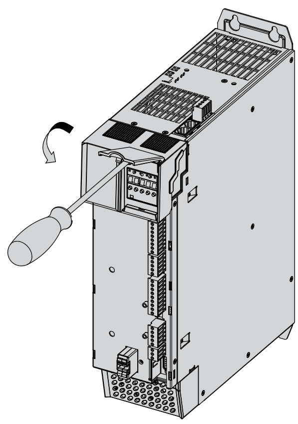
1. Align the power terminal cover with its latch position, and fix it.



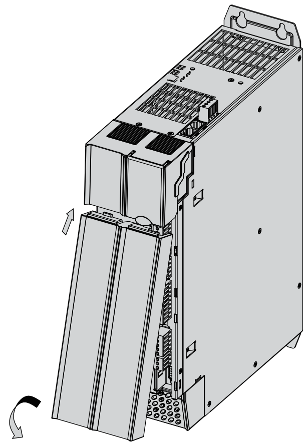
2. Insert the keypad



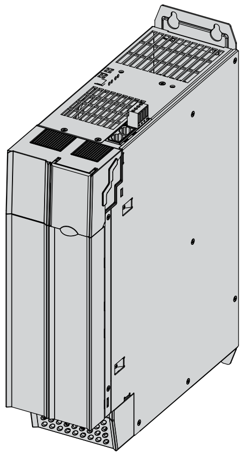
3. Align the upper cover with the position of the clasp. Press the upper cover to fix it. Tighten the fixing screw with a screwdriver.



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



5. The cover has been installed properly.



6.3 Installing the Drive unit

6.3.1 Installation Dimensions

Size-1

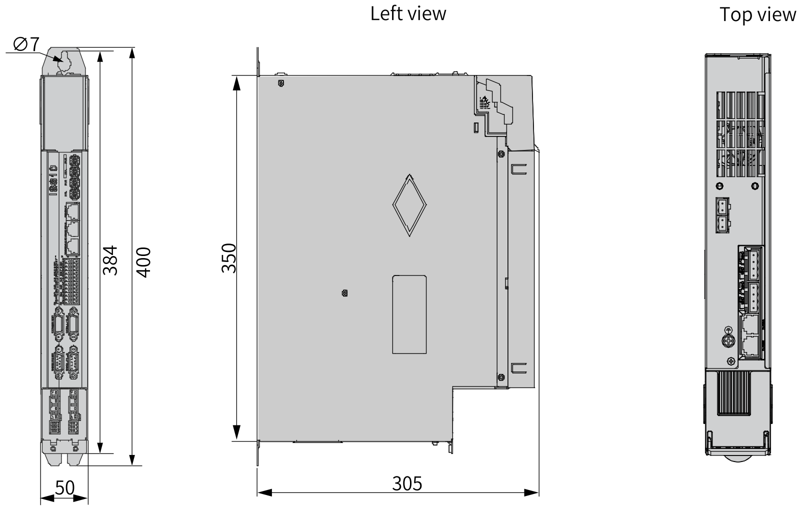


Figure 6-6 Outline dimensions of the size-1 (unit: mm)

Size-2

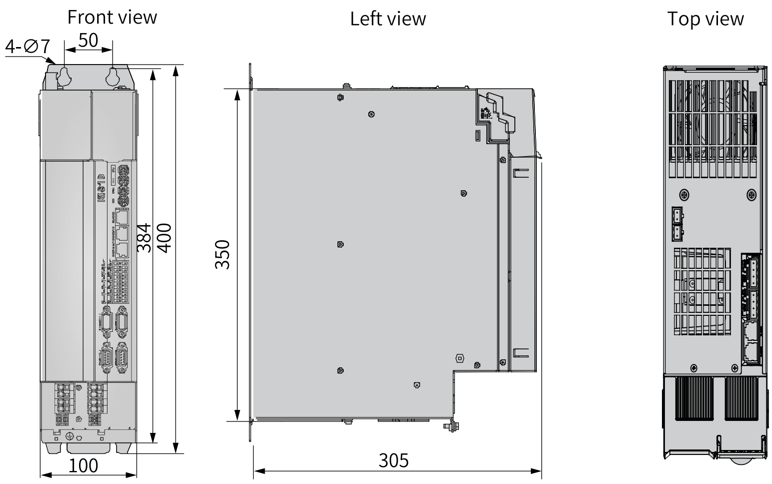


Figure 6-7 Outline dimensions of the size-2 (unit: mm)

Size-3

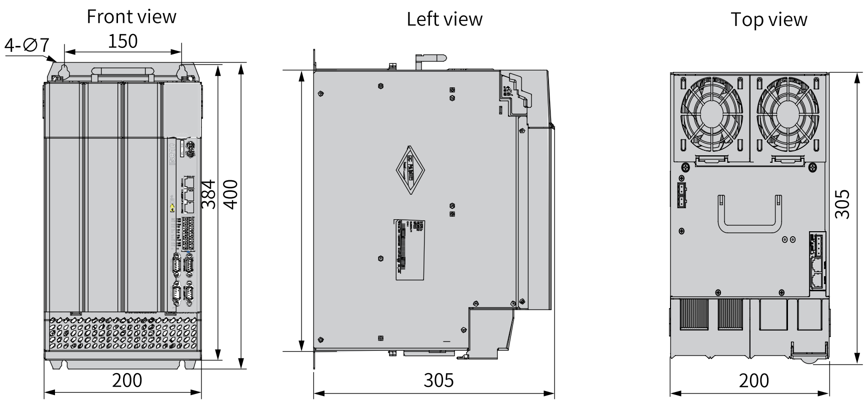


Figure 6-8 Outline dimensions of the size-2 (unit: mm)

Size-4

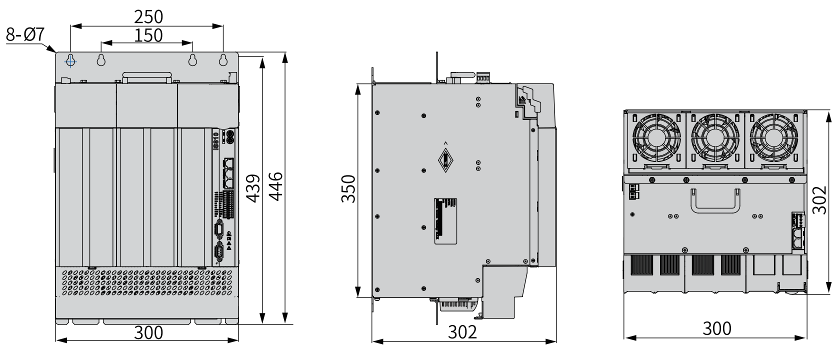
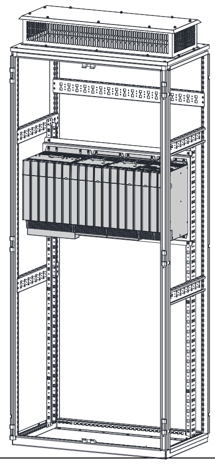
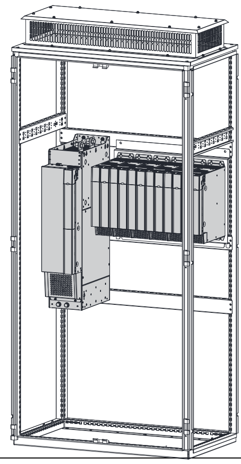


Figure 6-9 Outline dimensions of models in size-4 (unit: mm)

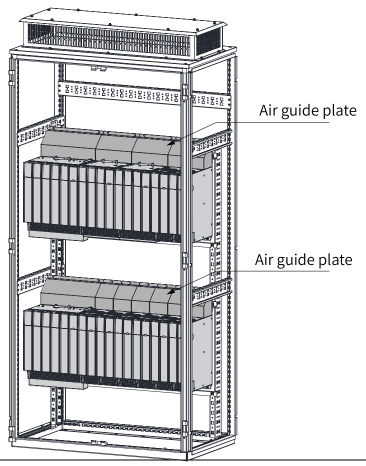
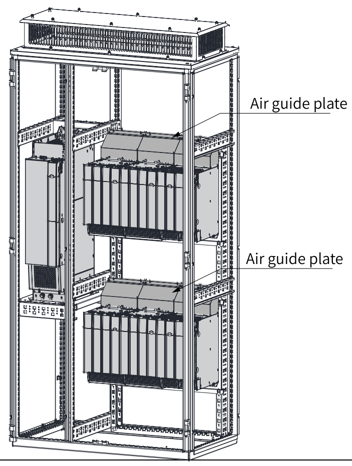
6.3.2 Installation Clearance

The drive supports single-row installation and two-row installation. The booksize unit must be installed closely in a group of at least three units to avoid damage to the product during transportation. During dual-row installation, install an air guide plate in the upper layer. The through-hole mounting method supports single-row installation only.

Single-row installation

Booksize unit	Vertical unit
	

Dual-row installation

Booksize unit	Vertical unit
	

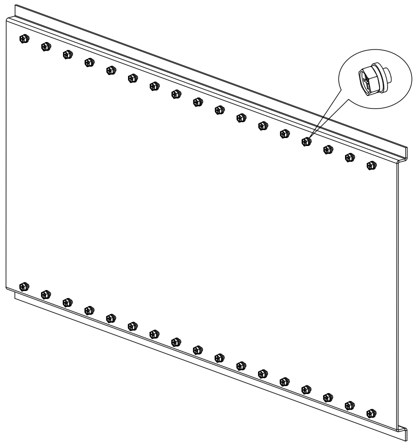
Note

- 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 78*.
- Do not install one or two units independently.
- The through-hole mounting method supports single-row installation only.

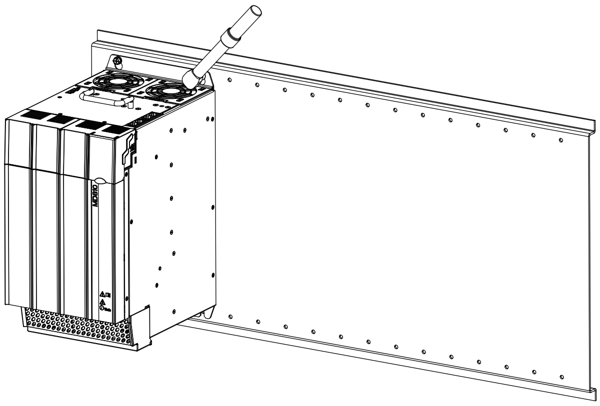
6.4 Installation Procedure

Backplate mounting

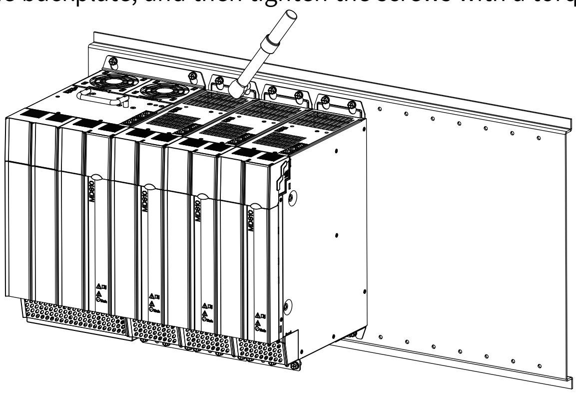
1. Pre-lock the M6x20 screws on the installation backplate with a clearance of about 5 mm between the screws and the backplate.



2. Hang the power supply unit to the pre-lock screws, and then tighten the screws with a torque wrench.

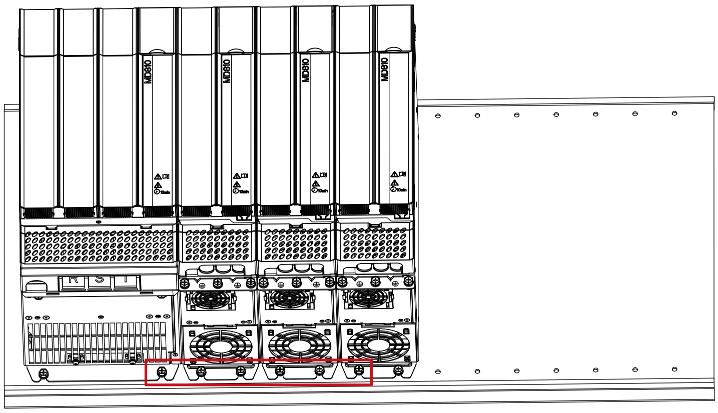


3. Hang the drive unit to the backplate, and then tighten the screws with a torque wrench.

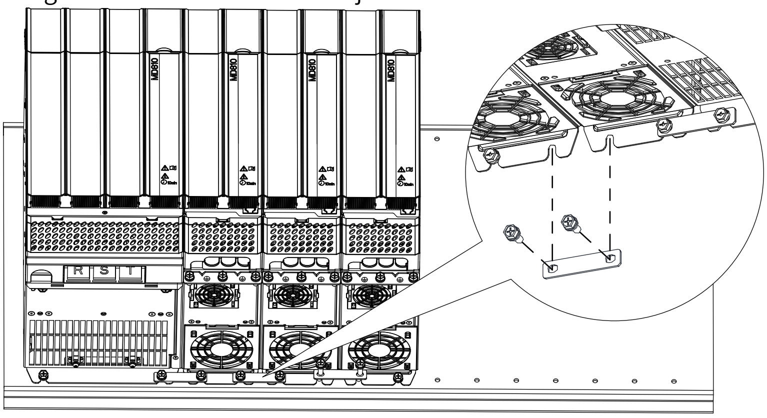


Note

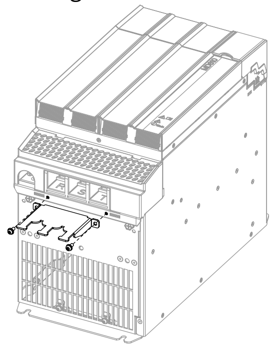
The screws on the lower side of the adjacent units are not locked (as shown in the figure below) for installing the grounding aluminum bar.



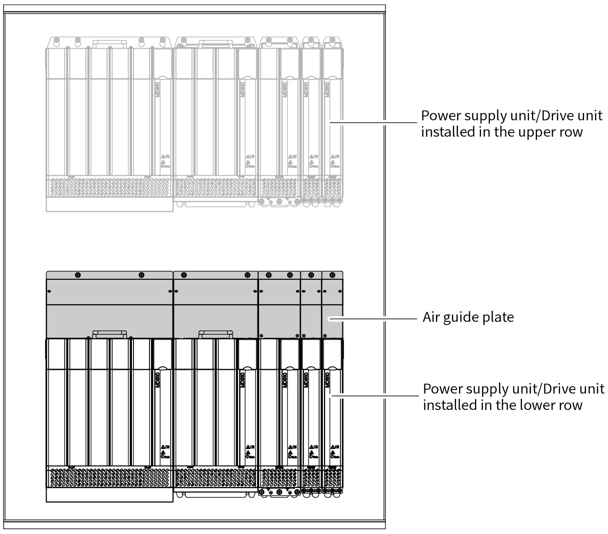
4. Install the grounding aluminum bar between adjacent units.



5. Install the shield bracket (optional). This step can be skipped for standard models as the shield bracket is not included in the standard configuration.



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



Note

For model selection details of preceding options, see " Connector Kit" on page 78.

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

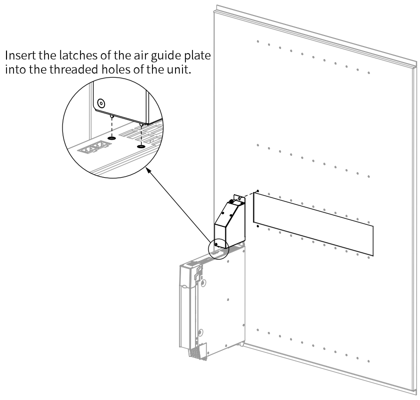


Figure 6-10 Installation of the air guide plate for unit with a width of 50 mm

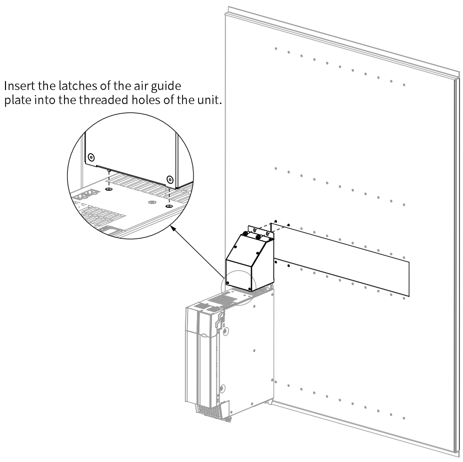


Figure 6-11 Installation of the air guide plate for unit with a width of 100 mm

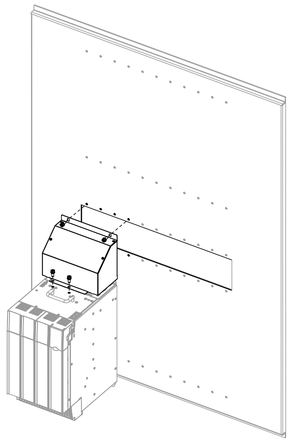


Figure 6-12 Installation of the air guide plate for power supply unit with a width of 200 mm

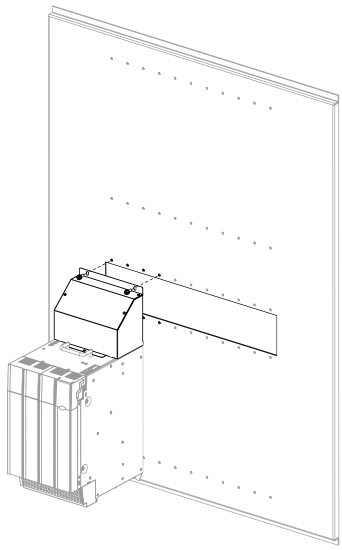


Figure 6-13 Installation of the air guide plate for drive unit with a width of 200 mm

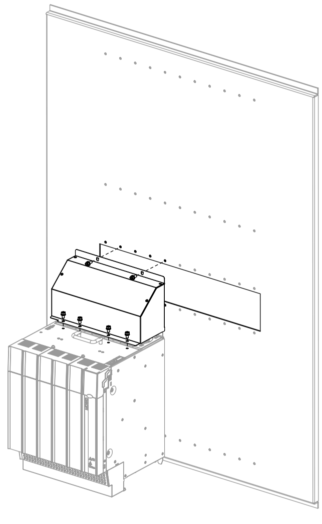
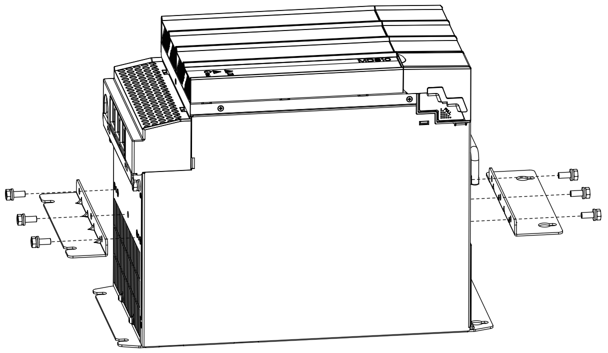


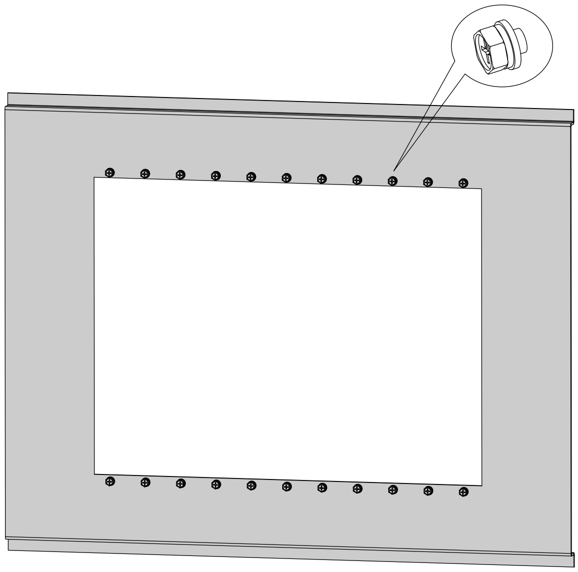
Figure 6-14 Installation of the air guide plate for unit with a width of 300 mm

Through-hole mounting

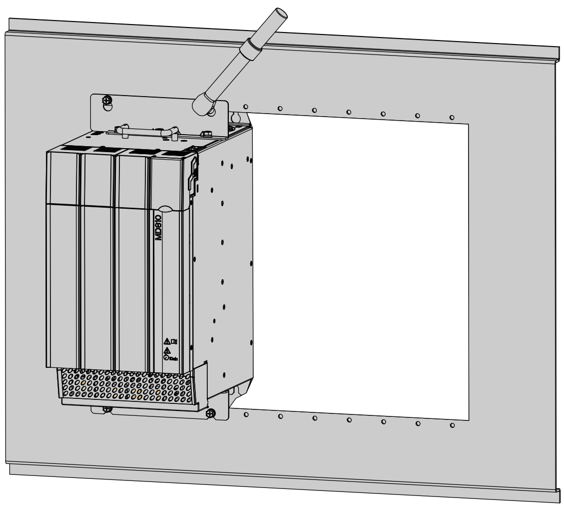
1. Install the optional through-hole mounting bracket.



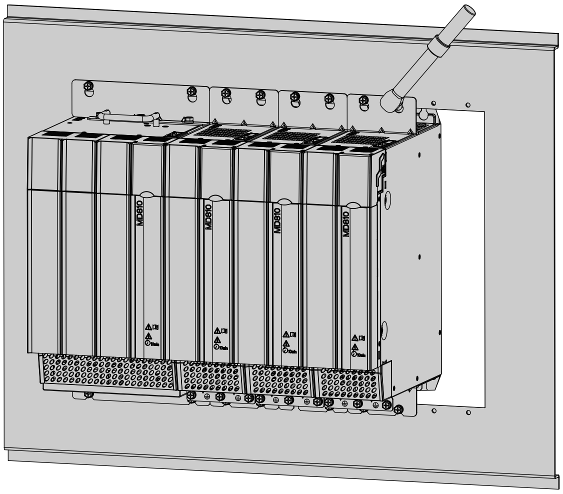
2. Pre-lock the M6x20 screws to the mounting backplate. Leave a clearance of 5 mm between the screws and backplate.



3. Hang the power supply unit to the pre-lock screws on the installation backplate, and then tighten the screws with a torque wrench.

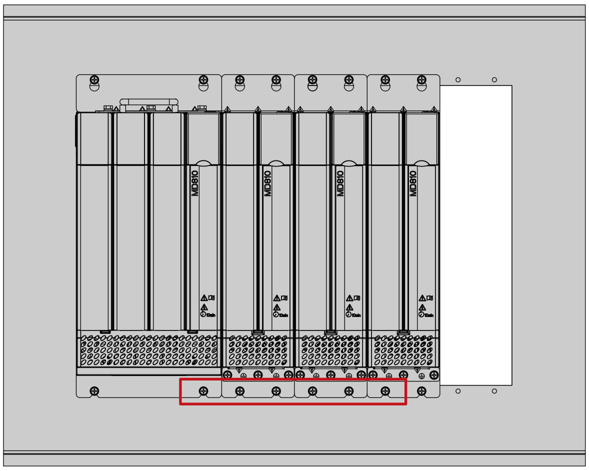


4. Hang the drive unit to the backplate, and then tighten the screw with a torque wrench.

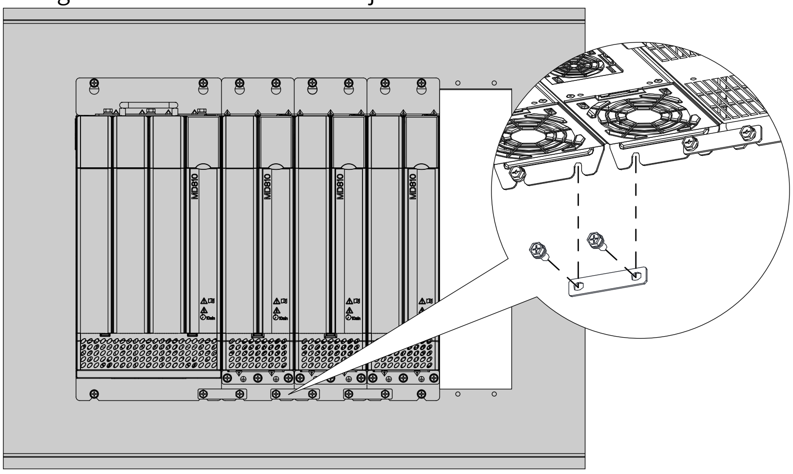


Note

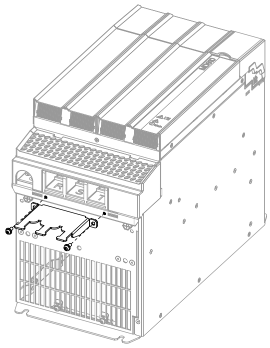
The screws on the lower side of the adjacent units are not locked (as shown in the figure below) for the convenience of installing the grounding aluminum bar.



5. Install the grounding aluminum bar between adjacent units.



6. Install the shield bracket (optional). This step can be skipped for standard models as the shield bracket is not included in the standard configuration.



Note

For model selection details of preceding options, see “Connector Kit” on page 78.

6.5 Installation Instructions

Recommended tightening torque (N.m)

M3	M4	M5	M6	M8	M10	M12
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:

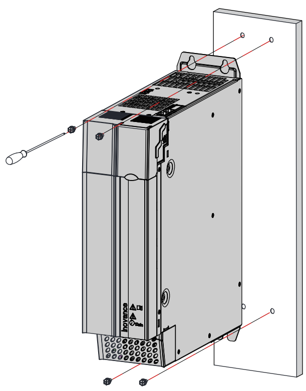


Figure 6-15 Wall-mounted power supply unit

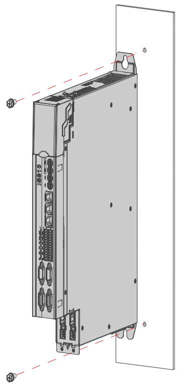


Figure 6-16 Wall-mounted drive unit

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.

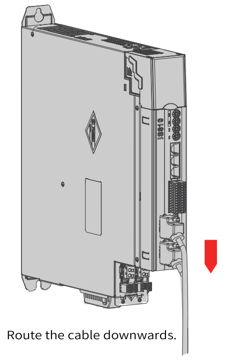


Figure 6-17 Routing direction

7 Wiring

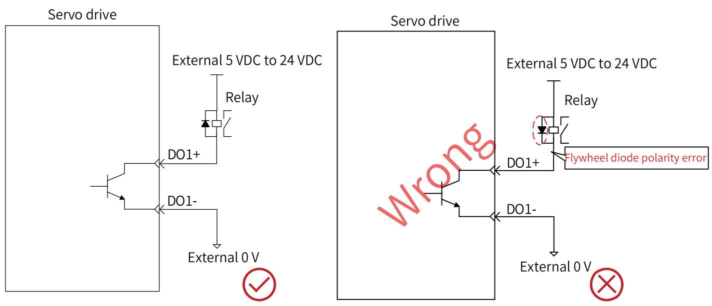
7.1 Wiring Precautions

Danger

- Wiring must be performed by authorized and qualified personnel only.
- To prevent electric shorck, wait for at least 10 min after turning off the power supply to allow the power indicator to turn off. Then measure the voltage between + and - of the busbar with a multimeter. After confirming the voltage is within the safety range, you can perform further operations.
- Perform wiring after the servo drive and motor are installed properly. Failure to comply will result in electric shock.
- Do not damage the cables or subject them to large tension or pressure. 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.

Note

- Carry out wiring correctly. Failure to comply will result in servo motor malfunction or physical injury.
- 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 without involving the electromagnetic contactor. Failure to comply may result in malfunction or faults.
- Connect an 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 high current flows through the product.
- Use the ALM 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.
- Before power-on, check the voltage specifications of the drive. Check whether the input power supply is correct (380 VAC to 480 VAC, 50 Hz/60 Hz).
- Do not reverse the directions of the flywheel diode. Failure to comply will damage the product and affect signal output.
- When connecting DO terminals to relays, pay attention to the polarity of the flywheel diode. Failure to comply may damage the drive and lead to signal output failure.



- 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 that the S-ON signal can be turned off upon power-off of the main circuit 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 cable and encoder cable is 3 m and 20 m respectively.
- 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 inspection only after the CHARGE indicator is off.
- Do not turn on or off the power supply frequently. If frequent ON/OFF operation is needed, the time interval between ON and OFF operations must be at least 10 min.
- As the servo drive carries a capacitor in the power supply, a high charging current will flow through and charge the capacitor for 10s when the power supply is turned ON/OFF. Therefore, frequent ON/OFF operations can deteriorate performance of the main circuit components in the servo drive.
- Observe the following precautions when wiring the main circuit connector:
  - Remove the connectors from the drive during 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.
  - Ensure that voltage of the input power supply 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 caused by static electricity

- Locations with strong electric field or magnetic field
- Locations with radioactive rays
- Locations with power cables around the equipment

7.2 System Wiring Diagram

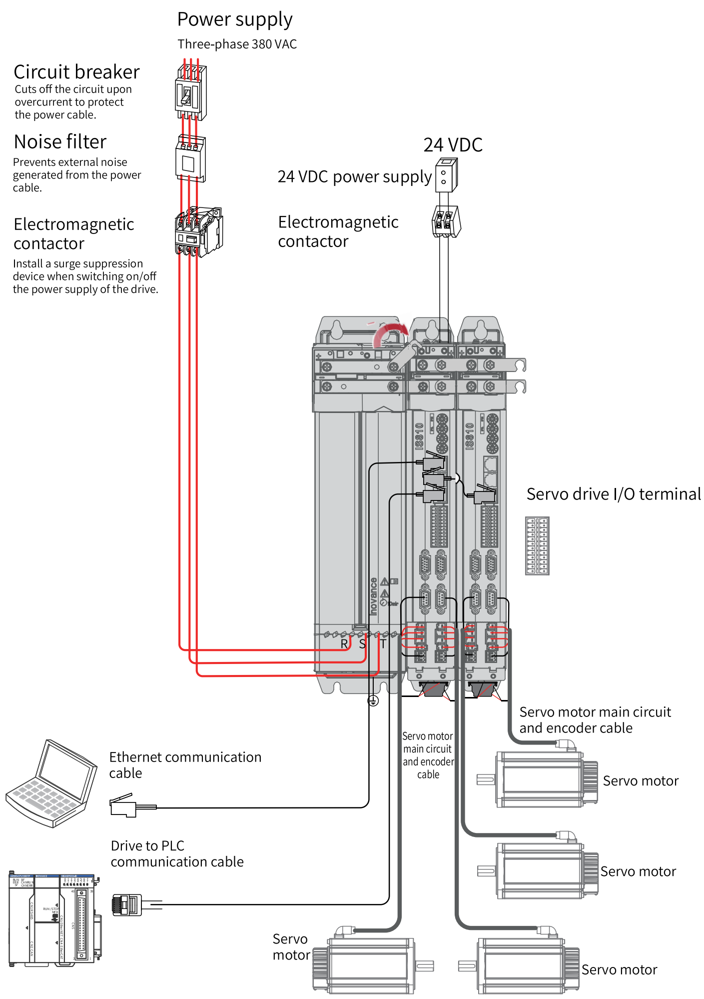


Figure 7-1 Wiring example of a three-phase 380 V system

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. The servo drive is not configured with the built-in protective grounding circuit. For the sake of safety, install a residual current device (RCD) to provide protections against overload and short circuit or a specialized RCD to protect the grounding cable.

Do not use an electromagnetic contactor to start or stop the servo motor. 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

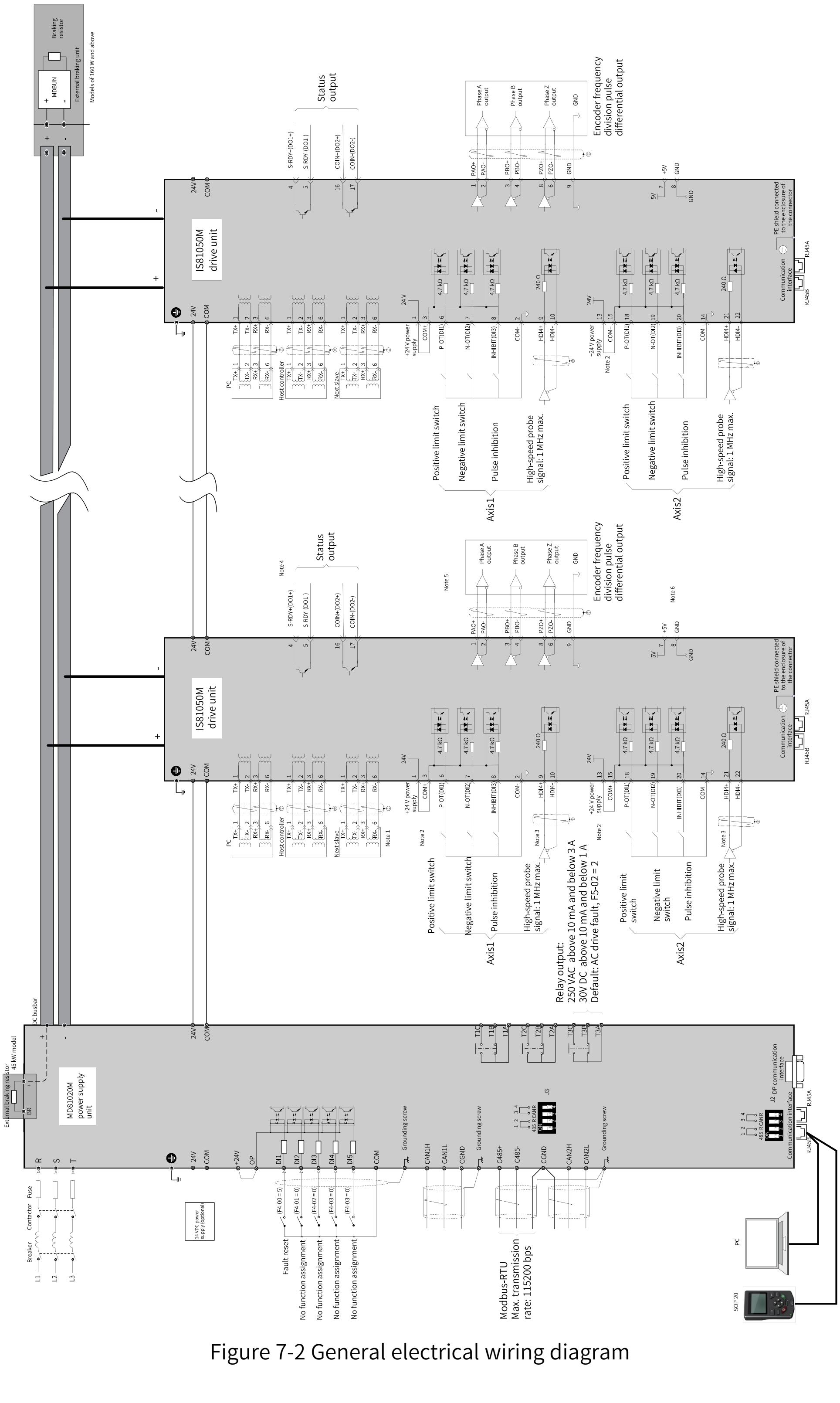


Figure 7-2 General electrical wiring diagram

Note

- [Note 1]: Use double-shielded Cat 5e cables for network interfaces. Straight-through and crossover Ethernet cables are allowable.
- [Note 2]: Internal +24 V power supply: 20 V to 28 V; maximum operating current: 200 mA
- [Note 3]: HDI4 and HDI8 are high-speed DIs. If they are used in low speed applications, increase the values of internal filtering parameters.
- [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 up to 30 VDC voltage and 50 mA current.
- [Note 5]: Use the shielded twisted pairs as the encoder frequency-division output cables, with both ends of the shield tied to PE. Connect GND and signal ground of the host controller reliably.
- [Note 6]: The internal +5 V power supply supports up to 200 mA current.

7.4 Terminals of Power Supply Unit

The drive must be used together with Inovance 810 series power supply unit or 880 series active rectifier unit. For details, visit www.inovance.com to download related user guides.

7.5 Terminals in Drive Unit

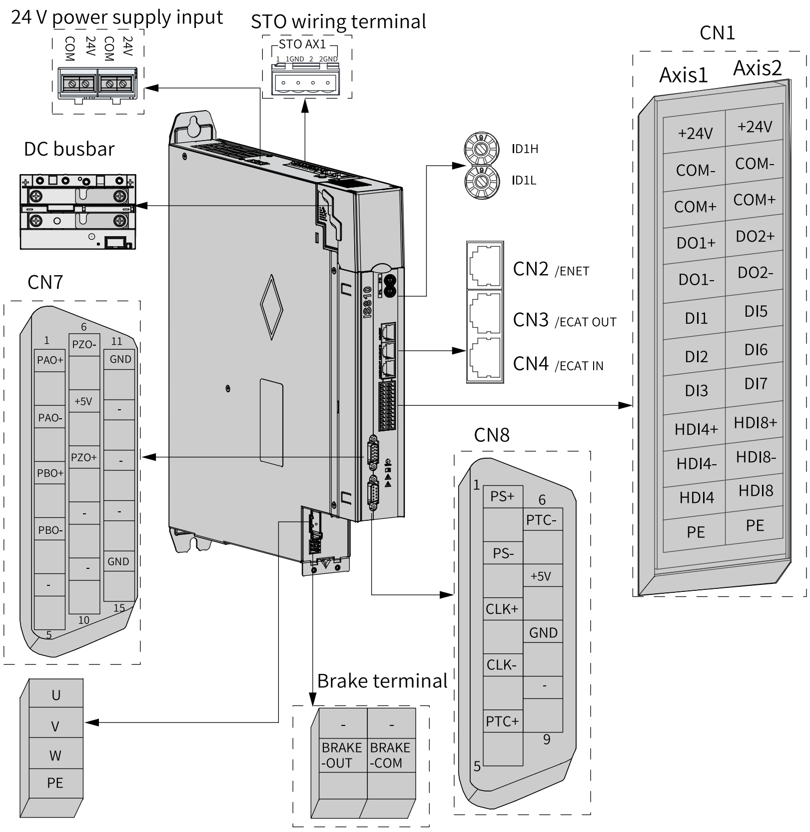


Figure 7-3 Terminal pin layout of single-axis drive unit

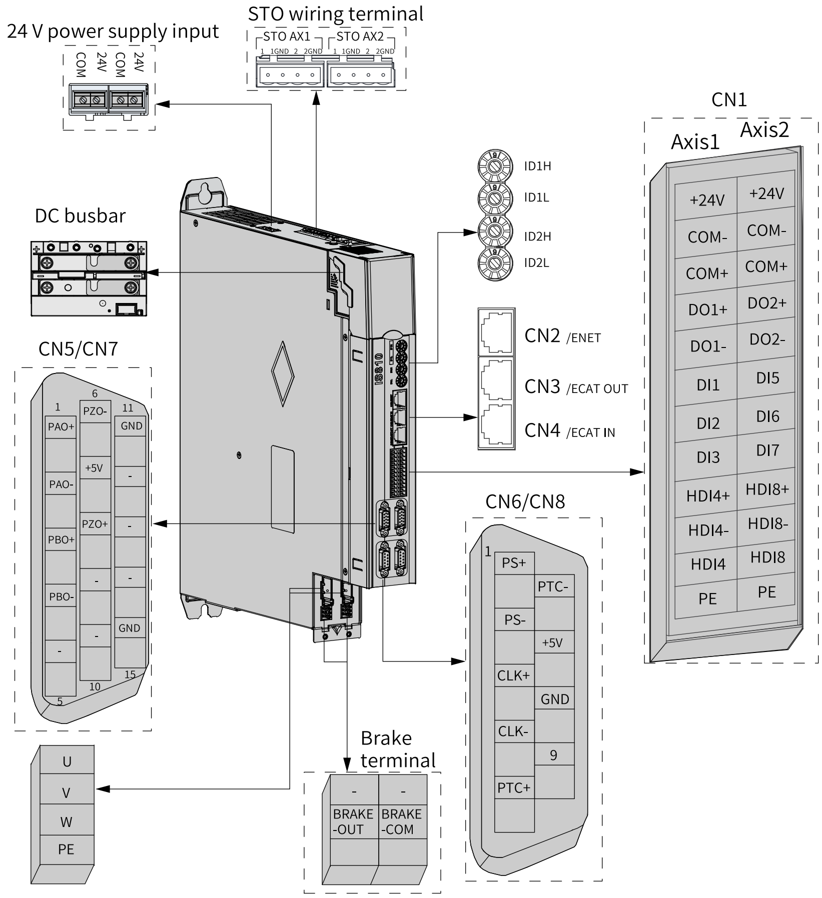


Figure 7-4 Terminal pin layout of dual-axis drive unit

Note

- For details of main circuit terminals, see *"7.6.1 Recommended Models and Specifications of Main Circuit Cables" on page 107*.
- For details of CN1 (control terminal), see *"7.7.1 Terminal Layout" on page 115*.
- For details of CN2 Ethernet communication terminal, see *"7.8 Ethernet Communication Terminal (CN2)" on page 121*.
- For details of CN3/CN4 EtherCAT communication terminal, see *"7.9.1 Terminal Layout" on page 122*.
- For details of CN5/CN7 fully closed-loop encoder terminal, see *" Terminal Layout" on page 125*.
- For details of CN6/CN8 motor encoder terminal, see *"7.11.1 Terminal Layout" on page 127*.
- For details of brake terminal, see *"7.12 Brake Terminal" on page 135*.
- For details of STO connection terminal, see *"7.13 STO Safety Terminal" on page 138*.
- For details of 24 V power supply terminal, see *"7.14 24 V Power Input Terminal" on page 139*.

7.6 Terminals of the Main Circuit

7.6.1 Recommended Models and Specifications of Main Circuit Cables

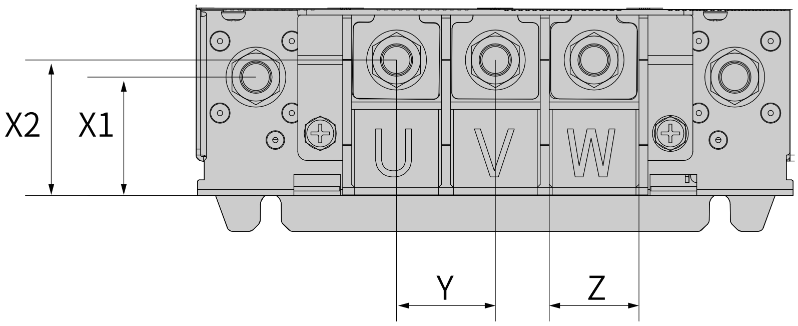


Figure 7-5 Diagram of the terminal block

Table 7–1 Specifications of the terminal block structure

Structure	Main circuit terminal						PE	
	X1 (mm)	X2 (mm)	Y (mm)	Z (mm)	Screw	Tightening torque (N·m)	Screw size	Tightening torque (N·m)
45 kW to 75 kW	39.5	45	33	30	M10 SEMS screw	25	M10 SEMS screw	25
120 kW	62	65	43	38	M12 combination screw	25	M12 combination screw	25

Table 7–2 Recommended main circuit cables and models

No.	Series	Servo drive model	U, V, W		PE	
			mm²	AWG	mm²	AWG
1	Size-1	3R5	3x0.75	18	0.75	18
2		5R4	3x1.5	16	1.5	16
3		8R4	3x1.5	16	1.5	16
4		12	3x1.5	16	1.5	16
5	Size-2	17	3x3.0	12	3	12
6		21	3x3.0	12	3	12
7		26	3x3.0	12	3	12
8		32	3x5.5	10	5.5	10
9		37	3x6.5	9	6.5	9
13	SIZE-3	90	3x16.5	5	16.5	5
14		112	3x21.0	4	21	4
15		152	3x26.5	3	26.5	3
16	Size-4	240	3x42	1	42	1

Note

- Tightening torque for screws of models in size-3 and size-4 is 30 N·m and 50 N·m respectively.
- Insufficient tightening torque may lead to equipment damage.
- For power cable specifications, see *"Table 5–1 Recommended power cable specifications" on page 76*

Cable lug selection

Recommended cable lugs are shown below.

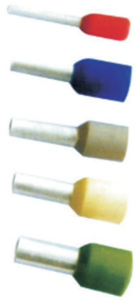


Figure 7-6 Appearance of the cable lug

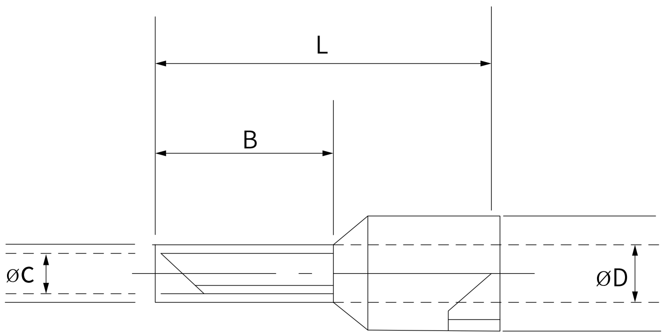


Figure 7-7 Dimension drawing of the cable lug

Table 7–3 Dimensions of the cable lug (mm)

Cross-sectional area of the cable (mm^2)	Dimensions				Color	Max. current (A)
	L	B	ØC	ØD		
0.2	10	6	0.7	1.9	Light 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				
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				

Cross-sectional area of the cable (mm^2)	Dimensions				Color	Max. current (A)
	L	B	ØC	ØD		
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				

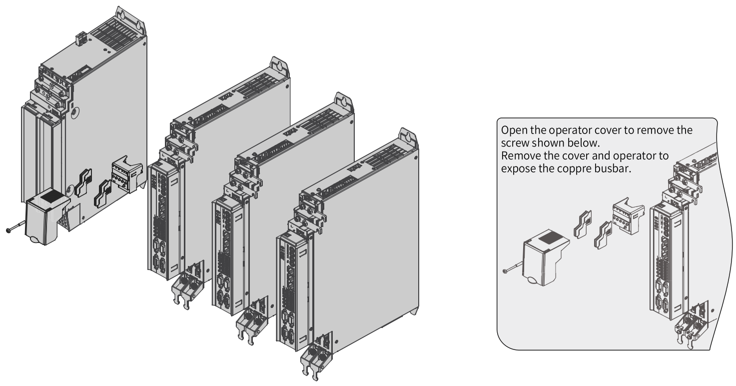
7.6.2 Wiring with the power supply unit

Connecting the DC bus power supply

Remove the keypad cover on the drive unit. Connect the power supply unit to the drive unit through the DC busbar. Use the pre-installed connector (busbar) for electrical connection of the device. Failure to comply may affect the stability and safety of operation.

Busbar

1. Loosen the screws on the keypad and remove the cover and the keypad, as shown in the following figure.



Note

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

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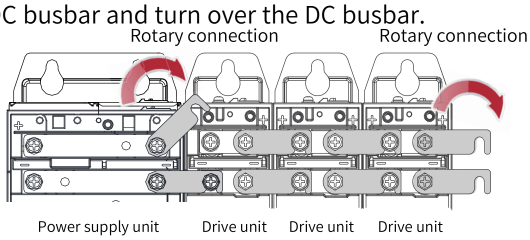
2. Loosen the screws of the DC busbar and turn over the DC busbar.



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 and calibrate the torques of all screws with a recommended torque of 2.6 N·m to 3 N·m.

Connecting the protective grounding terminal

Ground each device in the system properly. 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.

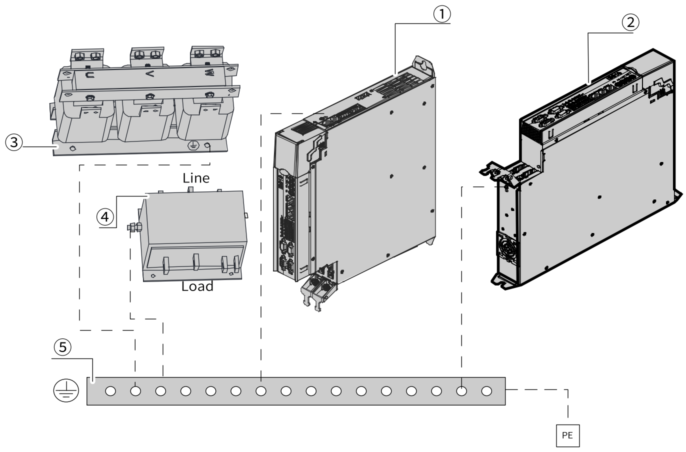


Figure 7-8 Connection of protective grounding

No.	Description
①	Ground the top of the drive unit.
②	Ground the bottom of the drive unit.
③	Ground the reactor.
④	Ground the filter.
⑤	Grounding copper busbar

Note

① and ② in the diagram show the situation where the top and bottom of the drive unit are grounded simultaneously.

Grounding and hose clamp of the shield

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

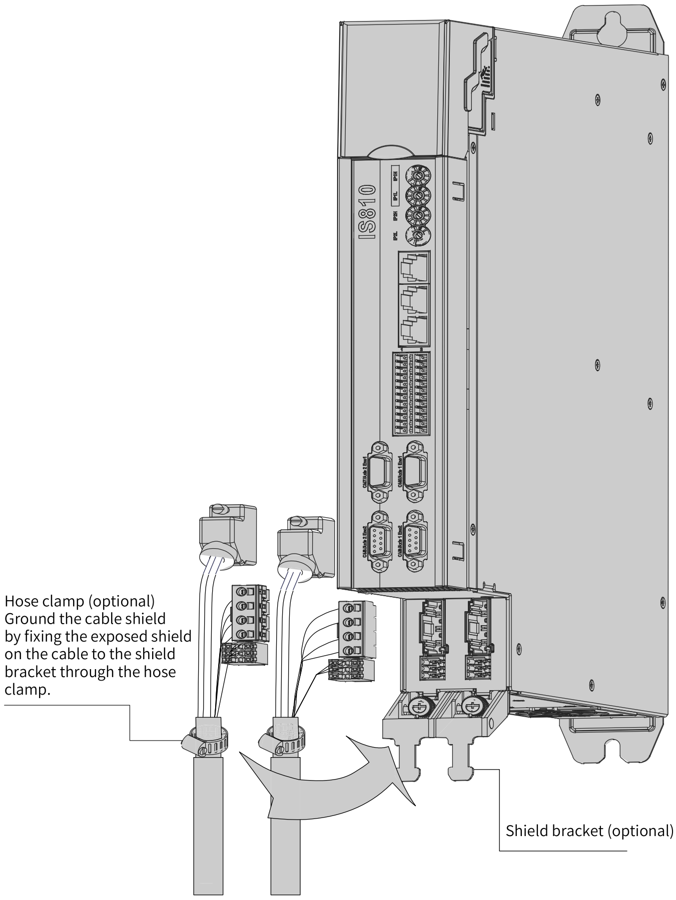


Figure 7-9 Grounding of the shield and use of the hose clamp

7.6.3 Wiring with the Motor

Properly ground PE of the servo drive and servo motor.

Connecting to the MS1 series motors

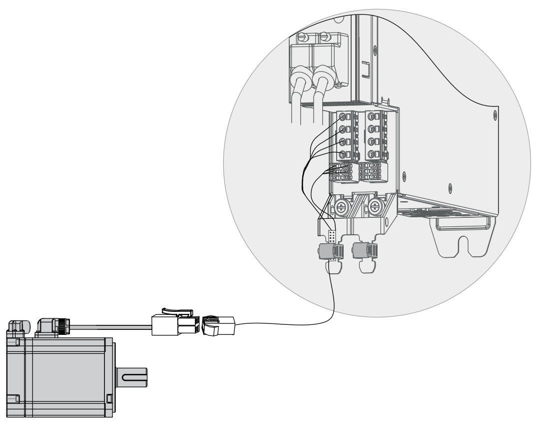
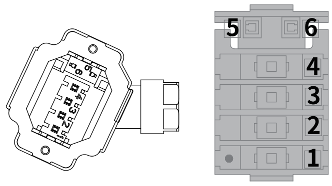


Figure 7-10 Terminal-type motor power cable connector

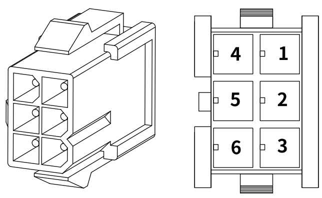
Table 7–4 Description of terminal-type motor power cable connector (motor side)

Applicable flange size [1]	Drawing of the connector	Pin layout		
		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.

Table 7–5 Description of the flying leads type motor power cable connector (motor side)

Applicable flange size [1]	Drawing of the connector	Pin layout		
		Pin No.	Signal name	Color
Flying leads type: 40 60 80	 Black 6-pin connector Recommendation: Plastic housing: MOLEX-50361736 Terminal: MOLEX-39000061	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.

Table 7–6 Power cable connector (motor side)

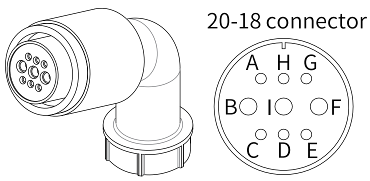
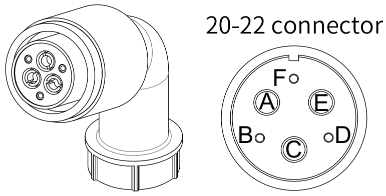
Applicable flange size [1]	Drawing of the connector	Pin layout		
		Pin No.	Signal name	Color
100 130	 MIL-DTL-5015 series 3108E20-18S aviation connector	B	U	Blue
		I	V	Black
		F	W	Red
		G	PE	Yellow/Green
		C	Brake (polarity insensitive)	Red
		E		Black

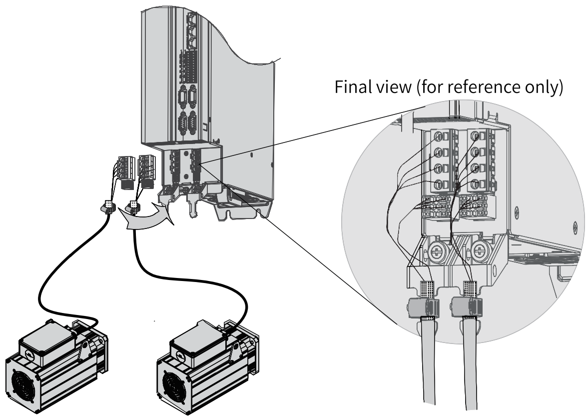
Table 7–7 Power cable connector (motor side)

Applicable flange size [1]	Drawing of the connector	Pin layout		
		Pin No.	Signal name	Color
180	 MIL-DTL-5015 series 3108E20-22S aviation 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.

Connecting to the ISMG series motor



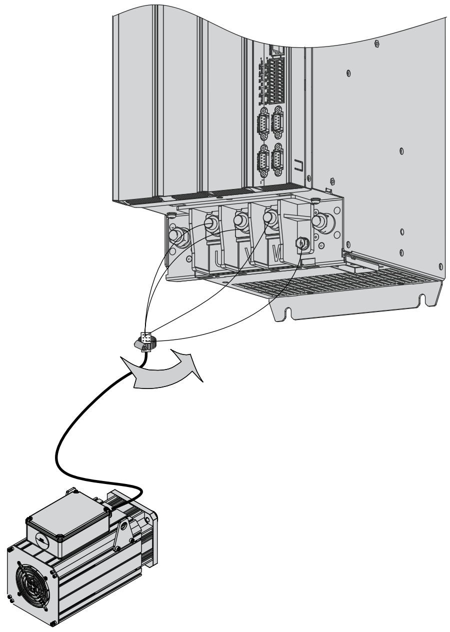


Figure 7-11 Example of connection of the drive unit output to ISMG series servo motor

- The specifications and installation methods of external main circuit cables must comply with the local regulations and related IEC standards.
- Do not connect the capacitor or surge protection device to the output side of the drive. Failure to comply can result in frequent occurrence of faults or even damage the drive.
- Electrical resonance may occur when the motor cable is excessively long, which can damage the motor insulation, leading to high leakage current and overcurrent. When the motor cable is longer than 100 m, install an AC output reactor close to the drive.
- Use shielded cables for motor output cables. Strip the cable to expose the shield, crimp the shield to the wire ferrule slot of the bracket with the wire ferrule, and crimp the lead wire of the shield to the PE terminal, as shown below.
- Ensure that the drain wire of the motor cable shield is as short as possible, with its width not shorter than 1/5 of its length.

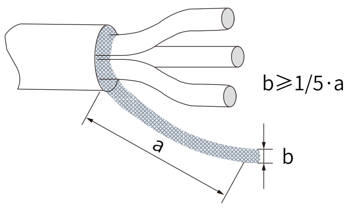


Figure 7-12 Drain wire of motor cable shield

- **Grounding terminal (PE)**
  - The terminal must be grounded properly with grounding cable resistance lower than 10 Ω. Failure to comply may lead to device malfunction or even damage the drive.
  - Do not connect the grounding terminal to the N terminal of the neutral wire of the power supply.
  - Use yellow-green cable as 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 to ensure the filtering effect.

7.7 Control Terminal (CN1)

7.7.1 Terminal Layout

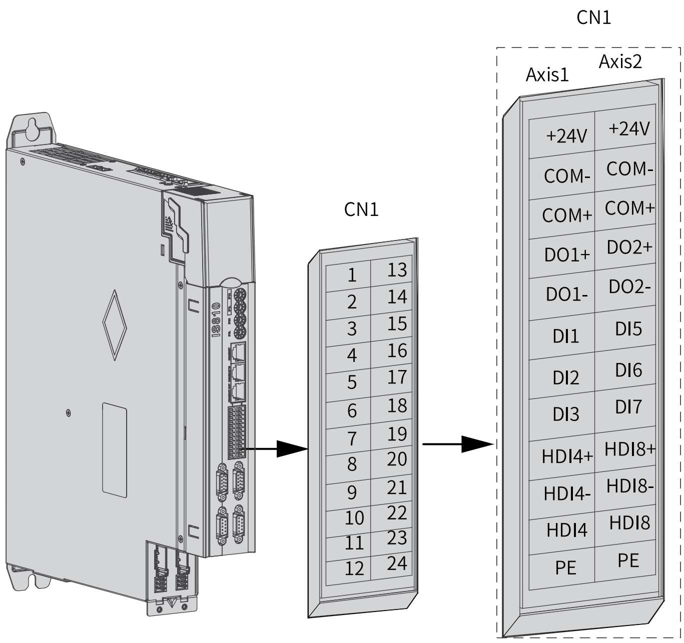


Figure 7-13 Pin layout of control circuit terminal connector of the drive

Table 7–8 CN1 terminal function

Terminal Symbol	Terminal Name	Terminal Function	
Axis 1 [1]	Axis 2 [1]	-	-
+24V	+24V	Internal 24 V power supply: 20 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 shield ground

Note

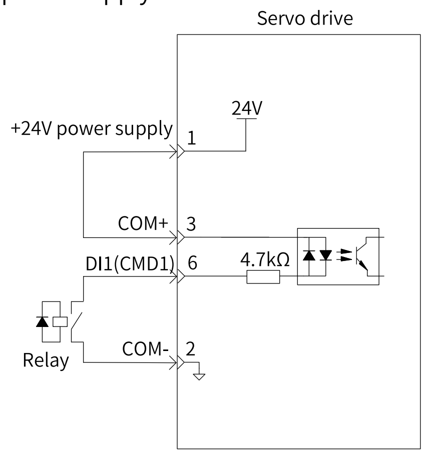
[1] The DI/DO terminals of axis 1 and axis 2 can be used in common. See parameter settings in *"16.4 Parameter Group H03" on page 393* and *"16.5 Parameter Group H04" on page 396*.

7.7.2 DI/DO Signals

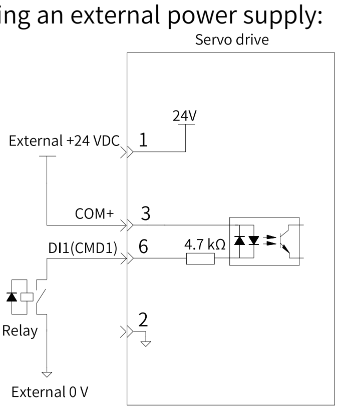
DI circuit

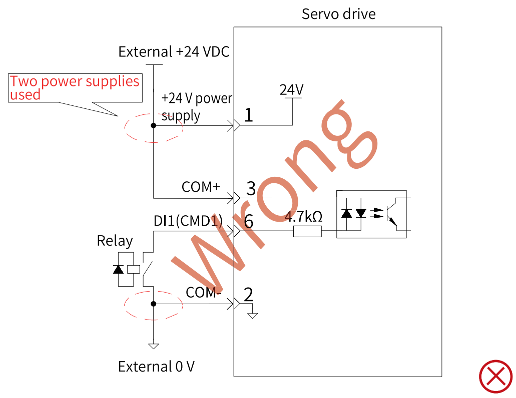
The circuits for DI1 to DI3, and DI5 to DI7 are the same.

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

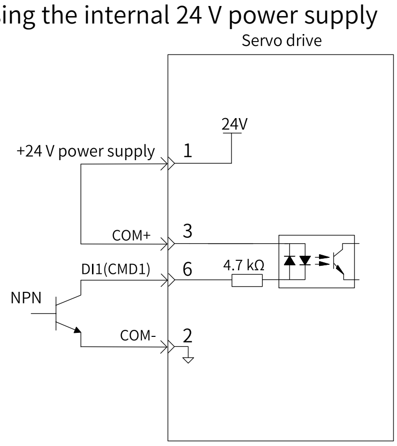


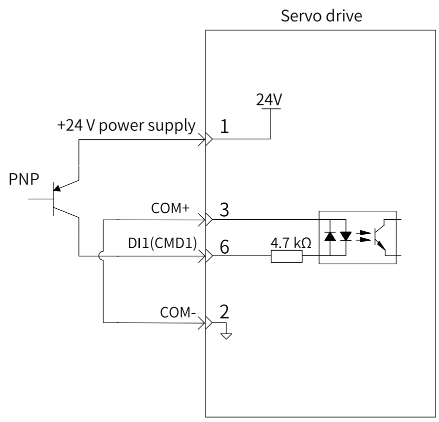
  - When using an external power supply:



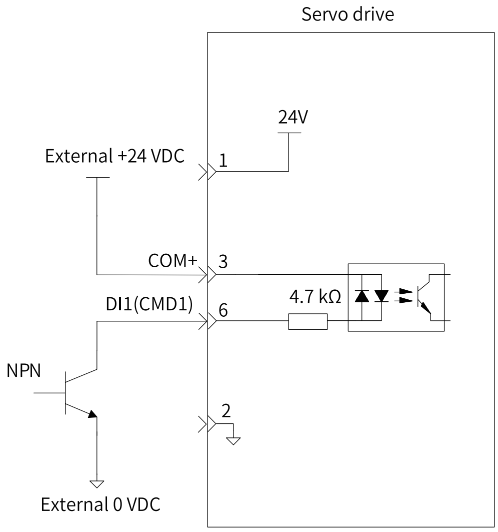


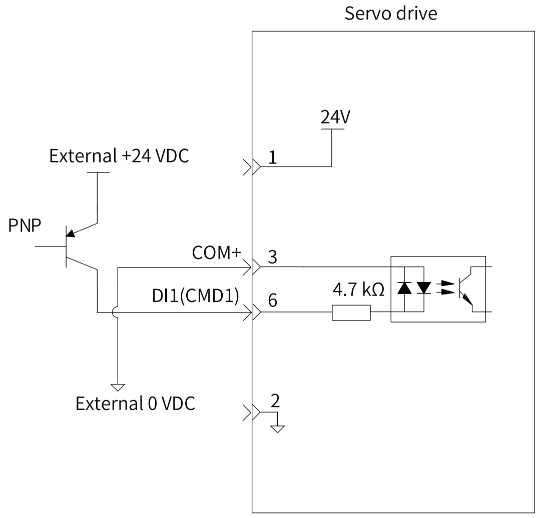
- When the host controller generates open-collector output:
  - When using the internal 24 V power supply





  - When using an external power supply:





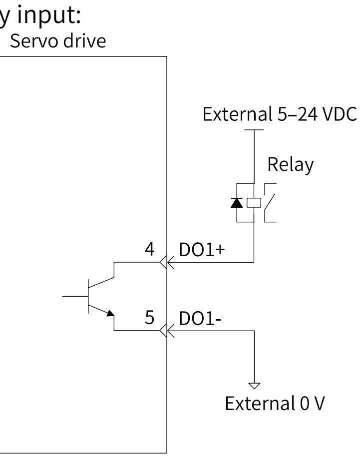
Note

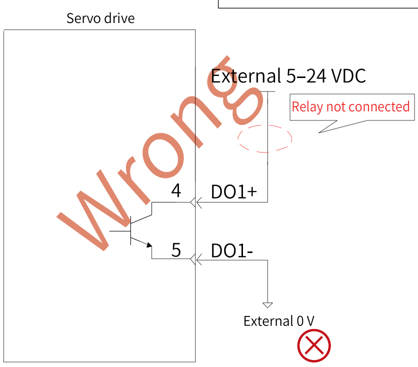
PNP and NPN input cannot be used together in the same circuit.

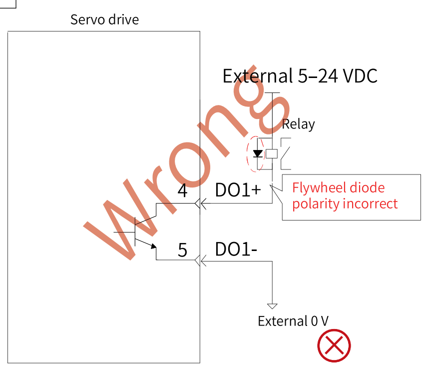
DO circuit

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

- When the host controller adopts relay input:



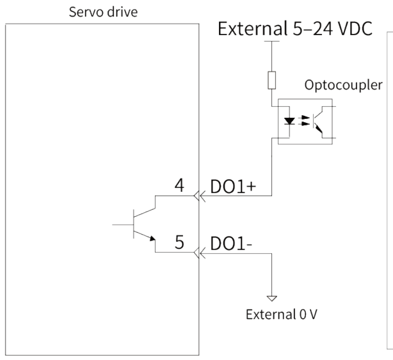


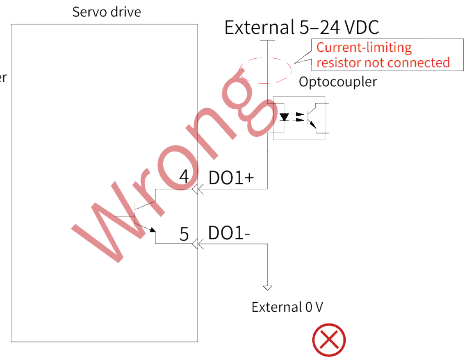


Note

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

- When the host controller adopts optocoupler input:





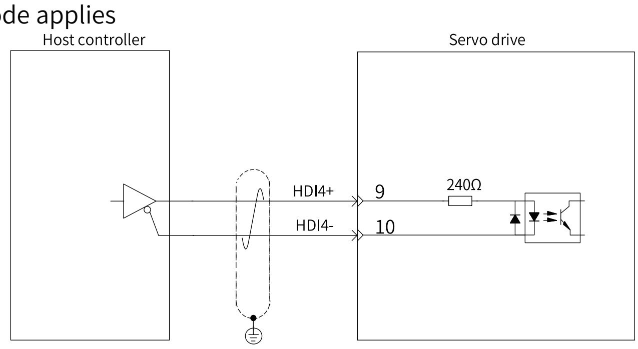
Note

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

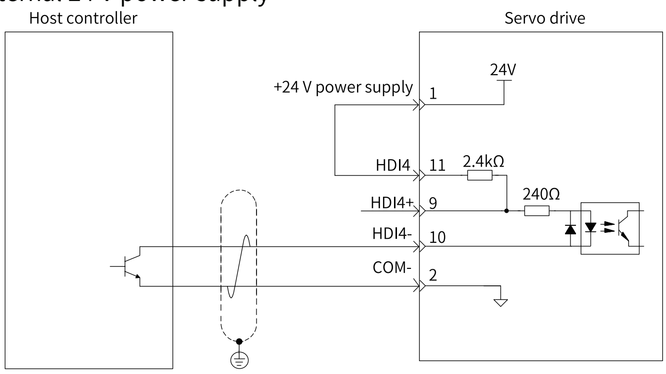
- Max. voltage: 30 VDC
- Max. current: DC 50 mA

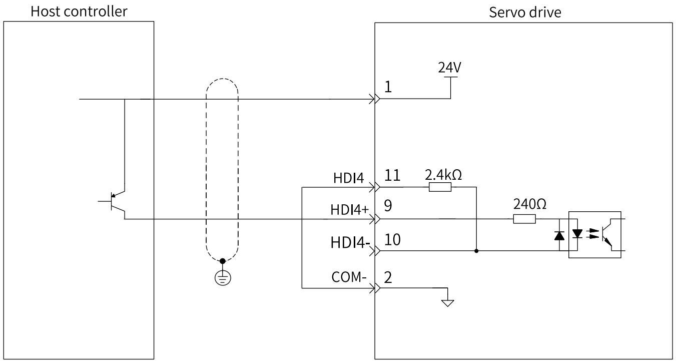
High-speed HDI4

- When differential mode applies

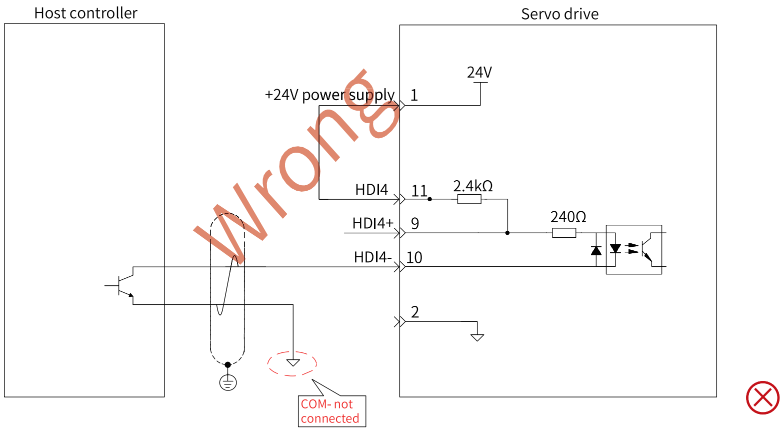


- When open collector mode applies
  - When using the internal 24 V power supply

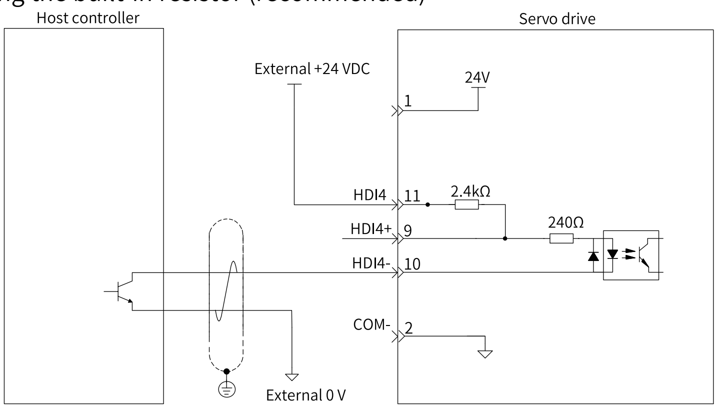


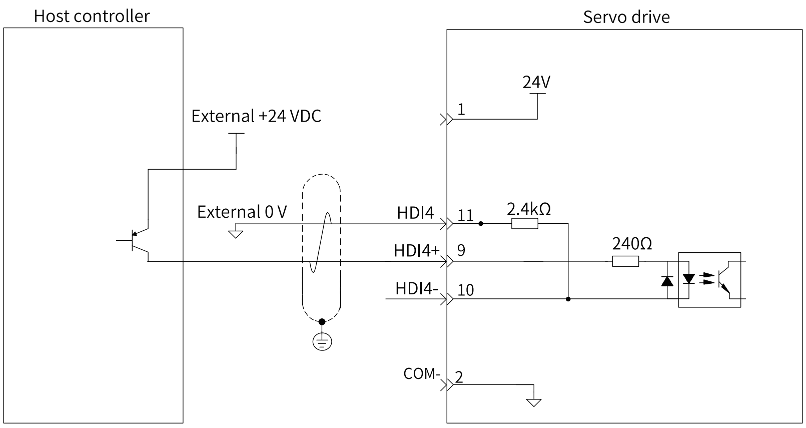


Wrong: Pin COM- is not connected, which cannot form a closed-loop circuit.

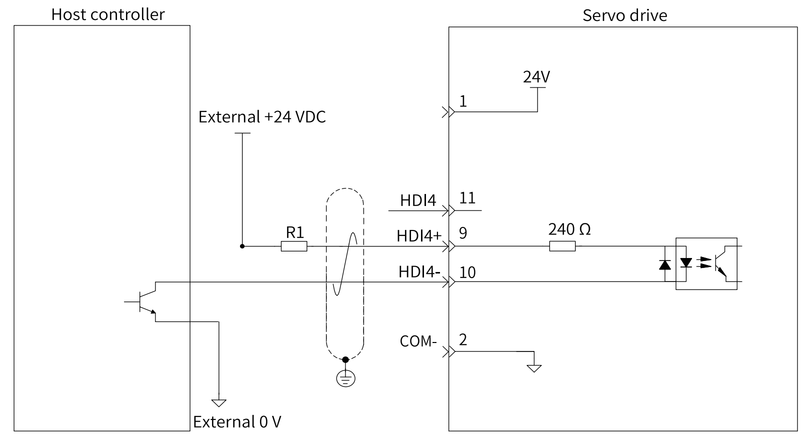


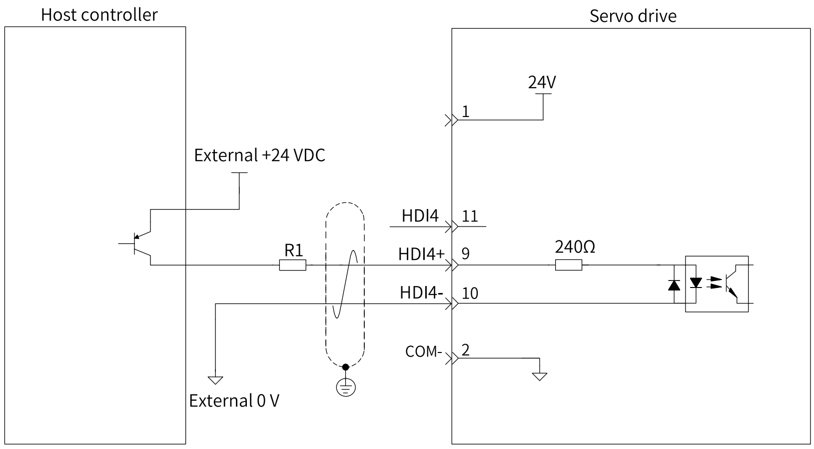
- When using an external power supply:
  - Scheme 1: Using the built-in resistor (recommended)





  - Scheme 2: Using the external resistor





Value of resistor R1 is calculated according to the following formula:

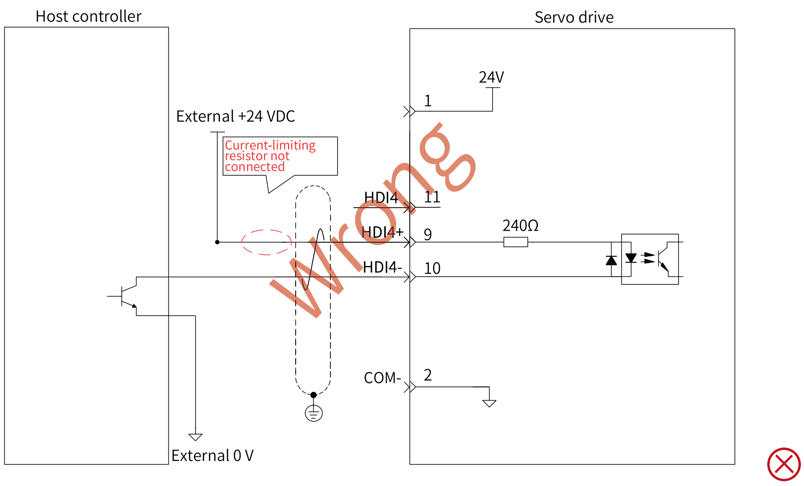
$$\frac{V_{CC}-1.5}{R1+240} = 10mA$$

Table 7–9 Recommended resistance of R1

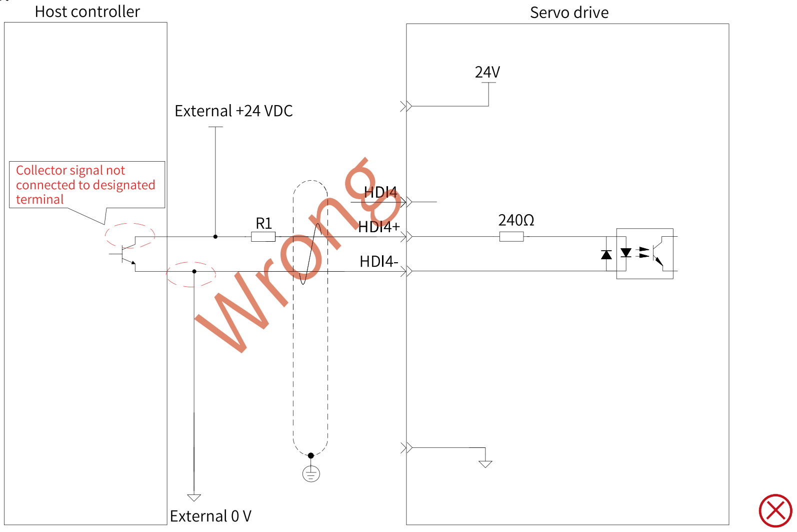
V_{CC} Voltage	R1 resistance	Power of R1
24 V	2.4 kΩ	0.5 W
12 V	1.5 kΩ	0.5 W

– The following figures show examples of improper wiring.

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



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



High-speed HDI8

The connection method of HDI8 is consistent with high-speed HDI4. See the preceding text.

7.8 Ethernet Communication Terminal (CN2)

CN2 is used for communication with the software tool and online upgrade.

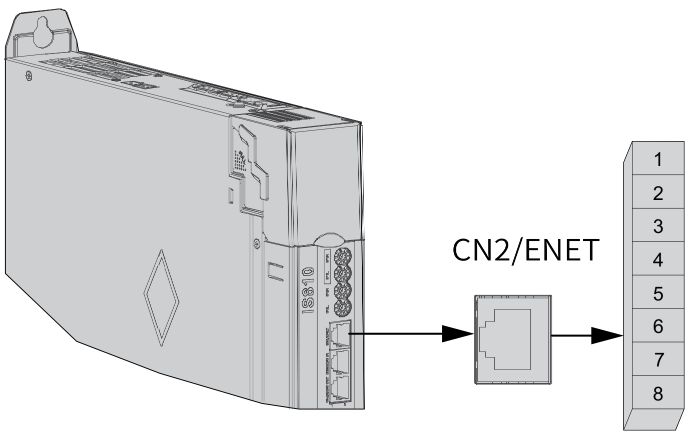


Figure 7-14 Ethernet terminal layout

Table 7–10 Description of communication signal terminal

No.	Assignment	Function and Specification
1	TX+	Transmit data (+)
2	TX-	Transmit data (-)
3	RX+	Receive data (+)
4	-	-
5	-	-
6	RX-	Receive data (-)
7	-	-
8	-	-

Note

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

7.9 EtherCAT Communication Terminal (CN3 and CN4)

7.9.1 Terminal Layout

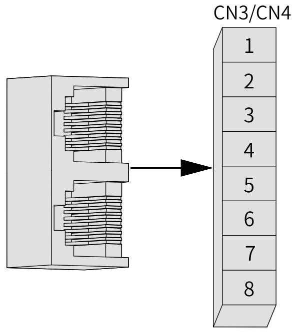


Figure 7-15 Layout of terminals

Table 7–11 Pin definitions of the communication signal connector

Pin No.	Assignment	Description
1	TX+	Transmit data (+)
2	TX-	Transmit data (-)
3	RX+	Receive data (+)
4	-	-
5	-	-
6	RX-	Receive data (-)
7	-	-
8	-	-
Enclosure	PE	Shield

7.9.2 Description of Terminals

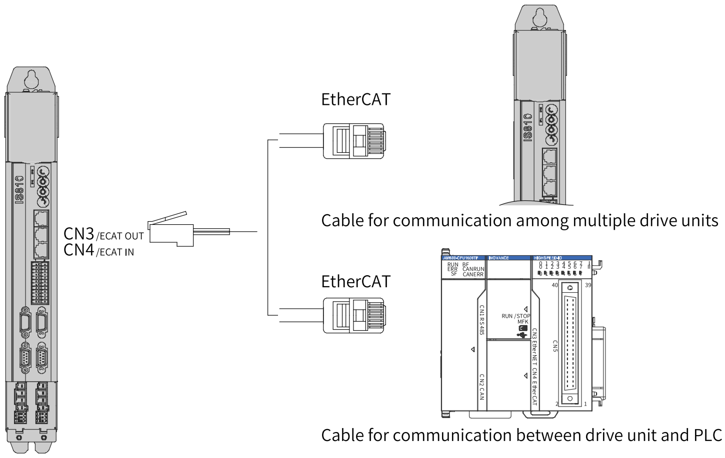


Figure 7-16 Wiring of communication cables

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 Layout" on page 122*.

7.9.3 Terminal Connection

- Topology

  The communication topology of EtherCAT is flexible without any limit, as shown in *"Figure 7–17 Communication network topology" on page 123*. The drive carries IN and OUT ports.

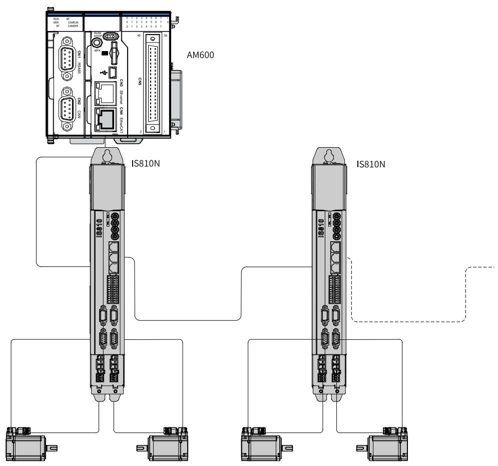
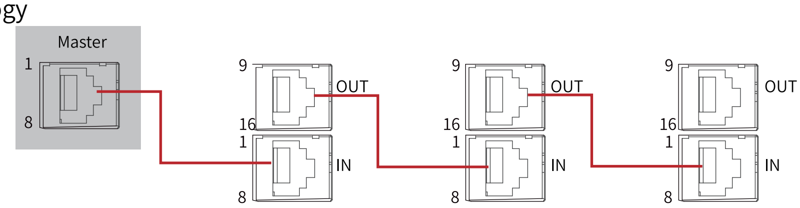
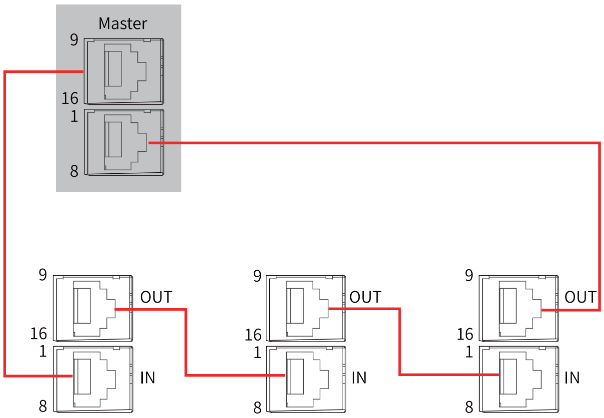


Figure 7-17 Communication network topology

- Linear topology



- Redundancy ring topology



Note

When using the redundant ring, set H0E.36 (EtherCAT AL enhanced link) to 1 (Enable), then power on the drive again.

7.9.4 Selection Instructions

Instructions for communication cable selection

Cable Length	Supplier
0.2 m to 10 m	Inovance
More than 10 m	Haituo

Information for ordering the communication cable

Table 7–12

Material Code	Cable Model	Length (m)
15040261	S6-L-T04-0.3	0.3
15040262	S6-L-T04-3.0	3
15041960	S6-L-T04-0.2	0.2
15041961	S6-L-T04-0.5	0.5
15041962	S6-L-T04-1.0	1
15041963	S6-L-T04-2.0	2
15041964	S6-L-T04-5.0	5
15041965	S6-L-T04-10.0	10

Note

- Cables shorter than or equal to 10 m must be ordered from Inovance.
- Cables longer than 10 m from are ordered from Haituo.

Specifications

Item	Detailed description
UL certification	UL-compliant
Cat 5e cable	Cat 5e cable
Double-shielded	Braided shield (coverage: 85%), aluminum foil shield (coverage: 100%)

Item	Detailed description
Environmental worthiness	Ambient temperature: -30°C to +60°C, resistant to industrial oil, corrosive acid and alkali
EMC test standard	GB/T 248082009

7.10 Fully Closed-loop Encoder Terminal (CN5/CN7)

Terminal layout

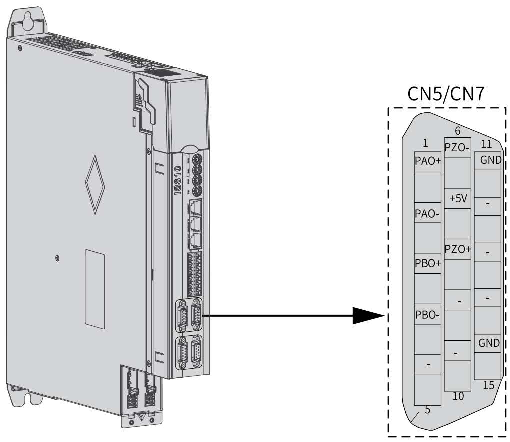


Figure 7-18 CN5/CN7 terminal layout

Description of Terminals

Table 7–13 CN5/CN7 (DB15) terminal description

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

7.10.1 Encoder Fully Closed-loop Input

Use shielded twisted pairs to match the high input frequency.

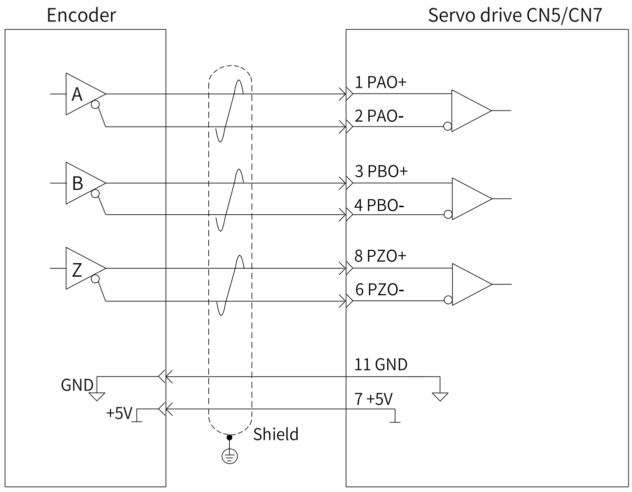


Figure 7-19 Terminal wiring diagram

- 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 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.

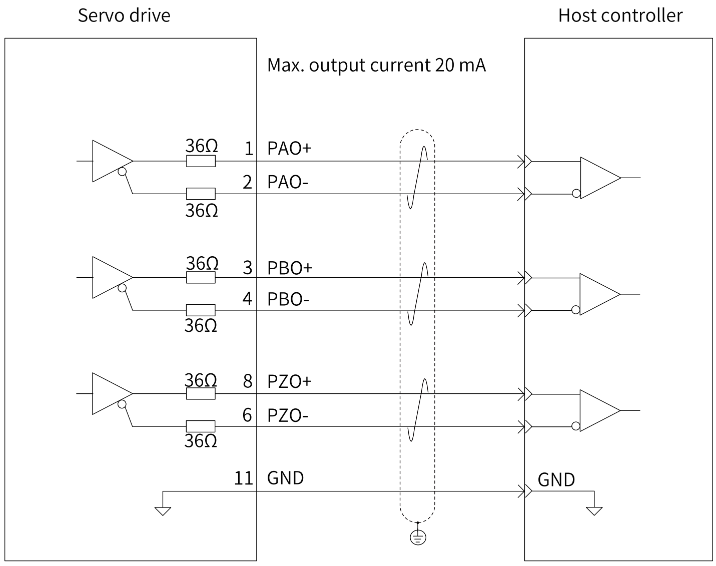


Figure 7-20 Differential receiving circuit

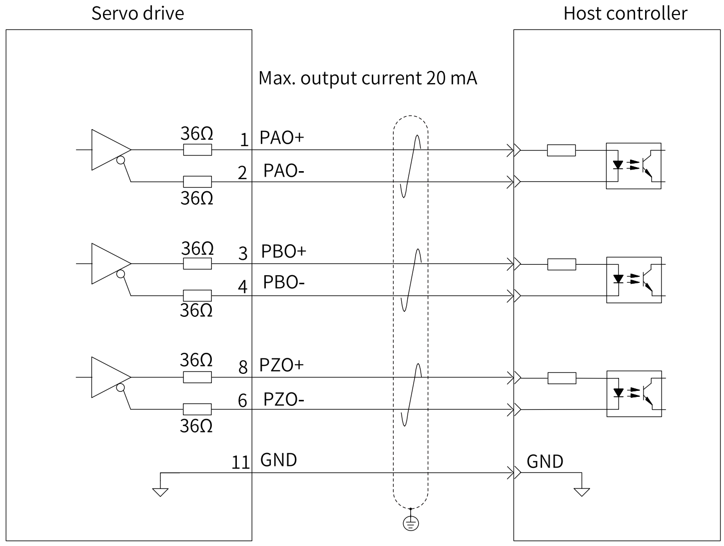


Figure 7-21 Optocoupler receiving circuit

7.11 Motor Encoder Terminal (CN6/CN8)

7.11.1 Terminal Layout

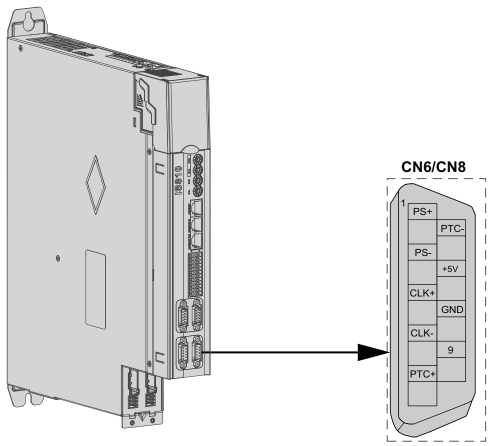


Figure 7-22 CN6/CN8 terminal layout

Table 7–14 CN6/CN8 terminal description

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)

Signal name	Pin No.	Function
+5V	7	Encoder +5 V power supply
GND	8	Encoder +5 V power supply ground
PE	Enclosure	Shield

7.11.2 Wiring of Motor Encoder

7.11.2.1 Connecting to the MS1 series motor encoder

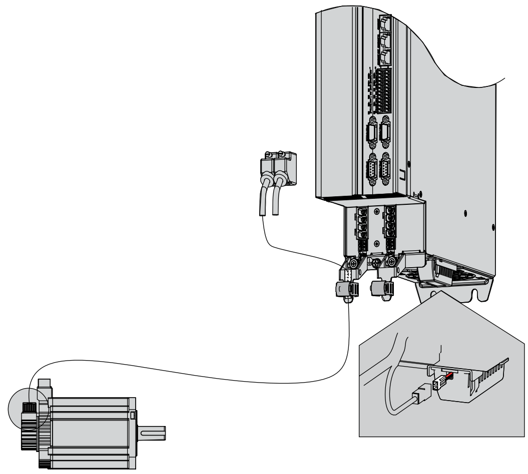


Figure 7-23 Connecting to the MS1 series motor encoder

The following figure describes the drain wire colors of the battery box.

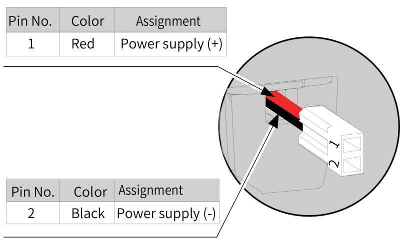
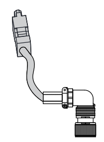
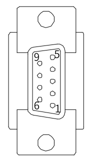
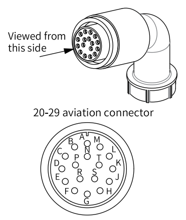


Figure 7-24 Drain wire colors of the battery box

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 7–15 Flying leads type motor encoder cable connector (9-pin)

Applicable Frame Size [1]	Drawing of the connector			Pin layout			
				Pin No.	Signal name	Color	Type
100 130 180		Drive side	 DB9 male	1	PS+	Blue	Twisted pair
				2	PS-	Purple	
				7	+5V	Red	Twisted pair
				8	0V	Orange	
				Enclosure	PE	-	-
		Motor side	 9-pin connector Recommendation: plastic enclosure: AMP172161-1 Terminal: AMP 770835-1	A	PS+	Blue	Twisted pair
				B	PS–	Purple	
				E	Battery (+)	Brown	Twisted pair
				F	Battery (-)	Black	
				G	+5V	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 Connecting to ISMG Series Motor Encoder

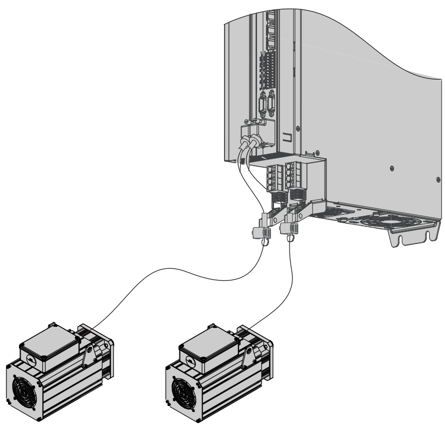


Figure 7-25 Connecting to the ISMG series motor encoder

Table 7–16 Encoder cable connectors on the drive side

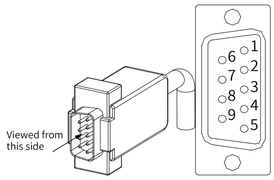
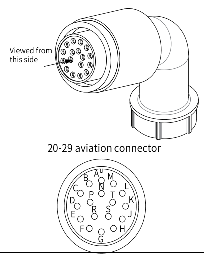
Drawing of the connector	Pin layout	
	Pin No.	Signal name
	1	PS+
	2	PS-
	5	PTC+
	6	PTC-
	7	+5V
	8	GND
Recommendation: Plastic housing of plug on cable side: DB9P (SZTDK), black housing Core: DB9P male (SZTDK), blue glue	Enclosure	PE

Table 7–17

Drawing of the connector	Drawing of the connector		
	Pin No.	Signal name	Type
MIL-DTL-5015 series 3108E20-29S aviation connector	A	PS+	Twisted pair
	B	PS-	
	G	+5V	Twisted pair
	H	GND	
	J	Shield	-
	K	PTC+	Twisted pair
	L	PTC-	

7.11.2.3 Connecting to Third-Party Communication-type Encoder

Connecting to HEIDENHAIN ENDAT2.2

The ENDAT signal interface is a bi-directional digital interface used for encoders. It is used to transmit the position value or the information in the encoder, as well as update the information in the encoder or save new information. As serial data transmission mode is used, it requires only four signal wires. The data transmission is synchronized with subsequent electronic circuit clock signals. The data type (position value, parameter, or diagnosis information) transmitted is sent to the mode instruction of the encoder through subsequent electronic circuit.

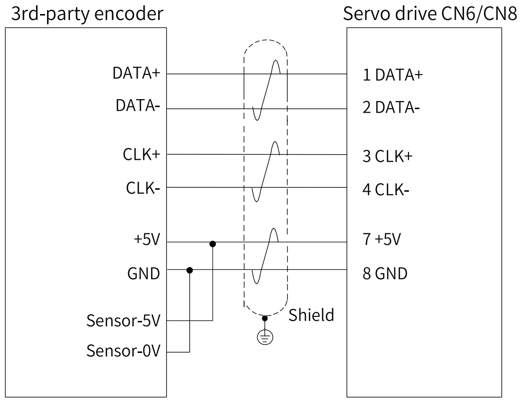
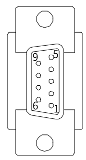
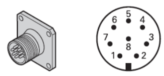
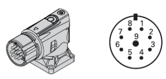
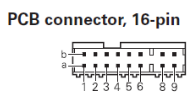


Figure 7-26 Connecting to the third-party encoder

Table 7–18 Motor encoder cable connector (9-pin connector)

Drawing		Pin layout		
		Pin No.	Assignment of signal	Description
Drive side	 DB9 male	1	DATA+	Data differential+
		2	DATA-	Data differential-
		3	CLK+	Clock differential+
		4	CLK-	Clock differential-
		5	PTC+	KTY84/PT1000/PTC
		6	PTC-	KTY84/PT1000/PTC
		7	5V	5 V power supply
		8	GND	5 V power supply GND
Motor side	 M12 interface	3	DATA+	Data differential+
		4	DATA-	Data differential-
		7	CLK+	Clock differential+
		6	CLK-	Clock differential-
		8	5V	5 V power supply
		5	GND	5 V power supply GND
		2	Sensor-5V	Encoder power supply
		1	Sensor-0V	Encoder power supply 0 V
	 M23 interface	5	DATA+	Data differential+
		6	DATA-	Data differential-
		1	CLK+	Clock differential+
		2	CLK-	Clock differential-
		3	5V	5 V power supply
		4	GND	5 V power supply GND
		7	Sensor-5V	Encoder power supply
		8	Sensor-0V	Encoder power supply 0 V
	 PCB interface	6a	DATA+	Data differential+
		1a	DATA-	Data differential-
		2b	CLK+	Clock differential+
		5a	CLK-	Clock differential-
		1b	5V	5 V power supply
		4b	GND	5 V power supply GND
		6a	Sensor-5V	Encoder power supply
		3a	Sensor-0V	Encoder power supply 0 V
		8a	KTY+	KTY84_130
		8b	KTY-	KTY84_130

Note

Contact Inovance for customized models.

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
- Terminal block and crimping terminal conversion cable for dual-axis drives (S6-C9)

Installing the battery box

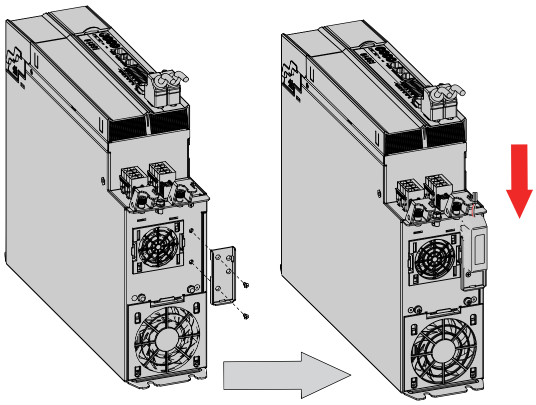


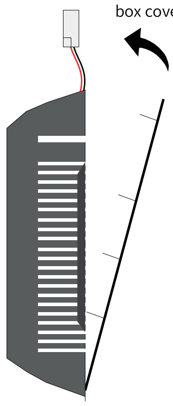
Figure 7-27 Installing the battery box (bottom view for drives in size-1)

Fix the flat-head screws into the flat-head slots.

Removing the battery box

The battery may generate leakage liquid after long-term use. Replace it every two years. Remove the battery box based on the procedure 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 during wiring.

7.11.4 Wiring for motor temperature detection

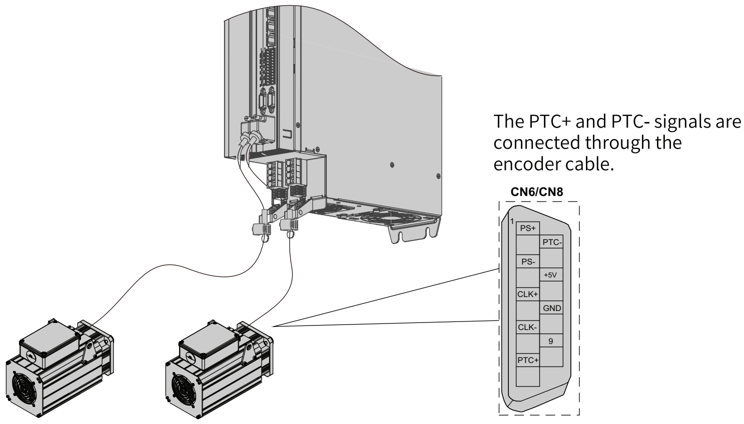


Figure 7-28 Terminal layout

Pin assignment	Pin description
PTC+	Motor temperature feedback input
PTC-	

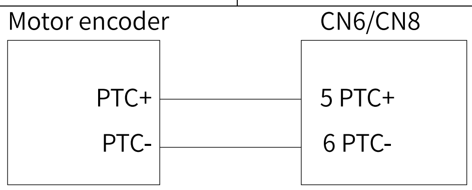


Figure 7-29 Wiring example for temperature detection

Note

The motor temperature feedback supports PTC and KTY, which can be selected in H0C.32 (*"16.12 Parameter Group H0C" on page 437*).

7.11.5 Wiring

Ground the servo drive and shield of the servo motor reliably. Otherwise, the servo drive will report a false alarm. It is recommended to use 16AWG to 26AWG shielded twisted pair cables. Connect the differential signals to the two conductors of the twisted pair and keep the wiring length as short as possible.

Do not the cable to "Reserved" terminals.

To determine the encoder cable length, take the voltage drop caused by cable resistance and the signal attenuation caused by distributed capacitors into account. It is recommended to use shielded twisted pair cables (above 26AWG as per UL2464 standard) with a length within 10 m. If cables longer than 10 m are needed, increase the cross sectional area properly. See details in the following table.

Table 7–19 Recommended cables

Cross sectional area	Ω/km	Allowable cable length (m)
26AWG (0.13mm^2)	143	10
25AWG (0.15mm^2)	89.4	16
24AWG (0.21mm^2)	79.6	18
23AWG (0.26mm^2)	68.5	20.9
22AWG (0.32mm^2)	54.3	26.4
21AWG (0.41mm^2)	42.7	33.5

To determine the signal cable length, take the voltage drop caused by cable resistance into account. Pay attention to the capacity of the power supply during power distribution. It is recommended to use shielded twisted pair cables of 26AWG or above.

Route the encoder cable and the power cable separately at a distance of at least 30 cm.

If the encoder cable is too short and an extension cable is needed, ground the shield properly to ensure a reliable shielding and grounding performance.

7.12 Brake Terminal

Terminal layout

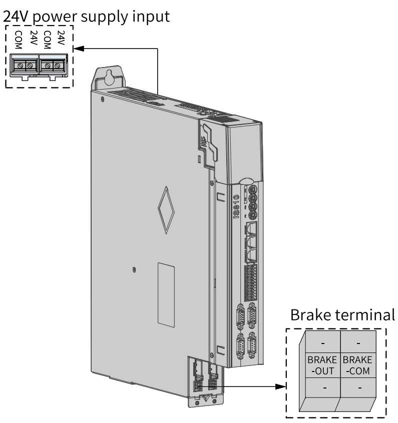


Figure 7-30 Pin layout

Table 7–20 Description of terminal pins

Terminal Name	Terminal Function
24V	External 24 V power supply
COM	External 24 VCOM
BRAKE-OUT	Brake+
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.

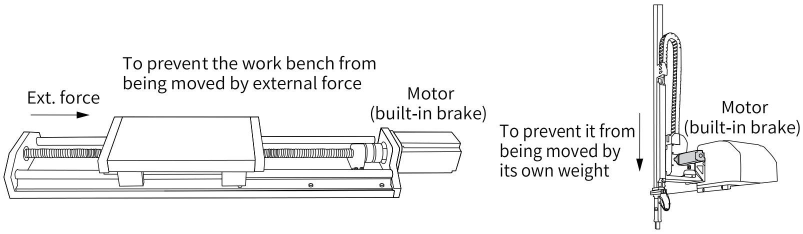


Figure 7-31 Application of the brake

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. Pay special attention when using magnetic sensors around the motor.

The brake input signal of the brake is polarity-insensitive. Prepare a 24 V power supply. The following figure shows the standard wiring of the brake signals (BK) and the brake power supply.

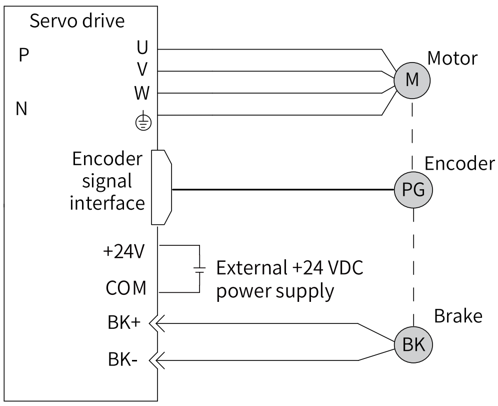


Figure 7-32 Wiring of the brake for models T017 and below

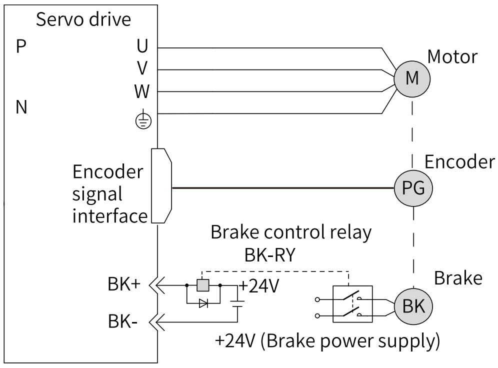


Figure 7-33 Wiring of the brake for models T017 to T037

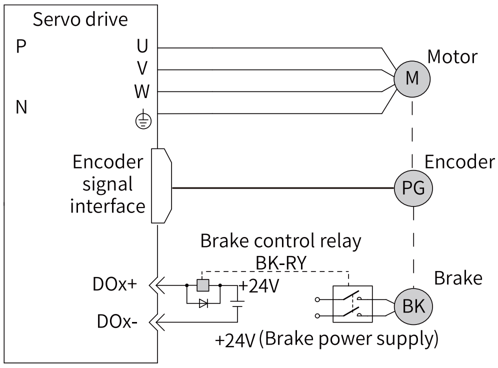


Figure 7-34 Wiring of the brake for models T037 and above

Note

- When determining the length of the motor brake cable, take the voltage drop caused by cable resistance into account. 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 T017 and below, the drive controls the motor brake through the brake terminal directly.
- For models between T017 and T037, the drive controls the motor brake through the external relay. The external relay is controlled through the brake terminal.
- For models of T037 and above, the drive controls the brake motor through the external relay. The external relay is controlled through the brake DO.

Brake specifications

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H02.09	2002–0Ah	Delay from brake output ON to command received	0 to 500	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 to 1000	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 to 3000	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 to 65535	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	Used to turn on or off the brake function.	0	-	UInt16	Real time	At stop

7.13 STO Safety Terminal

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.

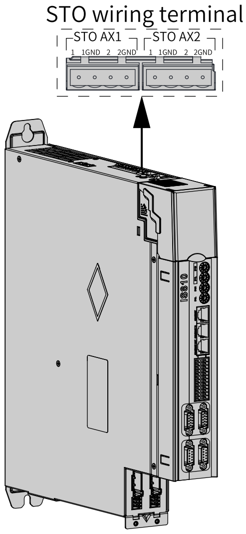


Figure 7-35 STO wiring terminal

Type	Name	Description
AX1 STO	1	Axis 1 STO 1 power supply (+)
	1GND	Axis 1 STO 1 power supply (-)
	2	Axis 1 STO 2 power supply (+)
	2GND	Axis 1 STO 2 power supply (-)
AX2 STO	1	Axis 2 STO 1 power supply (+)
	1GND	Axis 2 STO 1 power supply (-)
	2	Axis 2 STO 2 power supply (+)
	2GND	Axis 2 STO 2 power supply (-)

Note

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

For terminal wiring and functions, see *"14.1 Application Example of STO Function" on page 322*.

7.14 24 V Power Input Terminal

The power supply of the drive unit is divided into the control part and power part. The control part is preferably powered up by the DC busbar from the power supply unit. It is recommended to connect the 24 V switched-mode power supply on the drive unit to the external power supply as well. This is to protect the control circuit power supply of the drive unit against power failure 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:

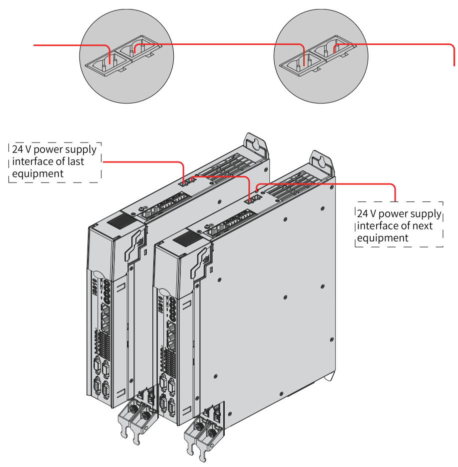


Figure 7-36 Cascaded connection of 24 V control circuit power supply

Note

- External 24 V control power and brake power input terminal; current specification: current needed by brake + 0.7 A
- External 24 V power supply range±10%, 21.6 V to 26.4 V

7.15 Related EMC Requirements

Take the following measures to suppress interference:

- Use cables shorter than 3 m for reference input and cables shorter than 20 m for encoders.
- Use a thick cable (above 2.0 mm^2) 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 radio frequency interference. For use in the domestic environment or environment subject to strong power supply 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 as close to the servo drive as possible.
  - Install a surge protection device on the relay, solenoid, and electromagnetic contactor coils.
  - Separate high-voltage cables from low-voltage cables by a distance of at least 30 cm. Do not put these cables in the same duct or bundle them together.
  - Do not share the power supply with an electric welder or an electric discharge machining device. When the servo drive is placed near 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 elements in the main circuit. The noise generated by such switches may affect the normal operation of the system due to improper wiring or grounding.

Therefore, the servo drive must be wired and grounded properly. A noise filter can be added if necessary.

Anti-interference wiring example

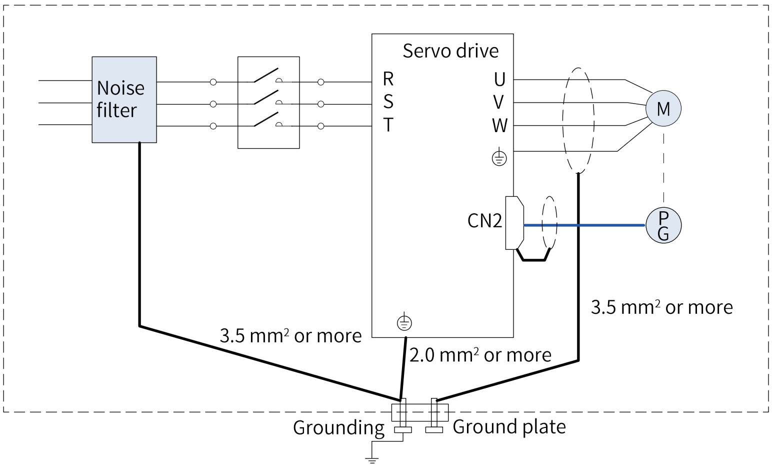


Figure 7-37 Anti-interference wiring example

Note

- For the grounding cable connected to the cabinet enclosure, use a cable of at least 3.5 mm^2. Braided copper cables are recommended.
- If a noise filter is used, abide by the requirements in "Use of the Noise Filter".

Grounding

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

- Grounding the enclosure of the servo motor
  Connect the grounding terminal of the servo motor to the PE terminal of the servo drive, and ground the PE terminal properly to minimize potential electromagnetic interference.
- Grounding 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.
- Grounding the servo drive
  Ground the PE terminal of the servo drive properly. Fix the retaining screw of this terminal securely to ensure good contact.

7.15.2 Use of the Power Filter

To prevent interference from the power cable and reduce the impact of the servo drive on other sensitive devices, install a proper noise filter on the input side of the power supply based on the input current. In addition, install a noise filter on the power supply line 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 place the input and output cables of the noise filter in the same duct or bundle them together.

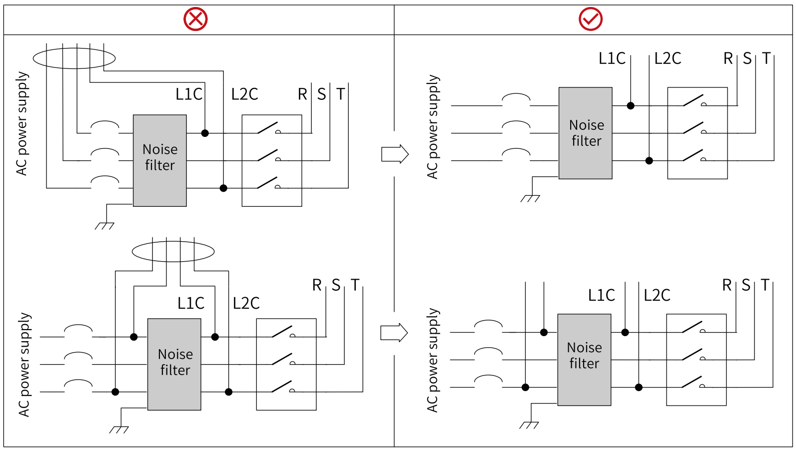


Figure 7-38 Separate routing of input and output cables of the noise filter

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

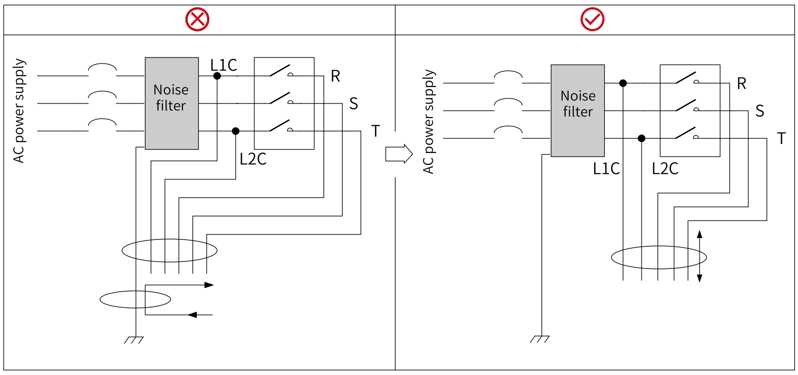


Figure 7-39 Separate routing of the grounding cable and the output cable of the noise filter

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

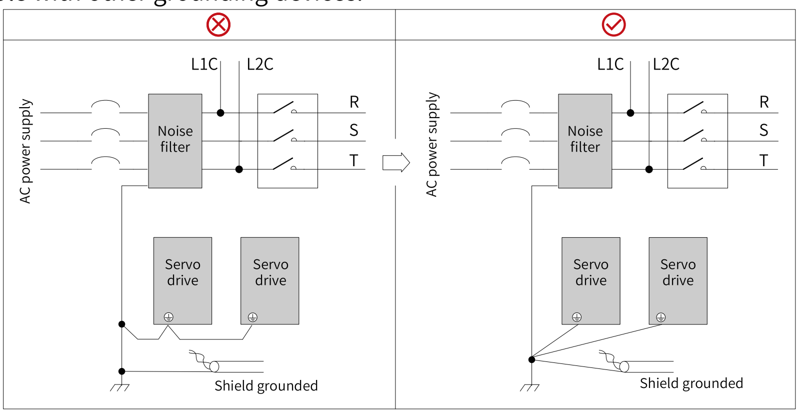


Figure 7-40 Single-point grounding

- 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 that the contact part is in good conductive condition and ground the metal plate properly.

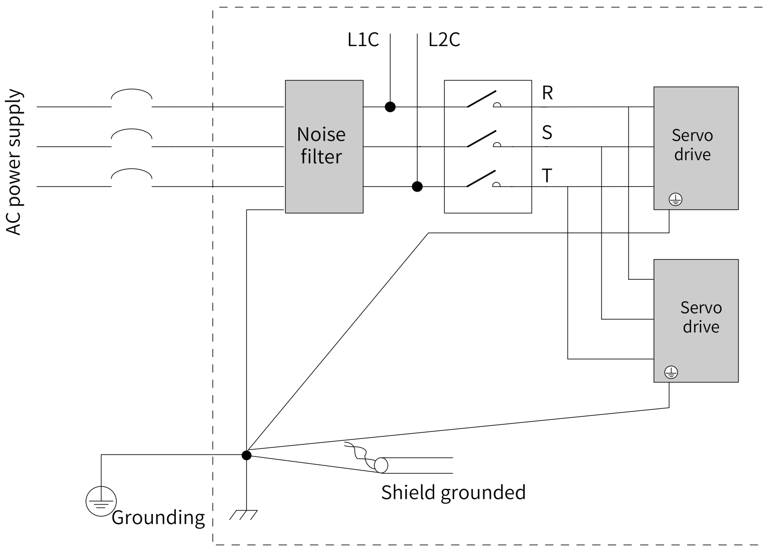


Figure 7-41 Grounding of the noise filter

7.15.3 Precautions for Use of the Cables

- Do not bend cables or subject tension to them. 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 cases where cables need to be moved, use flexible cables. Ordinary cables may be easily damaged after being bent for a long time. Cables provided together with low-power servo motors shall not be moved.
- If a cable drag chain is used, ensure that the following requirements are met.
  - The bending radius of the cable is at least 10 times its outer diameter.
  - Do not fix or bundle the cables inside the cable drag chain. The cables can be bundled and fixed only at two unmovable ends of the cable drag chain.
  - Do not wind or twist the cable.
  - The space factor inside the cable drag chain cannot exceed 60%.
  - Do not mix cables with great differences in size. This is to prevent thin cables from being crushed by the thick cables. To use them together, place a spacer between them.

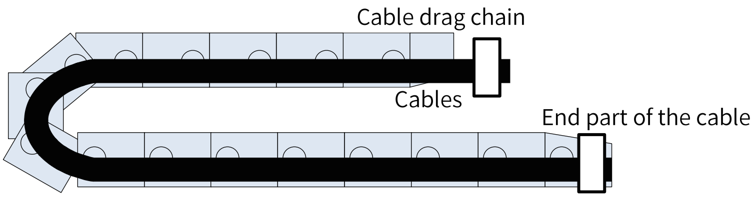


Figure 7-42 Cable drag chain

8 Commissioning Tool

8.1 Keypad

8.1.1 Components

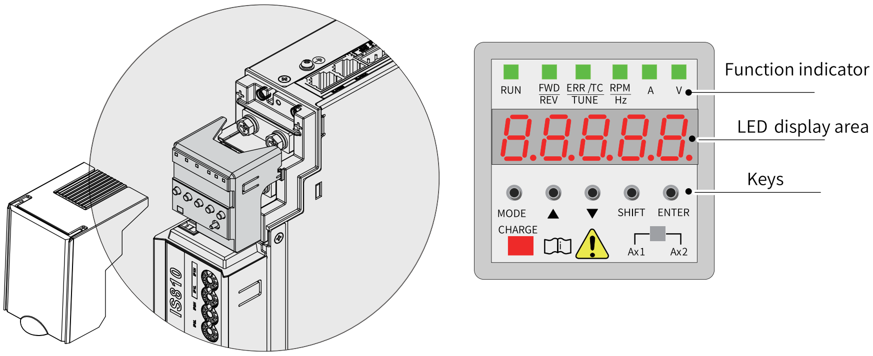


Figure 8-1 Magnified view of the keypad

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

Key	Name	Function
MODE	MODE	Used to switch among different modes. Return to the previous menu.
▲	Increment key	Used to increase the value of the blinking digit.
▼	Decrement key	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	OK 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

LED Display	Actual Data	LED Display	Actual Data	LED Display	Actual Data	LED Display	Actual Data
0	0	7	7	E	E	P	P
1	1	8	8	F	F	r	R
2	2	9	9	H	H	t	T
3	3	A	A	J	J	u	U
4	4	b	B	L	L	U	V
5	5, S	C	C	n	N	y	Y
6	6	d	D	o	O	8.	Axis 2

DIP switch

- **Hardware DIP switch of the communication address**

  IS810N has four DIP switches, which are divided into two groups for setting the axis address and node address.

  - The first group of DIP switches are IP1H and IP1L.
  - The second group of DIP switches are IP2H and IP2L.

  1. Axis address

     The axis address (H0E.02) is determined by the IS810N-INT DIP switch.

     The first group of DI switch values is loaded to axis 1 and the second group of DI switch values is loaded to axis 2.

     The axis address is only displayed in the serial port and Ethernet software tool.

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

  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.

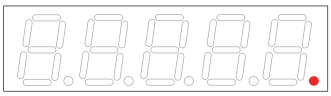
     - When H0E.08 is set to 1, the node address is determined by the first group of DIP switches. In this case, H0E-00 is used for display.
     - When H0E.08 is set to 0, the node address must be set through H0E.00.

- **DIP switches for axis selection**

IS810N-INT is equipped with two DIP switches, which are Ax1 and Ax2 (Ax2 is only available for dual-axis servo drive).

When you set the DIP switch to AX1, parameters of axis 1 will be commissioned. When you set the DIP switch to Ax2, parameters of Ax2 will be commissioned.

Function indicators

State		Description
RUN Operation indicator	RUN	OFF: stop or fault
	RUN	ON: Run
FWD/REV Forward/Reverse run indicator	FWD/REV	OFF: Forward
	FWD/REV	ON: Reverse
ERR/TC/TUNE Fault/Torque control/ Tuning indicator	ERR/TC/TUNE	ON (green): Running normally
	ERR /TC/TUNE	Quick blinking (red): Fault state (4 blinks/ s)
RPM/Hz A V		Frequency unit: Hz
RPM/Hz A V		Current unit: A
RPM/Hz A V		Voltage unit: V
		This point indicates the current operation axis: Solid off: Parameters of Ax1 are being operated currently. Solid on: Parameters of Ax2 are being operated currently.

8.1.2 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.

Mapping 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:

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

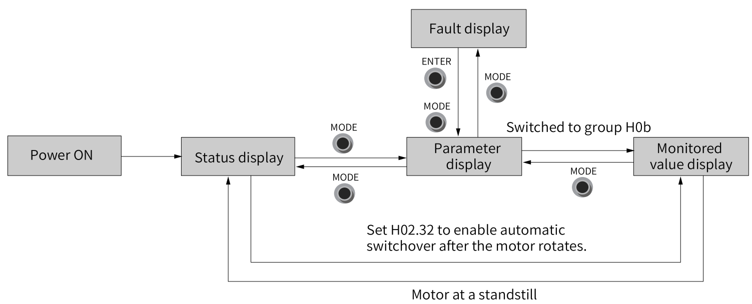
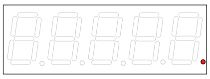
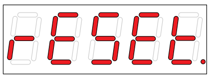
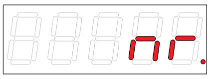
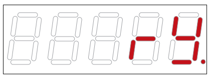
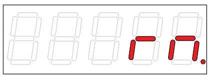
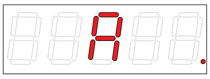
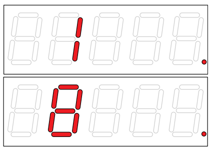
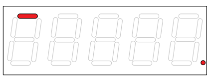
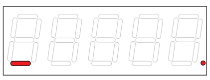


Figure 8-2 Switchover among different display modes

- 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 147* .
- 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 SET to stop the LEDs from blinking, and then press MODE to switch to parameter display.

Status display

Display	Name	Applicable Occasion	Meaning
	Current operating axis (as example only)	This is the parameter display interface after you select an axis using axis 1/axis 2 DIP switch	Parameters displayed on the keypad 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 Servo not ready (Not ready)	Initialization done, but servo drive not ready.	The servo drive is not ready to run because the main circuit is not powered on. For details, see Chapter "Troubleshooting".
	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
	1–8 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	Solid OFF: No communication connection is detected in the physical layer. Solid on: Communication connection is detected in the physical layer.
	CN4 connection indication	CN4 is connected successfully when EtherCAT is input	

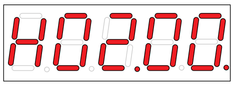
Parameter Display

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

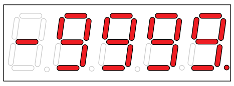
Display	Name	Description
HXX.YY	Parameter group	XX: Parameter group No. (decimal) YY: Offset within the parameter group (hexadecimal)

For example, H02.00 is displayed as follows:

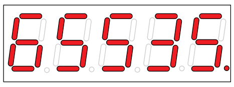
Display	Name	Description
	See H02.00.	02: Parameter group No. 00: Offset within the parameter group

- 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:

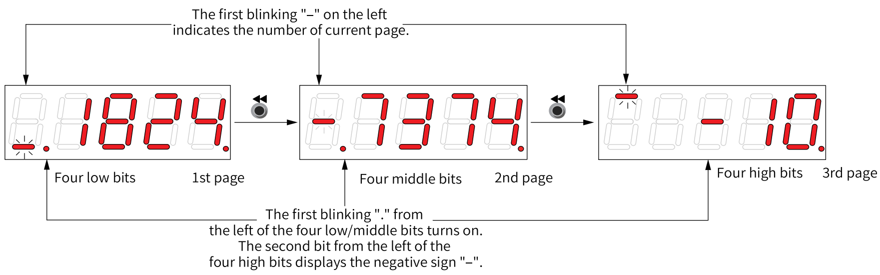


Figure 8-3 Display of "-1073741824"

Example: "1073741824" is displayed as follows:

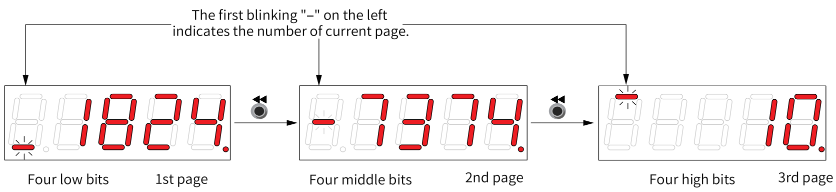
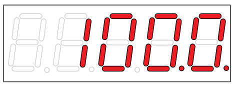
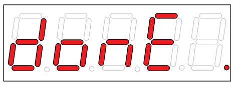
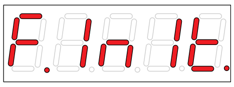
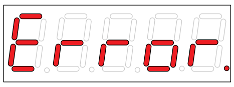
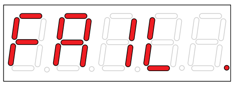


Figure 8-4 Display of "1073741824"

- 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

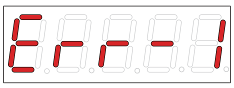
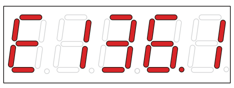
- Display of parameter setting status

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 error code immediately. When multiple faults or errors occur, the keypad displays the fault or error code of the highest fault level.
- Set in H0b.33 the number of history faults that can be viewed. View H0b.34 to display the selected fault or alarm codes.
- You can clear the latest 10 faults or alarms saved in the servo drive by setting H02.31 to 2.

Example: E136.1 is displayed as follows for axis 1.

Display	Name	Description
 	Err-1 E136.1 Displays the current fault code.	Err-1: Fault or alarm occurred on the servo drive axis 1 E136.1: Current fault code

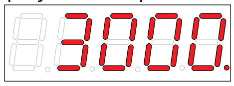
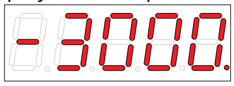
Note

- If axis 1 reports E136.1, the keypad flashes Err-1 E136.1 alternatively.
- If axis 2 reports E210.4, the keypad flashes Err-2 E210.4 alternatively.
- If axis 1 reports E136.1 and axis 2 reports E210.4, the keypad flashes Err-1 E136.1 Err-2 E210.4 alternatively.

Monitored value display

- Group H0b: Displays the parameters for monitoring the running status of the servo drive.
- Set H02.32 (Default keypad display) properly. After the motor operates normally, the keypad switches from status display to parameter display. The parameter group number is H0b and the offset within the group is the setpoint of H02.32.
- For example, if H02.32 = 00, the keypad displays the value of H0b.00 if the servo motor speed is not 0.

The following table describes the H0b.00.

Param.	Name	Unit	Meaning	Example
H0b.00	Motor speed actual value	rpm	The actual motor speed after round-off is displayed, in unit of 1 rpm.	Display of 3000 rpm:  Display of -3000 rpm: 

Note

For details of parameter group H0B, see *"19.1 Display of Monitoring Parameters" on page 565*

8.1.3 Parameter Settings

Example of parameter settings

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

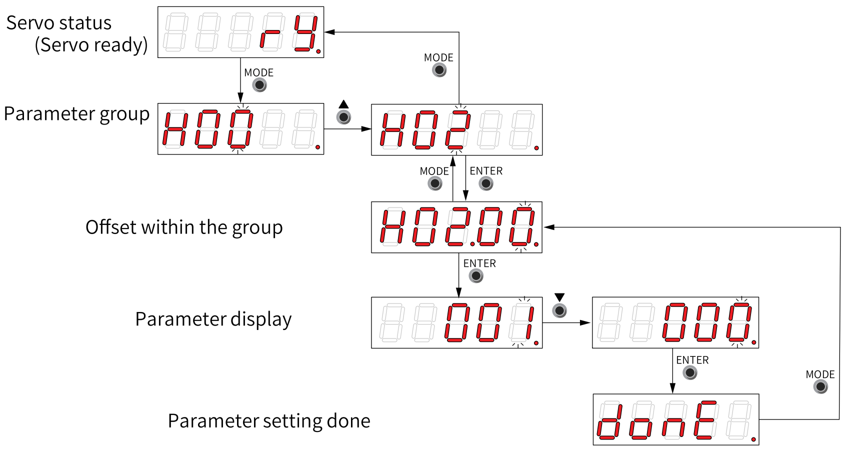


Figure 8-5 Example of parameter setting

- 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 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".

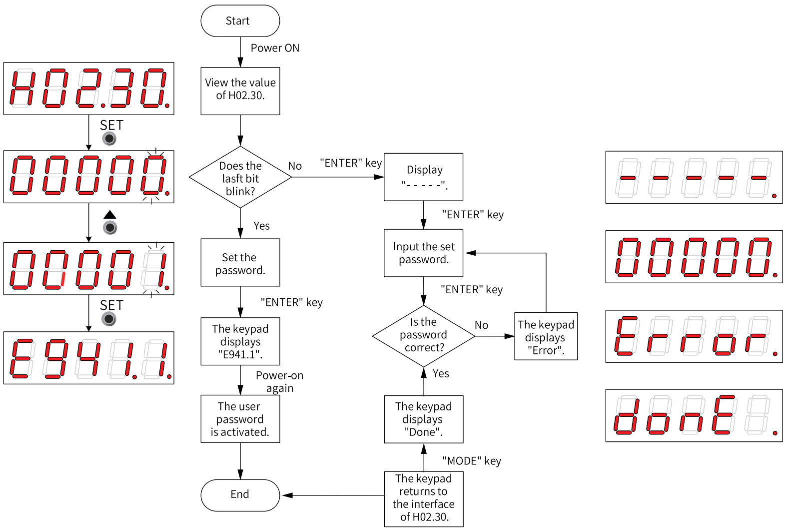


Figure 8-6 Procedure for setting the user password

To change the user password, input current password first to authorize the access to parameter setting. Enter H02.30 again, and you can set a new password according to the method described in the preceding figure.

Note

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

- Canceling 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)

The function setting of group H03 consists of three digits. The first digit is for setting the axis No. and last two digits are for assigning terminal functions. See the following dotted line frame in red for details.

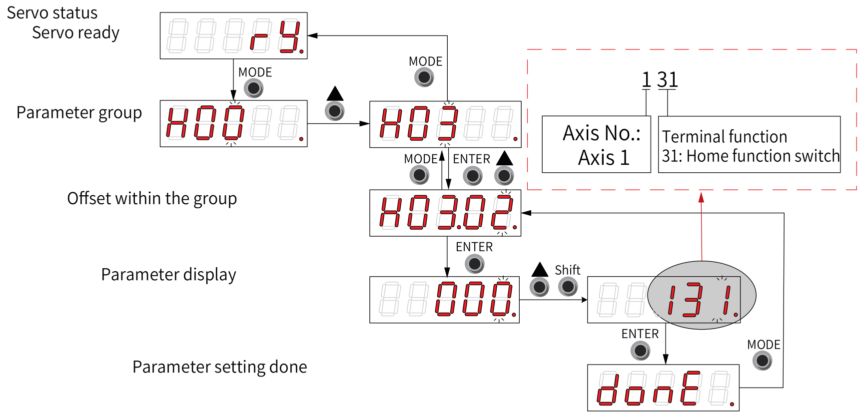


Figure 8-7 Procedure for DI function setting

Example: To set DI1 and DI2 as the home signals of two modules respectively, set H03.02 to 131 and H03.04 to 231 through the software tool or the keypad.

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 assigning functions. See the dotted line frame in red for details.

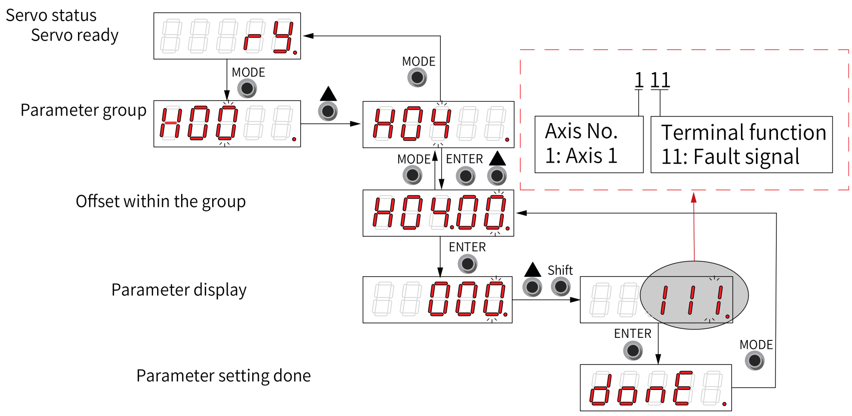


Figure 8-8 Procedure for DO function setting

Example: To set DO1 and DO2 as the fault signals of 2 modules respectively, set H04.00 to 111 and H04.02 to 211 through the software tool or keypad.

Note

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

8.2 Commissioning Software

8.2.1 Overview

The software tool InoDriverShop can be downloaded from http://www.inovance.com.

Use S6-L-T04 or CaT 5e (or higher standards) cables for communication between IS810 and PC.

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

8.2.2 Installation

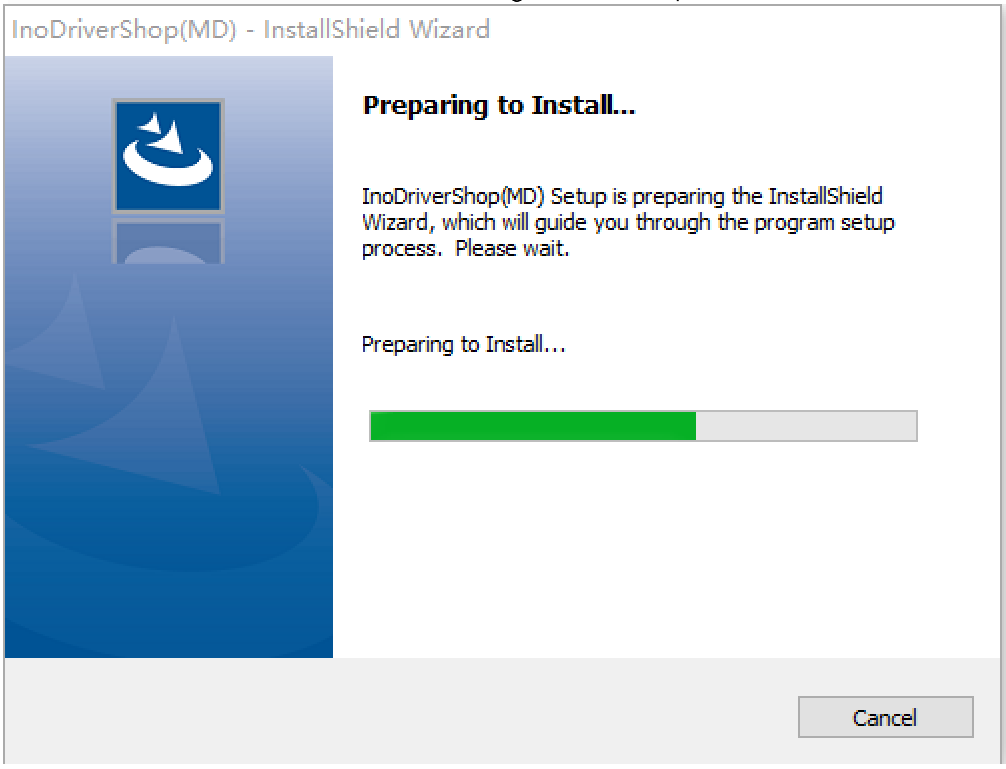
1. Software

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

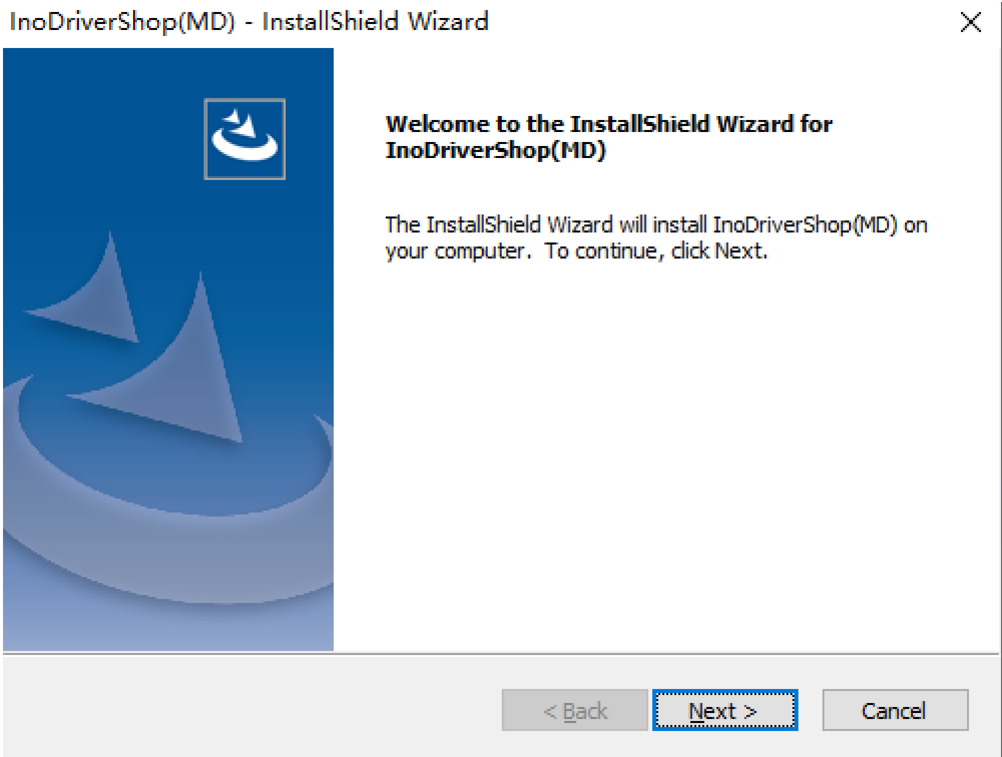
   b. Choose Support → Download, and then type in the keyword InoDriverShop and click Search.
   c. Click Download.

2. Unzip the package downloaded.

3. Click IDS InoDriverShop.exe to start installing InoDriverShop.

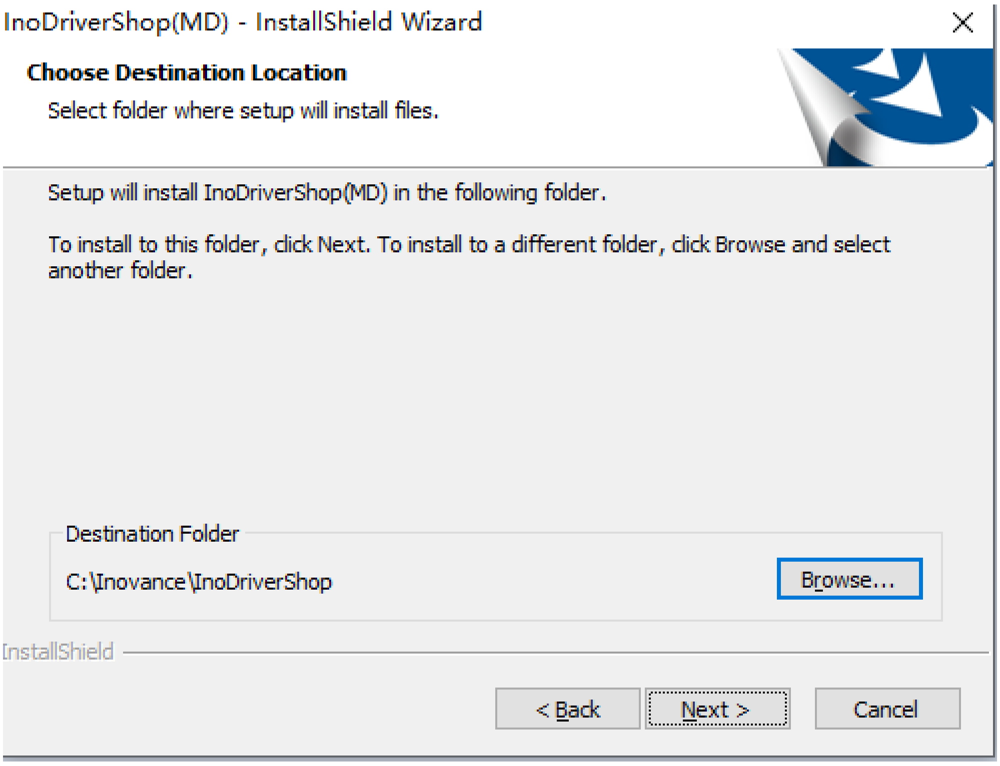


4. Click Next.

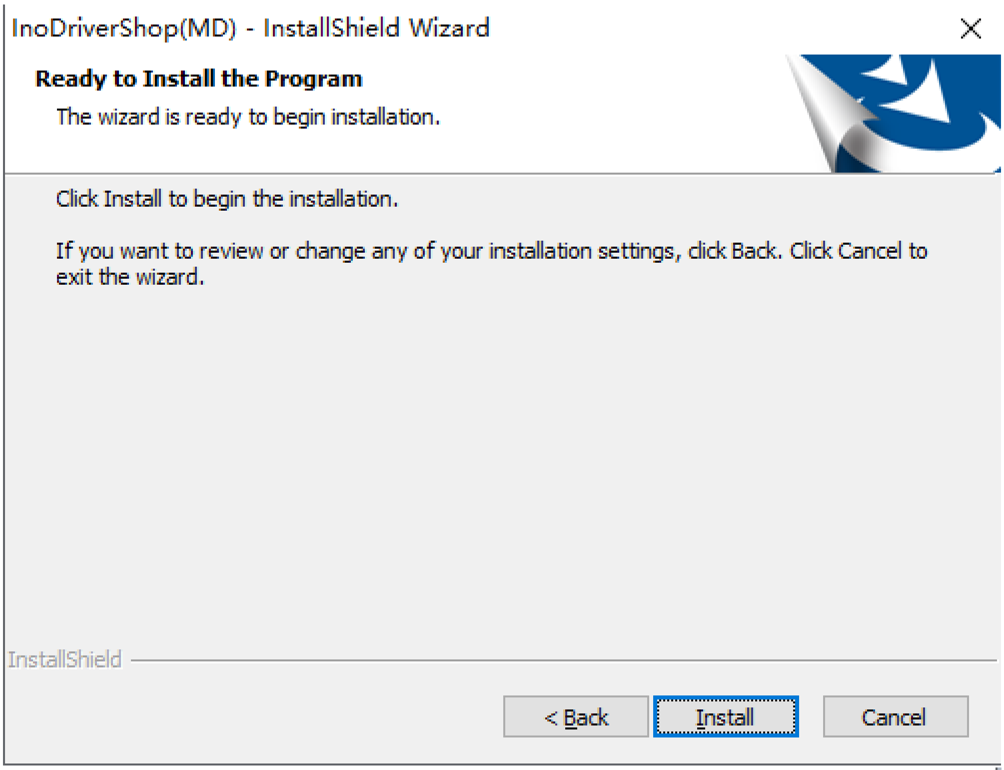


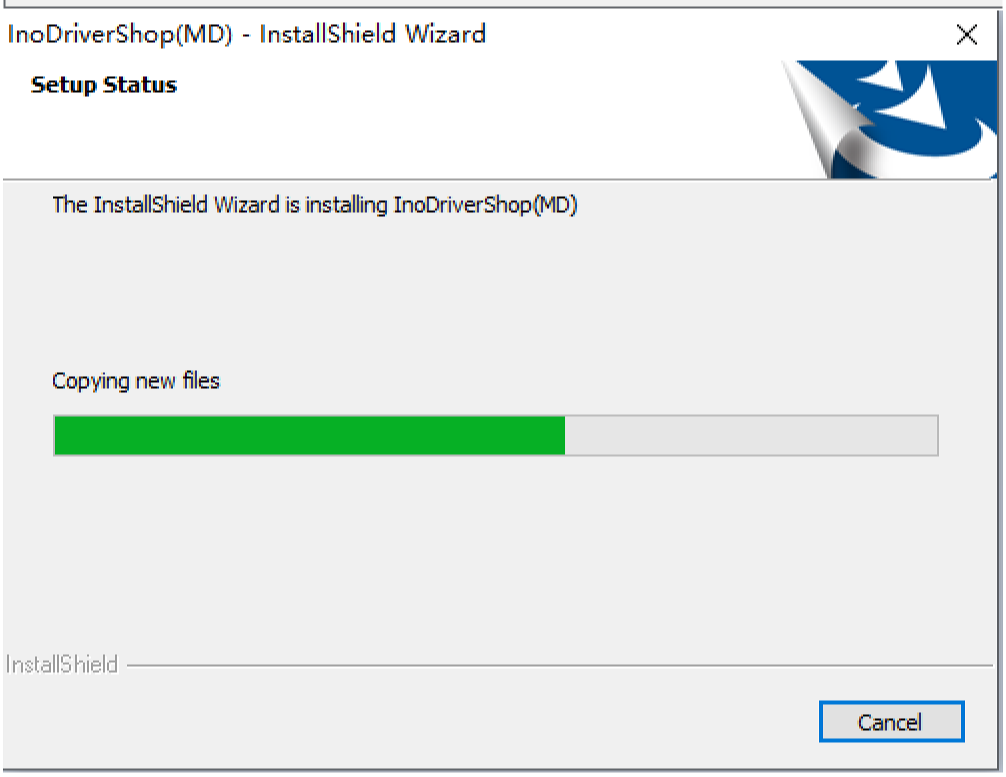
5. You can select the directory for installation as needed through the Browse button. The default directory for installation is "C:\Program Files\Inovance\InoDriverShop".
   In online upgrade, InoDriverShop will be upgraded directly in the original directory.

   After selecting the directory for installation, click Next.

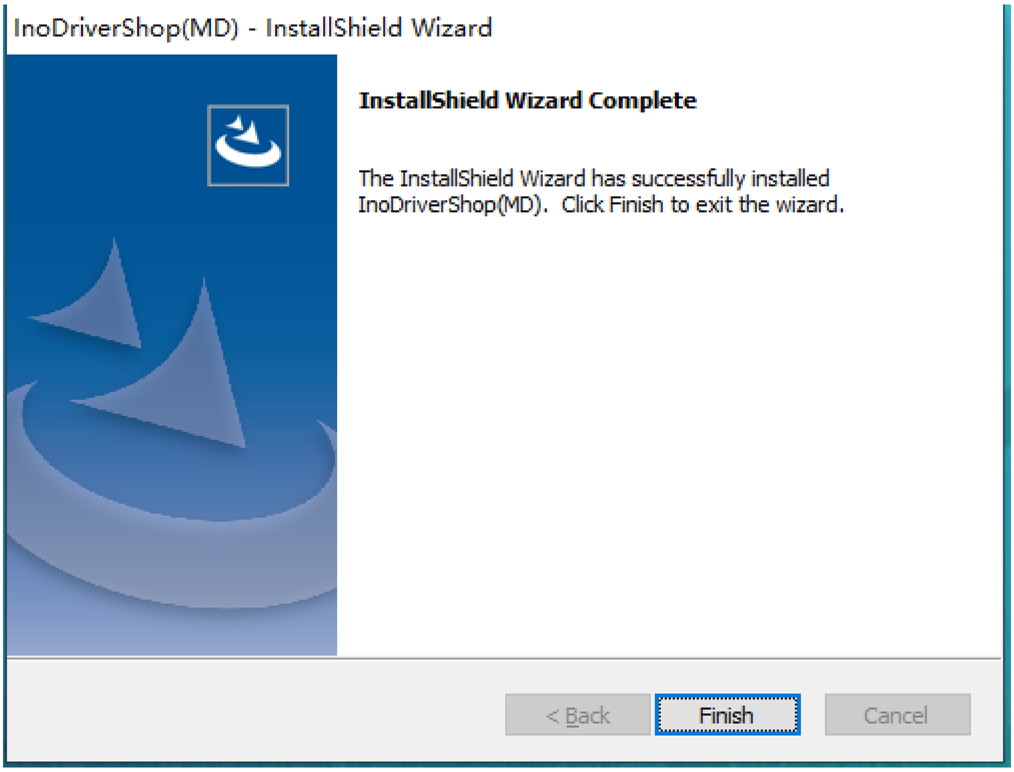


6. Click Install to start installation.





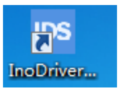
7. After installation is done, click Finish.



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

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 ① shown in the following figure to create a project.

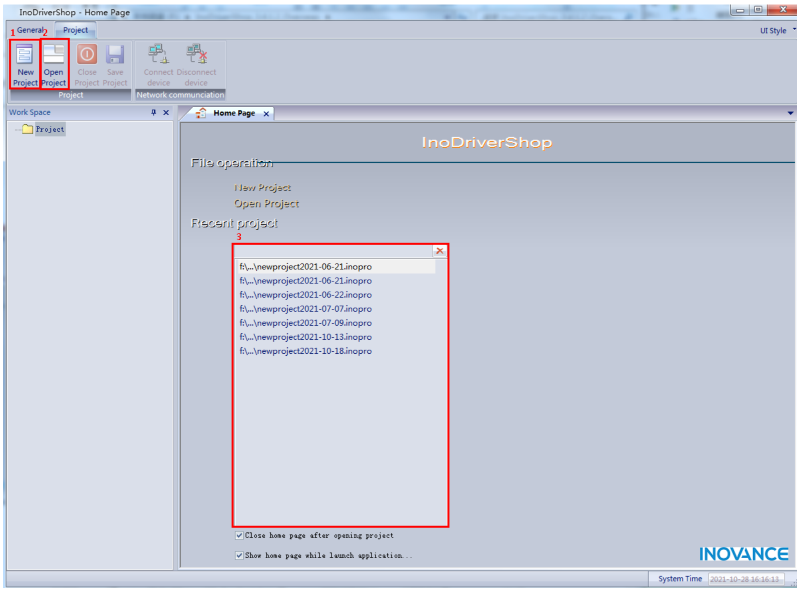


Figure 8-9 Start interface

Note

You can click 2 or 3 shown 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.

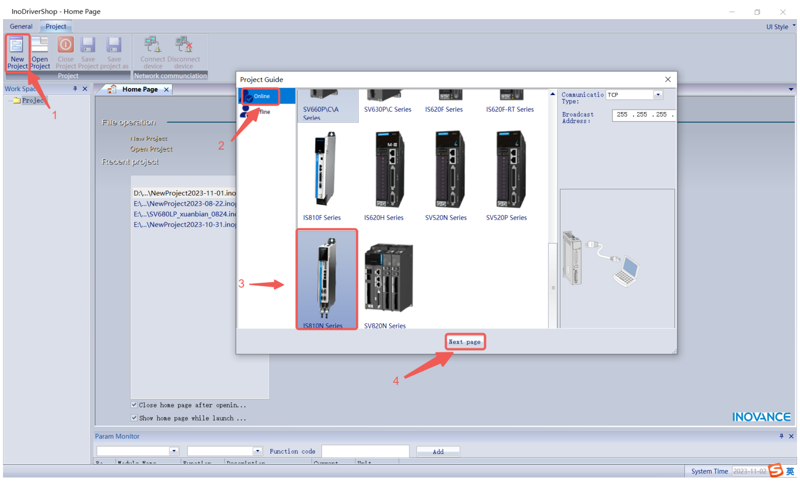


Figure 8-10 Project Guide interface

c. Click Next page to create a 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.

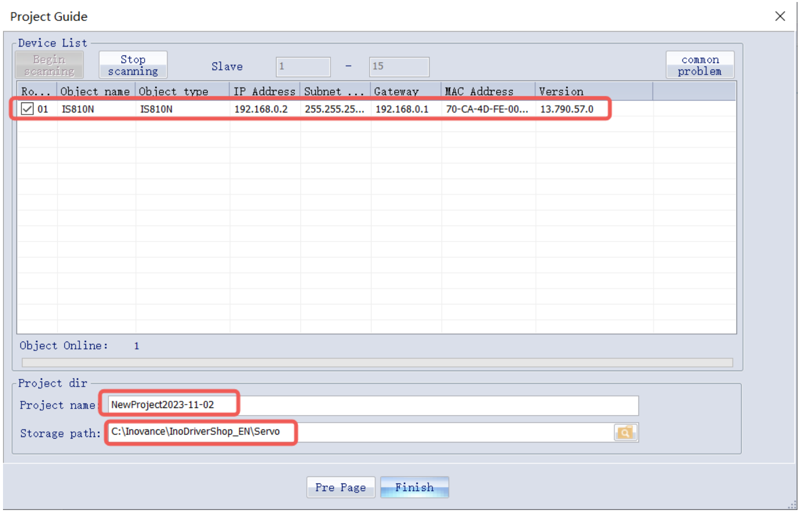


Figure 8-11 Scan interface

- 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 and add different standards or customized devices. You can also designate the directory for storage or create multiple offline devices.

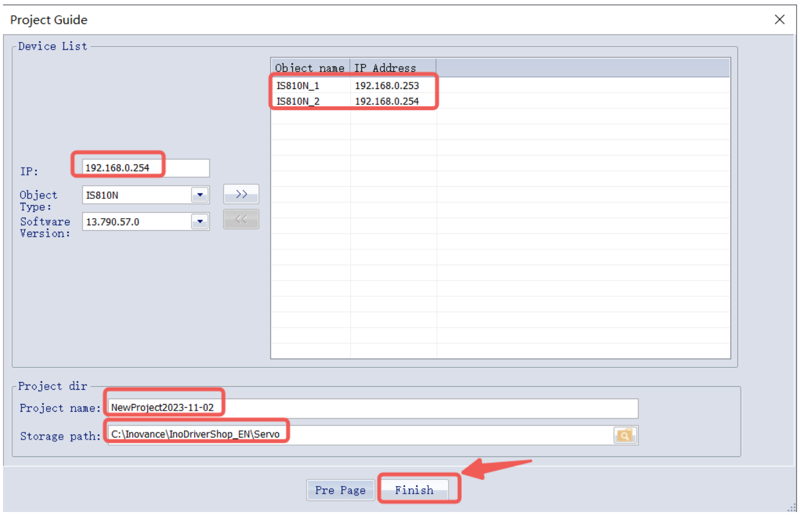


Figure 8-12 Project Guide interface for offline device

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.

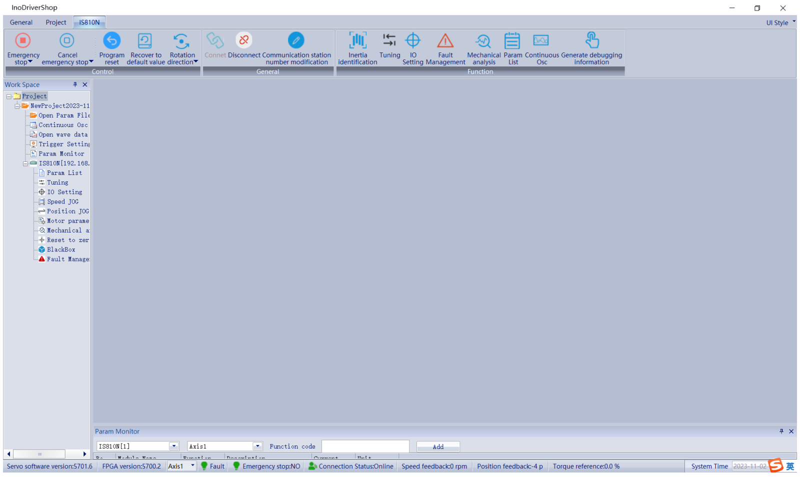
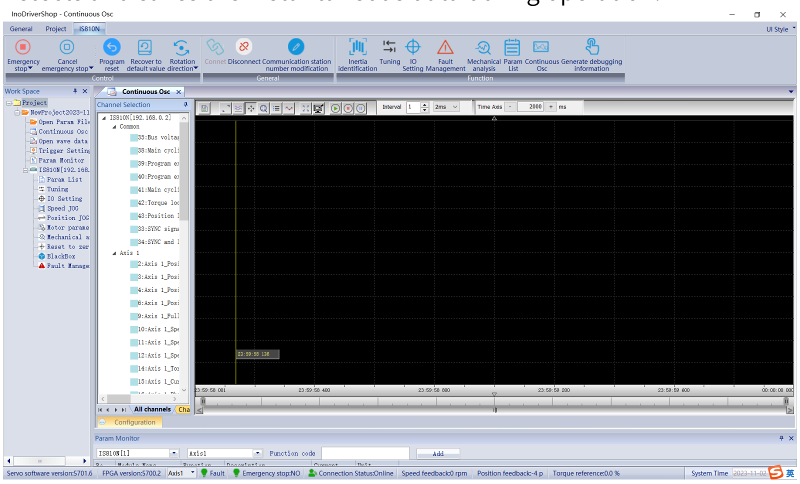


Figure 8-13 Main Interface

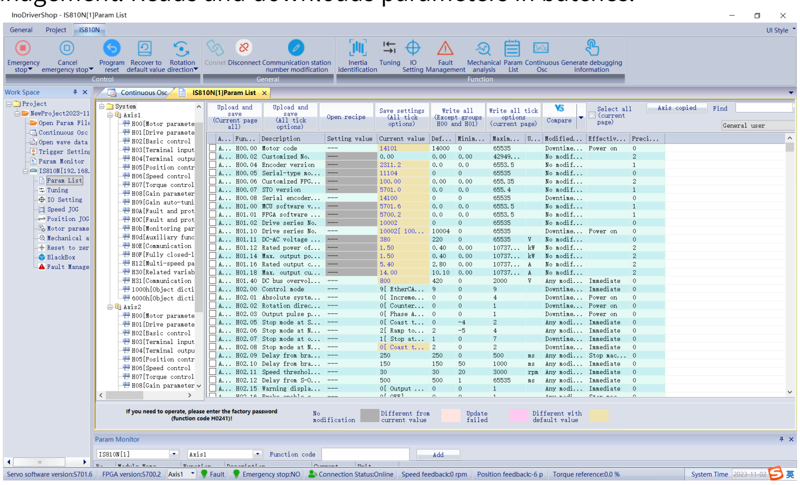
8.2.4 Common Functions

InoDriverShop features the following functions:

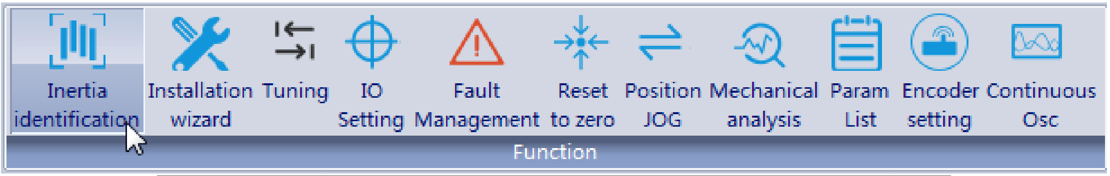
- Oscilloscope: Detects and saves the instantaneous data during operation.

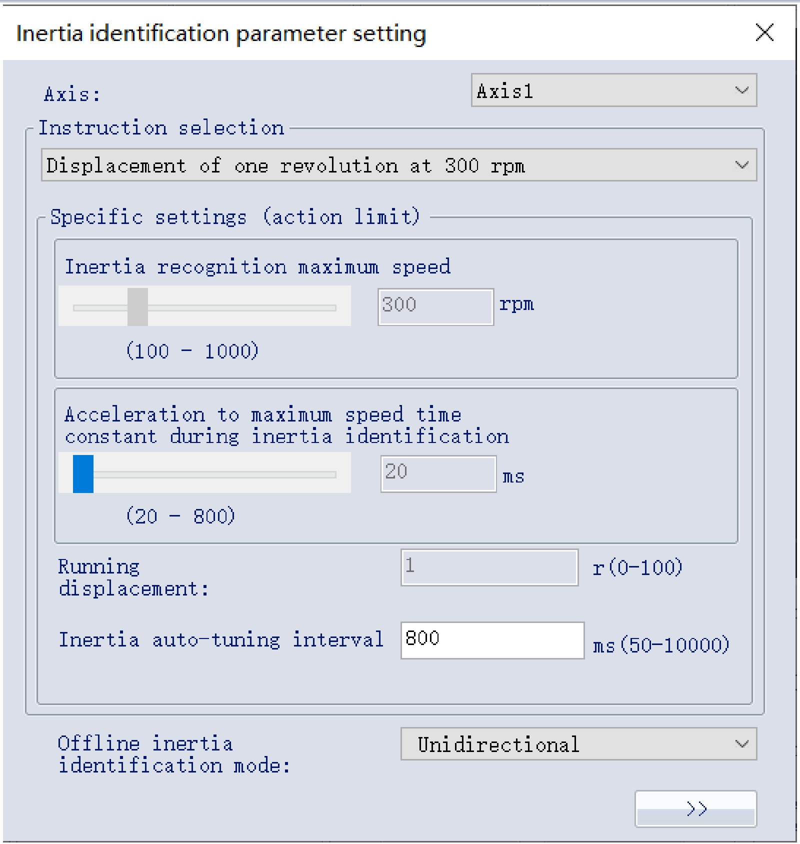


- Parameter management: Reads and downloads parameters in batches.

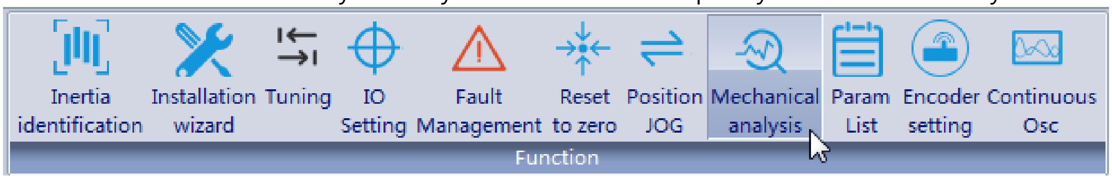


- Inertia auto-tuning: Generates the load inertia ratio automatically.

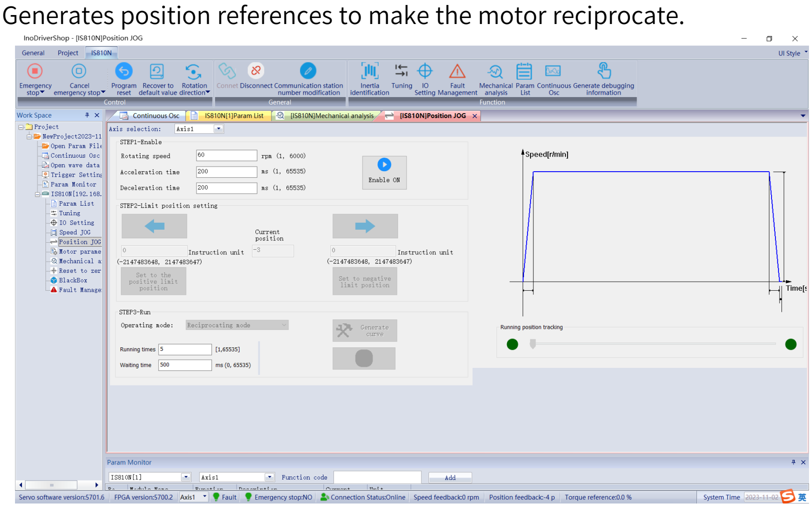




- Mechanical characteristic analysis: Analyzes the resonance frequency of the mechanical system.

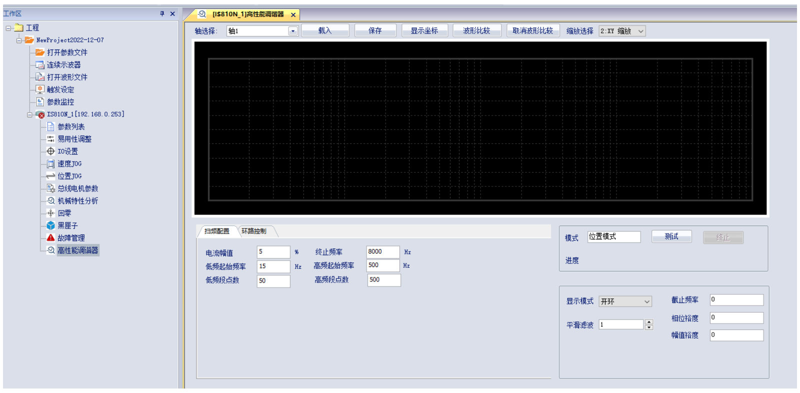


- Motion JOG: Generates position references to make the motor reciprocate.



- Gain tuning: Adjusts the stiffness level and monitors the motion data.

- High-performance tuner: Supports frequency domain auto-tuning, visualized virtual commissioning, and control parameter auto-tuning.
  - In frequency domain auto-tuning, the mechanical characteristics, open-loop characteristics, and closed-loop characteristics of the control system can be auto-tuned.
  - In visualized virtual commissioning, accurate virtual commissioning on the control system can be achieved.
  - The control parameter auto-tuning is performed based on the frequency domain.



9 Commissioning and Operation

9.1 Commissioning Flowchart

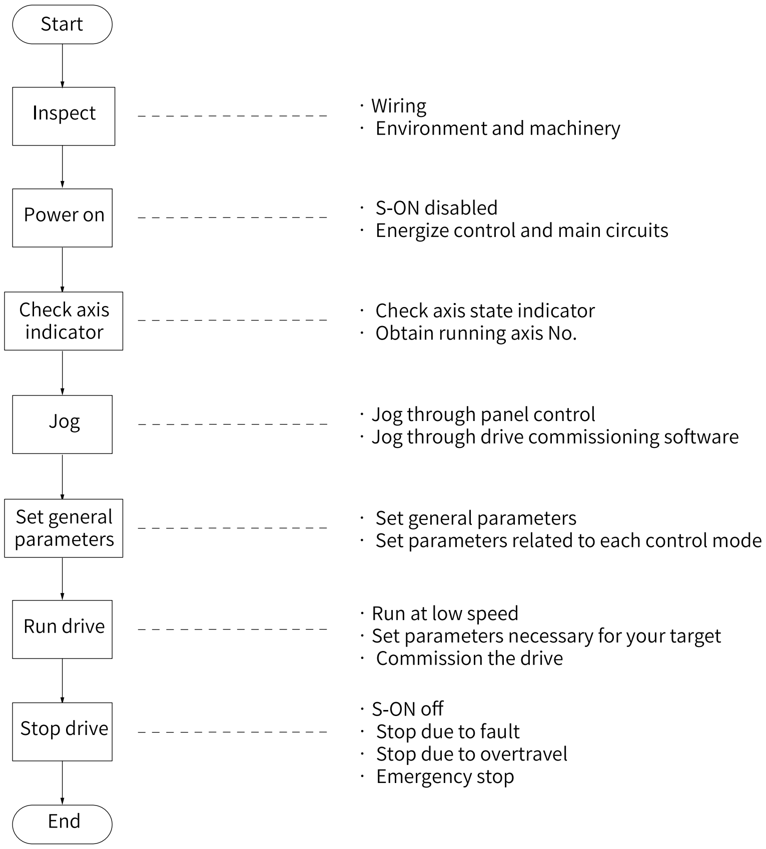


Figure 9-1 Commissioning flowchart of the drive

9.2 Inspection Before Commissioning

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

Table 9–1 Checklist before operation

Record	No.	Description
Wiring		
□	1	The main circuit power input terminals R, S, T of the power supply unit are connected correctly. The specifications of the input power supply is: 380 VAC to 480 VAC, 50/60 Hz.
□	2	The U/V/W cables are connected in the correct phase sequence on both ends.
□	3	The control signal cables, such as the brake signal cables and overtravel protection signal cables, 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		

Record	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 machine that connected to the motor are in good condition and ready to run.

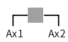
9.3 Power-on

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", "Nrd", and "Rdy" 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 operating axis number and axis status.

Name	Description
Axis status indicator 	Flashing: Axis is faulty ON: The current axis parameter is being operated. OFF: The current axis parameter is not being operated.

You can keep the MODE key pressed down to switch the axes. Observe whether axis 1 or axis 2 is being operated currently.

9.5 Jog

Perform jogging to check whether the servo motor can rotate properly without abnormal vibration or noise. The jog function can be enabled through the keypad speed jog mode, commissioning software speed jog mode , and keypad position jog 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. Adjust the jog speed through the UP/DOWN key and press the SET key to enter the jog state.

   The keypad displays "JOG" at this moment, and the motor is energized.
3. 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

Procedure:

1. Open the Speed JOG interface in the software tool.
2. Switch the drive to any control mode except communication bus control (H02.00 ≠ 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. Adjust the jog speed through the UP/DOWN key and press the ENTER key to enter the jog state.
   The keypad displays "JOG-P" at this moment, and the motor is energized.
3. Hold the UP/DOWN key down to make the motor jog forwardly or reversely.
   Press the MODE key to exit from jogging and return to the previous menu.

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H06.12	2006–0Dh	Acceleration ramp time of jog speed	0 to 65535	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

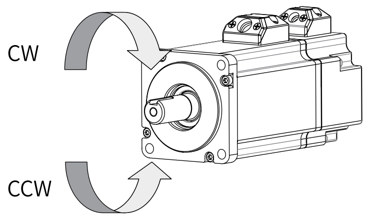
Set H02.02 to change the direction of rotation directly.

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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	Next power-on

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

Setpoint	Direction of rotation	Remarks
0	Counterclockwise (CCW) as forward direction	Defines the CCW direction as the forward direction when a forward run command is received, indicating the motor rotates in the CCW direction when viewed from the motor shaft side.
1	Clockwise (CCW) 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

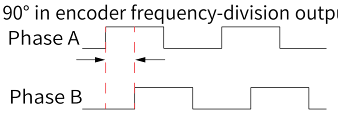
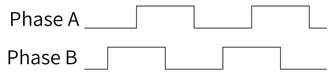
The output pulse of the servo drive is phase A + phase B quadrature pulse.

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

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H02.03	2002–04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	Defines the relation between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.	0	-	UInt16	At stop	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 Range:	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 encoder frequency-division output pulses. 

9.7 Operating the Servo Drive

When the drive is ready to run, 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

Record	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 direction of rotation 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 direction of rotation is correct, view the actual speed in H0b.00 and average load ratio in H0b.12 through the keypad or the software tool.
☐	4	After checking preceding conditions, adjust related parameters to make the motor operate as desired.
☐	5	Commission the drive according to Chapter "Adjustment".

Power-on sequence diagram

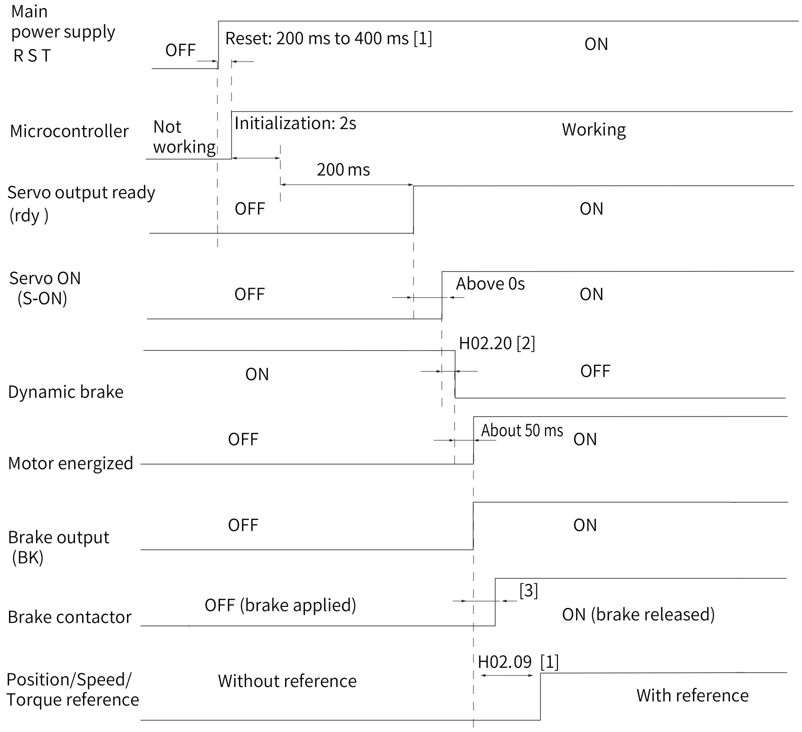


Figure 9-2 Power-on sequence diagram

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] Indicates the delay of brake contactor actions.
- [4] If the brake is not configured, H02.09 is inactive.

Sequence diagram for stop at alarm or fault

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

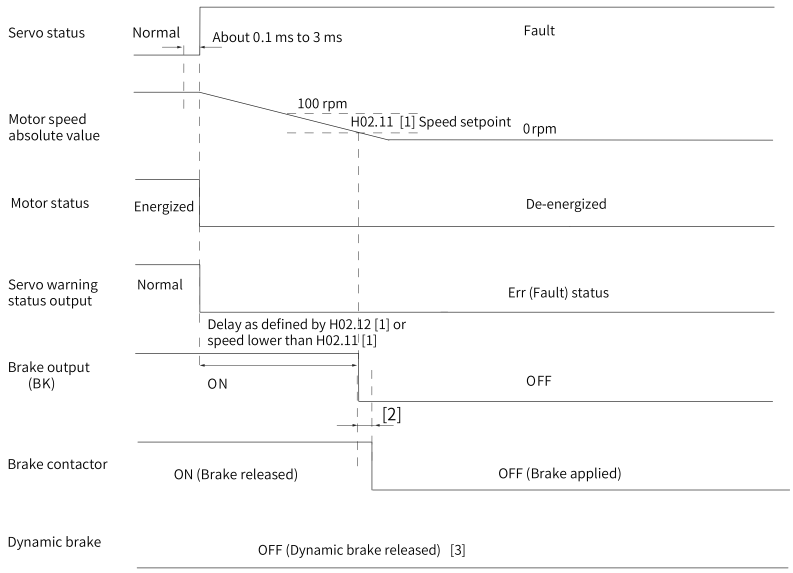


Figure 9-3 Sequence of "Coast to stop, keeping de-energized state" at No. 1 fault

Note

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

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

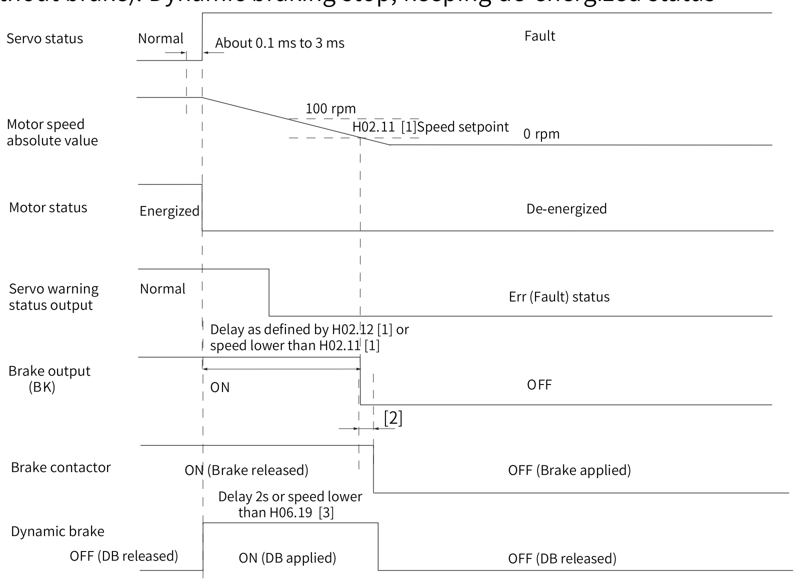


Figure 9-4 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 1 fault

Note

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

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

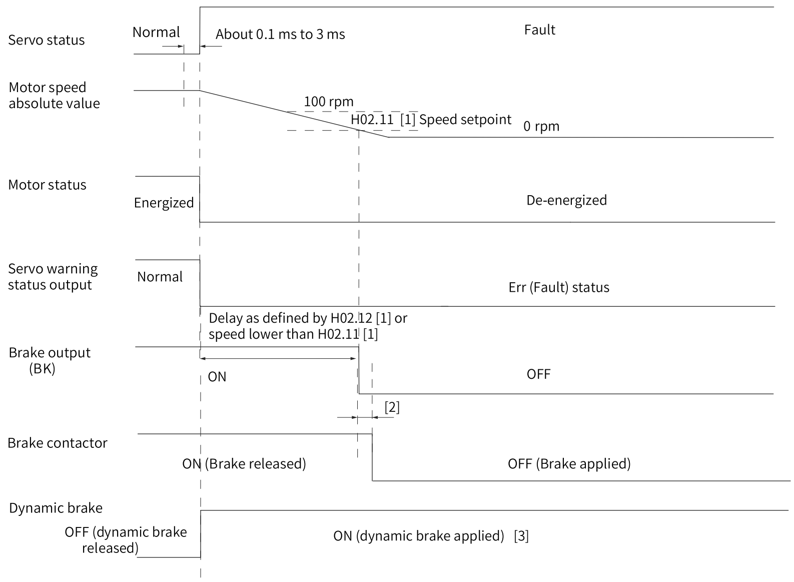


Figure 9-5 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 1 fault

Note

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

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

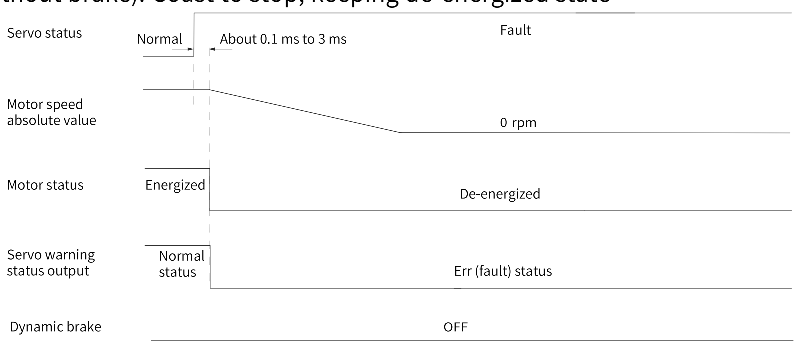


Figure 9-6 Sequence of "Coast to stop, keeping de-energized state" at No. 2 fault

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

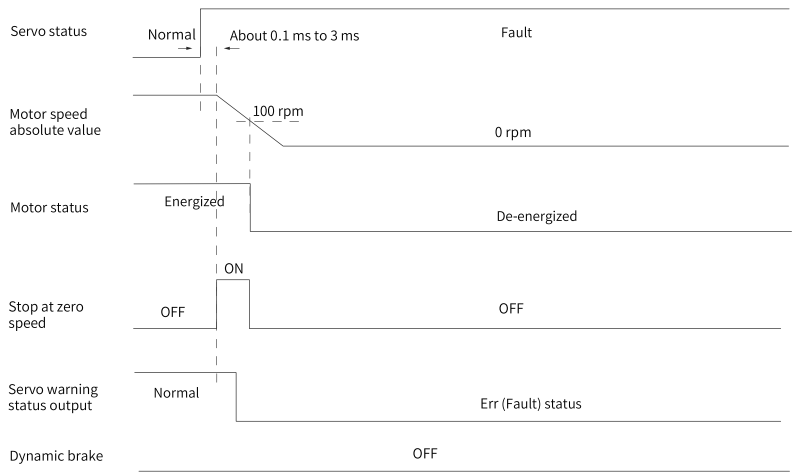


Figure 9-7 Sequence of "Stop at zero speed, keeping de-energized state" at No. 2 fault (without brake)

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

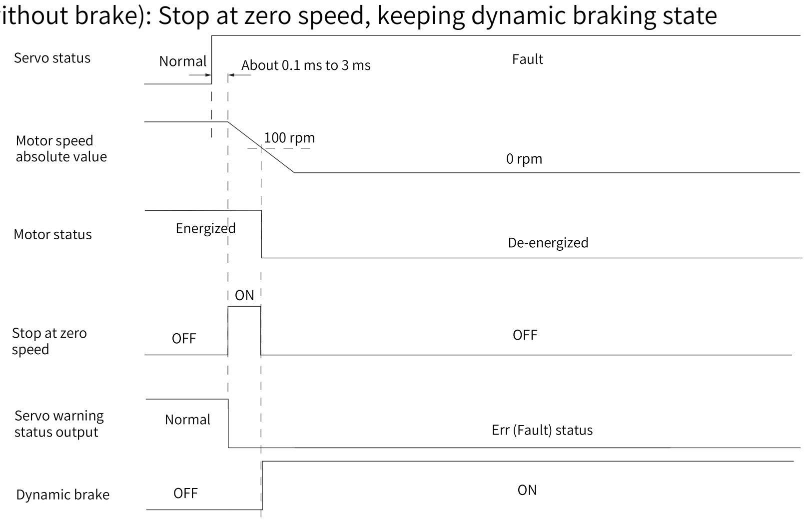


Figure 9-8 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (without brake)

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

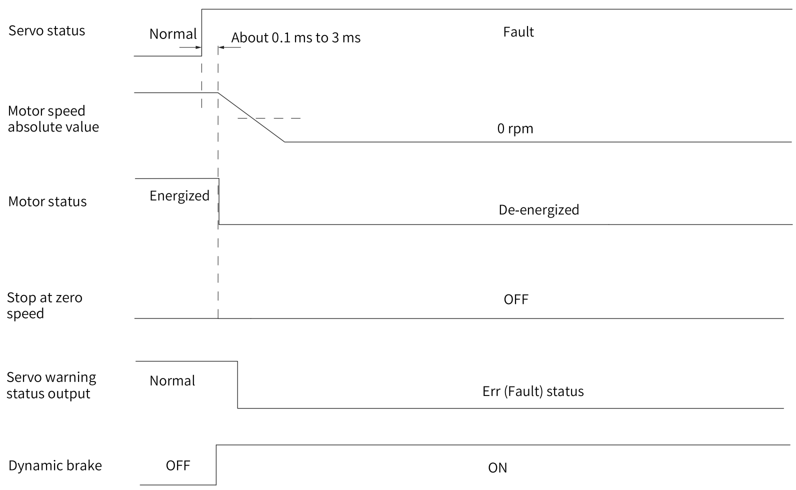


Figure 9-9 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 2 fault (without brake)

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

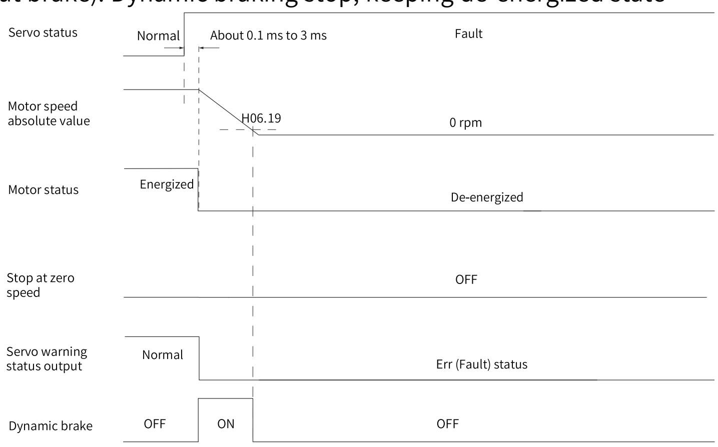


Figure 9-10 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 2 fault (without brake)

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

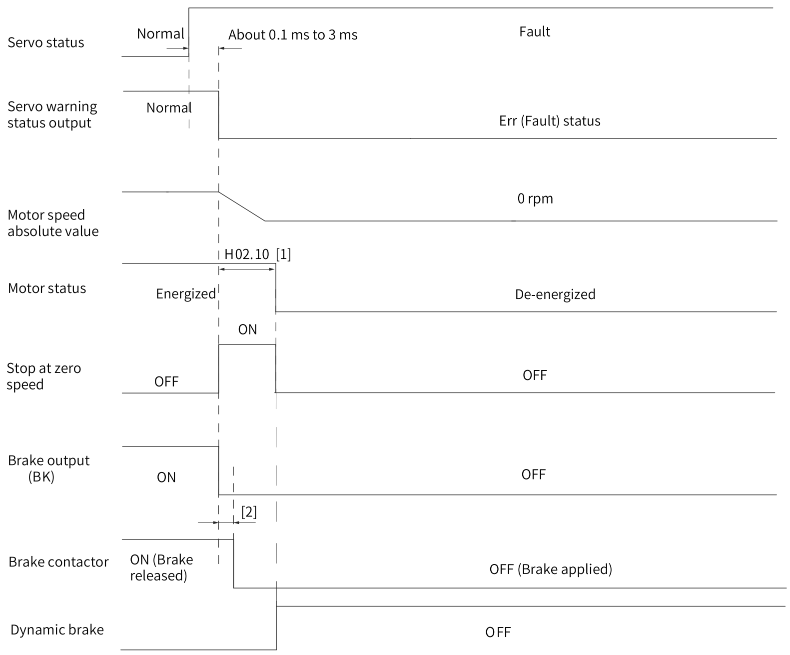


Figure 9-11 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (with brake)

Note

- [1] If the brake is not configured, H02.10 is inactive.
- [2] Indicates the delay of brake contactor actions.

- 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 9–12 Sequence for alarms that cause stop" on page 174*.
- Alarms that cause stop: Stop at zero speed, keeping position lock status

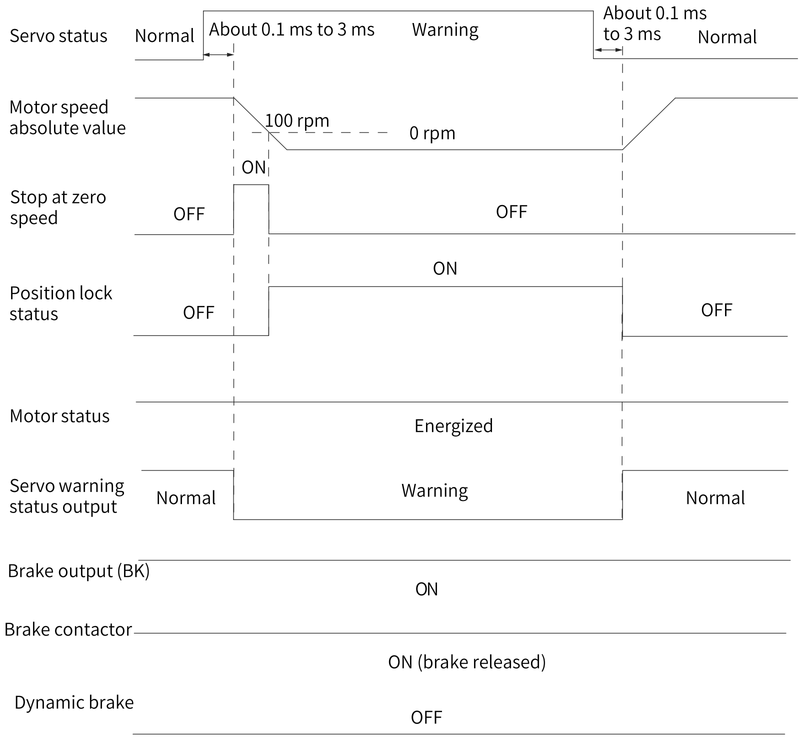


Figure 9-12 Sequence for alarms that cause stop

The other alarms do not affect the operation state of the drive. The sequence diagram for these alarms is shown in *"Figure 9–13 Sequence for alarms that do not cause stop" on page 174*.

- Alarms that do not cause stop

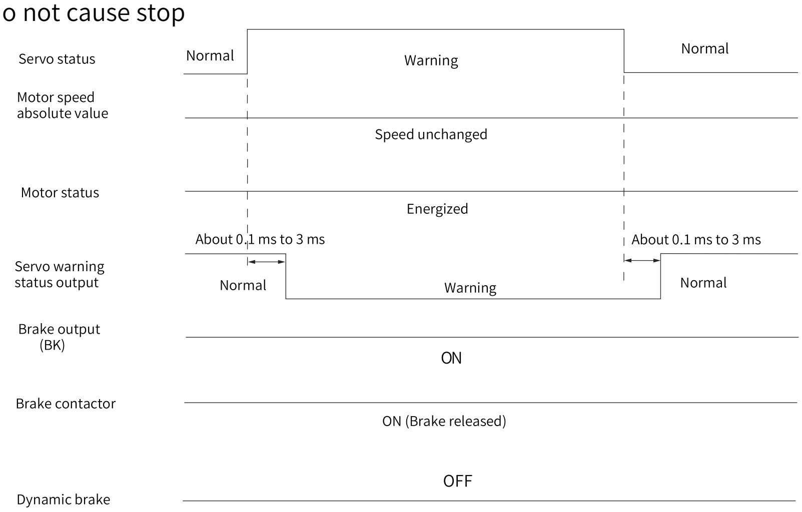


Figure 9-13 Sequence for alarms that do not cause stop

- Fault reset

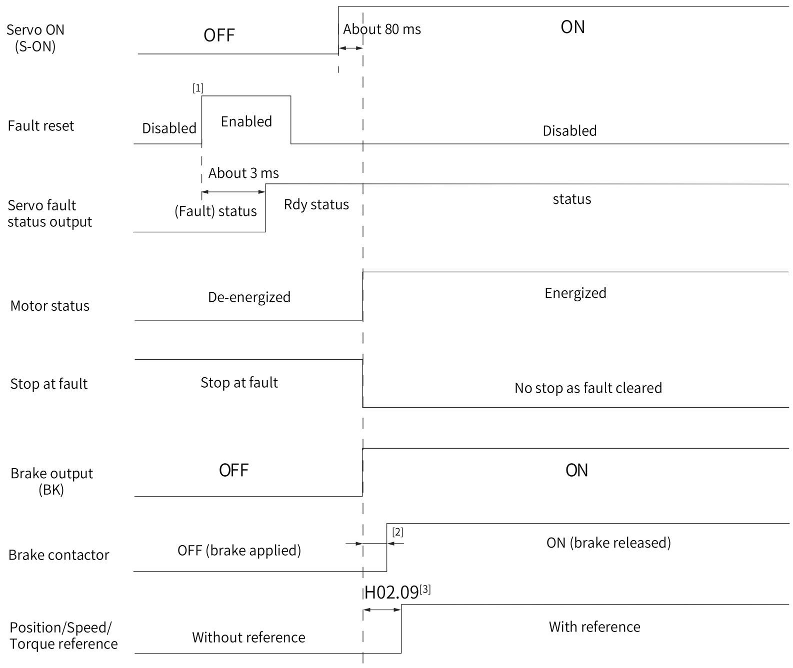


Figure 9-14 Sequence for fault reset

Note

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

9.8 Servo OFF

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 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.	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 dynamic braking 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:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 stop mode at S-ON OFF is forced to "Stop at zero speed, keeping de-energized state"								

Stop at fault

The stop mode varies according to the fault type. For fault classification, see section Troubleshooting.

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H02.08	2002–09h	Stop mode at No.1 fault	0: Coast to stop, keeping de-energized state 1: Dynamic braking stop, keeping de-energized state 2: Dynamic braking stop, keeping dynamic braking state	Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 1 fault occurs.	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 the brake output is enabled, stop mode at No.1 fault is forced to "Dynamic braking stop, keeping de-energized state."									

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 output is enabled, the stop mode at No. 2 fault is set to "zero speed stop, keeping the de-energized state" forcibly.								

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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H02.07	2002–08h	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state 3: Ramp to stop as defined by 6085h, keeping de-energized state 4: Ramp to stop as defined by 6085h, keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel	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.

Setpoint	Stop Mode
0	Coast to stop, keeping de-energized status
1	Stop at zero speed, keeping position lock status
2	Stop at zero speed, keeping de-energized status
3	Ramp to stop as defined by 6085h, keeping de-energized state
4	Ramp to stop as defined by 6085h, keeping position lock state
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" (bit 2 of H0A.71 is 0), 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.

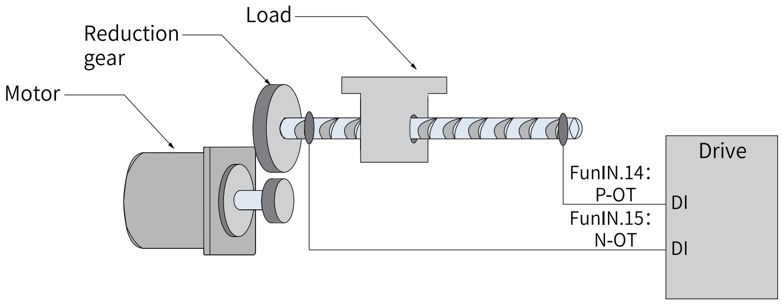


Figure 9-15 Installation of limit switches

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	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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0d.05	200d-06h	Emergency stop	0: No operation 1: Emergency stop	-	0	-	UInt16	Real time	Real time

Defines whether to enable emergency stop.

Setpoint	Function
0	No operation
1	Enable

When this function is enabled, the drive will stop in the stop mode defined by 605Ch.

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:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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.

Setpoint	Stop Mode
0	Coast to stop, keeping de-energized status
1	Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized status
2	Ramp to stop as defined by 6085h, keeping de-energized state
3	Stop at the emergency stop torque, keeping de-energized state
4	N/A
5	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 state
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:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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.

CSP/CST/PP/HM mode:

Setpoint	Stop mode
1	5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock status
2	Ramp to stop as defined by 6085h, keeping position lock state
3	Stop at emergency-stop torque, keeping position lock status

Profile torque mode:

Setpoint	Stop mode
1/2/3	Ramp to stop as defined by 6087h, keeping position lock state

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.

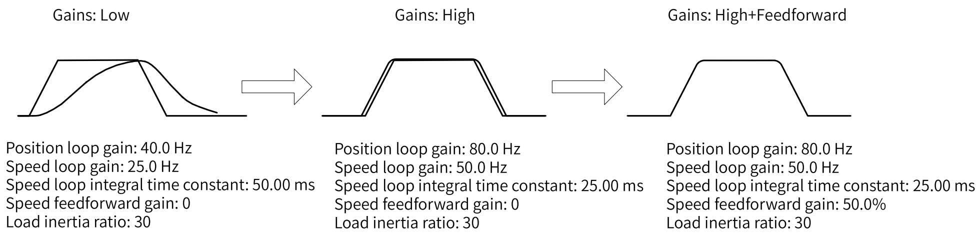


Figure 10-1 Example of gain tuning

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.

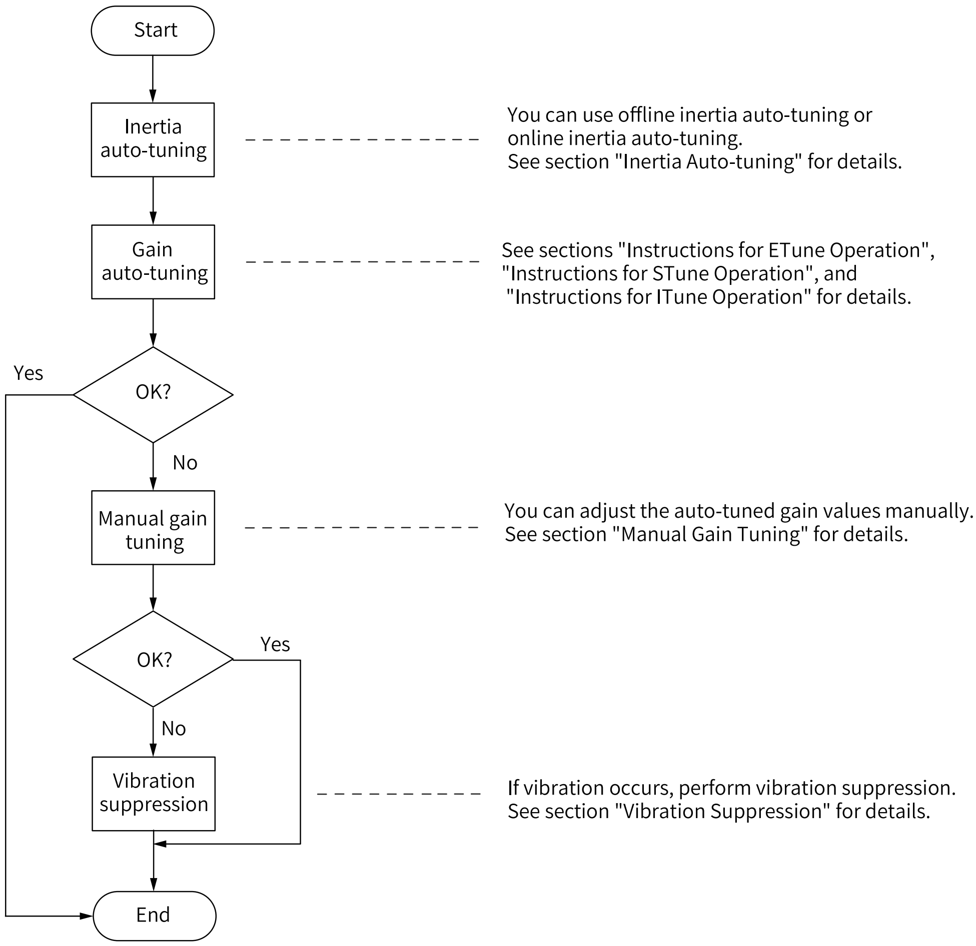


Figure 10-2 Gain tuning process

Table 10–1 Gain tuning process

Gain tuning process			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 186*
		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 188*
2	Gain auto-tuning		The servo drive generates a group of gain parameters based on the correct inertia ratio.	*"10.3.1 ETune" on page 190* and *"10.3.2 STune" on page 195*

Gain tuning process			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 202*
		Reference filter	Smoothens the position, speed, and torque references.	*"10.4.3 Position reference filter" on page 212*
		Feedforward gain	Improves the following behavior.	*"10.4.4 Feedforward Gain" on page 212*
		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 215*
		Torque disturbance observer	Improves the resistance against torque disturbance.	*"10.4.6 Torque disturbance observer" on page 216*
4	Vibration Suppression	Mechanical resonance	Suppresses mechanical resonance through the notch.	*"10.6.1 Mechanical Resonance Suppression" on page 227*

10.2 Inertia Auto-tuning

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

$$\text{Load inertia ratio} = \frac{\text{Total mechnical load moment of inertia}}{\text{Motor moment of inertia}}$$

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

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

The following two inertia auto-tuning modes are available:

- Offline Inertia Auto-tuning
  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 conditions must be fulfilled for an accurate calculation of the load inertia ratio during inertia auto-tuning:

- The actual maximum speed of the motor is higher than 150 rpm.
- The 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

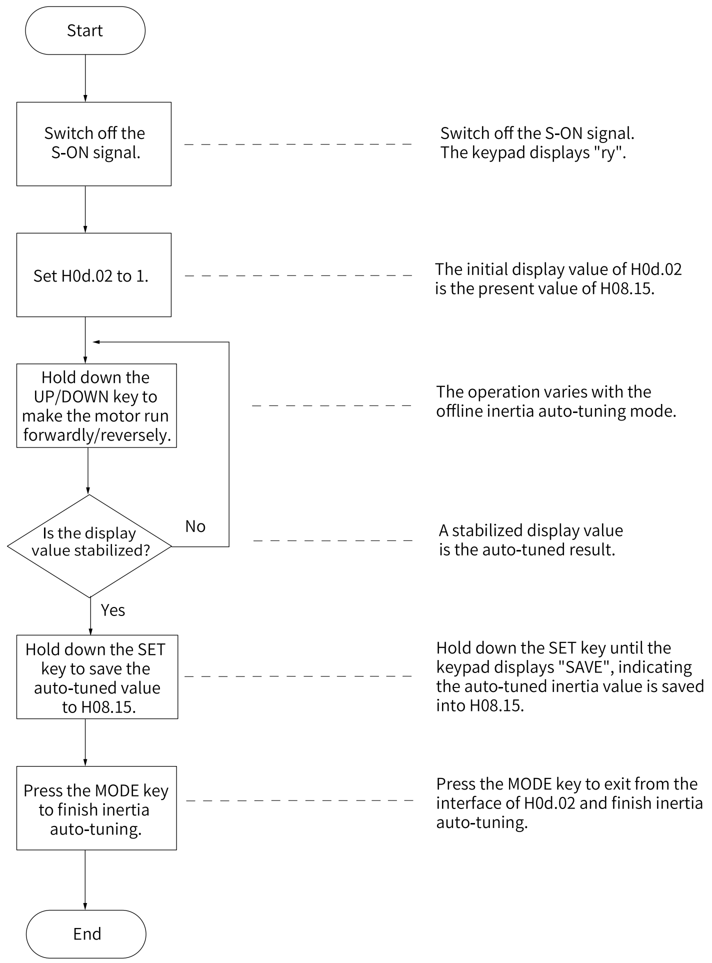


Figure 10-3 Offline inertia auto-tuning flowchart

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 H09.06, H09.07, and H09.09. Ensure that the travel distance available for the motor in the stop position is larger than H09.09. If not, decrease H09.06 or H09.07 until the requirements are met.

Operating procedure:

1. Switch off the S-ON signal.
2. In parameter display mode, switch to H0d.02 and press SET to enable offline inertia auto-tuning.
3. Press the UP/DOWN key to perform offline auto-tuning.
4. To stop the drive, release the UP/DOWN key. To restart auto-tuning, press the UP/ DOWN key again. The operating direction at start is determined by the UP/DOWN key. For applications requiring unidirectional movement, set H09.05 to 1.
5. Wait until the value displayed on the keypad is stabilized.
6. Hold the SET key down until the operating panel displays "SAVE".
7. Press the MODE key to exit.

For 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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 to 1000	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 accelerat ing to max. speed during inertia auto-tuning	20 to 800	Set the time for the motor to accelerate from 0 rpm to the maximum speed for inertia auto-tuning (H09.06) in offline inertia auto-tuning.	125	ms	UInt16	At stop	Real time
H09.08	2009–09h	Interval time after an individual inertia auto-tuning	50 to 10000	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 SET 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.

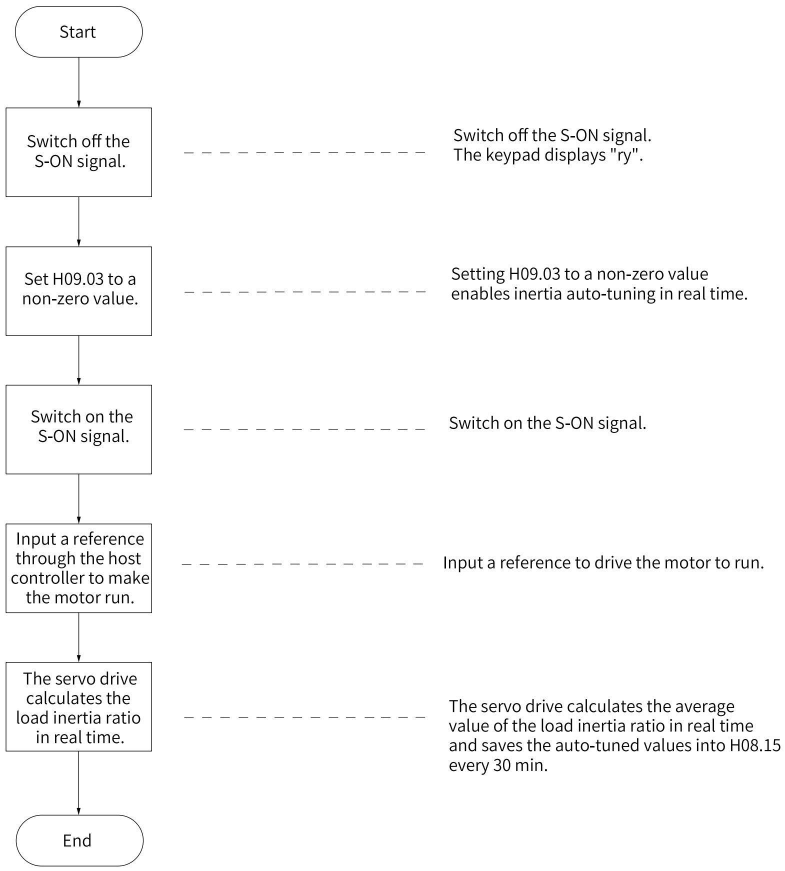


Figure 10-4 Online inertia auto-tuning flowchart

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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 Gain Auto-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.

Action

- **Operation flowchart**

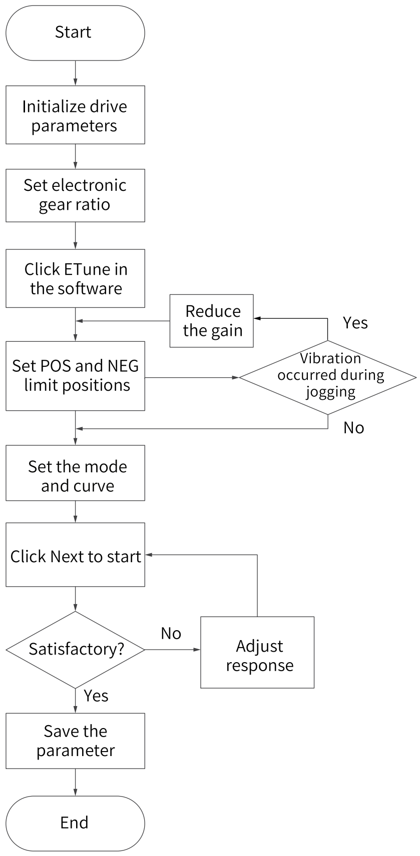
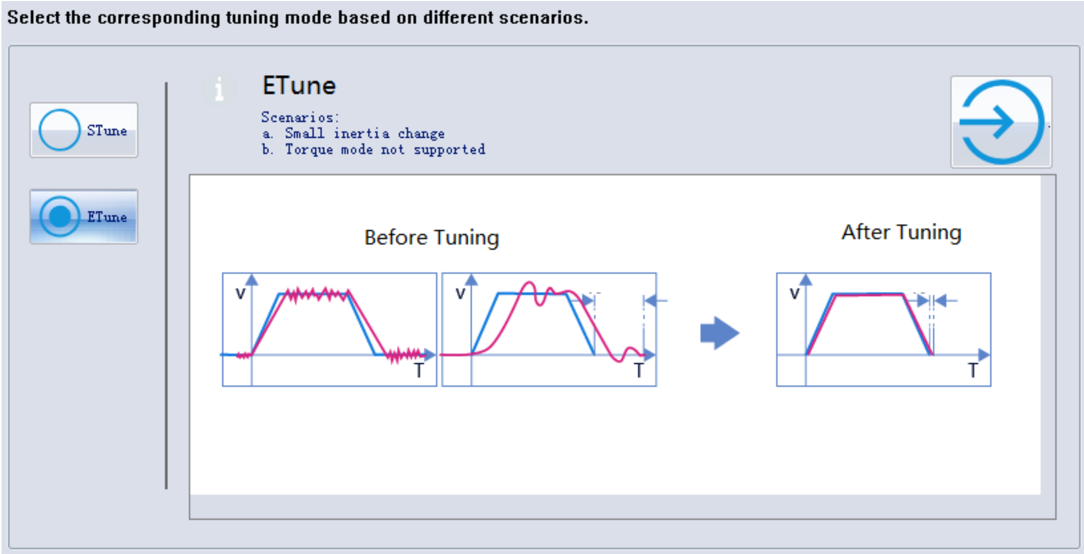


Figure 10-5 Operation flowchart

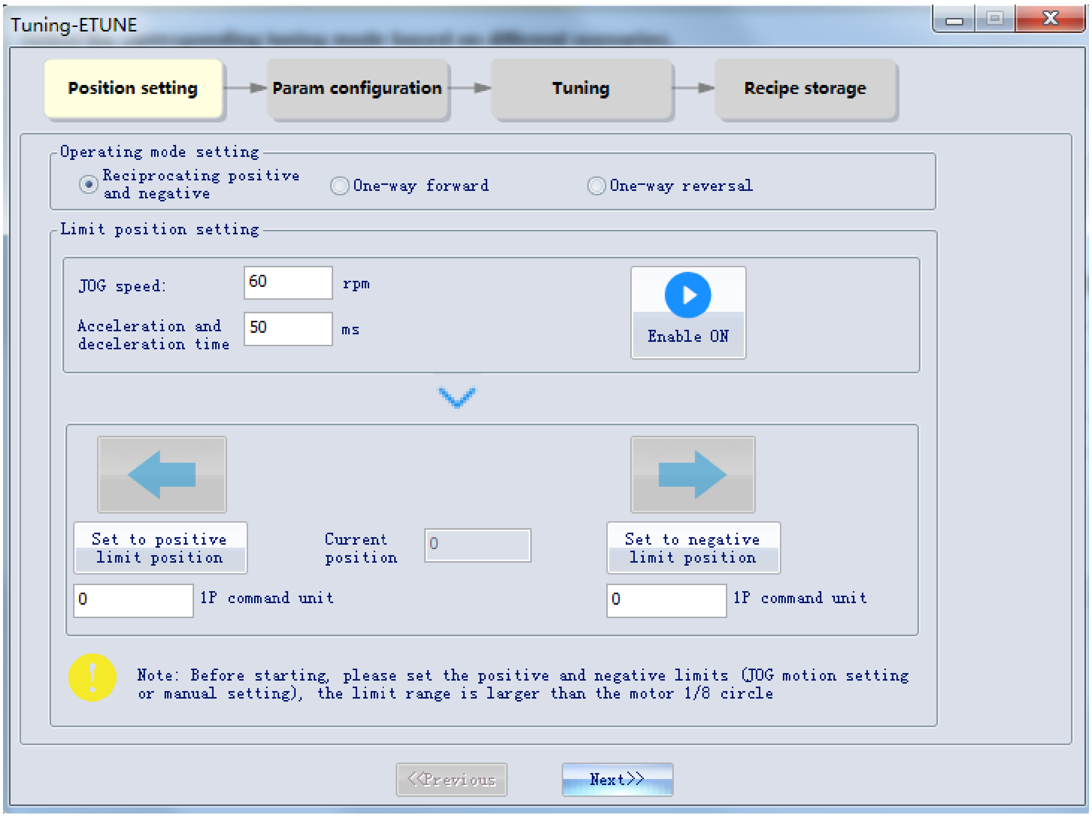
- **Detailed Description**

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.



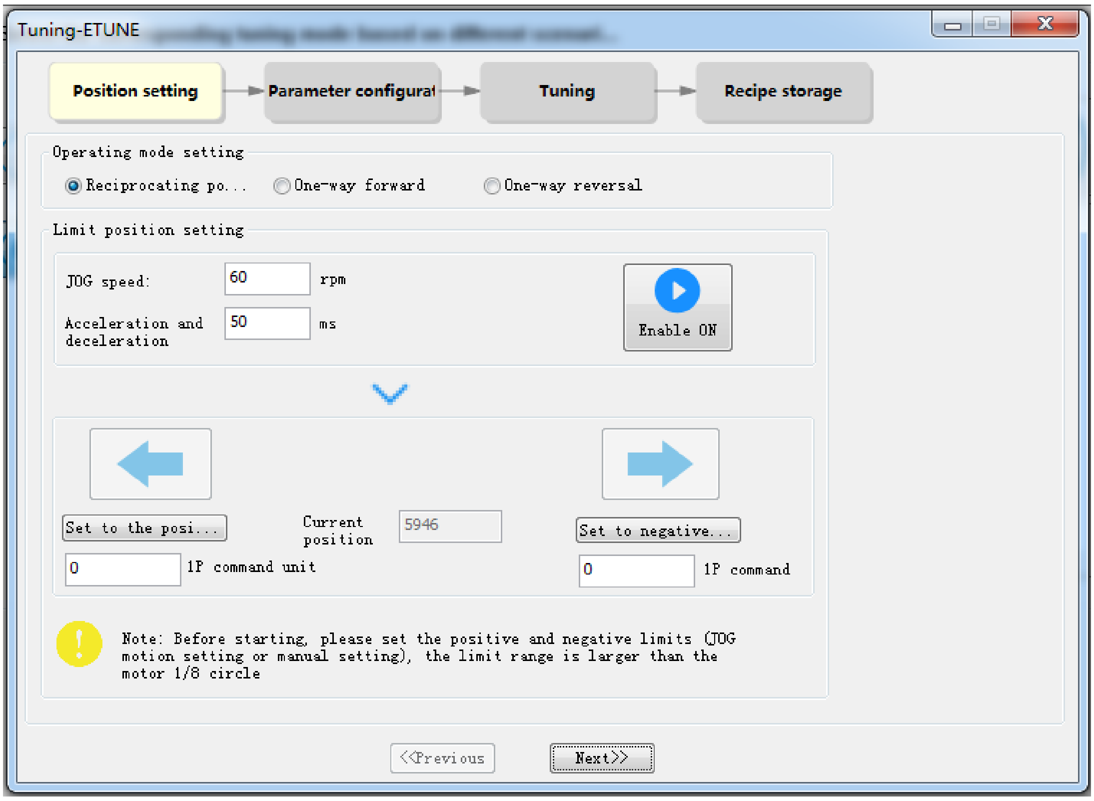
3. Designate the positive and negative limit positions allowed by the motor. The difference between the positive and negative limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio.

   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

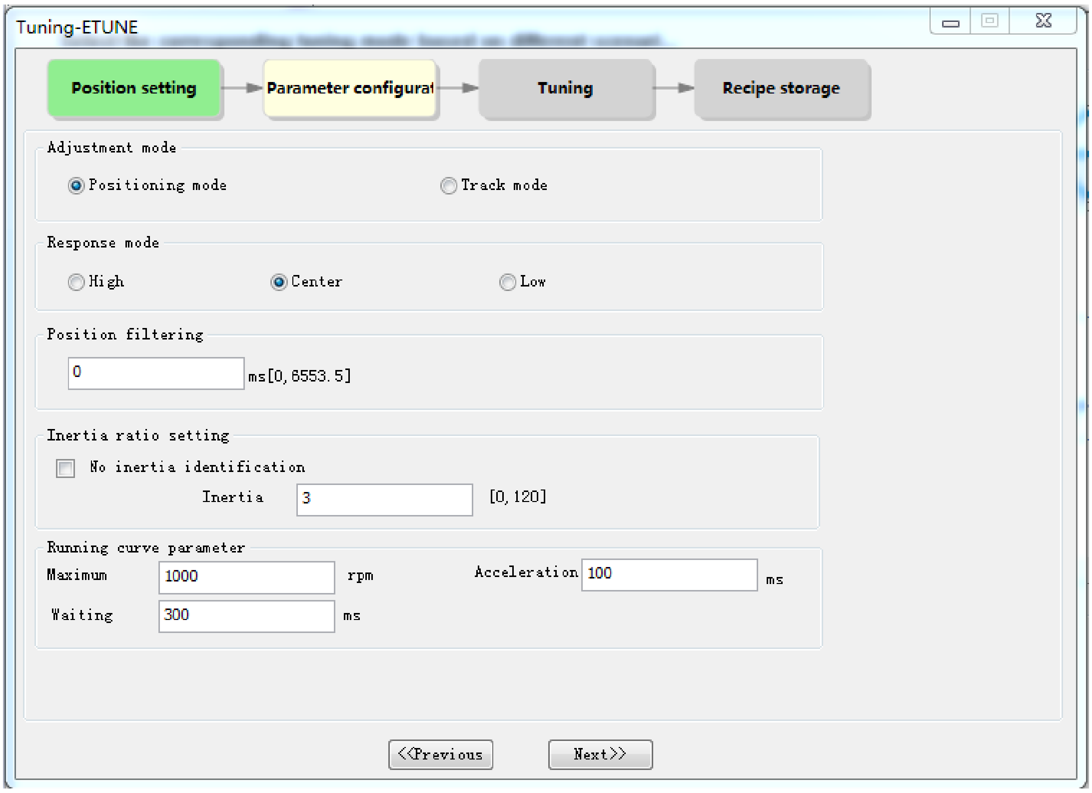
The difference between the positive and negative position limits must be larger than 1/8 of one revolution. The larger the value of the limit position, the better the adaptability of the auto-tuned parameters, but the longer will ETune adjustment take.



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

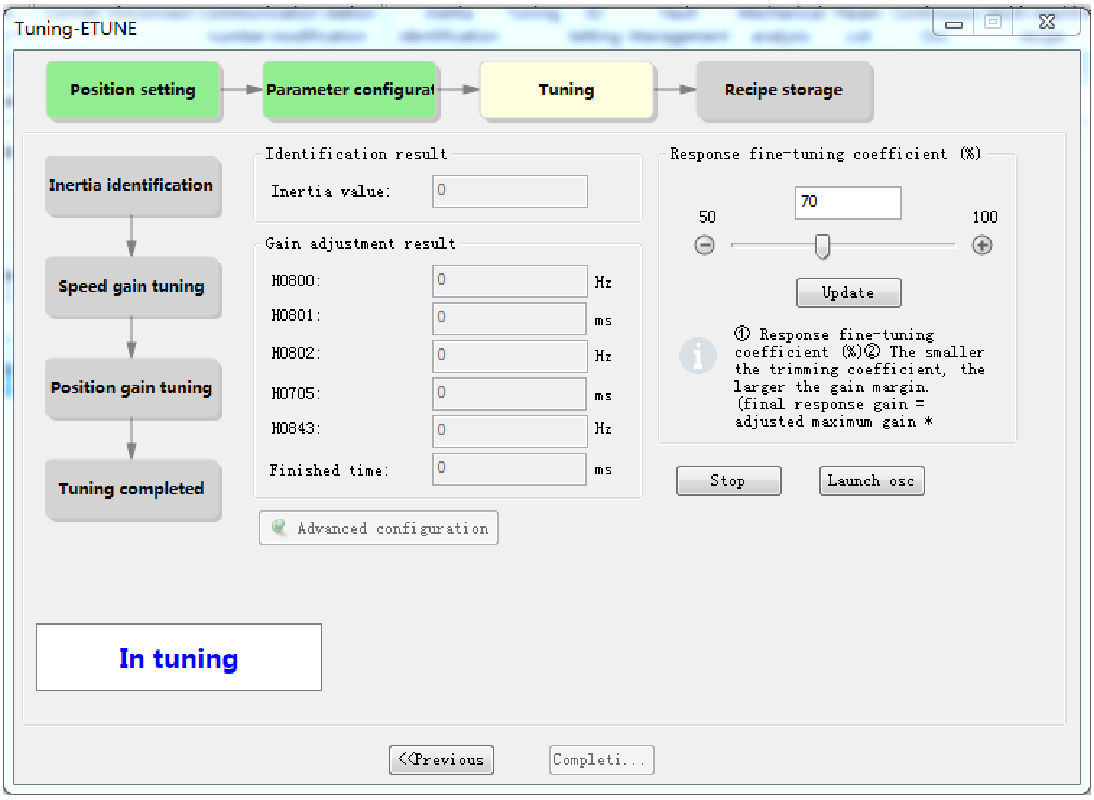
   The adjustment mode is divided into Positioning mode and Track mode.

   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.

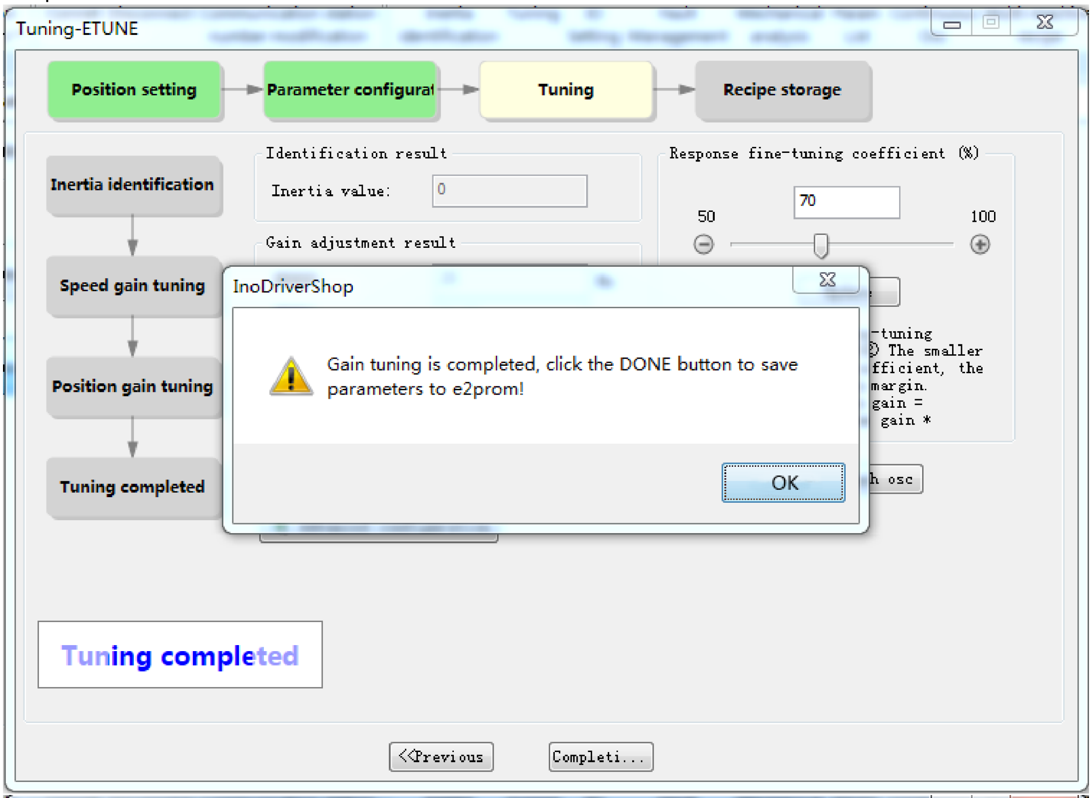


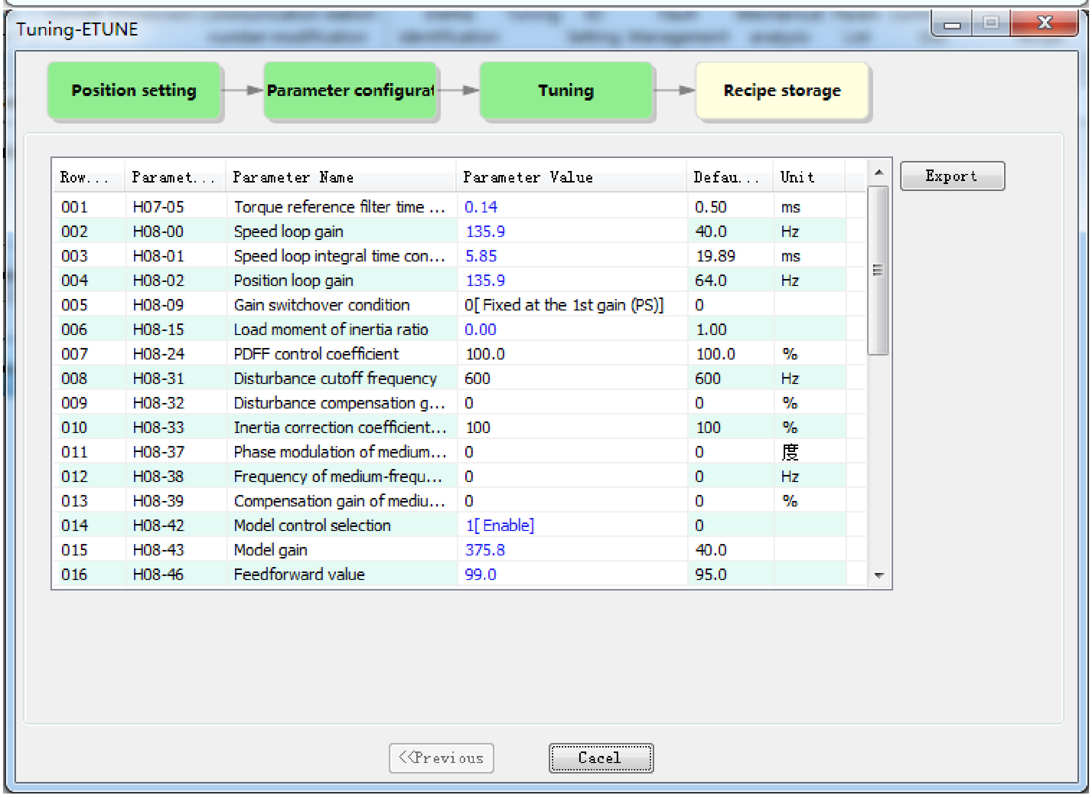
5. Click "Next" to start auto-tuning.

- 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.





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

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

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

Action

- **Operation flowchart**

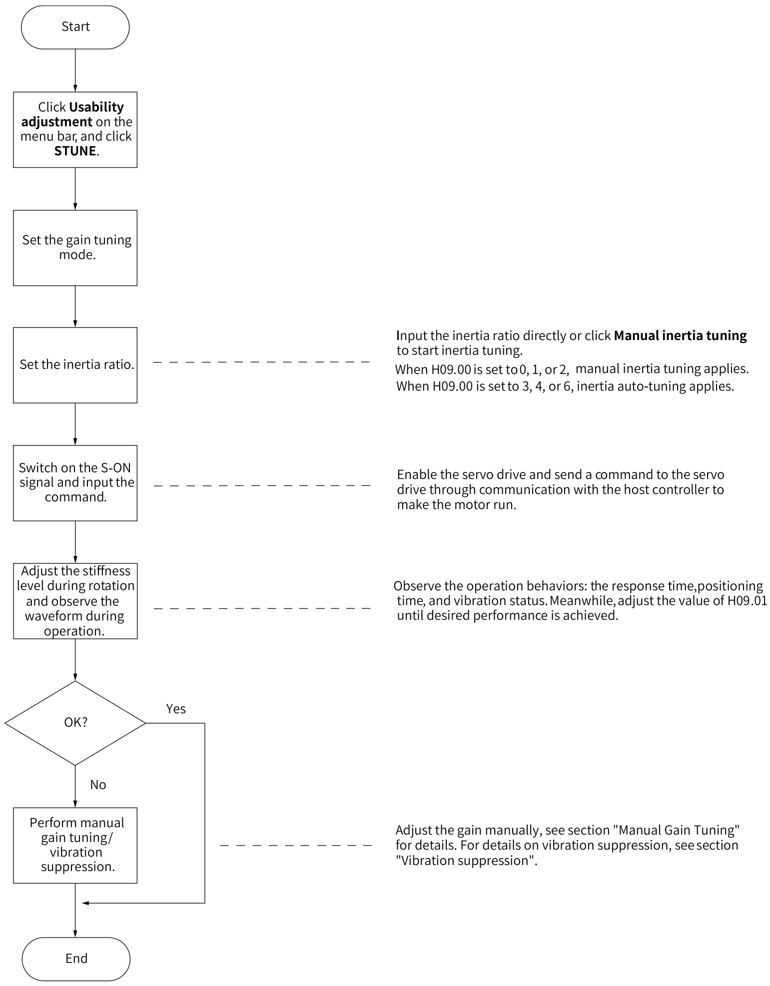


Figure 10-6 Operation flowchart

- **Detailed 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.

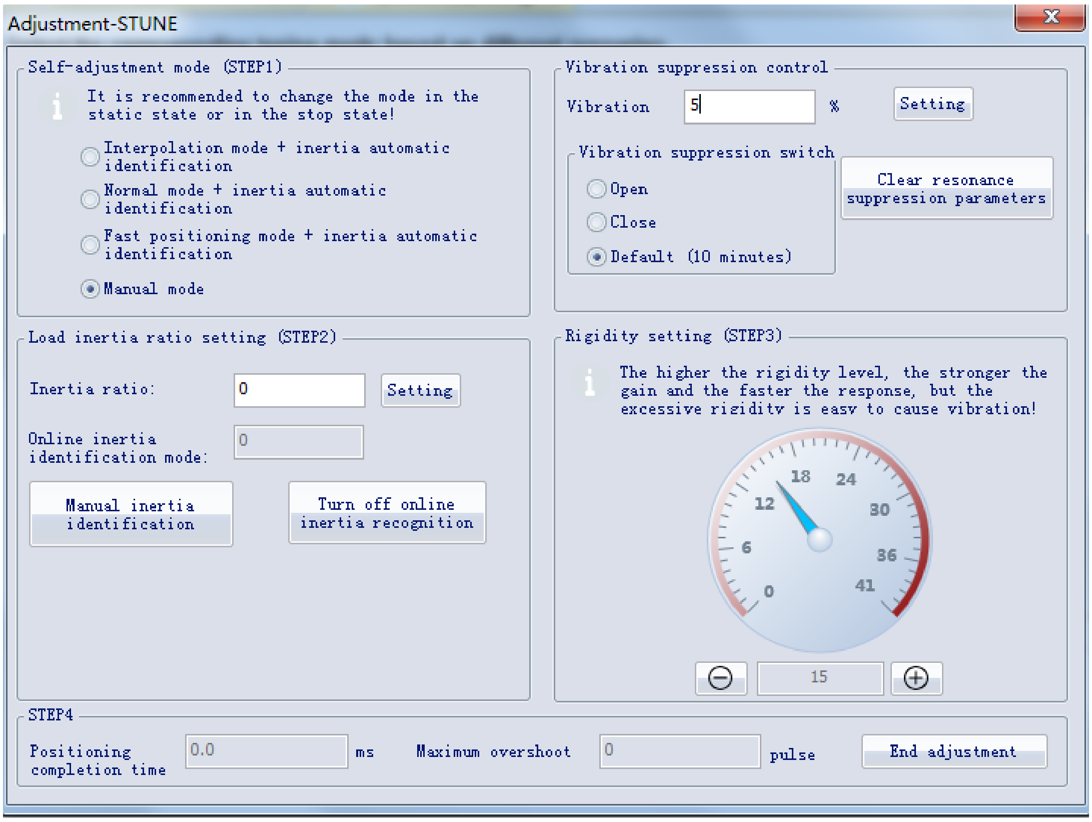
2. Adjust the stiffness level gradually during operation of the load. The present stiffness level value will be written to the drive automatically. Keep monitoring the operating waveform after increasing the stiffness level (increase by one level at a time) until desired performance is achieved.
3. In STune modes 3, 4, and 6, when the speed keeps higher than 100 r/min 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 and 4, 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 value range of H09.01 (Stiffness level) is 0 to 41. The level 0 indicates the weakest stiffness and lowest gain and level 41 indicates the strongest stiffness and highest gain.

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

Table 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 five 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

Param.	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 199*, 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 has a higher rigidity level than that in the 1st gain parameters.

Table 10–4 Parameters updated automatically in the positioning mode

Param.	Name	Description
H08.03	2nd speed loop gain	-
H08.04	2nd speed loop integral time constant	If H08.04 is set to a fixed value such as 512.00 ms, the second speed loop integral action is invalid, and only proportional control is used in the speed loop.
H08.05	2nd position loop gain	-
H07.06	2nd torque reference filter time constant	-

Values of speed feedforward parameters are fixed.

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

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

Values of gain switchover parameters are fixed.

Gain switchover is activated automatically in the positioning mode.

Param.	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 the positioning mode, the gain switchover condition is H08.09 = 10. In other modes, the original setting is used.
H08.10	Gain switchover delay	5.0 ms	In the positioning mode, the gain switchover delay is 5.0 ms. In other modes, the original 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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 to 1000	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 to 8000	-	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 to 8000	-	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: Disable1: Enable	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, or 6, the drive will suppress 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 drive exits from auto-tuning. If inertia auto-tuning is deactivated automatically, switching to modes 3, 4, or 6 will not activate inertia auto-tuning.
- Do not set H09.00 to 3, 4, or 6 in applications with slow acceleration/deceleration, strong vibration, and unstable mechanical couplings.
- In applications where the inertia does not change, set H09.03 (Online inertia auto-tuning mode) to 1 (Enabled, changing slowly). In applications where the inertia changes quickly, set H09.03 to 3 (Enabled, changing quickly).

Solutions to Common Faults

E661: Gains too low

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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 to 1000	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.

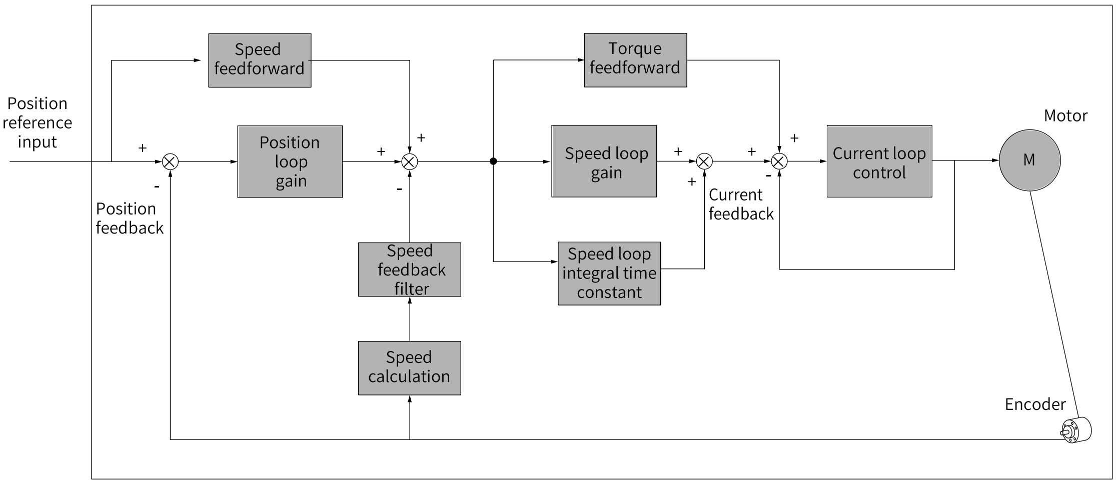


Figure 10-7 Basic control for manual gain tuning

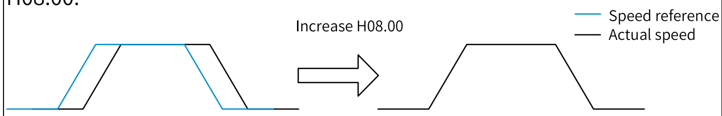
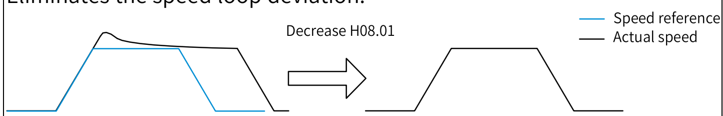
Note

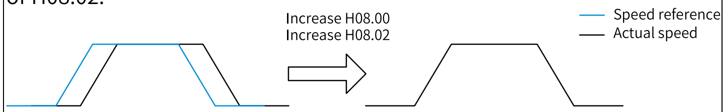
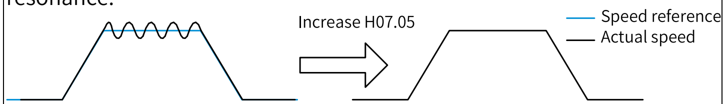
The response level of the inner loop must be higher than that of the outer loop. If it is not observed, the system may be unstable.

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

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

Table 10–6 Adjustment of gain parameters

Step	Param.	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 226*.
2	H08.01	Speed loop integral time constant	Function: Eliminates the speed loop deviation.  Note: Set H08.01 according to the following formula: $500 \leqslant \text{H08.00 x H08.01} \leqslant 1000$ For example, if H08.00 is set to 40.0 Hz, the setpoint of H08.01 must meet the following requirement: $12.50\ \text{ms} \leqslant \text{H08.01} \leqslant 25.00\ \text{ms}$ 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 inactive.

Step	Param.	Name	Description
3	H08.02	Position loop gain	Function: Defines the maximum frequency of position references that can be followed by the position loop. The maximum following frequency of the position loop equals the value of H08.02.  Note: To ensure system stability, the maximum follow-up frequency of the speed loop must be 3 to 5 times higher than that of the position loop. $3 \leqslant \frac{2 \times \pi \times H08.00}{H08.02} \leqslant 5$ For example, when H08.00 is set to 40.0 Hz, the position loop gain must meet the following requirement: 50.2 Hz ⩽ H08.02 ⩽ 83.7 Hz Adjust the setting based on the positioning time. Increasing the setpoint shortens the positioning time and improves the anti-interference capacity of a motor at standstill. An excessively high setpoint may easily lead to system instability and oscillation.
4	H07.05	Torque reference filter time constant	Function: Eliminates the high-frequency noise and suppresses mechanical resonance.  Note: Ensure the cutoff frequency of the torque reference low-pass filter is 4 times higher than the maximum follow-up frequency of the speed loop, as shown in the following formula: $\frac{1000}{2 \times \pi \times H07.05} \geqslant (H08.00) \times 4$ For example, when H08.00 is set to 40.0 Hz, the setpoint of H07.05 must be lower than or equal to 1.00 ms. If vibration occurs after H08.00 is increased, adjust H07.05 to suppress the vibration. For details, see *"Vibration Suppression" on page 226*. An excessively high setpoint weakens the responsiveness of the current loop. To suppress vibration at stop, increase H08.00 and decrease H07.05. If strong vibration occurs upon stop, decrease the setpoint of H07.05.

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H07.05	2007–06h	Torque reference filter time constant 1	0.00 to 30.00	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 to 2000.0	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 to 512.00	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 to 2000.0	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

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

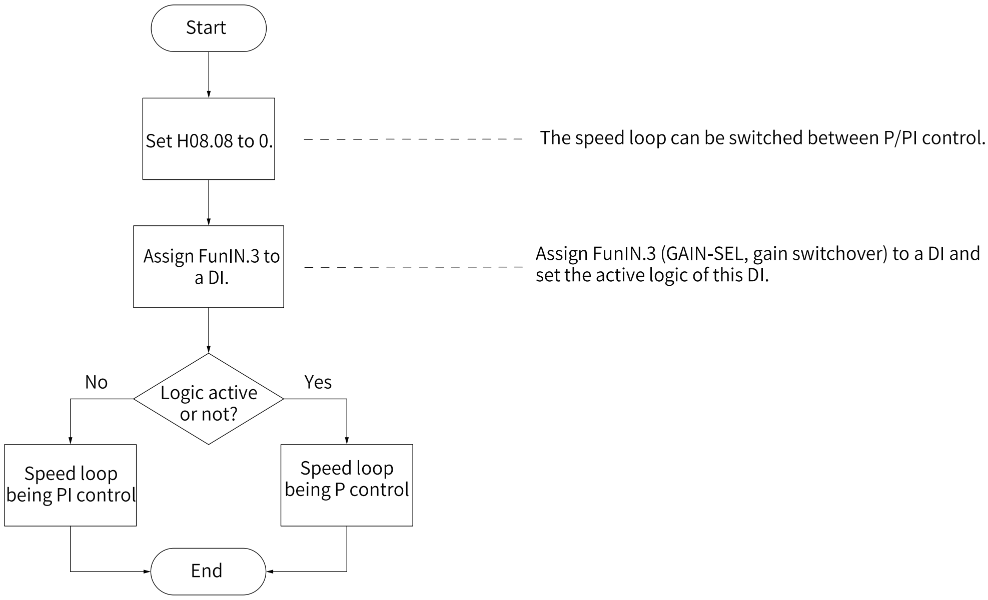


Figure 10-8 Gain switchover flowchart when H08.08 is set to 0

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.

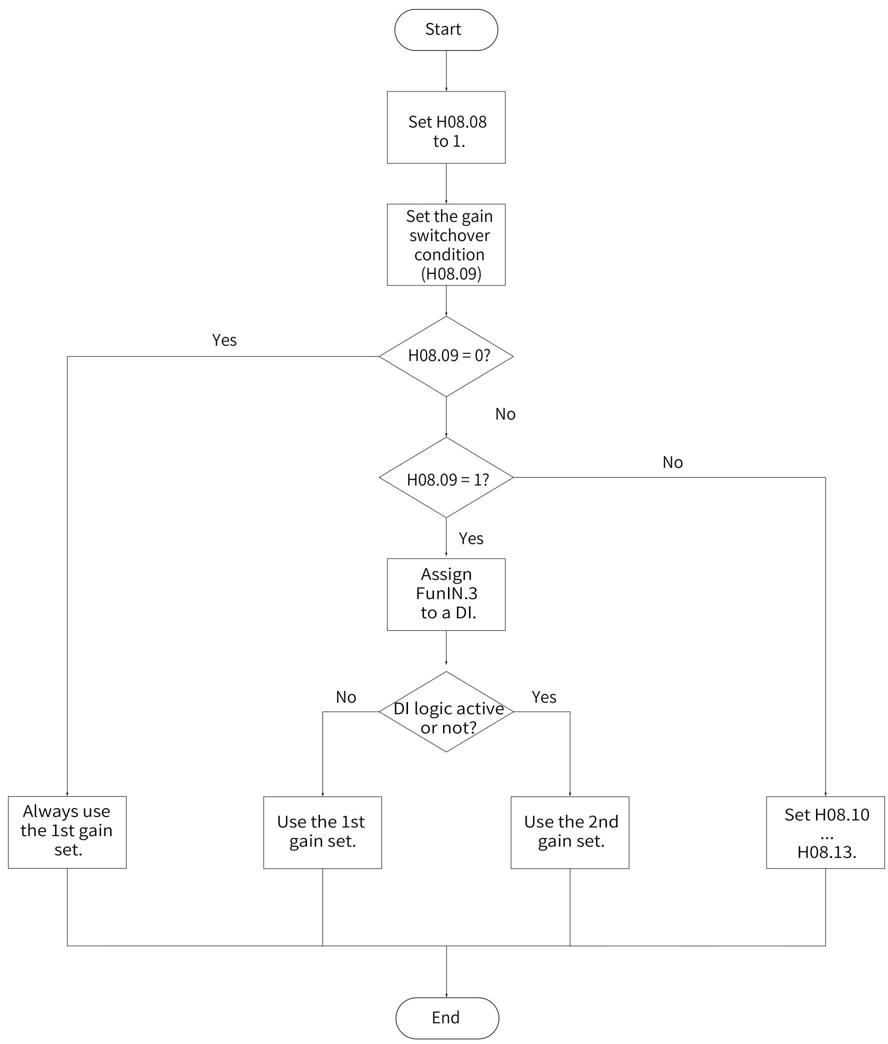
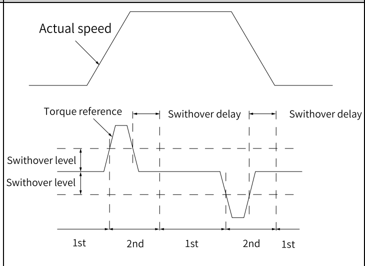
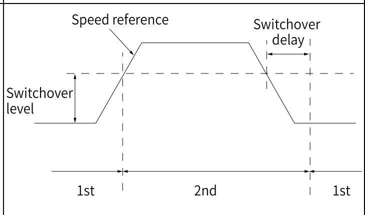
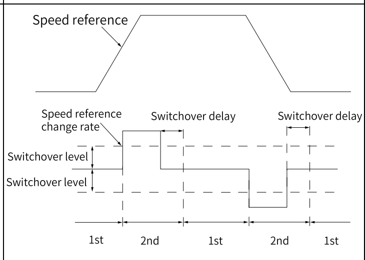
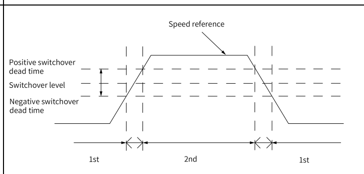
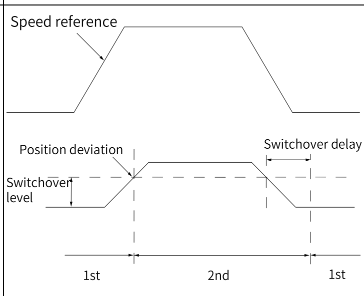
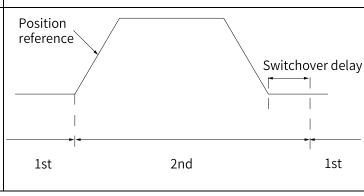


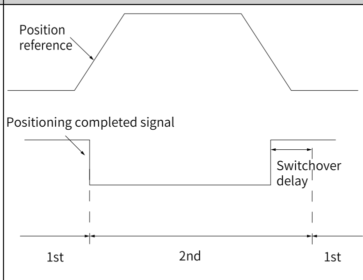
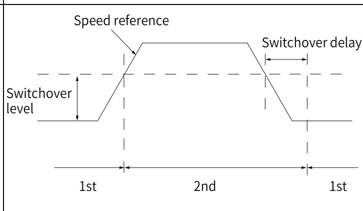
Figure 10-9 Gain switchover flowchart when H08.08 is set to 1

The following table describes the diagrams and parameters related to 11 kinds of gain switchover conditions.

Table 10–7 Conditions for gain switchover

Gain Switchover Condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay Time (H08.10)	Gain switchover level (H08.11)	Switchover Dead Time (H08.12)
0	Fixed to the 1st gain set	-	Inactive	Inactive	Inactive
1	Switched through external DI signal	-	Inactive	Inactive	Inactive

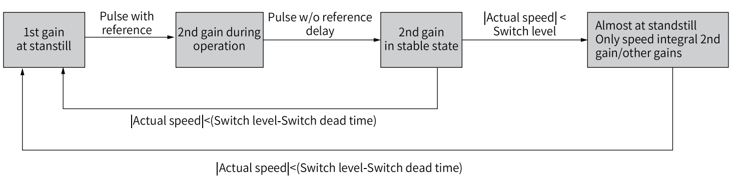
Gain Switchover Condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay Time (H08.10)	Gain switchover level (H08.11)	Switchover Dead Time (H08.12)
2	Torque reference		Active	Active (%)	Active (%)
3	Speed reference		Active	Active	Active
4	Speed reference change rate		Active	Active (10 rpm/s)	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

Gain Switchover Condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay Time (H08.10)	Gain switchover level (H08.11)	Switchover Dead Time (H08.12)
8	Positioning not completed		Active	Inactive	Inactive
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 set.

Note



☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H08.08	2008–09h	2nd gain mode setting	0: Fixed to the 1st gain set, P/PI switched through bit 26 of external 60FEh 1: Switched between the 1st and 2nd gain set 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 bit 26 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 to 1000.0	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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: Set H08.11 ⩾ H08.12. Otherwise, the drive forcibly sets H08.11 to the same value as H08.12.	30	-	UInt16	Real time	Real time
H08.13	2008–0Eh	Position gain switchover time	0.0 to 1000.0	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

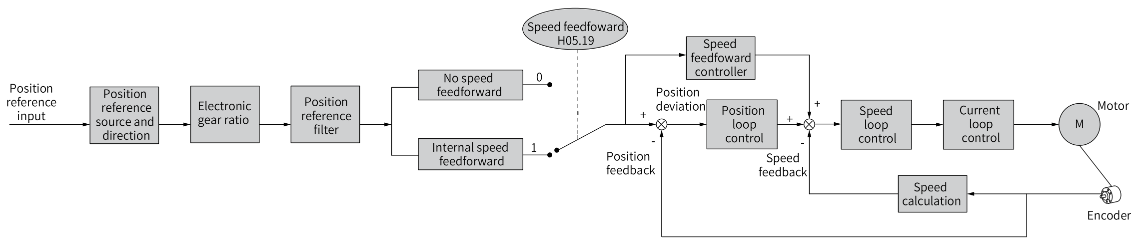


Figure 10-10 Operating procedure for speed feedforward control

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 to a non-zero value to activate speed feedforward and locate the corresponding signal source.

Param.	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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H08.18	2008–13h	Time constant of speed feedfor ward filter	0.00 to 64.00	Defines the filter time constant of speed feedforward.	0.50	ms	UInt16	Real time	Real time
H08.19	2008–14h	Speed feedfor ward gain	0.0% to 100.0%	In position control and full closed-loop control, speed feedforward is the product of speed feedforward 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, and then increase H08.19 gradually from 0 to a certain value at which speed feedforward reaches the required effect. Adjust H08.18 and H08.19 repeatedly to find the balanced setting. 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.

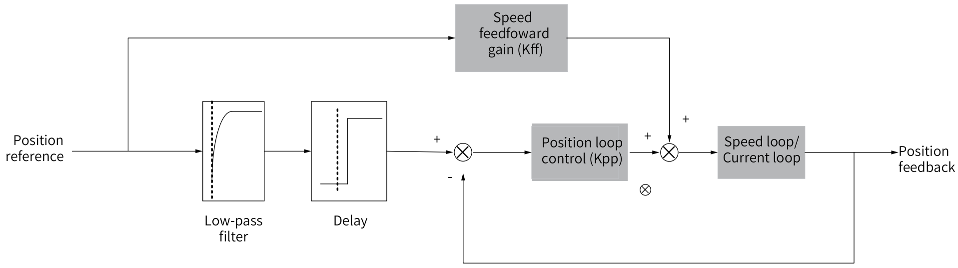


Figure 10-11 Zero phase control

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H05.04	2005–05h	First-order low-pass filter time constant	0.0 to 6553.5	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 feedforward1: 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 to 4.0	-	0.0	ms	UInt16	Real time	Real time

Torque feedforward

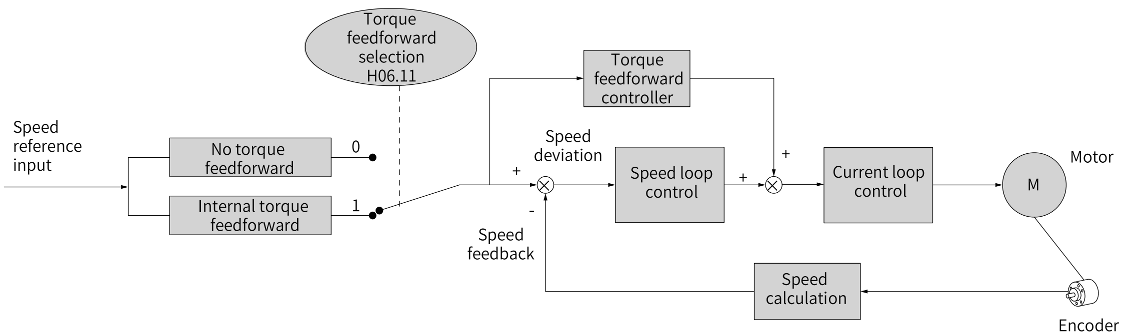


Figure 10-12 Operation diagram of torque feedforward control

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 to 1 to activate torque feedforward and locate the corresponding signal source.

Param.	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.

Param.	Name	Description
H08.20	Torque feedforward filter time constant	Function: • Increasing H08.21 improves responsiveness but may cause speed overshoot during acceleration/deceleration. • Decreasing H08.20 suppresses overshoot during acceleration/deceleration. Increasing H08.20 suppresses the noise. Note: • Set H08.20 to the default value, and then increase H08.21 gradually from 0 to a certain value at which torque feedforward reaches the required effect. • Adjust H08.20 and H08.21 repeatedly to find the balanced setting.
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.

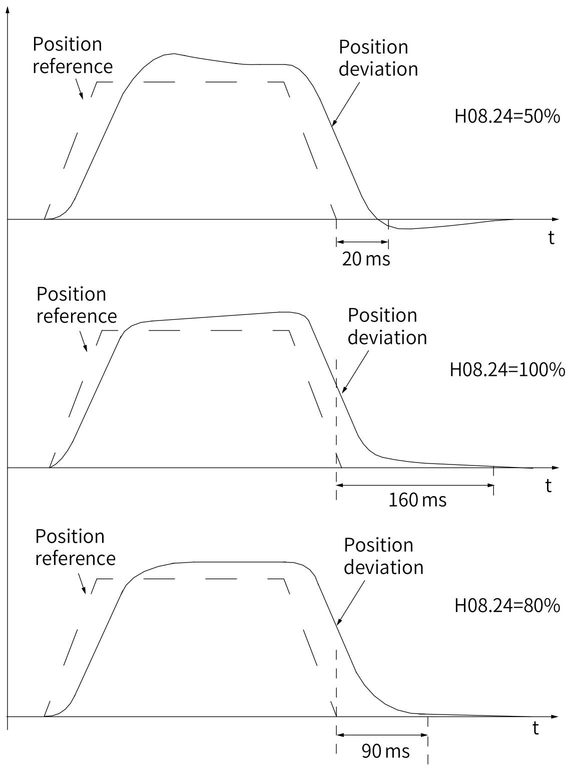


Figure 10-13 Example of PDFF control

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.

Param. No.	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.

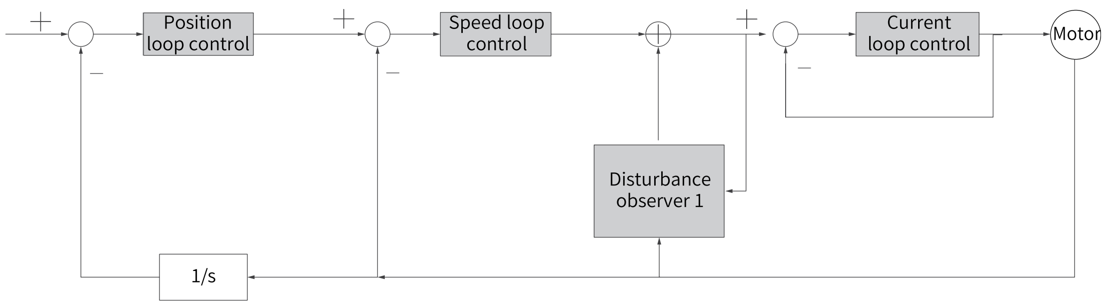
10.4.6 Torque disturbance observer

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 1.



Note

1/s: Integral element

Param.	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

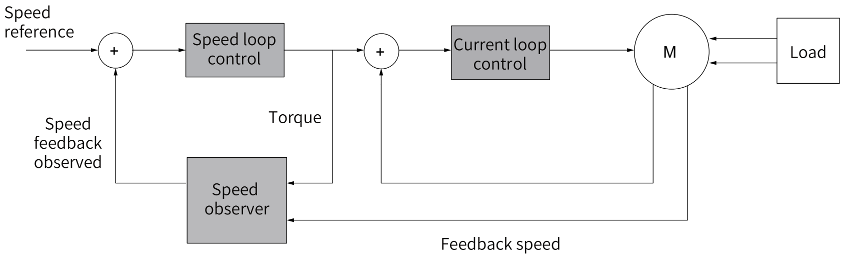
Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H08.31	2008–20h	Disturbance cutoff frequency	10 to 4000	Defines the cutoff frequency of the disturbance observer. Increasing the setpoint improves the responsiveness of the disturbance observer and the compensation effect. Note that an excessively high setpoint may incur resonance.	600	Hz	UInt16	Real time	Real time
H08.32	2008–21h	Disturbance compensa tion 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

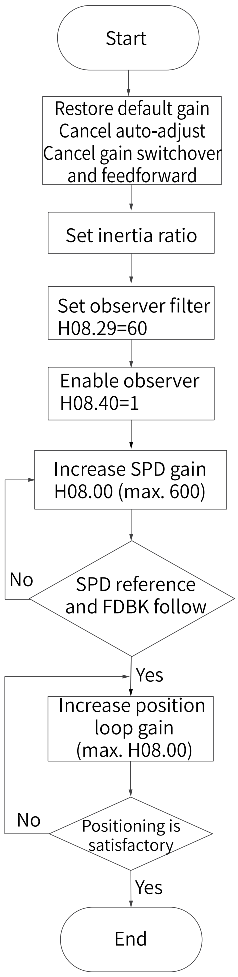
The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.

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 procedure



Related parameters

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H08.00	2008–01h	Speed loop gain	0.1 to 2000.0	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 to 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 to 10.00	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 result in 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 applicable to conveyor transmission and backlash.

10.4.8 Model Tracking

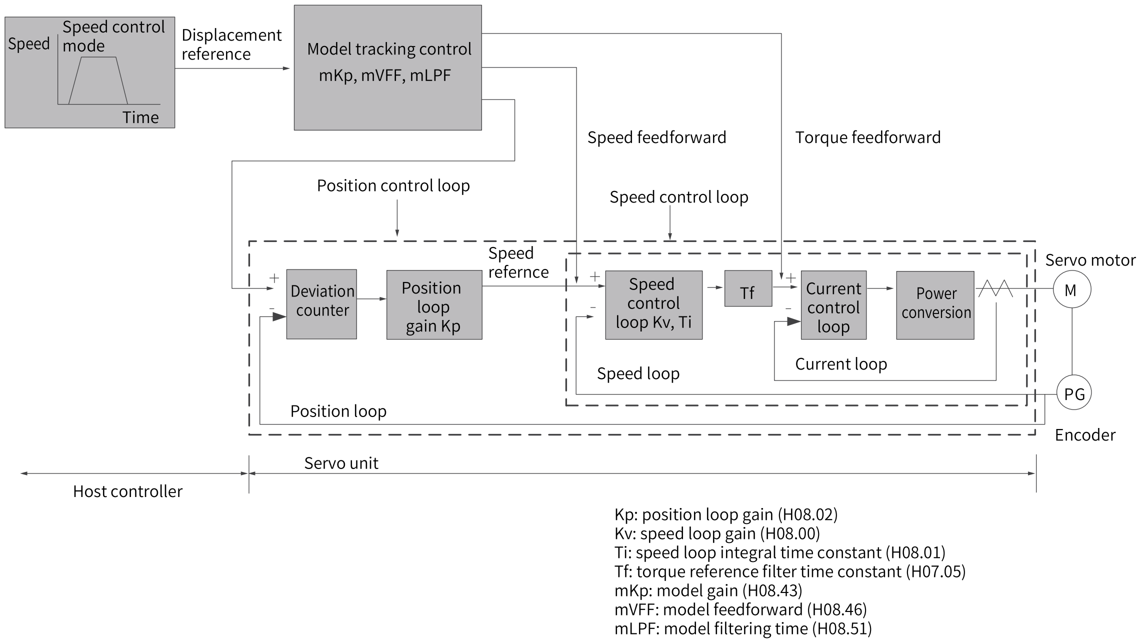
The model tracking control, which is only available in the position control mode, can be used to improve responsiveness and shorten the positioning time. It is only available in the position control mode.

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

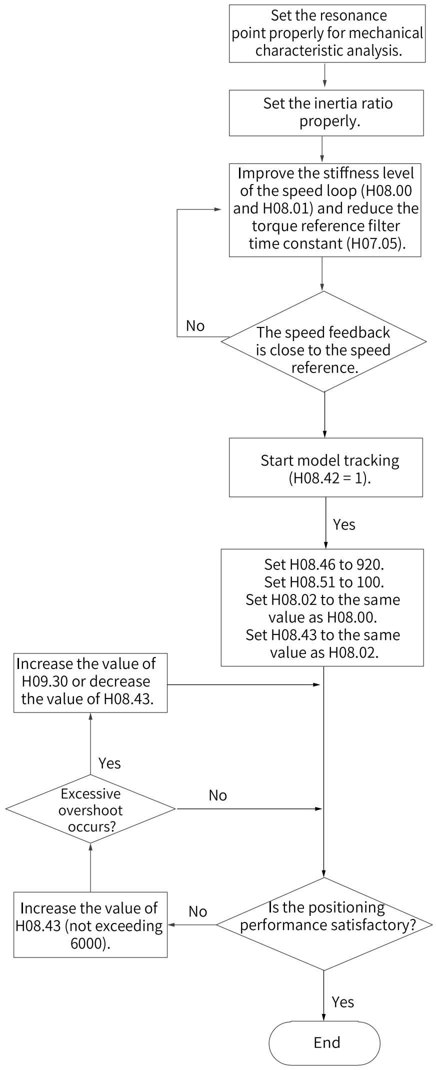
However, manual tuning is needed in the following situations:

- 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 procedure



Related parameters

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H07.05	2007–06h	Torque reference filter time constant 1	0.00 to 30.00	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 to 2000.0	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H08.01	2008–02h	Speed loop integral time constant	0.15 to 512.00	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 to 2000.0	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	Feedfor ward 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.

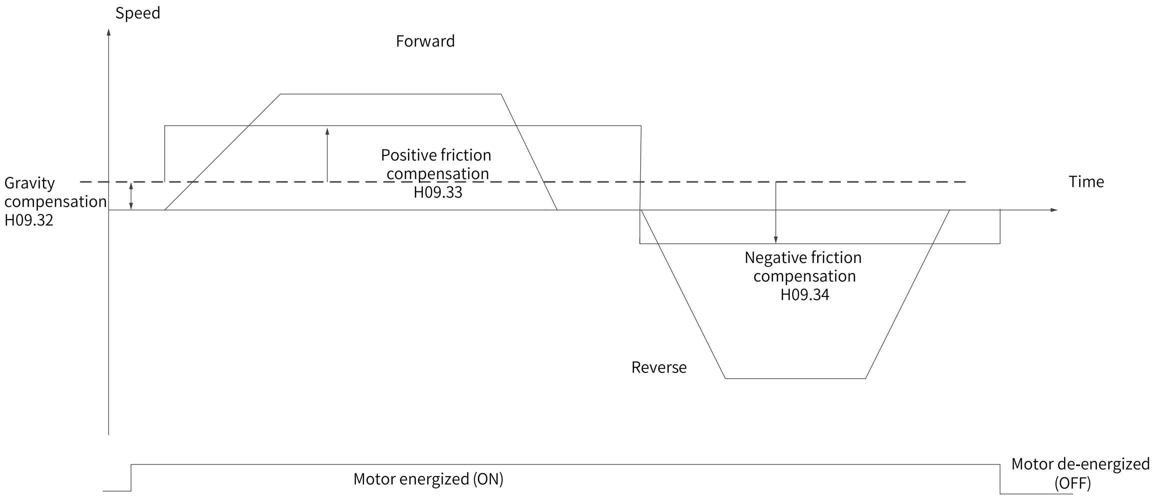
Note

Friction compensation is effective only in the position mode.

☆Related parameters

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 actual position reference. Forward direction requires positive compensation value. Reverse direction requires 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.

Gain parameters in the position control mode:

- 1st gain set:

Param.	Name	Function	Default
H07.05	Torque reference filter time constant 1	Defines the torque reference filter time constant.	0.50 ms
H08.00	Speed loop gain	Defines the speed loop proportional gain.	40.0 Hz
H08.01	Speed loop integral time constant	Defines the integral time constant of the speed loop.	19.89 ms
H08.02	Position loop gain	Defines the position loop proportional gain.	64.0 Hz

- 2nd gain set:

Param.	Name	Function	Default
H07.06	Torque reference filter time constant 2	Defines the torque reference filter time constant.	0.27 ms
H08.03	2nd speed loop gain	Defines the speed loop proportional gain.	75.0 Hz
H08.04	2nd speed loop integral time constant	Defines the integral time constant of the speed loop.	10.61 ms
H08.05	2nd position loop gain	Defines the position loop proportional gain.	120.0 ms
H08.08	2nd gain mode setting	Defines the mode of the 2nd gain set.	1
H08.09	Gain switchover condition	Defines the gain switchover condition.	0
H08.10	Gain switchover delay	Defines the gain switchover delay.	5.0 ms
H08.11	Gain switchover level	Defines the gain switchover level.	50
H08.12	Gain switchover hysteresis	Defines the dead time of gain switchover.	30
H08.13	Position gain switchover time	Defines the position loop gain switchover time.	3.0 ms

- Common gain set

Param.	Name	Function	Default
H08.18	Time constant of speed feedforward filter	Defines the filter time constant of the speed feedforward signal.	0.50 ms
H08.19	Speed feedforward gain	Defines the speed feedforward gain.	0.0%
H08.20	Torque feedforward filter time constant	Defines the filter time constant of the torque feedforward signal.	0.50 ms
H08.21	Torque feedforward gain	Defines the torque feedforward gain.	0.0%
H08.22	Speed feedback filtering option	Defines the speed feedback filtering function.	0
H08.23	Cutoff frequency of speed feedback low-pass filter	Defines the cutoff frequency of the first-order low-pass filter for speed feedback.	8000 Hz
H08.24	PDFF control coefficient	Defines the coefficient of the PDFF controller.	100.0%
H09.30	Torque disturbance compensation gain	Defines the torque disturbance compensation gain.	0.0%
H09.31	Filter time constant of torque disturbance observer	Defines the filter time constant of the disturbance observer.	0.5 ms
H09.04	Low-frequency resonance suppression mode	Defines the low-frequency resonance suppression mode.	0

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.

Param.	Name	Function	Default
H07.05	Torque reference filter time constant 1	Defines the torque reference filter time constant.	0.50 ms
H08.00	Speed loop gain	Defines the speed loop proportional gain.	40.0 Hz
H08.01	Speed loop integral time constant	Defines the integral time constant of the speed loop.	19.89 ms
H08.02	Position loop gain	Defines the position loop proportional gain.	64.0 Hz
H08.19	Speed feedforward gain	Defines the speed feedforward gain.	0.0%

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 224*.

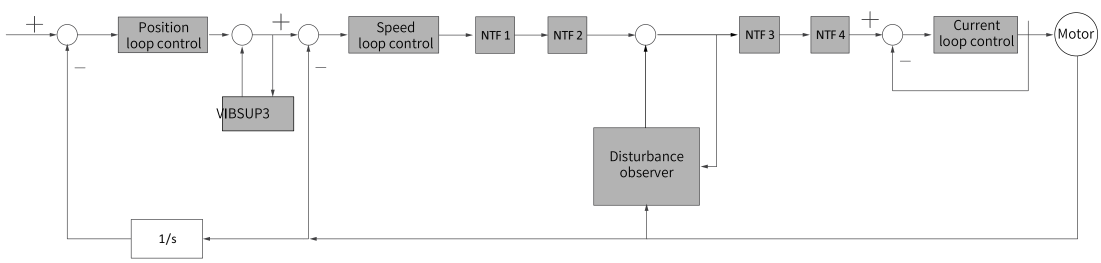
10.5.3 Parameter Adjustment in the Torque Control Mode

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 226*.
- 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 226*, 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:

- NTF1–4: 1st notch to 4th notch
- VIBSUP3: Suppression of medium- and low-frequency vibration reduction applied at a carrier frequency lower than 8 k under 300 Hz
- 1/s: Integral element

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H08.53	2008–36h	Medium- and low-frequency jitter suppression frequency 3	0.0 to 300.0	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.

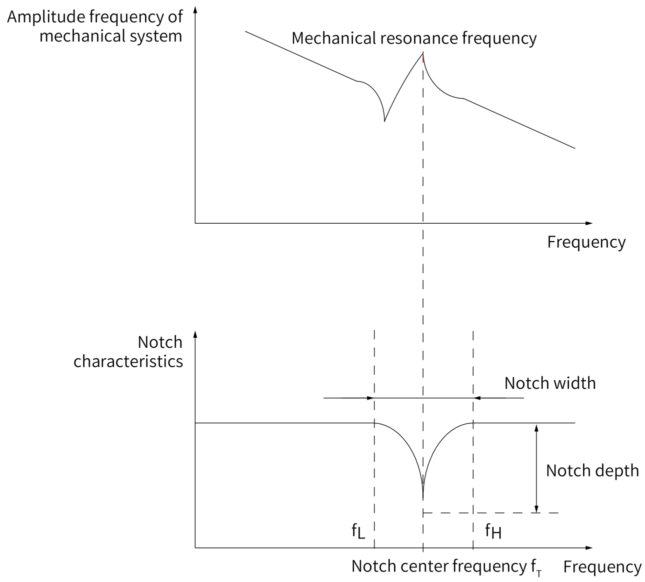


Figure 10-14 Operating principle of the notch

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

Table 10–8 Description of notch parameters

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

Note

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

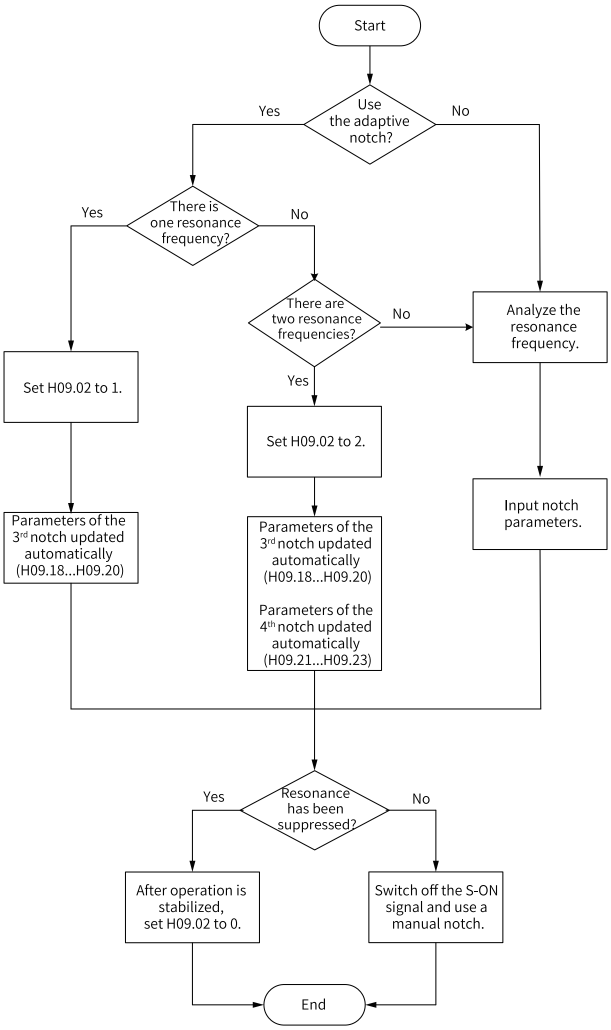


Figure 10-15 Using the notch

- Procedure for setting the adaptive notch:

1. Set H09.02 (Adaptive notch mode) to 1 or 2 based on the number of resonance points.
2. When resonance occurs, first set H09.02 to 1 to enable an adaptive notch. If new resonance occurs after the gain is adjusted, set H09.02 to 2 to enable two adaptive notches.
3. Parameters of the 3rd or 4th notches are updated automatically during operation, and parameter values are saved automatically to the corresponding parameters in group H09 every 30 min.
4. If resonance is suppressed, the adaptive notch works. When the system keeps operating stably within the time defined by H09.37, H09.02 will be set to 0 automatically. After the drive operates stably for a period of time, set H09.02 to 0 and the parameters of the adaptive notch are fixed to the latest setpoints.

   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 four notches as manual ones (H09.02 = 0).

Note

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

- Procedure for setting the manual notch:

  1. Analyze the resonance frequency.
  2. When using the manual notch, set the notch frequency to same value as the actual resonance frequency obtained in the following ways: The resonance frequency can be obtained by using the following methods:
     - Use the "Mechanical characteristic analysis" function in Inovance software tool.
     - Calculate the resonance frequency based on the motor phase current displayed on the oscilloscope interface of the software tool.
     - Set H09.02 to 3. During operation, the drive automatically detects the resonance frequency and stores it in H09.24.
  3. Input the resonance frequency obtained in step 1 to the parameter of the selected notch, and input the width level and depth level of this notch.
  4. If resonance has been suppressed, it indicates the notch functions well and you can continue adjusting the gain. If resonance occurs again, repeat steps 1 and 2.
  5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.

- Notch width level

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

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

  Where:

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

  f_H-f_L is the notch width, that is, the frequency bandwidth with an amplitude attenuation rate of –3 dB relative to the notch central frequency.

  The following figure shows the correspondence. Use the default value 2 in normal cases.

- Depth level of the notch

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

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

Note

If the amplitude frequency characteristic curve obtained 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.

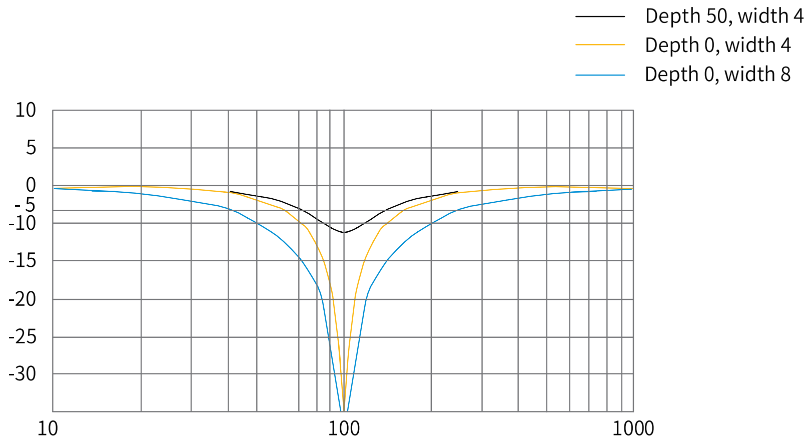


Figure 10-16 Notch frequency characteristics

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H09.02	2009–03h	Adaptive notch mode	0: The adaptive notches are no longer updated 1: An adaptive notch is active (Group 3 notches) 2: Two adaptive notches are active (Group 3 and Group 4 notches) 3: Only test the resonance point shown in H09.24 4: Clear the adaptive notches, restore the value of group 3 and group 4 notches to their default settings	Defines the operation mode of the adaptive notch. When the system keeps operating stably within the time defined by H09.37, H09.02 will be set to 0 automatically.	3	-	UInt16	Real time	Real time
H09.12	2009–0Dh	Frequency of the 1st notch	50 to 8000	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 8000 Hz deactivates the notch function. If the setpoint needs to be 4000 Hz, set the notch frequency to 3999 Hz or 4001 Hz.	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 to 8000	-	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 to 8000	-	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 to 8000	-	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 to 5000	When H09.02 (Adaptive notch mode) is set to 3, the current mechanical resonance frequency is displayed.	0	Hz	UInt16	Unchangeable	-

10.7 Mechanical Characteristic Analysis

Overview

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

Operating procedure

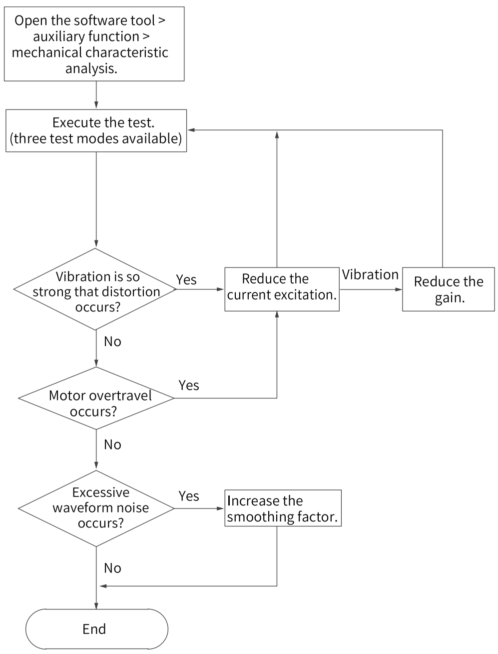


Figure 10-17 Operating procedure for mechanical characteristic analysis

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

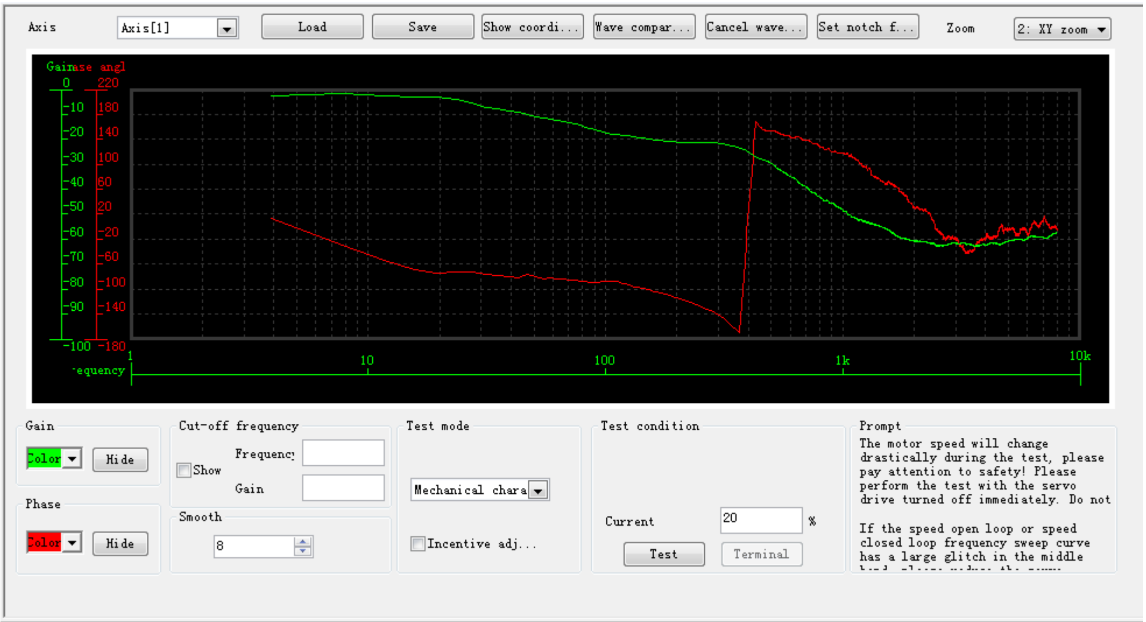


Figure 10-18 Example of the waveform obtained

An example of the waveform obtained with the mechanical characteristic analysis is shown in *"Figure 10–18 Example of the waveform obtained" on page 234*.

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 twenty faults/alarms, which can also be cleared.
Alarm code output	Used to output a four-bit alarm code when an alarm occurs.
Second encoder	Supports encoders with quadrature pulse feedback.
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 function	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.
Gain auto-tuning	Supports two auto-tuning modes: STune and ETune.
Gain switchover	Used to apply different gains for different status (operating or stop) of the motor. Gains can also be switched by external terminals during operation.
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 Function	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] The built-in brake function is only available in size-1 and size-2 models.

12 Basic Servo Functions

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

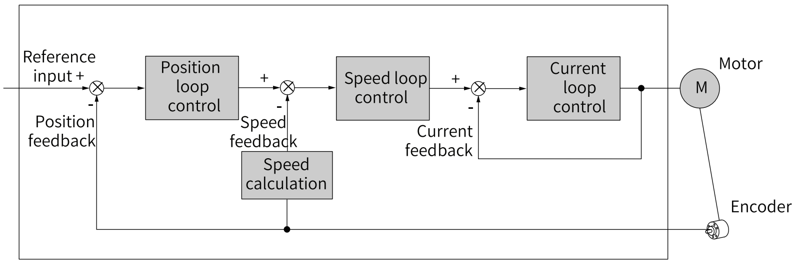


Figure 12-1 Structure of a basic servo system

As the control core of the servo system, the servo drive serves to perform accurate position control, speed control, and torque control on the servo motor through four control modes, which are position control, speed control, torque control, and compound control modes. 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 application requiring speed control or where a host controller is used for position control or the commands sent from the host controller are used as the speed references for the servo drive, such as the engraving and milling machine.
- Torque control
  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:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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: $\text{Motor speed (rpm)} = \frac{\text{Loaded shaft speed} \times \text{Gear ratio 6091h}}{\text{Encoder resolution}} \times 60$ The relation between motor acceleration (rpm/ms) and the load shaft acceleration (reference unit/s^2) is as follows: $\text{Motor acceleration} = \frac{\text{Loaded shaft acc.} \times \text{Gear ratio 6091h}}{\text{Encoder resolution}} \times \frac{1000}{60}$								
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 will be detected.								

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

Inovance 23-bit serial encoder resolution P = 8388608 (p/r)

The position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P x n}}{P_B} = \frac{8388608 \times 3}{10} = \frac{25165824}{10} = 2516582.4$$

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

Follow the process stipulated in the CiA402 protocol when operating the servo drive. Otherwise, the servo drive cannot run in the designated status.

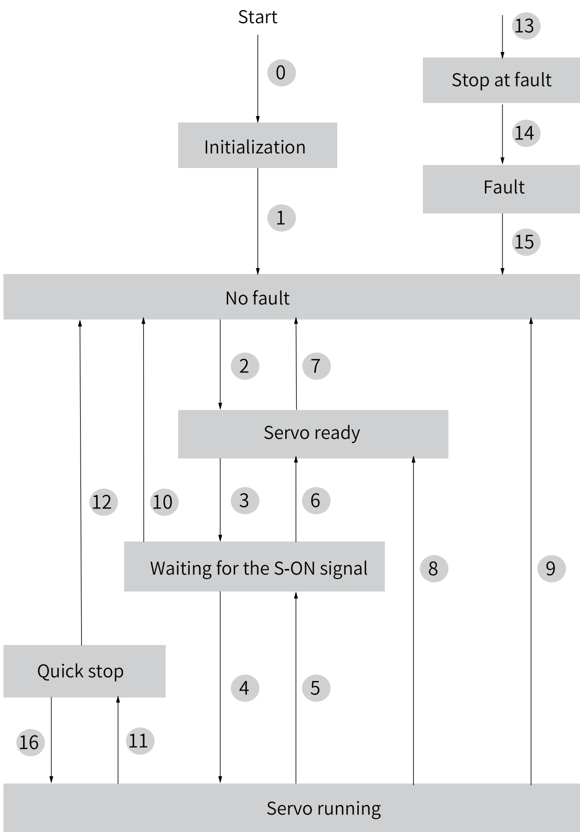


Figure 12-2 Switchover of the CiA402 state machine

See the following table for descriptions of different status.

Status	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.

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

The following table describes the control commands and status switchover.

CiA402 state switchover		Control word 6040h	bit0 to bit9 [1] of status word 6041h
0	Power-on → Initialization	Natural transition, control command not required	0x0000
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly enters status 13.	0x0250/0x270
2	No fault → Servo ready	0x0006	0x0231
3	Servo ready→Wait 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 state 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. If bit7 = 1, the other control words are invalid.	0x0250
16	Quick stop → Servo running	Set 605Ah to a value among 5 to 7. After the stop process is completed, 0x0F is sent after the stop process is completed.	0x0237

Note

[1]: Bit 10 to bit 15 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:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
6040h	Control word	0 to 65535	For details on the control word, see the following table.	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	S-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	Operating the Servo Drive	Enable operation	1: Active, 0: Inactive
4–6	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:
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	Reserved	Undefined
11–15	Manufacturer-specific	Manufacturer-specific	Manufacturer-specific

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
6041h	Status word	0 to 65535	For details on the control word, see the following table.	0	-	UInt16	Unchangeable	-

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode

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	S-ON	Switch on	1: Active, 0: Inactive
2	Operating the Servo Drive	Enable operation	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
12–13	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 bit 0 to bit 9 are the same in the operation modes. After commands in 6040h are sent in sequence, the servo drive feds back an acknowledged state.
- Meanings of bit12 and bit13 vary with the operation mode. For details, see parameters related to each mode.
- Meanings of bit10, bit11, and bit15 are the same in each operation mode and indicate the servo drive status after a certain mode of operation is implemented.

12.3 Operation Modes

Introduction to the modes of operation

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

☆Related parameters

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Used to select the operation mode of the drive:1 : Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: CSP mode 9: CSV mode 10: CST mode Others: N/A If an operation mode not supported is selected through SDO, an SDO error can be returned. If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.	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	Indicates the actual operation mode of the drive: 1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: CSP mode 9: CSV mode 10: CST mode	0	-	UInt16	Unchange able	-

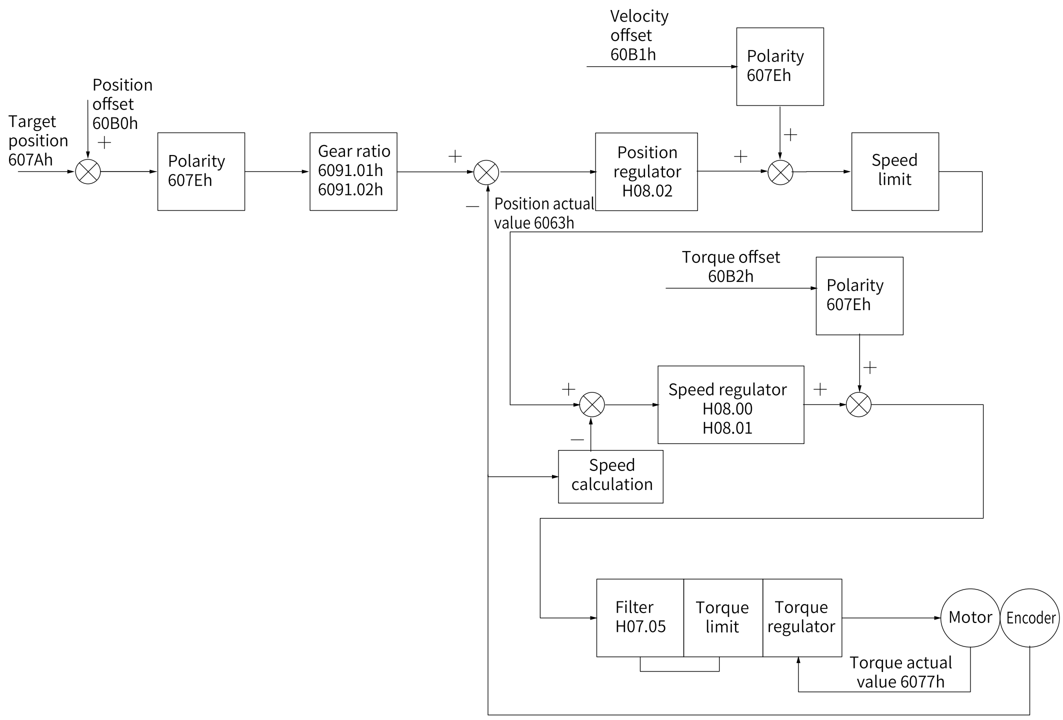
Communication cycle supported by each mode

The IS810N-INT series servo drive supports a minimum synchronization cycle of 1 ms or a maximum synchronization cycle of 20 ms.

12.4 Cyclic Synchronous Position (CSP) Mode

In the 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

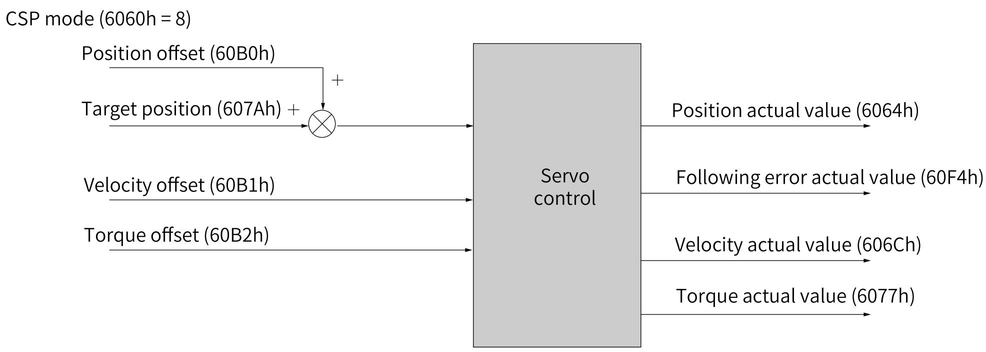


Figure 12-3 Cyclic synchronous position mode

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:

Used to set the control command.

bit	Name		Description
0	S-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	Operating the Servo Drive	Enable operation	1: Active; 0: Inactive

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		Description
0	Ready to switch on	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive
2	Enable operation	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive
7	Alarm	1: Active; 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reach	Not supported, always being 1
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follows the command value	Not supported, always being 1
13	Following error	0: EB00.0 (Excessive position deviation) not reported 1: EB00.0 (Excessive position deviation) reported

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

☆ Related parameters:

For parameter details, see *"16.23 Parameter Group 6000h" on page 482*.

12.4.5 Related Function Settings

Position deviation monitoring function

☆ Related parameters:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 to 65535	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.

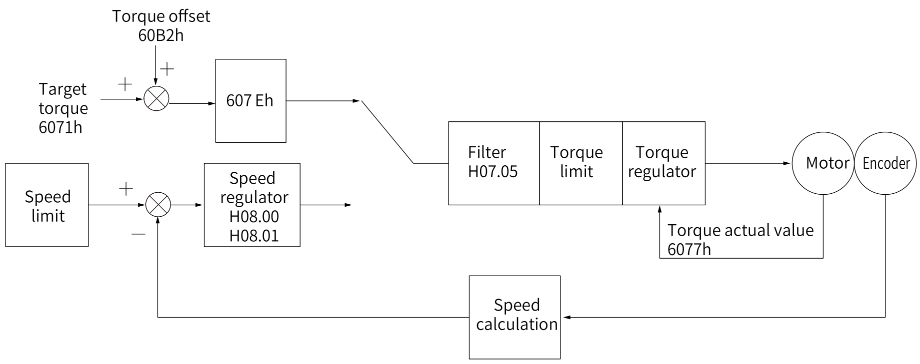
☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	0	-	UInt16	Real time	Real time

12.5 Cyclic Synchronous Torque (CST) Mode

In the 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

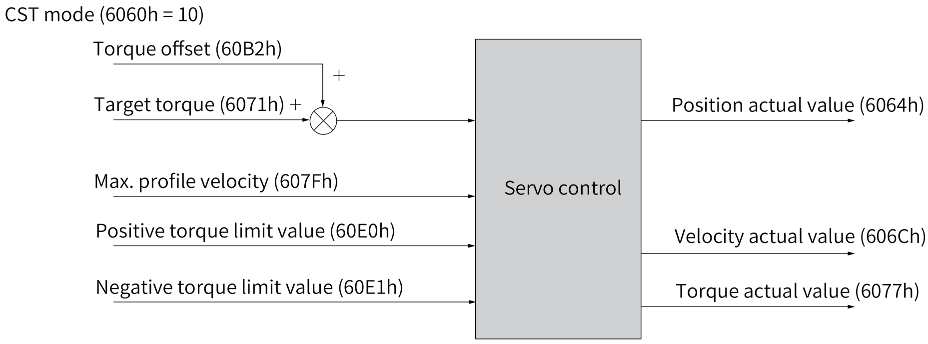


Figure 12-4 CST mode

12.5.3 Recommended Configuration

The basic configuration of cyclic synchronous torque (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	Unit:	-
Max.:	65535	Data Type:	Uint16
Default:	-	Change:	Real time
Access:	RW	Mapping:	RPDO

Value Range:

0 to 65535

Description:

Used to set the control command.

bit	Name		Description
0	S-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	Operating the Servo Drive	Enable operation	1: Active; 0: Inactive

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	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive
2	Enable operation	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive
7	Alarm	1: Active; 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reach	Not supported, always being 1
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follows the command value	Not supported, always being 1
13	N/A	N/A
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

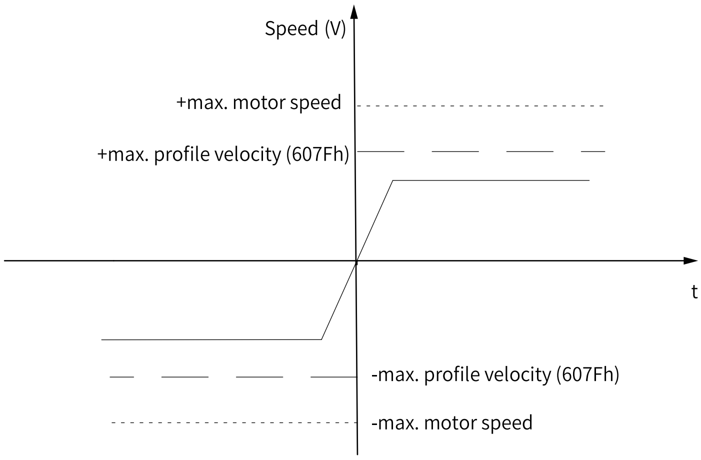
☆ Related parameters:

For parameter details, see *"16.23 Parameter Group 6000h" on page 482*.

12.5.5 Related Function Settings

Speed limit in the torque control mode

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

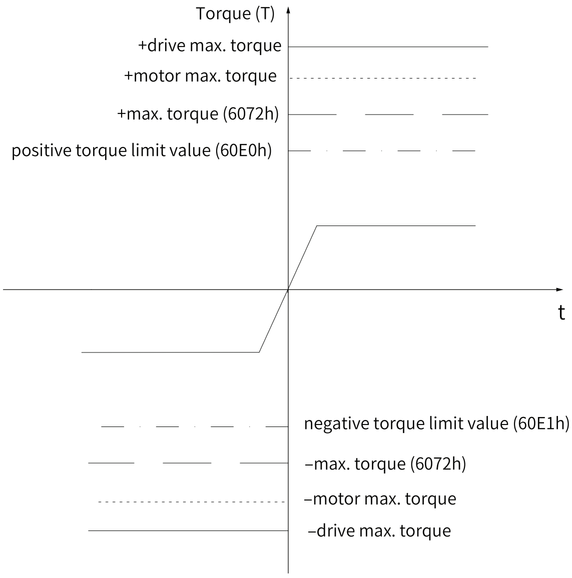


☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
607Fh	Maximum speed	0 to 4294967295	Defines the maximum speed in user-defined unit. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 rpm.	42949 67295	Refer ence unit/s	UInt32	Real time	Real time

Torque limit

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



☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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
60E0h	Positive torque limit	0 to 5000	Defines the maximum positive torque.	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.

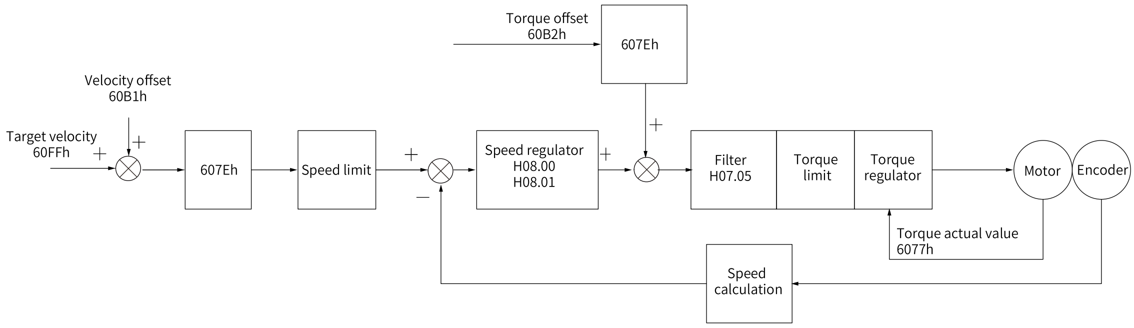
☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	0	-	UInt16	Real time	Real time

12.6 Cyclic Synchronous Velocity (CSV) Mode

In CSV mode, the host controller sends the target speed to the servo drive through cyclic synchronization. The servo drive executes speed control and torque control.

12.6.1 Function Block Diagram



12.6.2 Configuration Block Diagram

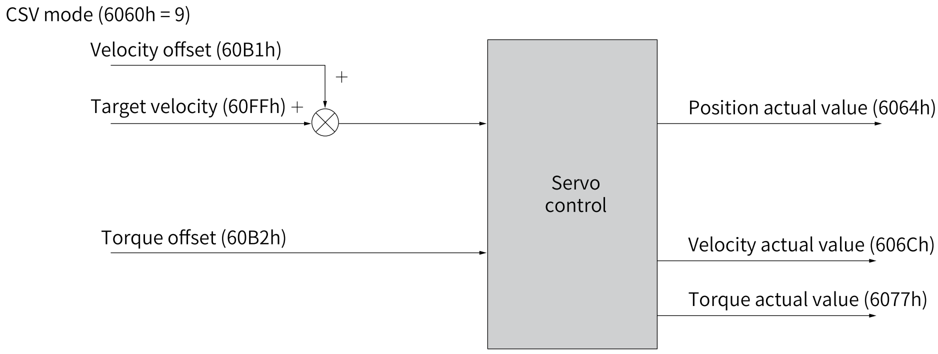


Figure 12-5 CSV mode

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

Value Range:

0 to 65535

Description:

Used to set the control command.

bit	Name		Description
0	S-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	Operating the Servo Drive	Enable operation	1: Active; 0: Inactive

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	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive
2	Enable operation	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive
7	Alarm	1: Active; 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reach	Not supported, always being 1
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Drive follows the command value	Not supported, always being 1
13	N/A	N/A
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

☆ Related parameters:

For parameter details, see *“16.23 Parameter Group 6000h” on page 482*.

12.6.5 Related Function Settings

Velocity reference polarity

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

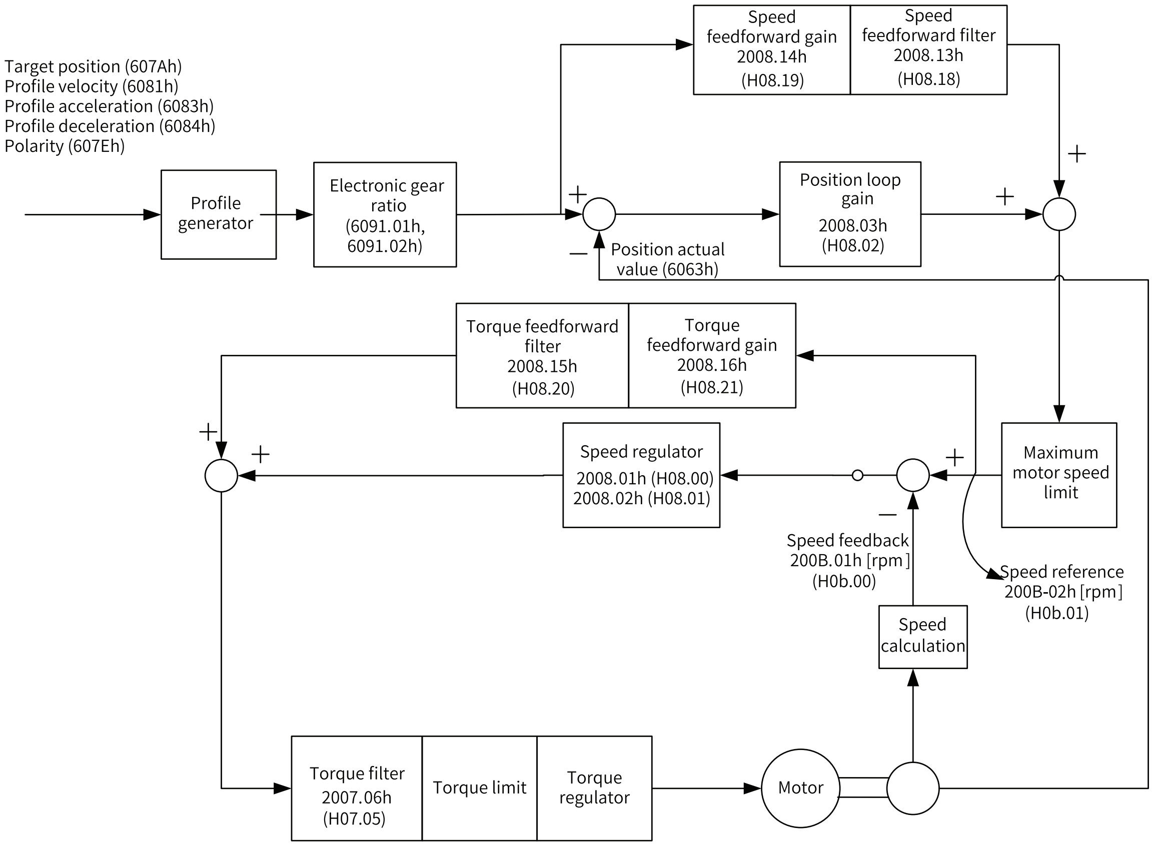
☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	0	-	UInt16	Real time	Real time

12.7 Profile Position (PP) Mode

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

12.7.1 Function Block Diagram



12.7.2 Configuration Block Diagram

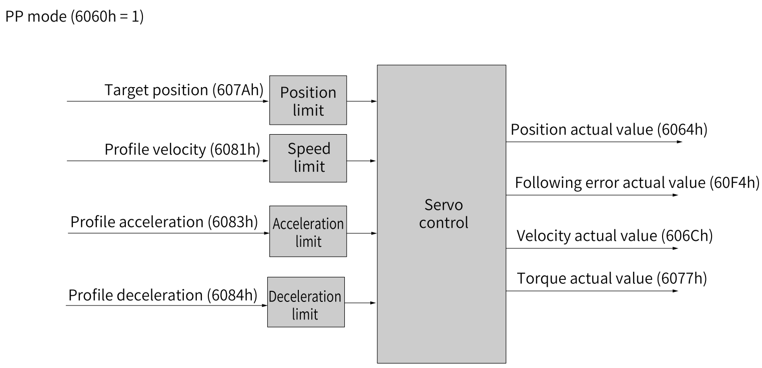


Figure 12-6 PP mode

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.

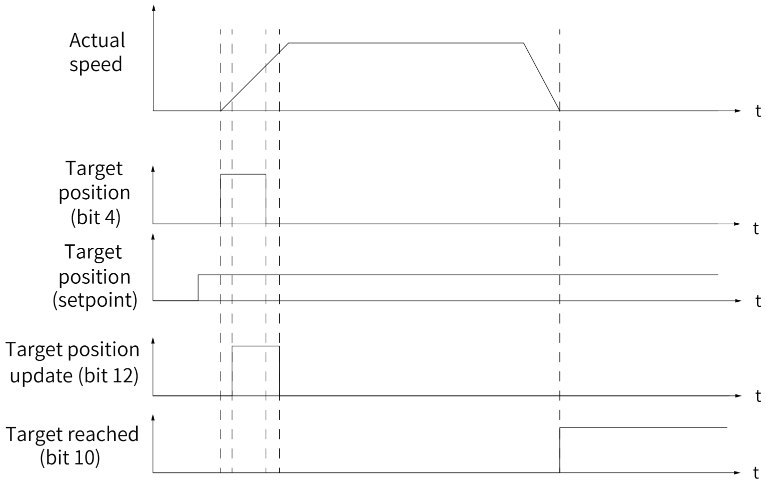


Figure 12-7 Sequence in sequential mode

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 the New set-point bit to 1, and the servo drive performs positioning towards the new target position.

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

Single-point mode:

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

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

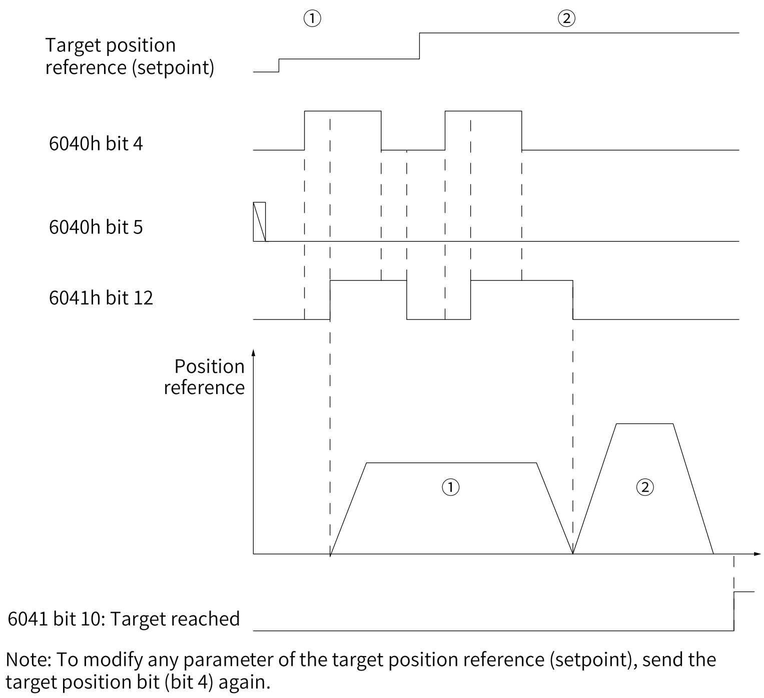
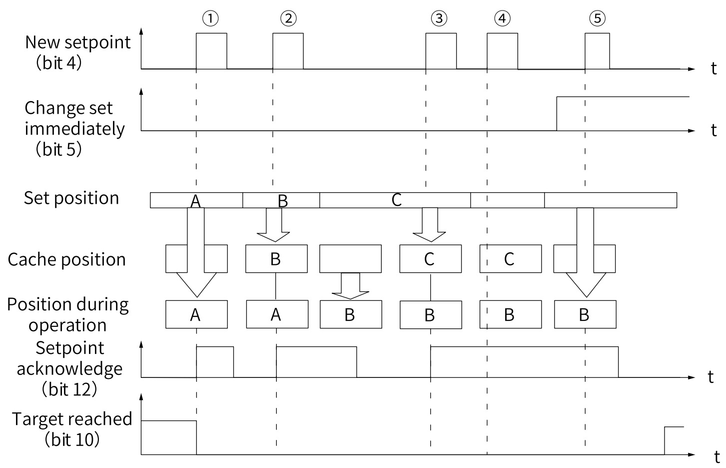


Figure 12-8 Sequence in the single-point mode

In the single-point mode, the servo drive can cache 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 of the setpoint to 1 (Change set immediately) to activate the setpoint.

12.7.3 Recommended Configuration

The basic configuration for 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 Unit: -

Max.: 65535 Data Type: Uint16

Default: - Change: Real time

Access: RW Mapping: RPDO

Setpoint:

0 to 65535

Description:

Used to set the control command.

bit		Description
0	Switch on	1: Active; 0: Inactive
1	Enable voltage	1: Active; 0: Inactive
2	Quick stop	0: Active; 1: Inactive
3	Enable operation	1: Active; 0: Inactive
4	New set-point	0→1: Trigger new target position 1→0: Clear bit12 of the status word
5	Change set immediately	0: Not immediately 1: Immediately
6	abs/rel	0: Target position being absolute 1: Target position being relative
8	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		Description
0	Ready to switch on	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive

bit		Description
2	Enable operation	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive
7	Alarm	1: Active; 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reach	0: Target position not reached 1: Target position reached
11	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Set-point acknowledge	0: Acknowledged 1: Not acknowledged
13	Following error	0: EB00.0 (Excessive position deviation) not reported 1: EB00.0 (Excessive position deviation) reported
14	Manufacturer-specific	Undefined
15	Home found	0: Home not found 1: Home found

☆ Related parameters:

For parameter details, see *"16.23 Parameter Group 6000h" on page 482*.

12.7.5 Related Function Settings

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:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 servo drive considers that the position is reached, and sets bit10 of status word 6041h to 1 in profile position mode. This flag bit is valid only when the S-ON signal is valid in profile position control mode.	46976	Refer ence unit	UInt32	Real time	Real time
6068h	Position window time	0 to 65535	Defines the window time for position reach, which is used together with 6067h.	0	ms	UInt16	Real time	Real time

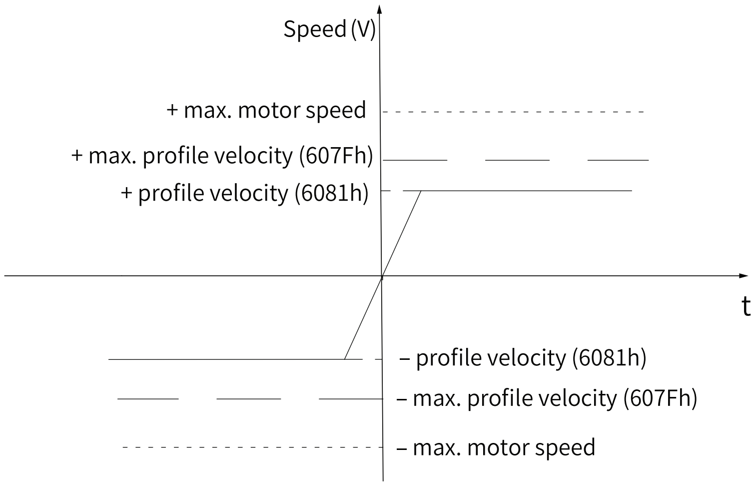
Position deviation monitoring function

☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Refer ence unit	UInt32	Real time	Real time
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 to 65535	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 operation. Note that the maximum operating speed of the motor cannot be exceeded.



☆ Related parameters:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
607Fh	Maximum speed	0 to 4294967295	Defines the maximum speed in user-defined unit. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 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:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
6083h	Profile accelera tion	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 23-bit motor 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 decelera tion	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 23-bit motor 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

Reference polarity

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

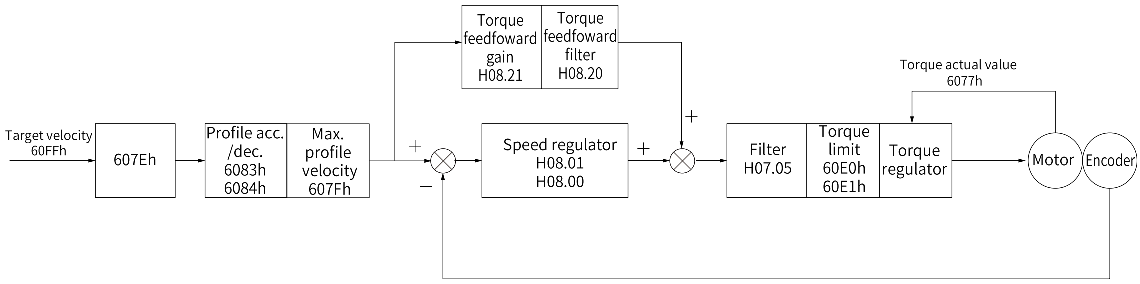
☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	0	-	UInt16	Real time	Real time

12.8 Profile Velocity (PV) Mode

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

12.8.1 Function Block Diagram



12.8.2 Configuration Block Diagram

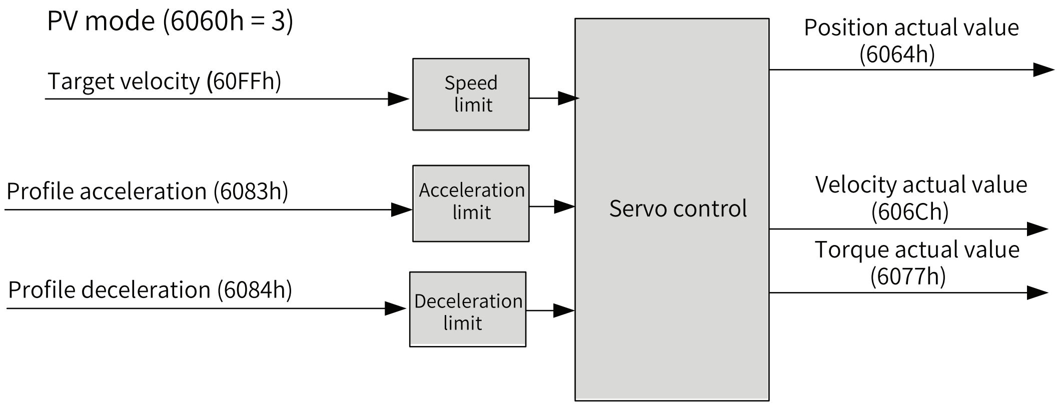


Figure 12-9 PV mode

12.8.3 Recommended Configuration

The basic configuration for 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	Unit:	-
Max.:	65535	Data Type:	Uint16
Default:	-	Change:	Real time
Access:	RW	Mapping:	RPDO

Value Range:

0 to 65535

Description:

Used to set the control command.

bit	Name		Description
0	S-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	Operating the Servo Drive	Enable operation	1: Active; 0: Inactive
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		Description
0	Ready to switch on	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive
2	Enable operation	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive
7	Alarm	1: Active; 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reach	0: Target velocity not reached 1: Target velocity reached
11	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12	Speed	0: Speed not being 0 1: Speed being 0
13	N/A	N/A

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

☆ Related parameters:

For parameter details, see *"16.23 Parameter Group 6000h" on page 482*.

12.8.5 Related Function Settings

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:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
606Dh	Velocity window	0 to 65535	Defines the threshold for speed reach. If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches the value defined by 606Eh, the speed is reached. In this case, bit 10 of the status word 6041h is set to 1 in the profile velocity mode. This flag bit is meaningful only when the servo drive is enabled in PV mode.	10	rpm	UInt16	Real time	Real time
606Eh	Velocity window time	0 to 65535	Defines the time window for speed reach, which is used together with 606Dh.	0	ms	UInt16	Real time	Real time

Monitoring on zero speed

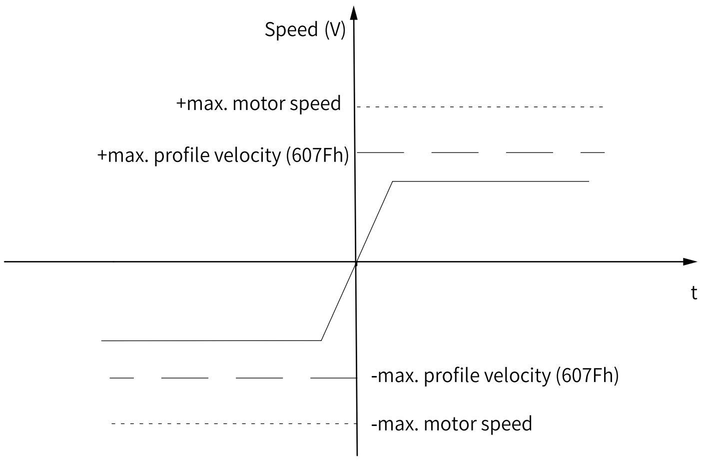
It is used to check whether the absolute value of motor speed feedback is lower than the set threshold. If yes, the motor is close to a standstill (zero speed) and bit12 of the status word is set to 1.

☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
606Fh	Zero speed signal threshold	0 to 65535	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 to 65535	Defines the time window for determining whether the user velocity is 0, which is 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 operation. Note that the maximum speed cannot exceed the maximum operating speed allowed by the motor.



☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
607Fh	Maximum speed	0 to 4294967295	Defines the maximum speed in user-defined unit. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 rpm.	42949 67295	Refer ence 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:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
60C5h	Max. accelera tion	0 to 4294967295	Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.	42949 67295	Refer ence unit/ s^2	UInt32	Real time	Real time
60C6h	Max. decelera tion	0 to 4294967295	Defines the maximum permissible deceleration in the profile position mode, profile velocity mode, and homing mode.	42949 67295	Refer ence unit/ s^2	UInt32	Real time	Real time

Reference polarity

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

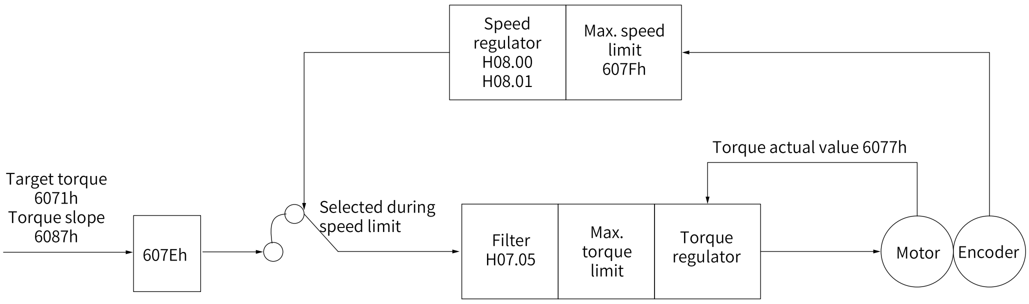
☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	0	-	UInt16	Real time	Real time

12.9 Profile Torque (PT) Mode

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

12.9.1 Function Block Diagram



12.9.2 Configuration Block Diagram

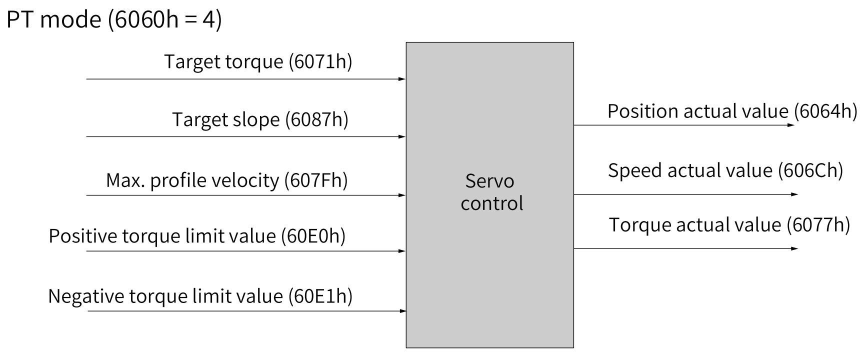


Figure 12-10 PT mode

12.9.3 Recommended Configuration

The basic configuration for the PT 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	Unit:	-
Max.:	65535	Data Type:	Uint16
Default:	-	Change:	Real time
Access:	RW	Mapping:	RPDO

Value Range:

0 to 65535

Description:

Used to set the control command.

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

☆ Related parameters:

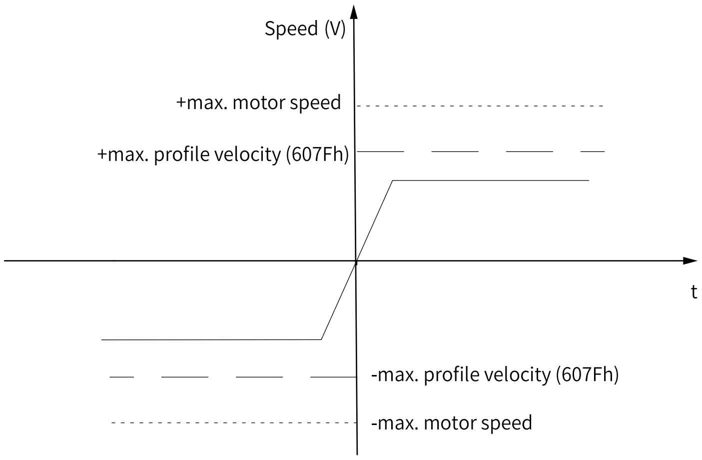
Note: For details on H07.17, see *“16.8 Parameter Group H07” on page 405*.

For parameter details, see *“16.23 Parameter Group 6000h” on page 482*.

12.9.5 Related Function Settings

Speed limit in the torque control mode

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

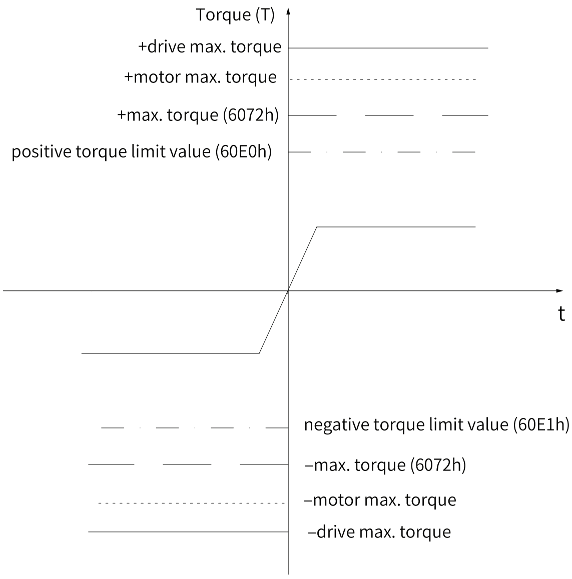


☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
607Fh	Maximum speed	0 to 4294967295	Defines the maximum speed in user-defined unit. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 rpm.	4294967295	Reference unit/s	UInt32	Real time	Real time

Torque limit

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



☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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
60E0h	Positive torque limit	0 to 5000	Defines the maximum positive torque.	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

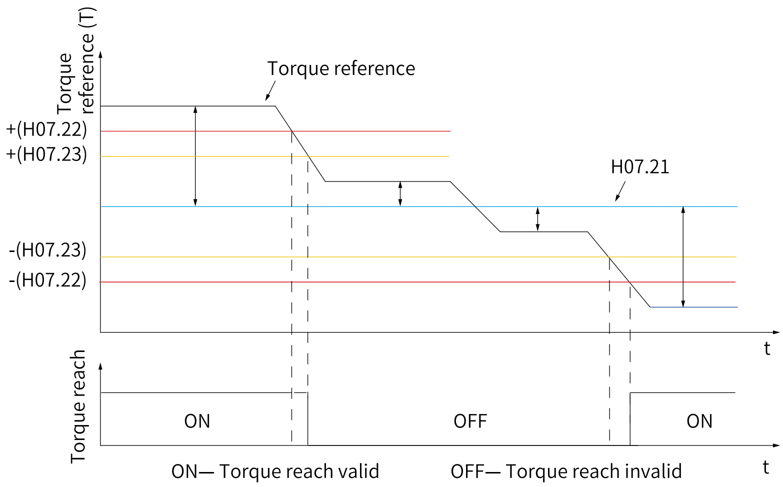
You can change the torque reference direction through setting the torque reference polarity.

☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	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:

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 active torque reach DO active.	20.0	%	UInt16	Real time	Real time
H07.23	2007–18h	Torque reach inactive value	0.0% to 500.0%	Defines the torque reference for invalid torque reach DO.	10.0	%	UInt16	Real time	Real time

12.10 Homing (HM) Mode

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

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

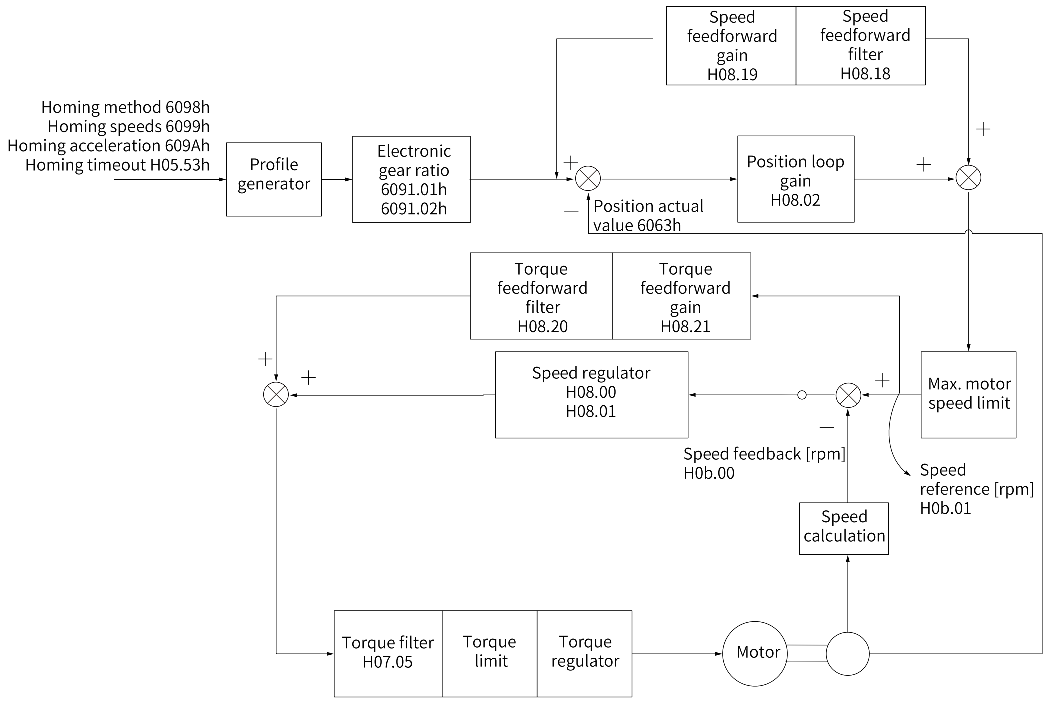
- Mechanical zero: absolute zero position on the machine

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

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

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

12.10.1 Function Block Diagram



12.10.2 Configuration Block Diagram

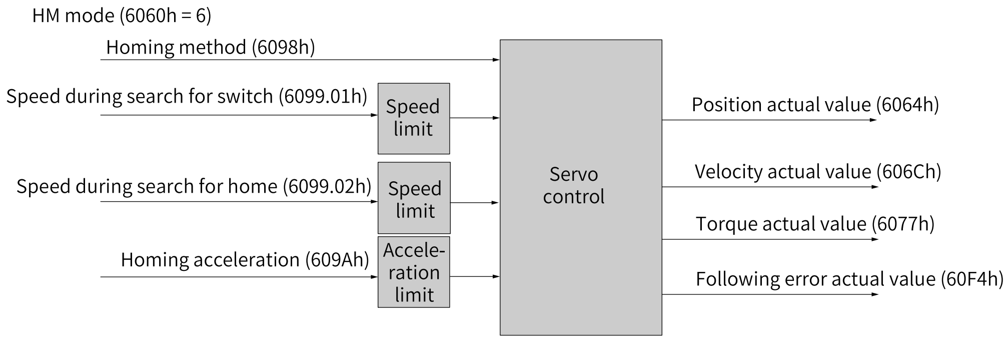


Figure 12-11 HM mode

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 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	S-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	Operating the Servo Drive	Enable operation	1: Active; 0: Inactive
4	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.: - Unit: -

Max.: - Data Type: Uint16

Default: - Change: -

Access: RO Mapping: TPDO

Value Range:

-

Description:

Indicates the servo drive status.

bit		Description
0	Ready to switch on	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive
2	Enable operation	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive

bit		Description
7	Alarm	1: Active; 0: Inactive
8	Manufacturer-specific	Undefined
9	Remote	1: Active, control word activated 0: Inactive
10	Target reach	1: Home located or homing interrupted
12	Homing attained	0: Home signal not found 1: Home signal found
13	Homing error	0: Homing error not occurred 1: Homing error occurred
15	Home found	0: Home not found 1: Home found

☆ Related parameters:

For parameter details, see *"16.23 Parameter Group 6000h" on page 482*.

12.10.5 Related Function Settings

Homing timeout

When the homing duration exceeds the value defined by H05.35 (Homing time limit), the servo drive reports E601.0 (Homing timeout).

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

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H05.35	2005–24h	Home search time limit	0 to 65535	Defines the maximum homing time.	10000	ms	UInt16	Real time	Real time

Actual position calculation method

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

☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 is activated only after homing is done upon power-on and bit15 of 6041h is set to 1. After homing is done, current position in user-defined unit (6064h) is equal to 607Ch. If 607Ch is outside the value of 607Dh (Software position limit), EE09.1 occurs (Home offset setting error).	0	Refer ence unit	Int32	Real time	At stop

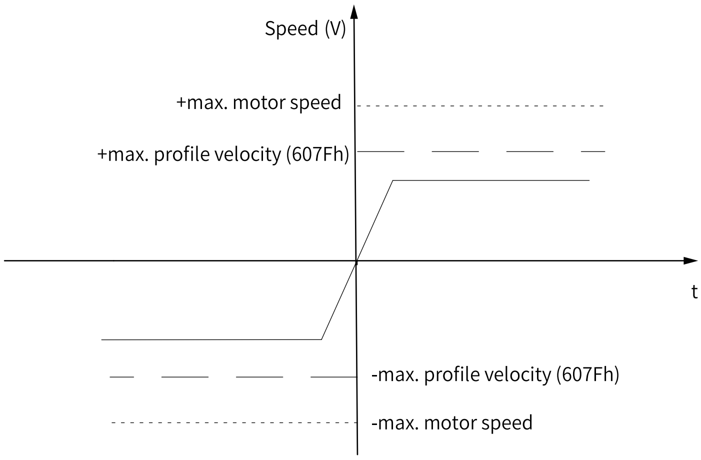
Position deviation monitoring function

☆ Related parameters:

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Refer ence unit	UInt32	Real time	Real time
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 to 65535	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 the HM mode, 607Fh can be used to limit the maximum speed in forward/reverse operation. Note that the maximum speed cannot exceed the maximum operating speed allowed by the motor.



☆ Related parameters:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
607Fh	Maximum speed	0 to 4294967295	Defines the maximum speed in user-defined unit. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 rpm.	4294967295	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:

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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: Z signal

Deceleration point: negative limit switch

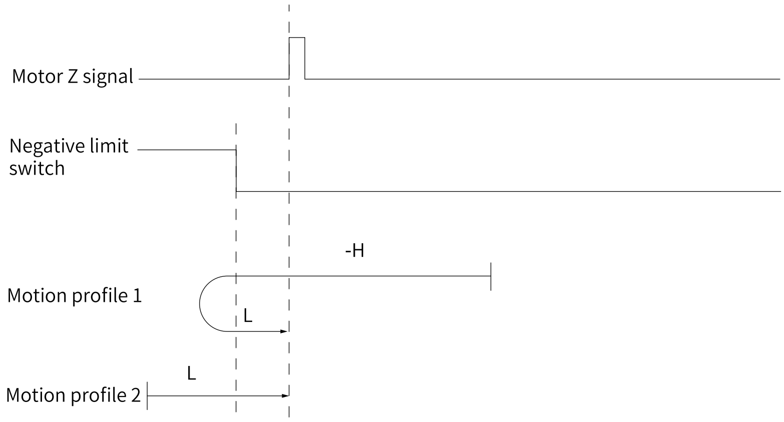


Figure 12-12 Motor running curve and speed in mode 1

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

Note

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

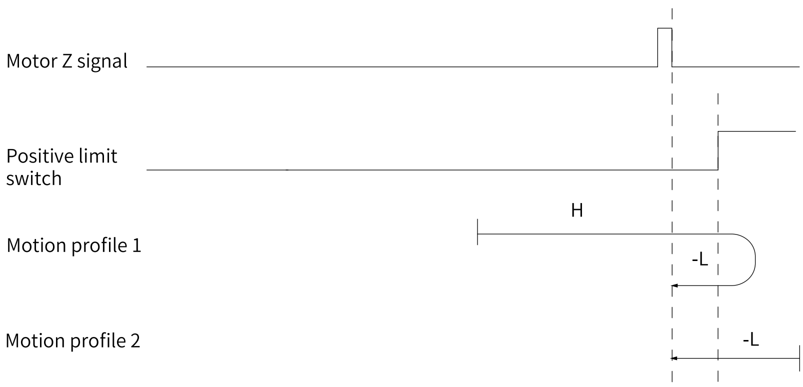


Figure 12-13 Motor running curve and speed in mode 2

- 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)

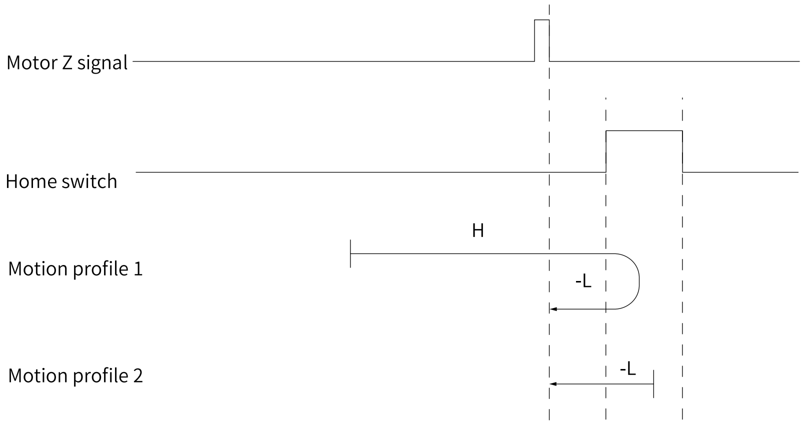


Figure 12-14 Motor running curve and speed in mode 3

- 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)

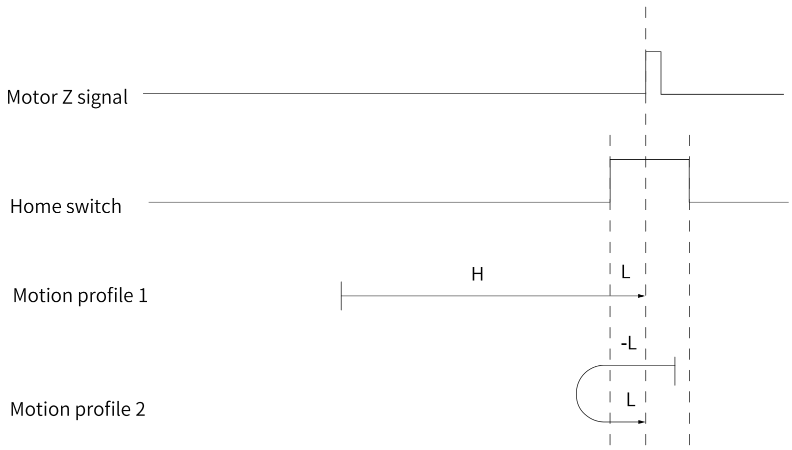


Figure 12-15 Motor running curve and speed in mode 4

- 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)

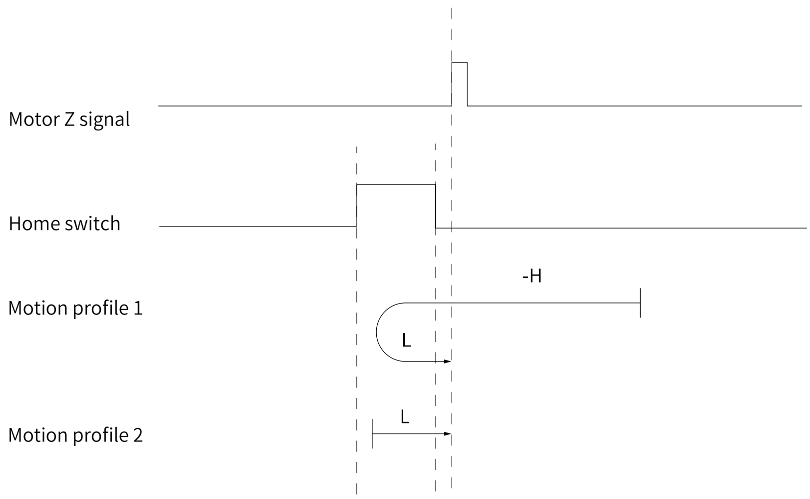


Figure 12-16 Motor running curve and speed in mode 5

- 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)

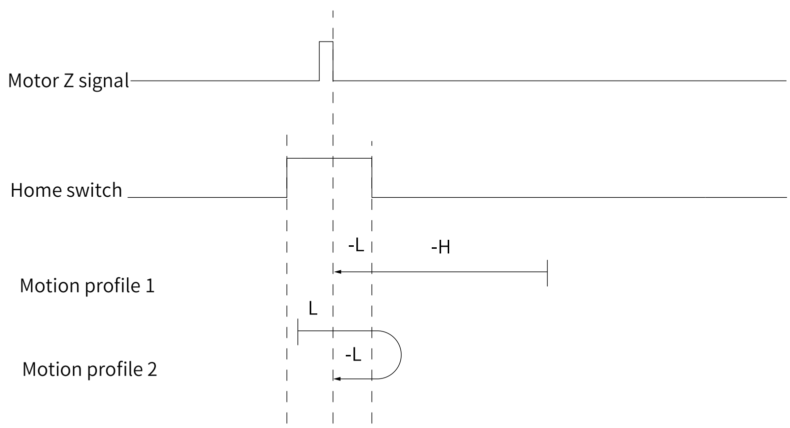


Figure 12-17 Motor running curve and speed in mode 6

- 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)

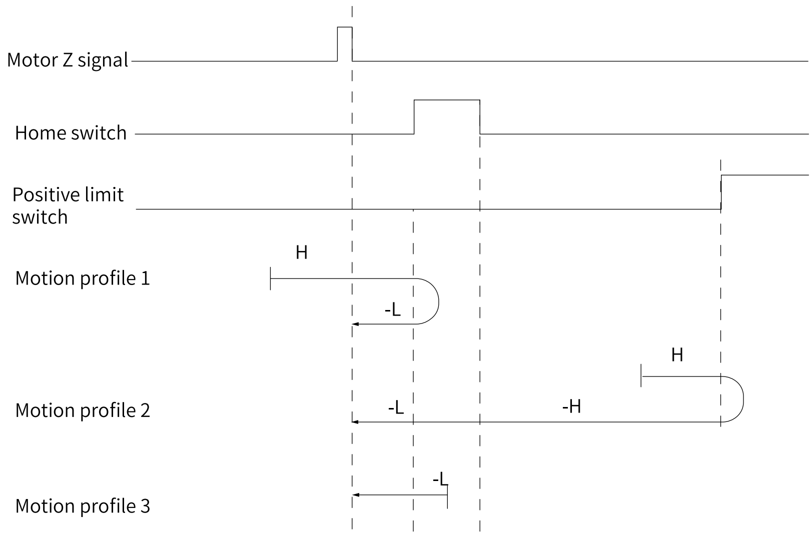


Figure 12-18 Motor running curve and speed in mode 7

- 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)

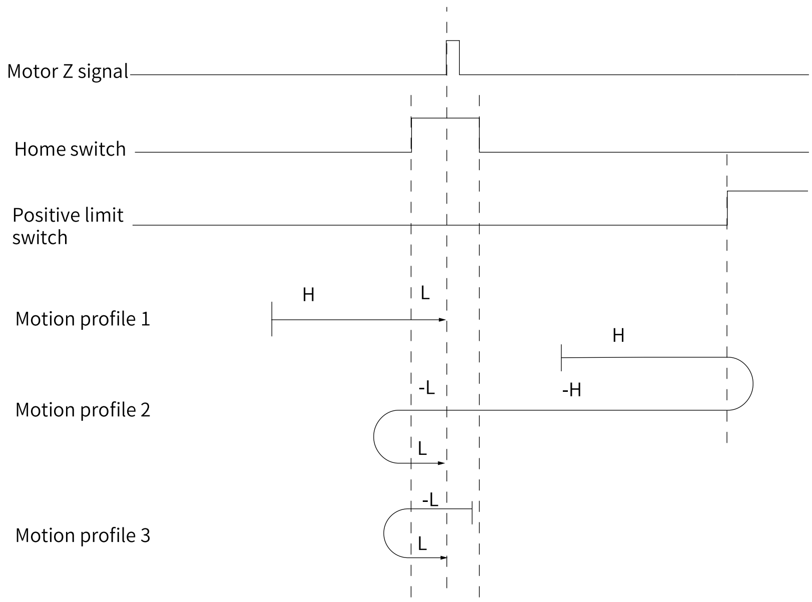


Figure 12-19 Motor running curve and speed in mode 8

- 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)

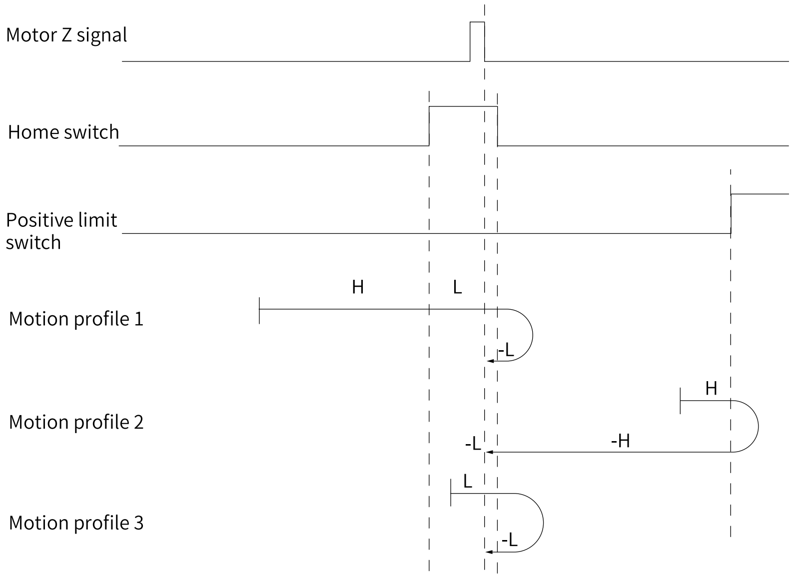


Figure 12-20 Motor running curve and speed in mode 9

- 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)

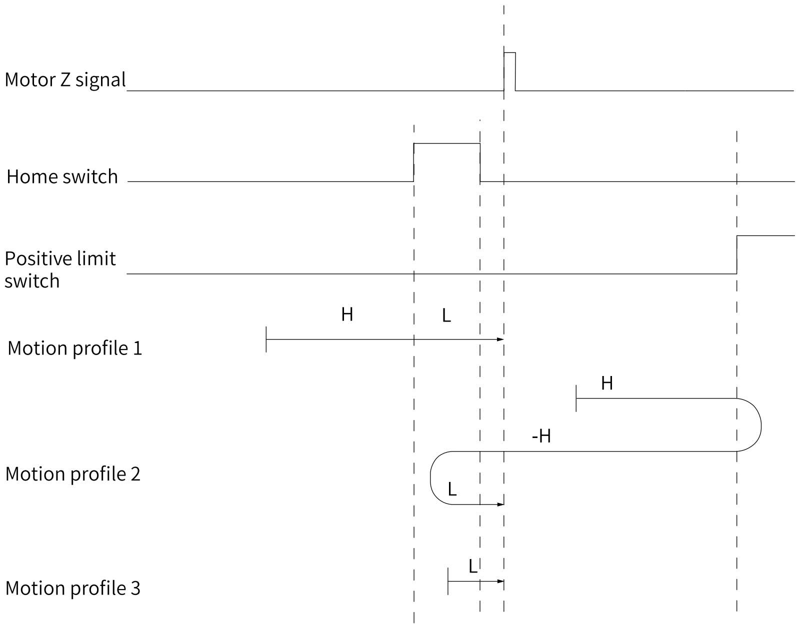


Figure 12-21 Motor running curve and speed in mode 10

- 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)

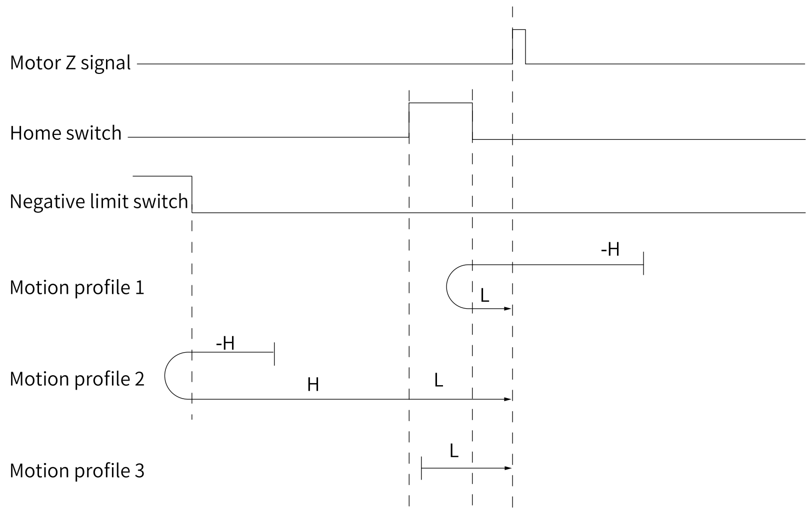


Figure 12-22 Motor running curve and speed in mode 11

- 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)

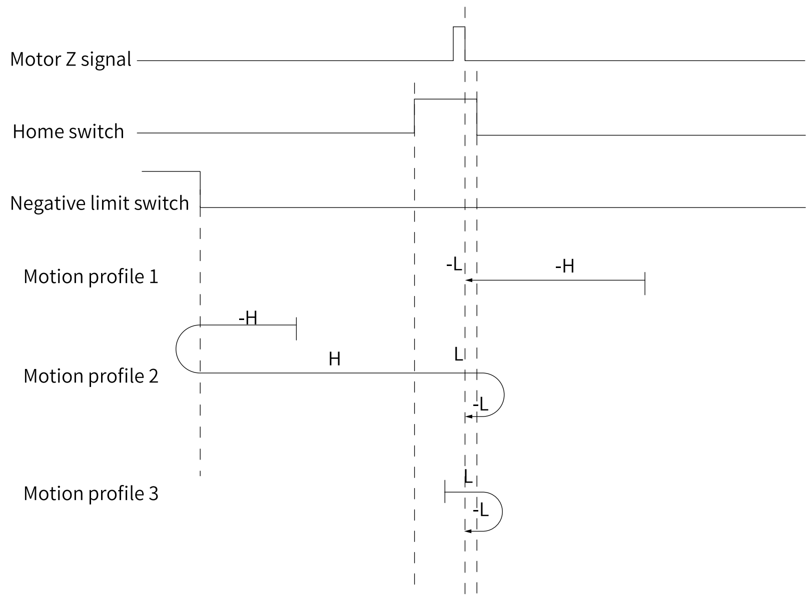


Figure 12-23 Motor running curve and speed in mode 12

- 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)

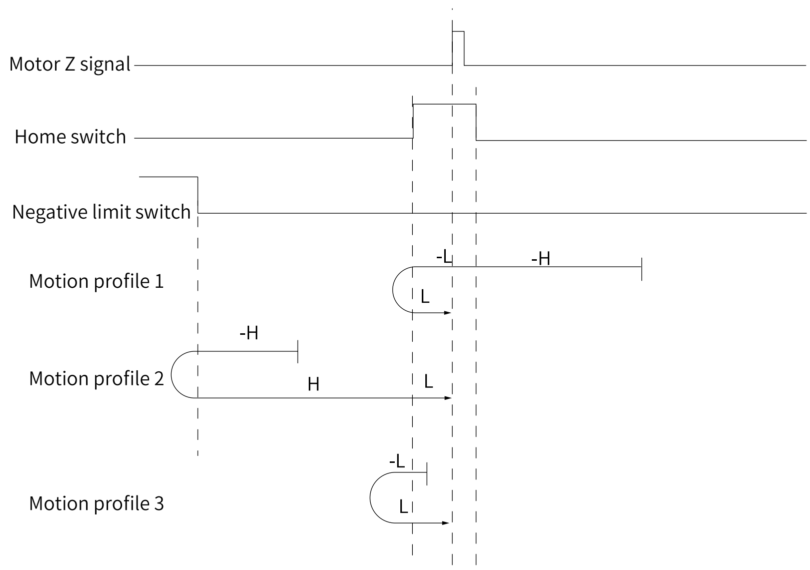


Figure 12-24 Motor running curve and speed in mode 13

- 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)

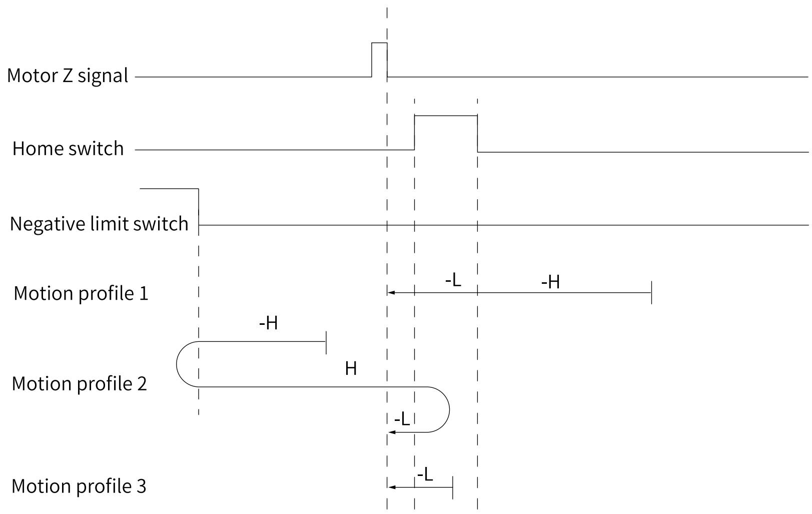


Figure 12-25 Motor running curve and speed in mode 14

- 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

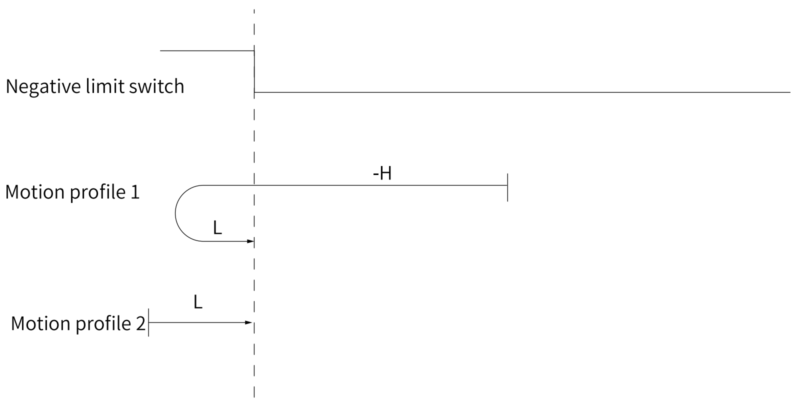


Figure 12-26 Motor running curve and speed in mode 17

- 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

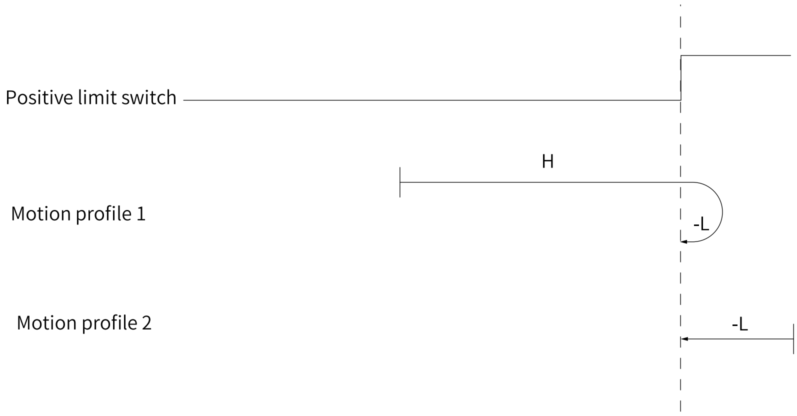


Figure 12-27 Motor running curve and speed in mode 18

- 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)

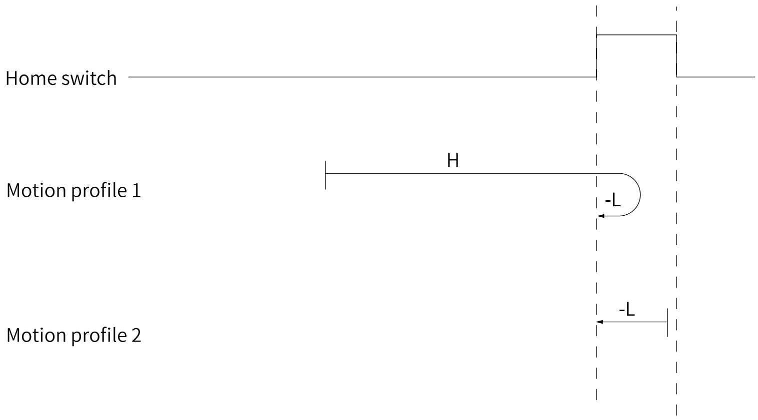


Figure 12-28 Motor running curve and speed in mode 19

- 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)

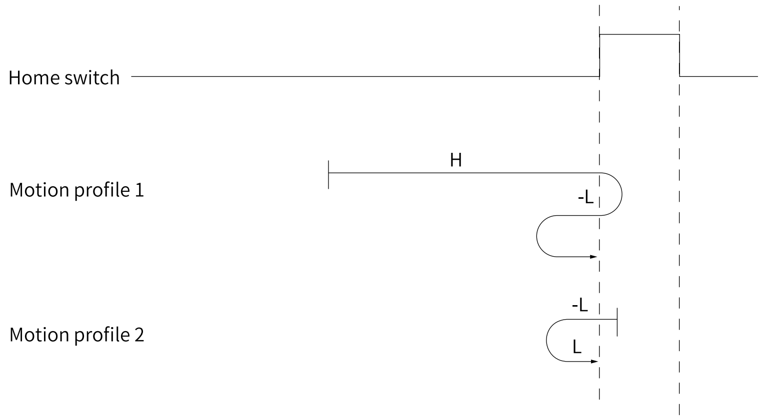


Figure 12-29 Motor running curve and speed in mode 20

- 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)

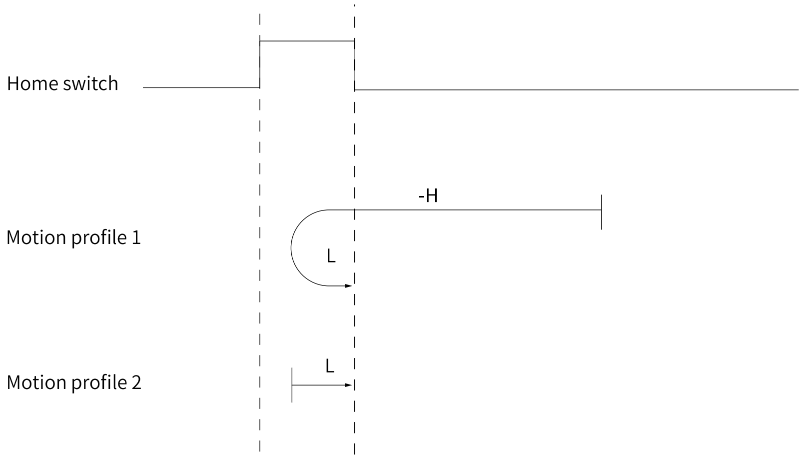


Figure 12-30 Motor running curve and speed in mode 21

- 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)

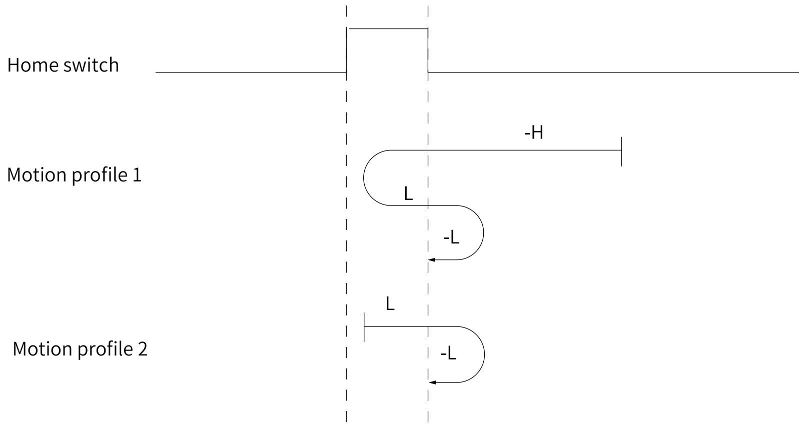


Figure 12-31 Motor running curve and speed in mode 20

- 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)

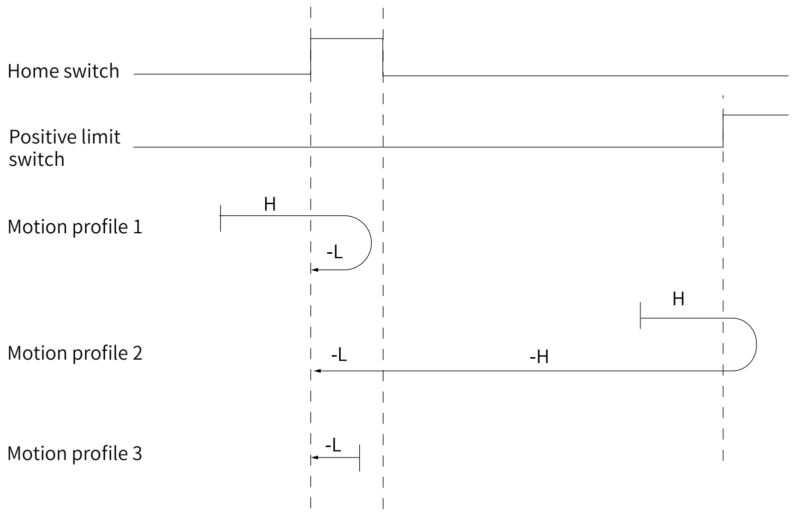


Figure 12-32 Motor running curve and speed in mode 23

- 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)

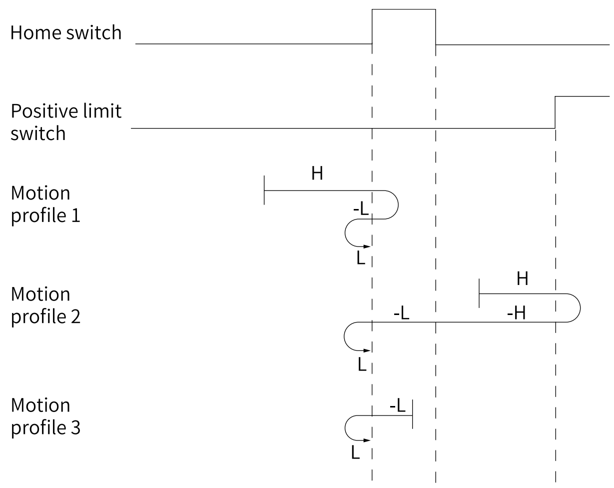


Figure 12-33 Motor running curve and speed in mode 24

- 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)

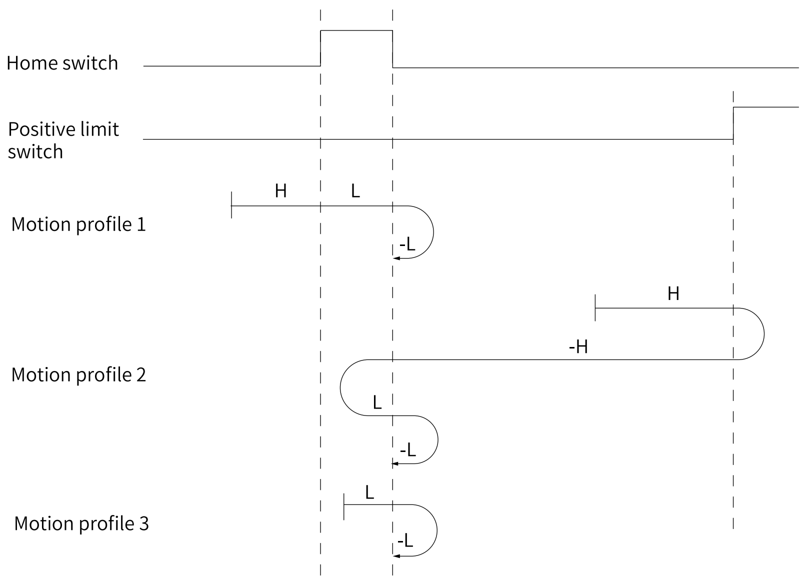


Figure 12-34 Motor running curve and speed in mode 25

- 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)

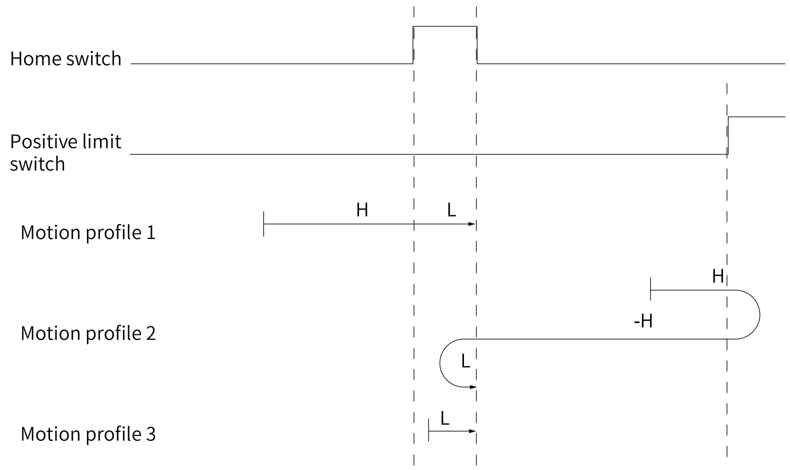


Figure 12-35 Motor running curve and speed in mode 26

- 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)

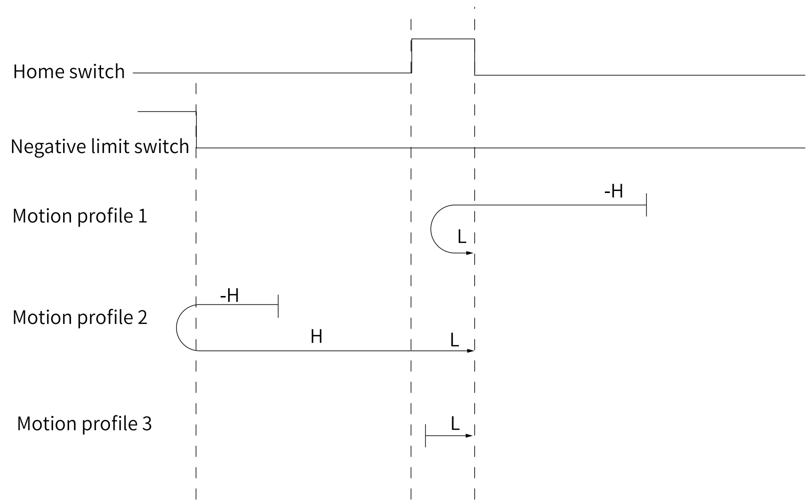


Figure 12-36 Motor running curve and speed in mode 27

- 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)

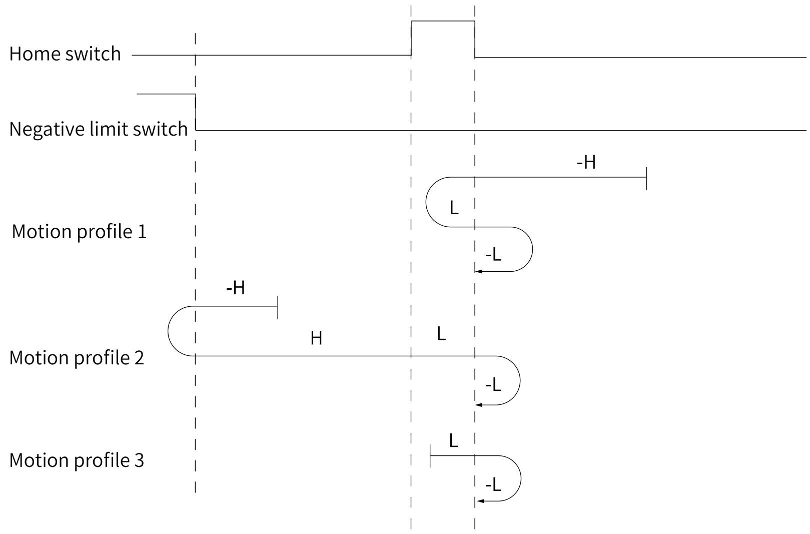


Figure 12-37 Motor running curve and speed in mode 28

- 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)

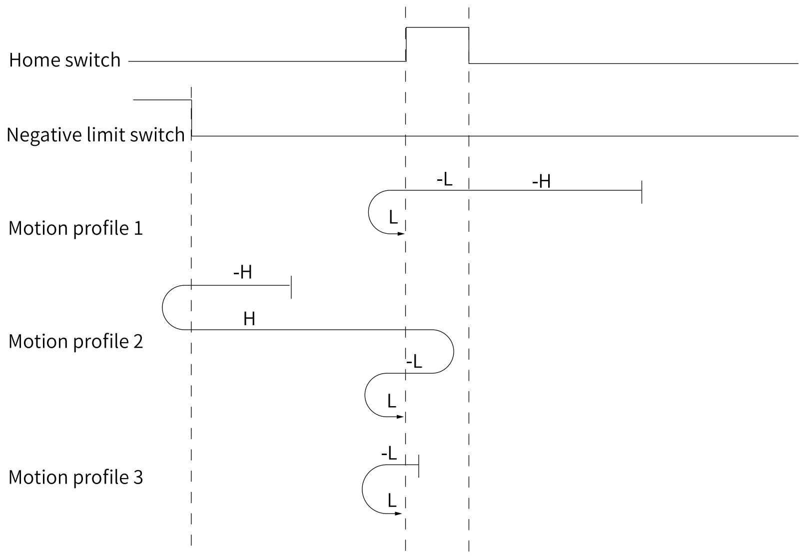


Figure 12-38 Motor running curve and speed in mode 29

- 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)

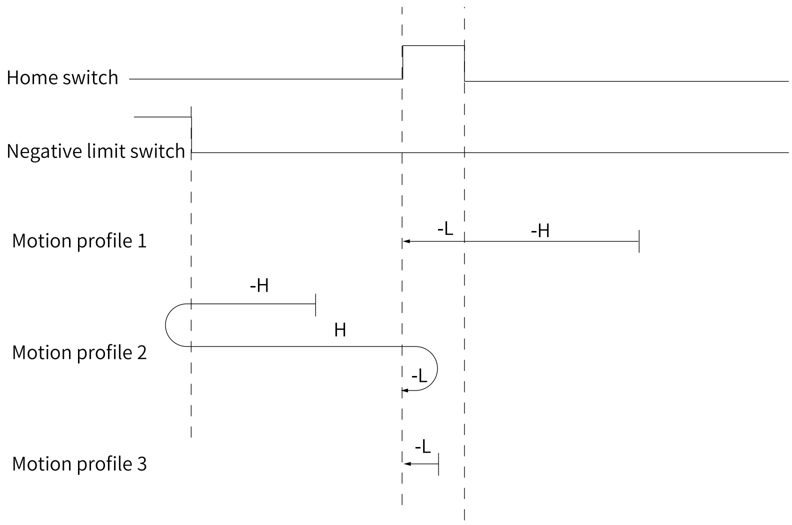


Figure 12-39 Motor running curve and speed in mode 30

- 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 = 33/34

Home: Z signal

Deceleration point: None

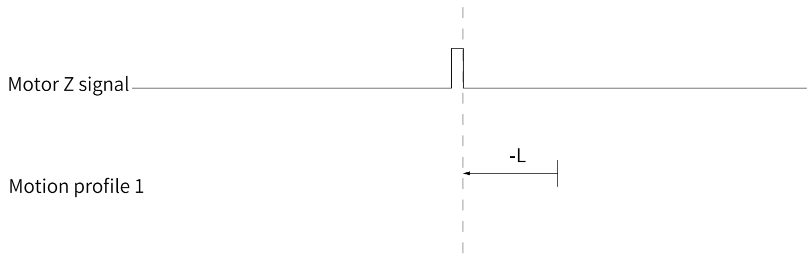


Figure 12-40 Motor running curve and speed in mode 33

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

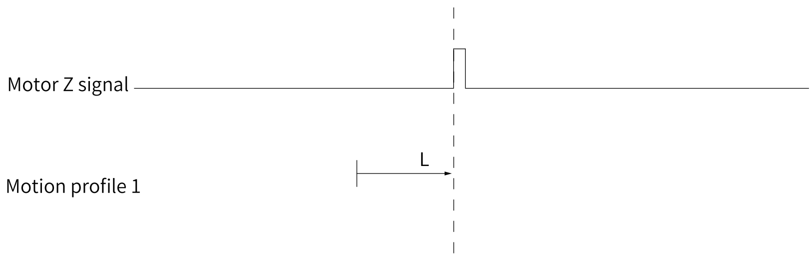


Figure 12-41 Motor running curve and speed in mode 34

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

6098h = 35

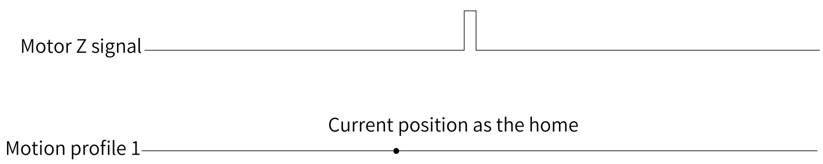


Figure 12-42 Motor running curve and speed in mode 35

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

60E6h = 0 (Absolute homing):

After homing is done, 6064h (Position actual value) is equal to the home offset 607Ch.

60E6h = 1 (Relative homing):

After homing is done, 6064h is the sum of the original value plus the home offset 607Ch.

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.

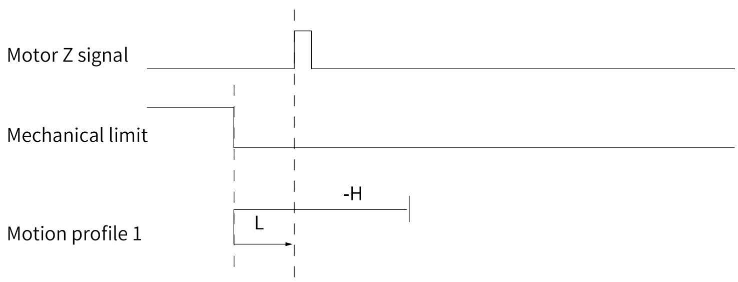


Figure 12-43 Motor running curve and speed in mode -1

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.

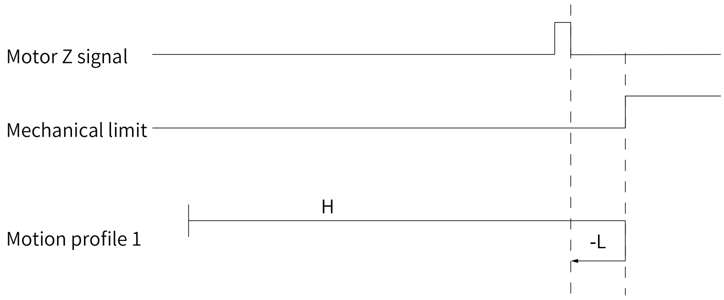


Figure 12-44 Motor running curve and speed in mode -2

13 Solution Application

13.1 Absolute Encoder System

13.1.1 Overview

The absolute encoder, which carries a resolution of 8388608 (2^{23}) PPR, detects the motor position within one revolution and counts the number of revolutions, with 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.

When using the absolute encoder, set H00.00 to 14101 (Inovance 23-bit absolute encoder) and set H02.01 (Absolute system selection) based on actual conditions. E731.0 is reported when the battery is connected for the first time. Set H0d.20 to 1 to reset the fault and perform the homing operation.

Note

When you change the value of H02.02 (Direction of rotation) or H0d.20 (Absolute encoder reset selection), the absolute position recorded by the encoder changes suddenly, causing the mechanical absolute position reference to change. In this case, perform the homing operation. After homing is done, the deviation between the mechanical absolute position and that recorded in the encoder will be calculated automatically and saved in the EEPROM of the drive.

13.1.2 Related Parameters

Absolute encoder system settings

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

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H00.00	2000–01h	Motor code	0 to 65535	14000: Inovance motor with 20-bit incremental encoder 14101: Inovance motor with 23-bit absolute encoder	14101	-	UInt16	At stop	Next power-on
H00.08	2000–09h	Serial 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 warning) 4: Absolute position single-turn mode	Used to set the absolute position function.	0	-	UInt16	At stop	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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0b.70	200b-47h	Number of absolute encoder revolutions	0 to 65535	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	0 to 2147483647	Displays the position feedback of the absolute encoder within one turn.	0	p	UInt32	Unchangeable	-

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0b.77	200b-4Eh	Encoder position (low 32 bits)	-2147483648 to +2147483647	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)	-2147483648 to +2147483647	Displays the high 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangeable	-

Absolute position linear mode

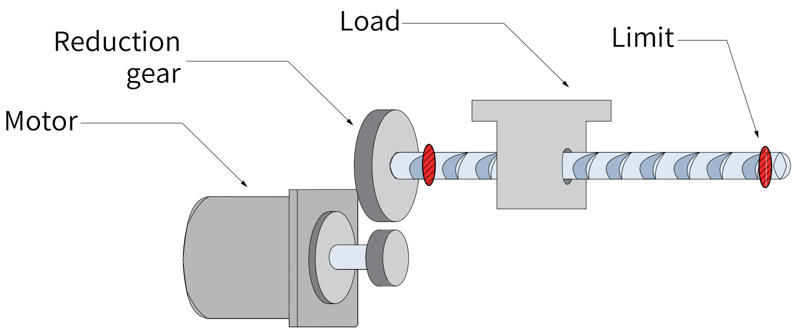


Figure 13-1 Application of the linear mode

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

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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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	Next power-on
H0b.07	200b-08h	Absolute position counter	-2147483648 to +2147483647	It displays the current motor absolute position in reference unit in the position control mode. 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)	-2147483648 to +2147483647	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)	-2147483648 to +2147483647	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.

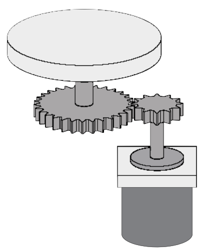
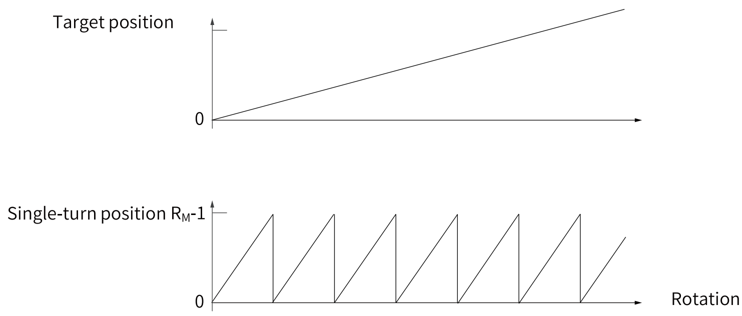
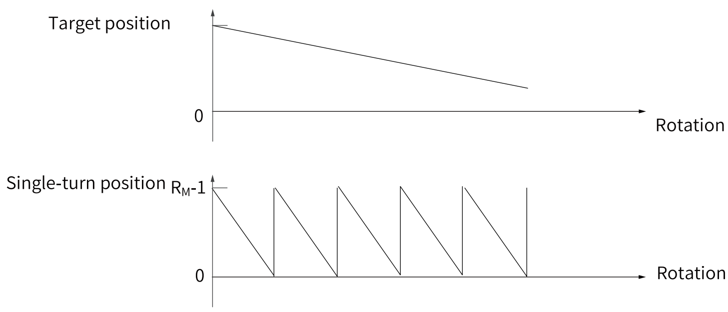


Figure 13-2 Application of the linear mode

The single-turn position range of the rotary load is 0 to (RM - 1) (RM: 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 rotary load during forward operation 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.

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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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)	-2147483648 to +2147483647	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)	-2147483648 to +2147483647	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)	-2147483648 to +2147483647	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

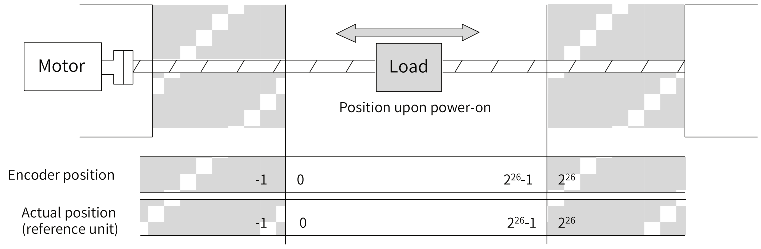
This mode applies to applications where the load travel range is within the single-turn range of the encoder. In this case, the absolute encoder needs no battery as it records the single-turn data only.

- 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 is 1:1, then:

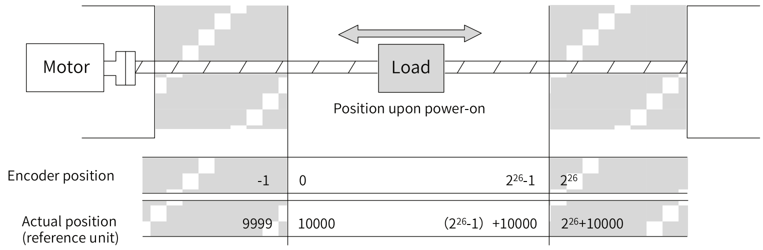
  When H05.36 (Mechanical home offset) is set to 0, the target position range is 0 to (2^{23} - 1).

  After homing is 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 fault) occurs when the battery is connected for the first time. Set H0d.20 to 1 to reset the fault and perform the homing operation.

When the battery voltage detected is lower than 3.0 V, E730.0 (Encoder battery alarm) occurs.

In this case, replace the battery according to the following steps.

1. Power on the servo drive and make it 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.
- 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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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	Set H0d.20 to determine whether to reset the encoder internal faults and encoder feedback multi-turn data.	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.

13.2 Fully Closed-loop Function

13.2.1 Fully 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:

Param.	Hex	Name	Setpoint	Description	Default	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: 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

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.

Caution

Perform necessary inspections before motor trial run. See section Commissioning and Operation for details.

Set this parameter properly. Improper setting may lead to runaway fault.

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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0F.04	200F-05h	External encoder pulses per revolution	0 to 2147483647	See the descriptions for details.	10000	-	UInt32	At stop	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 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).

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:

  $$\text{H0F.04} = \text{Internal encoder pulses per motor revolution x } \frac{Y_2 - Y_1}{X_2 - X_1}$$

  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) may occur after operation.

4. **Set the electronic gear ratio of external encoder.**

   If H0F.00 is set to 1, set H05.07/H05.09. If H0F.00 is set to 2, set H05.07/H05.09 for inner loop and H05.11/H05.13 for outer loop.

   See *“12.1 Conversion Factor” on page 236* 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 is used to set the allowable tolerance between the present motor position and the present position fed back by external encoder. The unit of H0F.08 is one reference unit (same as one external encoder unit).

  ☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0F.08	200F-09h	Excessive deviation threshold in compound 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

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 H0F.08 is set to 0, EB02.0 (Position deviation too large in fully closed loop) will not be outputted.
- 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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0F.10	200F-0Bh	Clear position deviation in compound control mode	0 to 100	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

If H0F.10 is set to 0, the deviation in compound control will not be cleared.

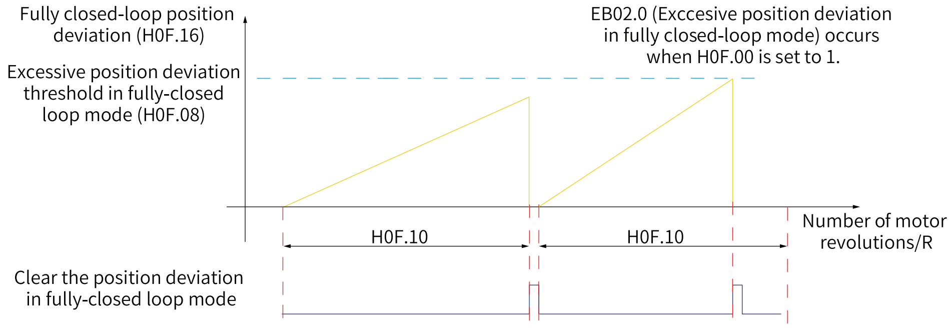


Figure 13-3 Description of position deviation clear in the fully closed-loop mode

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 revolutions, and then starts monitoring again.

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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0F.13	200F-0Eh	Compound vibration suppression 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

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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 Settings

After setting preceding fully closed-loop parameters, observe the internal/external encoder feedback through H0F.18 and H0F.20, and check whether the fully closed-loop wiring and the application mode of the external encoder are proper. If yes, enable the fully closed-loop function.

Set the following parameters while enabling the fully closed-loop function:

☆ Related parameters:

Param.	Hex	Name	Setpoint	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	0	-	UInt16	Real time	Real time
Defines the function of DI1.								

Param.	Hex	Name	Setpoint	Default	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	0	-	UInt16	Real time	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: Inner/Outer loop 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								

13.3 Software position limit

Function

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

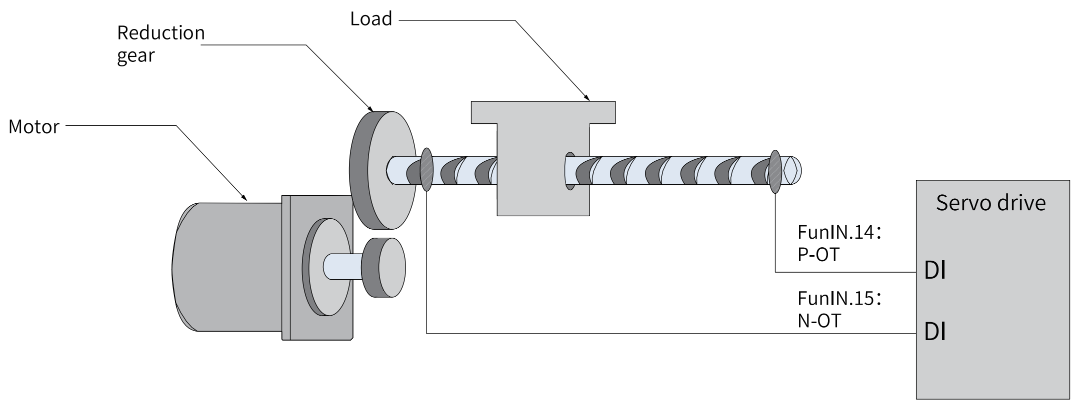


Figure 13-4 Installation of limit switches

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. This function is supported both in absolute position mode and incremental position mode.
In the incremental position mode, set H0A.01 to 2, and the servo drive performs homing to find the mechanical home after power-on and them starts the 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	Hardware wiring is not required, preventing malfunction due to poor cable connection.
3	Suffered from the risk of mechanical slip.	3	Internal position comparison can prevent malfunction due to mechanical slip.
4	Unable to sense or detect an overtravel fault after power-off.		

Related objects

☆ Related parameters:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 overtravel) and stops accordingly.	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 E952.0 (Reverse overtravel) and stops accordingly.	-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 alarm) 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 alarm) 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.

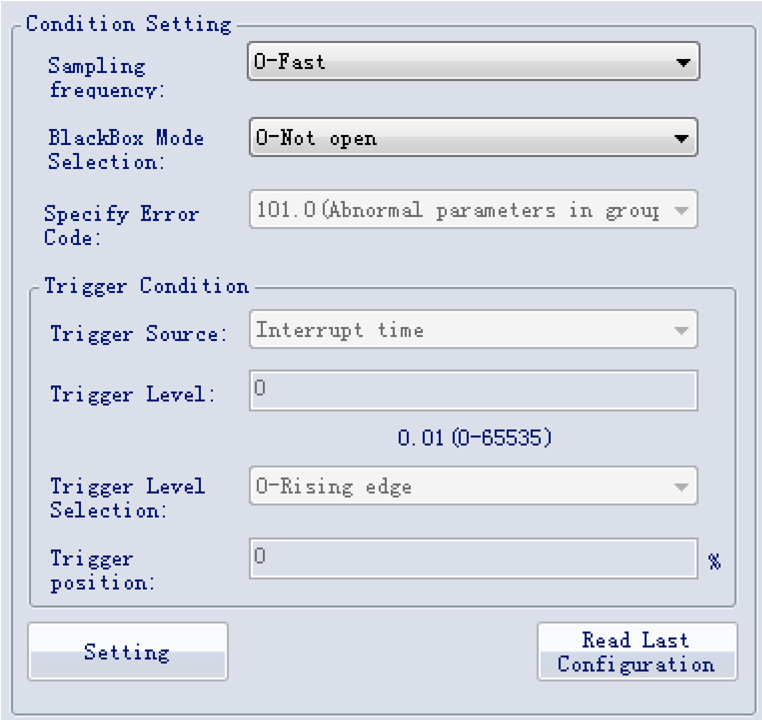
13.4 Black Box

Function

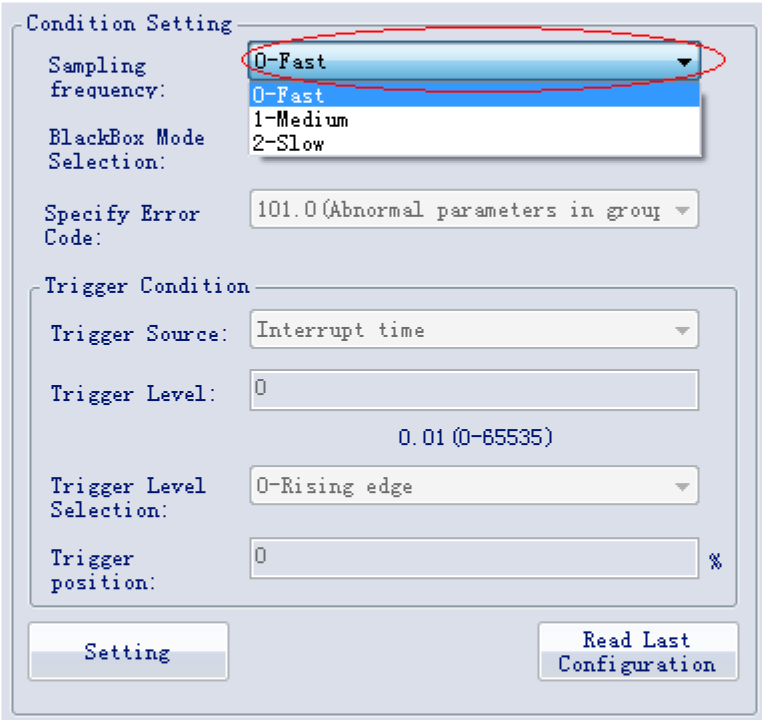
The black box function is used to capture and save the data generated upon occurrence of faults or under designated conditions. Such data can be read and uploaded by users through the software tool to facilitate troubleshooting.

The black box is not enabled by default. It is triggered upon occurrence of a fault or a sampling frequency of 8 k. The black box function will be turned off automatically after it is being triggered, but it cannot be turned on automatically upon fault reset or power cycling.

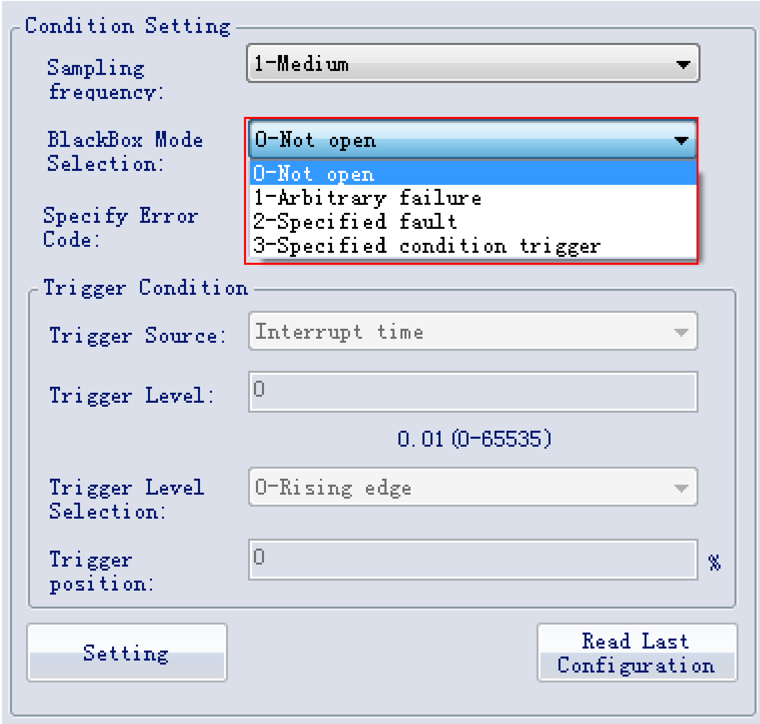
Triggering the black box



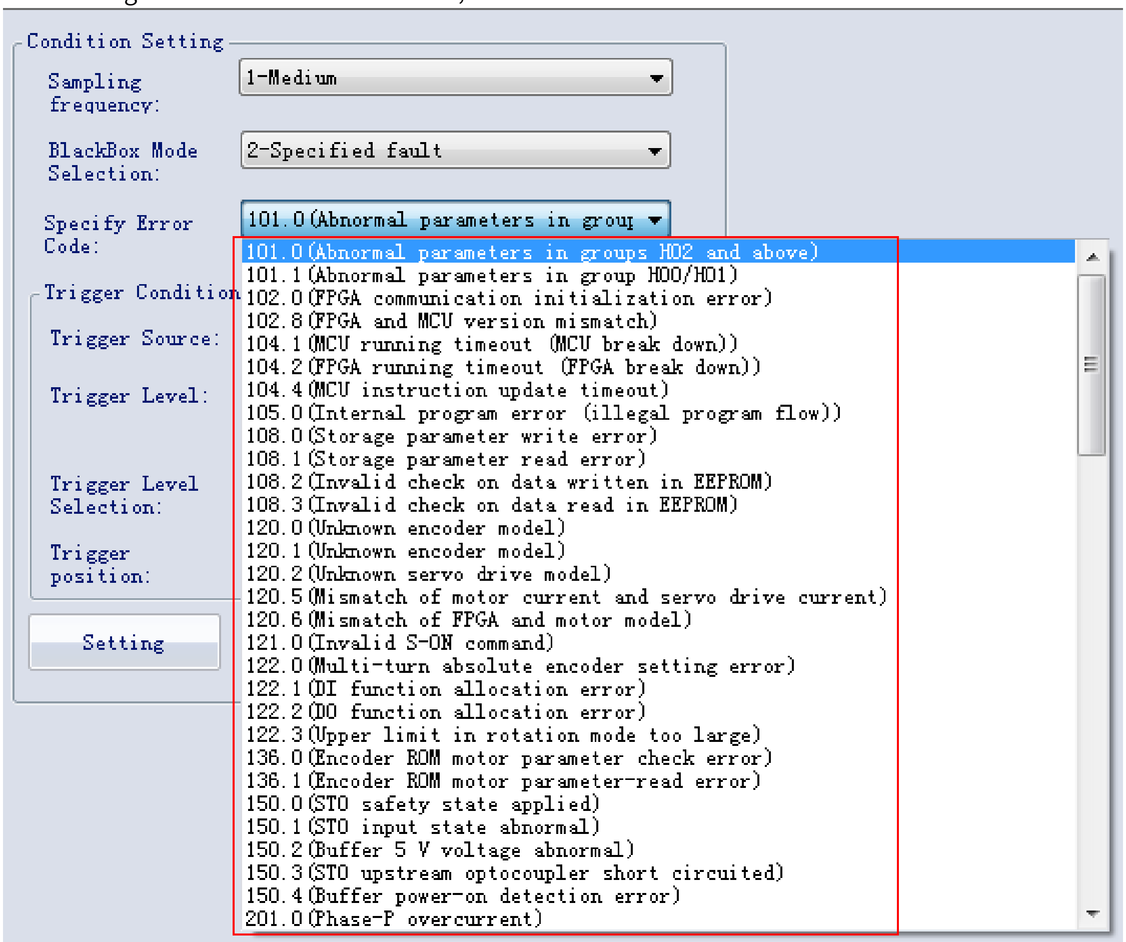
1. Sampling frequency: including three sampling frequencies, namely 8 k (fast), 4 k (medium), and 0.25 k (slow).



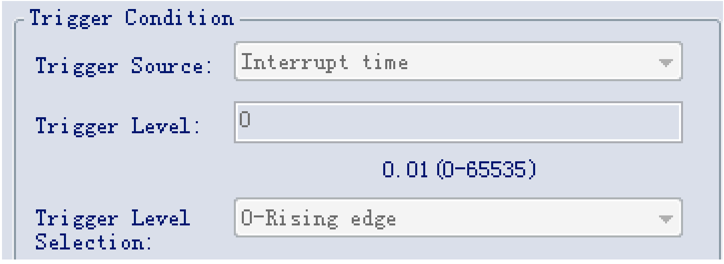
2. Black box mode selection: including three modes, namely Arbitrary fault, Specified fault, and Triggered based on designated condition.



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

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 IS810N series servo 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

Bit 3 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 a DI is used to trigger the touch probe, you can set the filter window of the touch probe signal 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.

Param.		Description
H0A.40	Bit 1	Touch probe rising edge compensation: 1: Enabled, 0: Disabled
	Bit 2	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 us, it is recommended to set the touch probe latch through the ON-edge of the DI.

There are two Z touch probe triggering sources: motor Z signal and frequency-division output Z signal, as shown in the following table.

Feedback Source	Param.	Description
Motor encoder	H05.41.bit 2 = 0, motor Z signal	The Z touch probe is triggered by the motor Z signal.
	H05.41.bit 2 = 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

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
60B8h	Touch probe function	0 to 65535	For details, see section "Steps" on page 316.	0	-	UInt16	Real time	Real time
60B9h	Touch probe status	0 to 65535	For details, see section "Steps" on page 316.	0	-	UInt16	Unchangeable	-
60BAh	Touch probe 1 positive edge	-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	-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	-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	-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	-
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	-

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 DI5 to trigger the touch probe. Background: touch probe 1 positive edge, continuous latching

Observe the following steps:

1. Set the function of DI5 (H03.14 = 38). Set the DI5 logic to NO (H03.11 = 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.

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
60B8h	Touch probe function	0 to 65535	See the following table for the touch probe function.	0	-	UInt16	Real time	Real time

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode

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 touch probe status in 60B9h.
   Assignment of each bit of 60B9h is shown in the following table.

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
60B9h	Touch probe status	0 to 65535	See the following table for the touch probe function.	0	-	UInt16	Unchangeable	-

bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	Bit0 to bit 2: Status of probe 1
1	Touch probe 1 positive edge value 0: No positive edge value latched 1: Edge value latched	
2	Touch probe 1 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
3 to 5	N/A	-
6 to 7	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: Status of probe 2
9	Touch probe 2 positive edge value 0: No positive edge value latched 1: Edge value latched	
10	Touch probe 2 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
11 to 13	N/A	-
14 to 15	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.

   If the position of touch probe 1 at the rising edge has been latched, the position value can be read in 60BAh. The number of latching events can be read in 60D5h.

   Illustration

The following figure shows touch probe function settings and status feedback sequence when DI5 is used as the trigger signal in case of latching at positive edge and continuous triggering.

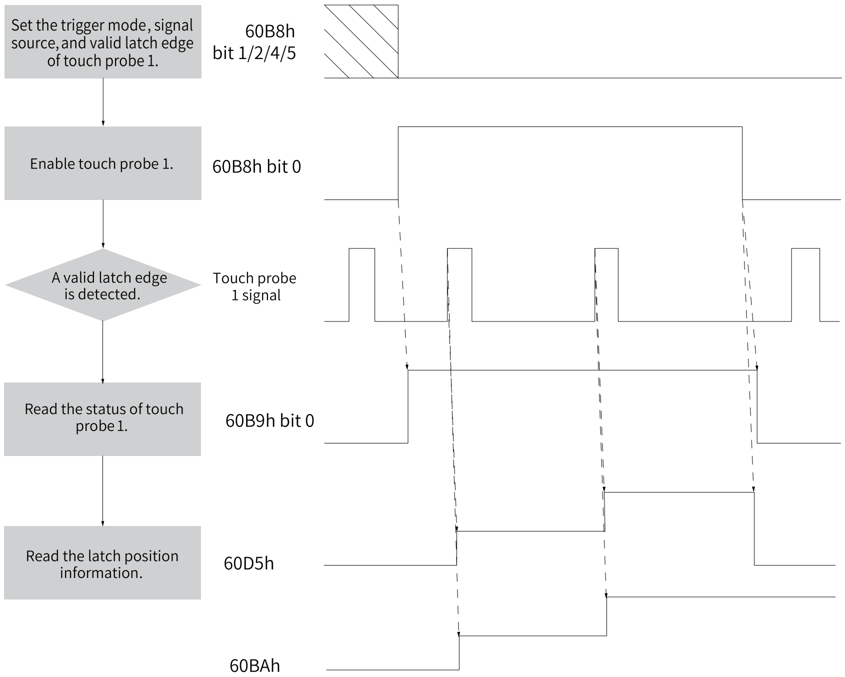


Figure 13-5 Procedure for use of the touch probe

13.6 EtherCAT-forced 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:

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H04.23	2004–18h	ECAT communi cation-forced DO logic in non-OP status	bit0: DO1 0: Status unchanged 1: No output bit1: DO2 0: Status unchanged 1: No output	Sets DO state upon ECAT communication failure.	0	-	UInt16	Real time	Real time

Descriptions for the setpoints are shown in the following *"Table 13–3" on page 321**table*.

Table 13–3 Description of setpoints

Setpoint	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 DO1 and status of DO2 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.

14 STO Function

14.1 Application Example of STO Function

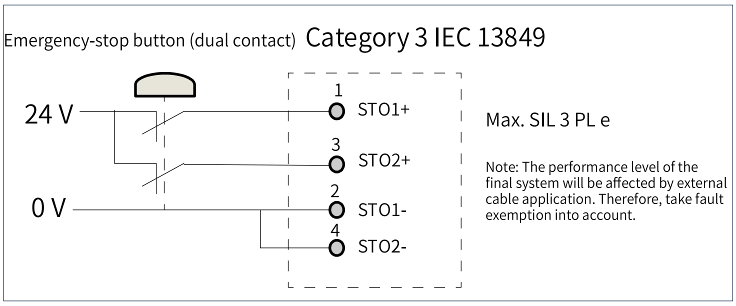


Figure 14-1 Example 1

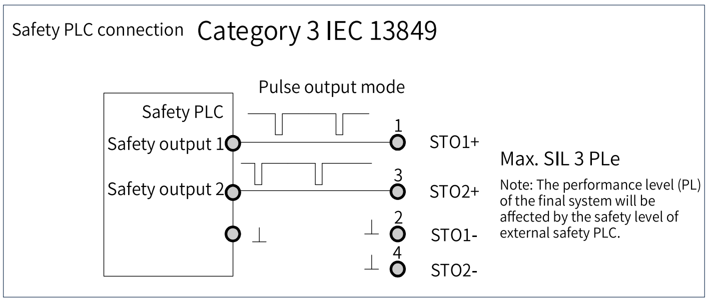


Figure 14-2 Example 2

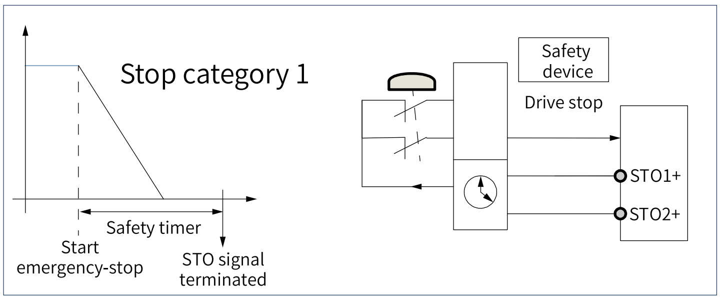


Figure 14-3 Example 3

14.2 Turning Off the STO Function

When the STO terminal is not used, connect it to an external 24 V power supply. The wiring mode of each drive is as follows. If the drives used all carry the STO function, connect the STO terminal of each drive to the external 24 V switched-mode power supply.

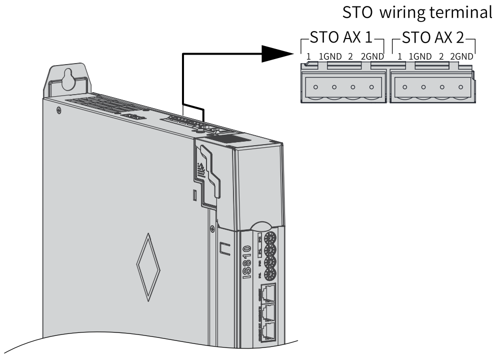


Figure 14-4 STO terminal layout

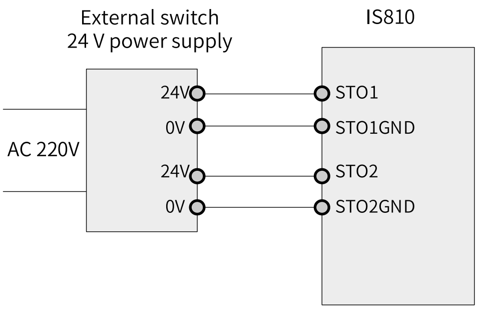


Figure 14-5 Wiring diagram of the STO terminal of the drive unit

The following figure shows a wiring diagram in which the STO terminals of multiple drives are cascaded to share one external switched-mode power supply.

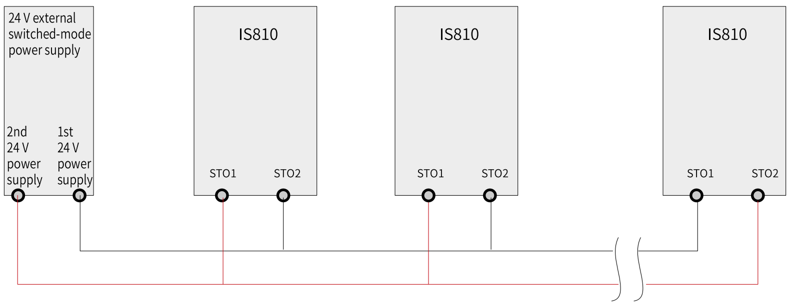


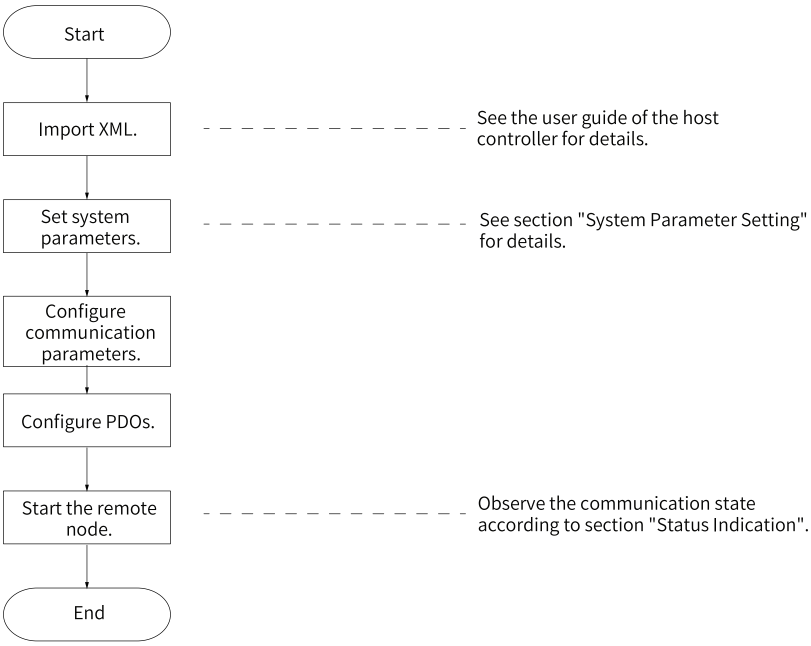
Figure 14-6 Wiring diagram of the STO terminal of the drive unit

15 Communication

15.1 Communication Overview

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 and adopts standard Ethernet physical layer with twisted pairs or optical fibers (100Base-TX or 100Base-FX) as the transmission media.



An EtherCAT system includes 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 x 100 Mbit/s (high-speed Ethernet, full duplex mode).
- Synchronization: synchronization jitter < 1 µs (300 nodes between two devices and cable length being 120 m)

Refresh time:

256 DI/DOs: 11 µs

1000 DI/DOs distributed in 100 nodes: 30 µs = 0.03 ms

200 AI/AOs (16-bit): 50 µs, sampling rate: 20 kHz

100 servo axes (8 bytes IN + 8 bytes OUT for each): 100 µs = 0.1 ms

12000 digital I/Os: 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		Specifications
Basic performance of EtherCAT slave	Communication protocol	EtherCAT protocol
	Available services	CoE (PDO, SDO)
	Synchronization mode	DC - Distributed clock FreeRun
	Physical layer	100BASE-TX
	Baud rate	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Topology	Ring and linear
	Transmission medium	Shielded cables of Cat 5e or higher
	Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
	Number of slaves	Up to 65535 in protocol, not exceeding 100 in actual use
	EtherCAT frame length	44 bytes to 1498 bytes
	Process data	A maximum of 1486 bytes per Ethernet frame
	Synchronous jitter of two slaves	< 1 us
	Refresh time	About 30 us for 1000 DI/DOs About 100 us for 100 servo axes Different refresh time can be set for different interfaces.
	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 kbit

15.1.3 Specifications of EtherCAT Communication

Item		Specifications
Communication protocol		IEC 61158 Type 12, IEC 618007 CiA 402 Drive Profile
Application layer	SDO	SDO request, SDO response
	PDO	Mutable 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	100M
	Interface	RJ45 x 2 (IN, OUT)

15.2 Hardware Configuration

For EtherCAT-related hardware, see *"7.9.1 Terminal Layout" on page 122*.

15.3 Communication Transmission Mode

15.3.1 Structure of EtherCAT Communication

Multiple kinds of application protocols are available for EtherCAT communication. The IEC 618007 (CiA 402)-CANopen motion control profile is used for the drive. The following figure shows the EtherCAT communication structure at the CANopen application layer.

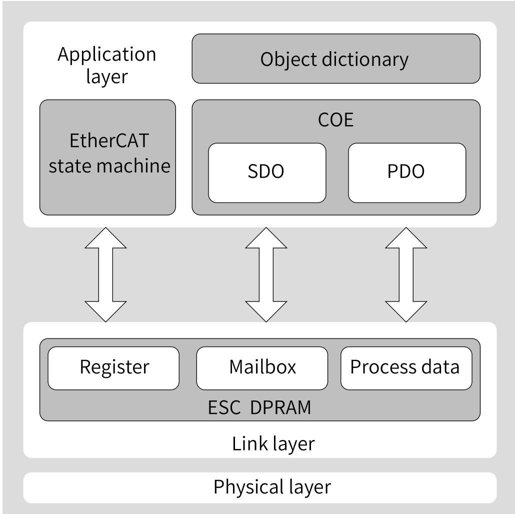


Figure 15-1 EtherCAT communication structure at CANopen application layer

The object dictionary in the application layer includes communication parameters, application process data and PDO mapping data. 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 EtherCAT state machine.

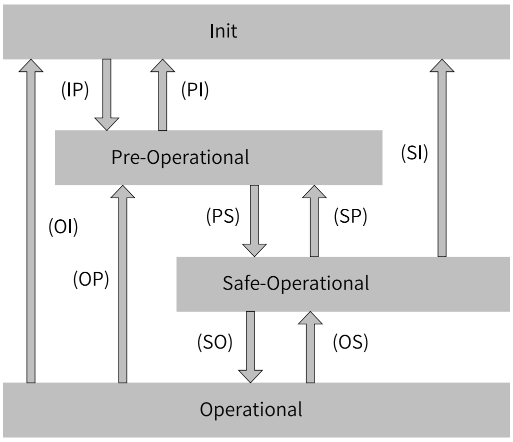


Figure 15-2 EtherCAT state machine

The EtherCAT state machine must support the following four states and coordinate the states between the master and slave application program during initialization and operation.

- Init: Initializing (abbreviated as I)
- Pre-operational: abbreviated as P
- Safety-operational: abbreviated as S
- Operational: abbreviated as O

Transition from Init state to Operational state must be in the sequence of Init, Pre-Operational, Safe-Operational, and Operational step by step. In transition from Operational state to 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)	No	No	No	Communication initialization No communication available in the application layer, EtherCAT slave controller (ESC) register can only be read/ written by the master
IP	No	No	No	Configuring the slave address by master; Configuring the mailbox channel; Configuring the distributed clock (DC); Request for Pre-Operational state
Pre-Operational (P)	Yes	No	No	Mailbox data communication in the application layer (SDO)
PS	Yes	No	No	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 for Safe-Operational state
Safe-Operational (S)	Yes	No	Yes	SDO, TPDO, and distributed clock mode can be used.
SO	Yes	No	Yes	The master sends valid output data to make a request for the Operational state.
Operational (O)	Yes	Yes	Yes	Normal operational state Both the 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 synchronous execution of slave tasks. A slave produces the synchronization signal according to the synchronized system time. The IS810N 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 us. The master must synchronize all the slaves to the same clock and continues doing so during operation to prevent clock skew caused by difference in the crystal oscillator. This is usually done by synchronizing the 0x910 register in ESC.
- SYNC starting time = 0x990 register (with ESC) - 0x920
  Note that the DC mode (0x981 = 0x03) can be enabled only before 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

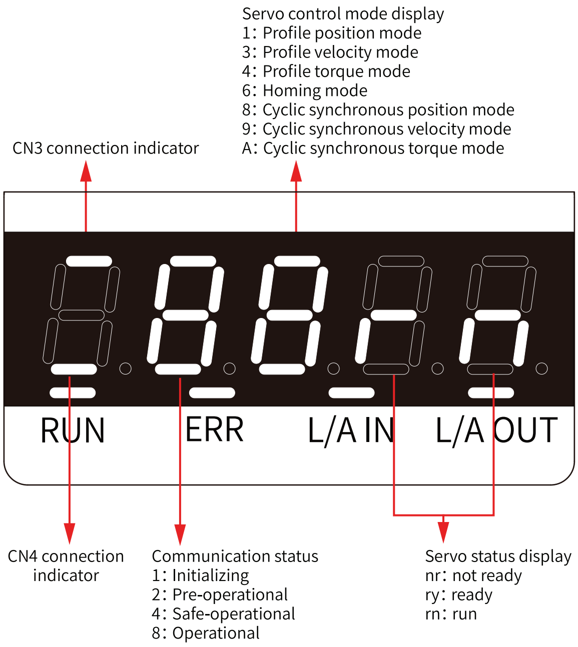


Figure 15-3 Status indication diagram

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

Status	SDO	RPDO	TPDO	Description	Display
Initialization	No	No	No	Communication initialization	1: Solid ON
Pre-operational	Yes	No	No	Network configuration initialized SDO is available	2: LED blinking at an interval of 400 ms
Safe-operational	Yes	No	Yes	SDO, TPDO, and distributed clock mode are available	4: LED blinking at interval of 1200 ms (ON for 200ms and OFF for 1000 ms)
Run	Yes	Yes	Yes	Normal operation state	8: Solid ON

Display of control modes

The 3rd bit on the LED display 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)	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 slave (servo) status.

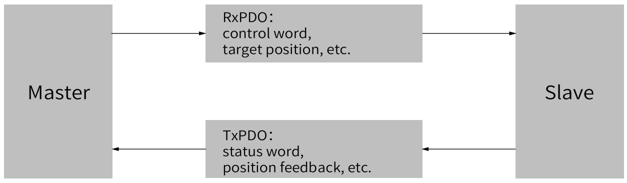
The following servo states are displayed.

Status	Description	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 The display "y" blinks when the motor speed is not 0. 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". When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.
Running	The S-ON signal is active and the motor is energized. Run	rn The display "n" blinks when the motor speed is not 0. 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". When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.

15.4 Communication 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

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 IS810 series drive is a dual-axis drive, in which each axis has one mapping-mutable RPDO and one mapping-mutable TPDO, as listed in the following table.

Axis 1	RPDO1	1600h	Mutable mapping
	TPDO1	1A00h	Mutable mapping
Axis 2	RPDO2	1610h	Mutable mapping
	TPDO2	1A10h	Mutable mapping

Note

In PDO configuration, RPDO1 and TPDO1 (or RPDO2 and TPDO2) must appear in pairs.

Mutable PDO mapping

Each axis provides one mapping-mutable RPDO and one mapping-mutable TPDO.

Mutable 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)

Mutable 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 series servo drive supports 9 operation modes, including CSP/CSV, CSP, CST, CSP/CST, CSP/CSV/CST, CST (Speed Limited), PP+TP, PP/PV/PT, and 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 1C10 to 1C2Fh. Multiple PDOs can be mapped to different sub-indexes. The IS810 series servo 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 TPDOs actually used.
1C13h	01h	Select 1A00h and 1A10h as the TPDOs actually used.

PDO configuration

PDO mapping parameters contain indicators of the process data for PDOs, including the index, subindex 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 following defines mapping parameters.

Bit	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 configuration:
  Follow the following PDO mapping configuration:

  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 PDO configuration 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 configuration.

     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.
- Pre-write a value outside 1600h/1610h to 1C12h and a value outside 1A00/1A10h to 1C13h.

15.4.2 Service Data Object (SDO)

The EtherCAT SDO is used to transfer non-cyclic data, such as communication parameter configuration and servo drive parameter configuration. The CoE service types of EtherCAT include:

- Emergency message
- SDO request:
- SDO response:
- TxPDO
- RxPDO
- Remote TxPDO transmission request
- Remote RxPDO transmission request
- SDO information.

The drive supports SDO request and SDO response.

15.5 Communication-related Parameters

Parameter address structure

Parameter access address: index+subindex, both of which are in hexadecimal.

CiA402 protocol establishes the following restrictions on the parameter address:

Index (Hex)	Description
0000h and 0FFFh	Data type
1000h and 1FFFh	CoE communication object
2000h and 5FFFh	Manufacturer-specific object
6000h and 9FFFh	Profile object
A000h–FFFFh	Reserved

System parameter setting

Set related parameters to allow the drive to be connected to the EtherCAT fieldbus network.

Param.	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 e2prom	0: Do not save 1: Save parameter 2: Save object dictionary 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.01h 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 Example

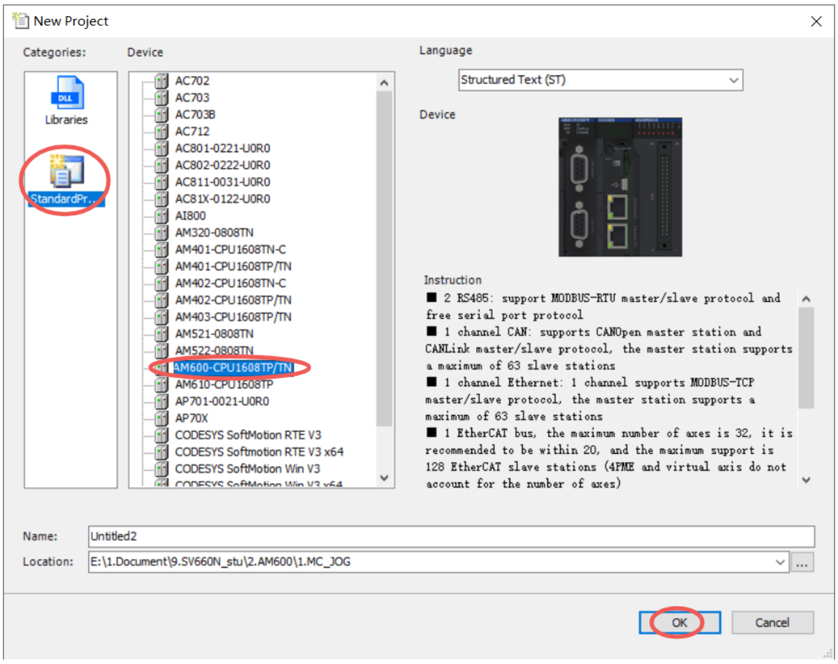
15.6.1 Operating in Cyclic Synchronous Position Mode with AM600 Controller

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.

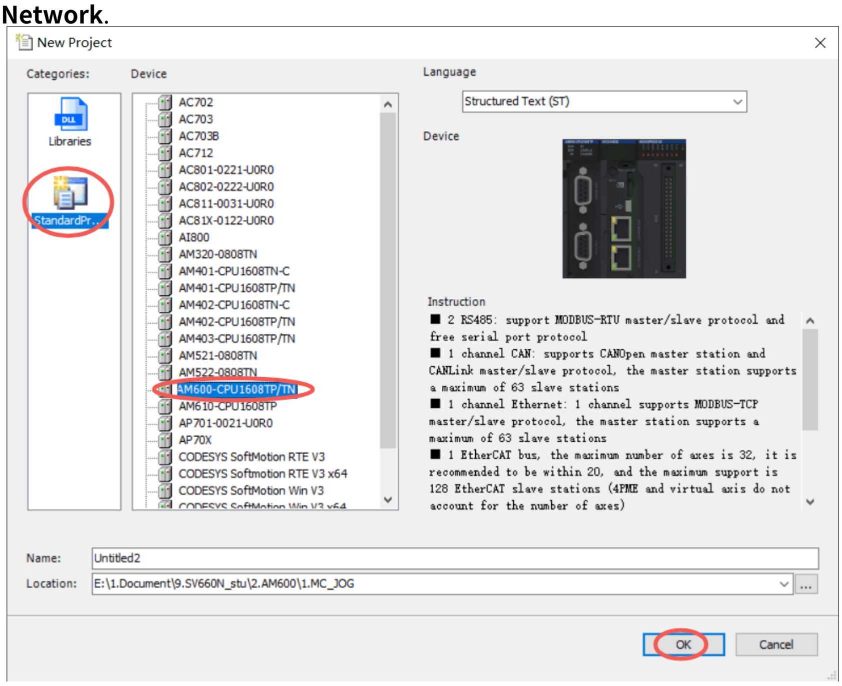
1. Creating Projects
   Create an AM600 project. Select AM600-CPU1608TP/TN, as shown in the following interface.



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**.

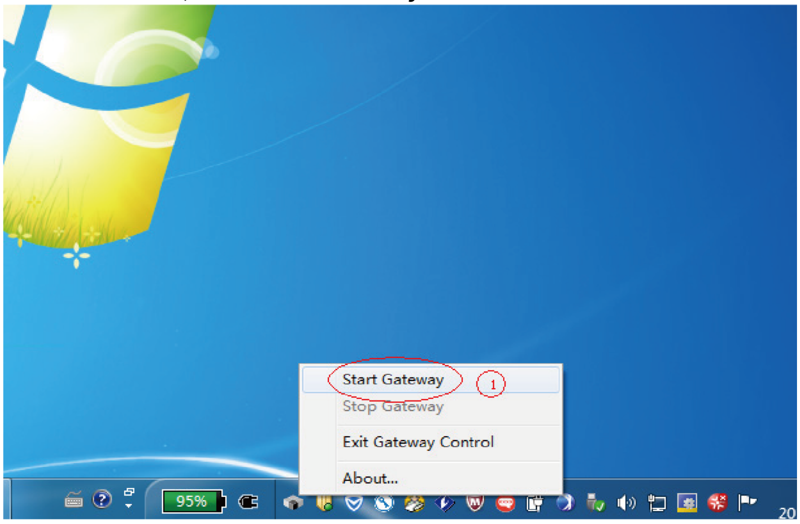


c. Select the AM600 device scanned. Now the communication connection between PLC and PC is completed. Next, perform the device configuration.

Note

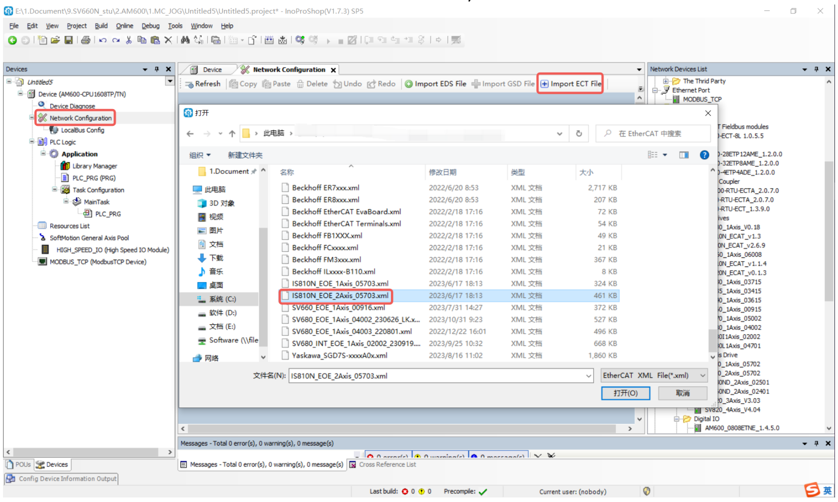
- Solution for failure to find AM600 device during scanning in InoPro
- Note: If the AM600 device cannot be scanned in InoPro, check whether the CoDeSys gateway is started. If not, start the gateway and perform scanning again.

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**.

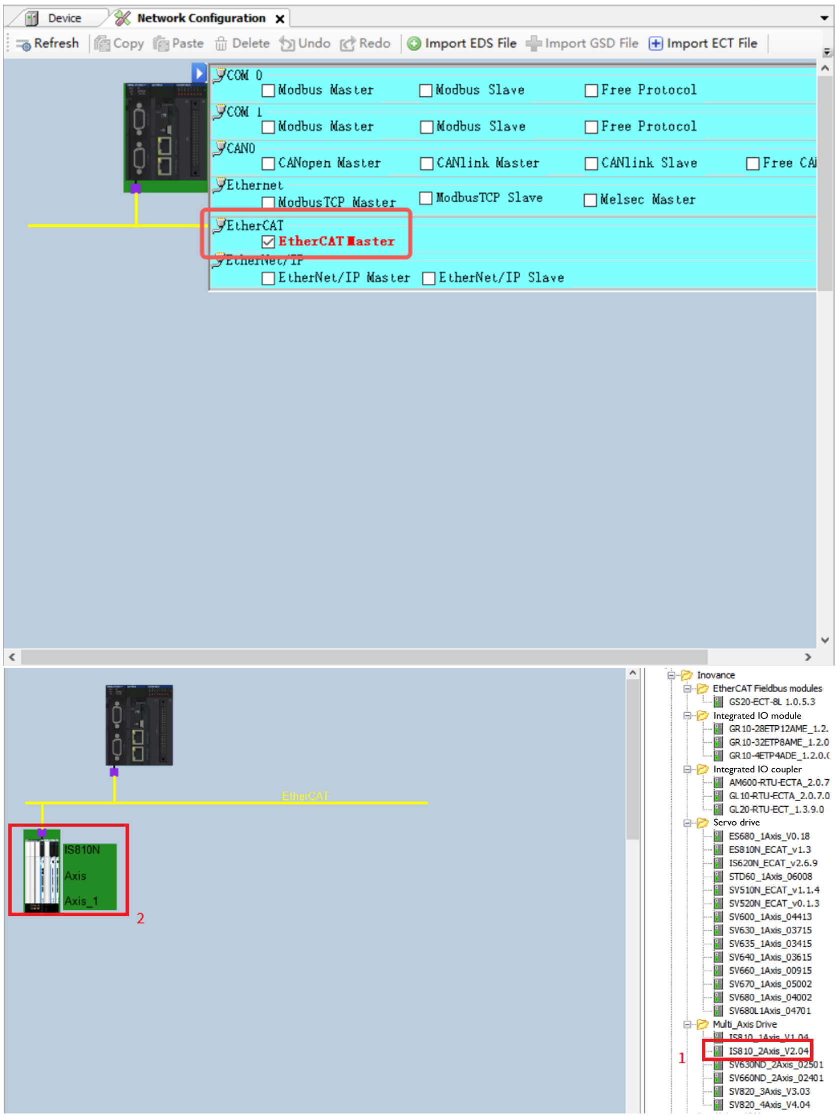


3. Add devices to perform configurations

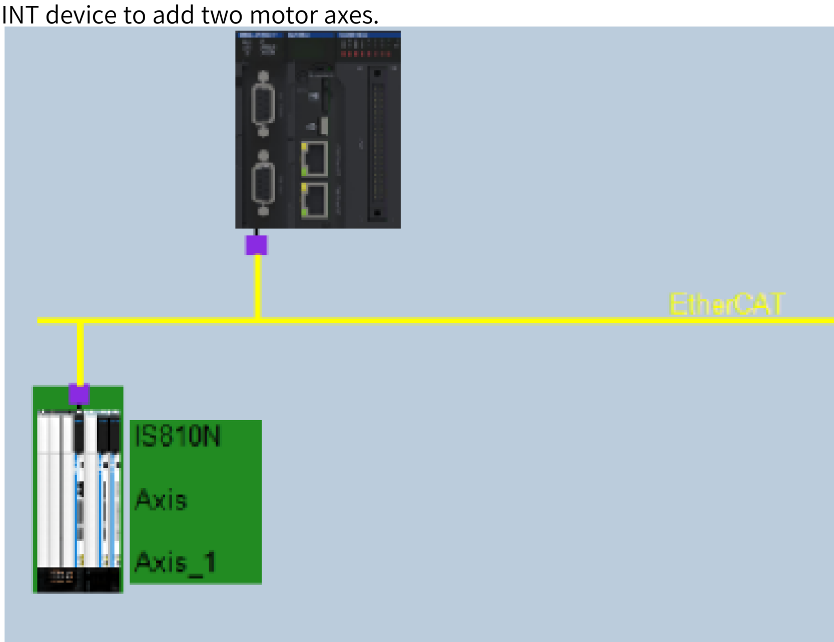
a. Adding the XML file of IS810N: Click **Import ECT File** in **Network Configuration** to add XML files (download XML files from Inovance’ s official website).



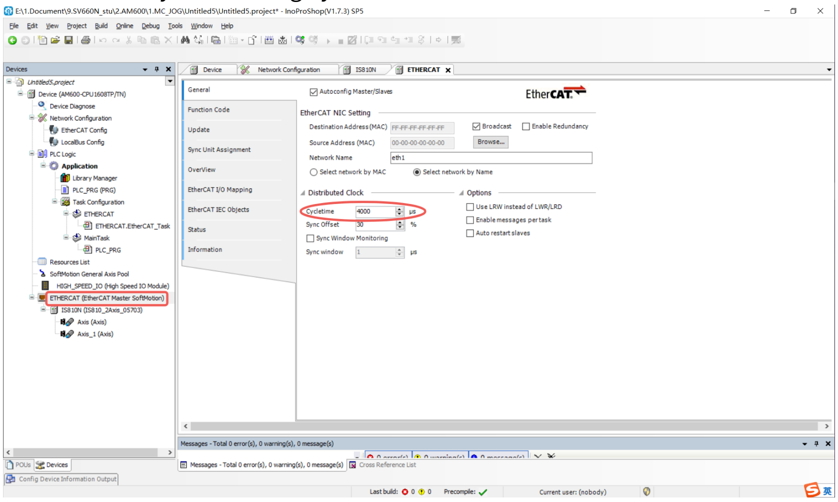
b. Performing device configurations for the system: Add the EtherCAT master and IS810N device. (Double-click or drag IS810_2Axis_V2.04.xml into the configuration interface.)



c. If the no axis is added after you add the drive, add two CiA402 motor axes manually. Right click on the IS810N-INT device to add two motor axes.



d. Configure EtherCAT master communication parameters by maintaining the default. Select **eth1** for the network. Select a synchronizing cycle.



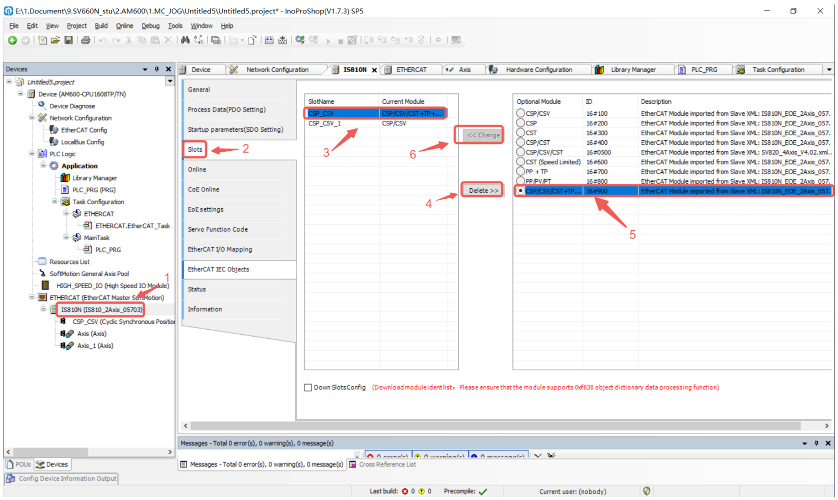
4. Configure the PDO mapping for the slave

a. The **Enable expert settings** is inactive by default. If you need to change the synchronization mode or other expert options, activate **Enable expert settings**.

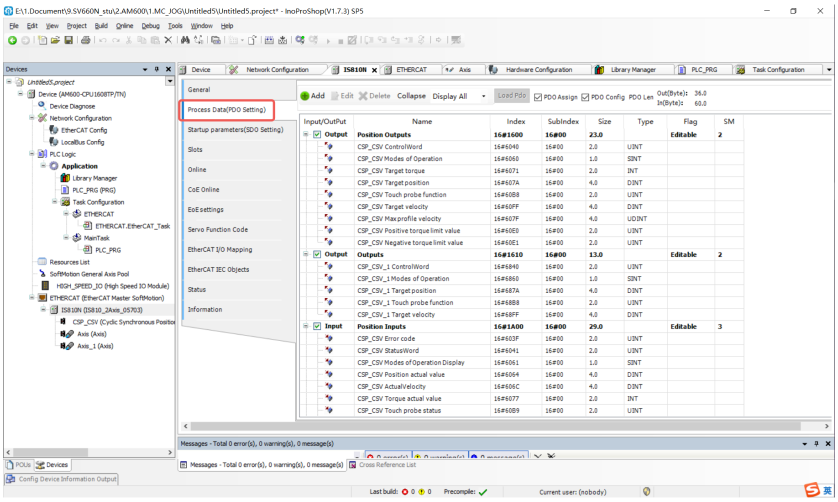
b. Check the corresponding PDO list.

In the PDO configuration interface, you may run a corresponding mode according to two axes and add a corresponding PDO object. IS810N has been designed with PDO list for easy use of each axis. Select a mode you need from "CSP/CSV+TP, CSP+TP, CST, CSP/CST+TP, CSP/CST/CSV+TP, PP+TP, and PP\PV\PT+TP", and the PDO list needed by this mode will be selected by XML files through working with the controller. Delete current slot configuration before insertion.

The following shows the configurations for CSP/CSV+TP mode.

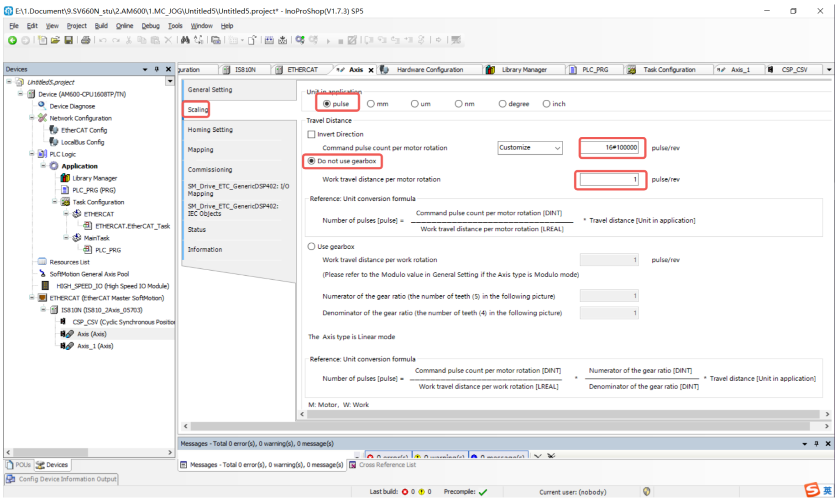


c. The PDO list configured according to the CSP (position) + CSV (velocity) + TP (probe) mode is as follows.



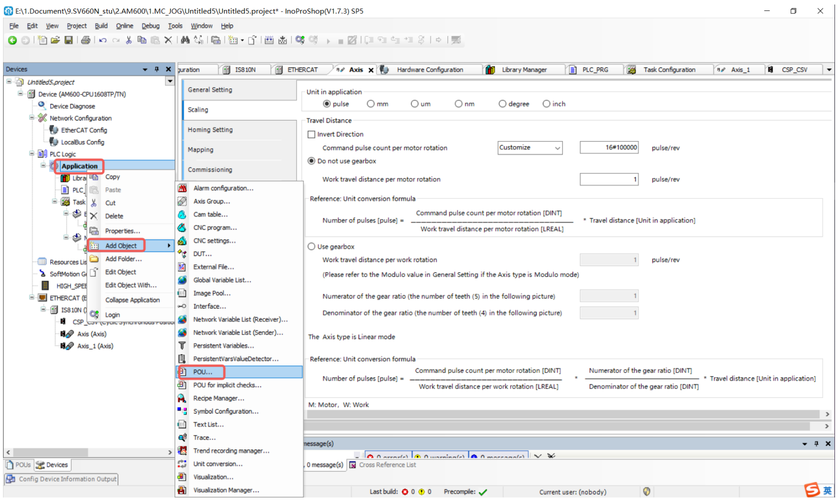
5. Axis scaling settings

   The axis is equipped with a 23-bit encoder, which generates 8388608 pulses per revolution of the motor, corresponding to 800000 in hex. The travel distance is configured based on 1000 reference units/revolution. Such conversion is similar to the electronic gear conversion performed on the host controller, which removes the need for setting the internal conversion ratio of the servo drive.

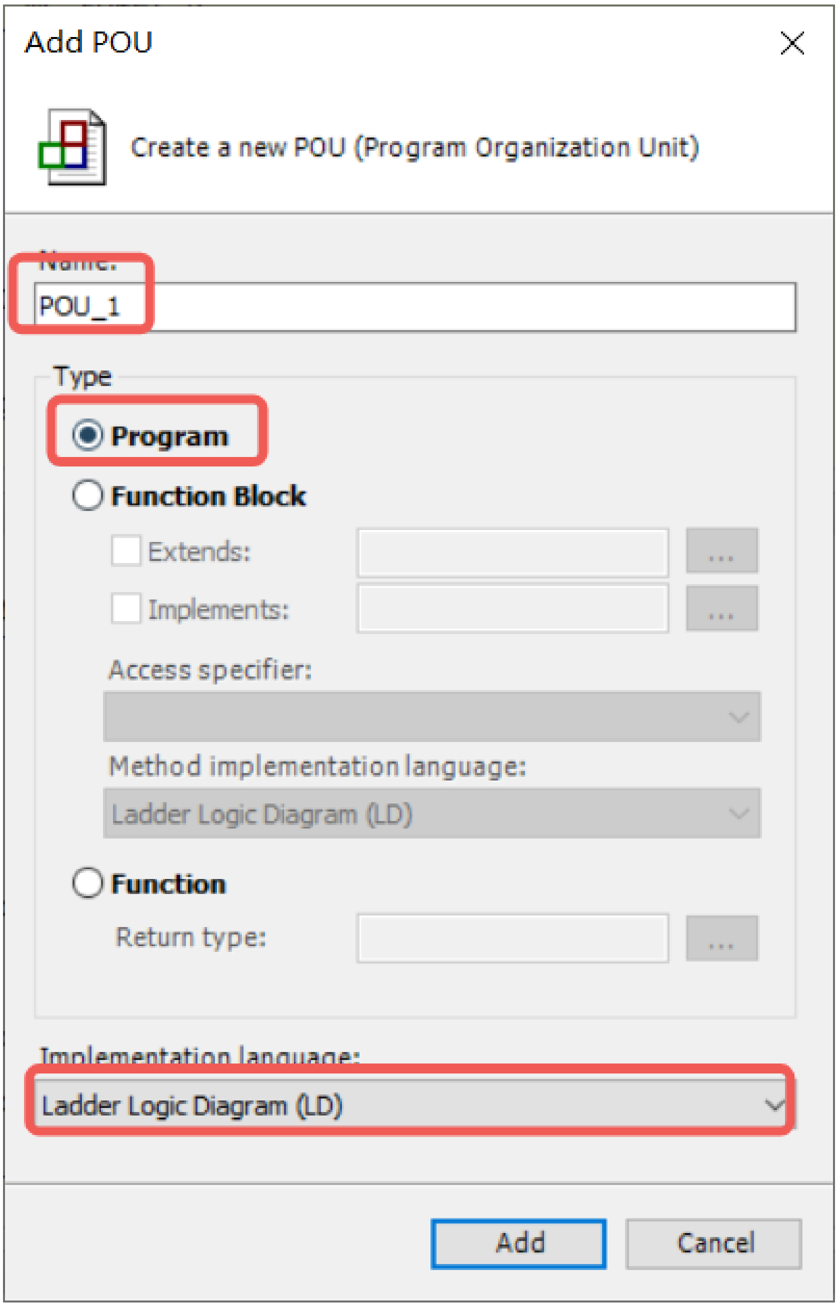


6. PLC program

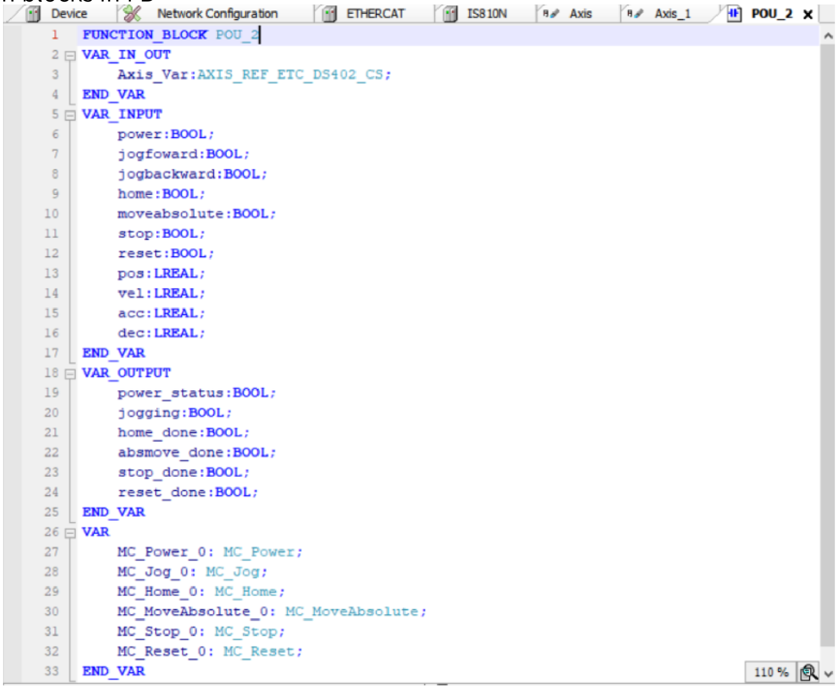
   a. Add a FB file that edits the function block in Application. Add functions blocks MC_Power, MC_Jog, and MC_MoveAbsolute.



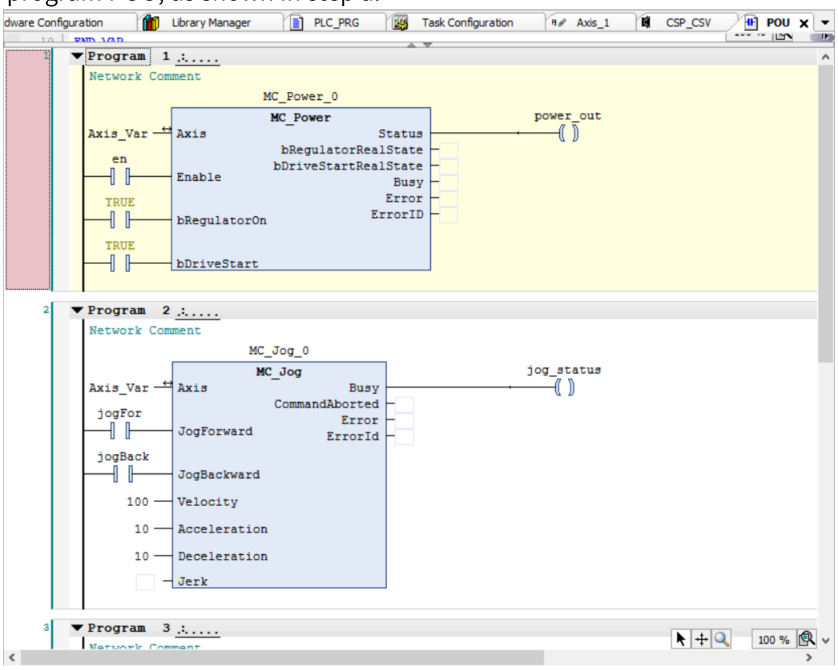
b. Definition part of FB



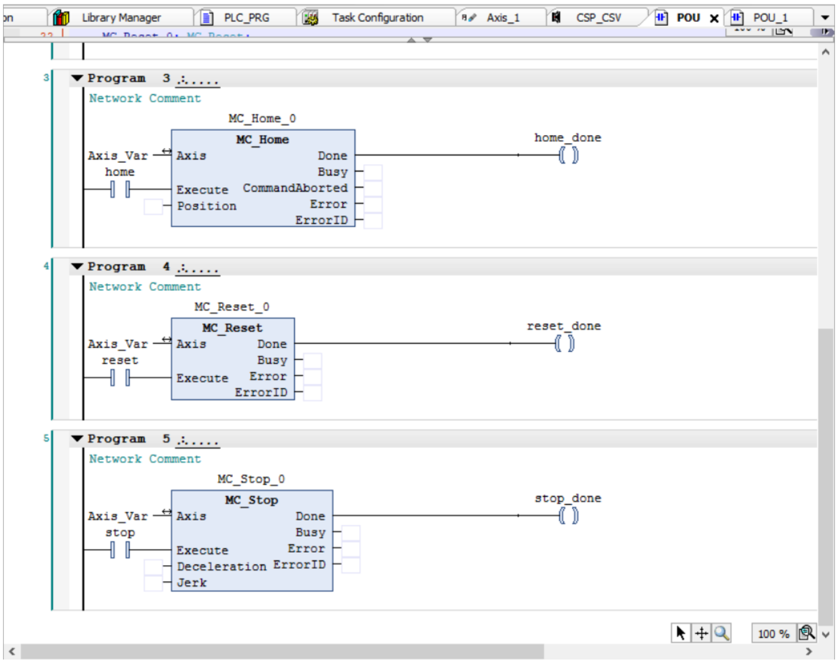
c. Five function blocks in FB



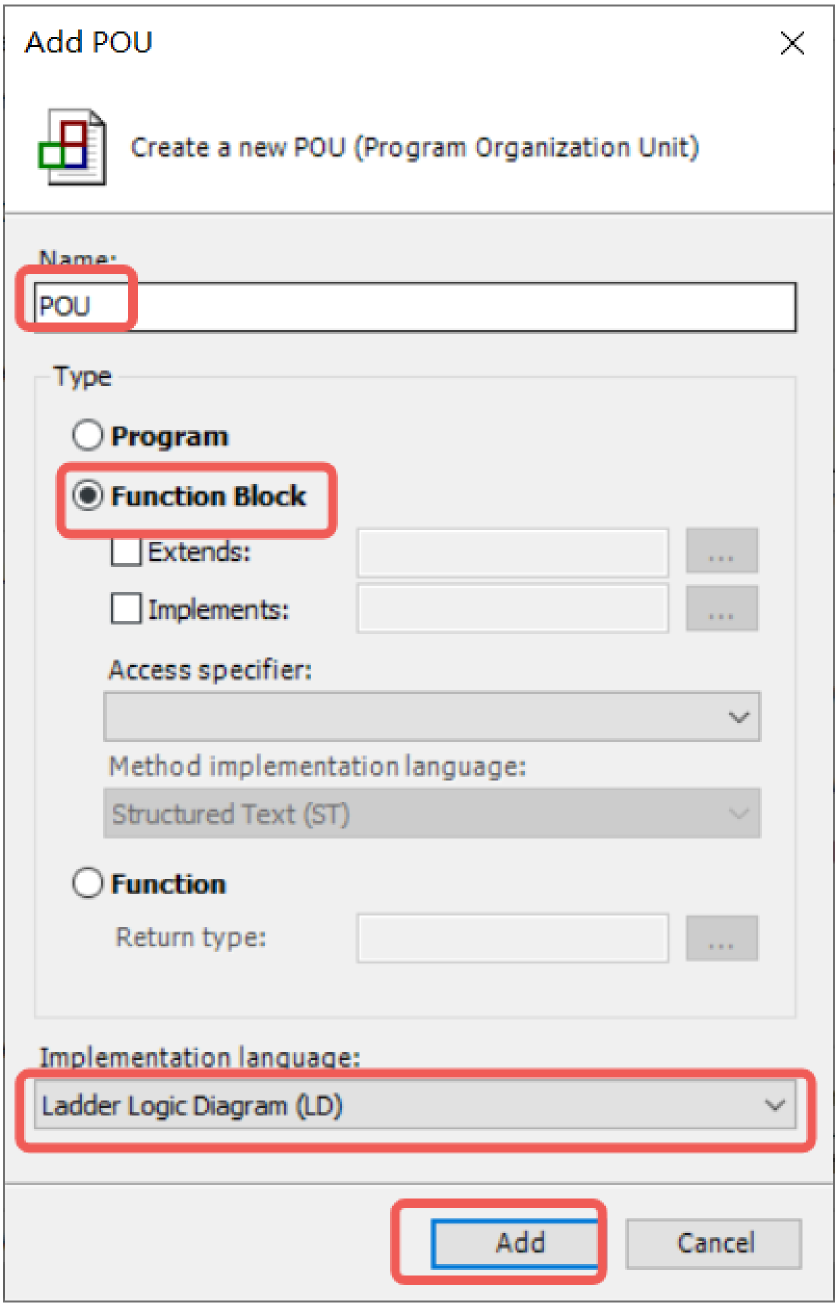
d. Add a main program POU, as shown in step a.

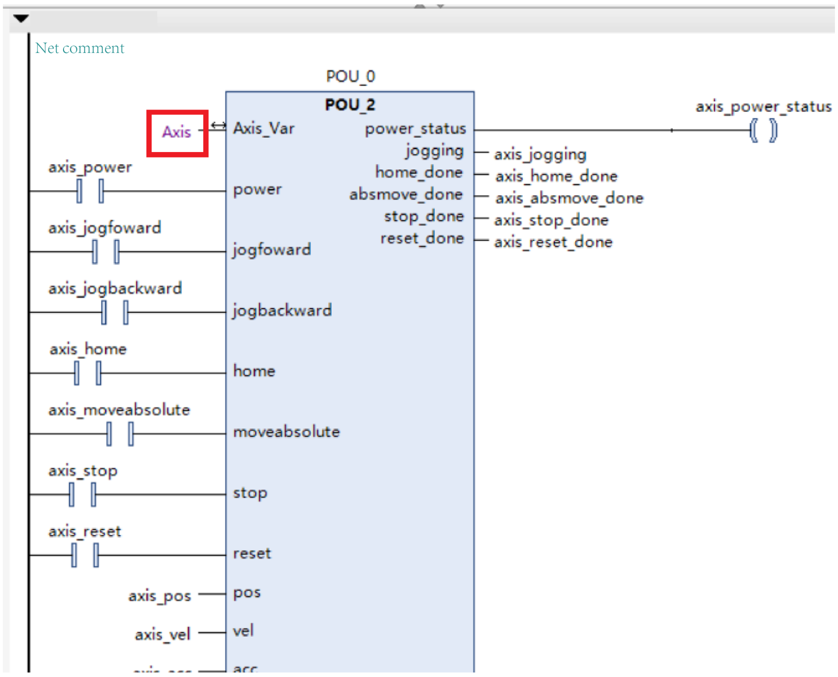


e. Add the FB function block to the newly created POU.

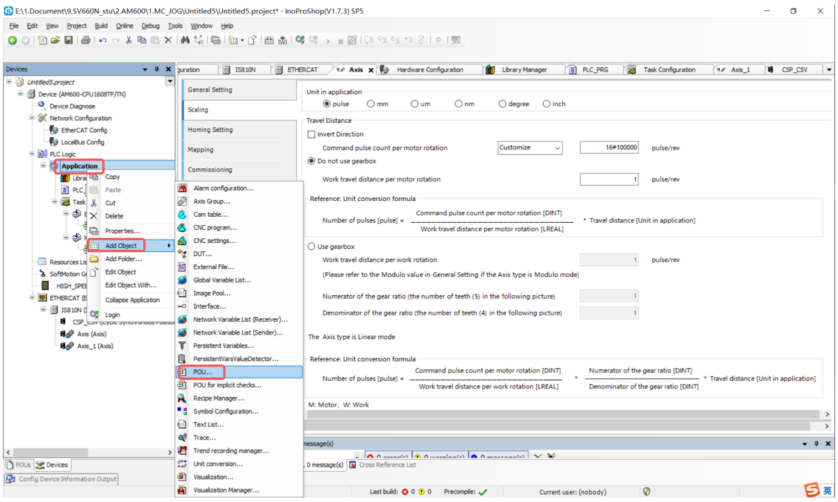


f. Add a program to **Application**, and instantiate the previous FB into two function blocks. Bind the two function blocks to two axes.

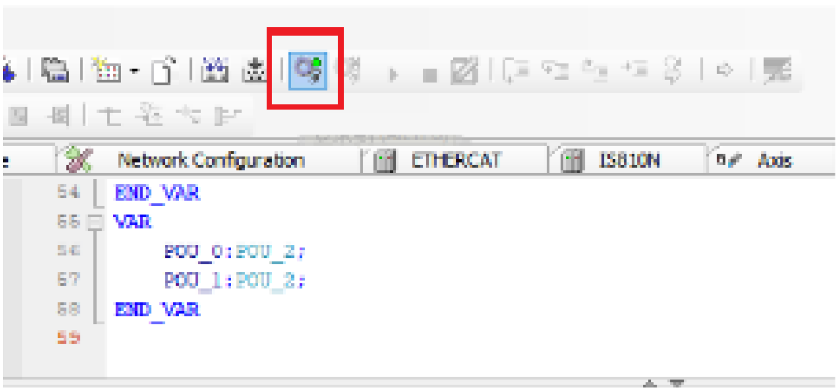

Add POU
Create a new POU (Program Organization Unit)
Name:
POU
Type
Program
Function Block
Extends:
Implements:
Access specifier:
Method implementation language:
Structured Text (ST)
Function
Return type:
Implementation language:
Ladder Logic Diagram (LD)
Add
Cancel



g. After calling this program in the EtherCAT task, you can perform enable, jog, homing, and absolute position operations.



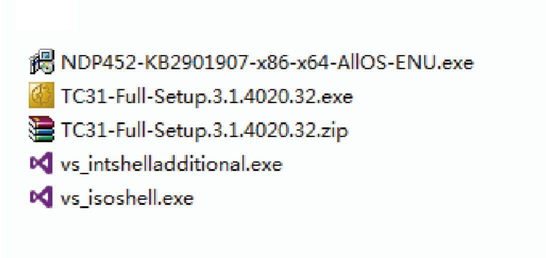
h. Log into the PLC and upload the program complied to the PLC. Then you can operate the operation bus manually.



15.6.2 Beckhoff Controller as the Master

The following section describes how to configure the IS810N servo drive with Beckhoff TwinCAT3 master used in CSP mode.

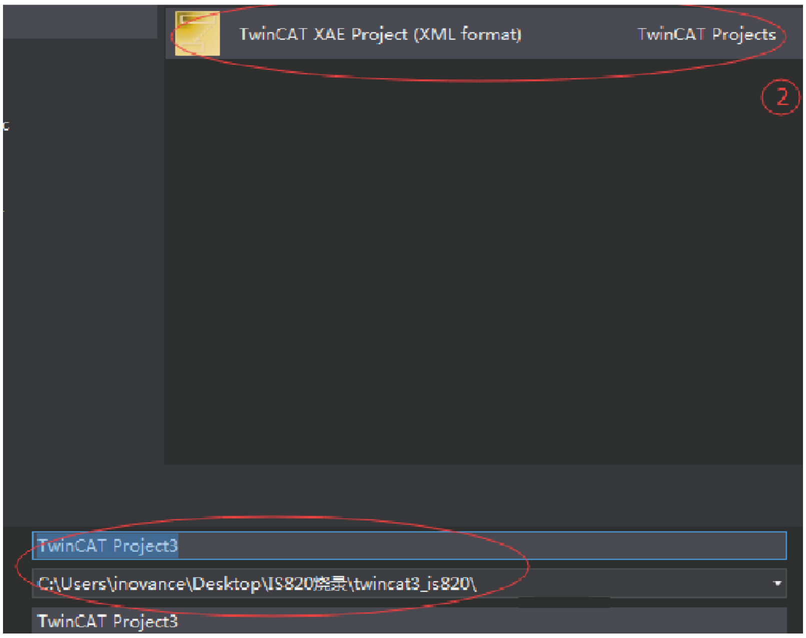
1. Installing the TwinCAT software
   The TwinCAT3 software, which supports Windows7 32-bit or 64-bit systems, can be downloaded from the official website of Beckhoff. The following description takes the 32-bit WIN7 system as an example.



Note

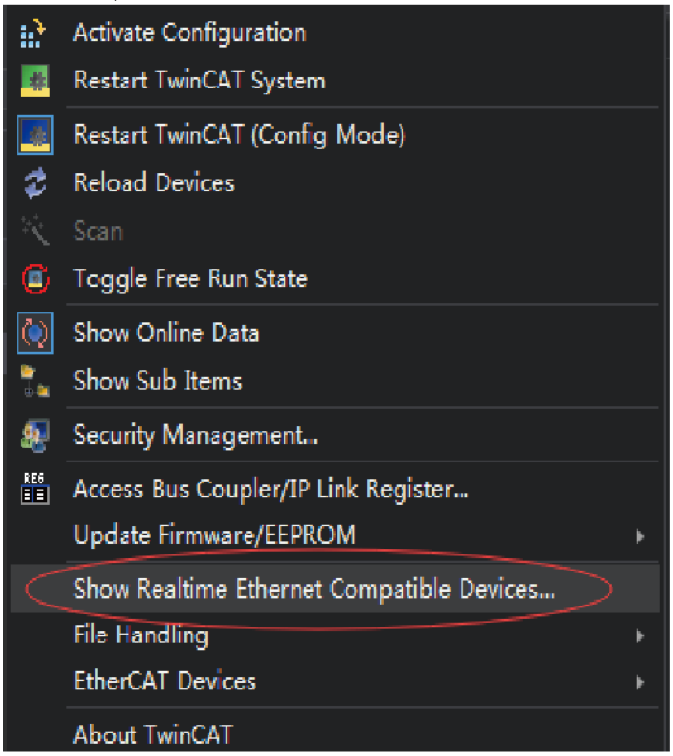
A Fast Ethernet (FE) card with Intel chip must be used in the case of direct drive by a PC. If the network card of other brands is used, the EtherCAT communication may fail.

2. Copy the IS810N-INT EtherCAT configuration file (Ino_MultiAxesDrive_ECAT_V0.10.xml) to the TwinCAT installation directory: TwinCAT\3.1\Config\Io\EtherCAT.
3. Open Visual studio, and create a New Twincat3 Project.

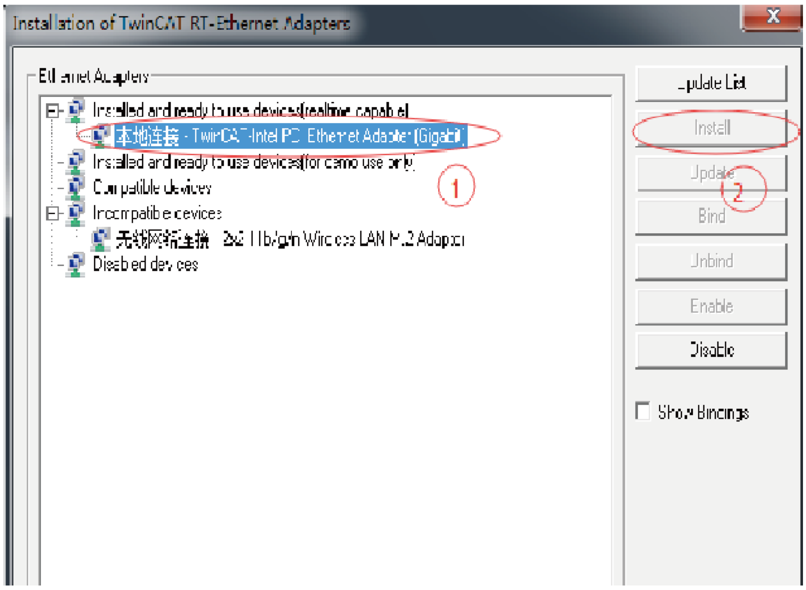


4. Install the TwinCAT network adapter driver.

a. Go to **TWINCAT** > **Show Real Time Ethernet Compatible Devices**. Select the local connection under **Incompatible devices**, and then click **Install**.

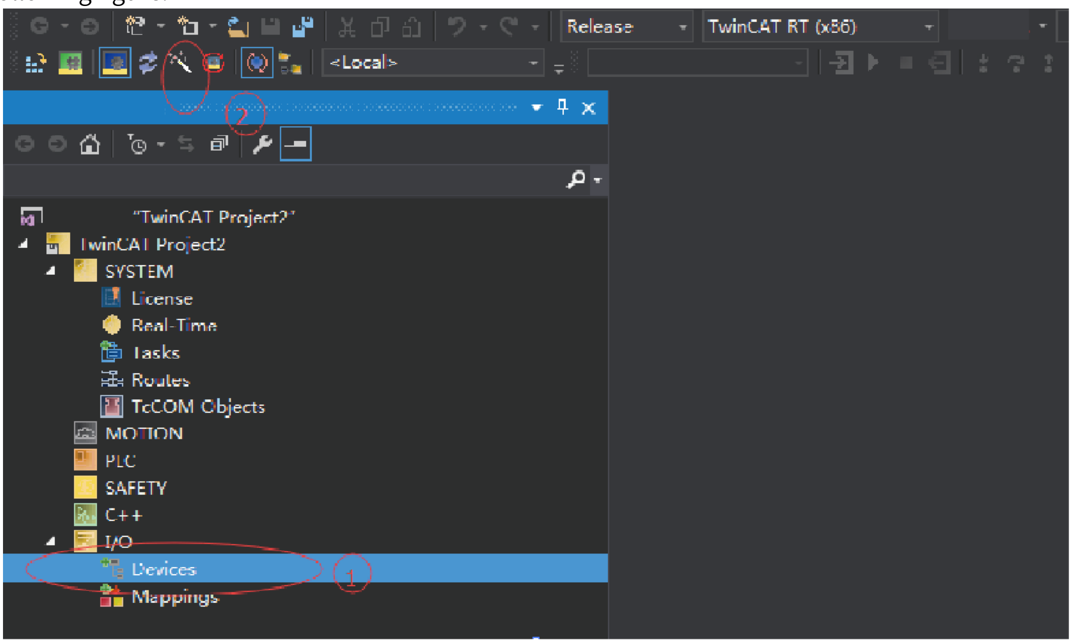


b. After installation, the installed network adapter is displayed in **Installed and ready to use devices**.

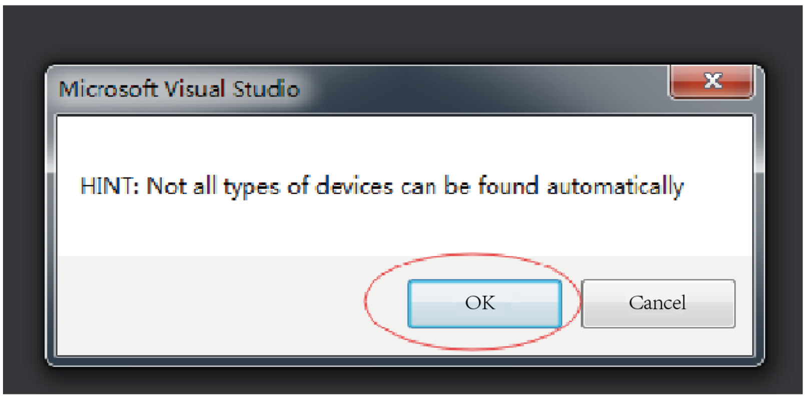


5. Search for devices.

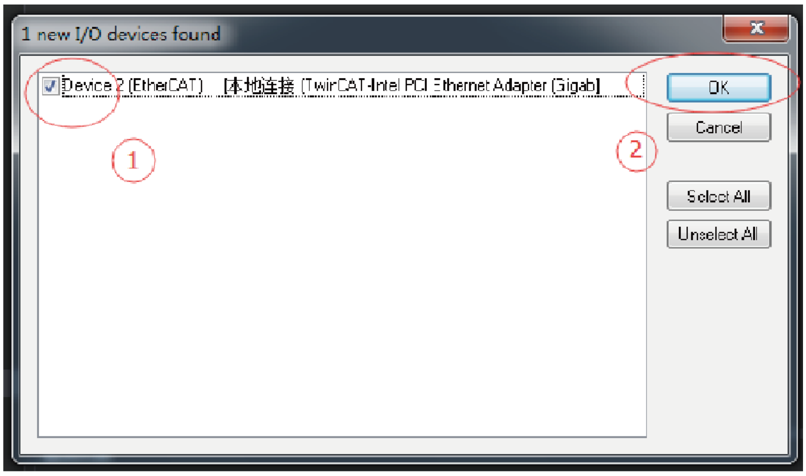
a. Create a project and search for devices. Select Devices and click , as shown in the following figure.



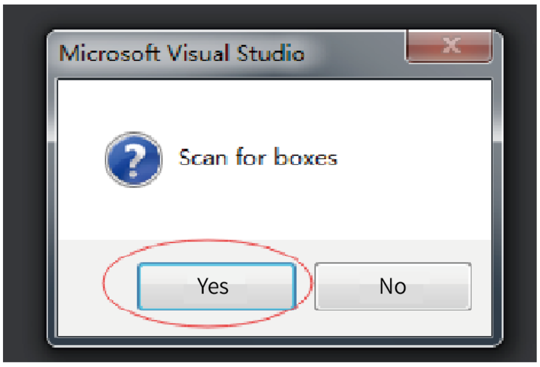
b. Click **OK**.



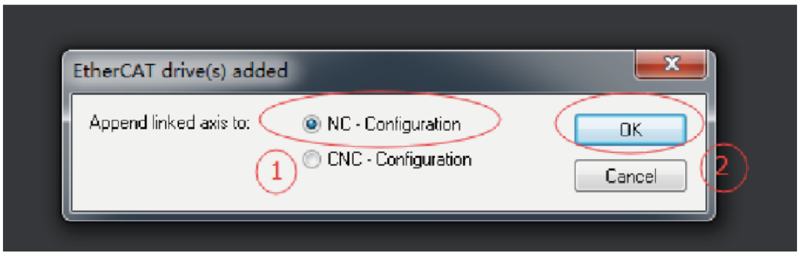
c. Click **OK**.



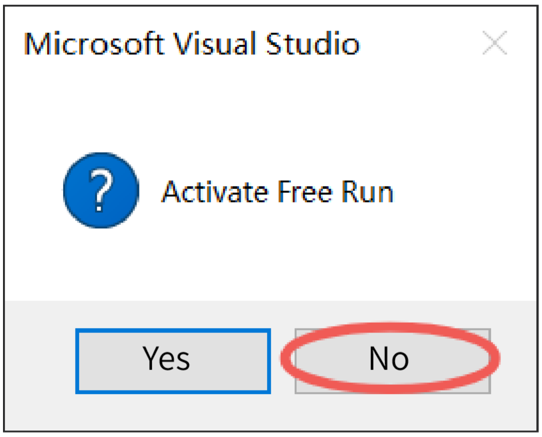
d. Click **Yes**.



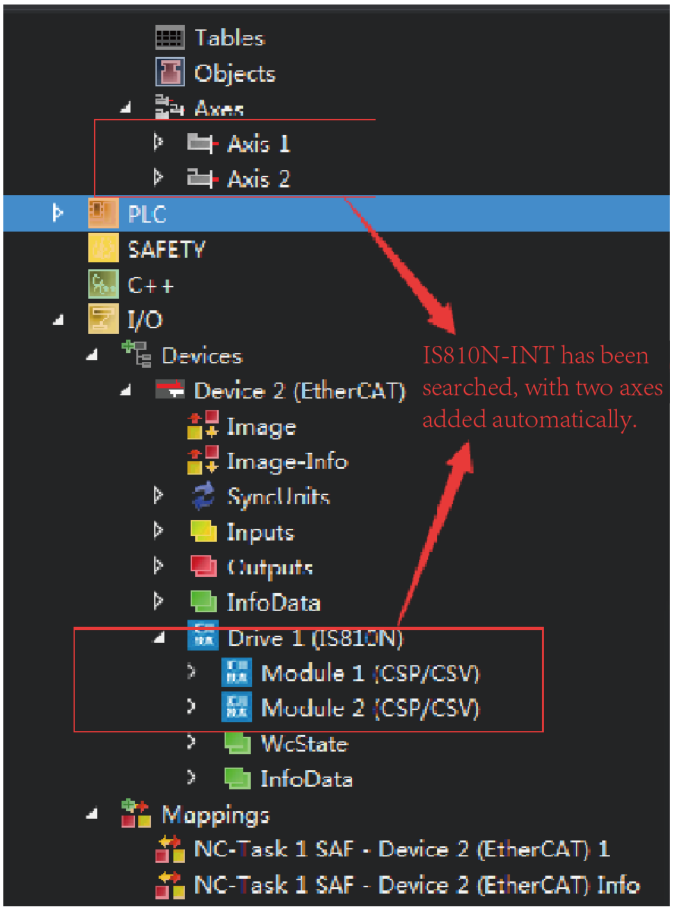
e. Click **OK**.



f. Click **No**.



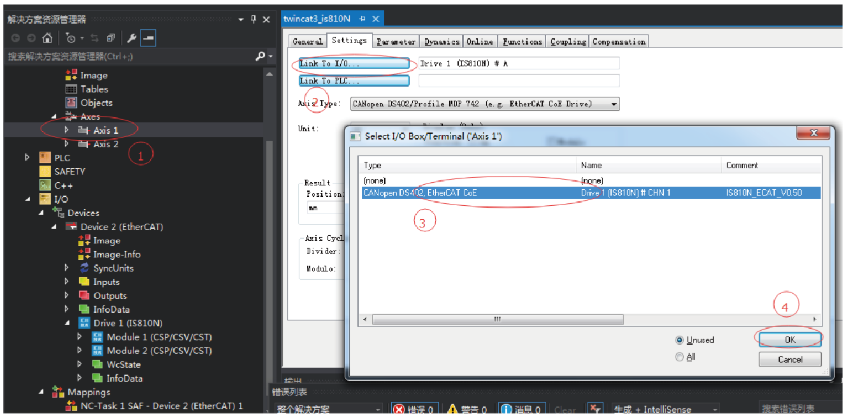
g. The equipment search is completed, as shown in the following:



6. Configure PDO contents

The following takes implementing CSP (position) + CSV (speed) + CST (torque) mode as an example:

Quickly select a running mode in **Slots**.



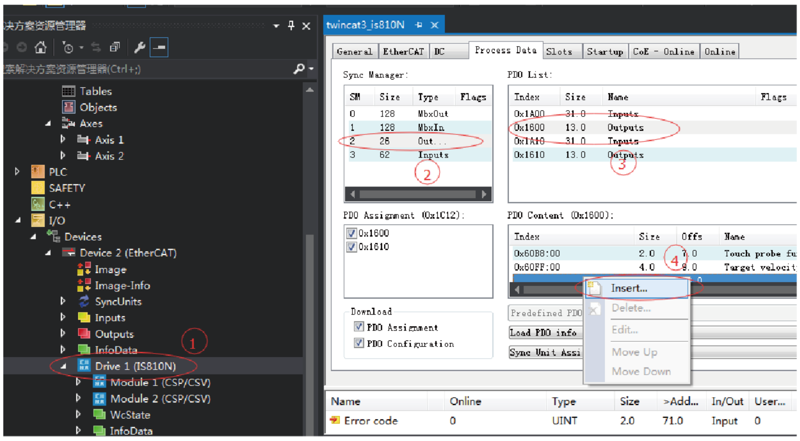
Note

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 procedure for configuring RPDO is as follows:

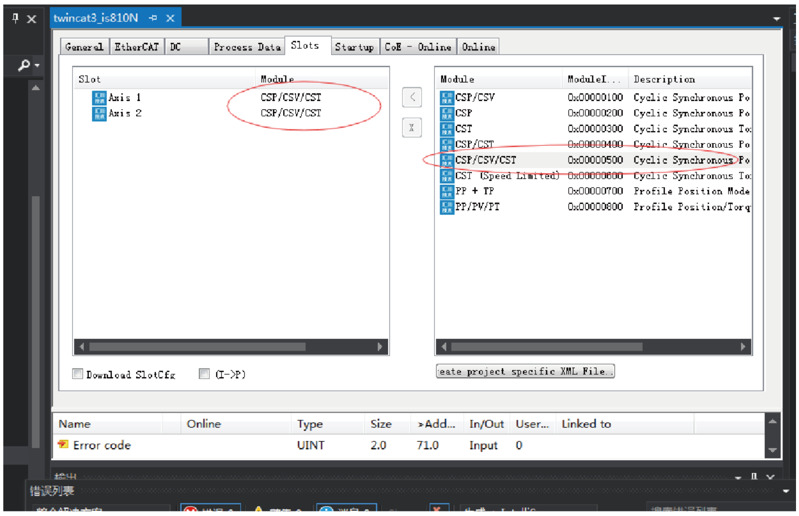
If the current PDO meets your requirements, you do not need to change it, otherwise you need to simply change the PDO list to suit your mode. To change the PDO list, right click the **PDO Content** window,click **Delete** to delete the redundant default PDOs, and click **Insert** to add the PDOs needed.



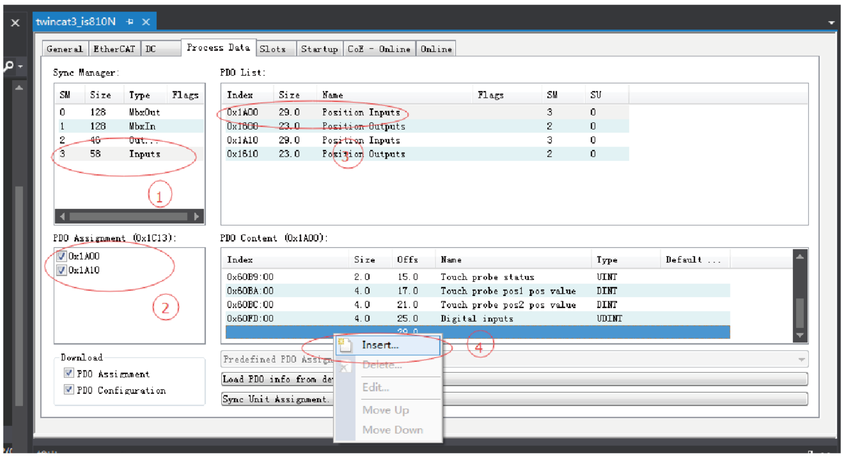
c. The following takes implementing CSP (position) + CSV (speed) + CST (torque) mode as an example:

Configure TPDO: If you use two axes, check 0x1A00 and 0x1A10.

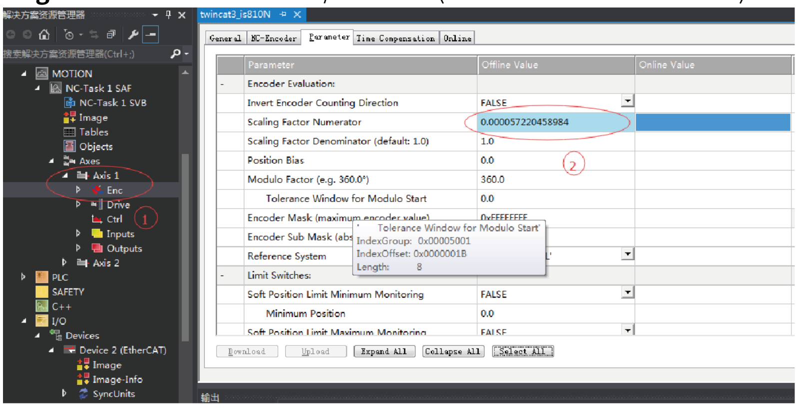
The procedure for configuring RPDO is as follows:



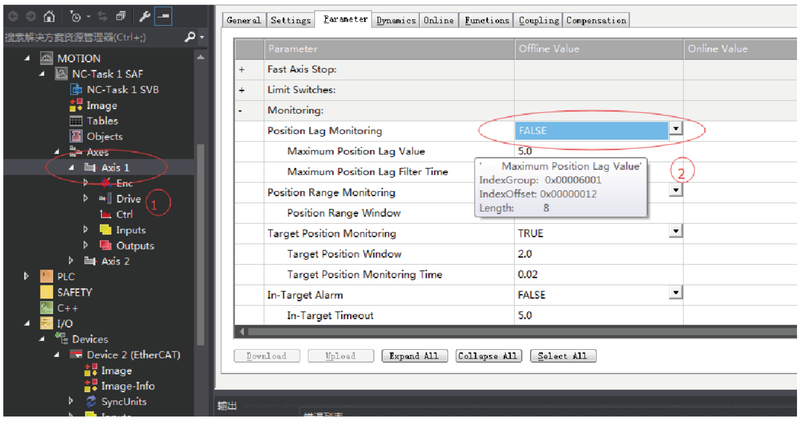
1). If the current PDO meets your requirements, you do not need to change it, otherwise you need to simply change the PDO list to suit your mode. To change the PDO list, right click the **PDO Content** window,click **Delete** to delete the redundant default PDOs, and click **Insert** to add the PDOs 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.)

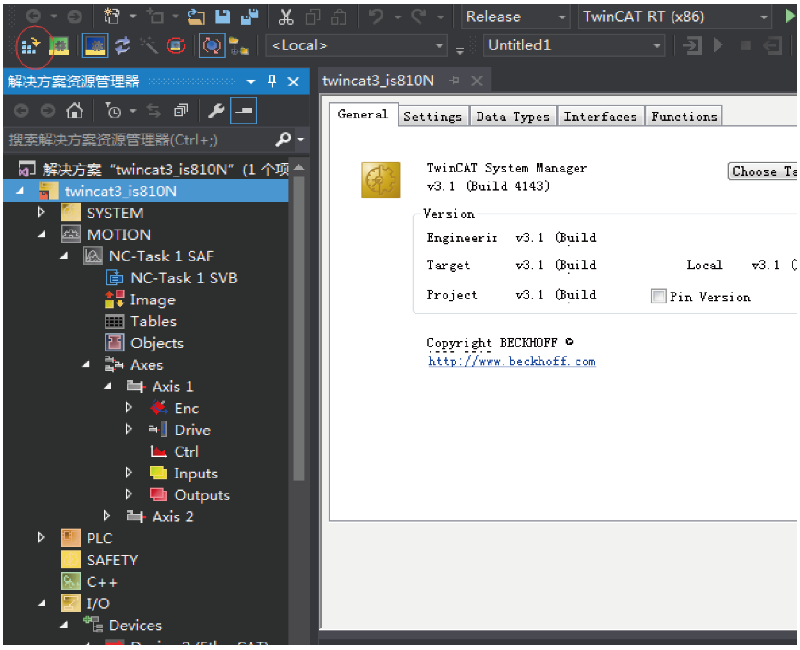


3). Click **Axis 1** in **Axes**, select **Parameter**, and hide the system deviation temporarily (same as other axes).

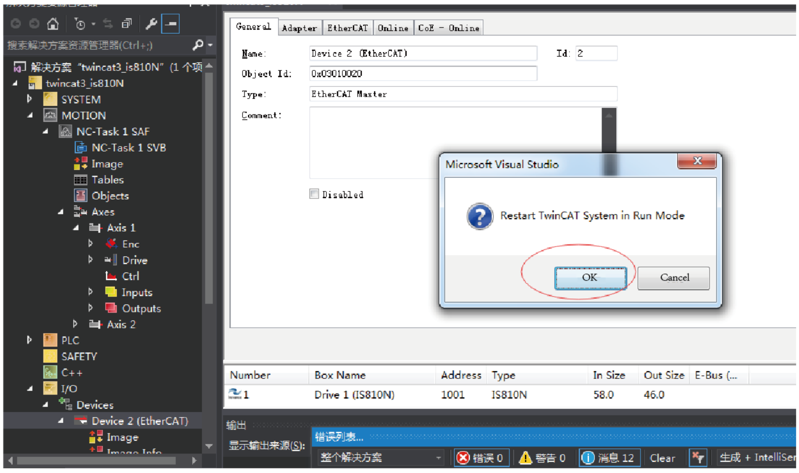


7. Activate the configuration and switch to the operation mode.

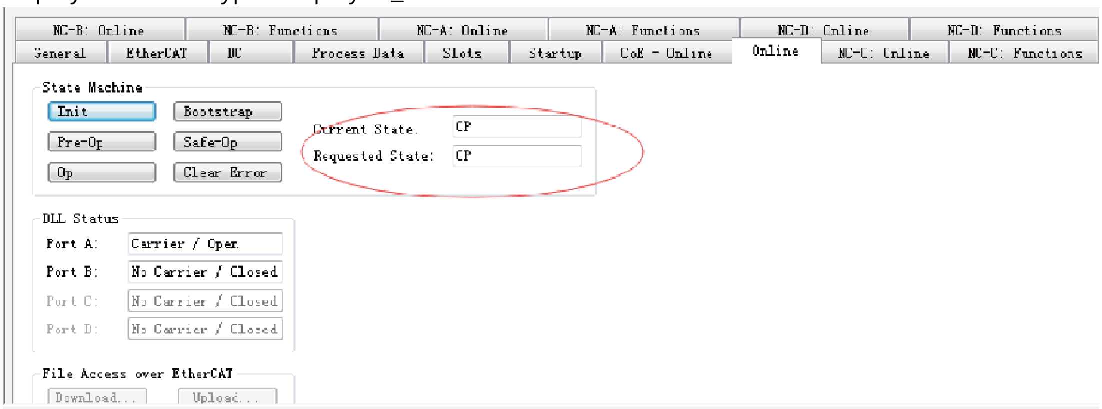
a. Click 



b. Click **OK**.

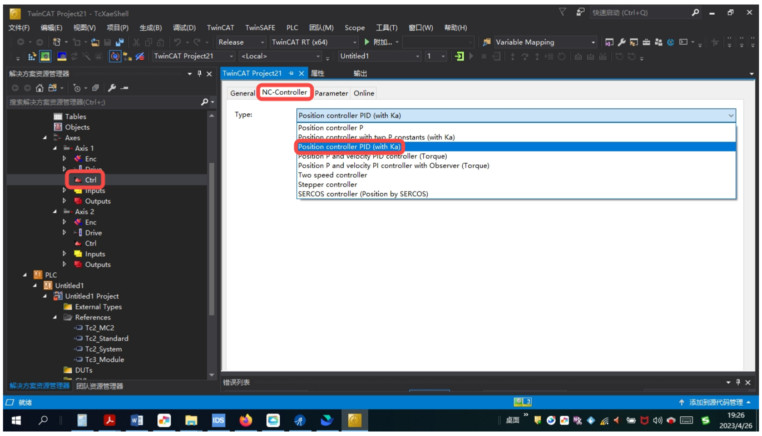


c. In the Online interface, you can view that the current state is OP, and the 3rd LED on the keypad displays "8". The keypad displays 1_88RY.



8. Control the servo drive through NC axis or PLC programs.

- You can select the control type.



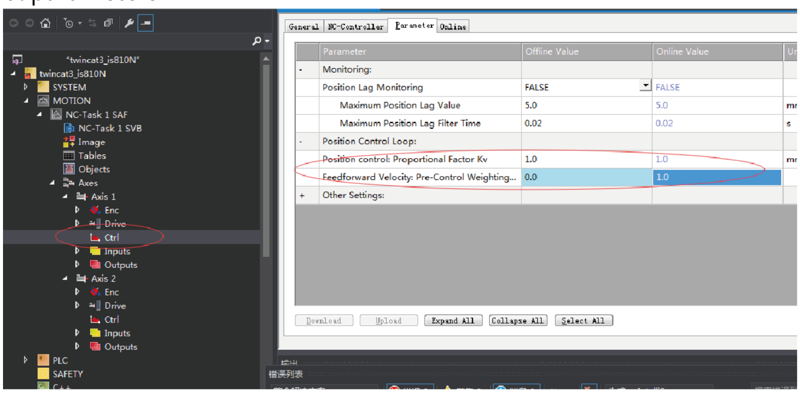
PID type of the control loop:

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.

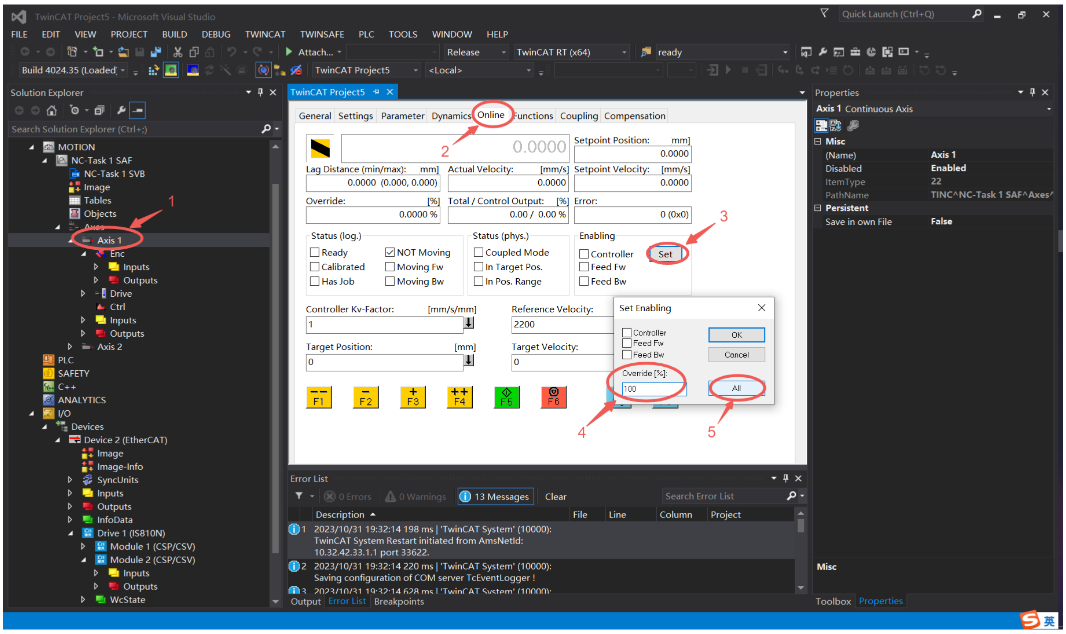
Position control: Proportional Factor Kv	1.0

Adjust the speed feedforward coefficient based on actual response.

Feedforward Velocity: Pre-Control Weighting [0.0 ...	0.0

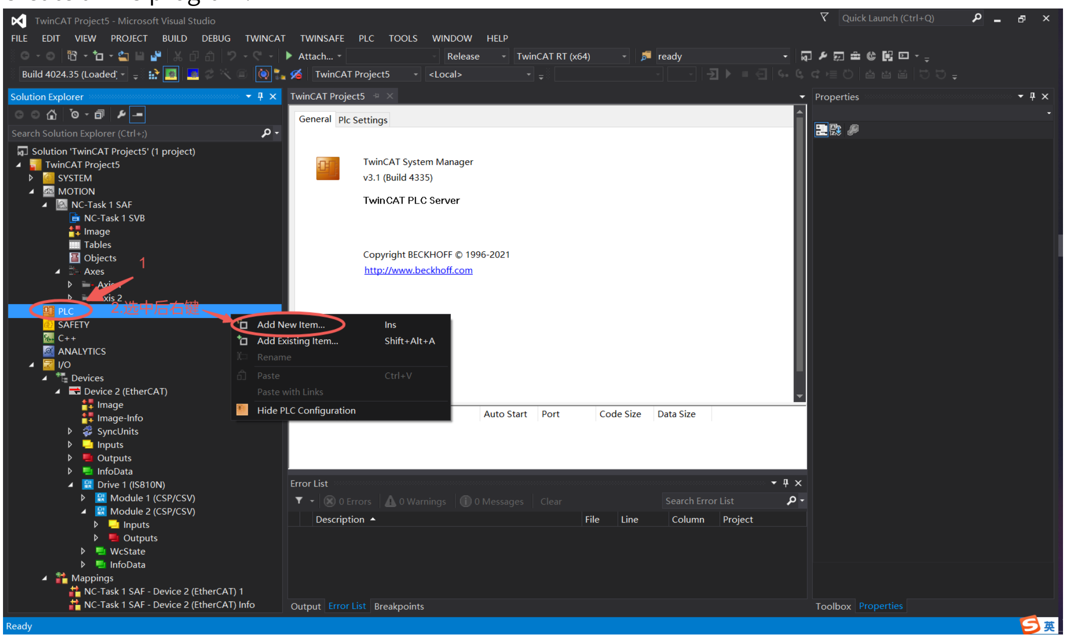
a. Jogging of NC axis

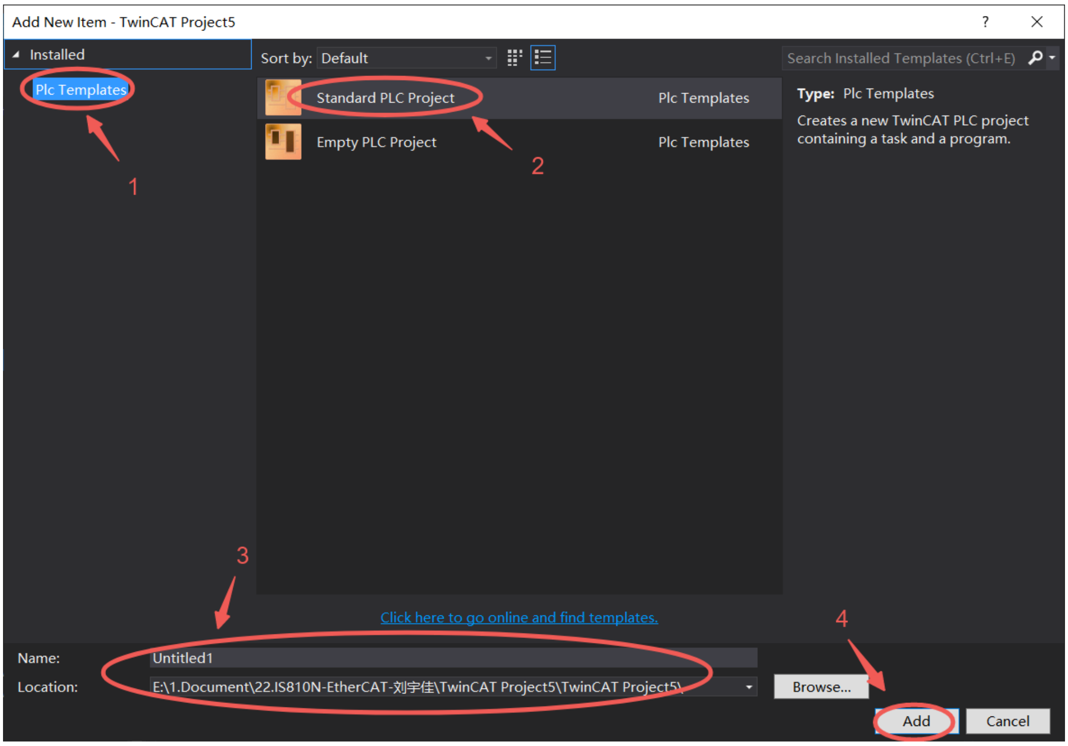
1). Click **Set** and then click **All** in the dialog box displayed to enable the drive. Click F1 to F4 to carry out the jogging.



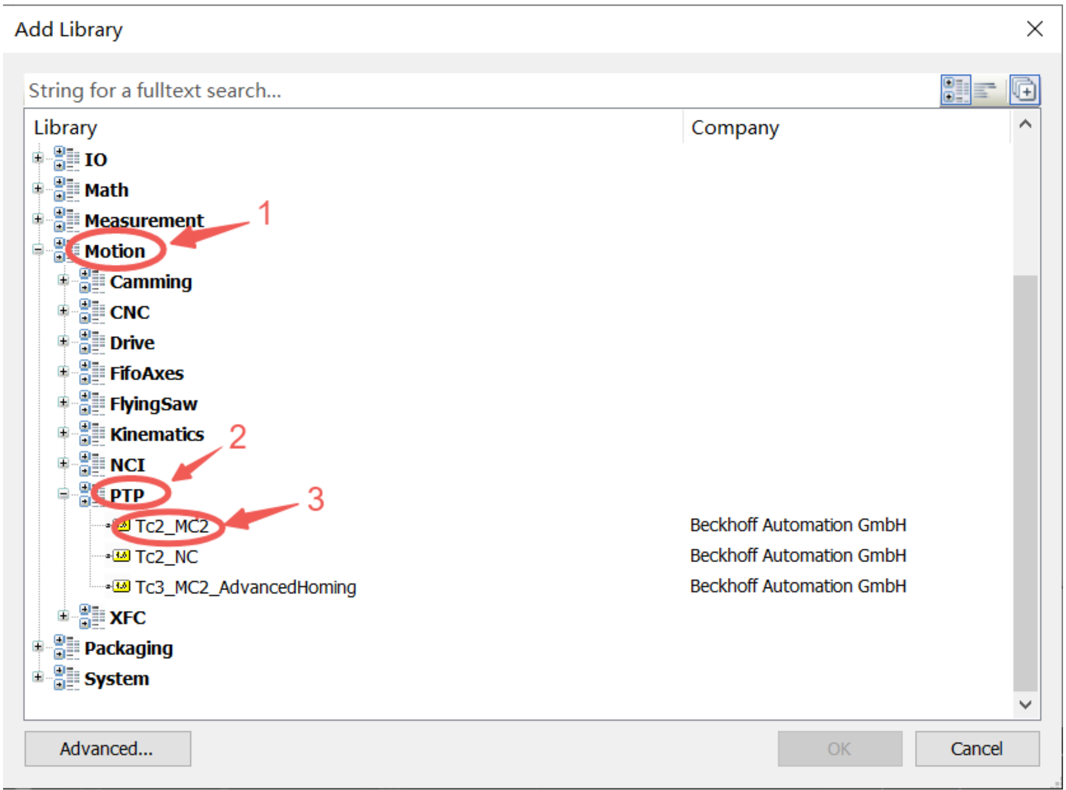
2). PLC program

3). Create a PLC program.

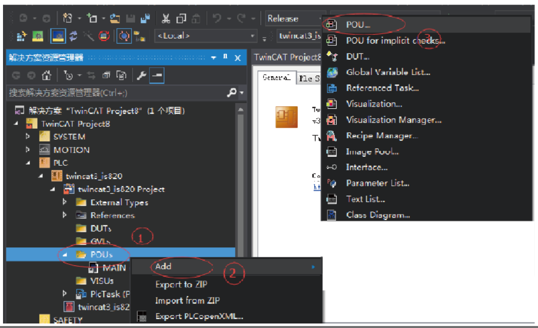


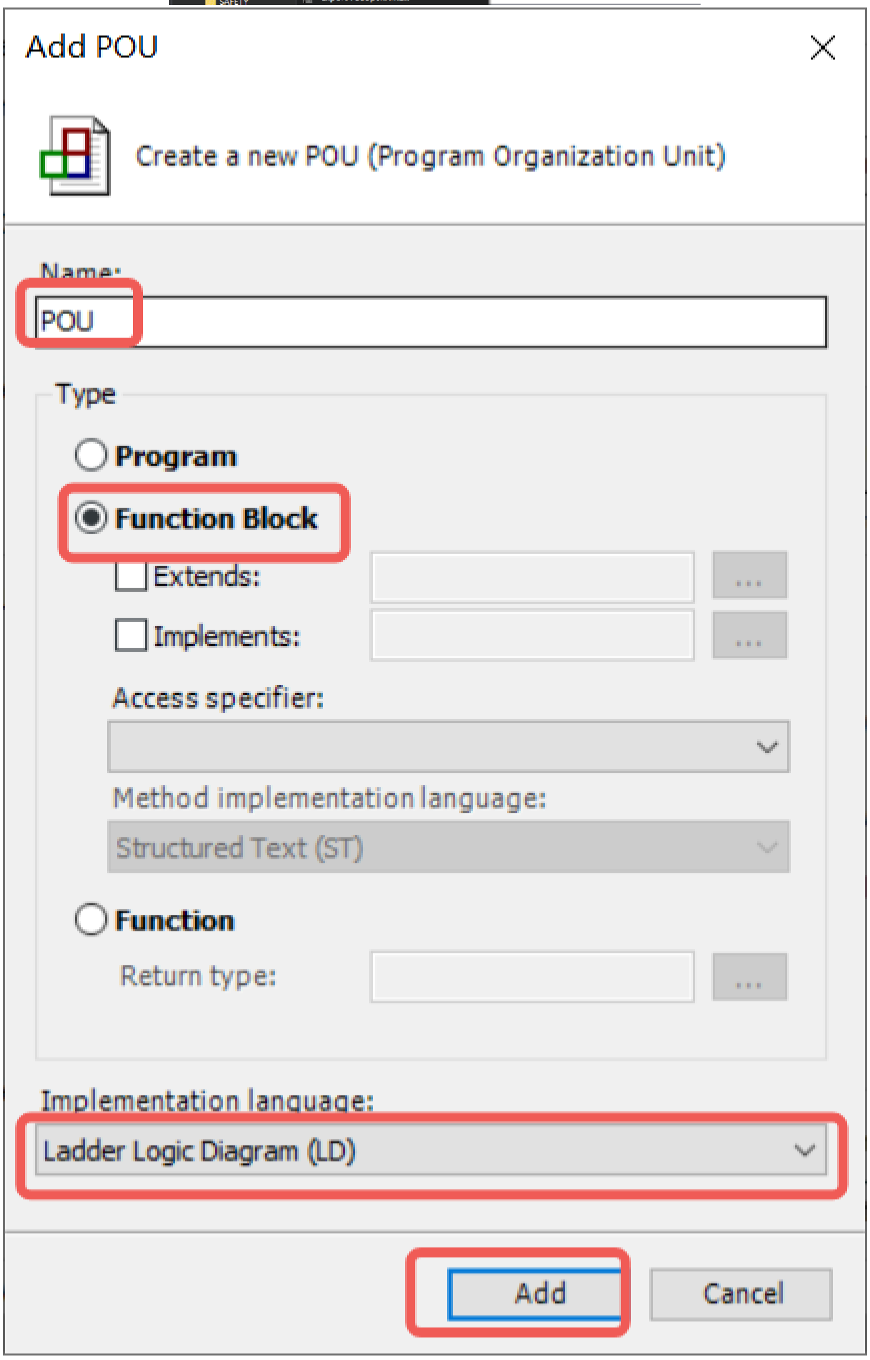


Add a motion control library for calling the motion control function blocks.

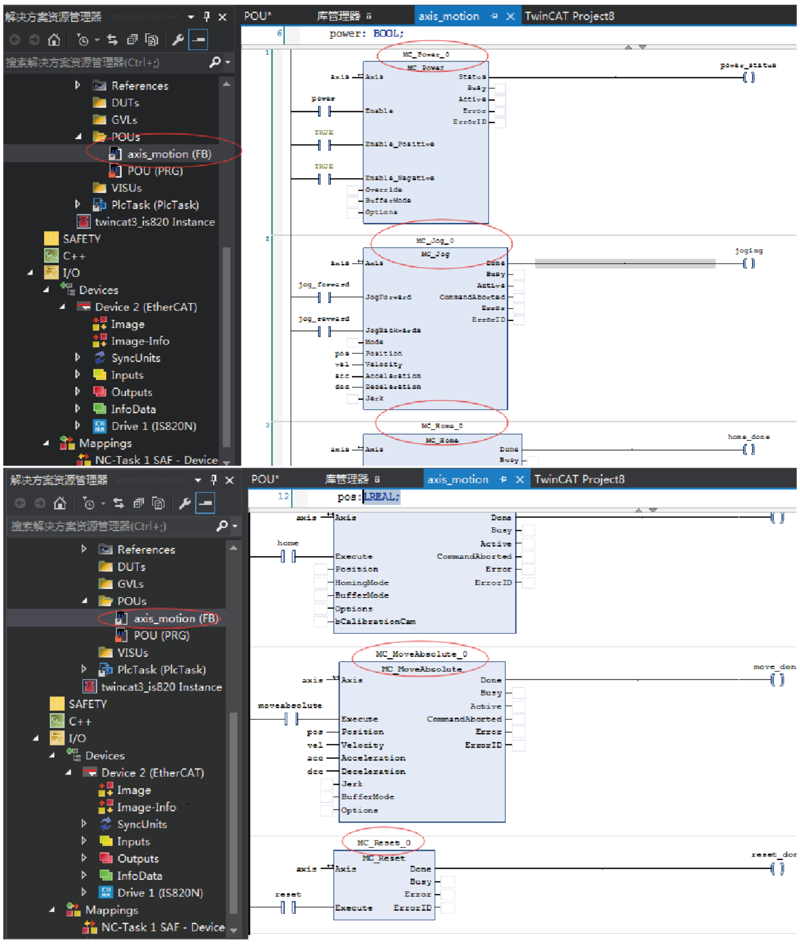


Create a new POU.



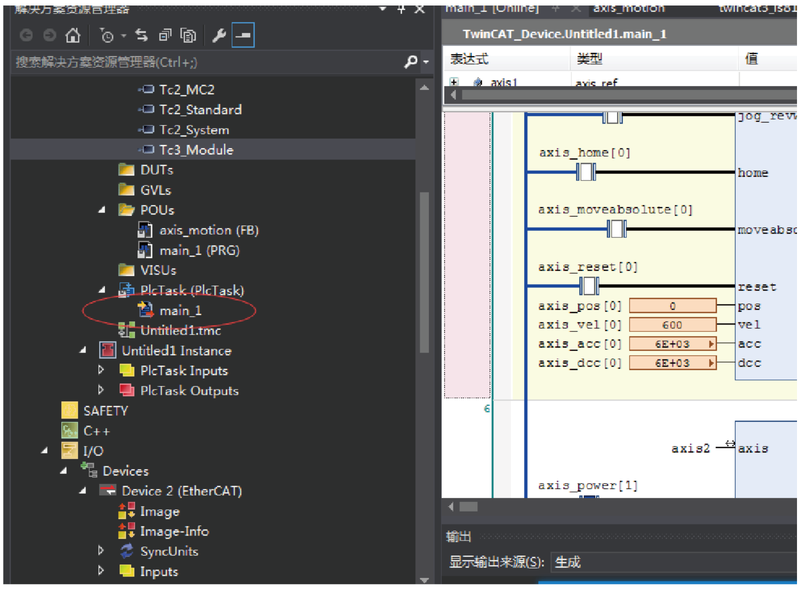


4). Create a new FB and add Mc_power, MC_jog, MC_home, MC_absolute, and MC_reset.

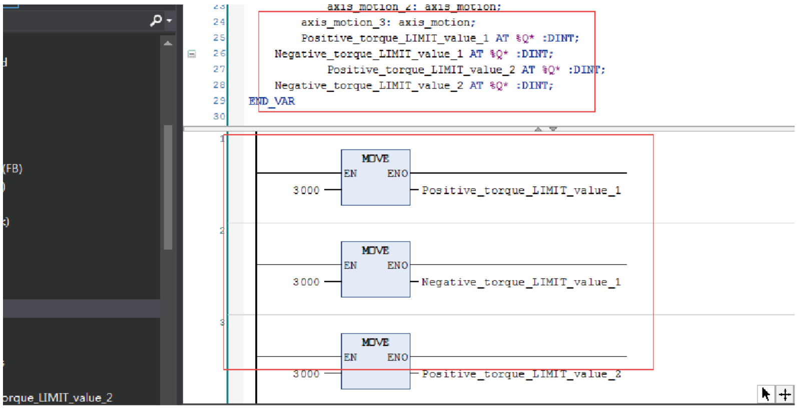


Call axis_motion in main.Call axis_motion in main.

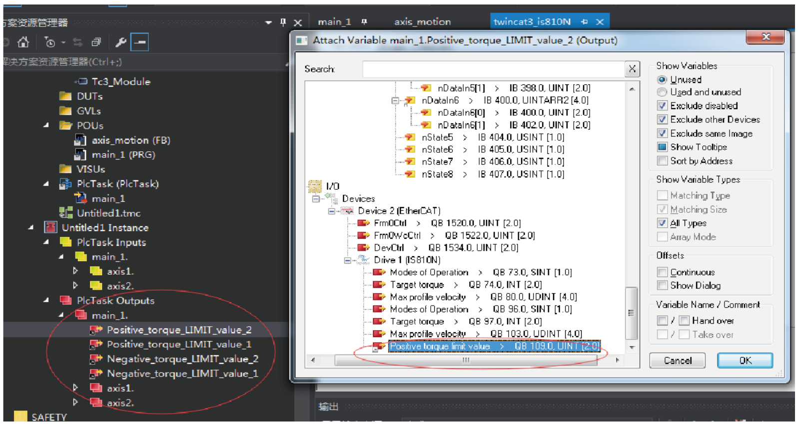
Call the program in **PLCTASK**.



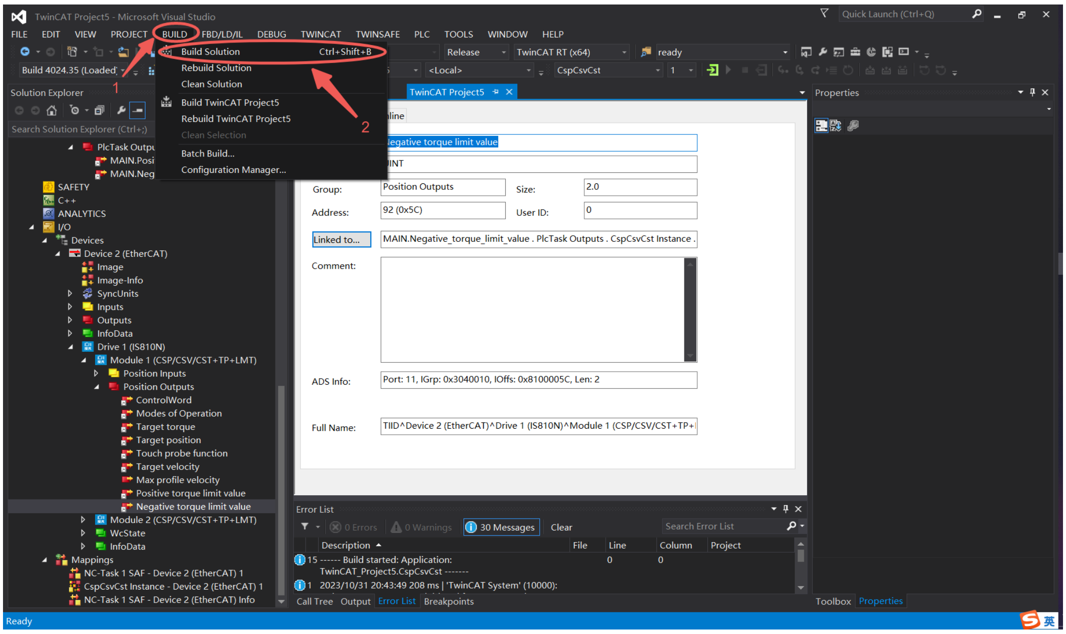
Because there are positive and negative maximum torque limits 60E1 and 60E0 in the CSP (position) +CSV (velocity) +CST (torque) mode, initial values must be assigned to them.

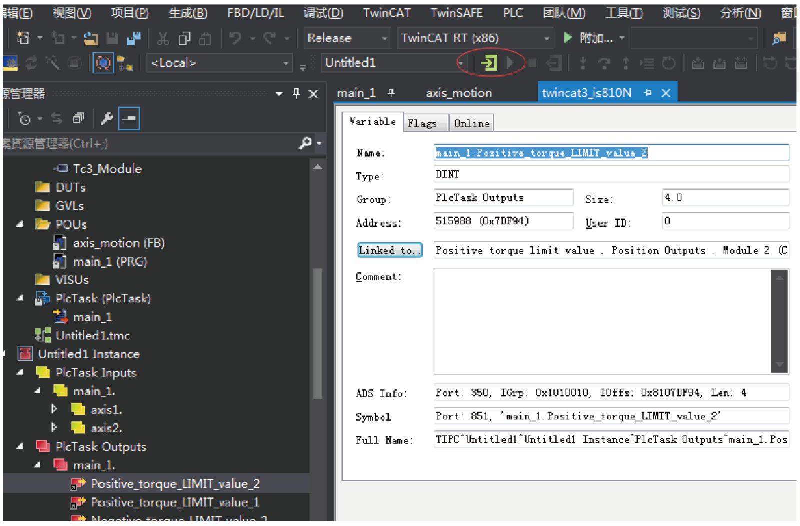


After compilation, perform variable link to 60E0 and 60E1.

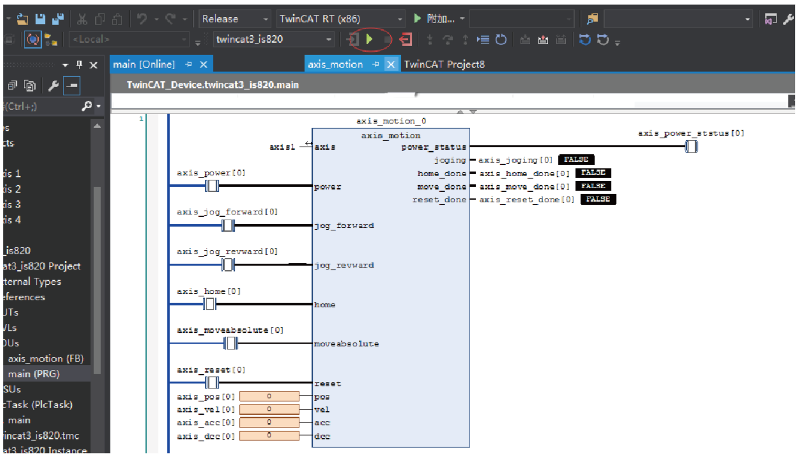


Compile the program. If there is no fault, configuration can be activated, and then log onto the PLC.



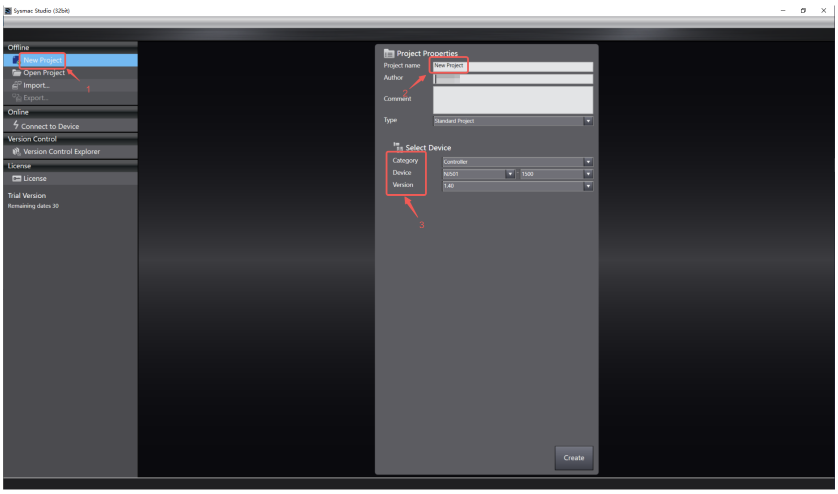


Run the PLC through a click, making the drive start operating through the bus.



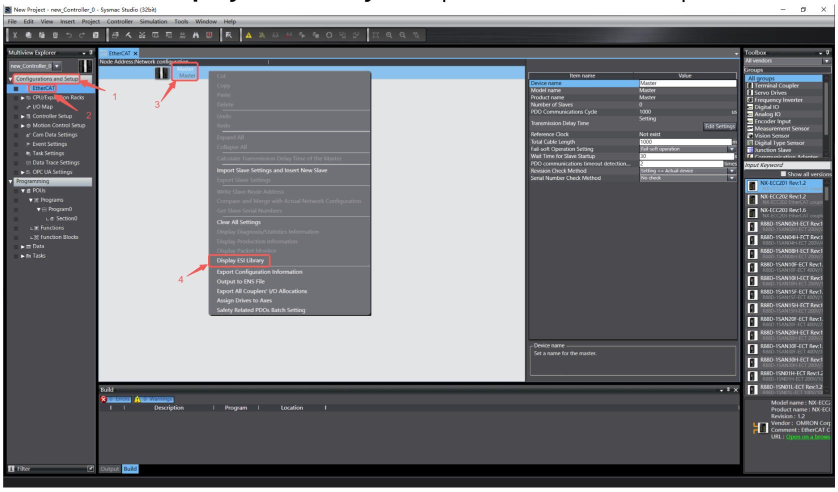
15.6.3 Omron EtherCAT Series PLC as the Master

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. Networking configuration

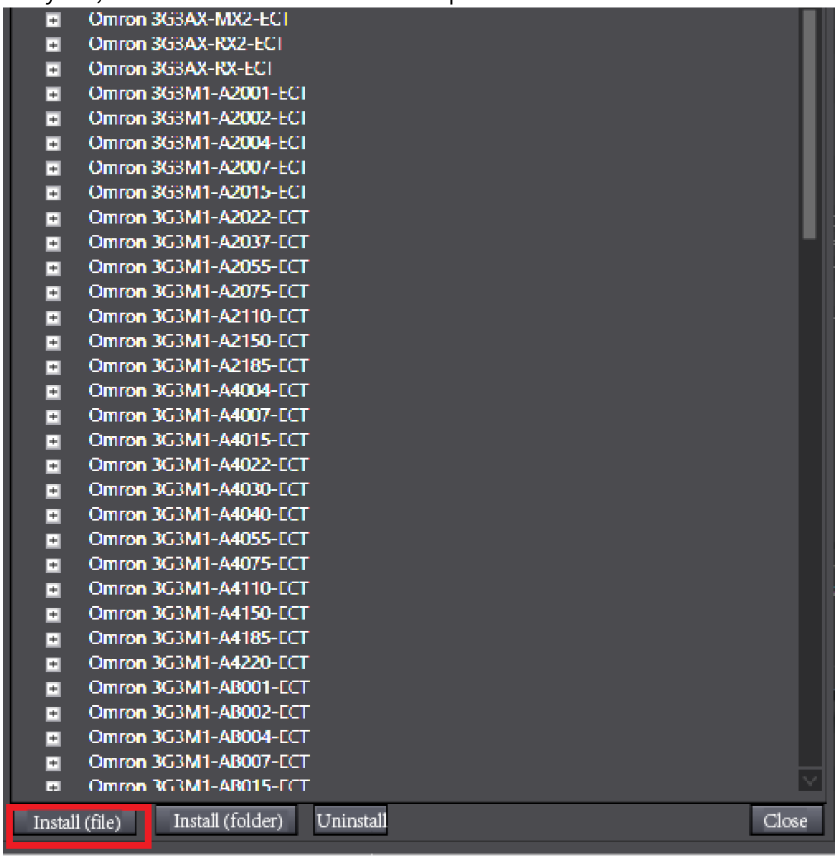
a. After creating a project, select the master icon on the EtherCAT device interface, and right-click to open the menu bar. Click **Display ESI Library** to import the device description file.

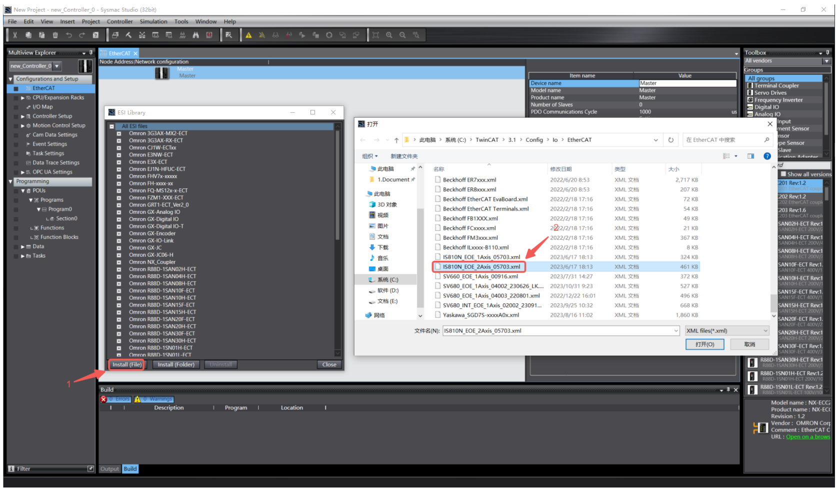


Note

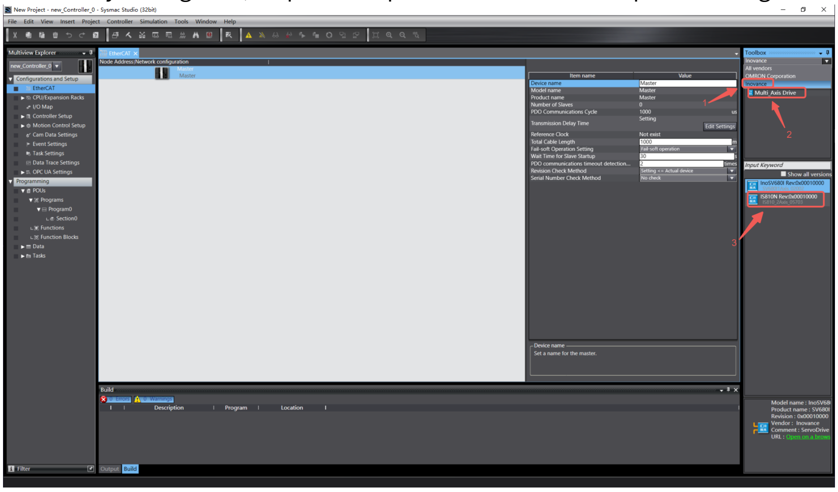
Note: Download the latest XML file of IS810N from Inovance official website.

b. In the ESI library list, click **Install** at the bottom to open the XML file of IS810N.



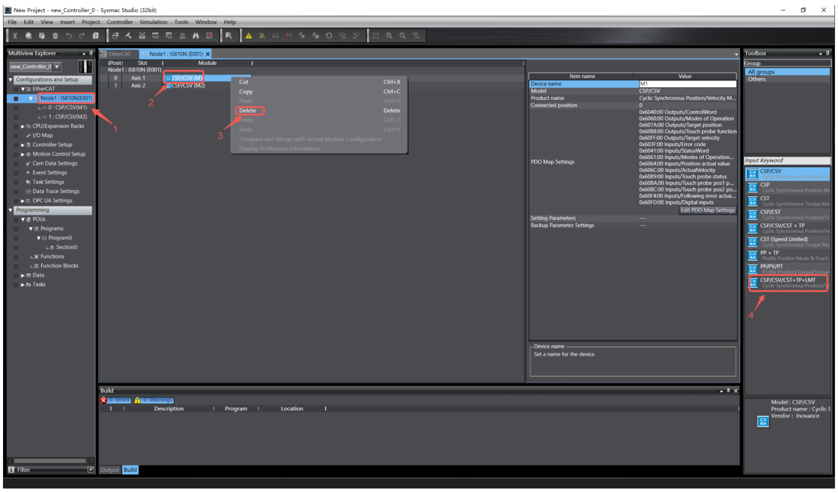


c. At the upper right of the software, click all suppliers and select **Multi-axis servo** in the menu. Double-click on the IS810N in the device list below to add the device into the configuration list. (If the network is already configured, skip this step and use the online upload configuration.)

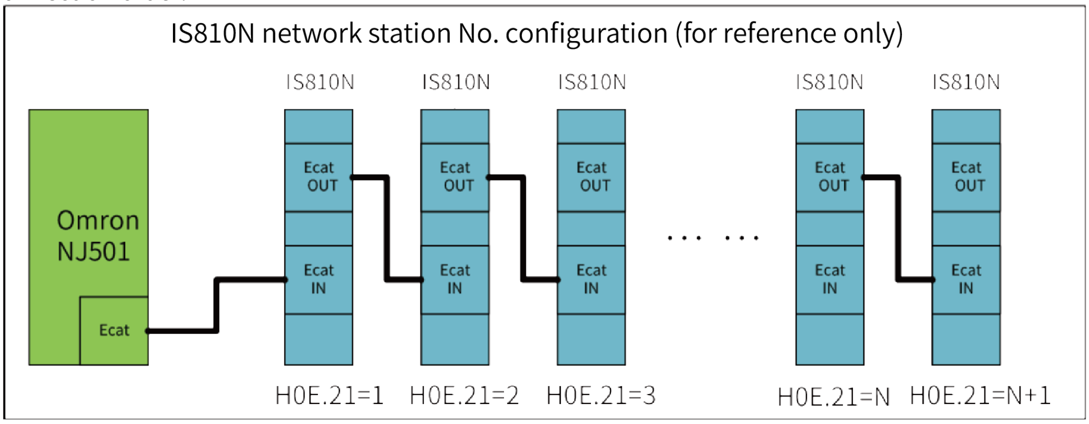


IS810N-INT has been designed with PDO list for easy use of each axis. Select a mode you need from "CSP/CSV+TP, CSP+TP, CST, CSP/CST+TP, CSP/CST/CSV+TP, PP+TP, and PP\PV\PT+TP", and the PDO list needed by this mode will be selected by XML files through working with the controller. Delete current slot configuration before insertion.

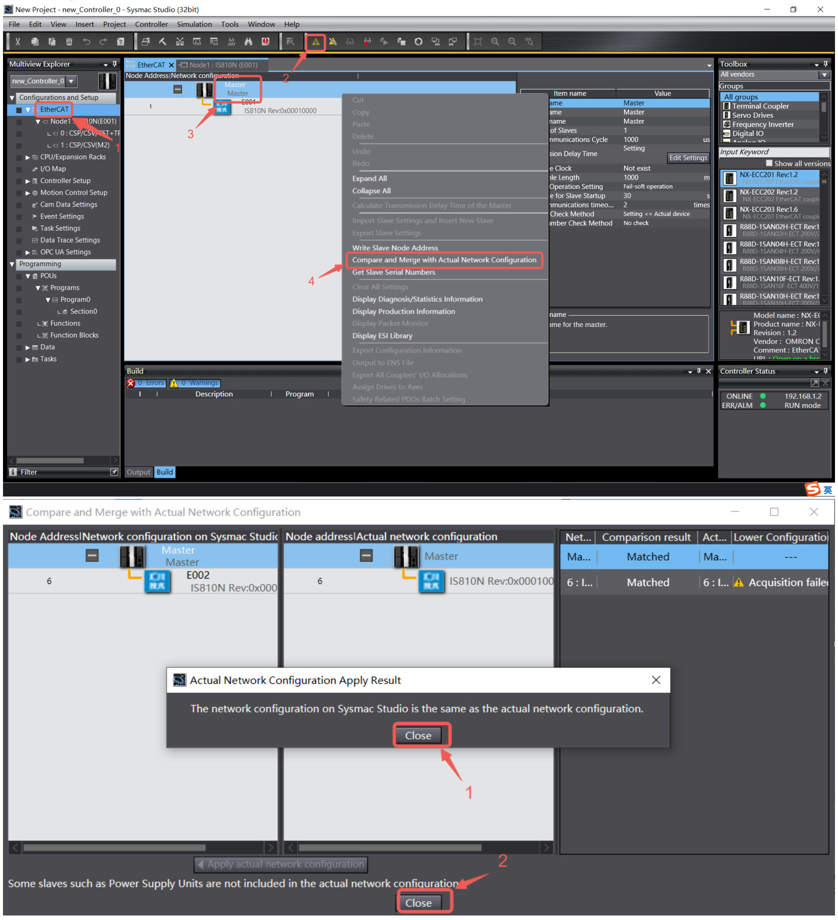
All the axes in this application example are selected with CSP/CSV+TP mode.



d. Set the EtherCAT communication site address through H0E.21. Power on again after setting. For easy configuration management , it is recommended to set the address according to the actual connection order.



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

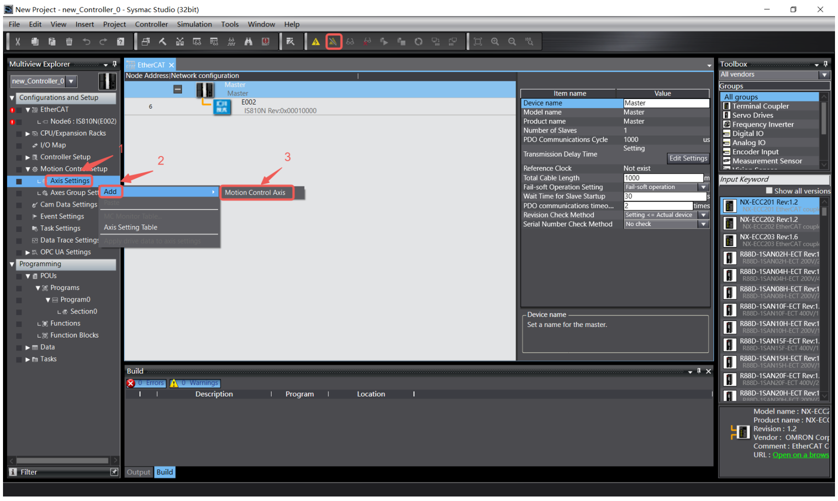
In the case of acquisition failure, click Apply.

---

3. Communication data configuration

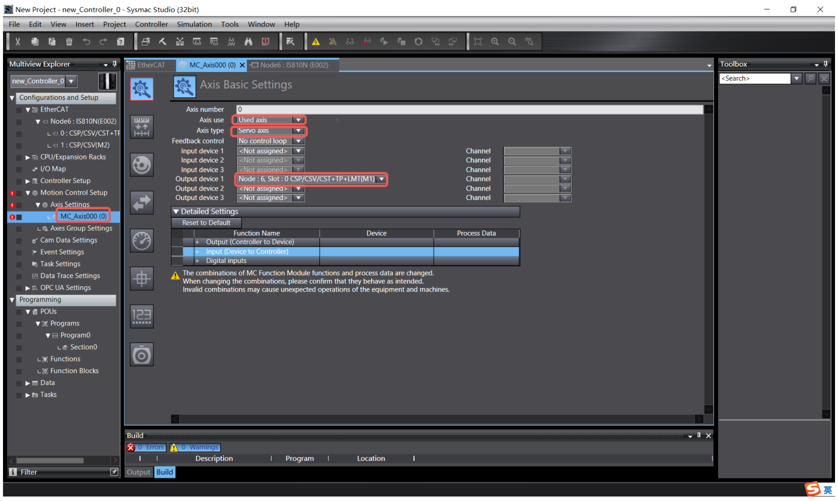
a. Motion control axis setting

Exit the online mode. Add **Axis Settings** in **Motion Control Setup**. Double-click **MC_Axis000** and configure an IS810N-INT device at a corresponding site in a corresponding **Axis Basic Settings** interface, as shown in the following figure. **MC_Axis000** can be renamed. After renaming, the NJ program uses this name to represent the IS810N-INT servo axis.



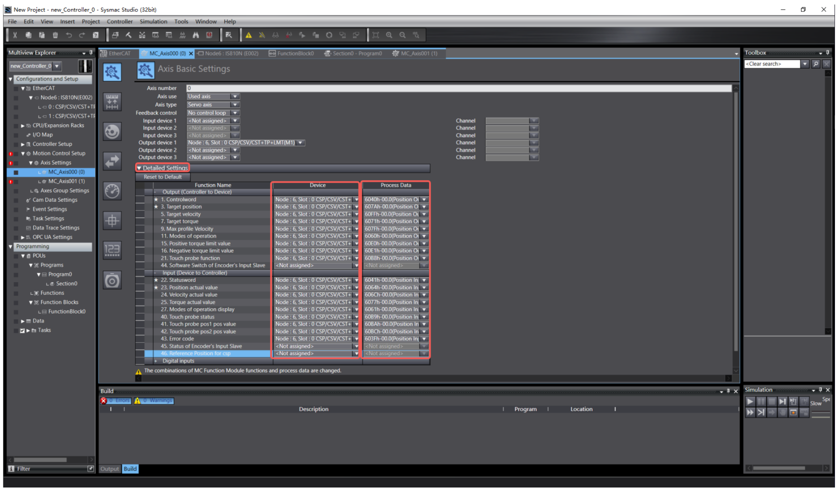
b. Motion control axis setting

Perform detailed configurations for axis parameters: All the axes under each slave need to be configured in the same configuration process. If the number of axes is less than 2, set the value of H02.00 of the IS810N-INT servo drive to **255** to shield this axis. If the number of axes is higher than 2, perform configurations as usual. The following example shows how to configure one of the axes.



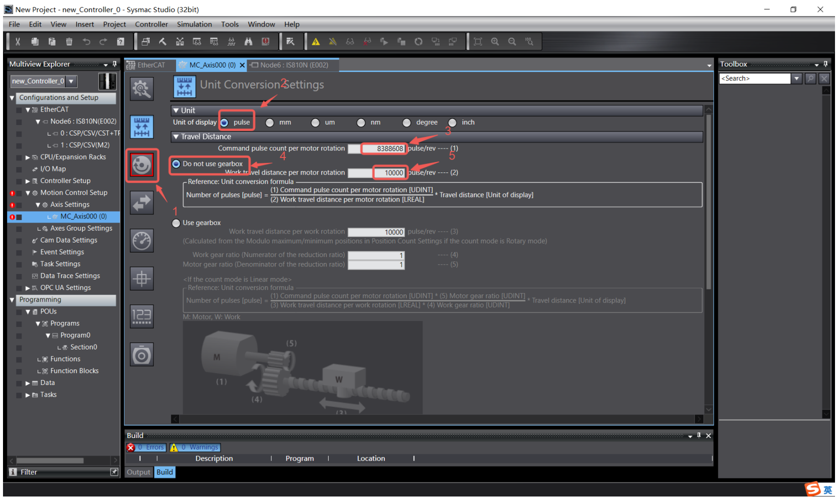
c. Configuration of mapping variables in servo axis communication

Click Detailed setting to unfold parameter configuration. Select the corresponding process data for mapping based on the I/O function names. Currently, all IS810N-INT axis need to be configured manually due to the limitation of Omron software tool. The following shows a configuration case for axis 2.

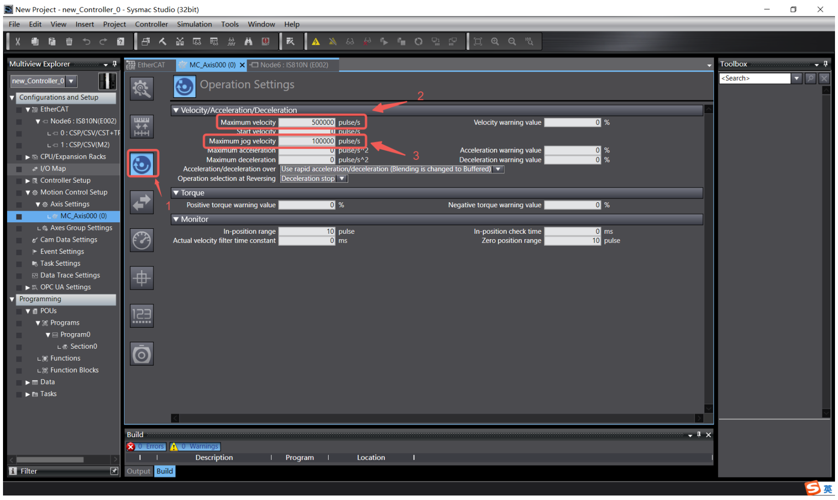


d. Configuring servo axis parameters

- Unit conversion setting:
  IS810N-INT is equipped with a 23-bit encoder, which means 8388608 pulses can be generated per revolution of the motor. The motor travel per revolution is 10000 pulses. Such conversion is similar to the electronic gear conversion performed on the host controller, which removes the need for setting the internal conversion ratio of the servo drive.



- Operation settings
  After the electronic gear ratio is set, an alarm will be reported when the maximum speed is reached, requiring a reset of parameters. Set the unit to the converted speed unit. 10000 pulses/s represents 1 R/S (60 rpm) of the motor. Set the maximum speed and jogging speed according to actual operation. If there is no special requirement, other parameters can be left unset.



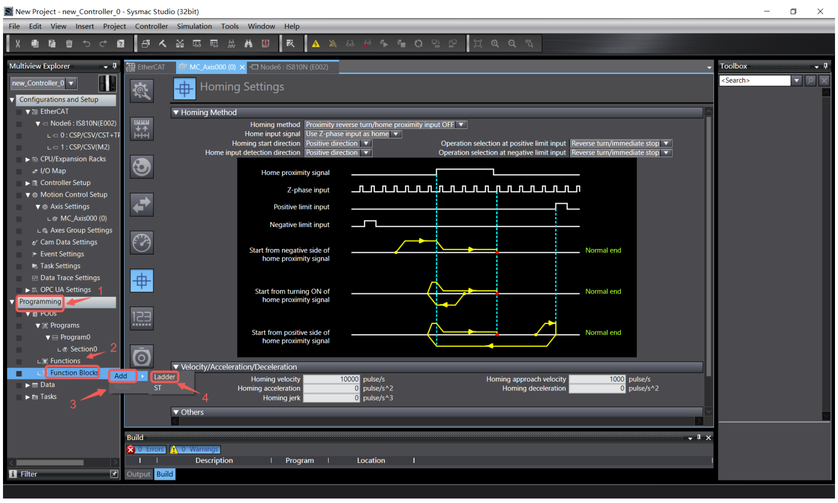
- Homing settings

  See the following table for how to set the homing mode.

NJ Software Description	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

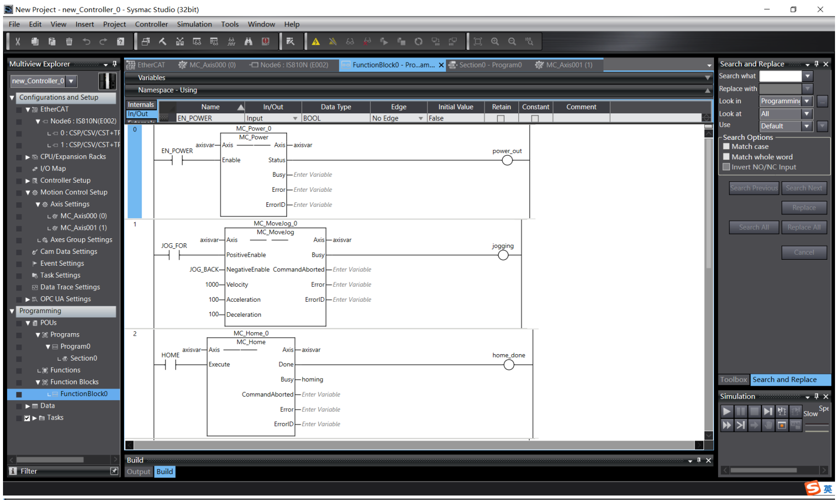
Note

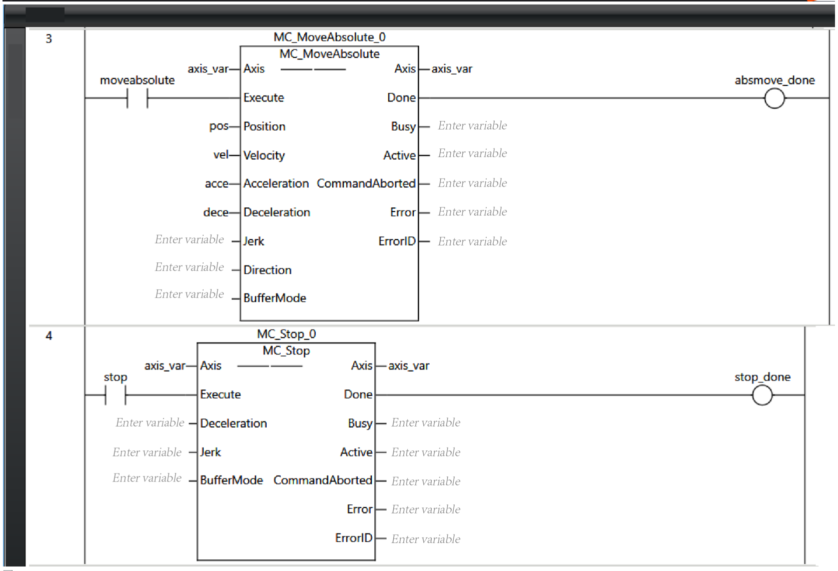
Phase Z signal and external home switch signal cannot be used at the same time.

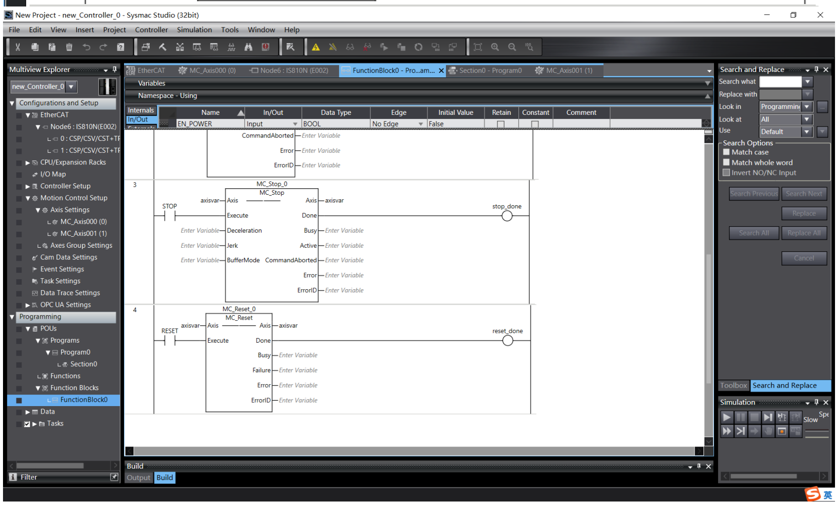


4. Program-controlled operation

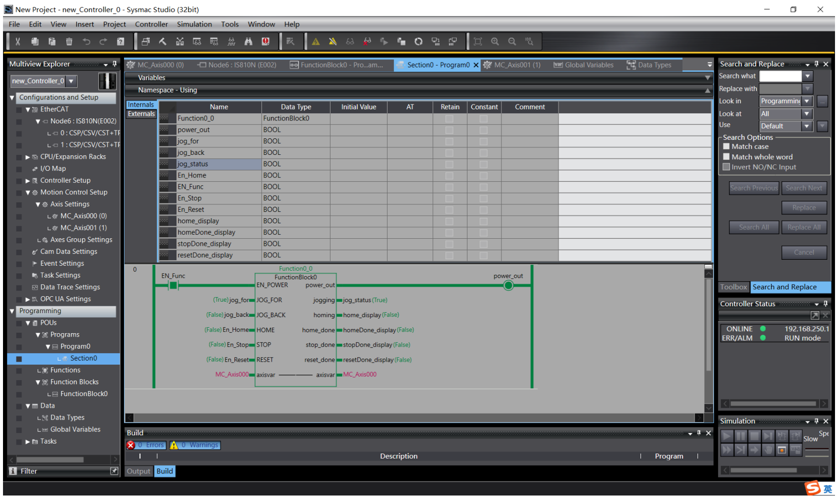
   a. After configurations are done, you can control the servo drive operations through the PLC program. To facilitate programming, a packetized function block is used for the convenience of testing. This function block contains MC_Power, MC_MoveAbsolute, MC_MoveJog, MC_Home, MC_Reset, and MC_Stop.







b. In section0, instantiate the function block completed currently and bind it to each axis. Then you can operate the axis through the bus.



c. After uploading the program to PLC, set the axis_power variable to True to enable corresponding axis, then set axis_jogfoward variable to True to drive the axis to run.

15.6.4 Operating in CSP Mode with AC801 Controller

The following show the configuration for communication between IS810N series drive and Inovance AC801 controller.

For details, see *"15.6.1 Operating in Cyclic Synchronous Position Mode with AM600 Controller" on page 341*.

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:

Operation 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 Parameter Group H00

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H00.00	2000–01h	Motor code	0 to 65535	14000: Inovance motor with 20-bit incremental encoder 14101: Inovance motor with 23-bit absolute encoder	14101	-	UInt16	At stop	Next power-on
H00.02	2000–03h	Custom ized No.	0.00 to 4294967295.00	Differentiates the customized MCU software version, which is not applicable to standard models.	0.00	-	UInt32	Unchangea ble	-
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	Unchangea ble	-
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	Unchangea ble	-
H00.06	2000–07h	FPGA custom ized No.	0.00 to 655.35	Differentiates the customized FPGA software version, which is not applicable to standard models.	0.00	-	UInt16	Unchangea ble	-
H00.07	2000–08h	STO version	0.0 to 655.4	Displays the software version of the STO function.	0.0	-	UInt16	Unchangea ble	-
H00.08	2000–09h	Serial 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: 220 V 1: 380 V	0	-	UInt16	At stop	Next power-on
H00.10	2000–0Bh	Rated power	0.01 to 655.35	-	0.75	kW	UInt16	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H00.11	2000–0Ch	Rated current	0.01 to 655.35	-	4.70	A	UInt16	At stop	Next power-on
H00.12	2000–0Dh	Rated torque	0.10 to 655.35	-	2.39	N·m	UInt16	At stop	Next power-on
H00.13	2000–0Eh	Maximum torque	0.10 to 655.35	-	7.16	N·m	UInt16	At stop	Next power-on
H00.14	2000–0Fh	Rated speed	100 to 10000	-	3000	rpm	UInt16	At stop	Next power-on
H00.15	2000–10h	Maximum speed	100 to 10000	-	6000	rpm	UInt16	At stop	Next power-on
H00.16	2000–11h	Moment of inertia	0.01 to 655.35	-	1.30	$kgcm^2$	UInt16	At stop	Next power-on
H00.17	2000–12h	Number of PMSM pole pairs	2 to 65535	-	5	-	UInt16	At stop	Next power-on
H00.18	2000–13h	Stator resistance	0.001 to 65.535	-	0.500	Ω	UInt16	At stop	Next power-on
H00.19	2000–14h	Stator induc tance Lq	0.01 to 655.35	-	3.27	mH	UInt16	At stop	Next power-on
H00.20	2000–15h	Stator induc tance Ld	0.01 to 655.35	-	3.87	mH	UInt16	At stop	Next power-on
H00.21	2000–16h	Linear back EMF coefficient	0.01 to 655.35	-	33.30	mV/rpm	UInt16	At stop	Next power-on
H00.22	2000–17h	Torque coefficient Kt	0.01 to 655.35	-	0.51	N·m/Arms	UInt16	At stop	Next power-on
H00.23	2000–18h	Electrical constant Te	0.01 to 655.35	-	6.54	ms	UInt16	At stop	Next power-on
H00.24	2000–19h	Mechani cal constant Tm	0.01 to 655.35	-	0.24	ms	UInt16	At stop	Next power-on
H00.25	2000–1Ah	Interpolater tempera ture 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	Next power-on

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H00.26	2000–1Bh	Configuration for connecting the interpolator to encoder	0 to 65535	-	0	-	UInt16	At stop	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	Next power-on
H00.28	2000–1Dh	Absolute encoder position offset	0 to 4294967295	Used to save the values obtained from angle auto-tuning.	8192	-	UInt32	At stop	Next power-on
H00.30	2000–1Fh	Encoder selection (HEX)	0: 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	Next power-on
H00.31	2000–20h	Encoder PPR	1 to 1073741824	Defines the number of pulses fed back by the encoder per motor revolution.	67108864	PPR	UInt32	At stop	Next power-on
H00.33	2000–22h	Electrical angle of Z signal	0.0° to 360.0°	-	180.0	°	UInt16	At stop	Next power-on
H00.34	2000–23h	Electrical angle of phase U rising edge	0.0° to 360.0°	-	180.0	°	UInt16	At stop	Next power-on
H00.35	2000–24h	Serial-type motor model	0 to 65535	-	0	-	UInt16	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H00.37	2000–26h	Absolute encoder function setting bit	0 to 65535	-	0	-	UInt16	At stop	Next power-on
H00.39	2000–28h	BiSSC single-turn data	0 to 32	Defines the length (up to 32 bits) of the single-turn data configured based on BiSSC protocol.	22	-	UInt16	At stop	Next power-on
H00.43	2000–2Ch	Number of BiSSC data bits	0 to 64	Defines the length (up to 64 bits) of the single-turn and multi-turn data configured based on BiSSC protocol.	32	-	UInt16	At stop	Next power-on
H00.44	2000–2Dh	Number of BiSSC fault bits	0 to 31	Defines the length of the fault configured based on BiSSC protocol.	2	-	UInt16	At stop	Next power-on
H00.54	2000–37h	BiSSC CRC	0 to 1	Defines the CRC polarity of the BiSSC protocol. 0: Positive 1: Negative	1	-	UInt16	At stop	Next power-on
H00.60	2000–3Dh	Motor attribute	0 to 65535	-	0	-	UInt16	At stop	Next power-on
H00.61	2000–3Eh	Brake apply time	0 to 65535	-	0	ms	UInt16	At stop	Next power-on
H00.62	2000–3Fh	Brake release time	0 to 65535	-	0	ms	UInt16	At stop	Next power-on
H00.63	2000–40h	Maximum motor current	0.00 to 65535.00	-	0.00	A	UInt32	At stop	Next power-on
H00.65	2000–42h	Rated motor current	0.00 to 65535.00	-	0.00	A	UInt32	At stop	Next power-on
H00.67	2000–44h	Moment of inertia	0 to 42950	-	0	kgc m^2	UInt32	At stop	Next power-on
H00.69	2000–46h	Linear back EMF coefficient	0.01 to 42949672.95	-	0.01	mV/ rpm	UInt32	At stop	Next power-on
H00.71	2000–48h	Motor carrier frequency	0 to 65535	Sets the carrier frequency of the motor. It is effective when bit13 of H00.60 is 1.	8000	Hz	UInt16	At stop	Next power-on
H00.72	2000–49h	Max. motor allowable demagnet ization current	0% to 65535%	Effective when greater than 0. Assigns the value of H00.72 to H07.25 when the motor field weakening is activated.	0	%	UInt16	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H00.73	2000–4Ah	Bit01 of motor SN code	0 to 65535	-	0	-	UInt16	At stop	-
H00.74	2000–4Bh	bit 23 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	-
H00.84	2000–55h	CRC polarity of BiSSC register	0 to 1	Defines the CRC polarity of the BiSSC protocol. 0: Positive 1: Negative	1	-	UInt16	At stop	Next power-on
H00.98	2000–63h	Motor attribute check	0 to 65535	-	0	-	UInt16	At stop	-

16.2 Parameter Group H01

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 models	2001–02h	FPGA software version	0.0 to 6553.5	Displays FPGA software version (with one decimal place).	0.0	-	UInt16	Unchangeable	-
H01.02 models	2001–03h	Servo drive series No.	0 to 65535	Displays the servo drive series No. (without decimal place).	0	-	UInt16	Unchangeable	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H01.07 models	2001–08h	Software test version	0.00 to 655.35	Displays the software test version (with two decimal places).	0.00	-	UInt16	Unchangea ble	-
H01.08 models	2001–09h	Model parame ter version	0.0 to 6553.5	Displays model parameter version, with 1 decimal place.	0.0	-	UInt16	Unchangea ble	-
H01.10 models	2001–0Bh	Drive series No.	10001: DT3R5 10002: DT5R4 10003: DT8R4 10004: DT012 10005: DT017 10006: DT021 10007: DT026 10008: DT032 10009: DT037 10010: ST045 10011: ST060 10012: ST075 10013: ST091 10014: ST112 10015: ST152 10016: ST240	Displays the drive series No. (without decimal place).	10004	-	UInt16	At stop	Next power-on
H01.11	2001–0Ch	DC-AC voltage class	0 V to 65535 V	Displays DC-AC voltage class (without decimal place).	220	V	UInt16	Unchangea ble	-
H01.12 models	2001–0Dh	Drive rated power	0.00 to 10737418.24	Displays the rated power of the servo drive (with two decimal places).	0.40	kW	UInt32	Unchangea ble	-
H01.14 models	2001–0Fh	Max. output power of the drive	0.00 to 10737418.24	Displays the maximum output power of the drive (with two decimal places).	0.40	kW	UInt32	Unchangea ble	-
H01.16 models	2001–11h	Rated output current of the drive	0.00 to 10737418.24	Displays the rated output current of the drive (with two decimal places).	2.80	A	UInt32	Unchangea ble	-
H01.18 models	2001–13h	Max. output current of the drive	0.00 to 10737418.24	Displays the maximum output current of the drive (with two decimal places).	10.10	A	UInt32	Unchangea ble	-
H01.20 models	2001–15h	Carrier frequen cy	2500 to 20000	Displays the carrier frequency (without decimal place).	8000	Hz	UInt16	At stop	Next power-on
H01.21	2001–16h	Dead zone time	0.01 and 20.00	Displays the dead zone time (with two decimal places).	2.00	us	UInt16	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H01.22	2001–17h	D-axis coupling voltage compen sation coeffi cient	0.0% to 1000.0%	Displays D-axis coupling voltage compensation coefficient (with one decimal place).	50.0	%	UInt16	Real time	Real time
H01.23	2001–18h	Q-axis back EMF compen sation coeffi cient	0.0% to 1000.0%	Displays Q-axis back EMF compensation coefficient (with one decimal place).	50.0	%	UInt16	Real time	Real time
H01.24	2001–19h	D-axis current loop gain	0 to 20000	Displays D-axis current loop gain (without decimal place).	500	Hz	UInt16	Real time	Real time
H01.25	2001–1Ah	D-axis current loop integral compen sation factor	0.01 to 100.00	Displays D-axis current loop integral compensation factor (with two decimal places).	1.00	-	UInt16	Real time	Real time
H01.26	2001–1Bh	Sinc3 filter data extrac tion rate in current sampling	0: Extraction rate 32 1: Extraction rate 64 2: Extraction rate 128 3: Extraction rate 256	Display Sinc3 filter data extraction rate in current sampling (without decimal place).	0	-	UInt16	At stop	Next power-on
H01.27	2001–1Ch	Q-axis current loop gain	0 to 20000	Displays Q-axis current loop gain (without decimal place).	500	Hz	UInt16	Real time	Real time
H01.28	2001–1Dh	Q-axis current loop integral compen sation factor	0.01 to 100.00	Displays Q-axis current loop integral compensation factor (with two decimal places).	1.00	-	UInt16	Real time	Real time
H01.29	2001–1Eh	Q-axis coupling voltage compen sation coeffi cient	0.0% to 1000.0%	Displays Q-axis coupling voltage compensation coefficient (with one decimal place).	50.0	%	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H01.30	2001–1Fh	Bus voltage gain tuning	50.0% to 150.0%	Displays bus voltage gain tuning (with one decimal place).	100.0	%	UInt16	At stop	Real time
H01.31	2001–20h	Minimum ON time of bootstrap circuit lower bridge	0.0 and 20.0	Displays the minimum ON time of bootstrap circuit lower bridge (with one decimal place).	0.0	us	UInt16	At stop	Next power-on
H01.32	2001–21h	Relative gain of UV sampling	1 to 65535	Displays the relative gain of UV sampling (without decimal place).	32768	-	UInt16	At stop	Next power-on
H01.34	2001–23h	Drive overtem perature threshold	0 to 150	Displays the drive overtemperature threshold (without decimal place).	95	°C	UInt16	Real time	Next power-on
H01.36	2001–25h	Current sensor range	0.00 to 9999.99	Displays the current sensor range (with two decimal places).	21.33	A	UInt32	At stop	Next power-on
H01.38	2001–27h	FPGA phase current protec tion threshold	0.0% to 100.0%	Displays FPGA phase current protection threshold (with one decimal place).	90.0	%	UInt16	At stop	Next power-on
H01.39	2001–28h	Current loop version	0 to 65535	Displays current loop version (without decimal place).	0	-	UInt16	At stop	Next power-on
H01.40	2001–29h	DC bus overvolt age protec tion threshold	0 V to 820 V	Displays DC bus overvoltage protection threshold (without decimal place).	800	V	UInt16	Real time	Real time
H01.41	2001–2Ah	DC bus voltage discharge threshold	0 V to 820 V	Displays DC bus voltage discharge threshold (without decimal place).	700	V	UInt16	Real time	Real time
H01.42	2001–2Bh	DC bus undervolt age threshold	0 V to 820 V	Displays DC bus undervoltage threshold (without decimal place).	350	V	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H01.52	2001–35h	D-axis proportional gain in performance priority mode	0 to 20000	Displays D-axis proportional gain in performance priority mode (without 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 two decimal places).	1.00	-	UInt16	Real time	Real time
H01.54	2001–37h	Q-axis proportional gain in performance priority mode	0 to 20000	Displays Q-axis proportional gain in performance priority mode (without 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 two decimal places).	1.00	-	UInt16	Real time	Real time
H01.56	2001–39h	Current loop low-pass cutoff frequency	0 to 65535	Displays current loop low-pass cutoff frequency (without decimal place).	11000	Hz	UInt16	At stop	Next power-on
H01.59	2001–3Ch	Serial encoder data transmission compensation time	0.000 to 10.000	Displays the data transmission compensation time of the serial encoder (with three decimal places).	0.000	us	UInt16	At stop	Next power-on
H01.60	2001–3Dh	FPGA scheduling frequency selection	1: 16 kHz 2: 8 kHz	Displays the FPGA scheduling frequency (without decimal place).	1	-	UInt16	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H01.61	2001–3Eh	Com mand schedul ing frequen cy	0: 4 kHz 1: 2 kHz 2: 1 kHz 3: 8 kHz	Displays the command scheduling frequency (without decimal place).	3	-	UInt16	At stop	Next power-on
H01.62	2001–3Fh	Auto-tuning of drive model	0 to 65535	Displays the auto-tuned drive model (without decimal place).	0	-	UInt16	Unchangea ble	-
H01.64 models	2001–41h	Heiden hain encoder recovery time	0.000 to 65.535	Displays PL and CPL filter time (without decimal place).	0.500	-	UInt16	At stop	Next power-on
H01.65	2001–42h	Heiden hain encoder baud rate	0 to 32767	Heidenhain recovery time	4000	-	UInt16	At stop	Next power-on
H01.66	2001–43h	Current loop configura tion	0 kHz to 31 kHz	Displays current loop configuration (without decimal place).	12	kHz	UInt16	Real time	Real time
H01.67	2001–44h	Dead zone compen sation coeffi cient	0.00 to 2.00	Displays the dead zone compensation coefficient (with two decimal places).	1.00	-	UInt16	Real time	Next power-on
H01.68	2001–45h	Current observer cutoff frequen cy	200 to 5000	Displays current observer cutoff frequency (without decimal place).	2000	-	UInt16	Real time	Real time
H01.69	2001–46h	Current observer correc tion coeffi cient	0.00 to 9.00	Displays current observer correction coefficient (with two decimal places).	1.00	-	UInt16	Real time	Real time
H01.72	2001–49h	Hide IGBT model identifica tion	0 to 65535	Displays whether to hide IGBT model identification (without decimal place).	0	-	UInt16	Real time	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H01.73	2001–4Ah	Sigma-delta signal phase compensation time	0 to 65535	Displays Sigma-delta signal phase compensation time (without decimal place).	1	us	UInt16	At stop	Next power-on
H01.75	2001–4Ch	Current loop amplification factor	0.00 to 655.35	Displays current loop amplification coefficient (with two decimal places).	1.00	-	UInt16	Real time	Real time
H01.78	2001–4Fh	Control circuit undervoltage threshold	0 to 2000	Displays control power undervoltage threshold, without decimal place.	200	V	UInt16	Real time	Real time
H01.79	2001–50h	Control voltage gain tuning	50.0% to 150.0%	Displays control voltage gain adjustment, with 1 decimal place.	100.0	%	UInt16	At stop	Next power-on
H01.82	2001–53h	Filter time of PL and CPL	0 to 32767	Displays PL and CPL filter time (without decimal place).	4000	-	UInt16	At stop	Real time
H01.87	2001–58h	Number of bits of Heidenhain encoder per revolution	0 to 32	Data bit of Heidenhain encoder per revolution	0	-	UInt16	At stop	Next power-on
H01.88	2001–59h	Number of bits of Heidenhain encoder per multiple revolutions	0 to 32	Data bit of Heidenhain encoder per multiple revolutions	0	-	UInt16	At stop	Next power-on

16.3 Parameter Group H02

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H02.00	2002–01h	Control mode	0: Speed control mode 1: Position control mode 2: Torque control mode 9: EtherCAT mode 255: Axis masked	0: Speed control mode 1: Position control mode 2: Torque control mode 9: EtherCAT mode 255: Axis masked	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 warning) 4: Absolute position single-turn mode	Used to set the absolute position function.	0	-	UInt16	At stop	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	Real time
H02.03	2002–04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	Defines the relation between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.	0	-	UInt16	At stop	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H02.06	2002–07h	Stop mode at No.2 fault	–5: Stop at zero speed, keeping dynamic braking state –4: Stop at emergency stop torque, keeping dynamic braking state –3: Ramp to stop as defined by 6085h, keeping dynamic braking state –2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state –1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H02.07	2002–08h	Stop mode at overtra vel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state 3: Ramp to stop as defined by 6085h, keeping de-energized state 4: Ramp to stop as defined by 6085h, keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel	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 com mand received	0 to 500	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H02.10	2002–0Bh	Delay from brake output OFF to motor de-energized	50 to 1000	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 to 3000	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 to 65535	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	Used to 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 braking relay coil ON delay	10 to 30000	-	30	ms	UInt16	Real time	Real time
H02.21	2002–16h	Permissible minimum resistance of regenerative resistor	1 Ω to 1000 Ω	-	40	Ω	UInt16	Unchangeable	-
H02.30 models	2002–1Fh	User password	0 to 65535	-	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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
H02.32	2002–21h	Selection of parameters in group H0b	0 to 99	Sets the offset of the parameter to be displayed on the operating panel. For example, the setpoint 0 indicates the value of H0b.00 (Motor speed actual value) is displayed on the keypad. The setpoint 1 indicates the value of H0b.01 is displayed on the operating panel.	50	-	UInt16	Real time	Real time
H02.35	2002–24h	Keypad data update frequency	0 to 20	-	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	Default	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 Parameter Group H04

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H04.00	2004–01h	DO1 function selection	0: No assignment 101: Servo ready 102: Motor rotation signal 109: Brake output 110: Alarm 111: Fault 121: Dynamic brake 131: Communication-forced DO 132: EDM output 201: Servo ready 202: Motor rotation signal 209: Brake output 210: Alarm 211: Fault 221: Dynamic brake 231: Communication-forced DO 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: Normally 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 selection	See H04.00.	Defines the function of DO2.	0	-	UInt16	Real time	Real time
H04.03	2004–04h	DO2 logic selection	0: Normally open 1: Normally closed	Defines the level logic of DO2 when the function assigned to DO is active.	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 communi cation-forced DO logic in non-OP status	bit0: DO1 0: Status unchanged 1: No output bit1: DO2 0: Status unchanged 1: No output	Sets DO state upon ECAT communication failure.	0	-	UInt16	Real time	Real time

16.6 Parameter Group H05

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H05.02	2005–03h	Pulses per revolution	0 to 4294967295	Defines the number of pulses required per revolution of the motor.	0	PPR	UInt32	At stop	Next power-on
H05.04	2005–05h	First-order low-pass filter time constant	0.0 to 6553.5	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 to 128.0	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 (numera tor)	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 (denomi nator)	1 to 1073741824	Defines the denominator of electronic gear ratio 1.	1	-	UInt32	Real time	Real time

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 selection	0: Position deviation cleared upon S-OFF or non-operational state 1: Position deviation cleared upon fault or non-operational 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 to 4194303	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	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 the 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 to 65535	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: Frequency-division output inhibited	Defines the output source of the pulse output terminal.	0	-	UInt16	Real time	Next power-on

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H05.39	2005–28h	Electronic gear ratio switch over condition	0: Switched after position reference 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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) bit 2: 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	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	Next power-on

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H05.47	2005–30h	Frequency-division Z pulse width	0 to 400	Defines the minimum output width (us) of frequency division output PZ.	0	us	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H05.60	2005–3Dh	Hold time of positioning completed	0 to 30000	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: 1 ms 1: 10 ms 2: 100 ms	Defines the homing time unit. The actual timeout time is H05.35 x H05.66 in 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 to 1000.0	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 to 100	Defines the pulse width output upon active motor Z signal.	4	ms	UInt16	Real time	Real time
H05.72	2005–49h	Threshold of inter/ outer loop switchover deviation	0 to 4294967295	-	32767	-	UInt32	At stop	Real time

16.7 Parameter Group H06

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 to +10000	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 to 10000	Defines the DI jog speed reference.	150	rpm	Int16	Real time	Real time
H06.05	2006–06h	Accelera tion ramp time of speed reference	0 to 65535	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: time for the speed reference to accelerate from zero to 1000 rpm. H06.06: time for the speed reference to decelerate from 1000 rpm to zero. Actual acceleration time t1 = Speed reference/1000 x Acceleration ramp time of speed reference Actual acceleration time t2 = Speed reference/1000 x Deceleration ramp time of speed reference	0	ms	UInt16	Real time	Real time
H06.06	2006–07h	Decelera tion ramp time of speed reference	0 to 65535	Sets deceleration ramp time of speed reference.	0	ms	UInt16	Real time	Real time
H06.07	2006–08h	Maximum speed limit	0 to 10000	Defines the maximum speed limit.	7000	rpm	UInt16	Real time	Real time
H06.08	2006–09h	Forward speed threshold	0 to 10000	Defines the forward speed threshold.	7000	rpm	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H06.09	2006–0Ah	Reverse speed threshold	0 to 10000	Defines the reverse speed threshold.	7000	rpm	UInt16	Real time	Real time
H06.10	2006–0Bh	Deceleration unit in emergency stop	0: x 1 1: x 10 2: x 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 to 65535	Sets the acceleration ramp time of jog speed.	10	ms	UInt16	Real time	Real time
H06.13	2006–0Eh	Speed feedforward smoothing filter	0 to 65535	Defines the speed feedforward smoothing filter time.	0	us	UInt16	Real time	Real time
H06.15	2006–10h	Zero clamp speed threshold	0 to 10000	Defines the zero clamp speed threshold.	10	rpm	UInt16	Real time	Real time
H06.16	2006–11h	Threshold of TGON (motor rotation) signal	0 to 1000	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 to 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	20 to 10000	Defines the threshold of speed reached signal.	1000	rpm	UInt16	Real time	Real time
H06.19	2006–14h	Threshold of zero speed output signal	1 to 10000	Defines the threshold of zero speed output signal.	10	rpm	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H06.26	2006–1Bh	Torque fluctuation auto-tuning enable	0 to 1	Used to enable the torque ripple auto-tuning function.	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	Next power-on
H06.31	2006–20h	Sine reference frequency	0 to 16000	Used to set the sine 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	Used to set the sine reference initial phase position.	0.0	-	UInt16	Real time	Real time
H06.35	2006–24h	Sine reference offset	-9900 to +9900	Used to set the sine reference offset.	0	-	Int16	Real time	Real time

16.8 Parameter Group H07

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H07.00	2007–01h	Source of main torque reference A	0: Keypad (H07.03)	Defines the source of 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 to 30.00	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 to 30.00	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	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%	Defines the torque reference source of emergency stop.	100.0	%	UInt16	Real time	At stop

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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	0 to 10000	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	0 to 10000	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 active torque reach DO active.	20.0	%	UInt16	Real time	Real time
H07.23	2007–18h	Torque reach inactive value	0.0% to 500.0%	Defines the torque reference for invalid torque reach DO.	10.0	%	UInt16	Real time	Real time
H07.24	2007–19h	Field weaken ing depth	60% to 115%	Set the flux weakening depth.	115	%	UInt16	Real time	Real time
H07.25	2007–1Ah	Max. permissi ble demagnet izing current	0% to 300%	Set the maximum allowable demagnetization current value.	100	%	UInt16	Real time	Real time
H07.26	2007–1Bh	Field weaken ing selection	0: Disabled 1: Enabled	Disable or enable field weakening.	1	-	UInt16	At stop	Real time
H07.27	2007–1Ch	Field weaken ing gain	0.001 to 1.000	Set the gain of flux weakening.	0.030	Hz	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 enable	0 to 1	Used to enable MTPA.	0	-	UInt16	At stop	Real time
H07.32	2007–21h	Changes in the non-standard function 6077 of slicers	0 to 1	-	0	-	UInt16	Real time	Real time
H07.34	2007–23h	Individual deviation threshold of field weakening	100 to 10000	Used to set individual deviation threshold of field weakening.	300	-	UInt16	Real time	Real time
H07.35	2007–24h	Individual deviation limit of field weakening	1 to 10000	Used to set individual deviation limit of field weakening	100	-	UInt16	Real time	Real time
H07.36	2007–25h	Time constant of low-pass filter 2	0.00 to 10.00	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 to 300	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	This coefficient is used to calculate the output torque.	1.000	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H07.44	2007–2Dh	80D motor tempera ture coefficient K2	0.000 to 6.000	This coefficient is used 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 Parameter Group H08

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H08.00	2008–01h	Speed loop gain	0.1 to 2000.0	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 to 512.00	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 to 2000.0	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H08.03	2008–04h	2nd speed loop gain	0.1 to 2000.0	-	75.0	Hz	UInt16	Real time	Real time
H08.04	2008–05h	2nd speed loop integral time constant	0.15 to 512.00	-	10.61	ms	UInt16	Real time	Real time
H08.05	2008–06h	2nd position loop gain	0.1 to 2000.0	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 set, P/PI switched through bit 26 of external 60FEh 1: Switched between the 1st and 2nd gain set as defined by H08.09	Defines the mode for switching to the 2nd gain set.	1	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H08.09	2008–0Ah	Gain switch over condition	0: Fixed to the 1st gain set (PS) 1: Switched as defined by bit 26 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 to 1000.0	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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: Set H08.11 ⩾ H08.12. Otherwise, the drive forcibly sets H08.11 to the same value as H08.12.	30	-	UInt16	Real time	Real time
H08.13	2008–0Eh	Position gain switch over time	0.0 to 1000.0	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 saving	0 to 65535	-	0	-	UInt16	Real time	Real time
H08.17	2008–12h	Zero phase delay	0.0 to 4.0	-	0.0	ms	UInt16	Real time	Real time
H08.18	2008–13h	Time constant of speed feedfor ward filter	0.00 to 64.00	Defines the filter time constant of speed feedforward.	0.50	ms	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 feedforward 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, and then increase H08.19 gradually from 0 to a certain value at which speed feedforward reaches the required effect. Adjust H08.18 and H08.19 repeatedly to find the balanced setting. 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 to 64.00	Defines the filter time constant of torque feedforward.	0.50	ms	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H08.21	2008–16h	Torque feedfor ward gain	0.0% to 300.0%	In control modes other than torque control, torque feedforward is the product of torque feedforward 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 to find the balanced setting. 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 to 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 (default control mode of speed loop) which features quick dynamic response. When this coefficient is set to 0.0, low-frequency interference can be filtered but the dynamic response will be slowed down. 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 to 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 to 10.00	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	Disturb ance compensa tion time	0.00 to 100.00	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	Disturb ance cutoff frequency	10 to 4000	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	-90 deg to +90 deg	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 to 1000	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: 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Positive torque feedforward value	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	Negative torque feedforward value	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 to 655.35	Sets the derivative time of single inertia model control torque feedforward.	0.00	ms	UInt16	Real time	Real time
H08.51	2008–34h	Model speed feedforward derivative time	0.00 to 20.00	Sets the derivative time of single inertia model control speed feedforward.	0.00	ms	UInt16	Real time	Real time
H08.53	2008–36h	Medium- and low-frequency jitter suppression frequency 3	0.0 to 300.0	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H08.56	2008–39h	Medium- and low-frequency jitter suppres sion phase modula tion 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 suppres sion frequency 4	0.0 to 300.0	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 suppres sion compensa tion 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 suppres sion phase modula tion 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 to 320.0	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	0.0 and 5120.0	Sets the low-pass filter time for zero deviation control position.	190.0	us	UInt16	Real time	Real time
H08.68	2008–45h	Speed feedfor ward 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 feedfor ward 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	0.00 to 512.00	Sets zero deviation control encoder delay time.	31.25	us	UInt16	Real time	Real time
H08.81	2008–52h	Anti-resonance frequency of dual-inertia model	1.0 to 400.0	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	Reso nance frequency of dual-inertia model	0.0 to 6553.5	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 feedfor ward 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 feedfor ward 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 Parameter Group H09

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H09.00	2009–01h	Auto-tuning 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H09.02	2009–03h	Adaptive notch mode	0: The adaptive notches are no longer updated 1: An adaptive notch is active (Group 3 notches) 2: Two adaptive notches are active (Group 3 and Group 4 notches) 3: Only test the resonance point shown in H09.24 4: Clear the adaptive notches, restore the value of group 3 and group 4 notches to their default settings	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 to 1000	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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H09.07	2009–08h	Time constant for accelerating to max. speed during inertia auto-tuning	20 to 800	Set the time for the motor to accelerate from 0 RPM to the maximum speed for inertia auto-tuning (H09.06) in offline inertia auto-tuning.	125	ms	UInt16	At stop	Real time
H09.08	2009–09h	Interval time after an individual inertia auto-tuning	50 to 10000	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%	Defines the warning threshold for current feedback vibration.	5.0	%	UInt16	Real time	Real time
H09.12	2009–0Dh	Frequency of the 1st notch	50 to 8000	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 to 8000	-	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 to 8000	-	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 to 8000	-	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 to 5000	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H09.37	2009–26h	Vibration monitor ing 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 to 8000	-	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 suppres sion 2 at mechani cal 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	Respon siveness of low-frequency resonance suppres sion 2 at mechani cal 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H09.57	2009–3Ah	STune resonance suppres sion switch over frequency	0 to 4000	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 suppres sion 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 to 8000	-	15	Hz	UInt16	Real time	Real time
H09.72	2009–49h	Ending frequency	0 to 8000	-	4000	Hz	UInt16	Real time	Real time
H09.73	2009–4Ah	Frequency subdivi sion	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 to 8000	-	500	Hz	UInt16	Real time	Real time
H09.76	2009–4Dh	Frequency subdivi sion 2	0 to 1000	-	500	-	UInt16	Real time	Real time
H09.77	2009–4Eh	Biquard1 mode	0: Disable 1: First-order low-pass 2: Second-order low-pass 4: Lead-lag 5: User-defined	Setting the Itune mode 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 to 8000	-	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H09.80	2009–51h	Biquard1 dominator frequency	0 to 8000	-	8000	Hz	UInt16	Real time	Real time
H09.81	2009–52h	Biquard1 dominator damping coefficient	0.100 to 10.000	-	0.707	-	UInt16	Real time	Real time

16.11 Parameter Group H0A

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 1: Enable 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	50–300	It determines the motor overload duration before E620.0 is detected. 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	0 to 20000	Defines the overspeed threshold of the motor.	0	rpm	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 the value, the servo drive detects EB00.0.	21989 5608	-	UInt32	Real time	Real time
H0A.12	200A-0Dh	Runaway protec tion	0: Disable 1: Enable	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-tempera ture threshold	120°C to 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 to 6.30	Defines the filter time of touch probe 1. An active input must last for the time defined by H0A.19.	2.00	us	UInt16	Real time	Real time
H0A.20	200A-15h	Filter time constant of touch probe 2	0.00 to 6.30	Defines the filter time of touch probe 2. An active input must last for the time defined by H0A.20.	2.00	us	UInt16	Real time	Real time
H0A.22	200A-17h	Sigma_ Delta filter time	0 to 65535	-	1	-	UInt16	At stop	Next power-on
H0A.23	200A-18h	TZ signal filter time	0 to 31	-	15	25 ns	UInt16	At stop	Next power-on
H0A.25	200A-1Ah	Speed display DO low-pass filter time	0 to 5000	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0A.27	200A-1Ch	Average filter time for speed display DO	0 to 100	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 to 255	-	15	25 ns	UInt16	At stop	Next power-on
H0A.32	200A-21h	Time threshold for motor stall overtem perature protec tion	10 to 65535	Defines the overtemperature duration before E630.0 (Motor stall) is detected by the servo drive. You can adjust the overtemperature detection sensitivity through changing the value of H0A.32.	200	ms	UInt16	Real time	Real time
H0A.33	200A-22h	Stall overtem perature protec tion	0: Disabled 1: Enabled	Defines whether to enable the detection for E630.0 (Motor stall overtemperature protection).	1	-	UInt16	Real time	Real time
H0A.35	200A-24h	Reading ROM upon power-on (for third-party encoder)	0: Enabled 1: Disabled	When this parameter is set to 0, motor parameters can be read from the encoder. When this parameter is set to 1, the motor parameters must be read from the drive.	0	-	UInt16	Real time	Next power-on
H0A.36	200A-25h	Encoder multi-turn overflow fault selection	0: Not hide 1: Hide	When H02.01 is set to 1 and the multi-turn overflow fault need not be detected, set H0A.36 to 1 to hide this fault.	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0A.40	200A-29h	Compen sation function selection	bit0: Overtravel compensation 0: Enabled 1: Disabled bit1: Touch probe rising edge compensation 0: Disabled 1: Enabled bit 2: 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 overtravel) and stops accordingly.	21474 83647	En coder 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 E952.0 (Reverse overtravel) and stops accordingly.	-2147 48364 8	En coder unit	Int32	At stop	Real time
H0A.46	200A-2Fh	Reso nance alarm threshold	0.0 to 100.0	Used to set the resonance alarm threshold	30.0	-	UInt16	Real time	Real time
H0A.49	200A-32h	Braking resistor overtem perature threshold	100°C to 175°C	Defines the temperature threshold for braking resistor overload.	115	°C	UInt16	Real time	Real time
H0A.50	200A-33h	Encoder communi cation 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	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0A.52	200A-35h	Encoder tempera ture protection threshold	0 to 175	Defines the temperature threshold for encoder overtemperature protection.	125	deg	UInt16	Real time	Real time
H0A.53	200A-36h	Probe DI ON compensa tion time	-3000 to +3000	Used to compensate for the action time when the touch probe is switched on. Example: If this parameter is set to the maximum value 3000 (unit: 25 ns), the maximum time will be 3000 x 25 = 75,000 ns.	200	25 ns	Int16	Real time	Real time
H0A.54	200A-37h	Probe DI OFF compensa tion time	-3000 to +3000	Used to compensate for the action time when the touch probe is switched off. Example: If this parameter is set to the maximum value 3000 (unit: 25 ns), the maximum time will be 3000 x 25 = 75,000 ns.	1512	25 ns	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 to 60000	-	10000	ms	UInt16	Real time	Real time
H0A.57	200A-3Ah	Runaway speed threshold	1 to 1000	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 to 100.0	Defines the speed feedback filter time for runaway protection detection.	2.0	ms	UInt16	Real time	Next power-on
H0A.59	200A-3Ch	Runaway protection detection time	10 to 1000	The runaway fault will be reported when the runaway state 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: Disable 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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	0 to 20000	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: 0: New overload curve 1: Old overload curve bit1: 0: Enable bleeder switch upon power failure 1: Hide bleeder switch upon power failure bit12: 0: Homing completion flag bit not saved upon power failure 1: Homing completion flag bit saved upon power failure	4098	-	UInt16	Real time	Real time
H0A.72	200A-49h	Maximum stop time in ramp-to-stop	0 to 65535	Defines the time for the motor to decelerate from the maximum speed to 0 during ramp-to-stop.	10000	ms	UInt16	At stop	Real time
H0A.73	200A-4Ah	STO 24 V disconnection filter time	1 to 5	Defines the delay from the moment when 24 V is disconnected to the moment when the STO state applies.	5	ms	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0A.74	200A-4Bh	Filter time for two inconsis tent STO channels	1 to 1000	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 to 25	Defines the delay from the moment the STO state is triggered to the moment the S-ON signal is switched off.	20	ms	UInt16	Real time	Real time
H0A.81	200A-52h	Enable voltage drop protec tion	0: No operation 1: Host controller executes torque limit 2: Servo executes torque limit	-	0	-	UInt16	At stop	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 to 1000	-	100	ms	UInt16	Real time	Real time
H0A.84	200A-55h	Instanta neous power failure holding time	20 to 50000	-	1000	ms	UInt16	Real time	Real time
H0A.85	200A-56h	Open circuit detection torque reference	4.0% to 400.0%	-	5.0	%	UInt16	At stop	Real time
H0A.86	200A-57h	Disconnec tion detection filter time	5 to 1000	-	30	ms	UInt16	At stop	Real time
H0A.87	200A-58h	U/V/W Hall state monitor ing window	0 to 1000	Defines the Hall signal filter time.	1	-	UInt16	Real time	Real time
H0A.88	200A-59h	BISSC data alarm enable	0 to 1	Used to enable original BiSSC data alarm function, which is only applicable to the encoder that adopts BiSSC protocol.	0	-	UInt16	At stop	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0A.89	200A-5Ah	Correct state of DDL BiSSC data	0 to 31	Defines the fault bit state during normal operation of BiSSC.	3	-	UInt16	At stop	Real time
H0A.90	200A-5Bh	Moving average filter time for displayed speed values	0 to 2	Defines the moving average filter time constant for displayed speed values.	0	ms	UInt16	At stop	Real time
H0A.91	200A-5Ch	Moving average filter time for displayed torque values	0 to 2	Defines the moving average filter time constant for displayed torque values.	0	ms	UInt16	At stop	Real time
H0A.92	200A-5Dh	Moving average filter time for displayed position values	0 to 2	Defines the moving average filter time constant for displayed position values.	0	ms	UInt16	At stop	Real time
H0A.93	200A-5Eh	Low-pass filter time for displayed voltage values	0 to 2	Defines the low-pass filter time constant for displayed position values.	0	ms	UInt16	Real time	Real time
H0A.94	200A-5Fh	Low-pass filter time for displayed thermal values	0 to 2	Defines the filter time constant for thermal display values.	0	ms	UInt16	Real time	Real time

16.12 Parameter Group H0C

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0C.00	200C-01h	Disconnection detection	0 to 3	-	0	-	UInt16	At stop	Real time
H0C.01	200C-02h	Disconnection detection gain	1.0 to 100.0	-	2.5	-	UInt16	Real time	Real time
H0C.02	200C-03h	Disconnection detection filter time	5 to 1000	-	30	-	UInt16	At stop	Real time
H0C.31	200C-20h	Drive overload protection mode	0: Overload curve 1: Junction temperature estimation	Used to switch the drive protection mode.	0	-	UInt16	At stop	At stop
H0C.32	200C-21h	PTC and KTY selection	0: Inhibited 1: PTC 2: KTY	Used to select motor PTC or KTY.	0	-	UInt16	At stop	At stop
H0C.33	200C-22h	PTC and KTY fault selection	0: Not hide 1: Hide	Used to hide motor PTC or KTY fault.	0	-	UInt16	Real time	Real time
H0C.34	200C-23h	KTY mode selection	0: KTY_84 1: KTY1000	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

16.13 Parameter Group H0b

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0b.00	200b-01h	Motor speed actual value	-32767 to +32767	It displays the actual speed of the servo motor after round-off, in unit of 1 rpm. Set in H0A.25 the filter time constant for H0b.00.	0	rpm	Int16	Unchangeable	-
H0b.01	200b-02h	Speed reference	-32767 to +32767	It displays the current speed reference of the drive in unit of 1 rpm in the position and speed control modes.	0	rpm	Int16	Unchangeable	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.02	200b-03h	Internal torque reference	-500.0% to +500.0%	It displays the current torque reference in unit of 0.1%. The value 100.0% corresponds to the rated motor torque.	0.0	%	Int16	Unchangea ble	-
H0b.03	200b-04h	Input (DI) signal monitor ing	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	Unchangea ble	-
H0b.05	200b-06h	Output (DO) signal monitor ing	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	Unchangea ble	-
H0b.07	200b-08h	Absolute position counter	-2147483648 to +2147483647	It displays the current motor absolute position in reference unit in the position control mode. This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.	0	p	Int32	Unchangea ble	-
H0b.09	200b-0Ah	Mechani cal angle	0.0° to 360.0°	Displays present mechanical angle in encoder unit of the motor. The setpoint 0 indicates the mechanical angle is 0°. Actual mechanical angle = 360° x H0b.09/ (Maximum value of H0b.09 + 1) Max. value of absolute encoder (H0b.09): 65535	0.0	°	UInt16	Unchangea ble	-
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 359.9°. Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle change from 0° to 359.9°.	0.0	°	UInt16	Unchangea ble	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.12	200b-0Dh	Average load ratio	0.0% to 800.0%	It displays the percentage of the average load torque relative to the rated motor torque, in unit of 0.1%. The value 100.0% corresponds to the rated motor torque.	0.0	%	UInt16	Unchangeable	-
H0b.15	200b-10h	Position following error (encoder unit)	-2147483648 to +2147483647	Used to count and display the position deviation value after being divided or multiplied by the electronic gear ratio in the position control mode. This parameter is a 32-bit integer, which is displayed as a decimal on the keypad. Note: H0B.15 can be cleared when the condition defined in H05.16 (Clear action) is met.	0	p	Int32	Unchangeable	-
H0b.17	200b-12h	Feedback pulse counter	-2147483648 to +2147483647	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 and 429496729.5s	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 to 655.35	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 to 6553.5	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 to +200	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	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.28	200b-1Dh	Absolute encoder fault information given by FPGA	0 to 65535	-	0	-	UInt16	Unchangeable	-
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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.34	200b-23h	Fault code of selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.35	200b-24h	Time stamp of the selected fault	0.0s and 429496729.5s	-	0.0	s	UInt32	Unchangea ble	-
H0b.37	200b-26h	Motor speed upon occur rence of the selected fault	-32767 to +32767	-	0	rpm	Int16	Unchangea ble	-
H0b.38	200b-27h	Motor phase U current upon occur rence of the selected fault	-3276.7 to +3276.7	-	0.0	A	Int16	Unchangea ble	-
H0b.39	200b-28h	Motor phase V current upon occur rence of the selected fault	-3276.7 to +3276.7	-	0.0	A	Int16	Unchangea ble	-
H0b.40	200b-29h	Bus voltage upon occur rence of the selected fault	0.0 to 6553.5	-	0.0	V	UInt16	Unchangea ble	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.41	200b-2Ah	Input terminal state upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.43	200b-2Ch	Output terminal status upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.45	200b-2Eh	Internal fault code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.46	200b-2Fh	Absolute encoder fault informa tion given by FPGA upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.47	200b-30h	System status informa tion given by FPGA upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.48	200b-31h	System fault informa tion given by FPGA upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.49	200b-32h	Encoder fault informa tion upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.51	200b-34h	Internal fault code upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.52	200b-35h	FPGA timeout fault standard bit upon occur rence of the selected fault	0 to 65535	-	0	-	UInt16	Unchangea ble	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.53	200b-36h	Position following error (reference unit)	-2147483648 to +2147483647	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	Unchangea ble	-
H0b.55	200b-38h	Motor speed actual value	-2147483648.0 to +2147483647.0	Displays the actual motor speed in unit of 0.1 rpm. This parameter is a 32-bit integer, which is displayed as a decimal on the keypad. H0A.25 defines the filter time for the speed feedback.	0.0	rpm	Int32	Unchangea ble	-
H0b.57	200b-3Ah	Control circuit bus voltage	0.0 to 6553.5	Displays the bus voltage of the control circuit.	0.0	V	UInt16	Unchangea ble	-
H0b.58	200b-3Bh	Mechani cal absolute position (low 32 bits)	-2147483648 to +2147483647	Displays the low 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.	0	p	Int32	Unchangea ble	-
H0b.60	200b-3Dh	Mechani cal absolute position (high 32 bits)	-2147483648 to +2147483647	Displays the high 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.	0	p	Int32	Unchangea ble	-
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	Unchangea ble	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.66	200b-43h	Encoder tempera ture	-32768 to +32767	-	0	deg	Int16	Unchangea ble	-
H0b.67	200b-44h	Load rate of braking resistor	0.0% to 200.0%	-	0.0	%	UInt16	Unchangea ble	-
H0b.70	200b-47h	Number of absolute encoder revolu tions	0 to 65535	Indicates the number of revolutions of the absolute encoder.	0	Rev	UInt16	Unchangea ble	-
H0b.71	200b-48h	Single-turn position fed back by the absolute encoder	0 to 2147483647	Displays the position feedback of the absolute encoder within one turn.	0	p	UInt32	Unchangea ble	-
H0b.74	200b-4Bh	System fault informa tion given by FPGA	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0b.77	200b-4Eh	Encoder position (low 32 bits)	-2147483648 to +2147483647	Displays the low 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangea ble	-
H0b.79	200b-50h	Encoder position (high 32 bits)	-2147483648 to +2147483647	Displays the high 32-bit value of the position feedback of the absolute encoder.	0	p	Int32	Unchangea ble	-
H0b.81	200b-52h	Single-turn position of the rotary load (low 32 bits)	-2147483648 to +2147483647	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	Unchangea ble	-
H0b.83	200b-54h	Single-turn position of the rotary load (high 32 bits)	-2147483648 to +2147483647	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	Unchangea ble	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0b.85	200b-56h	Single-turn position of the rotary load (reference unit)	-2147483648 to +2147483647	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.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 rotational speed	0.0 to 6553.5	-	0.0	-	Int16	Unchangeable	Real time
H0b.94	200b-5Fh	Individual power-on time	0.0s and 429496729.5s	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 and 429496729.5s	-	0.0	s	UInt32	Unchangeable	-
H0b.98	200b-63h	Fan level display	0s to 3s	-	0	s	UInt16	Unchangeable	-

16.14 Parameter Group H0d

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0d.00	200d-01h	Software reset	0: No operation 1: Enable	Programs in the drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.	0	-	UInt16	At stop	Real time
H0d.01	200d-02h	Fault reset	0: No operation 1: Enable	When a No. 1 or No. 2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause, stopping the keypad from displaying the fault and allowing the drive to enter the "rdy" state. When a No. 3 alarm occurs, you can enable the fault reset function directly, regardless of the servo drive status.	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 SET 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	Next power-on

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Used to enable forced DI/DO.	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). H0d.18 is displayed in hex on the keypad. In the converted binary value, bit(n) = 1 indicates that the DI is active high, and bit(n) = 0 indicates that the DI is active low.	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). H0d.19 is displayed in hex on the keypad. In the converted binary value, bit(n) = 1 indicates that the DO function is active, and bit(n) = 0 indicates that the DO function is inactive.	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	Set H0d.20 to determine whether to reset the encoder internal faults and encoder feedback multi-turn data.	0	-	UInt16	At stop	Real time
H0d.23	200d-18h	Torque fluctua tion auto-tuning	0 to 1	-	0	-	UInt16	At stop	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0d.25	200d-1Ah	Dead zone auto-tuning	0 to 65535	-	0	-	UInt16	At stop	Real time
H0d.26	200d-1Bh	Brake and dynamic braking started forcibly	0: Not forced 1: Dynamic brake deactivated forcibly 2: Brake released forcibly 3: Dynamic brake deactivated and released forcibly	-	0	-	UInt16	At stop	Real time

16.15 Parameter Group H0E

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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 communi cation 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

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 switchover: 0: Reference unit system (The speed type object dictionary unit is p/s, and the acceleration type object dictionary is p/s^2.) 1: User-defined 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	Selects group 6000 index (last 2 bits).	0 to 255	Sets the index.	255	-	UInt16	Real time	Real time
H0E.16	200E-11h	Selects 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	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	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Next power-on
H0E.32	200E-21h	EtherCAT synchronization error threshold	100 to 8000	-	3000	ns	UInt16	At stop	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0E.33	200E-22h	EtherCAT state machine status and port connec tion status	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0E.34	200E-23h	Number of excessive CSP position reference increment events	1 to 30	-	20	-	UInt16	Real time	Real time
H0E.35	200E-24h	AL fault code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H0E.36	200E-25h	EtherCAT enhanced link enable	0: Disabled 1: Enabled	-	0	-	UInt16	Real time	Next power-on
H0E.37	200E-26h	EtherCAT XML reset selection	0: Disabled 1: Enabled	-	0	-	UInt16	Real time	Next power-on
H0E.40	H0E-40	EOE enable	0:0-Disable 1:1-Enable	-	0	-	UInt16	Real time	Real time
H0E.41	H0E-41	Most significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.42	H0E-42	Second most significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.43	H0E-43	Second least significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.44	H0E-44	Least significant byte of EOE IP address	0 to 255	-	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0E.45	H0E-45	Most significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.46	H0E-46	Second most significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.47	H0E-47	Second least significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.48	H0E-48	Least significant byte of EOE subnet mask	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.49	H0E-49	Most significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.50	H0E-50	Second most significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.51	H0E-51	Second least significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H0E.52	H0E-52	Least significant byte of default EOE gateway	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.53	H0E-53	Most significant byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.54	H0E-54	2nd byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.55	H0E-55	3rd byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.56	H0E-56	4th byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.57	H0E-57	5th byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.58	H0E-58	Least significant byte of MAC used by EOE	0 to 255	-	0	-	UInt16	Unchangeable	-
H0E.60	H0E-60	Automatic Ethernet IP address identification	0:0-Disable 1:1-Enable	-	0	-	UInt16	Real time	Real time
H0E.61	H0E-61	Most significant byte of Ethernet IP address	0 to 255	-	192	-	UInt16	Real time	Real time
H0E.62	H0E-62	Second most significant byte of Ethernet IP address	0 to 255	-	168	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0E.63	H0E-63	Second least significant byte of Ethernet IP address	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.64	H0E-64	Least significant byte of Ethernet IP address	0 to 255	-	2	-	UInt16	Real time	Real time
H0E.65	H0E-65	Most significant byte of Ethernet subnet mask	0 to 255	-	255	-	UInt16	Real time	Real time
H0E.66	H0E-66	Second most significant byte of Ethernet subnet mask	0 to 255	-	255	-	UInt16	Real time	Real time
H0E.67	H0E-67	Second least significant byte of Ethernet subnet mask	0 to 255	-	255	-	UInt16	Real time	Real time
H0E.68	H0E-68	Least significant byte of Ethernet subnet mask	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.69	H0E-69	Most significant byte of default Ethernet gateway	0 to 255	-	192	-	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0E.70	H0E-70	Second most significant byte of default Ethernet gateway	0 to 255	-	168	-	UInt16	Real time	Real time
H0E.71	H0E-71	Second least significant byte of default Ethernet gateway	0 to 255	-	0	-	UInt16	Real time	Real time
H0E.72	H0E-72	Least significant byte of default Ethernet gateway	0 to 255	-	1	-	UInt16	Real time	Real time
H0E.80	200E-51h	Modbus baud rate	0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	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 to 20	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

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H0E.83	200E-54h	Modbus communi cation timeout	0 to 600	-	0	ms	UInt16	Real time	Real time
H0E.84	200E-55h	Sequence of Modbus communi cation 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	Unchangea ble	-
H0E.93	200E-5Eh	EtherCAT COE version	0.00 to 655.35	-	0.00	-	UInt16	Unchangea ble	-
H0E.96	200E-61h	XML version informa tion	0.00 to 655.35	-	0.00	-	UInt16	Unchangea ble	-

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	Default	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	Acceleration 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	Deceleration 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	Acceleration 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	Deceleration 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	Acceleration 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	Deceleration 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	Acceleration/ Deceleration 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	Acceleration/ Deceleration 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	Acceleration/ Deceleration 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	Acceleration/ Deceleration 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	Acceleration/ Deceleration 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	Accelera tion/ Decelera tion 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	Accelera tion/ Decelera tion 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	Accelera tion/ Decelera tion 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	Accelera tion/ Decelera tion 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	Acceleration/ Deceleration 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	Acceleration/ Deceleration 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 Parameter Group H21

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H21.00	2021–01h	Current loop gain switch over	0: No operation 1: Enabled	Used to enable or disable the current loop gain switchover function. 0: No operation, turned off 1: Enable, turned on	0	-	UInt16	Real time	Real time
H21.01	2021–02h	25% current reference gain coefficient	0.1% to 200.0%	0% to 25% current reference gain coefficient	100.0	%	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H21.02	2021–03h	50% current reference gain coefficient	0.1% to 200.0%	25% to 50% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.03	2021–04h	75% current reference gain coefficient	0.1% to 200.0%	50% to 75% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.04	2021–05h	100% current reference gain coefficient	0.1% to 200.0%	75% to 100% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.05	2021–06h	125% current reference gain coefficient	0.1% to 200.0%	100% to 125% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.06	2021–07h	150% current reference gain coefficient	0.1% to 200.0%	125% to 150% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.07	2021–08h	175% current reference gain coefficient	0.1% to 200.0%	150% to 175% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.08	2021–09h	200% current reference gain coefficient	0.1% to 200.0%	175% to 200% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.09	2021–0Ah	225% current reference gain coefficient	0.1% to 200.0%	200% to 225% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.10	2021–0Bh	250% current reference gain coefficient	0.1% to 200.0%	225% to 250% current reference gain coefficient	100.0	%	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H21.11	2021–0Ch	275% current reference gain coefficient	0.1% to 200.0%	250% to 275% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.12	2021–0Dh	300% current reference gain coefficient	0.1% to 200.0%	275% to 300% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.13	2021–0Eh	325% current reference gain coefficient	0.1% to 200.0%	300% to 325% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.14	2021–0Fh	350% current reference gain coefficient	0.1% to 200.0%	325% to 350% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.15	2021–10h	375% current reference gain coefficient	0.1% to 200.0%	350% to 375% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.16	2021–11h	400% current reference gain coefficient	0.1% to 200.0%	375% to 400% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.17	2021–12h	425% current reference gain coefficient	0.1% to 200.0%	400% to 425% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.18	2021–13h	450% current reference gain coefficient	0.1% to 200.0%	425% to 450% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.19	2021–14h	475% current reference gain coefficient	0.1% to 200.0%	450% to 475% current reference gain coefficient	100.0	%	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H21.20	2021–15h	500% current reference gain coefficient	0.1% to 200.0%	475% to 500% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.21	2021–16h	525% current reference gain coefficient	0.1% to 200.0%	500% to 525% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.22	2021–17h	550% current reference gain coefficient	0.1% to 200.0%	525% to 550% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.23	2021–18h	575% current reference gain coefficient	0.1% to 200.0%	550% to 575% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.24	2021–19h	600% current reference gain coefficient	0.1% to 200.0%	575% to 600% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.25	2021–1Ah	625% current reference gain coefficient	0.1% to 200.0%	600% to 625% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.26	2021–1Bh	650% current reference gain coefficient	0.1% to 200.0%	625% to 650% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.27	2021–1Ch	675% current reference gain coefficient	0.1% to 200.0%	650% to 675% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.28	2021–1Dh	700% current reference gain coefficient	0.1% to 200.0%	675% to 700% current reference gain coefficient	100.0	%	UInt16	Real time	Real time

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H21.29	2021–1Eh	725% current reference gain coefficient	0.1% to 200.0%	700% to 725% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.30	2021–1Fh	750% current reference gain coefficient	0.1% to 200.0%	725% to 750% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.31	2021–20h	775% current reference gain coefficient	0.1% to 200.0%	750% to 775% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H21.32	2021–21h	800% current reference gain coefficient	0.1% to 200.0%	775% to 800% current reference gain coefficient	100.0	%	UInt16	Real time	Real time
H12.25	2012–1Ah	Acceleration/ Deceleration time of speed 2	0: Zero acceleration/ deceleration time 1: Acceleration/ Deceleration time 1 2: Acceleration/ Deceleration time 2 3: Acceleration/ Deceleration time 3 4: Acceleration/ Deceleration time 4	Same as H12.22	0	-	UInt16	Real time	Real time

16.20 Parameter Group H30

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H30.00	2030–01h	Servo state read through 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 bit 2 corresponds to DO function 3 ... by analogy	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 bit 2 corresponds to DO function 19 ... by analogy	0	-	UInt16	Unchangeable	-
H30.16	2030–11h	Encoder communication timeout counting	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.17	2030–12h	Encoder communication CRC error counting	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.18	2030–13h	Encoder communication frame stop bit counting	0 to 65535	-	0	-	UInt16	Unchangeable	-
H30.20	2030–15h	ASCII code corresponding to bit 0 and bit 1 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangeable	-

Param.	Hex	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
H30.21	2030–16h	ASCII code corre sponding to bit 2 and bit3 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H30.22	2030–17h	ASCII code corre sponding to bit4 and bit5 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H30.23	2030–18h	ASCII code corre sponding to bit6 and bit7 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H30.24	2030–19h	ASCII code corre sponding to bit8 and bit9 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H30.25	2030–1Ah	ASCII code corre sponding to bit10 and bit11 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H30.26	2030–1Bh	ASCII code corre sponding to bit12 and bit13 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-
H30.27	2030–1Ch	ASCII code corre sponding to bit14 and bit15 of servo SN code	0 to 65535	-	0	-	UInt16	Unchangea ble	-

16.21 Parameter Group H31

Param.	Hex	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
H31.04	2031–05h	DO state set through communication	0 to 65535	Sets DO output status.	0	-	UInt16	Real time	Real time
H31.09	2031–0Ah	Speed reference set through communication	-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 communication	-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 Parameter Group 1000h

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
1000.00h	Device type	0 to 65535	-	0	-	UInt16	Unchangeable	-
1001.00h	Error register	0 to 255	-	0	-	UInt16	Unchangeable	-
1018.01h	Vendor ID	0 to 65535	-	0	-	UInt32	Unchangeable	-
1018.02h	Product code	0 to 65535	-	0	-	UInt32	Unchangeable	-
1018.03h	Revision	0 to 65535	-	0	-	UInt32	Unchangeable	-
1600.00h	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	-

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
1600.01h	RPDO1 mapping object 1	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: bit16...bit31: index bit8...bit15: sub-index bit0...bit7: object length	1614807040	-	UInt32	Real time	-
1600.02h	RPDO1 mapping object 2	0 to 2147483647	Same as 1600.01h.	1618608128	-	UInt32	Real time	-
1600.03h	RPDO1 mapping object 3	0 to 2147483647	Same as 1600.01h.	1622671360	-	UInt32	Real time	-
1600.04h	RPDO1 mapping object 4	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.05h	RPDO1 mapping object 5	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.06h	RPDO1 mapping object 6	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.07h	RPDO1 mapping object 7	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.08h	RPDO1 mapping object 8	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.09h	RPDO1 mapping object 9	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.0Ah	RPDO1 mapping object 10	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.0Bh	RPDO1 mapping object 11	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.0Ch	RPDO1 mapping object 12	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
1600.0D h	RPDO1 mapping object 13	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.0E h	RPDO1 mapping object 14	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.0F h	RPDO1 mapping object 15	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.10 h	RPDO1 mapping object 16	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.11 h	RPDO1 mapping object 17	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.12 h	RPDO1 mapping object 18	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.13 h	RPDO1 mapping object 19	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1600.14 h	RPDO1 mapping object 20	0 to 2147483647	Same as 1600.01h.	0	-	UInt32	Real time	-
1A00.00 h	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	-
1A00.01 h	TPDO1 mapping object 1	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: bit16...bit31: index bit8...bit15: sub-index bit0...bit7: object length	16148 72576	-	UInt32	Real time	-
1A00.02 h	TPDO1 mapping object 2	0 to 2147483647	Same as 1A00.01h.	16171 66336	-	UInt32	Real time	-
1A00.03 h	TPDO1 mapping object 3	0 to 2147483647	Same as 1A00.01h.	16227 36896	-	UInt32	Real time	-

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
1A00.04 h	TPDO1 mapping object 4	0 to 2147483647	Same as 1A00.01h.	1622802432	-	UInt32	Real time	-
1A00.05 h	TPDO1 mapping object 5	0 to 2147483647	Same as 1A00.01h.	1622933504	-	UInt32	Real time	-
1A00.06 h	TPDO1 mapping object 6	0 to 2147483647	Same as 1A00.01h.	1614741504	-	UInt32	Real time	-
1A00.07 h	TPDO1 mapping object 7	0 to 2147483647	Same as 1A00.01h.	1627193344	-	UInt32	Real time	-
1A00.08 h	TPDO1 mapping object 8	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.09 h	TPDO1 mapping object 9	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.0A h	TPDO1 mapping object 10	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.0B h	TPDO1 mapping object 11	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.0C h	TPDO1 mapping object 12	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.0D h	TPDO1 mapping object 13	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.0E h	TPDO1 mapping object 14	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.0F h	TPDO1 mapping object 15	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.10 h	TPDO1 mapping object 16	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.11 h	TPDO1 mapping object 17	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.12 h	TPDO1 mapping object 18	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
1A00.13 h	TPDO1 mapping object 19	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1A00.14 h	TPDO1 mapping object 20	0 to 2147483647	Same as 1A00.01h.	0	-	UInt32	Real time	-
1C12.00 h	Number of assigned PDOs	0 to 2	-	1	-	UInt8	Real time	-
1C12.01 h	PDO mapping object index of assigned RxPDO1	5632 to 5898	-	0	-	UInt16	Real time	-
1C12.02 h	PDO mapping object index of assigned RxPDO2	5632 to 5898	-	5632	-	UInt16	Real time	-
1C13.00 h	Number of assigned PDOs	0 to 2	-	5632	-	UInt8	Real time	-
1C13.01 h	PDO mapping object index of assigned TxPDO1	6656 to 6922	-	0	-	UInt16	Real time	-
1C13.02 h	PDO mapping object index of assigned TxPDO1	6656 to 6922	-	6656	-	UInt16	Real time	-
1C32.01 h	Sync mode	0 to 65535	-	6656	-	UInt16	Real time	-
1C32.02 h	Cycle time	0 to 4294967295	-	0	-	UInt32	Real time	-
1C32.04 h	Sync modes supported	0 to 65535	-	0	-	UInt16	Real time	-
1C32.05 h	Minimum cycle time	0 to 4294967295	-	0	-	UInt32	Real time	-
1C33.01 h	Sync mode	0 to 65535	-	0	-	UInt16	Real time	-

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
1C33.02h	Cycle time	0 to 4294967295	-	0	-	UInt32	Real 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 Parameter Group 6000h

Note

Axis 2 object dictionary requires +0x800 offset.

Example: Axis 2 error code object dictionary: 603Fh+0x800h=683Fh

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
603Fh	Error code	0 to 65535	When an error described in the DSP402 profile occurs on the servo drive, 603Fh is as described in DSP402. When an error not specified by the DS402 protocol occurs on the servo drive, 603Fh is 0xFF00. The value of 603Fh is in hexadecimal. In addition, the object dictionary 203Fh displays auxiliary bytes of fault codes in hexadecimal. 203Fh is a UInt32 value, in which the high 16 bits indicate the internal fault code of the manufacturer, and the low 16 bits indicate the external fault code of the manufacturer.	0	-	UInt16	Unchangeable	-
6040h	Control word	0 to 65535	See section "Basic Functions of the Servo Drive" for the description of the control word.	0	-	UInt16	Real time	Real time
6041h	Status word	0 to 65535	See section "Basic Functions of the Servo Drive" for the description of the control word.	0	-	UInt16	Unchangeable	-

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	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

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
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	Used to select the operation mode of the drive:1 : Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: CSP mode 9: CSV mode 10: CST mode Others: N/A If an operation mode not supported is selected through SDO, an SDO error can be returned. If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.	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	Indicates the actual operation mode of the drive: 1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: CSP mode 9: CSV mode 10: CST mode	0	-	UInt16	Unchangea ble	-
6062h models	Position reference	-2147483648 to +2147483647	The baud rate set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.	0	Refer ence unit	Int32	Unchangea ble	-
6063h models	Position actual value	-2147483648 to +2147483647	Indicates the absolute position feedback (encoder unit) of the motor in real time.	0	Pulse	Int32	Unchangea ble	-
6064h models	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	Refer ence unit	Int32	Unchangea ble	-
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	Refer ence unit	UInt32	Real time	Real time

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
6066h	Defines the time lapse to trigger excessive position deviation (EB00.0).	0 to 65535	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 servo drive considers that the position is reached, and sets bit10 of status word 6041h to 1 in profile position mode. This flag bit is valid only when the S-ON signal is valid in profile position control mode.	46976	Reference unit	UInt32	Real time	Real time
6068h	Position window time	0 to 65535	Defines the window time for position reach, which is 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 to 65535	Defines the threshold for speed reach. If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches the value defined by 606Eh, the speed is reached. In this case, bit 10 of the status word 6041h is set to 1 in the profile velocity mode. This flag bit is meaningful only when the servo drive is enabled in PV mode.	10	rpm	UInt16	Real time	Real time
606Eh	Velocity window time	0 to 65535	Defines the time window for speed reach, which is used together with 606Dh.	0	ms	UInt16	Real time	Real time
606Fh	Zero speed signal threshold	0 to 65535	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 to 65535	Defines the time window for determining whether the user velocity is 0, which is used together with 606Fh.	0	ms	UInt16	Real time	Real time

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 models	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 models	Target position	-2147483648 to +2147483647	Defines the target position of the servo drive in the profile position mode. bit6 of 6040h = 0: 607Ah indicates the absolute target position of current segment. When current segment is done positioning, the absolute position in user-defined unit (6064h) is equal to 607Ah. bit6 of 6040h = 1: 607Ah indicates the incremental target displacement of current segment. When current segment is done positioning, the incremental displacement in user-defined unit is equal to 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 is activated only after homing is done upon power-on and bit15 of 6041h is set to 1. After homing is done, current position in user-defined unit (6064h) is equal to 607Ch. If 607Ch is outside the value of 607Dh (Software position limit), EE09.1 occurs (Home offset setting error).	0	Reference unit	Int32	Real time	At stop

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
607D.01 h	Min. position limit	-2147483648 to +2147483647	Defines the minimum software position limit relative to the mechanical zero point. Min. software absolute position limit = (607D.01h) The software position limit is used to judge the absolute position. When homing is not performed, the internal software position limit is invalid. The condition for activating the software position limit is set in H0A.01 (object dictionary 0x200A.02h).	-21474 83648	Refer ence unit	Int32	Real time	Real time
607D.02 h	Max. position limit	-2147483648 to +2147483647	Defines the maximum software position limit relative to the mechanical zero. Maximum software absolute position limit = (607D.02h)	21474 83647	Refer ence 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 bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode. When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.	0	-	UInt16	Real time	Real time
607Fh	Maximum speed	0 to 4294967295	Defines the maximum speed in user-defined unit. Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 rpm.	42949 67295	Refer ence 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.	11184 8106	Refer ence unit/s	UInt32	Real time	Real time

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
6083h	Profile accelera tion	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 23-bit motor 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).	42949 67295	Refer ence unit/ s^2	UInt32	Real time	Real time
6084h	Profile decelera tion	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 23-bit motor 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).	42949 67295	Refer ence unit/ s^2	UInt32	Real time	Real time
6085h	Quick stop decelera tion	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.	21474 83647	Refer ence 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 profile torque mode, if 605Ah (Quick stop option code) = 1/2/5/6 or 605Dh (Halt option code) = 1/2, the servo drive decelerates to stop as defined by 6087h. If the value exceeds the torque reference limit, the servo drive runs at the limit.	42949 67295	0.1%/ s	UInt32	Real time	Real time

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
6091.01 h	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 x Gear ratio Relation between motor speed (rpm) and load shaft speed (reference unit/s): Motor speed (rpm) = Load shaft speed x 6091h x 60/Motor encoder resolution Relation between motor acceleration (rpm/ms) and load shaft acceleration (reference unit/s^2): Motor acceleration (rpm/ms) = Load shaft acceleration x 6091h x 1000/Motor encoder resolution/ 60	1	-	UInt32	At stop	Real time
6091.02 h	Shaft resolution	1 to 4294967295	Defines the denominator of the gear ratio.	1	-	UInt32	At stop	Real time

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
6098h	Homing method	-2 to +35	Defines the homing method: -2: Forward, positive mechanical limit as deceleration point and Z signal as home. -1: Reverse, negative mechanical limit as deceleration point and Z signal as home 1: Reverse, negative limit switch as deceleration point and Z signal as home, falling edge of the negative limit switch signal must be reached before Z signal. 2: Forward, positive limit switch as deceleration point and Z signal as home, falling edge of positive limit switch signal must be reached before Z signal. 3: Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal. 4: Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal. 5: Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal. 6: Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal. 7: Forward, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal. 8: Forward, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal. 9: Forward, home switch as deceleration point and Z signal as home, rising edge on the other side of the home switch signal must be reached before Z signal. 10: Forward, home switch as deceleration point and Z signal as home, falling edge on the other side of the home switch signal must be reached before Z signal. 11: Reverse, home switch as deceleration point and Z signal as home, falling edge on the same side of the home switch signal must be reached before Z signal. 12: Reverse, home switch as deceleration point and Z signal as home, rising edge on the same side of the home switch signal must be reached before Z signal. 13: Reverse, home switch as	1	-	Int16	Real time	Real time

Param.	Name	Setpoint	Description	Default	Unit	Data type	Change method	Effective mode
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 the homing timeout fault.	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. Setting this speed to a low value prevents overshoot during stop at high speed, avoiding excessive deviation between the stop position and the set mechanical home.	11184810	Reference unit/s	UInt32	At stop	Real time
609Ah	Homing acceleration	0 to 4294967295	It sets the acceleration during the homing operation.	4294967295	Reference unit/s^2	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 description of 60B8h, see *"Table 16–1 Description of 60B8h" on page 496*.	0	-	UInt16	Real time	Real time
60B9h	Touch probe status	0 to 65535	For description of 60B9h, see *"Table 16–2 Description of 60B9h" on page 497*.	0	-	UInt16	Unchangeable	-
60BAh models	Touch probe 1 positive edge	-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 models	Touch probe 1 negative edge	-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 models	Touch probe 2 positive edge	-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 models	Touch probe 2 negative edge	-2147483648 to +2147483647	Indicates the position feedback value (reference unit) latched at negative edge of touch probe 2 signal.	0	Reference unit	Int32	Unchangeable	-

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
60C5h	Max. accelera tion	0 to 4294967295	Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.	42949 67295	Refer ence unit/ s^2	UInt32	Real time	Real time
60C6h	Max. decelera tion	0 to 4294967295	Defines the maximum permissible deceleration in the profile position mode, profile velocity mode, and homing mode.	42949 67295	Refer ence 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	Unchangea ble	-
60D6h models	Touch probe 1 negative edge counter	0 to 65535	The counting value is added by "1" each time this object is triggered.	0	-	UInt16	Unchangea ble	-
60D7h models	Touch probe 2 positive edge counter	0 to 65535	The counting value is added by "2" each time this object is triggered.	0	-	UInt16	Unchangea ble	-
60D8h models	Touch probe 2 negative edge counter	0 to 65535	The counting value is added by "2" each time this object is triggered.	0	-	UInt16	Unchangea ble	-
60E0h	Positive torque limit	0 to 5000	Defines the maximum positive torque.	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	Refer ence unit	Int32	Unchangea ble	-
60FCh models	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	Unchangea ble	-

Param.	Name	Setpoint	Description	De fault	Unit	Data type	Change method	Effective mode
60FDh models	DI State	0 to 4294967295	Indicates the current DI terminal logic of the drive. 0: Inactive 1: Active The DI signal indicated by each bit is described 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 active22: 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	Unchangea ble	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	Refer ence unit/s	Int32	Real time	Real time
60FE.01 h	Physical output	0 to 4294967295	Indicates the DO logic. Signals indicated by each bit is as follows: Description of bit-related signals 0–15: N/A 16: DO1 forced output (0: OFF, 1: ON) When bit 16 of 60FE.02 = 1 17: DO2 forced output (0: OFF, 1: ON) When bit 17 of 60FE.02 = 1 18–25: N/A 26: P/PI switchover applied for gain switchover When bit 26 of 60FE.02 = 1 27–31: N/A	0	-	UInt32	Real time	Real time
60FE.02 h	Bitmask	0 to 4294967295	0 to 15: N/A 16: Forced DO1 output enable 17: Forced DO2 output enable 18–25: N/A 26: P/PI switchover enable 27–31: N/A	0	-	UInt32	Real time	Real time

Table 16–1 Description 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 Description of 60B9h

bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	Bit0 to bit 2: Status of probe 1
1	Touch probe 1 positive edge value 0: No positive edge value latched 1: Edge value latched	
2	Touch probe 1 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
3 to 5	N/A	-
6 to 7	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: Status of probe 2
9	Touch probe 2 positive edge value 0: No positive edge value latched 1: Edge value latched	
10	Touch probe 2 negative edge value 0: No negative edge value latched 1: Negative edge value latched	
11 to 13	N/A	-
14 to 15	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 Levels

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

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

Note

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

Fault and warning log

The servo drive can record the latest 20 faults and warnings and values of status parameters upon fault/warning. Among the latest 5 faults/warnings, if a fault/warning occurs repetitively, the servo drive records the fault/warning code and the drive status only once.

A fault/warning will still be saved in the fault log after reset. To remove the fault/warning from the fault log, set H02.31 to 1.

Read the value of H0b.34 to get the fault/warning code. See examples in the following table.

H0b.34 (Hexadecimal)	Description
0101	0: Fault subcode 101: Fault code

17.2 Fault Reset

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

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

Note

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

Operating procedure:

- To stop the keypad from displaying the fault/warning, set H0d.01 (Fault reset) to 1 or activate the DI terminal assigned with DI function 2 (FunIN.2: ALM- RST, fault and warning 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 warnings, 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 powered on again), 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 Symptom	Cause	Check method
FunIN.2	ALM-RST	Fault/Warning reset signal	The servo drive may, depending on the warning types, continue running after warning reset. When FunIN.2 is assigned to a low-speed DI, the effective level change of this DI must be kept for more than 3 ms. Otherwise, fault reset will be inactive. Do not assign FunIN.2 to a high-speed DI. Otherwise, fault/warning reset will be inactive. • Inactive: Not resetting the fault/warning • Active: Resetting the fault/warning

17.3 Alarm Codes

- E108.0: Parameter write error

  Cause:

  Parameter values cannot be written to EEPROM.

Cause	Troubleshooting	Measure
Parameter-write error	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

  Cause:

  Parameter values cannot be read from EEPROM.

Cause	Troubleshooting	Measure
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

  Cause:

  The check on the data written in EEPROM failed.

Cause	Troubleshooting	Measure
Parameter-write error	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
  Cause:

  The check on the data read in EEPROM failed.

Cause	Troubleshooting	Measure
An error occurs during parameter-reading.	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
  Cause:

  Single data is stored too frequently.

Cause	Troubleshooting	Measure
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. This channel displays the address that EEPROM is storing. 3 Check the number of storage events through "Func Test 2" in the oscilloscope.	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

Cause	Troubleshooting	Measure
The number of frequency divisions (quadrupled) exceeds the motor resolution.	Check the value of H05.17.	Adjust the value of H05.17 based on the motor resolution.

- E120.3: The motor and drive do not match in the power
  Cause:

  the motor and drive do not match in the rated power.

Cause	Troubleshooting	Measure
the motor and drive do not match in the rated power.	Check the rated motor voltage and current (H00.09, H00.11) and rated drive power (H01.10, H01.16).	• Replace the motor or drive. • If the motor and drive can work properly in spite of the mismatch, set bit4 of H0A.71 to 1 to shield the alarm.

- E121.0: Duplicate S-ON command
  Cause:

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

Cause	Troubleshooting	Measure
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 (200D-03h, 200D-04h, 200D-0Ch) are used.	Switch off the S-ON signal sent from the host controller.

- E122.0: Multi-turn absolute encoder setting error

  Cause:

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

Cause	Troubleshooting	Measure
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 replace with a matching motor.

- E122.6: Absolute function setting fault of the 2nd encoder

  Cause:

  The motor does not match the absolute mode.

Cause	Troubleshooting	Measure
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 (Incremental mode).

- E510.0: Frequency division output overspeed

  Cause:

  The single-channel output pulse frequency exceeds the frequency upper limit allowed by the hardware (4 MHz) when pulse output is used (H05.38 = 0/1/2).

Cause	Troubleshooting	Measure
The MCU detects excessive pulse increment fed back by FPGA.	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	Decrease the value of H05.17 (encoder frequency-division pulses) to allow the output pulse frequency, within the speed range required by the machine, to drop below the frequency upper limit allowed by the hardware.
	The input pulse frequency exceeds 2 MHz or interference exists in the pulse input pins when H05.38 is set to 1 (Reference pulse synchronous output). • High-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.	Decrease the input pulse frequency to a value within the frequency upper limit allowed by hardware. **Note:** In this case, if you do not modify the electronic gear ratio, the motor speed will 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 warnings caused by interference pulses superimposed to actual pulse references.

- E600.0: Inertia auto-tuning failure
  Cause:

  Vibration cannot be suppressed. You can set notch parameters (H09.12...H09.23) manually to suppress vibration.

  The auto-tuned values fluctuate dramatically. Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation.

  Mechanical couplings of the load are loose or 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.

Cause	Troubleshooting	Measure
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 a large inertia. In this case, increase the acceleration/deceleration time first to ensure the motor current is unsaturated.	Perform internal inspection to check whether the torque jitters upon stop (not FFT).	1 Rectify the fault and perform inertia auto-tuning again. 2 For vibration that cannot be suppressed, enable vibration suppression. 3 Ensure mechanical couplings are connected securely. 4 Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation.

- E601.0: Homing warning

  Cause:

Cause	Troubleshooting	Measure
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 assigned to a certain DI in group 2003h 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 is too low, resulting in a long homing process.	Increase the value of 6099.01h.

- E601.1: Homing switch error

  Cause:

  The homing switch is set improperly.

Cause	Troubleshooting	Measure
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 method setting error

Cause:

The homing method value is too large.

Cause	Troubleshooting	Measure
The homing method value is too large.	Check the homing method value (object dictionary 6098h).	Adjust the value of 6098h.

- E631.4: P-Mos short-circuited
  Description:

  The brake circuit is faulty.

Cause	Troubleshooting	Solution
When braking is used, the P-MOS short circuit occurred on the brake circuit.	Ensure the brake cable is connected, check if the fault persists after the servo drive is powered off and on again.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

- E631.5: N-Mos short-circuited
  Description:

  The brake circuit is faulty.

Cause	Troubleshooting	Solution
When braking is used, the N-MOS short circuit occurred on the brake circuit.	Ensure the brake cable is connected, check if the fault persists after the servo drive is powered off and on again.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

- E730.0: Encoder battery warning
  Cause:

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

Cause	Troubleshooting	Measure
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.

Note

E731.0 and E733.0 can trigger E730.0. See E731.0 and E733.0 for other solutions.

- E730.1: Inovance 2nd encoder battery voltage low
  Cause:

  Inovance 2nd encoder battery voltage is lower than 3.0 V.

Cause	Troubleshooting	Measure
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
  Cause:

  The logic of the DI terminal (including the hardware DI and virtual DI) assigned with DI function 34 (FunIN.34: EmergencyStop) is valid.

Cause	Troubleshooting	Measure
The DI function 34 (EmergencyStop) is triggered.	Check whether the logic of the DI assigned 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
  Cause:

  DI function parameters are set to invalid values.

Cause	Troubleshooting	Measure
DO (DI1 and DI5) function parameters are set to invalid values.	Check whether H03.02, H03.04, H03.06, H03.08, and H03.10 are set to invalid values.	Set DI function parameters to valid values.

- E902.1: Invalid DO setting
  Cause:

  DO function parameters are set to invalid values.

Cause	Troubleshooting	Measure
DO (DO1 and DO2) function parameters are set to invalid values.	Check whether H04.00 and H04.02 are set to invalid values.	Set DO function parameters to valid values.

- E902.2: Invalid setting for torque reach
  Cause:

  The DO parameters set for torque reach in the torque control mode are invalid.

Cause	Troubleshooting	Measure
The DO parameters set for torque reach in the torque control mode are invalid.	Check whether the value of H07.22 is lower than or equal to the value of H07.23 (unit: 0.1%).	Set H07.22 to a value higher than that of H07.23.

- E908.0: Model identification failure

Cause	Troubleshooting	Measure
1. The model identification check word store in EEPROM is incorrect.	1. Check whether the warning persists after restart.	Set H01.72 to 1 to disable model identification temporarily.
2. The model parameters are not written in the drive before delivery.	2. Check whether parameters can be saved to EEPROM.	

- E909.0: Motor overload warning
  Cause:

  The accumulative heat of the motor reaches the alarm threshold (90% of the maximum allowable heat).

Cause	Troubleshooting	Measure
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 the cables according to the wiring diagram. It is recommended to use the cables provided by Inovance. When customized cables are used, prepare and connect the customized cables according to the wiring instructions.
2. The load is so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load rate (H0b.12) keeps exceeding 100.0%.	Use a servo drive of higher capacity and a matching servo motor. Reduce the load and increase the acceleration/deceleration time.
3. Acceleration/Deceleration is too frequent or the load inertia is too large.	Check the mechanical inertia ratio or perform inertia auto-tuning. View the value of H08.15 (Load moment of inertia ratio). Confirm the individual operation cycle when the servo motor operates cyclically.	Increase the acceleration/ deceleration time.
4. 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 drive model (H01.10) and motor model based on *"Model and Nameplate" on page 21*.
6. The motor is stalled due to mechanical factors, resulting in overload during operation.	Check the running reference and motor speed (H0b.00) through Inovance servo commissioning software 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 or is very large but the motor speed is 0 RPM 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 sensor short-circuited

  Cause:

  The KTY sensor is short-circuited.

Cause	Troubleshooting	Measure
The KTY sensor is short-circuited.	Check whether both ends of the KTY sensor are short-circuited.	Replace the KTY sensor.

- E910.0: Control circuit overvoltage

Cause	Troubleshooting	Measure
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: 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.

Cause	Troubleshooting	Solution
1. The external braking resistor is connected improperly or disconnected.	Remove the external braking resistor and measure whether its resistance is "∞" (infinite). Measure whether the resistance between terminals P⊕ and C is "∞" (infinite).	Replace with a new external braking resistor. After confirming the resistance measured is the same as the nominal value, connect it between terminals P⊕ and C.
		Connect the external braking resistor between terminals P⊕ and C with a proper cable.
2. The jumper between terminals P⊕ and D is shorted or disconnected when the built-in braking resistor is used.	Measure whether the resistance between terminals P⊕ and D is "∞" (infinite).	Ensure terminals P⊕ and D are jumpered.
3. H02.25 (braking resistor type) is set improperly when an external braking resistor is used.	• Check the setpoint of H02.25. • Measure the resistance of the external braking resistor connected between P⊕ and C. Check whether the resistance measured is too large by comparing it with the value listed in Table "Specifications of the braking resistor". • Check whether the value of H02.27 is larger than the resistance of the external braking resistor connected between terminals P⊕ and C.	Set H02.25 correctly. H02.25 = 1 (external, naturally ventilated) H02.25 = 2 (external, forced-air cooling)
4. The resistance of the external braking resistor is too large.		Select a proper braking resistor according to section "Specifications of the Braking Resistor".
5. The setpoint of H02.27 (Resistance of external braking resistor) is higher than the resistance of the external braking resistor used.		Set H02.27 according to the resistance of the external braking resistor used.

Cause	Troubleshooting	Solution
6. The input voltage of the main circuit is beyond the specified range.	Check whether the input voltage of the main circuit cable on the drive side is within the following range: • 220 V servo drive:• Value range: 220 V to 240 V• Allowable deviation: –10% to +10% (198 V to 264 V) • 380 V servo drive: • Effective value: 380 V to 440 V• Allowable deviation: –10% to +10% (342 V to 484 V)	Replace or adjust the power supply according to the specified range.
7. The load moment of inertia ratio is too large.	Perform moment of inertia auto-tuning or calculate the total mechanical inertia according to mechanical parameters. Check whether the actual load inertia ratio exceeds 30.	• Select an external braking resistor with large capacity and set H02-26 to a value consistent with the actual power. • Select a larger servo drive. • Reduce the load if allowed. • Increase the acceleration/deceleration time if allowed. • Increase the motor operation cycle if allowed.
8. The motor speed is excessively high and deceleration is not done within the set time. The motor is in the continuous deceleration status during cyclic operation.	View the motor speed curve in cycle running and check whether the motor is in deceleration status for a long period.	
9. The capacity of the servo drive or the braking resistor is insufficient.	View the motor's single cycle speed curve and calculate whether maximum braking energy can be absorbed completely.	
10. The servo drive is faulty.	-	Replace the servo drive.

- E921.0: Dynamic brake resistor overload warning
  Description:

  The dynamic braking resistor is close to overload.

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 is higher than or equal to 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).

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 resistance allowed by the servo drive.	Measure whether the resistance of the external braking resistor between terminals P⊕ and C is lower than the value of H02.21 (Permissible minimum resistance of braking resistor).	• If yes, replace with an external braking resistor that matches the servo drive, then set H02.27 according to the resistance of the resistor used. Finally, connect the new resistor between P⊕ and C. • If not, set H02.27 to a value consistent with the resistance of the external braking resistor used.

- E924.0: Braking transistor overtemperature
  Description:

  The estimated temperature of the braking transistor is higher than H0A.18 (IGBT overtemperature threshold).

Cause	Troubleshooting	Solution
1. The junction temperature of the braking transistor is too high. 2. The braking transistor will be turned off automatically after overload occurs.	The braking transistor temperature exceeds the threshold defined by H0A.49.	Control the working conditions and usage of the braking transistor.

- E941.0: Parameter modifications activated at next power-on
  Cause:

  The parameters modified are those whose "Effective time" is "Next power-on".

Cause	Troubleshooting	Measure
The parameters modified are those whose "Effective time" is "Next power-on".	Check whether parameters you modified are those whose "Effective Time" is "Next power-on".	Power off and on the servo drive again.

- E942.0: Parameter saved frequently
  Cause:

  The number of parameters modified at a time exceeds 200.

Cause	Troubleshooting	Measure
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 warning
  Cause:

  The logic of the DI terminal assigned with DI function 14 (FunIN.14: P-OT, positive limit switch) is valid.

Cause	Troubleshooting	Measure
1. The logic of the DI assigned with FunIN.14: P-OT (Positive limit switch) is valid.	• 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

  Cause:

  The logic of the DI terminal assigned with DI function 15 (FunIN.15: N-OT, negative limit switch) is valid.

Cause	Troubleshooting	Measure
1. The logic of the DI assigned with FunIN.15: P-OT (Negative limit switch) is valid.	• 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.

- E971.0: Undervoltage warning for voltage drop protection

Cause	Troubleshooting	Measure
The bus voltage is lower than the undervoltage threshold.	Check the bus voltage.	Check the power supply.

- E980.0: Encoder algorithm error

  Cause:

  An encoder algorithm error occurs.

Cause	Troubleshooting	Measure
Internal fault of the encoder	If the servo drive is powered off and on several times but the warning is still reported, it indicates that the encoder is faulty.	Replace the servo motor.

- E999.E (Resonance alarm)

  Cause:

  Resonance has been detected.

Cause	Troubleshooting	Measure
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. • Check whether resonance parameters are set properly. • Increase the value of H0A.46 or set it to 0 to mask this function.

17.4 Fault Codes

17.4.1 Solutions to Faults

- E101.0: Parameter error in H02 and above

  Cause:

  The total number of parameters changes, which generally occurs after software update.

  Values of parameters in groups H02 and above exceed the limit, which generally occurs after software update.

Cause	Troubleshooting	Measure
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.	1. Restore default settings (H02.31 = 1), and write parameters again. 2. Enlarge the power capacity or replace with a power supply of higher capacity, restore default settings (H02.31 = 1) and write parameters again.
	2. Measure whether the input voltage of the control circuit cable on the non-drive side is within the following range: 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: –10% to +10% (342 V to 484 V)	Increase the power supply capacity or replace with a power supply of higher capacity. Restore system parameters to default settings (H02.31 = 1), and write parameters again.
2. Instantaneous power failure occurs 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.
3. The number of write operations within a certain period of time exceeds the limit.	1. Check whether instantaneous power failure occurs during parameter storage. 2. Check whether parameters are updated frequently through the host controller.	1 If the servo drive is faulty, replace the servo drive. 2 Change the parameter writing method and write parameters again.

Cause	Troubleshooting	Measure
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
  Cause:

  The total number of parameters changes, which generally occurs after software update.

  Values of parameters in groups H00 or H01 exceed the limit, which generally occurs after software update.

Cause	Troubleshooting	Measure
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. Drive parameters in group H01 are mapped based on the 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.	Replace the motor or servo drive.

- E101.2: Address error in read/write operation after the number of parameters changes

Cause	Troubleshooting	Measure
The total number of parameters changes after software update, leading to address error in read/ write operation.	Read H0b.90 and H0b.91 and obtain the abnormal parameter group number	Rectify the wrong values. Restore default settings.

- E101.9: Parameter attribute initialization check error
  Cause:

  Parameter attribute initialization check error.

Cause	Troubleshooting	Measure
Parameter attribute initialization check error	Check that H0A.99 = AA5C.	If the problems persists after the servo drive is powered off and on several times, replace the servo drive.

- E102.0: FPGA communication establishment error
  Cause:

  The communication between MCU and FPGA cannot be established.

Cause	Troubleshooting	Measure
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

  Cause:

  FPGA is faulty.

Cause	Troubleshooting	Measure
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 version mismatch

  Cause:

  FPGA and MCU versions do not mismatch.

Cause	Troubleshooting	Measure
The software versions of MCU and FPGA are inconsistent.	1 Check whether the MCU version (H01.00) is 9xx.x (the fourth digit displayed on the keypad is 9); 2 Check whether the FPGA version (H01.01) is 9xx.x (the fourth digit displayed on the keypad is 9).	Contact Inovance for technical support. Update the FPGA or MCU software.

- E104.1: MCU running timeout (MCU break down)

  Cause:

  The access to MCU times out.

Cause	Troubleshooting	Measure
1. The FPGA is faulty.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.
2. The communication handshaking between FPGA and HOST is abnormal.		
3. Access timeout occurs between HOST and the coprocessor.		

- E104.2: Current loop operation timeout (FPGA break down)

  Cause:

  The MCU torque interrupt scheduling time is abnormal. This fault is reported only during commissioning.

Cause	Troubleshooting	Measure
1.FPGA fault	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.
2. The communication handshaking between FPGA and MCU is abnormal.		

- E104.4: MCU command update timeout

  Cause:

  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, a warning will be reported.

Cause	Troubleshooting	Measure
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 unnecessary functions. 2 Replace the servo drive.

- E120.0: Unknown encoder model

  Cause:

  The servo drive detects the encoder model during initialization upon power-on. If the encoder model does not comply with the requirement, E120.0 occurs.

Cause	Troubleshooting	Measure
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 23-bit servo motor are used. Meanwhile, check whether H00.00 (Motor code) is set to 14101.	If the motor code is unknown, set H00.00 to 14101 when the IS810N series servo drive and servo motor equipped with 23-bit encoder are used.
	Check the servo drive code (H01.02) to see whether this servo drive code exists.	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

  Cause:

  The servo drive detects the motor model defined by H00.00 during initialization upon power-on. If the motor model does not exist, E120.1 occurs.

Cause	Troubleshooting	Measure
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

  Cause:

  The servo drive detects the servo drive model defined by H01.10 during initialization upon power-on. If the servo drive model does not exist, E120.2 occurs.

Cause	Troubleshooting	Measure
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

  Cause:

  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.

Cause	Troubleshooting	Measure
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
  Cause:
  - The motor model is set improperly, causing mismatch and malfunction of the servo drive.
  - The motor model is set properly, but the motor encoder is not supported by the servo drive.

Cause	Troubleshooting	Measure
The FPGA software version does not match the motor model defined by H00.00.	Check whether the FPGA software version (H01.01) supports the motor model (H00.00).	Update the FPGA software to support the motor model defined by H00.00 or replace the motor.

- E120.7: Model check error
  Cause:

The servo drive model parameter cannot be identified.

Cause	Troubleshooting	Measure
Model parameter CRC check failed	Check that the model parameter is present.	Write the model parameter again.

- E120.8: Junction temperature parameter check error
  Cause:

The junction temperature parameter is identified incorrectly.

Cause	Troubleshooting	Measure
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
  Cause:

The same function is assigned to different DIs.

The DI function No. exceeds the maximum number allowed for DI functions.

Cause	Troubleshooting	Measure
1. Multiple DIs are assigned with the same function.	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.

- E122.2: Different DOs assigned with the same function

Cause	Troubleshooting	Measure
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
  Cause:

The upper limit (reference range) of the mechanical single-turn position exceeds 2^{31} in the absolute position rotation mode.

Cause	Troubleshooting	Measure
The upper limit of the mechanical single-turn position exceeds 2^{31} 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 2^{31}.

- E122.4: Different VDIs assigned with the same function
  Cause:

  The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Cause	Troubleshooting	Measure
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.

- E122.5: DI and VDI assigned with the same function
  Cause:

  The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Cause	Troubleshooting	Measure
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
  Cause:

Cause	Troubleshooting	Measure
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 function is used.	Set the value of H02.01 to a value except 2 if fully closed-loop is used.

- E122.9: Fully closed-loop function pin conflict
  Cause:

  The frequency division output pin conflicts with the fully closed loop second encoder pin.

Cause	Troubleshooting	Measure
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.

- E136.0: Encoder ROM motor parameter check error
  Cause:

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.

Cause	Troubleshooting	Measure
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. 2 Measure signals PS+, PS-, +5V and GND on both ends of the encoder cable and observe whether signals at both ends are consistent. For signal assignment, see Chapter "Wiring" in the hardware guide.	1 Use the encoder cable provided by Inovance. Ensure motor terminals are connected securely and servo drive screws are tightened properly. Use a new encoder cable if necessary. 2 Route encoder cables and power cables (R/S/T, U/V/W) through different routes.
3. The 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
  Cause:
  - The encoder cable is not connected properly.
  - A communication error occurs on the encoder due to interference.

Cause	Troubleshooting	Measure
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.

- E150.0: STO safety state applied
  Cause:

  The STO input protection applies (safety state).

Cause	Troubleshooting	Measure
Two 24 V inputs are disconnected simultaneously, triggering the STO function.	1. Check whether the STO function is activated.	There is no need to take any corrective actions. After the STO terminal is back to normal, clear the fault using the fault reset function.
	2. Check whether the STO power supply is normal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
	3. The fault persists after preceding causes are rectified.	Replace the servo drive.

- E150.1: STO input state abnormal
  Cause:

  The single-channel input of STO is ineffective.

Cause	Troubleshooting	Measure
1. STO input power supply is abnormal.	Check whether the STO power supply is normal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
2. STO input resistor is abnormal.	After STO is triggered, only one STO signal is sent to MCU after the 24 V power supply is cut off due to input resistor drift.	Replace the servo drive.
3. The STO fails.	The fault persists after preceding causes are rectified.	Replace the servo drive.

- E150.2: Buffer 5 V voltage detection 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.

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:

  Short circuit occurs on the optocoupler of the upstream hardware circuit of STO. The drive displays E150.3.

Cause	Troubleshooting	Solution
Short circuit occurs on the upstream optocoupler of STO1 or STO2.	The fault persists and the keypad displays E150.3 after restart.	Replace the servo drive.

- E150.4: PWM buffer hardware detection failure
  Description:

  An error occurs on the PWM Buffer integrated circuit during initialization detection upon power-on (the PWM signal cannot be blocked).

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

  Cause:

  An excessively high current flows through the positive pole of the DC-AC circuit.

Cause	Troubleshooting	Measure
1. Gains are set improperly, leading to motor oscillation.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	1 Motor parameters are set improperly, modify motor parameter values. 2 Current loop parameters are set improperly, modify current loop parameter values. 3 Speed loop parameters are set improperly, leading to motor oscillation. 4 Servo drive operates improperly. Replace it.
2. The encoder cable is aged or corroded, or connected incorrectly or loosely.	Check whether the encoder cable provided by Inovance is used. Check whether the cable is aging, corroded, or connected loosely. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten or replace the encoder cable.
3. The servo drive is faulty.	1 Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. 2 Disconnect the motor cable and power on the servo drive again, but the fault persists. 3 Check whether resistance of the external brakingresistor is too small or the brakingresistor is short-circuited (between terminals P⊕ and C).	1 Replace with a brakingresistor with matching resistance and perform wiring again. 2 Replace the servo drive.
4. Overcurrent occurs on the brakingresistor.	Check whether resistance of the external brakingresistor is too small or the brakingresistor is short-circuited (between terminals P, C).	Use a brakingresistor of matching resistance. Perform wiring again.

- E201.1: Phase-U overcurrent

  Cause:

  A current higher than the threshold is collected in the phase-U current.

Cause	Troubleshooting	Measure
1 Motor cables are in poor contact. 2 Motor cables are grounded. 3 U/V/W cables of the motor are short-circuited.	1 Check whether the servo drive power cables and motor cables on the U, V, and W sides of the servo drive are loose. 2 After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	1 Tighten the cables that are loose or disconnected. 2 Replace the motor in case of poor insulation.
4. The motor is damaged.	1 Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring. 2 Disconnect the motor cables and measure whether the resistance among UVW phases of motor cables is balanced.	1 Connect the motor cables correctly. 2 Replace the motor if the resistance is unbalanced.

- E201.2: Phase-V overcurrent
  Cause:

  A current higher than the threshold is collected in the phase-V current.

Cause	Troubleshooting	Measure
1 Motor cables are in poor contact. 2 Motor cables are grounded. 3 U/V/W cables of the motor are short-circuited.	1 Check whether the servo drive power cables and motor cables on the U, V, and W sides of the servo drive are loose. 2 After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	1 Tighten the cables that are loose or disconnected. 2 Replace the motor in case of poor insulation.
4. The motor is damaged.	1 Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring. 2 Disconnect the motor cables and measure whether the resistance among UVW phases of motor cables is balanced.	1 Connect the motor cables correctly. 2 Replace the motor if the resistance is unbalanced.

- E201.4: Phase-N overcurrent
  Cause:

  An excessively high current flows through the negative pole of the DC-AC circuit.

Cause	Troubleshooting	Measure
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 brakingresistor.	Check whether resistance of the external brakingresistor is too small or the brakingresistor is short-circuited (between terminals P⊕ and C).	Replace with a brakingresistor 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

Cause:

Cause	Troubleshooting	Measure
The servo drive fails to receive the data fed back by the encoder in three consecutive cycles.	Check bit 12 of H0b.30. Encoder wiring is incorrect. The encoder cable is loosened. The encoder cable is too long. The encoder communication suffers from interference. The encoder is faulty.	1 Check whether the motor model is correct. 2 Check the condition of the encoder cable. 3 Check whether the encoder version (H00.04) is set properly. 4 The servo drive operates improperly. Replace it.

- E208.4: FPGA current loop operation timeout

Cause:

The operating time of the current loop exceeds the interval threshold.

Cause	Troubleshooting	Measure
FPGA operation times out.	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

Cause:

An abnormal motor phase current or bus voltage is detected during power-on self-testing.

- The DC bus voltage exceeds the discharge threshold.
- The phase U current of drives in size 1/2/3/4 exceeds 1/4 of the value of H01.07.

Cause	Troubleshooting	Measure
1. The servo drive power cables (U/V/W) are short-circuited to ground.	Disconnect the motor cables and measure whether the servo drive power cables (U/V/W) are short-circuited to ground (PE).	Connect the cables again or replace the servo drive power cables.
2. The motor is short-circuited to ground.	After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	Replace the motor.
3. The 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.
4. The motor speed is too high during phase-to-ground detection.	Check whether the motor is in the generating status during power-on.	Reduce the motor speed.

- E234.0: Runaway
  Cause:

The torque reference direction is in reverse to the speed feedback direction in the torque control mode.

The speed feedback direction is in reverse to the speed reference direction in the position or speed control mode.

Cause	Troubleshooting	Measure
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 rotor upon power-on.	The U/V/W phase sequence is correct, but E234.0 occurs when the servo drive is enabled.	Power off and on the servo drive again.
3. The encoder model is wrong or the encoder is wired improperly.	View the servo drive and servo motor nameplates to check whether the devices used are Inovance IS810N series servo drive and servo motor equipped with 23-bit encoder.	Replace with a mutually-matching servo drive and servo motor. For use of IS810N series servo drive and servo motor equipped with 23-bit encoder, set H00.00 to 14101. Check the motor model, encoder type, and encoder cable connection again.
4. The encoder cable is aged or corroded, or connected incorrectly or loosely.	1 Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. 2 Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.10 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten or replace the encoder cable.

Cause	Troubleshooting	Measure
5. The gravity load in vertical axis applications is too large.	Check whether the load of the vertical shaft is too large. Adjust brake parameters H02.09...H02.12 and check whether the fault is cleared.	Reduce the load of the vertical axis, increase the stiffness level, or hide this fault without affecting the safety performance and normal use.
6. Improper parameter settings lead to excessive vibration.	The stiffness level is set to an excessively high value, leading to excessive vibration.	Set a proper stiffness level to avoid excessive vibration.

- E400.0: Main circuit overvoltage

  Cause:

  The DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold.

  380 V servo drive: Normal value: 540 V Undervoltage threshold: 760 V

Cause	Troubleshooting	Measure
1. The voltage input to the main circuit is too high.	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 U/V/W on the drive side is within the following range: 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: –10% to +10% (342 V to 484 V)	Replace or adjust the power supply according to the specified range.
2. The power supply is unstable or affected by lightning.	Check whether the power supply is unstable, affected by lightning, or complies with the preceding range.	Connect a surge protection device (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 brakingresistor fails.	If the built-in brakingresistor is used (H02.25 = 0), check whether terminals P ⊕ and D are jumpered. If yes, measure the resistance between terminals C and D. If an external brakingresistor is used (H02.25 = 1 or 2), measure the resistance of the external brakingresistor connected between terminals P ⊕ and C. For details, see the braking resistor specifications in related section.	1 If the resistance is "∞" (infinite), the brakingresistor is disconnected internally. 2 If a built-in brakingresistor is used, change to use an external brakingresistor (H02.25 = 1 or 2) and remove the jumper between terminals P ⊕ and D. Select an external brakingresistor of the same resistance and equal or higher power than the built-in one. 3 If an external brakingresistor is used, replace with a new one and connect it between P⊕ and C. 4 Set H02.26 (Power of external brakingresistor) and H02.27 (Resistance of external brakingresistor) to values consistent with the specifications of the external brakingresistor used.

Cause	Troubleshooting	Measure
4. The resistance of the external brakingresistor is too large, resulting in insufficient energy absorption during braking.	Measure the resistance of the external brakingresistor connected between terminals P⊕ and C, and compare the measured value with the recommended value.	1 Replace with a new external brakingresistor that carries the recommended resistance, and connect it between P⊕ and C. 2 Set H02.26 (Power of external brakingresistor) and H02.27 (Resistance of external brakingresistor) to values consistent with the specifications of the external brakingresistor used.
5. The motor is in abrupt acceleration/deceleration status and the maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/ deceleration time during operation and measure whether the DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold during deceleration.	After confirming the input voltage of the main circuit is within the specified range, increase the acceleration/deceleration time if the operating conditions allow.
6. The bus voltage sampling value deviates greatly from the measured value.	Check whether H0b.26 (Bus voltage) is within the following range: 380 V servo drive: H0b.26 > 760 V Measure whether the DC bus voltage detected between terminals P⊕ and N⊖ is lower 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
  Cause:

  The DC bus voltage between P⊕ and N⊖ is lower than the undervoltage threshold.

  380 V servo drive: Normal value: 540 V Undervoltage threshold: 380 V

Cause	Troubleshooting	Measure
1. The power supply of the main circuit is unstable or power failure occurs.	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 U/V/W on the drive side is within the following range: 380 V servo drive: Effective value: 380 V to 440 V Allowable deviation: –10% to +10% (342 V to 484 V) Measure the voltages of all the three phases.	Increase the capacity of the power supply.
2. Instantaneous power failure occurs.		
3. The power supply voltage drops during operation.	Monitor the power supply voltage and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and voltage drop.	
4. A three-phase servo drive is connected to a single-phase power supply, leading to phase loss.	Check whether the main circuit is wired correctly and whether phase loss detection (H0A.00) is hidden.	Replace the cables and wire the power cables correctly. Three-phase: U, V, W
5. The servo drive is faulty.	Check whether H0b.26 (Bus voltage) is within the following range: 380 V servo drive: H0b.26 < 380 V The fault persists after the main circuit is powered off and on repeatedly.	Replace the servo drive.

- E410.1: Main circuit de-energized

  Cause:

  Phase loss occurs on the three-phase servo drive.

Cause	Troubleshooting	Measure
The power supply is disconnected during operation.	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 U/V/W on the drive side is within the following range: 380 V servo drive: Effective value: 380 to 440 V Allowable deviation: -10% to +10% Measure the voltages of all the three phases.	Increase the capacity of the power supply.
	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.	
	Check whether 200B.1Bh (Bus voltage) is within the following range: 380 V servo drive: H0b.27h < 380 V. The fault persists after the main circuit is powered off and on repeatedly.	Replace the servo drive.
	Check the wiring of the main circuit.	Replace the cables and wire the power cables correctly. Three-phase: U, V, W

- E410.1: Main circuit de-energized
  Cause:

  Phase loss occurs on the three-phase servo drive.

Cause	Troubleshooting	Measure
The power supply is disconnected during operation.	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 U/V/W on the drive side is within the following range: 380 V servo drive: Effective value: 380 to 440 V Allowable deviation: -10% to +10% Measure the voltages of all the three phases.	Increase the capacity of the power supply.
	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.	
	Check whether 200B.1Bh (Bus voltage) is within the following range: 380 V servo drive: H0b.27h < 380 V. The fault persists after the main circuit is powered off and on repeatedly.	Replace the servo drive.
	Check the wiring of the main circuit.	Replace the cables and wire the power cables correctly. Three-phase: U, V, W

- E430.0: Control circuit power supply undervoltage

  Cause:

Cause	Troubleshooting	Measure
1. The control power supply of servo drives in size C/D/E are unstable or fails.	Check the specifications of the power supply and measure whether the voltage input to the main circuit is within the following range: 380 V servo drive: Effective value: 380 to 440 V Allowable deviation: –10% to +10% (342 V to 484 V) Measure the voltages of all the three phases.	Increase the capacity of the power supply.
2. The control 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

  Cause:

  The actual speed of the motor exceeds the overspeed threshold.

Cause	Troubleshooting	Measure
1. UVW phase sequence is incorrect.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the U, V, and W cables according to correct phase sequence.
2. H0A.08 is set improperly.	Check whether the overspeed threshold is lower than the maximum speed. Overspeed threshold = 1.2 x Maximum motor speed (H0A.08 = 0). Overspeed threshold = H0A.08 (when H0A.08 ≠ 0, and H0A-08 < 1.2 x maximum motor speed).	Re-set the overspeed threshold according to the mechanical requirements.
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, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. – In PP mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6081h (Profile velocity). – In HM mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6099.01h and 6099.02h. • Speed control mode:• View the gear ratio 6091h, and the values of 60FFh (Target velocity), H06.06 to H06.09, and 607Fh. • Torque control mode:• View the speed limit defined by H07.17 and check the corresponding speed limit.	• Position control mode: – CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when generating references. – PP: Decrease the value of 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. • Speed control mode:• Reduce the target velocity, speed limit, and gear ratio. – Increase 6083h and 6084h in PV mode. – In CSV mode, the host controller needs to perform speed ramp additionally. • 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
  Cause:

  The FPGA speed measurement overflows.

Cause	Troubleshooting	Measure
1. FPGA internal speed overflows.	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 motor speed overshoots.	Check in the software tool whether the speed feedback exceeds the overspeed threshold.	Adjust the gain or mechanical running conditions.

- E500.2: Velocity feedback error 2

Cause	Troubleshooting	Measure
Communication error occurred between boards of the drive.	The alarm persists in spite of repeated power off and on.	Replace the servo drive.

- E602.0: Angle auto-tuning failure
  Cause:

  Unusual jitter occurs on the encoder feedback during angle auto-tuning.

Cause	Troubleshooting	Measure
The data fed back by the encoder is abnormal.	Check if the encoder communication is being disturbed.	Check the wiring of the encoder.

- E602.2: U/V/W phase sequence reversed
  Cause:

  A wrong U/V/W phase sequence is detected during angle auto-tuning.

Cause	Troubleshooting	Measure
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
  Cause:

  The motor speed exceeds the rated speed when the servo drive is switched on.

Cause	Troubleshooting	Measure
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
  Cause:

  The accumulative heat of the motor reaches the fault threshold.

Cause	Troubleshooting	Measure
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 the cables according to the wiring diagram. It is recommended to use the cables provided by Inovance. When customized cables are used, prepare and connect the customized cables according to the wiring instructions.
2. The load is so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	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. Check the value of H08.00 (Load inertia ratio). Confirm the individual operation cycle when the servo motor operates 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.	View the motor model in H00.00 and the drive model in H01.10.	Read the servo drive nameplate and set the servo drive model (H01.10) and motor model based on *"Model and Nameplate" on page 21*.
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. • 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.
7. The servo drive is faulty.	The fault persists after the servo drive is powered off and on again.	Replace the servo drive.

Note

When this fault occurs, stop the servo drive for at least 30s before further operations.

- E630.0: Motor stall

Cause:

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

Cause	Troubleshooting	Measure
1. Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	Perform motor trial run without load and check cable connections and the phase sequence.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The motor parameters (especially the number of pole pairs) are set improperly and motor angle auto-tuning is not performed.	View parameters in group H00 to check whether the number of pole pairs are set properly. Perform angle auto-tuning on the motor several times and check whether the value of H00.28 is consistent during angle auto-tuning.	Modify the motor parameter values.
3. The communication commands are being disturbed.	Check whether jitter occurs on the commands sent from the host controller and whether EtherCAT communication is being disturbed.	Check whether the communication line between the host controller and the servo drive is being disturbed.
4. The motor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad. • References in the position control mode: H0b.13 (Input position reference counter) • References in the speed control mode: H0b.01 (Speed reference) • References in the torque control mode: H0b.02 (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode. Check the current feedback (torque reference) waveform.	Check whether any mechanical part gets stuck or eccentric.

Note

When this fault occurs, stop the servo drive for at least 30s before further operations.

- E631.0: SBC brake circuit diagnosis exception

  Description:

  In the SOS state, the actual speed or position change exceeds the preset monitoring threshold.

Cause	Troubleshooting	Solution
1. The SBC circuit is abnormal when the board 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.	The 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.

Cause	Troubleshooting	Solution
The brake or the 24 V power supply is not connected when the brake function is used.	Check whether 24 V power supply or the brake is not connected when H02.16 is set to 1.	1 Set H02.16 to 0. 2 Replace the motor. 3 Connect the brake cable and 24 V power supply.

- E631.2: P-Mos disconnected
  Description:

  The brake circuit is faulty.

Cause	Troubleshooting	Solution
When braking is used, P-MOS open circuit occurred on the brake circuit.	Ensure the brake cable is connected, check if the fault persists after the servo drive is powered off and on again.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

- E631.3: N-Mos disconnected
  Description:

  The brake circuit is faulty.

Cause	Troubleshooting	Solution
When braking is used, N-MOS open circuit occurred on the brake circuit.	Ensure the brake cable is connected, check if the fault persists after the servo drive is powered off and on again.	1 Replace the servo drive. 2 Turn off the brake switch H02.16.

- E640.0: IGBT over-temperature
  Cause:

  The IGBT temperature reaches the fault threshold defined by H0A.18.

Cause	Troubleshooting	Measure
1. The ambient temperature is too high. 2. The servo drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault records (set H0b.33 and view H0b.34) to check whether an overload fault/warning is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	• Improve the cooling conditions of the servo drive to lower down the ambient temperature. • Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The 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 5 minutes after power-off.	Replace the servo drive.

Note

When this fault occurs, stop the servo drive for at least 30s before further operations.

- E640.1: Flywheel diode overtemperature

  Cause:

  The temperature of the flywheel diode reaches the fault threshold defined by H0A.18.

Cause	Troubleshooting	Measure
1. The ambient temperature is too high. 2. The servo drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault records (set H0b.33 and view H0b.34) to check whether an overload fault/warning is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	• Improve the cooling conditions of the servo drive to lower down the ambient temperature. • Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The 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 5 minutes after power-off.	Replace the servo drive.

Note

When this fault occurs, stop the servo drive for at least 30s before further operations.

- E650.0: Heatsink overtemperature

  Cause:

  The temperature of the servo drive power module is higher than the overtemperature threshold.

Cause	Troubleshooting	Measure
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). Check whether an overload fault or warning (E620.0, E630.0, E650.5, E909.0, E920.0, E922.0) occurs.	Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The 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 5 minutes after power-off.	Replace the servo drive.

Note

When this fault occurs, stop the servo drive for at least 30s before further operations.

- E660.0: Motor overtemperature

  Cause:

  The temperature of the air-cooled motor is too high.

Cause	Troubleshooting	Measure
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 disconnected

  Cause:

  The KTY sensor is disconnected.

Cause	Troubleshooting	Measure
The KTY sensor is disconnected.	Detect the resistance on both ends of KTY during stop.	Replace the KTY sensor.

- E661.0: STune error

Cause	Troubleshooting	Measure
During ETune operation, the gain drops to the lower limit: 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.	1 Set the notch manually. 2 Modify the electronic gear ratio to improve the command resolution, increase the command filter time constant in the parameter configuration interface. 3 Check whether the machine suffers from periodic fluctuation. 4 Set H09.58 to 1 to clear resonance suppression parameters, and perform STune again.

- E662.0: ETune failure

Cause	Troubleshooting	Measure
Check whether resonance that occurred during ETune operation cannot be suppressed.	Check whether there is abnormal noise or torque fluctuation during operation.	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 machine suffers from periodic fluctuation. 5 Check whether the positioning threshold is too low. Increase the reference acceleration/ deceleration time.

- E663.0: ITune error

Cause	Troubleshooting	Measure
Check whether resonance that occurred during ITune operation cannot be suppressed.	Check whether there is abnormal noise or torque fluctuation during operation.	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 in the parameter configuration interface. 3 Check whether the machine suffers from periodic fluctuation. 4 Increase the value of H09.11 as appropriate.

- E664.0: Excessive system resonance

Cause	Troubleshooting	Measure
Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H09.54.	Check whether there is abnormal noise or torque fluctuation during operation.	1 Check whether the inertia ratio or loop gain parameters are set properly. 2 Check whether resonance parameters are set properly. 3 Increase the value of H09.54 or set it to 0 to mask this function.

- E731.0: Encoder battery failure
  Cause:

  The voltage of the absolute encoder battery is lower than 2.9 V.

Cause	Troubleshooting	Measure
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.

- E733.0: Encoder multi-turn counting error
  Cause:

  An encoder multi-turn counting error occurs.

Cause	Troubleshooting	Measure
The encoder is faulty.	Set H0d.20 to 2 to clear the fault, but E733.0 persists after restart.	Replace the motor.

- E735.0: Encoder multi-turn counting overflow
  Cause:

  A multi-turn counting overflow occurs on the absolute encoder.

Cause	Troubleshooting	Measure
The number of forward revolutions exceeds 32767 or the number of reverse revolutions exceeds 32768.	Check whether the value of H0b.70 (Number of absolute encoder revolutions) is 32767 or 32768 when the servo drive works in the absolute linear mode (H02.01 = 1).	Set H0d.20 to 2 to power on again. Perform homing if necessary.

- E740.0: Absolute encoder communication timeout
  Cause:

  Communication timeout occurs on the absolute encoder.

Cause	Troubleshooting	Measure
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 the encoder cable connections. 4 Replace the servo motor.

- E740.2: Absolute encoder error
  Cause:

  A communication error occurs on the RX side of the encoder.

Cause	Troubleshooting	Measure
1. The encoder is wired improperly.	Check the wiring of the encoder.	Connect the encoder cables according to the correct wiring diagram.
2. The encoder cable connections become loose.	Check whether vibration on site is too strong, which loosens the encoder cable and even damages the encoder.	Re-connect encoder cables and ensure encoder terminals are connected securely.
3. The encoder Z signal is being disturbed.	Check the field cable layout: Check whether ambient devices are generating disturbance and whether multiple disturbance sources such as variable-frequency devices are present inside the cabinet. Make the drive stay in "rdy" state and rotate the motor shaft counterclockwise (CCW) manually. Then observe whether the value of 200B-12h (Electrical angle) increases/decreases smoothly. Turning one circle corresponds to five 0°–360° (for Z series motor). For X series motors, turning one circle corresponds to four 0–360°. If 200B-12h (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.	Standard encoder cables are recommended. If non-standard encoder cables are used, check whether the cables meet the specifications and whether they are shielded twisted pairs (STPs). Route the motor cables and encoder cables through different routes. Ensure the servo motor and servo drive are grounded properly. Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts.
4. The encoder is faulty.	Replace with a new encoder cable. If the fault no longer occurs after cable replacement, it indicates the original encoder cable is damaged. Keep the motor in a certain position, power on the servo drive several times and check the change of H0B-17 (200B-12h). 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
  Cause:

  The encoder is faulty.

Cause	Troubleshooting	Measure
Internal fault of 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 the encoder cable is proper. 3 Replace the motor.

- E740.6: Encoder data write error
  Cause:

The attempt to write the encoder data fails.

Cause	Troubleshooting	Measure
An error occurs when writing the position offset after angle auto-tuning.	Replace with a new encoder cable. If the fault no longer occurs after cable replacement, it indicates the original encoder cable is damaged. Keep the motor in a fixed position, restart several times and observe the change of the electrical angle H0b.17 upon each restart, which should be within ±30°.	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

  Cause:

  Nikon encoder communication failure

Cause	Troubleshooting	Measure
A communication error occurs on the Nikon encoder.	Restart and check whether the fault persists.	Try resetting the encoder fault manually through H0d.21. If the fault cannot be reset, check whether the encoder and other cables are connected improperly.

- E760.0: Encoder overtemperature

  Cause:

  The temperature of the absolute encoder is too high.

Cause	Troubleshooting	Measure
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: Nikon encoder over-temperature or overspeed

  Cause:

  Encoder over-temperature or overspeed

Cause	Troubleshooting	Measure
Motor overtemperature	Check if the ambient temperature or the average load rate is too high.	Switch off the S-ON signal to wait for the encoder to cool down.

- E770.0: Fully-closed input phase A wire breakage

Cause	Troubleshooting	Measure
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 input phase B wire breakage

Cause	Troubleshooting	Measure
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 input phase Z wire breakage

Cause	Troubleshooting	Measure
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 2nd encoder initialization communication error

Cause	Troubleshooting	Measure
1. The encoder cable connections are incorrect or loosened.	1 Check the encoder cable connections. 2 Check whether vibration on site is too strong, 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 Inovance 2nd encoder communication error

<table>
<tr><th>Cause</th><th>Troubleshooting</th><th>Measure</th></tr>
<tr><td>1 Encoder wiring is incorrect.
2 The encoder cable is loosened.</td><td>1 Check the wiring of the encoder.
2 Check whether vibration on site is too strong, which loosens the encoder cable and even damages the encoder.
3 Replace with a new encoder cable. If the fault no longer occurs after cable replacement, it indicates the original encoder cable is damaged.</td><td rowspan="3">1 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.
2 Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts.
3 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.</td></tr>
<tr><td>3. The encoder Z signal is being disturbed.</td><td>1 Check whether ambient devices are generating interference and whether multiple interference sources are present in the cabinet.
2 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 motor). 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.</td></tr>
<tr><td>4. The encoder is faulty.</td><td>Keep the motor in a fixed position, restart several times and observe the change of the electrical angle H0b.17 upon each restart, which should be within ±30°.</td></tr>
</table>

- E939.0: Motor power cable disconnected

  Description:

  At least one phase of the motor power cables is damaged.

Cause	Troubleshooting	Measure
Any one or two phases of the motor power cables are damaged.	Check the wiring of U/V/W power cables.	1 Check whether the power cables are disconnected or in poor contact. Re-connect the power cables. 2 Replace the servo motor.

- E939.1: Phase-U power cable disconnected
  Description:

  The phase-U power cable of the motor is disconnected.

Cause	Troubleshooting	Measure
The phase-U power cable of the motor is disconnected.	Check the wiring of the phase-U power cable.	1 Check whether the power cables are disconnected or in poor contact. Re-connect the power cables. 2 Replace the servo motor.

- E939.2: Phase-V power cable disconnected
  Description:

  The phase-V power cable of the motor is disconnected.

Cause	Troubleshooting	Measure
The phase-V power cable of the motor is disconnected.	Check the wiring of the phase-V power cable.	1 Check whether the power cables are disconnected or in poor contact. Re-connect the power cables. 2 Replace the servo motor.

- E939.3: Phase-W power cable disconnected
  Description:

  The phase-W power cable of the motor is disconnected.

Cause	Troubleshooting	Measure
Motor W phase power cable breakage	Check the wiring of the phase-W power cable.	1 Check whether the power cables are disconnected or in poor contact. Re-connect the power cables. 2 Replace the servo motor.

- EA33.0: Encoder read/write check error
  Cause:

  Internal parameters of the encoder are abnormal.

Cause	Troubleshooting	Measure
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
  Cause:

  The position deviation is larger than the value of 6065h in position control mode.

Cause	Troubleshooting	Measure
1. Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive UVW cables or 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 position loop gain and speed loop gain of the servo drive. 1st gain set: H08.00...H08.02 2nd gain set: H08.03...H08.05	Adjust the gain values manually or perform gain auto-tuning.

Cause	Troubleshooting	Measure
5. The position reference increment is too large.	Position control mode: • In CSP mode, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. • In PP mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6081h (Profile velocity). • In HM mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6099.01h and 6099.02h.	• CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when generating references. • PP: Decrease the value of 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 (Threshold of excessive position deviation) is too low under current operating conditions.	Check whether the value of 6065h is too low.	Increase the value of 6065h.
7. The servo drive/motor is faulty.	Monitor the operating waveform using the oscilloscope function of Inovance commissioning software and check whether the operating waveform includes the following information: position reference, position feedback, speed reference, torque reference	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

- EB00.1: Position deviation overflow

  Cause:

  The position deviation is too large.

Cause	Troubleshooting	Measure
1. Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive UVW cables or 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	Measure
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 position loop gain and speed loop gain of the servo drive. • 1st gain set: H08.00...H08.02 • 2nd gain set: H08.03...H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is too large.	Position control mode: • In CSP mode, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. • In PP mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6081h (Profile velocity). • In HM mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6099.01h and 6099.02h.	• CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when generating references. • PP: Decrease the value of 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 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.

- EB01.1: Individual position reference increment too large

  Cause:

  The target position increment is too large.

Cause	Troubleshooting	Measure
The target position increment is too large.	Check the variation between two adjacent target positions using the software tool.	1 Check whether the maximum speed of the motor fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profile reference speed. If not, replace the servo motor. 2 Before switching the mode or enabling the servo drive, check whether the target position is aligned with current position feedback. 3 The communication sequence of the host controller is abnormal, leading to slave data error. Check the communication sequence of the host controller.

- EB01.3: Command overflow

  Cause:

  The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.

Cause	Troubleshooting	Measure
The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.	Check whether the host controller continues sending commands after overtravel warning is reported by the servo drive.	1 Detect the servo limit signal (bit0 and bit1 of 60FD recommended) through the host controller. 2 Stop sending limit direction commands when an active servo limit signal is detected by the host controller.

- EB02.0: Position deviation exceeding threshold in fully closed-loop

  Cause:

  The absolute value of position deviation in fully closed-loop mode exceeds the value of H0F.08 (Excessive position deviation threshold in fully closed-loop mode).

Cause	Troubleshooting	Measure
1. Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive UVW cables or 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	Measure
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 position loop gain and speed loop gain of the servo drive. 1st gain set: H08.00...H08.02 2nd gain set: H08.03...H08.05	Adjust the gain values manually or 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 for a single synchronous cycle and convert it to the speed information. In PP mode, view the gear ratio 6091-01h/6091-02h and define the value of 6081h (Profile velocity). In HM mode, view the gear ratio 6091-01h/6091-02h, and define the value of 6099-01h and 6099-02h.	IP/CSP: Decrease the position reference increment for a single synchronous cycle. The host controller should cover the position ramp when generating references. PP: Decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease the value of 6099-01h and 6099-02h or increase the acceleration/ deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of H0F.08 (Threshold of excessive position deviation) is too low under current operating conditions.	Check whether the value of 6065h is too low.	Increase the value 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
  Cause:

  The absolute value of the fully closed-loop position deviation is greater than 2^{31}.

Cause	Troubleshooting	Measure
1. Power output (UVW) phase loss or incorrect phase sequence occurs in 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 UVW cables or encoder cable is disconnected.	Check the wiring.	Connect the cables again. The 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 position loop gain and speed loop gain of the servo drive. • 1st gain set: H08.00...H08.02 • 2nd gain set: H08.03...H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is too large.	Position control mode: • In IP/CSP mode, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. • In PP mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6081h (Profile velocity). • In HM mode, check the gear ratio 6091.01h/6091.02h and determine the value of 6099.01h and 6099.02h.	• IP/CSP: Decreases the position reference increment per synchronization cycle. 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: Decrease 6099.01h and 6099.02h or decrease the acceleration/deceleration ramp (609Ah). Reduce the gear ratio as needed.

Cause	Troubleshooting	Measure
6. The value of H0F.08 (Threshold of excessive position deviation) is too low under current operating conditions.	Check whether the value of 6065h is too low.	Increase the value of 6065h.
7. The servo drive/motor is faulty.	Monitor the operating waveform using the oscilloscope function of Inovance commissioning software and check whether the operating waveform includes the following information: position reference, position feedback, speed reference, torque reference	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

- EB03.0: Electronic gear ratio beyond the limit - H05.02
  Cause:

  The electronic gear ratio (H05.02) exceeds the limit: (0.001, 4000 x Encoder resolution/10000).

Cause	Troubleshooting	Measure
The electronic gear ratio converted by H05.02 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.	Adjust the value of H05.02.

- EB03.1: Electronic gear ratio beyond the limit - Electronic gear ratio 1
  Cause:

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

Cause	Troubleshooting	Measure
The electronic gear ratio 1 exceeds the maximum gear ratio or is less than the minimum gear ratio.	Check if the electronic gear ratio 1 is within the range of 0.001–4000 x Encoder resolution/10000.	Change the value of electronic gear ratio 1 (H05.07/H05.09).

- EB03.2: Electronic gear ratio beyond the limit - Electronic gear ratio 2
  Cause:

  The electronic gear ratio 2 exceeds the limit: (0.001–4000 x Encoder resolution/10000).

Cause	Troubleshooting	Measure
The electronic gear ratio 2 exceeds the maximum gear ratio or is less than the minimum gear ratio.	Check if the electronic gear ratio 2 is within the range of 0.001–4000 x Encoder resolution/10000.	Change the value of electronic gear ratio 2 (H05.11/H05.13).

- EE08.0: Synchronization (SYNC) signal loss
  Cause:

  The SYNC signal is turned off when the EtherCAT network is in the OP state.

Cause	Troubleshooting	Measure
1. The data received by the slave is abnormal during synchronous communication.	Check whether the communication cable is shielded twisted pairs. Check whether the drive is grounded properly. Check whether the network port of the drive is damaged.	Use shielded twisted pair cables. Connect cables according to wiring instructions. Check the network connection status through the first LED.
2. The data sent by the master is abnormal during synchronous communication	The synchronization clock of the host controller is not activated. The synchronization clock error of the host controller is excessively high.	Measure the synchronization cycle through an actual oscilloscope or the oscilloscope tool in the software tool. If the synchronization cycle is 0, the host controller synchronous clock is not activated. In this case, check whether the network cables connected to each slave come in from the IN port and out from the OUT port. If yes, restart the network. If the network cables are connected in the correct sequence, without the need for prior check, restart the network directly. If the synchronization cycle is not 0 and within the permissible fluctuation range (2 us) of the drive, increase the synchronization loss threshold of the slave (200E-21h).
3. The network switches from OP to non-OP when the servo drive is enabled.	Check whether the network status switches from OP to non-OP.	Check the network status switchover program of the host controller.

- EE08.1: Network status switchover error

  Cause:

  When the servo drive is enabled, the EtherCAT network status switches from OP to other status.

Cause	Troubleshooting	Measure
1. The data received by the slave is abnormal during synchronous communication.	Check whether the communication cable is shielded twisted pairs. Check whether the drive is grounded properly. Check whether the network port of the drive is damaged.	Use shielded twisted pair cables. Connect cables according to wiring instructions. Check the network connection status through the first LED.
2. The data sent by the master is abnormal during synchronous communication	The synchronization clock of the host controller is not activated. The synchronization clock error of the host controller is excessively high.	Measure the synchronization cycle through an actual oscilloscope or the oscilloscope tool in the software tool. If the synchronization cycle is 0, the host controller synchronous clock is not activated. In this case, check whether the network cables connected to each slave come in from the IN port and out from the OUT port. If yes, restart the network. If the network cables are connected in the correct sequence, without the need for prior check, restart the network directly. If the synchronization cycle is not 0 and within the permissible fluctuation range (2 us) of the drive, increase the synchronization loss threshold of the slave (200E-21h).
3. The network switches from OP to non-OP when the servo drive is enabled.	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
  Cause:

  The network cable of the servo drive is connected improperly. (The low 16 bits of H0E.29 represents the number of IN port loss events. The high 16 bits of H0E.29 represents the number of OUT port loss events.)

Cause	Troubleshooting	Measure
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. Replace with a new network cable .

- EE08.4 Data frame loss protection error
  Cause:

  PDO data is corrupted due to EMC interference or an inferior network cable.

Cause	Troubleshooting	Measure
The data is lost due to EMC interference, poor quality of the network cable or improper connection.	Check whether the high 16 bits of H0E-25 have values that are increased.	• Check whether the servo drive is grounded properly and rectify the EMC problem. • Check whether the network cable used is the one designated by Inovance. • Check whether the network cable is connected properly.

- EE08.5: Data frame transfer error
  Cause:

  The upstream slave detects that the data frame has been corrupted and marked, which is then transferred to the downstream slave, leading to a warning event.

Cause	Troubleshooting	Measure
The upstream station detects that the data frame has been corrupted and marked, which is then transfered to the slave, leading to a warning report.	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 station to locate the fault cause.

- EE08.6: Data update timeout
  Cause:

  The slave is in the OP status and does not receive the data frame in a long time.

Cause	Troubleshooting	Measure
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 product of H0E.22 x communication cycle.	• 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
  Cause:

  The lower limit of the software limit is equal to or larger than the upper limit.

Cause	Troubleshooting	Measure
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
  Cause:

  The home offset exceeds the upper/lower limit.

Cause	Troubleshooting	Measure
1. The home offset is outside the software position limit.	The home offset is outside the software position limit when the encoder works in the incremental mode, absolute linear mode, and single-turn absolute mode.	Set the home offset to a value within the software position limit.
2. The home offset is beyond the upper/lower limit in the rotation mode.	The home offset is outside the mechanical single-turn upper/ lower limit when the encoder works in the rotation mode.	Set the home offset to a value within the mechanical single-turn upper/lower limit.

- EE09.2: Gear ratio beyond the limit

  Cause:

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

Cause	Troubleshooting	Measure
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.

- EE09.3: Homing mode setting error

  Cause:

  The MCU does not receive the synchronization signal when the servo communication is switched to OP status.

Cause	Troubleshooting	Measure
1. The communication synchronization clock is configured improperly.	Replace with another master (such as Beckhoff or Omron PLC) and perform tests to compare between different masters.	Rectify improper configurations.
2. The EtherCAT 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.

- EE09.5: PDO mapping beyond the limit

  Cause:

  The number of mapping object bytes in TPDO or RPDO exceeds 40.

Cause	Troubleshooting	Measure
The number of mapping object bytes in TPDO or RPDO exceeds 40.	Check the number of self-indexes configured in 1600h or 1A00h.	The number of mapping object bytes in TPDO or RPDO cannot exceed 40.

- EE10.0: Protection against MailBox setting error

Cause	Troubleshooting	Measure
1. The master station is configured incorrectly. 2. The slave XML file is incorrect.	The keypad displays the fault code.	Check the configuration of SM0 and SM1 channels for errors.

- EE10.1: SM2 setting error
  Cause:
  - PDO mapping object dictionary index exceeds the set maximum (0x1600–0x170A).
  - The SM length and RxPDO length are not 0 when SM2 is not enabled.
  - 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.

Cause	Troubleshooting	Measure
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
  Cause:
  - PDO mapping object dictionary index exceeds the set maximum (0x1A00–0x1B0A).
  - The SM length and TxPDO length are not 0 when SM3 is not enabled.
  - 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).

Cause	Troubleshooting	Measure
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 exceeds the limit (the maximum index is 0x1A).	Ensure that the SM3 channel is configured correctly. The index of the TxPDO mapping object dictionary is correct.

- EE10.3: PDO watchdog setting error

Cause	Troubleshooting	Measure
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)

Cause	Troubleshooting	Measure
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

  Cause:

  The attempt to load the XML file fails during EtherCAT communication.

Cause	Troubleshooting	Measure
1. The XML configuration file is not programmed.	Check whether the XML version displayed in H0E.96 is normal.	Program the XML file.
2. The servo drive is faulty. The XML file is modified unexpectedly.	The XML version number is not empty.	Set H0E. 37 to 1 and power on and off again.

- EE11.1: EEPROM read failure

  Cause:

  The EEPROM communication of external EtherCAT devices fails.

Cause	Troubleshooting	Measure
The EtherCAT data in the EEPROM cannot be read	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

- EE11.2: EEPROM update failure

  Cause:

  The communication is normal but the message in the EEPROM is wrong or lost.

Cause	Troubleshooting	Measure
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

Cause	Troubleshooting	Measure
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.	Program the XML file.

- EE12.0: EtherCAT initialization failure

Cause	Troubleshooting	Measure
1. The device configuration file is not programmed.	When the host controller scans the slave, the slave ID is empty.	Program the device configuration file.
2. The servo drive is faulty.	The servo drive is faulty.	Replace the servo drive.

- EE13.0: EtherCAT sync period setting error

  Cause:

  After the system switches to the operation mode, the synchronization cycle is not an integer multiple of 125 us or 250 us.

Cause	Troubleshooting	Measure
The synchronization cycle is not an integer multiple of 125 us or 250 us.	Check the setting of the synchronization cycle in the controller.	Modify the synchronization cycle to an integer multiple of 125 us or 250 us.

- EE14.0: SYNC signal pulse width error
  Cause:

  The SYNC signal pulse width is abnormal.

Cause	Troubleshooting	Measure
SYNC signal pulse width error	The EtherCAT communication is normal, but the oscilloscope in the software tool detects that the SYNC cycle is 0.	Write 1 to H0E.31 to enable XML reset, which is activated at next power-on.

- EE15.0: Excessive EtherCAT sync period error
  Cause:

  The synchronization cycle error exceeds the threshold.

Cause	Troubleshooting	Measure
The synchronization cycle error of the controller is too large.	• Measure the synchronization cycle of the controller. • Through a digital oscilloscope. • Measure the synchronization cycle of the controller by using the oscilloscope function in the software tool.	Increase the value of H0E.32.

Note

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

- EE16.0: MCU and ESC communication error

Cause	Troubleshooting	Measure
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

Cause	Troubleshooting	Measure
The MAC address is not programmed.	This fault persists after the servo drive is powered off and on several times.	Program the MAC address.

- EE21.1: EthernetPHY configuration error
  Description:

  The Ethernet PHY is configured improperly.

Cause	Troubleshooting	Measure
The Ethernet PHY is configured improperly.	This fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

17.4.2 Internal Faults

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

17.5 List of Alarm Codes

Table 17–1 Resettable alarm list

Fault code	Display	Name	Fault level	Resettable	Error code	Auxiliary code (203Fh)
E108	E108.0	Storage parameter write error	No. 3	Yes	0x5530	0x01080108
	E108.1	Storage parameter read error	No. 3	Yes	0x5530	0x11080108
	E108.2	Invalid check on data written in EEPROM	No. 3	Yes	0x5530	0x21080108
	E108.3	Invalid check on data read in EEPROM	No. 3	Yes	0x5530	0x31080108
	E108.4	Single data is stored too many times	No. 3	Yes	0x0108	0x41080108
E110	E110.0	Frequency-division pulse output setting error	No. 3	Yes	0x0110	0x01100110
E120	E120.3	Drive and motor power not match	No. 3	Yes	0x7122	0x31200120
E121	E121.0	Duplicated S-ON command	No. 3	Yes	0x0121	0x01210121
E122	E122.0	Multi-turn absolute encoder setting error	No. 3	Yes	0x6320	0x01220122
	E122.6	Absolute function setting fault of 2nd encoder	No. 3	Yes	0x6320	0x61220122
E510	E510.0	Frequency division pulse output overspeed	No. 3	Yes	0x0510	0x05100510
E600	E600.0	Inertia auto-tuning failure	No. 3	Yes	0x0600	0x06000600
E601	E601.0	Homing alarm	No. 3	Yes	0x0601	0x06010601
	E601.1	Homing switch error	No. 3	Yes	0x0601	0x16010601
	E601.2	Homing mode setting error	No. 3	Yes	0x6320	0x26010601
E631	E631.4	P-MOS short-circuited	No. 3	Yes	0x0631	0x46310631
	E631.5	N-MOS short-circuited	No. 3	Yes	0x0631	0x56310631
E730	E730.0	Encoder battery failure	No. 3	Yes	0x7305	0x07300730
	E730.1	Inovance 2nd encoder battery voltage too low	No. 3	Yes	0x7305	0x17300730
E900	E900.0	DI emergency braking	No. 3	Yes	0x0900	0x09000900

Fault code	Display	Name	Fault level	Resettable	Error code	Auxiliary code (203Fh)
E902	E902.0	DI setting invalid	No. 3	Yes	0x6320	0x09020902
	E902.1	DO setting invalid	No. 3	Yes	0x0902	0x19020902
	E902.2	Torque reach setting invalid	No. 3	Yes	0x0902	0x29020902
E908	E908.0	Model identification check code error	No. 3	Yes	0x0908	0x09080908
E909	E909.0	Motor overload alarm	No. 3	Yes	0x3230	0x09090909
	909.2	KTY sensor short-circuited	No. 3	Yes	0x3230	0x2909E909
E910	E910.0	Control circuit overvoltage	No. 3	Yes	0x3210	0x09100910
E920	E920.0	Braking resistor overload	No. 3	Yes	0x3210	0x09200920
E921	E921.0	Dynamic braking resistor overload alarm	No. 3	Yes	0x3210	0x09210921
E922	E922.0	Resistance of the external braking resistor too small	No. 3	Yes	0x6320	0x09220922
E924	E924.0	braking transistor over-temperature	No. 3	Yes	0x3230	0x09240924
E941	E941.0	Modified parameters activated at next power-on	No. 3	Yes	0x6320	0x09410941
E942	E942.0	Parameter storage too frequent	No. 3	Yes	0x7600	0x09420942
E950	E950.0	Positive limit switch alarm	No. 3	Yes	0x5443	0x09500950
E952	E952.0	Negative limit switch alarm	No. 3	Yes	0x5444	0x09520952
E971	E971.0	Undervoltage alarm for voltage drop protection	No. 3	Yes	0x0971	0x09710971
E980	E980.0	Encoder algorithm error	No. 3	Yes	0x0980	0x09800980
E999	E999.E	Resonance alarm	No. 3	Yes	0x00000999	0xE9990999

17.6 List of Fault Codes

No. 1 non-resettable faults:

Table 17–2 List of No. 1 non-resettable faults

Fault code	Display	Fault name	Fault level	Resettable	Error code	Auxiliary code (203Fh)
E101	E101.0	Abnormal parameters in groups H02 and above	No. 1	No	0x6320	0x01010101
	E101.1	Group H00/H01 parameter error	No. 1	No	0x6320	0x11010101
	E101.2	Address error in read/write operation after the number of parameters changes	No. 1	No	0x6320	0x21010101
	E101.9	Parameter attribute initialization check error	No. 1	No	0x0101	0x91010101
E102	E102.0	FPGA communication establishment error	No. 1	No	0x7500	0x01020102
	E102.1	FPGA initialization start error	No. 1	No	0x7500	0x11020102
	E102.8	FPGA and MCU version mismatch	No. 1	No	0x7500	0x81020102
E104	E104.1	MCU operation timeout (MCU crashed)	No. 1	No	0x7500	0x11040104
	E104.2	FPGA operation timeout (FPGA crashed)	No. 1	No	0x7500	0x21040104
	E104.4	MCU command update timeout	No. 1	No	0x7500	0x41040104
E120	E120.0	Unknown encoder model	No. 1	No	0x7122	0x01200120
	E120.1	Unknown motor model	No. 1	No	0x7122	0x11200120
	E120.2	Unknown drive model	No. 1	No	0x7122	0x21200120
	E120.5	Motor and drive current mismatch	No. 1	No	0x7122	0x51200120
	E120.6	FPGA and motor model mismatch	No. 1	No	0x7122	0x61200120
	E120.7	Model check error	No. 1	No	0x0120	0x71200120
	E120.8	Junction temperature parameter check error.	No. 1	No	0x0120	0x81200120
E136	E136.0	Encoder ROM motor parameter check error	No. 1	No	0x7305	0x01360136
	E136.1	Encoder ROM motor parameter read error	No. 1	No	0x7305	0x11360136
E201	E201.0	Phase-P overcurrent	No. 1	No	0x2312	0x02010201
	E201.1	Phase-U overcurrent	No. 1	No	0x2312	0x12010201
	E201.2	Phase-V overcurrent	No. 1	No	0x2312	0x22010201
	E201.4	Phase-N overcurrent	No. 1	No	0x2312	0x42010201

Fault code	Display	Fault name	Fault level	Resettable	Error code	Auxiliary code (203Fh)
E210	E210.0	Output short-circuited to ground	No. 1	No	0x2330	0x02100210
E234	E234.0	Runaway	No. 1	No	0x0234	0x02340234
E740	E740.0	Absolute encoder communication timeout	No. 1	No	0x0740	0x07400740
	E740.2	Absolute encoder error	No. 1	No	0x7305	0x27400740
	E740.3	Absolute encoder single-turn calculation error	No. 1	No	0x7305	0x37400740
	E740.6	Encoder write error	No. 1	No	0x7305	0x67400740
E755	E755.0	Nikon encoder communication fault	No. 1	No	0x0FFF	0x07550755
E765	E765.0	Nikon encoder over-temperature or overspeed	No. 1	No	0x0765	0x07650765
EA33	EA33.0	Encoder read/write check error	No. 1	No	0x7305	0x0A330A33
EE12	EE12.0	EtherCAT initialization failure	No. 1	No	0x0E12	0x0E120E12
EE16	EE16.0	MCU and ESC communication error	No. 1	No	0x0E16	0x0E160E16

No. 1 resettable faults

Table 17–3 List of No. 1 resettable faults

Fault code	Fault subcode	Fault name	Fault level	Resettable	Error code	Auxiliary code (203Fh)
E150	E150.0	STO safety state applied	No. 1	Yes	0x0150	0x01500150
	E150.1	STO input state abnormal	No. 1	Yes	0x0150	0x11500150
	E150.2	Buffer 5 V supply error	No. 1	Yes	0x0150	0x21500150
	E150.3	STO input circuit hardware diagnosis failure	No. 1	Yes	0x0150	0x31500150
	E150.4	PWM Buffer hardware diagnosis failure	No. 1	Yes	0x0150	0x41500150
E208	E208.2	Encoder communication timeout	No. 1	Yes	0x0208	0x22080208
	E208.4	FPGA current loop operation timeout	No. 1	Yes	0x0208	0x42080208
E400	E400.0	Main circuit overvoltage	No. 1	Yes	0x3210	0x04000400
E410	E410.0	Main circuit undervoltage	No. 1	Yes	0x3220	0x04100410
	E410.1	Main circuit disconnected	No. 1	Yes	0x0410	0x14100410
E500	E500.0	Motor overspeed	No. 1	Yes	0x8400	0x05000500
	E500.1	Speed feedback overflow	No. 1	Yes	0x8400	0x15000500
	E500.2	FPGA position feedback pulse overspeed	No. 1	Yes	0x0500	0x25000500

Fault code	Fault subcode	Fault name	Fault level	Resettable	Error code	Auxiliary code (203Fh)
E602	E602.0	Angle auto-tuning failure	No. 1	Yes	0x0602	0x06020602
	E602.2	U/V/W phase sequence reversed	No. 1	Yes	0x0602	0x26020602
E605	E605.0	Speed too fast upon S-ON	No. 1	Yes	0x8400	0x06050605
E620	E620.0	Motor overload	No. 1	Yes	0x3230	0x06200620
E630	E630.0	Motor stall over-temperature protection	No. 1	Yes	0x7121	0x06300630
E631	E631.0	SBC brake circuit diagnosis exception	No. 1	Yes	0x0631	0x16310631
	E631.1	24 V or brake not connected	No. 1	Yes	0x0631	0x06310631
	E631.2	P-MOS open circuit	No. 1	Yes	0x0631	0x26310631
	E631.3	N-MOS open circuit	No. 1	Yes	0x0631	0x36310631
E640	E640.0	High IGBT junction overtemperature	No. 1	Yes	0x4210	0x06400640
	E640.1	Flywheel diode overtemperature	No. 1	Yes	0x0640	0x16400640
E650	E650.0	Heatsink overtemperature	No. 1	Yes	0x4210	0x06500650
E660	E660.0	Motor overtemperature	No. 1	Yes	0x4210	0x06602660
	E660.1	KTY sensor disconnected	No. 1	Yes	0x4210	0x16602660
E770	E770.0	Fully-closed input phase A wire breakage	No. 1	Yes	0x7305	0x07700770
	E770.1	Fully-closed input phase B wire breakage	No. 1	Yes	0x7305	0x17700770
	E770.2	Fully-closed input phase Z wire breakage	No. 1	Yes	0x7305	0x27700770
	E770.6	2nd encoder initialization communication error in fully closed-loop mode	No. 1	Yes	0x7305	0x67700770
	E770.7	Inovance 2nd encoder communication error in fully closed-loop mode	No. 1	Yes	0x7305	0x77700770
E939	E939.0	Motor power cables disconnected	No. 1	Yes	0x0939	0x09390939
	E939.1	Phase-U power cable disconnected	No. 1	Yes	0x0939	0x19390939
	E939.2	Phase-V power cable disconnected	No. 1	Yes	0x0939	0x29390939
	E939.3	Phase-W power cable disconnected	No. 1	Yes	0x0939	0x39390939

No. 2 resettable faults

Table 17–4 List of No. 2 resettable faults

Fault Code	Display	Fault Name	Fault level	Resettable	Error code	Auxiliary Code (203Fh)
E122	E122.1	DI function assignment error	No. 2	Yes	0x6320	0x11220122
	E122.2	DO function assignment error	No. 2	Yes	0x6320	0x21220122
	E122.3	Upper limit in the rotation mode too high	No. 2	Yes	0x6320	0x31220122
	E122.4	VDI function assignment error	No. 2	Yes	0x0122	0x41220122
	E122.5	DI and VDI assigned with the same function	No. 2	Yes	0x0122	0x51220122
	E122.7	Fully closed-loop parameter setting error	No. 2	Yes	0x6320	0x71220122
	E122.9	Fully closed-loop function pin conflict	No. 2	Yes	0x6320	0x91220122
E430	E430.0	Control power supply undervoltage	No. 2	Yes	0x3120	0x04300430
E661	E661.0	STune failure	No. 2	Yes	0x0661	0x06610661
E662	E662.0	ETune failure	No. 2	Yes	0x0662	0x06620662
E663	E663.0	ITune failure	No. 2	Yes	0x0663	0x06630663
E664	E664.0	Resonance too strong	No. 2	Yes	0x0664	0x06640664
E731	E731.0	Encoder battery failure	No. 2	Yes	0x7305	0x07310731
E733	E733.0	Encoder multi-turn counting error	No. 2	Yes	0x7305	0x07330733
E735	E735.0	Encoder multi-turn counting overflow	No. 2	Yes	0x7305	0x07350735
E760	E760.0	Encoder over-temperature	No. 2	Yes	0x4210	0x07600760
EB00	EB00.0	Excessive Position Deviation	No. 2	Yes	0x8611	0x0B000B00
	EB00.1	Position deviation overflow	No. 2	Yes	0x8611	0x1B000B00
EB01	EB01.1	Individual position reference increment too large	No. 2	Yes	0x6320	0x1B010B01
	EB01.3	Reference overflow	No. 2	Yes	0x6320	0x3B010B01
EB02	EB02.0	Position deviation too large in fully closed-loop mode	No. 2	Yes	0x8611	0x0B020B02
	EB02.1	Fully closed-loop position deviation overflow	No. 2	Yes	0x8611	0x1B020B02
EB03	EB03.0	Electronic gear ratio beyond the limit - H05.02	No. 2	Yes	0x0B03	0x0B030B03
	EB03.1	Electronic gear ratio beyond the limit - Electronic gear ratio 1	No. 2	Yes	0x0B03	0x1B030B03
	EB03.2	Electronic gear ratio beyond the limit -Electronic gear ratio 2	No. 2	Yes	0x0B03	0x2B030B03

Fault Code	Display	Fault Name	Fault level	Resettable	Error code	Auxiliary Code (203Fh)
EE08	EE08.0	Synchronization signal loss	No. 2	Yes	0x0E08	0x0E080E08
	EE08.1	Status switchover error	No. 2	Yes	0x0E08	0x1E080E08
	EE08.3	Network cable connected improperly	No. 2	Yes	0x0E08	0x3E080E08
	EE08.4	Data frame loss protection error	No. 2	Yes	0x0E08	0x4E080E08
	EE08.5	Data frame transfer error	No. 2	Yes	0x0E08	0x5E080E08
	EE08.6	Data update timeout	No. 2	Yes	0x0E08	0x6E080E08
EE09	EE09.0	Software position limit setting error	No. 2	Yes	0x6320	0x0E090E09
	EE09.1	Home setting error	No. 2	Yes	0x6320	0x1E090E09
	EE09.2	Gear ratio beyond the limit	No. 2	Yes	0x6320	0x2E090E09
	EE09.3	Homing method setting error	No. 2	Yes	0x6320	0x3E090E09
	EE09.5	PDO mapping beyond the limit	No. 2	Yes	0x6320	0x5E090E09
EE10	EE10.0	Protection against MailBox setting error	No. 2	Yes	0x0E10	0x0E100E10
	EE10.1	SM2 setting error	No. 2	Yes	0x0E10	0x1E100E10
	EE10.2	SM3 setting error	No. 2	Yes	0x0E10	0x2E100E10
	EE10.3	PDO watchdog setting error	No. 2	Yes	0x0E10	0x3E100E10
	EE10.4	Protection against incomplete PLL (no sync signal)	No. 2	Yes	0x0E10	0x4E100E10
EE11	EE11.0	ESI check error	No. 2	Yes	0x5530	0x0E110E11
	EE11.1	EEPROM bus read failure	No. 2	Yes	0x5530	0x1E110E11
	EE11.2	EEPROM update failure	No. 2	Yes	0x5530	0x2E110E11
	EE11.3	ESI and drive mismatch	No. 2	Yes	0x0E11	0x3E110E11
EE13	EE13.0	EtherCAT sync period setting error	No. 2	Yes	0x6320	0x0E130E13
EE14	EE140	SYNC signal pulse width error	No. 2	Yes	0x0E14	0x0E146E14
EE15	EE15.0	Excessive EtherCAT SYNC cycle error	No. 2	Yes	0x0E15	0x0E150E15
EE21	EE21.0	MAC address not programmed	No. 2	Yes	0x0FFF	0x0E216E21
	EE21.1	Ethernet PHY configuration error	No. 2	Yes	0x0FFF	0x1E216E21

18 Maintenance

18.1 Routine Maintenance

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 checklist

Standard operating conditions:

The required environmental conditions are as follows: Average ambient temperature: 30°C Average load rate: Below 80% Daily operating time: Below 20 hours

Routine checklist

Check the following items during routine inspection.

Table 18–1 Routine checklist

Type	Inspection cycle	Item
Routine checklist	Routine	Check the ambient temperature, humidity, dust, and foreign objects.
		Check whether unusual vibration and noise is generated.
		Check whether the mains voltage is normal.
		Check whether unusual odor is generated.
		Check whether the air vent is stuck with fiber threads.
		Check whether the front end and connectors of the drive are clean.
		Check for intrusion of unwanted objects on the load side.
Regular inspection	1 year	Check whether the fastening parts get loose.
		Check whether the equipment is overheated.
		Check whether the terminal is damaged.
		Check whether the fastening parts of the terminal become loose.

18.2 Component Replacement

The equipment can be dismantled and repaired only by Inovance engineers.

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. Contact Inovance or the Inovance agent to check whether the parts need to be replaced.

Table 18–2 Standard Replacement Interval

Object	Type	Standard replacement interval	Remarks
Drive	Bus filter capacitor	About five years	The standard replacement cycle is for reference only. If any device/component works improperly before the replacement cycle expires, replace it immediately.
	Fan	2 to 3 years (10,000 h to 30,000 h)	
	Aluminum electrolytic capacitor on the PCB	About five years	
Motor	Bearing	3 to 5 years (20,000 h to 30,000 h)	
	Oil seal	5,000 h	
	Encoder	3 to 5 years (20,000 h to 30,000 h)	
	Absolute encoder battery	Depends on the operating condition. See the operation instructions for the encoder battery for details.	

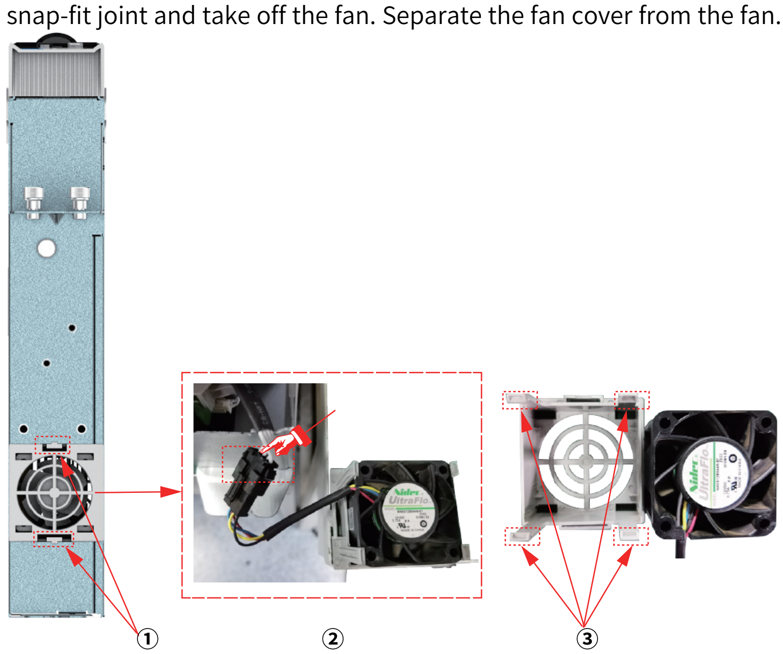
Fan replacement cycle

The fan replacement method varies with the drive models. See the following for details.

- **Size-1**

1. Removing the fan

   a. Press the snap-fit joint to draw out the fan and protective cover.
   b. Pull out the terminal.
   c. Pull out the snap-fit joint and take off the fan. Separate the fan cover from the fan.

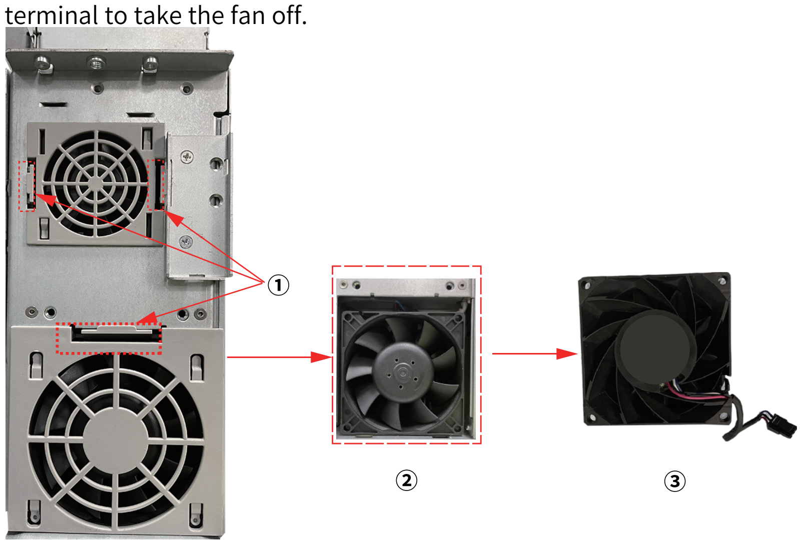


2. Install the fan based on the same procedure, but in the reverse order.

- **Size-2**

1. Removing the fan

a. Press the snap-fit joint to draw out the fan and protective cover.
b. Pull out the fan.
c. Pull out the terminal to take the fan off.

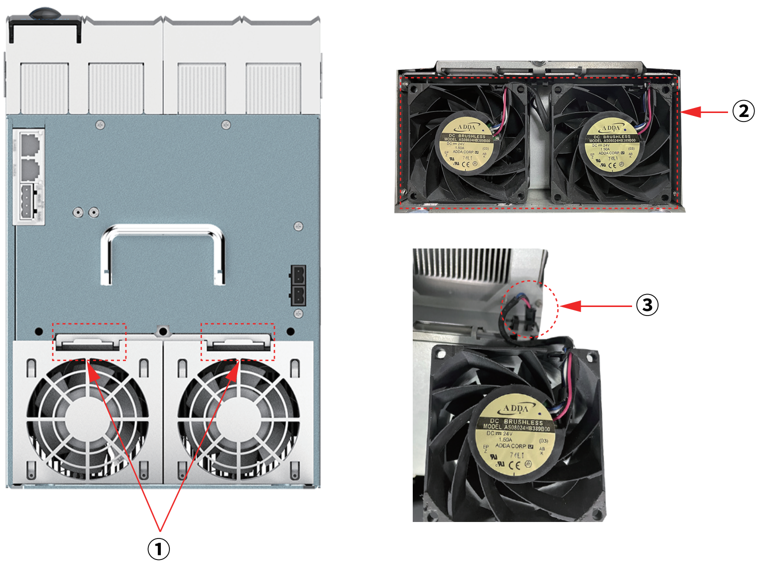


2. Install the fan based on the same procedure, but in the reverse order.

- **Size-3 & Size-4**

1. Removing the fan

a. Remove the four screws to take off the fan and protective cover.
b. Pull out the fan.
c. Take off the fan.



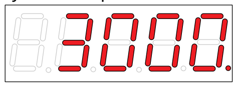
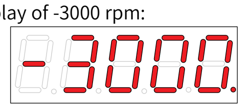
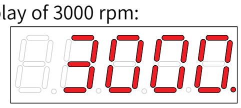
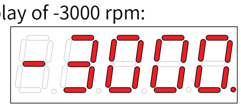
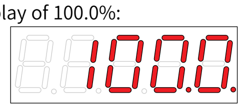
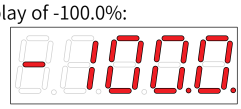
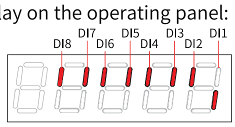
2. Install the fan based on the same procedure, but in the reverse order.

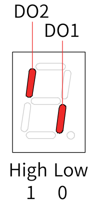
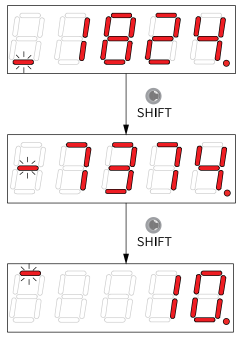
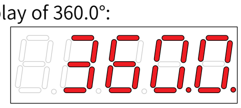
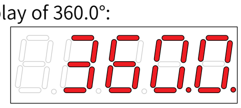
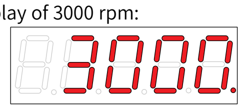
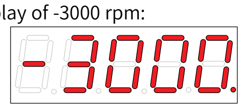
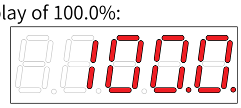
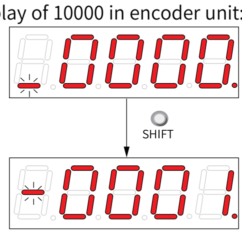
19 Appendix

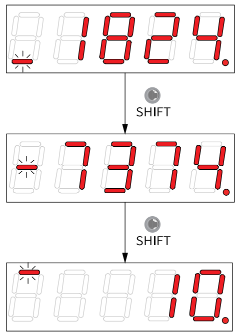
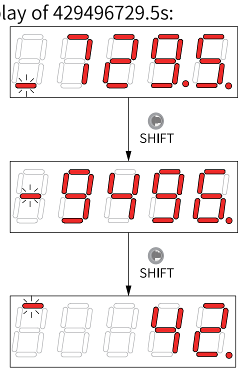
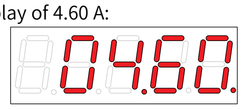
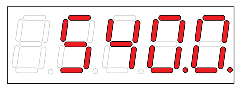
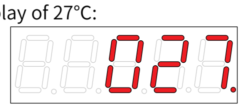
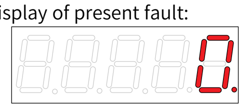
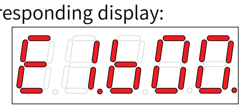
19.1 Display of Monitoring Parameters

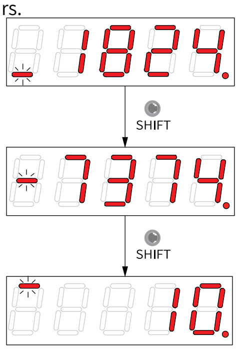
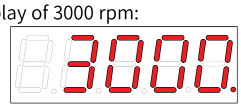
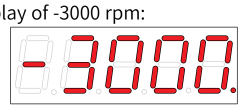
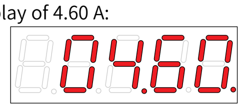
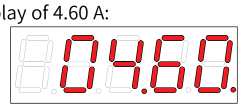
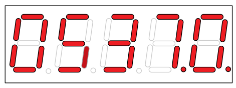
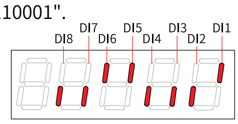
Group H0b: Displays the parameters for monitoring the running status of the servo drive.

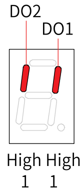
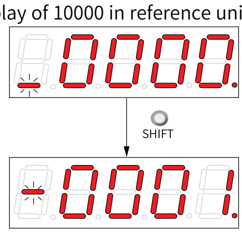
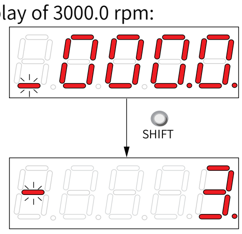
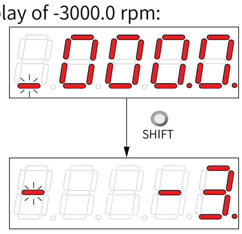
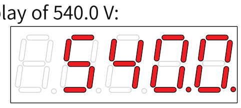
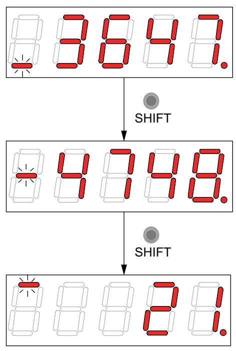
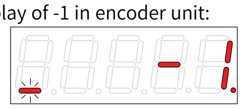
Group H0b (Monitored values) is described as follows (Take the parameter axis 1 as an example):

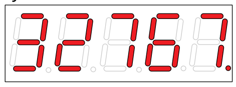
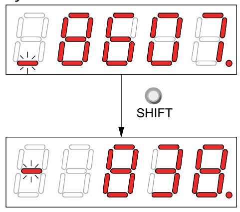
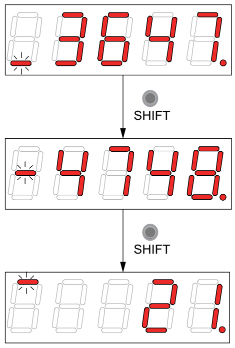
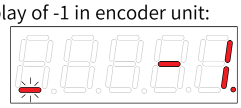
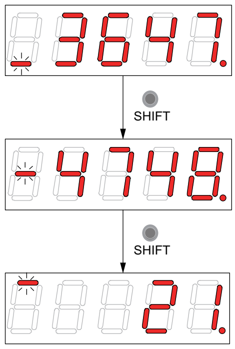
Param.	Name	Unit	Meaning	Example
H0b.00	Motor speed actual value	rpm	The actual motor speed after round-off is displayed, in unit of 1 rpm.	Display of 3000 rpm:  Display of -3000 rpm: 
H0b.01	Speed reference	rpm	Displays the present speed reference of the servo drive.	Display of 3000 rpm:  Display of -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 eight DIs: Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0") H0b.03 value read by the software tool is a decimal.	For example, if DI1 is low level, 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: 

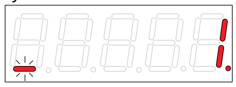
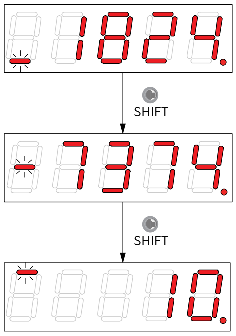
Param.	Name	Unit	Meaning	Example
H0b.05	Output (DO) signal monitoring	-	Level status of DO terminals: Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0") H0b.05 value read by the software tool is a decimal.	For example, if DO1 is low level and DO2 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	Displays current absolute position of the motor (reference unit).	Display of 1073741824 in reference unit: 
H0b.09	Mechanical angle	0.1°	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:  Display of -3000 rpm: 
H0b.12	Average load ratio	0.1%	It indicates the percentage of the average load torque to the rated torque of the motor.	Display of 100.0%: 
H0b.15	Encoder position deviation counter (32-bit decimal display)	Encoder unit	Encoder position deviation = Sum of input position references (encoder unit) – Sum of pulses fed back by the encoder (encoder unit)	Display of 10000 in encoder unit: 

Param.	Name	Unit	Meaning	Example
H0b.17	Feedback pulse counter (32-bit decimal display)	Encoder unit	Counts and displays the number of pulses fed back by the encoder (encoder unit). ***Note*** When the motor used is equipped with an absolute encoder, 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	It indicates the DC bus voltage of the main circuit.	Display of 540.0 V rectified from 380 V: 
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 selected fault	-	It indicates the fault code selected by 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: 

Param.	Name	Unit	Meaning	Example
H0b.35	Time stamp of the selected fault	s	It indicates the total servo running time when the fault displayed in H0b.34 occurs. When no fault occurs, the displayed value of H0b.35 is "0".	If H0b.34 = E1.B00, H0b.35 = 107374182.4, the current fault code is B00 and the total servo running time is 107374182.4s when this fault occurs. 
H0b.37	Motor speed upon occurrence of the selected fault	rpm	It indicates the servo motor speed when the fault displayed in H0b.34 occurs. When no fault occurs, the displayed value of H0b.37 is "0".	Display of 3000 rpm:  Display of -3000 rpm: 
H0b.38	Motor phase U current upon occurrence of the selected fault	0.01 A	It indicates the phase U winding current effective value of the motor when the fault displayed in H0b.34 occurs. When no fault occurs, the displayed 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	It indicates the phase V winding current effective value of the motor when the fault displayed in H0b.34 occurs. When no fault occurs, the displayed value of H0b.39 is "0".	Display of 4.60 A: 
H0b.40	Bus voltage upon occurrence of the selected fault	V	It indicates the DC bus voltage of the main circuit when the fault displayed in H0b.34 occurs. When no fault occurs, the displayed value of H0b.40 is "0".	Display of 537.0 V rectified from 380 V: 
H0b.41	Input terminal state upon occurrence of the selected fault	-	It indicates the high/level state of the eight DI terminals when the fault displayed in H0b.34 occurs. The method for determining the DI level status is the same as that of H0b.03. When no fault occurs, all DIs are displayed as low level in H0b.41 (indicated by the decimal value 0).	For example, when the value of H0B-41 read in the software tool is 0x31, the corresponding binary value is "00110001". 

Param.	Name	Unit	Meaning	Example
H0b.43	Output terminal status upon occurrence of the selected fault	-	It indicates the high/level state of the two DO terminals when the fault displayed in H0b.34 occurs. View in the same way as 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	It indicates the actual motor speed, precision to 0.1 rpm.	Display of 3000.0 rpm:  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: 

Param.	Name	Unit	Meaning	Example
H0b.70	Number of absolute encoder revolutions	Rev	Displays the present number of revolutions of the absolute encoder.	Display of 32767: 
H0b.71	Single-turn position feedback of an absolute encoder	Encoder unit	Displays the single-turn position feedback of the absolute encoder.	Display of 8388607 in encoder unit: 
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 rotation 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: 

Param.	Name	Unit	Meaning	Example
H0b.83	Single-turn position feedback of the load in rotation 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.	Display of 1073741824 in reference unit: 

19.2 DI/DO Function Assignment

Code	Name	Function	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	Fault and alarm reset	Inactive: Disabled Active: Enabled	"Edge-triggered" will be applied even if "level-triggered" is selected. To reset No. 1 and NO.2 resettable faults, switch off the S-ON signal first. The servo drive may, depending on the alarm type, continue running after reset.
FunIN.14	P-OT	Positive limit switch	Enabled: Forward drive inhibited Disabled: Forward drive permitted	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	Active: Reverse drive inhibited Inactive: Reverse drive allowed	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	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	Enabled: Position lock is applied after stop at zero speed. Disabled: Current operating state is unaffected.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.38	TouchProbe1	Touch probe 1	Disabled - Touch probe is not triggered. Enabled - Touch probe is triggerable.	The touch probe logic is only related to the touch probe function (60B8h).
FunIN.39	TouchProbe2	Touch probe 2	Disabled - Touch probe is not triggered. Enabled - Touch probe is triggerable.	The touch probe logic is only related to the touch probe function (60B8h).
Description of DO signals				
FunOUT.1	S-RDY	Ready to switch on	Enabled: The servo drive is ready. Disabled: The servo drive not ready.	The servo drive is ready to run.
FunOUT.2	TGON	Motor rotation	Inactive. Absolute value of filtered motor speed is lower than the setpoint of H06.16. Active, absolute value of filtered motor speed reaching the setpoint of H06.16	-
FunOUT.9 models	BK	Brake	Inactive-brake deactivated Active-Brake activated	-
FunOUT.10 models	WARN	Alarm	Enabled: The servo drive issued an alarm. Disabled: The servo drive issued no alarm or the alarm has been reset.	-
FunOUT.11 models	ALM	Fault	Active: Fault occurred on the servo drive Inactive: No fault occurred on the servo drive or the fault has been reset.	-
FunOUT.21 models	DB	Dynamic brake	Active: Dynamic braking activated Invalid: Dynamic braking deactivated	-

Code	Name	Function	Description	Remarks
FunOUT.31 models	Communication-forced DO		See *"Table 19–1 Communication-forced DO" on page 573*	-
FunOUT.32 models	EDM	EDM output	Active: STO triggered Inactive: STO not triggered	The EDM outputs active signals only when both the 24 V input voltages for STO1 and STO2 are disconnected simultaneously.

Table 19–1 Communication-forced DO

Type	Data	Description
Bit 0	0	DO1 status unchanged
	1	No output
Bit 1	0	DO2 status unchanged
	1	No output

19.3 Capacitance Table

Dual-axis IS810	Capacitance/uF
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

Downloads

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Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park, Guanlan Street, Longhua New District, Shenzhen

Tel: (0755) 2979 9595 Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 16 Youxiang Road, Yuexi Town, Wuzhong District, Suzhou 215104, P.R. China

Tel: (0512) 6637 6666 Fax: (0512) 6285 6720